INSTITUTO
UNIVERSITÁRIO
DE LISBOA

Proposal and Evaluation of Online Medical Services Expansion Mode for Specialties: A Patient Perceived Value Perspective

ZHANG Zhemin

Doctor of Management

Supervisor:
PhD Bráulio Alexandre Barreira Alturas, Associate Professor,
ISCTE University Institute of Lisbon

July, 2021

BUSINESS
SCHOOL

Marketing, Operations and General Management Department

Proposal and Evaluation of Online Medical Services Expansion Mode for Specialties: A Patient Perceived Value Perspective

ZHANG Zhemin

Doctor of Management

Supervisor:
PhD Bráulio Alexandre Barreira Alturas, Associate Professor,
ISCTE University Institute of Lisbon

July, 2021

BUSINESS
SCHOOL

Marketing, Operations and General Management Department

Proposal and Evaluation of Online Medical Services Expansion Mode for Specialties: A Patient Perceived Value Perspective

ZHANG Zhemin

Doctor of Management

Jury:

PhD Álvaro Augusto da Rosa, Associate Professor with Habilitation
ISCTE University Institute of Lisbon
PhD Isabel Pedrosa, Adjunct Professor,
ISCAC - Coimbra Business School
PhD Nelson José António, Retired Full Professor,
ISCTE University Institute of Lisbon
PhD Zhang Chichen, Professor,
Southern Medical University
PhD Bráulio Alexandre Barreira Alturas, Associate Professor,
ISCTE University Institute of Lisbon

July, 2021

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: Zhang Zhemin Date: 29/06/2021

Name: ZHANG Zhemin

作者申明

本人郑重申明：除了论文致谢中明确说明并致以谢意的部分外，所呈交的论文不包含任何他人或作者本人已用于获得任何教育机构的学位和证书而使用过的材料。同时尽我所知，除了文中特别加以标注引用的内容外，本论文不包含任何其他个人或集体已经发表或撰写的成果作品。

作者签名：张哲民 日期：2021.6.29

姓名(拼音)：ZHANG Zhemin

[This page is deliberately left blank.]

Abstract

There is a great imbalance and difference in the distribution of Chinese medical resources in urban and rural areas, as most medical resources are concentrated in urban areas. Against the backdrop of China's promotion of "Internet + medical healthcare", medical institutions are encouraged to apply Internet and other information technologies to expand the space and content of medical services, but patients in remote places lack independent choice of consultation platform.

Based on the theory of Maslow's hierarchy of needs, customer perception theory, Synergy theory, TAM and ACSIM, the model building of remote patients' perceived value satisfaction with online medical services for specialties is hypothesized. Take F hospital as the subject, The research provides an empirical research on the process rebuilding and redesigning specialized online health services based on the perceived value of remote patients. To obtain the perceived value needs of remote patients' visits, this study carries out questionnaire survey to understand the main needs of remote patients visiting. The results show that: social contact and respect value need > safety and survival value need > self-value need > cost losses value. Meanwhile, the preliminary evaluation indicators of patients' perceived value are derived based on the results of the questionnaire.

The research is mainly to verify the effect of the implementation of the Internet-based specialized medical partnership medical service access model for remote patients. The post-test questionnaire is designed to understand the overall level of remote patients' perceived value of online medical services, including the level of perceived ease of use, the level of perceived usefulness, the level of perceived value, the level of satisfaction, and the level of synergy. Among them, the perceived usefulness scores the highest, It is found that the cost of the new model in terms of time, distance, expense, and energy has been significantly reduced.

The research, through building the SEM model, tests the path relationships of relevant dimensions and mediating effect of the model of remote patients' perceived value satisfaction with online medical services for specialties.

Keywords: Perceived Value; TAM (Technology Acceptance Model); Synergy theory; Internet + medical service; Medical treatment dilemma

JEL: M15; I12

[This page is deliberately left blank.]

Resumo

Verifica-se um grande desequilíbrio na distribuição dos recursos médicos chineses nas áreas urbanas e rurais, visto que a maioria dos recursos médicos está concentrada nas áreas urbanas. No contexto da promoção chinesa de "Internet + saúde médica", as instituições médicas são incentivadas a recorrer à Internet e a outras tecnologias de informação para expandir o espaço e o conteúdo dos serviços médicos, mas os pacientes em lugares remotos não têm escolha independente da plataforma de consulta.

Com base na teoria da hierarquia de necessidades de Maslow, teoria da perceção do cliente, teoria da sinergia, TAM e ACSIM, realizou-se a construção do modelo de satisfação do valor percebido de pacientes remotos, com serviços médicos online para especialidades. Considerou-se o hospital F como caso de estudo. A investigação fornece uma pesquisa empírica sobre o processo de reconstrução e redesenho de serviços de saúde online especializados, com base no valor percebido de pacientes remotos. Para obter as necessidades de valor percebido das visitas de pacientes remotos, neste estudo realizou-se uma pesquisa por questionário para entender as principais necessidades das visitas de pacientes remotos. Os resultados mostram que: contato social e respeito valor necessidade e > segurança e valor de sobrevivência necessidade > necessidade de valor próprio > valor de perdas de custo. Enquanto isso, os indicadores de avaliação preliminar do valor percebido dos pacientes são derivados com base nos resultados do questionário.

O objetivo principal do presente trabalho é verificar o efeito da implementação do modelo de acesso a serviços médicos especializados, baseada na Internet para pacientes remotos. O questionário pós-teste foi projetado para compreender o nível geral de valor percebido de pacientes remotos de serviços médicos online, incluindo o nível de facilidade de uso percebida, o nível de utilidade percebida, o nível de valor percebido, o nível de satisfação e o nível de sinergia. Entre eles, a utilidade percebida pontua mais alto. Verifica-se que o custo do novo modelo em termos de tempo, distância, despesa e energia foi reduzido significativamente.

Por meio da construção do modelo SEM, testaram-se as relações do caminho de dimensões relevantes, e o efeito mediador do modelo de satisfação de valor percebido de pacientes remotos, com serviços médicos online para especialidades.

Palavras-chave: Valor percebido; TAM (Technology Acceptance Model); Teoria da sinergia;

Internet + serviço médico; Dilema do tratamento médico
JEL: M15; I12

摘　要

中国城乡医疗资源配置的整体现状是资源高度集中于大城市，区域配置不均衡。在国家促进“互联网+医疗健康”的大背景下，鼓励医疗机构应用互联网等信息技术拓展医疗服务空间和内容，但异地患者缺乏对远程会诊平台自主选择权的问题。

本研究以马斯洛需求层次理论、顾客感知理论、顾客让渡价值理论、流程再造理论，协同理论、技术接受模型理论（TAM）以及美国满意度指数ACSI模型理论为基础，在理论学习基础上，假设异地患者专科互联网就医服务感知价值满意度理论模型构建。并以 F 医院为例，对基于异地患者感知价值的专科互联网就医服务流程再造进行了实证研究。结果显示，尊重与社交感知价值需求>安全与生存价值需求>自我价值需求>成本价值。同时通过问卷统计结果得出患者感知价值初步评价指标。

课题组针对异地患者基于互联网专科医联体就医服务模式实施后的效果进行验证。设计后测问卷了解异地患者互联网就医服务感知价值整体水平，还包括感知易用性水平、感知有用性水平、感知价值水平、满意度水平和协同力水平，其中感知有用性的水平最高，发现新模式在时间、货币、路程和精力四方面的成本付出均有显著降低。

本研究还通过构建 SEM 模型验证异地患者互联网就医服务感知价值和满意度模型的相关构面的路径关系，以及中介效应。

关键词：感知价值；技术接受理论；协同理论；互联网+医疗服务；就医困境

JEL: M15; I12

[This page is deliberately left blank.]

Acknowledgements

I got to know the ISCTE-SMU Doctor of Management in Healthcare Program by peer recommendation. It's a great honor for me to be admitted. Here, I have made many new friends from various sectors, and also met helpful professors. I would like to thank ISCTE and Southern Medical University for giving me the opportunity to return to school.

Shanghai Pulmonary Hospital is the largest specialized hospital in China featuring the diagnosis and treatment of respiratory diseases, with 1,200 beds. I have served as the vice president of the hospital for the past 14 years, during which I have accumulated experience in hospital management and received many training in management. In this program, I have reviewed classical management theories and learned new management mode and concept systematically through the courses by professors from Portugal and China, which helped me to form a better understanding of management. By going through the whole process of thesis writing, namely from research proposal, literature review, empirical research, statistical analysis to final conclusion, I have formed a clear idea of my research path. After more than three years of hard work and struggle, the thesis was finally completed, for which I must deliver my thanks to Professor Bráulio Alturas for his careful guidance and support.

And I would like to extend my sincere gratitude to Professor Virginia Trigo, Professor Nelson Antonio and all professors from ISCTE who are warm-hearted and fully committed to Sino-Portuguese academics exchanges.

My thanks also go to the leaders and teachers of Southern Medical University. Thanks to Professor Xia Weidong and Professor Wang Dong for their guidance.

Besides, I want to thank Ms. Xu Ruimin and Ms. Ou Weiyan for their care and help.

Thanks to Ms. Jia Lanlan from Guangdong University of Foreign Studies and her team for their guidance and help.

Also, I would like to thank all the colleagues in the research group for their help and hard work.

Finally, my thanks go to my family for their support.

[This page is deliberately left blank.]

致　谢

我是从同行那里了解到中葡卫生政策管理博士项目的。我非常荣幸能够进入这个班学习。认识了很多跨界朋友，学术导师和有益的朋友。感谢 ISCTE 和南方医科大学给了我重返校园的机会。

上海市肺科医院是中国最大的以呼吸系统疾病诊治为特色的专科医院，开放床位1200 张，我在医院担任副院长 14 年，有一定的医院管理经验，也参加过很多的管理学习班。通过中葡老师的课堂教学，系统地重新学习经典管理理论和新的管理模式和理念。对管理理论有了新的认识。在撰写论文过程中，通过课题立项，文献回顾，实证研究和分析总结，培养了自己科研的管理思路。经过三年多的艰苦努力，论文终于完成了，这是一个非常艰难的过程。感谢 Bráulio Alturas 教授的悉心指导和支持。

感谢 Virginia Trigo 教授和 Nelson Antonio 教授以及其他 ISCTE 热心、善良、致力于中葡教育交流的教授们。

感谢南方医科大学的领导和老师，感谢夏卫东教授以及王东教授的指导。

我要感谢许睿敏老师和欧玮艳老师，感谢他们一直以来对我的关心和帮助。

感谢广东外语外贸大学的贾兰兰老师和她的团队对我的指导和帮助。

感谢课题组的所有同事给予我的帮助和辛勤工作。

最后，我要感谢我的家人对我的支持。

[This page is deliberately left blank.]

Contents

List of Tables

[This page is deliberately left blank.]

List of Figures

[This page is deliberately left blank.]

Chapter 1: Introduction

1.1 General background

Influenced by China's economic development, medical policies, fiscal investment priority and medical expenses, as well as the demand and income of urban and rural citizens, there is a great imbalance and difference in the distribution of Chinese medical resources in urban and rural areas, as most medical resources are concentrated in urban areas while there is an extremely low allocation in less developed rural areas (Wang, 2011). There is a huge gap between the rural areas and developed areas in terms of medical technology and resources, thus the needs of rural patients cannot be met in the local area. With the accelerating urbanization in China, the increasing cross-regional population, and the increasing aging population, the demand for medical treatment from other places (the place outside patients residence and workplace) has expanded continuously (Xu et al., 2019).

At present, the general situation of receiving medical treatments from other places (the place outside patient residence and workplace) is that the Grade-A Tertiary hospitals in big cities are overcrowded, and the situation is even severer in the key departments of key hospitals. Problems such as the patient's inability to register and be hospitalized in time, as well as an insufficient number of beds are popping up (Hu, 2006). On the contrary, in the underdeveloped areas such as towns and villages, the number of patients received by medical institutions is far less than expected. Due to the small number of patients, the medical income of medical institutions is low, so the institutions lack funds for development, which forms a vicious circle (Ying & You, 2006).

There are many defects in the management model of seeking medical treatment in other places (the place outside patients residence and workplace), and how to solve these problems is very challenging (Zhang, 2015). China's medical insurance adopts the principle of territorial management, which brings many inconveniences for insured persons when seeking medical treatment in other areas. In particular, patients who go to the outpatient department in other areas often cannot enjoy medical insurance. The establishment of a system of receiving medical treatment from other areas is not only a goal of national attention, but also an aspiration of Chinese residents.

In 2018, China's Medical Service and Quality Safety Report was released by the National Health Commission of the People's Republic of China at a press conference, which analyzed 30.82 million discharged patients who were admitted to 856 tertiary hospitals in 2017 (Pan, 2019). Among them, 23.09 million patients were treated outside the local province, accounting for 7.49% of the total discharges of the analyzed tertiary hospitals. In particular, Shanghai had the largest number of medical patients from other provinces, ranking first in the inflow of patients from other areas, accounting for 19.93%. Among the inpatients admitted to the tertiary hospitals in Shanghai, 38.73% were non-residents in Shanghai.

As one of the cities with the most abundant medical resources and the most advanced medical technology in China, Shanghai not only bears the medical service needs of the permanent residents of Shanghai, but also bears the medical needs from other provinces and cities (Feng & Wu, 2009). The specialized departments of some Grade-A Tertiary Hospitals in Shanghai often have cases where patients are unable to register for a long time, which makes them unable to seek medical treatment. How to solve this problem has become an issue of increasing social concern (Yu, Liu, & Huang, 2007). Take Shanghai Pulmonary Hospital (F Hospital) as an example. The volume of outpatient and inpatient services is increasing by about 12% every year, and the number of people visiting the hospital from different places accounts for about 60% (Zhang & Ai, 2019). While some patients are transferred to the F Hospital after diagnosis and treatment in local hospitals, other patients, upon detecting the diseases in local places, immediately go to the F Hospital for medical treatment or hospitalization, without hierarchical diagnosis and transfer. With strong preferences in hospital choices, patients often have to wait a long time to make an appointment at F Hospital.

Generally speaking, most out-of-provincial patients have already carried out preliminary diagnosis or treatment in local hospitals, and they come to major hospitals autonomously or with the introduction by other people. Basically, they have a clear mind about choosing treatment departments or experts, as well as expert outpatients or special outpatients. They want a famous expert for their medical treatment. Due to the unfamiliarity of people and place as well as the large cost, treatment duration matters for patients from other places, which requires the hospital to provide fast and convenient reception services as quickly as possible (Yang et al., 2010).

To solve the problem of difficult medical services, National Health Commission of the People's Republic of China promotes high-quality medical resources for the central and western regions and grass-roots medical institutions through the construction of medical treatment partnership, counterpart support, and telemedicine to enhance the medical service ability and

level of these regions and institutions. Since September 2015 when the General Office of the State Council issued the Guiding Opinions on Propelling the Building of a Hierarchical Diagnosis and Treatment System (CSCGO, 2015), the medical consortium has sprung up in China, in order to achieve the sharing of medical resources, connectivity of medical information and the homogeneity of service quality in a certain area and to guide patients for proper treatment.

Alliance members can share core medical resources and promote a two-way referral within the alliance. The reasonable cooperation between hospitals of various levels will form an integrated system of medical services, reduce indirect medical expenses and enhance accessibility and equality of medical services (Xiang, Jiang, & Zhang, 2016). As for horizontal medical treatment partnership, although medical alliance or specialist alliance between regions regularly send expert groups to treat illnesses in clinics, make the rounds and do surgeries, specialized experts can directly communicate with patients and their relatives to satisfy their demand for treatment, and also face-to-face mentor community-level medical staff on medical techniques. With an expanded size of medical alliance, the demand for experts increases, and the expert groups of core hospitals cannot meet the increasing demand of both partnership members and local patients for medical treatment. In a long run, this kind of medical partnership will not be sustainable and the actual function of the alliance and the medical work of core hospitals themselves will be affected.

Amid the development of internet technology, telemedicine grows rapidly in recent years, especially since April 2018 when the General Office of the State Council issued the Opinions on Promoting the Development of “Internet plus Health Care” (CSCGO, 2018). This policy aims to promote the strategy of “Healthy China”, improve modern management of health care, optimize resource allocation, innovate service mode and encourage medical institutions to expand service scope and content. Meanwhile, the medical alliance is encouraged in the document to make use of internet technology, speed up the all-around combination of medical resources, connectivity and sharing of information as well as efficient coordination of business, carry out services such as appointment-based diagnosis and treatment, two-way referral and telemedicine, promote “community-level checkup and higher-level diagnosis” and finally establish an ordered pattern of hierarchical diagnosis and treatment.

Nowadays, remote medical consultation is the most widely applied mode of the internet in China’s medical system (Zhao, Zuo, & Yang, 2014; Hao et al., 2015). Thanks to the growing technology, remote clinic services grows rapidly and helps alleviate the problems of “inaccessible and unaffordable medical services” in rural areas (Wu & Chen, 2015). However,

today's remote clinic services are limited to consultation of medical records and guidance in clinics between consultation experts and community-level doctors. Also, it cannot directly serve the patients, and the direct reservation and medical consultation between experts and patients cannot be realized (Zhou et al., 2018). Reported by foreign scholars, comparing the number of telemedicine consultations to the number of outpatient visits, Sunnaas Sykehus was the hospital which performed best, reporting in 2013 a relative use of telemedicine of 3.51 % of all outpatient activity, consisting mainly of rehabilitation visits. That is, the hospital has been replacing outpatient face-to-face visits with remote consultations performed via videoconferencing. Helse Stavanger, the most active hospital delivering telemedicine, reached a relative use of 0.58 % of the overall outpatient activity. Despite this remarkable growth, the level was still low compared to the number of outpatient visits, indicating great potential for using telemedicine to replace traditional outpatient visits (Zanaboni & Wootton, 2016).

Measures for the Administration of Internet Hospitals (for Trial Implementation) states clearly that for patients who receive medical treatment in normal hospitals, when their doctors invite other doctors to join consultation via the internet, the invited doctors can give diagnosis opinions and prescription; while for those who did not go to normal hospitals, doctors can only provide follow-up treatment services for certain common diseases and chronical illnesses (CNHC, 2018). Besides, urban tertiary hospitals with specialty are encouraged to share data resources and cooperate in businesses with remote medical institutions, community-level healthcare institutions, as well as between general practitioners and specialists via the internet, in a bid to promote the downward sharing of quality medical resources (Zhai, Zhang, & Zhao, 2018).

Specialist alliances led by hospitals with obvious specialty should take the specialty cooperation as the starting point, and use effective means to build a continuous interactive platform for the exchanges between the alliance members so as to create platforms for improving the efficiency and level of health services and satisfy patients' medical needs. "Internet plus Health Care" mode can be used to solve the dilemma of the increasing demand of patients for receiving direct medical treatment by expert teams. Meanwhile, the efficiency of the medical services of medical alliance can be improved through cross-regional medical treatment.

Faced with the new coronavirus pneumonia that has recently emerged in China, the health administration and the city's tertiary hospitals have recommended to minimize cross-regional patient visits and reduce the possibility of disease transmission due to the movement of people. The use of "Internet plus Health Care" mode can be helpful for cross-regional specialty

consultation.

With the development of communication technology and computer technology, the construction and application of telemedicine in China have developed rapidly. It is a new type of medical service mode that connects hospitals, patients, and experts through a telemedicine service system to effectively deliver high-quality medical services. However, many problems need to be solved during the development of telemedicine.

(1) Currently, most hospitals in China have different standards for building remote platforms, and a benign operation model has not yet been established. At the national policy level, there is a lack of clear guidance and specifications, such as procedures, steps, and methods for constructing telemedicine platforms, and unified technical standards for equipment purchase as well (Ji, 2018). Moreover, telemedicine services have not yet been included into the scope of medical insurance reimbursement in most provinces and cities, which cannot increase the enthusiasm of patients to use this platform. In the initial research of TAM, perceived usefulness and perceived ease of use are the most common and significant determinants of technology acceptance (Bakken et al., 2006). Another direct determinant of behavioral intention to accept technology is facilitating conditions (Yi et al., 2006). Facilitating conditions is defined as the existence of adequate organizational and technical infrastructure for a user's support to adopt a new technology (Venkatesh, Thong, & Xu, 2012). Facilitating conditions combine three basic constructs: perceived behavioral control, facilitating conditions, and compatibility (Compeau & Higgins, 1995). The successful usage of telemedicine services is significantly dependent upon the presence of adequate technological infrastructure. Moreover, the usage of telemedicine services also requires a continuous connection between health care professionals, service providers, and end-users, located in distant areas.

(2) Unlike the previous service modes, telemedicine, as a new medical service mode, can provide easy and fast medical diagnosis for patients, but the acceptance of different people is also divergent: some community-level doctors believe that telemedicine is a denial of their ability, so they are unwilling to consult with experts in large hospitals; the vast majority of rural patients know nothing about telemedicine, nor do they know how to apply, let alone try it with willingness. Users have a general tendency to exhibit resistance whenever any new innovative technology is implemented based on their pre-conceived evaluation of change. Resistance can significantly alter the decision of a user to adopt or discard a new technology, hence, the failure and problems of many IT-based health systems can be tracked to user's resistance because of the inclusion of hard influence tactics (Bartos, Butler, & Crowley, 2011).

(3) The starting point for designing mobile medical platform is closely related to users'

physiological and psychological needs. With the increase of mobile medical platforms and the enrichment of their functions, the needs of patients when using mobile medical platforms are not only at the functional level, but aim to pursue more emotional needs at an advanced level. We need to let patients trust this new type of medical service mode and create value for patients in the process of delivering services. For patients, this value mainly refers to the experience value of telemedicine services, but at present the channels for patients to seek medical treatment through remote platforms are obstructed. The benefits of tele-medicine can be manifested only if patients are ready to use it proactively. Therefore the investigation of attitude and acceptance of patients towards telemedicine services become integral for its effective utilization (Hu et al., 1999). However, the technology acceptance model TAM by Davis so far represents the most established and substantial foundation of technology acceptance.

1.2 Research contents and objectives

In order to solve the problem of medical treatment for remote patients, in 2018, F Hospital began to explore and establish an online services expansion mode for specialty medical treatment partnership centered on remote patient value. It aims to construct a reasonable procedure of Internet medical treatment for remote patients to alleviate the problem of "inaccessible and unaffordable medical services" and the problem of patients' rights to choose the hospital.

Shanghai Pulmonary Hospital is affiliated to Tongji University (hereinafter referred to as F Hospital). Founded in 1933, it is a modern tertiary specialized hospital integrating medical, teaching and scientific research functions. The hospital has 1,200 beds.According with the Hospital Management Institute, Fudan University, F Hospital has been ranked among the top 100 hospitals in two lists: National Hospitals Ranking and the Science and Technology Evaluation Matric (STEM). In the list of national specialized department ranking by the institute . F Hospital's thoracic surgery department ranks third in China; in the ranking of STEM, its thoracic surgery and phthisiology rank second in China and first in Shanghai, and the respiratory medicine ranks the 5th in China and the 1st in Shanghai (Zhang & Ai, 2019).

In 2017, the Pulmonary Hospital established the Shanghai Pulmonary Hospital Specialist Alliance (SPHSA). Led by F Hospital, SPHSA is composed of some Chinese hospitals specialized in pulmonary disease treatment and general hospital featuring the diagnosis and treatment of lung diseases, with the principle of "practical cooperation, equal quality and common progress". By the end of 2020, the alliance has 38 secondary and tertiary hospitals,

covering thirteen provinces or cities, many other hospitals wish to be its members.

F Hospital develops Internet remote platforms for specialist alliance members and establishes a remote clinic and ward round system, which enables remote patients to make appointments through the outpatient appointment system of alliance members and then receive outpatient and inpatient services at local hospitals. Specialized physicians of the F Hospital can offer clinic services and rounds of the alliance hospitals without leaving Shanghai, and surgeons can screen the surgical patients through remote clinics, and arrange a time for the surgeries. So as to explore a new mode of online medical service expansion for remote patients.

Reengineering of the online medical treatment procedure for specialties enables alliance doctors and the remote experts of F hospital to receive patients at the same time, and the use of alliance hospital's outpatient information system enables them to complete the medical records, and make a plan for the physical examinations, diagnosis and treatment simultaneously. A mobile remote ward round system can be established to take remote rounds for inpatients.

Despite its acknowledged benefits, telemedicine will be a useful health service only when people will begin to utilize it. Therefore, the general attitude of end-users towards acceptance of telemedicine services will play a significant role. To foster the adoption of telemedicine services among people, it is initially very important to analyze the factors influencing their perception (Kamal, Shafiq, & Kakria, 2020).

This research starts at such issues as "difficulty in seeking specialist treatment for remote patients" and "difficulty in seeking medical consultation", borrows Maslow's hierarchy of needs, customer value theory, Synergistic theory, TAM theory and business process re-engineering theory, and achieve the following goals.

(1) This research proposes the perceived value indicators of remote patients' medical demand, then selects usable indicators by Delphi method and calculates their weighted value by the Analytic Hierarchy Process, and finally builds an assessment system based on remote patients' perceived value indicators.

(2) After that, the assessment system will be incorporated in the telemedicine information platform of medical treatment partnership for specialties, so as to build a patient-centered diagnosis and treatment platform.

(3) This research explores the establishment of a research model using the TAM and Synergistic Theory as the main theoretical framework.,

(4) After putting the platform into use, an empirical analysis will be conducted to compare multiple factors before and after the re-engineering of online specialty treatment process of the medical treatment partnership for specialties, including the score of remote patients' perceived

value (gains and sacrifices), time cost, money cost and degree of satisfaction.

1.3 Research problem and question

Research studies have shown that telemedicine is gradually becoming the most prominent service of ICT with remarkable effects on the traditional mechanism of health care services (Rho, Choi, & Lee, 2014). Evaluations of telemedicine have sought to assess various measures of effectiveness (e.g., diagnostic accuracy), efficiency (e.g., cost), and engagement (e.g., patient satisfaction) to determine its success. Few studies, however, have looked at evaluating the organizational impact of telemedicine, which involves technology and process changes that affect the way that it is used and accepted by patients and clinicians alike (Coughlan, Eatock, & Eldabi, 2006). However, there is not yet a set of scientific evaluation index system to evaluate the value-based medical model in China, and it still lacks reference for the popularization and implementation of the value medical model in China.

Based on F hospital, this research solves the dilemma of medical treatment in other places by establishing the expansion mode of specialized internet medical service based on patient value within the alliance, and puts forward the following research questions

RQ1: To what extent the expansion mode of specialized internet medical service improves the medical treatment of patients in other places (the place outside patient's residence and workplace)?

RQ2: How can the index system of perceived value of patients in other places reflect the medical needs of patients in other places?

RQ3: What are the factors related to the technology of Internet medical service for patients in other places, that affect the perceived value and satisfaction of patients choosing telemedicine?

RQ4: To what extent the cooperation between specialist alliance hospitals affects the perceived value and satisfaction of remote patients in choosing telemedicine?

1.4 Research methods

1.4.1 Literature search

During literature research, keywords such as "customer value", "Internet health", "medical treatment partnership", "medical treatment partnership for specialties", "business process management" are searched solely or combinedly on China National Knowledge Infrastructure

(CNKI) and Web of Science for a large number of excellent theses, periodicals, journals and books to seek supportive theories and provide a theoretical foundation for the research.

1.4.2 Action research method(PDCA)

In this study, the perceived value system was designed based on the theory of remote patient values, and the remote diagnosis and treatment platform of medical treatment partnership for specialties was correspondingly developed. Problems are discovered and timely corrected in operation. Functional module settings are adjusted according to patients' needs. And via cyclic usage and correction based on data demands, problems can be found and the process can be optimized, thus forming a feasible and practical Internet diagnosis and treatment process centering on remote patient values for medical treatment partnership for specialties.

1.4.3 Comparative study

A comparative study is conducted on the satisfaction between the online medical services centering on remote patient values of medical treatment partnership for specialties and traditional diagnosis and treatment for remote patients. Qualitative and quantitative methods are employed to highlight the features of the new model and strengthen its advantages, so as to lay a solid foundation for future promotion of remote medical service from medical treatment partnership for specialties.

1.4.4 Questionnaire survey

Before develop and design the online medical treatment process information platform of medical treatment partnership for specialties, the treatment demands of patients from other places should be investigated. The remote medical treatment service information platform should be designed based on the investigation together with indicators of the patient-perceived value system. Therefore, a five-point Likert scale is harnessed in this research. Meanwhile, a statistical analysis is conducted to compare patient satisfaction on the effectiveness before and after the design and development of the information platform.

1.4.5 Analytic hierarchy process

Analytic hierarchy process is a method to solve and judge the matrix eigenvectors by resolving the decision-making problem into general objective, sub-goals, evaluation criteria and specific alternatives. During this process, the priority weights of each element on the certain element in

the upper level can be computed, and the final weights of each alternative on the general objective can be calculated by hierarchically merging. Hence, the analytic hierarchy process is utilized to acquire patient-perceived value indicators at levels I, II and III. And the weights of the indicators are calculated to finally form the indicator evaluation system of the perceived value of remote patients in medical treatment.

1.4.6 Empirical study

A questionnaire survey is employed to collect data. The SPSS is used to investigate the demands of remote patients, verify the reliability and validity of the questionnaire. In the meantime, via the empirical study, it can be tested whether patients are satisfied with the new remote service of medical treatment partnership for specialties based on patient-perceived value and whether it is significantly effective, thus providing strong verification for the effectiveness of research results.

1.4.7 IE program analysis

Program analysis of industrial engineering is utilized to diagnose and analyze the process of outpatient treatment in the hospital. According to the status quo of the outpatient treatment, this method is harnessed to mark the attributes of procedures to be corrected, such as wait, movement, examination and treatment. Procedures that can be merged, canceled or simplified are found to shorten clinic time, thus simplifying and optimize the process. Besides, an analysis is conducted to compare the process before and after improvement.

1.5 Research framework

Based on theoretical and empirical analysis, this research is divided into six parts.

Chapter 1: Introduction. This part includes the general background, research content and objectives, research problems and questions, research methods, research framework, and technical route. The last section is the chapter summary.

Chapter 2: Literature review. Based on the literature review and analysis of China's Internet medical services development, this part mainly includes the development of telemedicine services in China. Development history of Internet medical care in China is analyzed in this part, and then the current status of Internet medical service development and the countermeasures to alleviate the problem of difficult medical services for patients are analyzed

as well. Based on the literature review of foreign Internet medical services and the comparative analysis of Internet medical service modes at home and abroad, this chapter discusses the difficulties and puts up with some thoughts on the use of Internet medical services for remote patients to seek medical treatment in other places. Research steps are raised based on previous analysis. A summary is given at the end of this chapter.

Chapter 3: Theoretical framework. This part mainly includes the related theoretical literature review, the analysis of the relationship among Customer Value Theory, Maslow's Hierarchy of Needs and Business Process Reengineering via the use of Synergistic theory and TAM (Technology Acceptance Model) theory. Analysis of Customer Satisfaction Theory, Internet medical services, the theoretical framework of the research and establishment of research mode are given in this part. The last section is the chapter summary.

Chapter 4: Empirical research on the online medical services expansion mode for specialties. This part illustrates the background of China's Internet medical services. Based on Customer Value Theory and literature research, Delphi Method and Analytic Hierarchy Process are used to sort out the index system based on the perceived value of remote patients, and to design and develop an information platform for online medical treatment procedure for specialties based on Customer Value Theory. In this part, a description of the establishment of the online medical treatment platform for specialties in F Hospital is given after referring to and corresponding to the patient's perceived value index, modifying and optimizing each module of the information platform via PDCA Cycle. The last section is the chapter summary.

Chapter 5: Statistics and discussion of survey results. An empirical analysis of the practical effects of the research is conducted in this part, including the comparison of change of the perceived value score of remote patients, the change of time cost and currency cost, and comparative analysis of satisfaction of remote patients. The post-test questionnaire design employed the SEM model to verify the path correlations and the mediation of relevant constructs of the satisfaction model of remote patients' perceived value of online medical service. The last section is the chapter summary.

Chapter 6: Conclusions, recommendations, and limitations of the research. This part includes research conclusions, research contributions, research limitations and future research directions.

Annex C, Figure C1 shows the framework of technical route

1.6 Chapter summary

This chapter introduces the background of this research and expounds the reasons and status quo of remote medical treatment in China as well as the development and existing problems of medical treatment partnership. Especially in the development of hierarchical diagnosis and treatment and the medical treatment partnership, some hospitals with oblivious specialty characteristics have low recognition of patients. This chapter also analyzes the shortcomings of the current operation mode of medical treatment partnership. This research is based on the dilemma of "difficult to receive medical treatment" for patients in remote places. For example, the number of people seeking medical treatment in remote places increases, the waiting time for patients is too long, the medical treatment partnership experts' consultations and medical treatment in other hospitals are not conducive to the sustainable development of the leading hospital and the alliance, and patients in remote places lack independent choice of consultation platform. All of these problems have established the purposes of this research, namely, to explore and set up an Internet diagnosis and treatment model of medical treatment partnership for specialists centered upon patient values in remote places, develop a remote Internet platform for specialist alliance units, and construct a remote outpatient and ward rounds system so as to allow local patients to complete specialist medical service appointments on the Internet independently through the outpatient information system of the alliance hospitals, and enable patients to accomplish outpatient service or hospitalization in the local hospital through the core hospital and local hospitals for joint outpatient and ward rounds.

This chapter determines the research questions, framework and methods through the analyses of research purpose, and forms the specific technical route, which can lay a solid foundation for the smoothness of the follow-up research.

Chapter 2: Literature Review

2.1 Introduction

Medical and healthcare services have always been one of the priority areas that countries across the world focus upon. They are not only closely related to people's livelihood and welfare, but also exert a significant influence on a country's economic prosperity and social stability. In the process of changing medical services nature from hospitals to patient-oriented, the importance of patient value management has been increasingly recognized and receiving extensive public attention. How hospitals can create patient values and further obtain competitive advantages will become a critical issue in the medical service industry.

The concept of modern medical services is to meet the demand and expectations of medical service objects and even strive to exceed their expectations. Only when medical institutions can accurately identify and grasp the medical demand of medical service objects and further apply them, will they provide targeted services that meet their needs more effectively. This is the prerequisite, effective route and entry point for achieving high-quality, efficient, secure and convenient services (Ma et al., 2006). As the medical market continues to grow, patients also become more mature and they have the proper right to request services and enjoy added values. In this regard, the key to the competition in the medical market depends on who can attain the insight into the patients' inner world and provide them with the greatest values so as to win their loyalty and become invincible in the market competition. This patient-oriented concept precisely reflects hospitals' public welfare nature and their concept of being patient-centered and offering wholehearted services. Therefore, patient-oriented management and business concepts shall be considered as the mainstream trend of future hospital construction and development strategies.

Process-based management has become a hot topic of current management research. In today's medical service market that is constantly changing, full of huge challenges and with increasingly fierce competition, many medical institutions have tried to apply the concept of process-based management to improve services and management, continuously promote the quality and efficiency of medical services, and reduce the medical services cost to meet patients' demand in order to establish and maintain competitive advantages (Liu & Tang, 2006; Zhan,

Xu, & Lu, 2008). It is the growth direction of medical service organizations to construct a process system that "places patients' needs at the center", comply with the principle that "all work activities must take the patients' needs as the core" and build the activities of medical service institutions on the basis of being "patient needs-oriented".

The design of the telemedicine platform should reflect the rationality of the telemedicine treatment process and pay attention to the patients' physiological and psychological needs. Self-selection of doctors and online medical consultations are the core medical service functions of the telemedicine platform, and are also important links for patients to consciously use telemedicine and directly experience the quality of services.

At present, the theoretical research on the components of customer values and business process management evaluation has not formed a systematic theoretical and operational framework, and there are relatively few empirical studies. Especially in the medical field, although many hospitals are trying to be "patient-centered" and to optimize and transform the management of medical service processes, these explorations are generally preliminary and limited, and they are methodologically incompatible with the medical industry. Most researches haven't proceeded from the system demonstration of the relationship between the hospital and the medical service target, the internal and external competition environment of the hospital, the contribution of each link in the whole medical service process to the goal, and the actual medical needs of different groups. Therefore, it is required to demonstrate and improve the components of patient values in theory and the evaluation of business process management based upon the perspective of patients, and also to verify their components in practice to apply the theory of patient values and business process management in specific fields.

2.2 Overview of foreign medical services

2.2.1 Foreign medical service models

In the medical and health service systems of various countries, the government and the market are participating as two crucial roles. In accordance with the two standards of "whether the provider and purchaser of medical services are unified" and "whether the property rights are unified", the vertical integration model of foreign medical service systems can be divided into the following four models (Xiang, Jiang, & Zhang, 2016).

(1) Medical model in Cuba

Cuba has established the National Health-care System (NHS) so that the medical service

costs in Cuba are almost entirely covered by government funds. Public hospital financing depends on the government budget, which is a model of the unification of medical service providers and buyers, as well as the unification of property rights.

Cuba's medical security system is a three-level medical service system. The family doctor clinics in each area and the polyclinics in the jurisdiction are collectively called the "primary medical network". The general hospitals in provincial capitals and important cities are collectively named the "secondary medical network". By analogy, the national hospitals in the capital are naturally called the tertiary medical network, which is basically in specialized hospitals or scientific research institutions. In Cuba's tertiary medical service system, the focus is on the primary medical network, of which the manifestation is the "polyclinic". The core of the "polyclinic" is the "general family doctor system".

Every general family doctor is responsible for at least 120 families' medical healthcare and prevention and treatment, ranging from prevention and treatment of common diseases to healthcare. Although the coverage of general family doctors has reached almost 100%, namely, almost everyone has his/her own family doctor. Nevertheless, residents can still consult other people's family doctors. For patients whose general family doctor clinics and polyclinics are incapable of cure, the general family doctors are responsible for sending them to the secondary or tertiary medical network, conducting real-time follow-up of the disease, and cooperating with the secondary and tertiary doctors for treatment (Wu, 2015).

The medical security system in Cuba is purely public. All medical and healthcare expenditures depend on the state finances, and financing counts upon the government budget. It is the spirit of the Cuban Constitution that all citizens shall have access to medical and healthcare services. Therefore, all Cuban residents can enjoy full free medical and healthcare services. In Cuba, all medical and healthcare institutions have only one goal, that is, to protect and promote the health of people, and they do not have the pressure to make profits or make a living.

In regard of Cuba's current approach, it is reasonable to allocate medical and healthcare resources on a first-come-first-served basis or in accordance with the urgency of the disease. In Cuba, the national health level is the absolute judgment scale of the government's governance level and the investment of fiscal expenditures on medical and healthcare is an absolute priority. Even in times of economic difficulties, the Cuban government would rather reduce national defense expenditures to ensure sufficient expenses in medical and healthcare services.

In recent years, amidst the mighty economic reforms in Cuba, the medical and healthcare sector has remained stable and intact. MINSAP (Ministry of Public Health/Ministerio de Salud

Pública) is the highest centralized management department of the entire system. This ministry makes overall plans for the formulation of relevant rules, the design and layout of the institutional structure, and the distribution of medical personnel. Although Cuba has achieved full medical coverage, the overall medical security level is comparatively low and the system can only provide the most fundamental security. Firstly, Cuba's medicine prices are relatively low, and only some of the fees are charged. But medicine is in a state of planned economy supply, so patients often cannot purchase the medicines they need or those with better curative effects. Secondly, the Cuban medical system can effectively prevent acute infectious diseases and immunization in a timely and effective manner and the family doctor system can ensure that residents receive medical services in the first time. However, it cannot guarantee the cure of diseases, the timely use of medical equipment for inspection or the timely and full supply of medicines.

(2) Medical model in the United Kingdom

The NHS consists of two parts: basic healthcare and hospital healthcare, which can be further divided into basic healthcare, regional hospitals and teaching hospital healthcare. Basic healthcare refers to the medical services provided by community medical centers and various clinics, of which the specific provision is provided by general practitioners and the funds required are supported by national taxes. It is responsible for the basic medical service needs of residents in their jurisdictions, while regional hospitals and teaching hospitals only provide medical services above the second level and accept patients referred by community medical centers and various clinics in principle. Under the NHS, a stringent step-by-step referral system is implemented for patients at all levels of medical institutions. Unless it is an emergency or other special condition, patients must be recommended by a community general practitioner if they want to receive medical treatment in a higher-level hospital. After their condition becomes stable, they must be transferred down to the community medical center, where the general practitioners will provide them with healthcare services (Zhang & Nie, 2017).

Under the NHS framework, the government assumes three functions: the provider of medical services, the purchaser of medical services, and the manager of medical services. This is mainly reflected in the function setting of government departments: the Ministry of Health and Social Security is the highest health administration agency in the UK, being responsible for the control and distribution of medical resources.

Under the traditional NHS framework, the British government mainly adopts price control approach to manage and control medical services. The service charges, medical equipment renewal and related management costs of public medical institutions are all allocated by the

central government down to the local healthcare bureau, and then further transferred to the medical institutions in compliance with the preset plan. From the 1970s to the early 1990s, the payment of medical services was mainly raised and reimbursed through taxation, which accounts for around 90% of the total medical service costs. However, in the past decade, the proportion of taxation expenditures on medical services has dropped to approximately 70%. Meanwhile, in general, the British government's financial expenditures on medical services have always been the mainstay.

Although this British medical model can better achieve the goal of fair distribution of medical resources, this model requires the government to have higher financial expenditures on medical and healthcare. At the same time, patients do not need to pay or just pay for a small proportion of the treatment expenses, so it is easy to engender problems such as excessive demand for medical services and inefficient utilization of medical resources.

(3) Medical model in the United States

The Health Maintenance Organization (HMO) in the United States combines medical insurance and medical service provision as a whole. A typical case is Kaiser Permanente in U.S., which is characterized by the integration of service providers and purchasers as well as the achievement of cooperation with physicians and hospitals through contracts approaches.

First of all, deeply influenced by liberalism, the medical service system in the United States, characterized by market-led medical service, is contrary to the British government-led medical service system. Secondly, medical services in the United States are mainly private, and private organizations take up over 70% of the total number of medical service organizations. Residents pay HMO in the form of prepaid funds and HMO selects medical institutions and doctors in its organization system to provide medical services to patients. After the patient receives medical treatment, he/she does not directly settle expenses with the doctor or medical institution, but submits the expense list to HMO so that HMO can settle with the patient's prepaid expenses. Therefore, HMO plays the role of a third party between patients and medical institutions.

After 1935, the U.S. government's control and management of the medical services supply has mainly gone through three stages: the first stage is from the adoption of Social Security Act in 1935 to the 1970s when the U.S. government implemented medical services deregulation on the supply of medical services. Back then, the government increased financial investment in medical services, and encouraged the development of private medical insurance, hoping to achieve the effective supply of medical services by improving the public's ability to pay for medical services; the second stage is in the 1970s and 1980s. Due to the expansion of medical service costs, the U.S. government began to reduce its financial investment in medical services,

and adopted price control measures, access measures and incentives to control the increase in medical service costs; the third stage is from the 1990s to date when the government tried to establish a universal medical security system, hoping to ensure the fair supply of medical services by strengthening social control and at the same time, to apply modern information technology into incentive control methods so as to improve the efficiency and quality of medical service supply.

This market-led model is conducive to improving the efficiency of medical resource allocation to a certain extent, and it can also give residents more freedom and room of choice in medical and healthcare services and health insurance. However, this medical model led by private insurance and medical institutions is giving rise to high and ever-rising medical expenditures in the United States. In this regard, it greatly decreases the attractiveness of the community medical model in the United States (Liu, 2009).

(4) Medical model in Singapore

The medical model in Singapore is to separate service providers and purchasers, and implement a four-in-one medical security system: national subsidies, personal savings, health insurance, and health insurance funds; in this model, the government possesses the property rights of all public hospitals and carries out corporate reforms. These hospitals are operated and managed according to the group model, and two major groups are set up to manage and operate these public hospitals and joint clinics in Singapore. The characteristic of this model is that the two major groups are independent economic entities and they can improve efficiency and reduce costs through competition.

Singapore's medical model is an integrated one that combines the government and the market. This model not only brings the government's role into play, but also focuses on mobilizing other entities to provide medical services. The integrated model was formed in the reform of the medical security system in the 1980s, which is different from the universal welfare model in the United Kingdom and the market-led model in the United States. Instead, it is an intermediate model that simultaneously emphasizes the role of the government, the market, and the multiple entities of society.

The integrated feature of Singapore's medical model is also reflected in its three-M medical insurance system, namely, Medisave, Medishield and Medifund (Zhang & Nie, 2017). The Medisave compulsively requires individuals to join, in which the individual and the employer respectively pay for half of the expenses and individuals must deposit 6% and 8% of their monthly salary in their medical savings account till retirement; the Medishield is similar to domestic major disease medical insurance and it requires voluntary participation. This is used

to protect the medical needs of major and chronic diseases and help those patients who still cannot pay off their medical expenses after using the Medisave; the Medifund is similar to the domestic medical assistance system. The government allocates S$100 to 200 million from the budget to establish a healthcare fund to help those poor groups who do not have healthcare savings or sufficient savings balance to cover medical expenses.

Singapore's medical system is absolutely not sheer perfect. As the government stipulates that the subsidy is only available for seeing a doctor in public institutions, yet the public institution is always busy, so patients' waiting time is often quite long.

In addition, the hierarchical system in foreign medical institutions, the strict initial diagnosis by primary medical institutes and referral systems, emphasis on the government's responsibility for providing basic health services, and the integration of government and market in the allocation of medical resources are also crucial factors for the successful integration of foreign medical service systems.

2.2.2 Practice of medical treatment partnership in foreign countries

The concept and practice of the medical treatment partnership originated from Kaiser Permanente in the United States. The group is a vertically integrated management system whose basic structure is a trinity of insurance companies, hospital groups and physician groups, organically integrating medical and insurance resources (Yu, 2013). This model has gradually developed into a successful global medical model. The professors in Stanford University pointed out that medical competition should not be a competition among medical institutions and medical institutions, but should be a competition among medical systems at the system level so as to promote the optimal development of medical undertakings (Enthoven, Crosson, & Shortell, 2007). The medical system refers to a "vertical integration" medical service system formed by different levels and types of medical institutions, providing patients with different aspects and various levels of continuous and overall medical services (Enthoven & Tollen, 2005).

The practice of constructing medical consortia in foreign countries is much earlier than that in China. Due to the differences in the medical and health systems of various countries, the main modes of construction are varied as well. According to literature statistics, the main models of foreign medical associations can be divided into horizontal integration, vertical integration, and horizontal and vertical integration in compliance with the morphological structure. In accordance with the connection method, it can be divided into entity union and

virtual union. The former is the integration of ownership and assets, the establishment of a legal and independent entity, of which the management is close and unified; the link of the latter is management and technology, and the way of union is comparatively loose (Tao & Wu, 2015).

The experience summary of the operation mode of medical treatment partnership in foreign countries, especially in developed countries, has very important reference significance for standardizing the top-level design of China's medical treatment partnership construction, accelerating the rational allocation of medical resources among medical institutions at all levels, and promoting the rational and effective diversion of patients' medical treatment.

First of all, foreign general practitioners have become the first "gatekeeper" of the medical treatment in medical treatment partnership. In the United States, commonly-seen diseases are treated by junior doctors, while major and hardly-seen diseases are referred to specialists for follow-up treatment based on disease diagnosis standards. This is an effective measure to solve the inefficiency of medical care. The initial diagnosis and treatment of patients by junior general practitioners is the first "gatekeeper" of life and health. If the patients encounter a situation that requires a referral, they need to be approved by the doctor and a referral form authorized by the doctor shall be issued to the specialist hospital before patients being accepted by the specialist (Yao, 2018).

Secondly, the hierarchical function positioning of many foreign medical institutions is quite conspicuous. Baker, M., a professor at the Royal College of General Practitioners in the United Kingdom, pointed out that medical treatment partnership can be divided into two or three levels of medical networks based upon regional medical needs. Medical institutions at all levels have clear functional positioning and enjoy their own priorities so as to maximize the benefits of resources at all levels and avoid resource intensiveness and waste. The levels include first-level primary care, second-level referral care, and third-level senior specialist care (Baker, 2016).

Thirdly, the construction of foreign medical treatment partnership was implemented earlier, which has effectively promoted the medical resource integration. Balto thinks that the medical resource integration can promote the technological exchanges and cooperation among hospitals at all levels and lift up the medical service quality, which not only benefits patients, but also helps reduce medical costs (Balto, 2012). John N. proposed that the construction of medical treatment partnerships is a way to realize the medical resource integration. In the integration process, medical and healthcare institutions at different levels can collaborate, share information, and are more closely connected to improve the hospitals' service quality and service coordination (Yao, 2018).

2.2.3 Internet medical treatment in foreign countries

The Internet medical treatment firstly appeared in the United States, which is much earlier, faster in development and higher in coverage degree than those in China (Xue & Liang, 2007). In 1960s, the concept of telemedicine and telemedical treatment was proposed, which provides telemedical services. It was mainly employed in non-invasive monitoring of astronauts and first aid for the wounded and sick on the battlefield. Since then, medical institutions have begun to apply telemedicine, and have gradually conducted projects such as remote medical consultations, remote consultations, remote transmission of medical images, and remote surgery.

Since 1976, the US government has achieved the goal of reducing costs and increasing economic benefits through telemedicine services. The United States has taken a relatively mature telemedicine approach, which can allow doctors to evaluate and diagnose diseases of patients in remote places on the Internet, use high-resolution TV screens to conduct “FACE TO FACE” medical follow-up with patients, provide follow-up recommendations, and monitor the patients’ physical signs in different places; it can also share medical data through the network and use Internet video or audio to assist medical treatment, which not only saves the time spent by patients or medical service personnel on the way, but also achieves the same medical service effect.

After that, the United Kingdom in Europe, Japan and South Korea in Asia, Mexico in America, and other relatively developed countries in Europe also followed the United States to focus upon the practical application of telemedicine in remote areas, develop large-scale telemedical services and systems, promote experimental projects and adopt Internet technology to realize the sharing and integration of medical resources (Eichelberg et al., 2006).

Since the 1990s, many countries have proactively promoted regional medical and health informatization based on electronic health records and medical information exchange as specific tasks, such as the “European Electronic Health Action Plan” and the U.S. National Health Information Network. At the same time, Personal Digital Assistant (hereinafter abbreviated as PDA) is widely employed in hospital data collection, such as body temperature, pulse, and blood pressure data. And this is the prototype of Internet medical treatment. As science and technology develops, technicians have integrated the advantages of PDA into smart phones and tablet computers, making it more convenient for users to obtain mobile medical services.

Since 2000, the combination of the Internet and medical treatment has promoted medical efficiency, but there has also been research on such problems as data collection regulations and

shared privacy. Although the implementation and adoption of EHR agreements in the United States and the United Kingdom are increasing, both countries are also facing considerable obstacles in realizing their respective national EHR systems (Wilson & Khansa, 2018). This is mainly reflected in the need to improve patient health and ensure patient information security so that appropriate security and privacy regulations for data collection, data processing, and data sharing are essential.

The rapid development and promotion of telemedicine services have brought obvious benefits to European and American countries, improving the overall medical level of the region, strengthening the integration of regional medical resources, promoting the development of high-tech, reducing the waste of medical resources, providing patients with more convenient services, and better giving full play to the social and economic benefits of medical institutions.

2.2.4 Research on business process management of hospitals

Since the 1990s, many foreign hospitals have realized the importance of the theory of process management and introduced it into their business to put into practice. Some medical institutions make different process reengineering schemes according to the needs of patients and market competition, and establish patient-centered process-oriented organizations, so as to improve management mode and performance. Foreign hospitals generally conduct process reengineering by four steps: demand analysis, planning, action and monitoring. Numerous examples have proved that the medical treatment efficiency for patients has been improved.

Hospital process management based on operational application contains two basic ideas: (1) to identify which steps are key to the process and make them as simple and effective as possible, and (2) to discard trivial details (Ho, Chan, & Kidwell, 1999). As for foreign practice, the Ohio State University Wexner Medical Center in the United States first identified key processes based on its goals and then prioritized these processes to start the business process reengineering. The reengineering focuses on improving patient satisfaction, reducing costs, and improving clinical service quality (Marsh, Guanciale, & Simon, 1995).

Hillingdon Hospital in the United Kingdom changed the site of the laboratory in process reengineering, effectively reducing test time and significantly improving the medical treatment efficiency for patients (Patel et al., 2008). A hospital in Stockholm, Sweden solved the bottleneck confronting surgical staff by reengineering the existing outpatient system centering on patient flow through management techniques for industrial enterprises. New York Hospital implements outpatient process reengineering, in which a process team was responsible for

providing patients with all services from registration to discharge. Walston et al. Walston studied the obstacles encountered in the introduction of business process reengineering into hospital process management, and the results showed that comprehensive coordinating services must be taken into account in process reengineering (Walston, Burns, & Kimberly, 2000).

Many foreign scholars have conducted systematic analysis and research on hospital business via mathematical quantitative models and put forward corresponding process reengineering schemes based on the results of quantitative analysis. Chadha, R. made a comprehensive comparison and analysis between queuing theory and lean production method, which was innovative in hospital process optimization (Chadha, Singh, & Kalra, 2012). This research demonstrated that patient satisfaction is an important basis for measuring and judging medical institutions (Lv, 2018). Gospodarevskaya and Churilov (2011) emphasized the construction and improvement of process evaluation indicators in their study, which provided important support for the smooth implementation of national medical standards.

2.2.5 Influence of patient value application on treatment effect by medical partnership

Foreign research on hospitals' patient-centered business process reengineering investigated patients from three perspectives: cognition, emotion and behavior. The research found that emotion and cognitive satisfaction are highly correlated with the extent of doctor-patient communication, which is of great significance for business process reconstruction (Jia, 2010). Therefore, the design of the telemedicine platform should reflect the reasonable process of telemedicine and pay attention to the physiological and psychological needs of patients. Independent selection of doctors and online medical consultation are core medical services of the telemedicine platform, as well as an important process for patients to consciously choose telemedicine and directly experience the service quality. The study of patient value also plays a particularly important role in the process reengineering of medical treatment services in medical treatment partnerships in an era of the Internet.

Some foreign scholars found that adults with chronic diseases were more likely to report unmet medical needs in a study. The research proved that it remained to be figured out whether unmet medical needs were associated with an increased risk of adverse health outcomes and with other measures of resource utilization. This is an important issue (Ronksley et al., 2013). Rubeis and Ketteler (2020) conducted a study showing that patient autonomy should be taken into account in the internet- and mobile-based interventions, which is associated with patient well-being and critical to medical alliances. However, excessive emphasis on autonomy may

harm patients' health. Tzelepis et al. (2019) used Skype and FaceTime to conduct video counseling on smoking cessation progress with patients. They intervened in patient compliance, satisfaction, and the effectiveness of the medical treatment partnership, as well as conducting an economic assessment. The conclusion was that a high-quality random experiment was needed to determine the effectiveness of smoking cessation. Bisseling et al. (2019) studied the positive effect of medical treatment partnerships on psychotherapy. And the research showed that early medical treatment partnerships could not predict failed treatment. Practice based on intervention against depression and anxiety of patients would positively influence the treatment effect and reduce psychological confusion. Accordingly, the study of psychological factors and the sense of value of patients influences the treatment effect of medical treatment partnership.

2.3 Review on Chinese medical service

2.3.1 Chinese medical service model

During the period from 1949 to China's reform and opening up, the planned economy system was gradually established, and a government-oriented medical model was formed, in which the government raised funds, and public hospitals provided medical services under the supervision of the government. Medical and health care investment mostly came from the government that could directly price medical services. Those services were provided at low prices or even free of charge. In 1952, 1960 and 1972, the government significantly reduced the medical service prices three times and provided financial subsidies when prices were lower than costs (Cai, Zhang, & Wang, 2018).

This was at the early stage of China's economic development. The staff of state-owned enterprises and large collectively-owned enterprises in urban and rural areas and their family members enjoyed the labor protection medicare system developed by the country. Civil servants of state organs and employees of public institutions in cities, counties, and towns and their families enjoyed the state-funded medical treatment. With the establishment of China's Rural Cooperative Medical System and the primary health care provided by rural doctors, rural residents, who accounted for 80% of China's total population, have received health security. A complete hierarchical medical system was formed, in which minor illnesses were treated at health stations (or health centers), major diseases at district-, enterprise- or county-level hospitals, and serious diseases at large urban public hospitals. Thus, an orderly and well-structured medical model was set up. Large public hospitals were not overcrowded because of

poor transport and little mobility.

The year 1978 marked the beginning of China's reform and opening up. Chinese supply models of medical services were continuously explored and evolving. From 1978 to 1984, Chinese medical services were supplied in a government-directed pattern. Between 1985 and 2005, with the autonomy of medical institutions strengthened, there were diverse medical service providers and an imperfect market-oriented model was set up. Since 2005, a combined medical service supply model jointly led by the government and involved with the market has been explored (Wang, 2011).

In chronological order, it is a transitional period to initiate new healthcare reform policies between 2005 and 2009. In 2005, Liu Xinmin, Director of Department of Policy and Regulation, Ministry of Health, stated, "Marketization is not the direction of healthcare reform." The government announced that the market mechanism should be reasonably introduced with adherence to the premise of government leadership. In 2006, the basis of a new round of healthcare reform has been set – the government should dominate in the practice and ensure basic medical services. In addition, a new scheme was published at the end of the year (Cu, 2012).

The year 2009 witnessed the launch of "universal health coverage". Followed by the free medical service during the era of the planned economy and social healthcare insurance reform during the era of the market economy, China's healthcare insurance system entered a new stage. On April 6, 2009, the highly anticipated "New Healthcare Reform Scheme" – Opinions of the CPC Central Committee and the State Council on Deepening the Reform of the Medical and Health Care System – was published. And Plan on Recent Priorities in Carrying out the Reform of the Medical and Health Care System (2009-2011) was released the next day, aiming at the settlement of difficulties and high costs of getting medical services (Cu, 2012). The "New Healthcare Reform Scheme" pointed out the new reform direction and depicted a framework to achieve "universal health coverage" by 2020. Its greatest highlight was regarding the basic medical and health care system as a public product that benefited all people, marking the further transformation of the government to a servant.

Five major reform measures were coordinated and promoted under the leadership of the State Council of China: (1) propelling the establishment of basic healthcare coverage system, (2) initiatively establishing a national essential drug system, (3) improving infrastructure for community-level medical service system, (4) providing equal access to basic healthcare services, and (5) implementing pilot reform of public hospitals. After several years of reform and pilot work, these measures have made significant progress and obtained some results,

achieving partial goals.

In terms of the healthcare system, China adopts the healthcare system dominated by the government and involved with the market. China's medical service system consists of three parts: professional public health agencies, community-level medical institutions and hospitals. By ownership, China's medical institutions are categorized into public and private ones, among which public medical institutions are dominating while private ones supplementary. Public medical institutions are built by the government, comprising urban healthcare service system based on general and specialized hospitals in various provinces, cities, counties and departments, as well as rural healthcare service network based on health centers in towns and clinics in villages. So far, China has basically established a healthcare service system which benefits both urban and rural areas. It consists of medical institutions at various levels, with different ownership and of diverse types.

With regard to China's medical institutions, the quantity is on the rise as a whole. Concerning urban and rural distribution, approximately 80% of China's healthcare resources are clustered in cities, two-thirds of which in metropolises. According to statistics, there were 1.014 million medical institutions in China in 2019, including 34 thousand hospitals consisting of 12 thousand public hospitals and 22 thousand private ones (Chen, 2020).

Since the new healthcare reform, the government has paid much attention to the development of functions and strengthening of abilities in the community-level healthcare system. Community-level medical institutions include community healthcare service institutes, health centers in towns and clinics in villages, totaling 960 thousand in 2019.

Despite yearly increasing investment in healthcare resources, "difficulties in being hospitalized" remain unsolved with the continuously rising number of hospital beds in recent years due to China's large population. As of 2019, there were 8.92 million beds in medical institutions in China, including 6.97 million in hospitals and 1.38 million in town health centers. At present, the rate of utilization of beds in community-level medical institutions is far lower than that in large hospitals.

Concerning health security, China has set up a multi-level health security system dominated by basic health security, complemented by supplementary health security and based on urban and rural medical assistance. The basic health security is the principal part of China's health security system, including three aspects: the medical insurance for urban workers, the medical insurance for urban residents and the new rural cooperative medical insurance. In 2018, 76.739 million people in straitened circumstances were aided financially to procure basic medical insurance; 53.61 million person-times were assisted to be in hospital and to receive outpatient

service.

During the last 70 years, the Chinese government has been committed to establishing and improving the healthcare system, enhancing medical science and technology and propelling the construction of Healthy China, making every endeavor to provide people with lifelong healthcare service. As of March 2019, over 1.3 billion Chinese obtained basic medical insurance including that for workers and urban and rural residents, achieving the goal of universal healthcare coverage. The year 2016 saw the launch of the interprovincial on-the-spot settlement of medical bills which brought convenience to more and more people.

Since 2018, with living standards upturning after reform and opening up, people have raised their demands for medical services. In particular, self-paying rural residents are not satisfied with the medical diagnosis and treatment capacity of the county hospitals in the local. When suffering from serious diseases, they would flood into large public hospitals in cities for medical services. Hence, the number of outpatients and inpatients has doubled in many urban public hospitals.

On January 10, 2020, Ma Xiaowei, Minister of National Health Commission said in the National Medical Management Conference that China should innovate and develop a high-quality public hospital system, consolidate and innovatively improve the “Three-level Network” of medical service (Zhang, 2020). In other words, China should boost the development of a “dual center” comprising a national medical center and a national regional medical center in a province, improve the medical service capacity of county hospitals, and establish an integrated medical service system based on medical treatment partnership.

2.3.2 The proposal of hierarchical diagnosis and treatment model and consequent problems

Since 2009, China has explicitly proposed in official documents to accelerate the construction of an orderly hierarchical diagnosis and treatment system to alleviate such problems as difficulties and high costs of getting medical services. However, few regions have explored hierarchical diagnosis and treatment. Besides, China’s hierarchical diagnosis and treatment system is still confronted with the following problems:

First of all, there is a lack of specific execution rules and implementation plans as guidance in the current design of hierarchical diagnosis and treatment system in China. Secondly, residents generally distrust community-level medical institutions but tend to psychologically rely on large hospitals. Thirdly, the insufficient knowledge held by medical institutions at all

levels on the hierarchical diagnosis and treatment model results in difficulties in the rapid development of the system. Driven by economic interests, medical institutions at all levels are reluctant to refer patients. Furthermore, due to the impeded information sharing among them, even if willing to do so, medical institutions at all levels dare not refer patients easily (Liu, 2016).

To solve the above problems, the Twelfth Five-year Plan in 2012 proposed clearly to keep strengthening the capacity building of community-level healthcare services, gradually establish the system of initial diagnosis in community, hierarchical treatment and dual referral, and apparently raise the proportion of outpatient and emergency visits in community-level medical institutions to the gross. Therefore, in recent years, in order to respond to the call of the country and establish a medical treatment system of initial diagnosis in community, hierarchical treatment and dual referral, various regions in China have made preliminary explorations on the establishment of a hierarchical diagnosis and treatment system in light of local realities (CSCGO, 2015, 2017). And the following representative models have been formed:

(1) Family doctor contract. This model cultivates family doctors as the "goalkeepers" of resident health, healthcare resources and costs and sets up a dual referral system with superior medical institutions.

(2) Regional medical treatment partnership. Hospitals and community-level medical institutions in a specific region collaborate to build a community of shared interests led by higher medical institutions. In their study on the medical treatment partnership in Chaoyang District, Beijing, Shi et al. pointed out that the medical institutions in that region had improved the utilization efficiency of healthcare resources by developing multiple businesses of telemedicine, professional guidance and targeted assistance in key specialties via medical treatment partnership (Shi et al., 2014).

(3) Hierarchical diagnosis and treatment of chronic diseases. This model aims at the efficiency maximization of healthcare resources. Xiamen started with diabetes to set up the hierarchical diagnosis and treatment of chronic diseases. The relevant department of the Xiamen government established a website called "Diabetic Gathering". Every patient who joins the website will be assigned a diabetes specialist with an intermediate title or above, a health manager trained and certified and a community general practitioner, which is the "trio for treatment" model.

These three models have arisen during the development of hierarchical diagnosis and treatment, but the results were yet to be satisfactory. A questionnaire survey made by Yu et al. involving 789 patients in county-level public hospitals in Jilin Province showed that only 28.4%

of the patients surveyed had heard of hierarchical diagnosis and treatment. A survey on the awareness of dual referral indicated that up to 71.4% of patients surveyed had never heard of dual referral. For patients, there was a low awareness rate of policies concerning hierarchical diagnosis and treatment and few channels to get access to dual referral policies. Additionally, they showed a low willingness to get initial treatment in community-level medical institutions (Yu et al., 2018).

2.3.3 The achievements and problems of the development of medical treatment partnership

The concept of "medical treatment partnership" was officially proposed in the 2013 National Health Conference. In the Conference, large hospitals were encouraged to help improve the service capacity of community-level medical institutions by technical assistance. After years of exploration and practice, China has built a clear model for medical treatment partnership and it is significantly effective (Wang et al., 2019). In April 2017, Guiding Opinions of the General Office of the State Council on Propelling the Building and Development of Medical Treatment Partnership was published. It clearly stated that the construction of medical treatment partnership is an important step and an institutional innovation to deepen healthcare reform, which is of great significance.

The development of medical treatment partnership in China started around 2014. And in recent years, its construction and development has achieved some results and obtained the recognition for its practice among Chinese scholars. Yi believed that the construction and development of medical treatment partnership enable the tertiary public hospitals in the region to give full play to its leading role, facilitate the flow of high-quality medical resources to the community-level hospitals, and thus gradually alleviate the existing problems such as insufficient high-quality medical resources and irrational allocation (Yi, 2017). Yi (2017) also stated that the medical treatment partnership improves the ability to diagnose and treat common and frequently-occurring diseases in community health service centers, achieves resource sharing, and resolves such problems as limit space and long waiting time for patients to register, visit doctors and get medicine in large hospitals. Yao pointed out that the establishment of medical treatment partnership can change the inverted pyramid pattern of medical treatment, effectively promote the vertical allocation of quality medical resources, and alter the status quo that quality medical resources and talent are excessively clustered in large general hospitals while the community-level hospitals lack resources in every aspect (Yao, 2017).

Problems also occur during the development and operation of medical treatment partnerships in China. One of the main problems is the impeded sharing mechanism. Huang et al. believed that the medical treatment partnership is actually a community of shared interests. But medical treatment partnerships compete with each other in a closed state, while there is a lack of strict internal accountability, thus failing to change the status quo of weak technical ability of community-level institutions and strengthen their role, and instead limiting patients' own choices for medical services (Huang et al., 2016). He said that the current medical treatment pattern is shaped like an inverted pyramid, and institutions in the medical treatment partnership have yet established effective communication channels and information-sharing mechanisms for patients' medical treatment (He, 2017). Zhen analyzed the difficulties in the development of medical treatment partnership from the perspective of patients. Firstly, patients need to register again and be re-charged in the process of outpatient referral to superior medical institutions and face the problem of recalculating the deductible when paying hospitalization fees. Secondly, community-level institutions and large hospitals do not share the same drug catalog, which results in inconvenient drug prescription for patients. Thirdly, the medical treatment partnership does not share information internally, which is not convenient for patients to refer to superior or inferior medical institutions, resulting in their unsmooth experience in the medical treatment process. Finally, residents are inertially inclined to choose general hospitals due to their long-term trust. In his dissertation (Zhen, 2017). Xue studied the status quo of hierarchical diagnosis and treatment of chronic diseases in medical treatment partnerships in Chongqing and found that medical service institutions at all levels or medical treatment partnerships do not specify dual referral rules, making the dual referral unsmooth (Xue, 2018). Wang et al. analyzed the coordination difficulties in the process, management, resource, and system in regional medical treatment partnership. It was believed that establishing internal trust within a medical treatment partnership is the strategy to conduct disease management (Wang et al., 2018).

2.3.4 The achievements and problems of the development of telemedicine

The 1980s witnessed the exploration of telemedicine in China. Recently, telemedicine has rapidly developed. The earliest telemedicine practice began in 1982 when the consultation based on medical records was conducted by email. In the early 1990s, telemedicine has been widely concerned by society since it was successfully applied to diagnosing flesh-eating disease for a lady in Shandong Province and thallotoxicosis for a female college student in Beijing. In

the late 1990s, telemedicine was moving from theoretical exploration to practical application. National Health Commission, China Medical Foundation, and the Health Department, General Logistics Department, People's Liberation Army successively initiated Jinwei National Medical Health Information Network Project, China Medical Foundation Network, and No. 2 Military Medical Project (a telemedicine website). Some famous medical colleges and hospitals have set up remote medical consultation centers and successively carried out various forms of telemedicine with hundreds of hospitals across China. At present, visual and real-time specialist consultation, transmission and sharing of diagnosis and treatment data, and pathomorphological diagnosis can be provided for patients with severe and difficult diseases in various places (Zhu, 2006). It can be seen that the earliest concept of Internet medical treatment is remote medical consultation. And according to literature research, remote medical consultation at that time was carried out with one-way data transmission and non-real-time sharing, and face-to-face treatment by doctors could not be achieved.

However, Zhu (2006) believed that with the establishment of a telemedicine service network, community-level medical service will act as the end of telemedicine and provide telemedicine with community support, instead of merely curing diseases and saving lives. With the rise of Internet hospitals in developed countries, their practice has served as a reference for the improvement of the remote medical consultation in China's hospitals. Since 2012, data transmission for remote consultation has been realized, and the transformation to a patient-centered and network-based telemedicine platform has been achieved, which has provided a solid foundation for the improvement of medical service quality in China. In 2014, Opinions of the National Health and Family Planning Commission on Propelling the Telemedicine Service in Medical Institutions was printed and published to optimize medical resource allocation, achieve resource sharing to inferior institutions, improve medical service capacity, clarify supervision and management regulations and ensure the legitimate rights and interests of both doctors and patients.

Since 2014, scholars have mostly focused on telemedicine technology. They often adopted the Delphi method and Analytic Hierarchy Process to build the impact evaluation indicator system for remote medical consultation in hospitals. Wang and Wei (Wang & Wei, 2014) used such methods to set an impact evaluation indicator system for remote medical consultation in hospitals including factors concerning cognition, communication, location and personnel, equipment and Internet, and problem-solving, totaling 5 first-level indicators, 10 second-level indicators and 25 third-level indicators. They recognized the importance of research on telemedicine technology providing a theoretical basis for the effective practice of telemedicine

(Xiao, Xiao, & Han, 2015). Ruan (2015) proposed to provide online medical services such as appointment and registration, medical guidance, expert recommendation, online report query and online payment via the Internet. Based on the cloud technology of the Internet. Lin and Dong (2017) established and developed overall connected cloud storage, and constituted an intelligent medical service system with physical medical institutions, so as to truly realize reasonable and orderly medical treatment and assist the implementation of hierarchical diagnosis and treatment. This shows that medical information platform based on the Internet has been an important means to provide medical services in recent years, and also a significant way to enhance medical service efficiency.

However, during the promotion of telemedicine, there are still some problems in the standardization system of telemedicine, the extent of understanding and trust between doctors and patients, and responsibility determination in medical laws and regulations. Therefore, in recent years, some experts have adopted qualitative methods to explore these problems and put forward measures. Most studies analyzed laws, policies, charges, operational models, cost-effectiveness and other aspects (Liu & Liu, 2017).

2.3.5 Achievements and problems of the integration between medical treatment partnership and the Internet

In April 2018, the General Office of the State Council issued the Opinions of the General Office of the State Council on Promoting the Development of “Internet plus Health Care” to further promote the integration between medical treatment partnership and the Internet in China (CSCGO, 2018). The quality of medical service of distant medical treatment partnership has also been improved. Upon the “Internet +” policy, many scholars have done in-depth research on the combination of medical treatment partnership and the Internet, and achieved certain results. Yao, with Fuzhou No.1 Hospital as research subject, explored the application of Internet technologies in the spread of hierarchical diagnosis and treatment. Through referral platforms and telemedicine services, the online referral services within medical treatment partnership have basically been materialized, which has effectively promoted the diagnosis and treatment capacity of grass-root medical institutions, and greatly benefited the development of hierarchical diagnosis and treatment (Yao, 2018). Considering the status quo of medical imaging in medical treatment partnership, some scholars adopted the latest framework to build the cloud data center and the cloud collaboration platform of medical imaging in medical treatment partnership, which allows access to member hospitals at all levels, thereby realizing

the unified storage, management and interconnection of data, and building a coordinated system of medical services (Xiong, Ying, & Shan, 2020).

In carrying out medical treatment partnerships in China, the lack of an internal information-sharing platform prevails, hence it is difficult to achieve seamless continuity of medical services. The sharing of electronic medical record and resident health record within medical treatment partnership helps referral hospitals to acquire the shared information, thereby saving time and money on certain medical inspections during the transfer. Therefore, a digital medical platform should be built to assist regional medical treatment partnership to carry out services including remote appointment, one-stop inspections, medical report and online consultation; and encourage member institutions to provide services such as remote medical consultation, training, online surgical guidance and project management. For example, several subsidiary diagnosis facilities were established in the medical treatment partnership of Luwan District of Shanghai including a regional inspection center and a medical imaging center, to share inspection results and realize appointed diagnosis and treatment, as well as dual referral; Beijing Ditan Hospital has built an interconnection with all the other member institutions in its medical treatment partnership, so all patients' medical records can be shared between member institutions. The two cases are both great examples in exploring the internal information platform of medical treatment partnership.

However, the privacy of data and security of information-sharing are major concerns in the integration between medical treatment partnership and the Internet. Scholars put forward the authorities should strengthen the regulation on third-party health consultation, and gradually enhance the overall regulation on Internet medical services from such aspects as the approval of multi-spot practice, rules concerning the scope of Internet medical services, and regulations on electronic medical record.

2.3.6 Internet hospital in China is still in its infancy

Experts have not reached any consensus in terms of the definition of Internet hospital. Whereas there are similarities among the definitions proposed by different scholars. Yang holds that Internet hospital is a professional Internet health platform providing online health consultation and information services in virtue of the Internet (Yang, 2012). Ni et al. (2016) believe that Internet hospital, supported by physical hospital's overall capacity, adopts such information technologies as cloud computing, big data and mobile intelligent terminal to bring medical resources into the field of the Internet. With people's health as the core, it provides whole-

process online medical and health services covering pre-hospital, in-hospital and post-hospital stages. Additionally, domestic research on Internet hospital is dispersed and few in number, most of which focus on platform establishment, research approaches, function exploration, and cognitive survey research on the sensitivity of privacy in online medical services. It can be seen that, overall, the research in this field is still in its infancy.

2.3.7 Research on the integration between China's medical treatment partnership for specialties and the Internet

Since general hospitals in medical treatment partnership are unable to meet patients' needs for diagnosis and treatment in certain specialties, the emergence of remote medical treatment partnership for specialties in recent years has further promoted the in-depth coordination for specialties in China, which is also the direction of research in this filed in recent years. Therefore, it can be found that domestic scholars are gradually shifting their focus from the practical research on the integration between medical treatment partnership and the Internet to the medical treatment partnership for specialties. There are quite a few research results concerning medical treatment partnership for specialties. Since 2015, domestic scholars prefer to adopt Internet applications to the advantages of medical treatment partnership for specialties, then carry out studies on the medical service quality for remote patients. The number of relevant research results is rising. Most of them are centered on using the Internet to break through the contradiction between resources and demands in medical treatment partnership for specialties.

Some scholars believe that, only by building a fully functional remote medical platform of the medical treatment partnership for specialties, which not only reduces costs but also lifts efficiency, can we catch up with the trend of medical informatization and meet the growing demands of hospitals (Bo, Hong, & Yu, 2019). Li et al. (Li et al., 2020) proposed that the management mode of "Internet + medical treatment partnership for specialties" can effectively improve the self-management ability of gout patients, increase the rate of uric acid compliance, and upgrade patients' quality of life. Gao et al. did a thorough research on the building of medical treatment partnership in grade-A tertiary hospital, set up a service platform supported by information technologies (comprehensive full-life electronic health record, medical technician appointment, and the integration platform for hospital bed), introduced the EPAs-competency combining the service data of hospitals, so as to promote the coordination of general practitioners and specialists (Gao et al., 2020).

2.3.8 The diagnosis and treatment model in domestic Internet medical treatment partnership for specialties facilitates the reshaping of hospital's service process

The emergence of medical treatment partnership for specialties in the context of the Internet also helps hospitals to rebuild internal management process, which has achieved certain positive results. Process management has always been an important means for hospitals to improve efficiency. Most hospitals prefer the process re-engineering theory, and have introduced it to the health system or their own business process re-engineering, which have borne some fruits. Domestic research on business process re-engineering made its debut in Beijing Hospital in 1995. It originated from the innovative lean management theory as well as the needs for cultural integration, aiming to reform the process of primary public hospitals. Associate professor Ma was the first domestic scholar to conduct practical research on the average hospital stay and reasonable hospitalization process of one single disease (Ma et al., 1999). Based on the queuing theory, Chen (Chen, 2009) did a comprehensive analysis on the health inspection system by setting up a mathematical mode. In a series of analysis made by Zhang (2012), the building and perfection of the data collection remain the main focus and the data collection is reasonably sequenced. Based on the business process re-engineering theory, Luo (2016) proposed effective supplement to hospitals' emergency process.

The development of the Internet promoted the application of information technologies into the business process of domestic hospitals, thereby facilitating the modernization of these hospitals. For example, domestic hospitals often informationize the outpatient process with the following tools: all-purpose rechargeable card, magnetic bank card, bank IC card, bank-hospital one-card pass, integrated registering and charging system, improved inspection and testing system, and optimized outpatient dispensing process (Wang, 2011).

In the "medical treatment partnership for specialties + Internet" mode for medical services, the demand for the improvement and reform of service process within domestic hospitals is growing, which echos with the trend of the times. From Zhang's perspective, the expected long-term effect of building up medical treatment partnership for specialties, promoting standardized training for specialists, as well as telemedicine, is to improve the academic capability of primary hospitals, which in turn facilitates the standardization and management of hospital business process. The practice and popularization of telemedicine require a profound coordinated system for specialties. Remote medical treatment partnership for specialties is an applaudable way to do so (Zhang, Chen, & Lu, 2018). Zhang (2019) in his study on "Internet + Medical Service" development with Weifang Traditional Chinese Hospital as the case, applied multiple

approaches including service process re-engineering, smart medical system, scientific research platform for talents, remote diagnosis and treatment platform, and refined management system, to testifying the Internet's effect on promoting the quality of medical service in hospitals.

2.3.9 The research on the diagnosis and treatment mode of medical treatment partnership for specialties based on patient values is still at the initial stage

The development of medical services should be in accordance with the patient values, and the focus should be on whether the diagnosis and treatment mode in the context of "medical treatment partnership + Internet" can substantially meet patients' needs. Therefore, some domestic scholars have adopted Internet technologies to study patient satisfaction from the perspective of patient evaluation, although the level and depth of such research are still at an early stage. In China, related studies began in 2016. Most of them focus on establishing informationized medical platforms based on patient data, and exploring patient perception factors using related management theories.

Wang and Xiao (2016) believe that the value of medical services is to relieve physical pain and psychological diseases, so as to improve patients' quality of life. And the "Internet +" era has further enriched the value of medical services. It carries multiple features that traditional medical services cannot compete with, including preventability, traceability, mobility, convenience and accessibility. Having a loyal "customer group" can greatly accelerate the process. The core processes of hospital are medical process, nursing process, medical technician process and medicine process.

Wang (2016)integrated the "online and offline" service management concept into the follow-up service management of telemedicine, and proposed the integration of management. In the meantime, he built a follow-up service management platform of telemedicine based on his research, and sought out the deficiencies of the Zeithaml model. Then, through adding such factors as time, space and spiritual benefits, he made the value model of follow-up service of telemedicine more complete. Tian (2018) applied the five dimensions of patient perceived values to identifying that patient perceived value and resource efficiency can affect patient satisfaction in the context of mobile medical system. Chen et al., with Jiangsu Stomatological Hospital as the case, studied its patient services and integrated application platform and explore the development model of an Internet service system featuring "personal service windows + self-help terminal + mobile application + intelligent service robots" in stomatological hospitals (Chen et al., 2018).

Lv (2018)with a patient-centered perspective, discussed the consulting process from the angle of process improvement. By combining the status quo of specialized hospitals in Dalian, he used a large amount of data to conduct empirical analysis based on the existing theories concerned and information technologies, and then proposed appropriate adjustments and improvements. From the micro perspective of doctor-patient interaction. Hu adopted quantitative research approaches to analyze the content and influential factors of patient perceived values. She proposed the "patient-centered and process-guided" operation method to improve patient satisfaction, and applied the satisfaction management theory and Six Sigma management theory to studying the methods of improving business process in grade-A tertiary hospitals.

Li (2019) proposed a new framework based on a theory of patient perceived values, which targets customers, medical information service personnel and medical information products. They brought up a medical information assessment system based on patient perceived values from nine aspects: product value, service value, personnel value, context value, brand value, conflict cost, time and energy cost, spiritual cost and risk cost, and then used the gray clustering method to test the system's scientific city and certainty . Wang and Su (2017) collected and summarized the current medical information service projects, and constructed a perceived value indicator system for medical information service projects from the perspective of 8 evaluation indicators in 2 dimensions: total value and total cost; By "Online Good Doctor" information consultation service platform, Fang et al. (2019) analyzed and concluded that the monetary cost, functional value, and online doctor value are important factors affecting the perceived value of online medical community information consultation services.

However, according to a thorough literature review, the author found that there are still deficiencies in the Internet diagnosis and treatment model of domestic medical treatment partnership for specialties. For example, general medical treatment partnerships and those for specialties should both respond to the policies and top-level design of the country. The guidance and regulations formulated by the country play the major role in promoting the sound development of medical treatment partnership for specialties, yet the underlying information system is completed by the member institutions on their own. Thus corresponding supervise systems are needed to ensure the successful promotion of the medical service model based on medical treatment partnership for specialties. Budget has also become another major problem in the development of medical treatment partnership.

2.4 Review of research on medical services at home and abroad

Medical and health-care services have always been one of the priority areas that countries across the world focus upon. They are not only closely related to people's livelihood and welfare, but also exert a significant influence on a country's economic prosperity and social stability. Medical system is one of the fundamental socioeconomic systems of a country. A scientific and comprehensive medical service system, as well as fair and efficient medical resource allocation have always been the expectation of the people, and the goals that state governments strive to achieve. Fundamental medical service mechanism, medical service institutions and the corresponding security system are important components of a country's medical service system. Overall, most developed countries have rather comprehensive medical service systems, but there still exist issues hindering socio-economic development, thus continuous improvement is underway. In developing countries like China, however, medical service system is a major project in progress, which is still in its exploratory stage.

Reviewing the overseas research on the process management of online medical service of medical treatment partnership, it is found that extensive practical experience and Internet technologies have been applied in telemedicine since early stages. In the meantime, the effect of medical treatment partnership has also promoted the hierarchical diagnosis and treatment in developed countries and reduced costs. According to the research on the management of hospital business process, overseas hospitals are able to apply Internet technologies effectively and set up the information platform combing patients' needs, thereby carrying out demand analysis, planning, execution and monitoring. Certain practical effect has been produced. At the same time the research on the reform of online medical service platform based on patient value theory in recent years has also been in progress, offering much empirical data. Yet most studies on patient value have been conducted from the perspective of patient's psychological factors, which belong to the scope of psychology and lack specific theoretical foundation.

Reviewing domestic literature, scholars share similar recognition of patient value. They believe that the core of the perceived value is the trade-off between the perceived gains and sacrifices, which is also the guidance for the author to lay the theoretical foundation for this study. Yet there are also deficiencies. For example, most research on online medical process re-engineering focused on hospitals, ignoring patient-centered medical service management. Although more studies on online medical process based on customer value theory have been done in recent years, they are still at the initial stage. Being rather superficial and incomplete, most of them stay at the level of concept description and strategy study. Unlike previous studies

on patient satisfaction, the assessment of patient value, particularly, lacks empirical support, which is not conducive to the improvement of service management in hospitals. Additionally, in the research on the online medical environment of medical treatment partnership for specialties, corresponding laws, regulations and standards concerning medical practice management are often neglected. Yet such laws, regulations and standards are important methods for patients to protect their information security.

2.5 Practical significance

Based on previous literature, this study avoids the disadvantage of "hospital outweighs patients" in telemedicine, and focuses on remote patients. With a patient-centered view, the author further explores the customer value theory, coordination theory and process re-engineering theory, which serve as the theoretical foundation of this study. Based on the customer value theory, this study explores the development model of online specialist medical services built up by F Hospital and other member institutions, thereby reshaping the telemedicine process and shifting the traditional doctor-patient relationship from the active-passive mode to coordination and mutual participation. Meanwhile, according to the Measures for the Administration of Internet Diagnosis and Treatment in China, and the Measures for the Administration of Internet Hospitals (for Trial Implementation), the necessary technical standards for the operation of medical treatment partnership are embedded in the online medical service platform, so as to ensure the rationality of relevant regulations as well as the patients' safety and benefits, and supplement certain areas with few existing results (CNHC, 2018).

In this study, the medical model featuring "process re-engineering of online medical services for specialties based on patient values" transforms from the previous "treatment-centered" mode to the "patient-centered" value service mode, which will benefit hierarchical diagnosis and treatment, guide the patients to seek local medical services, enhance the patients' rights to choose medical services, and eventually make the development mode of online specialist services replicable and feasible in China.

2.6 Research steps

According to the above roadmap, specific steps are designed to ensure smooth progress. The detailed steps are as follows:

(1) Raise question and determine the goal. The research goals are determined according to

a thorough analysis of such problems as “difficulty in seeking treatment for remote patients”, “experts from medical treatment partnership falling short of meeting hospital demands”, and “limited choices for remote patients seeking medical treatment”.

(2) Theoretical study. The author carries out a theoretical study on customer value theory, Maslow’s hierarchy of needs, coordination theory and business process re-engineering theory; in the meantime, reviews previous research that applies such theories to addressing online medical problems at the core of patient value. The previous results offer certain reference for this study.

(3) Design the theoretical framework of this study based on the literature review, and propose theoretical model and hypothesis.

(4) Design the questionnaire of remote patients’ medical value based on Maslow’s hierarchy of needs, learn the status quo of remote patients’ medical demand, send out and collect questionnaire, organize data and offer detailed analysis, lay solid foundation for the indicator system of remote patients’ perceived value based on customer value theory.

(5) Combing the above analysis and literature review, determine the indicators of remote patients’ perceived value based on customer value theory.

(6) Use Delphi method to verify the determined indicators for the second- and third-round.

(7) Use the Analytic Hierarchy Process to calculate the weighted values of the indicators at various dimensions, as well as second- and third-level indicators, obtain reasonable assignment of the weight, build a formal indicator system of remote patients’ perceived value based on customer value theory.

(8) Based on the above indicator system, design the telemedicine information platform of medical treatment partnership for specialties, incorporate the indicators in the platform, and re-optimize the medical process with the IE theory. The goal is to improve remote patients’ medical experience, as well as the efficiency and quality of medical services from the perspective of patients’ perceived value. The information platform will be put into use once the design is completed. Collect relevant medical data, find out problems in the trial stage and make adjustments to further improve the information platform, and then prepare to collect more reasonable and exact data in the following process.

(9) Stage of empirical study. The multiple factors before and after the re-engineering of online specialty treatment process of the medical treatment partnership for specialties, including the score of remote patients’ perceived value, time cost, money cost and degree of satisfaction, will be compared in order to testify the effectiveness of the results produced by this study, that is, the process re-engineering research can significantly improve patients’ experience and

satisfaction and the result is worth replicating.

(10) Use empirical data to verify the theoretical model and hypothesis. The theoretical model of this study is formed.

(11) Conclusion and suggestions. Conclude the contents and results of this study, and propose suggestions for the shortcomings in this study.

2.7 Chapter summary

This chapter introduces the development direction and process of domestic medical services, that is, the shift from creating value for hospitals to creating value for patients. Starting from medical service concepts, this chapter analyzes typical medical service models at home and abroad, including the universal medical model in the United Kingdom, the market-oriented medical model in the United States, the mixed medical model in Singapore, the special medical model for the elderly and infants in Cuba, and the domestic medical model combining the market and state support. Through comparison, practical experience with reference significance is drawn.

By thoroughly reviewing the relevant literature at home and abroad, this chapter comprehensively reviews the literature covering such topics as Internet medicine, Internet process management, the domestic development of hierarchical diagnosis and treatment, the achievements and problems of medical treatment partnership and telemedicine, the status quo of health care in the Internet age, as well as the current situation of online medical model of medical treatment partnership for specialties based on patient value. This chapter introduces the innovative aspect of this research, that is, the shift from the previous “hospital-centered” consultation mode to the “patient-centered” value service mode. The key question of the research is also determined, that is, building a medical perceived value system of remote patients and proposing an improved online specialty treatment process based on customer value theory.

[This page is deliberately left blank.]

Chapter 3: Theoretical Framework

3.1 Definition of related concepts

3.1.1 Medical treatment partnership

Medical treatment partnership, referring to regional medical alliance, is the integration of medical resources in a certain area. It is often consisted of the secondary and tertiary hospitals, community hospitals and village hospitals in this area. Chinese medical treatment partnership can be divided into four types according to the way of integration, including horizontal integration, vertical integration, virtual integration and entity integration. Horizontal integration exists among medical institutions with similar scales and functions with the aim of sharing certain types of resource; vertical integration is formed among medical institutions with different technical levels, functions and scales according to specific functions and division of labor (Shortell et al., 1993). Virtual integration is the contract-based cooperation on medical technology without changing asset ownership. Entity integration is based on asset ownership and the alliance owns the assets of affiliated institutions. China's practices in the integration of medical service system can be concluded as follows (Dai, Chen, & Wei, 2012).

(1) Technical assistance and contract-based alliance: the alliance provides technical assistance to grass-root institutions according to the signed contract. (2) Hospital as trustee: governments entrust the management of medical institution to higher-level medical institutions, and the entrusted institution has independent legal person status. (3) Group-like alliance: medical management committee or council is established to forge a medical group, so as to manage and allocate the internal medical resources as a whole. (4) Hospital acquisition: the ownership and management rights of grass-root medical institutions are obtained by hospitals through such means as merger, acquisition and direct sponsorship (Zhang et al., 2009). (5) Medical group formed by alliance and acquisition: through entity integration based on ownership, a medical group with independent legal person status is formed. Among the above practices, hospital acquisition and medical group formed by alliance and acquisition belong to the type of medical alliance with single ownership.

The aim of such alliance is to address the dilemma that people have difficulties in seeking medical treatment, so that people can get proper treatment for minor conditions in grass-root

hospitals instead of scrambling for appointment in tertiary hospitals. Eventually, the expected outcomes can be realized, namely the satisfaction of the public, governments and medical workers. In March 2015, the General Office of the State Council released the Outlines of the National Medical and Health Service System (2015-2020), pointing out to "establish a well-coordinated working mechanism for hospitals at different levels, grass-root medical institutions and hospitals, as well as medical institutions for continuous treatment" (CSCGO, 2015; Xue, 2018).

3.1.2 Medical treatment partnership for specialties

Medical treatment partnership for specialties is a supplementary form of alliance existing among several medical institutions based on the coordination of specialties, aiming to improve the medical treatment level for critical diseases. In August 2018, China's National Health Commission and National Administration of Traditional Chinese Medicine jointly released the Notification on the Key Tasks for Further Promoting Hierarchical Diagnosis and Treatment System, demanding that national level and provincial level hospitals should give full play to their advantages of major clinical specialties, and attaching great importance to specialty partnership centered on critical diseases and medical resources in short supply. According to the requirements of "building high-quality and efficient medical treatment service system", the F Hospital in Shanghai, together with relevant specialty hospitals in China, has been exploring the future path for specialty partnership. In such process, its high-level techniques, disciplines and human resources serve as the foundation, specialty as the core, and information technologies as the underlying support.

Most general medical treatment partnerships are led by governments or hospital leaders, with the aim of improving hospital influence rather than serving patients and discipline development. Such medical treatment partnership tends to suffer talents outflow once the original enthusiasm fades away. In comparison, medical treatment partnership for specialties is people-oriented, and focuses on the standardized treatment of diseases and talent cultivation, so as to provide equal treatment for patients. Building a medical treatment partnership for specialties often includes the following aspects: remote medical consultation, dual referral, interdisciplinary coordination, remote imaging, remote teaching, portal websites and sub-sites.

3.1.3 Internet medical services

Internet medical care is the application of internet in medical industry, which includes health

services such as health education, medical information query, e-health file, disease risk evaluation, online illness consulting, e-prescription, remote consultation, treatment and rehabilitation, all of which are based on the internet.

Internet medical services represent a new development direction of the medical industry, which is conducive to addressing the contradiction between imbalanced medical resource allocation and people's growing demand for health and medical services. The National Health Commission has been actively guiding and supporting the development of online medical services. While fighting the coronavirus in 2020, many Chinese hospitals and online health platforms have launched online medical services.

In April 2018, the General Office of the State Council released the Opinions of the General Office of the State Council on Promoting the Development of "Internet plus Health Care" which aims to promote the Health China Initiative, improve the modernized management of medical system, innovate service models, optimize resource allocation, reduce service costs, and lift service efficiency, thereby meeting people's growing demand for medical and health services (CSCGO, 2018). Medical institutions are encouraged to expand service space and enrich service contents with the help of information technologies such as the Internet, so as to form an integrated "online + offline" medical service system covering the whole process of diagnosis. The Opinions also requires medical alliances apply Internet technologies to realize balanced allocation of medical resources, interconnected information-sharing and highly efficient business cooperation; encourages such services as appointed diagnosis and treatment, dual referral and telemedicine; and promotes the mechanism of "inspection at grass-root institutions and diagnosis at higher-level hospitals", thereby establishing a well-structured hierarchical diagnosis and treatment system (CSCGO, 2018). See details of policy documents related to the Internet medical service in Annex B, Table B1.

3.1.4 Customer value theory

Customer value management (CVM) is a strategy to integrate customer needs and expectations into the key processes and management activities of enterprises, and is known as the "best practice" to meet customer needs. The effectiveness of this management method and its contribution to the competitiveness of enterprises have been verified in many international conglomerates such as IBM (Zhang & Wang, 2008). In the process of medical service switching its focus from hospital to patient, the importance of patient value management has gained more and more recognition and concern. How to create patient value to gain competitive advantage

will become an important issue in medical service industry.

The concept of modern medical services is to meet the needs and expectations of medical service objects and strive to exceed their expectations. Only by accurately identifying, understanding and applying the medical needs of medical service objects, can medical institutions provide targeted services to meet the needs more effectively, which is the prerequisite, effective path and entry point for achieving high quality, efficient, safe and convenient services (Ma et al., 2006). As the medical market matures gradually, the patient side also begins to mature, and requiring services and enjoying added value have become the right of patients. The key to winning the medical market competition is to understand patients' thoughts, provide the greatest patient value and gain patient loyalty, by doing which one can be invincible in the competition. This patient-oriented concept embodies the public welfare nature of the hospital and the idea of patient-centered and wholehearted medical services for patients. Therefore, the patient-oriented management and operating concept should be the mainstream trend of the development strategy for hospital construction.

3.1.5 Process management and process reengineering

Process management (PM) is a systematic method that sets meeting customer needs and exceeding their expectations as the primary goal of the organization, centers on standardized and direct business processes, and aims to continuously improve organizational performance. The essence of this method is to construct excellent customer-oriented business processes, thereby creating values to meet customer needs. Process-based management has become a hotspot in current management research. In the context of a rapidly changing medical service market full of challenges and fierce competition, in order to establish and maintain competitive advantage, many medical institutions have tried to apply the concept of process management to improve service and management as well as the quality and efficiency of medical services, and reduce the cost of medical services, so as to meet the needs of patients (Liu & Tang, 2006). The future development direction of medical service institutions is to construct the "patient needs-centered" process system and put the activities of medical service institutions on the "patient needs-oriented" basis according to the principle that "meeting the needs of patients must be the priority of all work activities".

The design of telemedicine platform should reflect a rational process of telemedicine and pay attention to the physiological and psychological needs of patients. Independent medical choice and online medical inquiry are the core functions in telemedicine platforms, as well as

an important link for patients to consciously choose telemedicine and directly perceive the service quality.

Process reengineering refers to the thorough reconstruction of the enterprise's business process after in-depth analysis, and the purpose of process reengineering is to help the enterprise to reduce operating costs, and improve the quality and efficiency of customer services, so that it can adapt to the new business environment as soon as possible, which is characterized by "3C", namely, customer, competition, and change. Wang (2011) believes that the core of process reengineering is continuous thinking and constant improvement to break the inappropriate old rules and operation methods. The indicators in process reengineering that can measure performance include product attributes, service quality, customer satisfaction, enterprise cost, and work efficiency of employees.

3.2 Theoretical basis

3.2.1 Synergetic

Synergetic, put forward by German physicist Haken in 1970, is widely used in modern management research. Synergetic holds that, although different systems have different attributes, they share a mutual influencing and cooperative relationship in the whole environment. It is reflected in various social phenomena, including the cooperation and coordination between different units, the coordination of interdepartmental relations, the role of competition among enterprises, and the interference and restriction among systems. The content of the theory mainly includes synergetic effect, servo principle, and self-organization principle.

Synergetic effect is the enhancement of the whole effect in the complex open system, which is produced by the subsystems under certain external influence. Lan and Cui (2009)think that the servo principle is to describe the synergetic process of the system from the stability of the internal factors of the organization, that is, fast variables obey slow variables, and order parameters dominate subsystem behaviors. It describes the self-organizing process of the system in terms of the interaction between internal stable factors and unstable factors. Its essence is to stipulate the simplified principle of the system at the critical point. While studying Synergetic, Jiang (2004) believes that, based on the universality of the theory, the orderly self-organizing process of the system can be applied to more disciplines to realize the mutual promotion and understanding among different disciplines. Wang (2006) holds that, according

to the desired goals of synergetic management and the structure and functions of the system, the value can be maximized through such process: self-organization of the system, confirmation of order parameters, continuous and effective management, and realization of synergetic effect.

Annex C, Figure C2 shows the model of managing synergetic process.

3.2.2 The theory of Maslow's hierarchy of needs

The theory of Maslow's hierarchy of needs was proposed by Abraham Maslow in 1943. Its basic content is to divide human needs in a low-to-high order into five kinds: physiological needs, safety needs, love and belonging, esteem and self-actualization (Maslow, 1943). The theory of Maslow's hierarchy of needs belongs to the realm of humanism study. It concerns not only motivation, but also human nature and value.

Maslow believes that human beings have some innate needs, and the lower level needs are more basic and similar to animals; the higher level needs are more exclusive to human beings. At the same time, needs appear in order, that is, the higher needs can only show after the lower needs are satisfied. Thus the hierarchy of needs is formed (Hoerthersall, 2011).

3.2.3 Customer perceived value theory

Zaithaml (1988) first put forward customer perceived value theory from the perspective of customer in 1988. The customer perceived value is defined as the overall evaluation of the utility of the product or service after weighing the perceived benefits with the cost of obtaining the product or service.

Zaithaml believes that enterprises should adopt the customer-oriented view and take customers' perception of value as the decisive factor while designing, creating and providing value for customers. Customer value is determined by the customer, not the supplier. Customer value is actually customer perceived value (CPV). Zaithaml summed up the four benefits of perceived value according to customer survey in an exploratory study. Zeithaml's research has influenced the development of customer perceived value theory the most. In an exploratory research on beverage market, she summarized the connotation of CPV and built a model of it (Yu, 2009). Figure 3.1 shows Zeithaml's model of CPV.

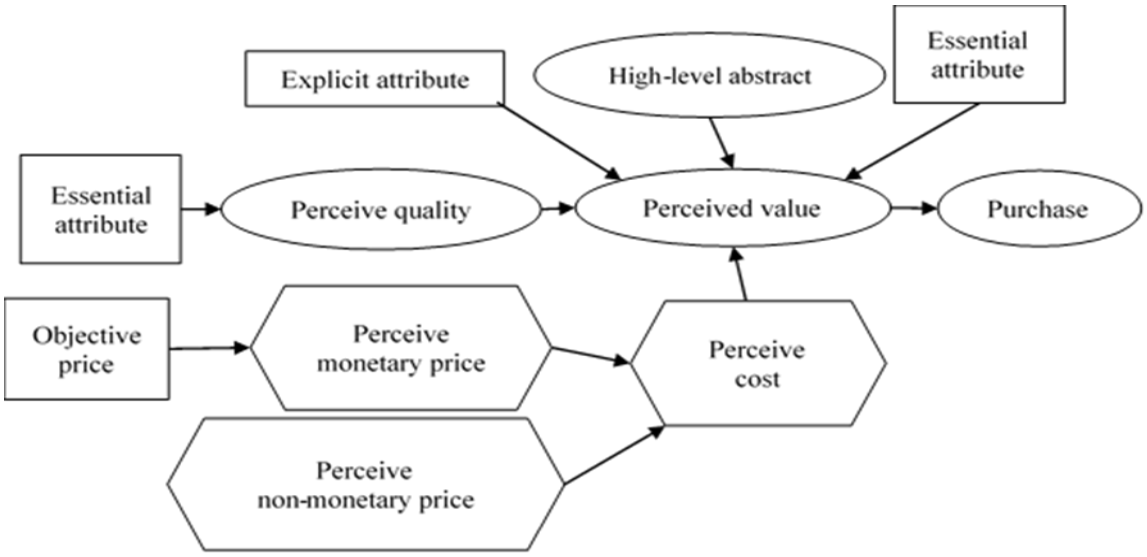

Figure 3.1 Zeithaml's model of CPV

Source: Zeithaml (1988)

Therefore, patient perceived value is also an extension of CPV in the field of medical services. It can be defined as: patient perceived value is the difference between the expectation for medical services and the effect of medical treatment, as well as the difference between profit and cost. For example, the longer the waiting time for medical service is, the greater the perceived cost of the patient will be. If the consultation can be served in time, the perceived profit of the patient will be greater.

Teke et al. (2012) reviewed the assessment indicators of CPV, analyzed the perceived value of patients seeking medical treatment through empirical data, and divided patient perceived value into functional value, emotional value and social value. Specifically, they include such aspects as facilities, service quality, price, professionalism, novelty, control and enjoyment. Peng and Zhang (2013) analyzed patient perceived value from the perspective of the willingness to acquire medical knowledge. According to her investigation and analysis, patient perceived value includes functional value, technical value and human value.

According to the theory of Maslow's hierarchy of needs, customers have different levels of demands and their perceived value of the same product or service (profit-cost) is also different, that is, customer values vary in customers with different levels of demands. Professor Woodruff from University of Tennessee in the United States introduced Gutman's means-end theory to analyze customer value and proposed the value hierarchy of customer needs. He divides customer value into value of product attribute, value of application results, and value of customer goals from an outside-in perspective (Shen, 2006).

3.2.4 Customer delivered value theory

Customer delivered value theory was first put forward in 1996 by Philip Kotler, a famous American marketing expert. It is defined as: the difference between total customer value and total customer cost. Total customer value refers to a set of benefits that customers expect to obtain when buying a product or service, including product value, service value, personnel value and image value. Total customer cost refers to the time, energy, physical strength and money paid by the customer to buy a product, so the total customer cost includes monetary cost, time cost, mental cost and physical cost (Kotler, 2011).

In general, consumers always want to minimize the cost of purchasing products, and at the same time get more practical benefits, so as to satisfy their own needs to the most. Therefore, while purchasing products, customers often compare and analyze different products from the aspects of value and cost, then choose the one with the highest value and lowest cost, that is, the one that maximizes customer delivered value. Customer delivered value theory stands from the angle of enterprises' long-term development, focusing on developing loyal customers, and targeting the satisfaction of both sides. It has broadened the research scope of marketing theory.

Annex C, Figure C3 shows model of customer delivered value.

3.2.5 Process reengineering theory

Process reengineering, put forward by American scholars Michael Hammer and Jame Champy, is a mature management theory often used by enterprises in various countries. They believe that in the process of process reengineering, we should seek the overall improvement of the process instead of focusing on the optimization of a certain link (Lin, 2012).

Process reengineering usually has five stages. The first stage is the preparatory stage, which aims to find and establish a process reengineering team, and confirm the desired goals of process reengineering; the second stage is the self-examination stage, at which the task is to diagnose the problems existing in the outpatient services of the system and determine the crux of the problems; the third stage is the project design stage, at which the environment construction and scheme design of the process reengineering should be completed; the fourth stage is to carry out the new process; and the final stage concerns the adjustment and improvement of the new process. Process reengineering does not happen overnight. It has to undergo continuous improvement, repeated trials, and gradual progress, which requires the organization to carry out multiple and continuous revision and improvement according to the diagnosis of existing process (Wang et al., 2014). By applying the theory and method of process

reengineering, we can reconstruct the online outpatient process, adjust and improve the structure, cut out inefficient links, reconfigure links with similar functions, and increase the application of artificial intelligence, thereby realizing the goal of continuous, safe and highly efficient medical treatment, and eventually enhancing patient perceived value and hospital management performance (Zhang, 2016).

In addition, the IE (industrial engineering) theory is also a common method for the process reengineering in many medical institutions abroad. This idea, with a century-long history, first appeared in the industrial programs abroad, and later was applied in the medical and health system. IE is an engineering science and technology which mainly targets management problems. Currently, its application field has been expanded from production to service (Xu, 2014). The goal of IE is to analyze the configuration of a series of elements including people, materials and equipment, thereby finding out how the elements can be more reasonably configured to improve the current operating system. It appeared relatively late in China. In the period after China's reform and opening up, the theories that came to China's industrial enterprises first had exerted great impact on China's economic development. IE is an inevitable choice for China to access international market, participate in competition and improve production efficiency.

3.2.6 Technology Acceptance Model (TAM)

TAM was proposed by Davis in his doctoral thesis in 1986. With the theory of reasoned action (TRA) as the main theoretical basis, Davis made a series of improvements to the theory and then put forward TAM with the main purpose of predicting and explaining user acceptance and adoption of information technology. The structure of TAM is shown in the Figure 3.2. There are several hypotheses in TAM: the users' intention to use the system depends on their attitudes toward using and perceived usefulness; users' attitudes toward using the system depends on perceived ease of use and perceived usefulness; perceived usefulness is affected by perceived ease of use; the external variables such as system design features directly influence perceived ease of use and perceived usefulness. Davis (1989) defines perceived usefulness as "the degree to which a person believes that using a particular system would enhance his/her job performance", and perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort".

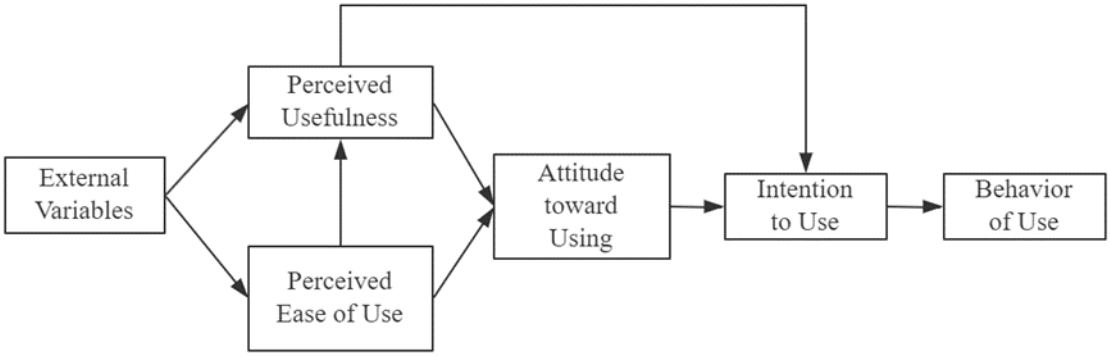

Figure 3.2 Technology Acceptance Model (TAM)

Source: Davis (1986)

The TAM model is still the most popular among researchers engaged in Acceptance and Use of Technology (Alturas, 2021). Considering that this study will develop a medical information system based on the perceived value of remote patients, and patients' acceptance of using this technology will be an important factor affecting their intention to use it, part of TAM is integrated into the theoretical framework of this study.

3.2.7 The American customer satisfaction index model (ACSIM)

ACSIM was developed based on the SCSB model by Dr. Fornell and others of the University of Michigan in the United States. Nowadays, ACSIM has been the most influential model. According to this model, the degree of customer satisfaction is determined by their expectations of service quality, perception of quality and perception of value; customer loyalty depends on the degree of customer satisfaction and complaint handling (Fornell et al., 1996).Figure 3.3 shows The American Customer Satisfaction Index Model.

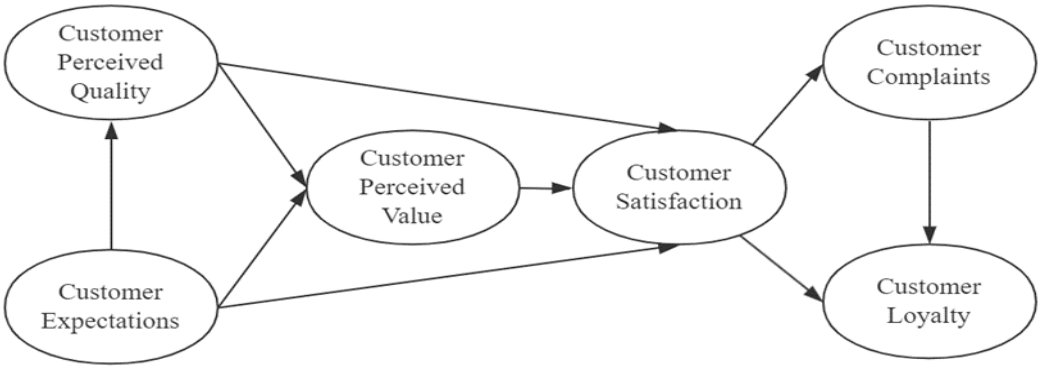

Figure 3.3 The American Customer Satisfaction Index Model (ACSIM)

Source: Fornell (1989)

3.3 Model construction of remote patient value satisfaction with online medical service for specialties

3.3.1 Basic idea and design of model construction hypothesis

The hypotheses of this study are based on the integration of ACSIM and TAM, and the research explores the model of remote patients' satisfaction with medical service based on customer value.

Based on the study of the above research theory, this thesis adopts the theory of consumer value, the theory of Maslow's hierarchy of needs, and coordination theory as the basis of the theoretical research framework, and studies the process reengineering of the online treatment for specialties. Integrating TAM and ACSIM, this thesis combines variables of benefits and cost in the theoretical model of customer perceived value as well as variables of synergy capabilities to construct the model of remote patient value satisfaction with online treatment for specialties. The basic theoretical model is designed as Figure 3.4:

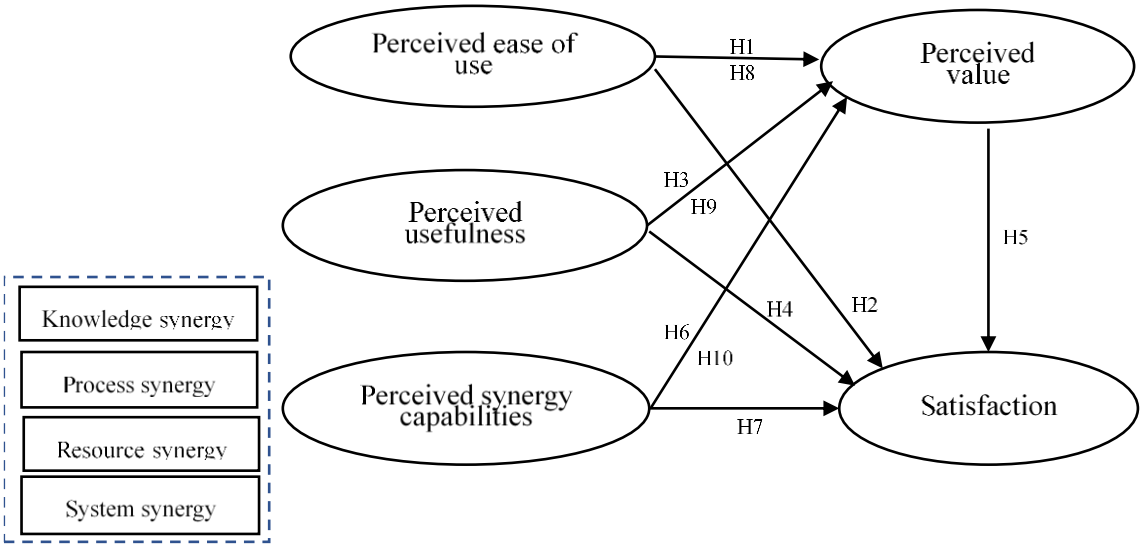

Figure 3.4 Remote patient perceived value satisfaction model (RPPVSM) with online medical service

3.3.2 Existing research basis related to the model hypotheses

3.3.2.1 TAM: perceived usefulness and perceived ease of use are important variables to measure technology

TAM was proposed by Davis (1986), with TRA developed by Ajzen and Fishbein (1975) as reference for the theoretical basis. Two core variables in the model are perceived usefulness and perceived ease of use. The results of the research model prove that the two variables have a

significant impact on the attitudes toward using technology, which provides an important basis for the future study of user behavior. This cause-effect relationship is also proved by many scholars and widely used (Davis, 1989).

3.3.2.2 The combination of TAM and ACSIM: perceived usefulness and perceived ease of use influence significantly perceived value and satisfaction.

On this basis, many scholars also use perceived usefulness and perceived ease of use to test the significance of perceived value. They used structural equation modeling (SEM) for verification and found that the two variables can significantly affect customer perceived value, which provides a theoretical basis for the model research in this thesis (Cai, 2015). In his thesis Model Construction and Empirical Research of Online Shopping Customer Satisfaction Based on Technology Acceptance Model, Cai (2015) has used SEM to verify that perceived ease of use and perceived usefulness significantly affect perceived value and customer satisfaction, which, at the same time, proved that perceived value influences significantly customer satisfaction. Figure 3.5 shows satisfaction model in Model Construction and Empirical Research of Online Shopping Customer Satisfaction Based on Technology Acceptance Model.

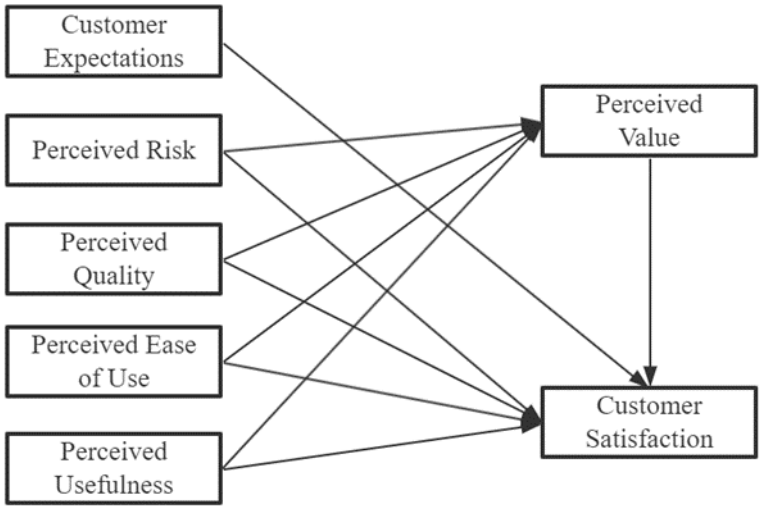

Figure 3.5 Satisfaction model in Model Construction and Empirical Research of Online Shopping Customer Satisfaction Based on Technology Acceptance Model

Source: Cai (2015)

Meanwhile, the combination of ACSIM and TAM enriches customer satisfaction model based on information technology and perceived value. The research hypotheses of integrating the two models (ease of use and usefulness significantly affect perceived value, perceived value significantly influences customer satisfaction, and customer satisfaction also significantly affects loyalty) have been proved by many scholars. Integrating TAM and ACSIM, Yu and Lv

(2011) synthesized trust, safety, and loyalty to construct the model of factors influencing user loyalty. They obtained 265 valid data through the questionnaire survey, and used SME to verify the model. The results showed that ease of use and usefulness have significant positive effects on the perception level and the perception level has an obvious effect on satisfaction. In addition, there are similar researches in China. For example, based on models such as ACSIM and the European Customer Satisfaction Index Model (ECSIM), China customer satisfaction index (CCSI) was studied in 1998, and the research to test the model feasibility was carried out in China in 2002, which thus formed a model of customer satisfaction evaluation index in line with China's situation, including durable consumer goods, non-durable consumer goods, service industry, public services, government administrative departments and banks. This model has proved that perceived value has a significant impact on customer satisfaction while customer satisfaction has a significant effect on consumer loyalty. China Customer Satisfaction Index Model (CCSIM) is shown in Figure3.6.

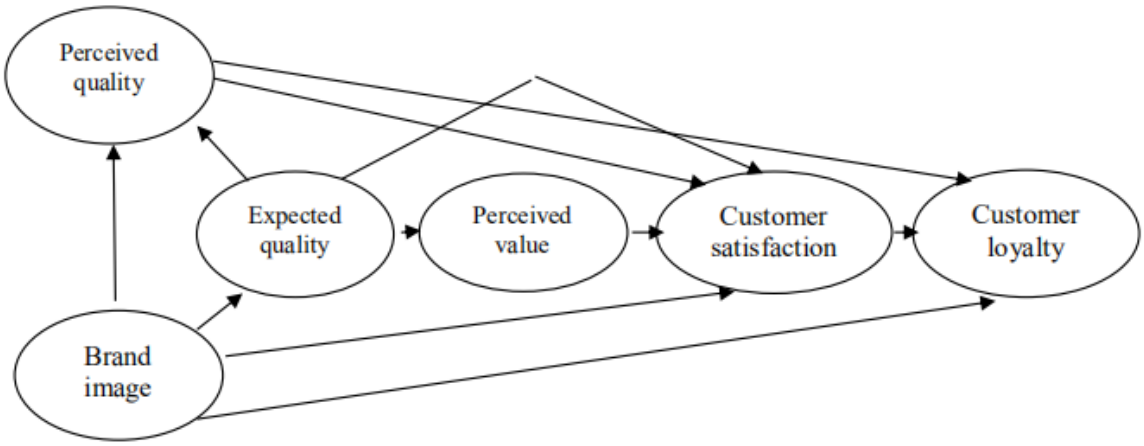

Figure 3.6 The framework of CCSI model

Source: Wang and Shen (2010)

3.3.2.3 The assessment of customer perceived value (CPV): benefits-cost

The CPV theory was first proposed by Zaithaml in 1988 from the perspective of customer. He defines CPV as the consumer's overall assessment of the utility of a product or service based on perceptions of what is received and what is given in obtaining the product or service. It means that the change of patient perceived value is the difference between benefits and cost.

In the studies on measuring customer perceived value in the service industry, some scholars have proved that in the process of tourists' experience of perception, they use "perceived benefits-perceived cost" for assessment to form their overall perception of tourism (Chen, 2010). Meanwhile, the CPV theory is also widely used for verification in other areas. For example,

Huang used the difference of profits and loss of the CPV theory to demonstrate farmer perceived value of land ownership (Huang, 2012). Figure 3.7 shows the concept model of farmer perceived value of land ownership.

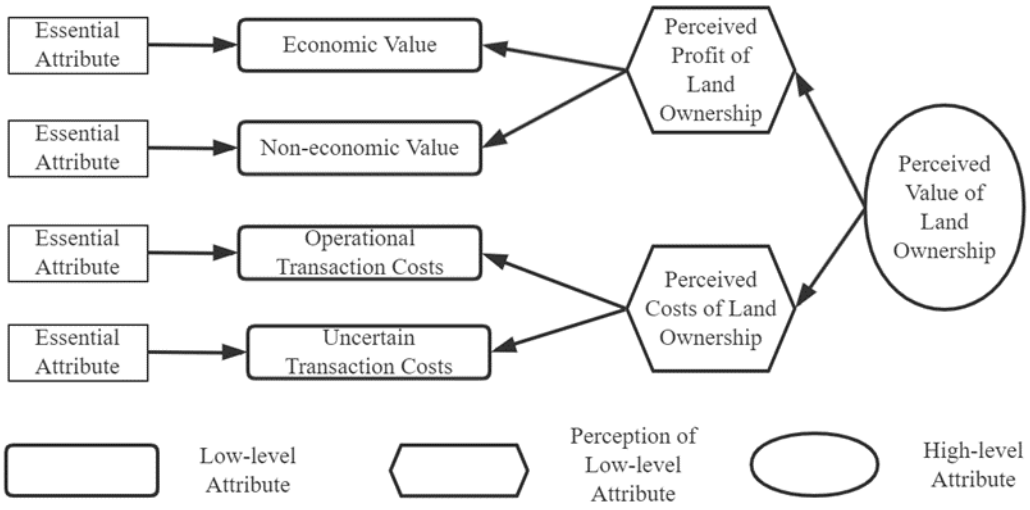

Figure 3.7 The concept model of farmer perceived value of land ownership

Source: Huang (2012)

According to the theory of Maslow's hierarchy of needs, customers have different levels of demands and their perceived value of the same product or service (profit-cost) is also different, that is, customer values vary in customers with different levels of demands. Professor Woodruff from the University of Tennessee in the United States introduced Gutman's means-end theory to analyze customer value and proposed the value hierarchy of customer needs. He holds that customer value can be divided into value of product attributes, value of use result and value of customer target from the surface to the inside (Shen, 2006).

The difference between benefits and cost in the CPV theory can be adopted as the perceived value variables in ACSIM, and benefits and cost can be two variables to measure perceived value.

3.3.2.4 The synergy capabilities model of public hospital groups: 10 factors influencing synergy capabilities

Synergy capabilities refer to the potentials to coordinate and develop various resources to create value and competitive advantages by managing activities under certain environmental conditions (Dranove, Durkac, & Shanley, 1996). If the public hospital group is regarded as a system, then the synergy within the system depends on the subsystems, that is, the sub-medical institutions cooperate with each other and coordinate resources to create core competence. The process of synergy is interactive, coordinated, synchronous and stably developing.

Ansoff (1987) was the first one to propose the concept of synergy. He divided it into four

categories: operational, management, investment, and sales. Buzzell and Gale (1999) holds that synergy is the business performance of enterprises, which can be carried out through marketing, research and development, resource sharing or business behavior, and "similar" business is carried out to create value.

Some scholars studied the structure of business synergy from the perspective of management, and hold that synergy is composed of five elements: system synergy, knowledge synergy, process synergy, resource synergy and relational synergy (Mao & Du, 2006). Wu, Han and Men (2005) divided the synergy of enterprise clusters into three levels: micro-level synergy (knowledge, technology, business, and compact), meso-level synergy (culture, organization, and ability), and macro-level synergy (strategy synergy).

In her thesis Study on Synergy Capabilities of Public Medical Group in China, Luo (2014) indicated and used exploratory factor analysis to sort out various factors that affect the synergy capabilities among public hospitals, including macro-level strategy synergy, culture synergy, meso-level system synergy, information synergy, resource synergy and organization synergy, as well as micro-level innovation synergy, compact synergy, business synergy and process synergy. Finally, she used SEM to test the confirmatory factor analysis (CFA) of synergy capability factors in public hospital groups and a total of 10 factors can reflect the level of synergy capabilities. This test has provided a solid foundation for future study in the field of hospital synergy.

Annex C, Figure C4 shows research model on synergy capabilities of public medical group in China.

Scholars at home and abroad have carried out rich analyses and research on the synergy mechanism of enterprise groups, and these research results can be used for reference for the analysis of the synergy mechanism of public hospital groups.

3.3.3 Proposal of research hypotheses

3.3.3.1 Direct impact on hypotheses

(1) The influence of perceived ease of use on perceived value and satisfaction

Environmental facilities and invisible atmosphere; the process refers to the interactive process between patients and medical workers where the perception of patients is formed: the explanation why patients perceive satisfaction in the medical industry indicates their subjective feelings of the medical service. Their subjective evaluations are often related to their own income, educational backgrounds, experience, health and personal characteristics, while

patients can produce different feelings due to different hierarchy of needs. The theory of Maslow's hierarchy of needs can highlight the levels of patients' subjective feelings. Most scholars tend to choose the multi-item scale to measure satisfaction from three perspectives: the difference between expectations and perception, performance results, and overall customer satisfaction.

Foreign scholars such as Zeithaml (1988) and Chinese scholars such as Wang, Weng, and Jiang (2001) believe that factors such as the reliability of service, time and cost saving, environment, and attitudes of service personnel can affect people's satisfaction with service.

Zeithaml (1988) holds that perceived value is the result of comparisons that customers make between accepting and giving up service. Woodruff (1997)pointed out that customer value is that customers of an organization can gain attributes of value they want from the products that they use or purchase. Gallarza and Saura (2006) consider that perceived value can be measured from the difference between perceived actual cost and perceived benefits. Zifko-Baliga and Krampf (1997) analyzed from three aspects: structure, process and outcome that the structure of patient perceived value is the tangible interactive result of the hospital itself, including technological quality, reliability and recovery rate. Based on this, evaluation of doctors, nurses, outcome and structure are the main measurable dimensions of patient perceived value. Pan and Chen (2015) measured the patient's evaluation of medical service from five dimensions: quality, emotion, price, reputation and information, and 20 measurable indicators were determined through expert analysis method and tested in three hospitals in Taiwan. The results show that medical quality is the perceived value dimension that patients concern most, while the perception of facilities and price is relatively low.

Ease of use in TAM is an important variable to measure the attitudes of technology acceptance, which not only has a positive influence on the user's attitudes towards using technology but also affects user perceived value. In his thesis Model Construction and Empirical Research of Online Shopping Customer Satisfaction Based on Technology Acceptance Model, Cai (2015) used SEM to verify that perceived ease of use has a significant effect on perceived value and customer satisfaction. According to Hoffman and Novak (1996), the simpler and more convenient the shopping website is, the more likely it is for customers to have pleasant shopping experiences. Therefore, if information technology in the field of telemedicine faces its customer groups (patients), the ease of use of telemedicine information technology will affect the perception of patients. At the same time, perception can control the transaction behavior of patients and improve their satisfaction. In the model of remote patient perceived value satisfaction with online medical service for specialties of this study, perceived

ease of use plays an important role in the structure of this research model. Therefore, based on the above explanation, the following hypotheses are made:

H1: Perceived ease of use of technology has a significant positive effect on perceived value.

H2: Perceived ease of use of technology has a significant positive impact on satisfaction.

(2) The influence of perceived usefulness on perceived value and satisfaction

Perceived usefulness means that the feelings brought by medical services that patients enjoy in the information technology platform of online hospitals can improve their perception of the performance of medical service. Ajzen and Fishbein (1975) hold that when a certain behavior people take have good results, they will have a good impression on this behavior. Bhattacherjee and Hikmet (2007) proposed that when users perceive the usefulness of information technology, their sense of perceived value and satisfaction of users will be improved and thus repurchase intention is formed.

The research of Devaraj, Fan, & Kohli, (2002) shows that perceived usefulness has a positive impact on satisfaction. In traditional medical service, patients can only make appointments through on-site registration, and they have to wait for paper reports and the appointment time for specialist consultation. Therefore, the sense of self-control is not strong. Compared with this, whether the sense of usefulness of using technology in telemedicine information platform of medical treatment partnership for specialties based on remote patient perceived value, which is developed by this research, can have a relatively significant positive effect on the patient's satisfaction with medical treatment? Is this consistent with the verification results that the usefulness of online shopping technology platform has a positive effect on satisfaction? Therefore, this research puts forward the following hypotheses:

H3: Perceived usefulness of technology has a significant positive influence on perceived value.

H4: Perceived usefulness of technology has a significant positive effect on satisfaction.

(3) The influence of perceived value on satisfaction

When customer perceived value is achieved, an overall satisfaction level can be formed. Or if the difference between customer perceived value and their expected value that is greater than 0 can make them satisfied, it may affect the purchase satisfaction level of customers. ACSIM was proposed by Fornell et al. (1996) of the University of Michigan in the United States. In this model, it is proved that customer satisfaction is determined by customer expectation of service quality, perception of quality, and perception of value, and the influence of perceived value on satisfaction is significantly positive. There are also many studies that share the same idea that perceived value has a significant effect on satisfaction (Gronholdt, Martensen, &

Kristensen, 2000).

Elements of human value as mentioned above such as emotion, personnel value and image value are used to measure perceived value and satisfaction. Satisfaction is measured in the form of scale from three perspectives: difference between expectations and perception, performance and overall customer satisfaction. Through comprehensive analysis, the calculation of domestic patient perceived value is the sum of the medical technology value obtained in the process of medical treatment and the value out of the medical technology. In the calculation, medical technology refers to the service value gained by patients in the process of seeking medical treatment, and value beyond that includes service value, personnel value, and image value. Different levels of value perception and their own levels are related to personal characteristics, so customers can have a corresponding level of satisfaction at different levels of value perception, and the final level of satisfaction depends on the weight of each level of satisfaction. Therefore, it is an important research relationship for patients whether the perceived value that they experience in medical service can positively affect their satisfaction and promote their willingness to experience again. Therefore, this research puts forward the following hypothesis:

H5: Perceived value has a positive influence on customer satisfaction.

(4) The influence of perceived synergy capabilities on perceived value and satisfaction

Synergy capabilities of the model in this research mean that in the implementation process of the online specialty treatment model for remote patients based on customer value theory, whether there is the synergy of all parties to enable the new medical treatment mode to be carried out smoothly. It can be learned from the previous literature on synergy capabilities that the cooperation of subsystems within public hospital groups is an important force for joint development and innovation, and a starting point for patients to experience new technology and new medical mode. The elements of synergy capabilities mainly include culture synergy, strategy synergy, system synergy, information synergy, resource synergy, organization synergy, innovation synergy, and compact synergy. In particular, the coefficients of variables such as strategy synergy and innovation synergy are relatively high (Luo, 2014). Besides, the synergy effect can be measured through calculating efficiency and cost, which is related to the desire for innovation synergy, including innovation in resource synergy, operation synergy and value synergy (Wang, 2012). The studies on synergy capabilities play a relatively important role in the influence of the regulatory role of the model of remote patient perceived value satisfaction with online medical service for specialties. Therefore, based on the above analysis and discussion, the research puts forward the following hypotheses:

According to the previous scholars' research on the influence of cooperation synergy

variables on satisfaction, Qu put forward a research model of supply chain quality cooperation satisfaction, that is, a conceptual model of influencing factors of supply chain satisfaction from the perspective of quality synergy. See details in Annex C, Figure C5. The assumption of the model is that there is correlation between four dimensions of supply chain quality synergy (internal quality management of supply chain member enterprises, interface quality cooperation, supply chain organizational structure, supply chain quality risk control) and supply chain satisfaction, and it has a greater impact on the improvement of satisfaction. This model also demonstrates the positive influence of cooperation capabilities on satisfaction from the perspective of cooperation synergy (Qu, 2009).

Therefore, combined with the synergy capabilities elements of cooperation synergy of public hospitals and the theoretical basis of the impact about cooperation synergy on satisfaction, the following assumptions are put forward:

H6: Perceived synergy capabilities has a positive effect on perceived value.

H7: Perceived synergy capabilities has a positive impact on satisfaction.

3.3.3.2 Mediation effect hypotheses

In the model of this study, the influence of perceived ease of use of technology on satisfaction and the influence of perceived usefulness on satisfaction will be verified in the direct effect first. According to the domestic scholar Cai's thesis Model Construction and Empirical Research of Online Shopping Customer Satisfaction Based on Technology Acceptance Model, it has been validated that perceived ease of use and perceived usefulness of technology significantly affect perceived value and customer satisfaction, as shown in Figure 3.8 (Cai, 2015). But will perceived ease of use affect satisfaction through perceived value? Will perceived usefulness affect satisfaction through perceived value variable? These questions need to be verified by the model.

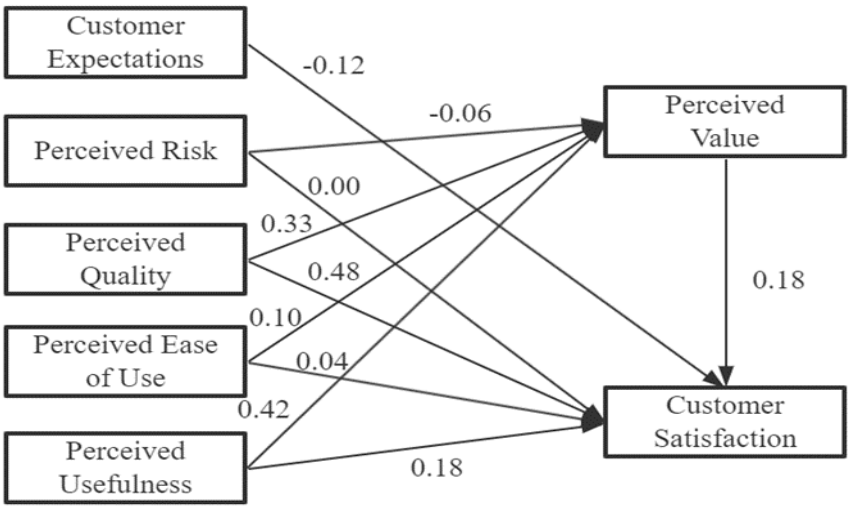

Figure 3.8 The test results of the model of online shopping satisfaction based on TAM

Source: Cai (2015)

Therefore, the following hypotheses are proposed:

H8: Perceived ease of use can have a significant positive effect on satisfaction through perceived value variable.

H9: Perceived usefulness can have a significant positive effect on satisfaction through perceived value variable.

H10: Perceived synergy capabilities can have a significant positive effect on satisfaction through perceived value variable.

Based on action research, independent-samples t test of SPSS is used to compare the difference between patient satisfaction with the new mode of online medical service for specialties after it is put into operation and with the mode of medical treatment in Shanghai Pulmonary Hospital for an empirical test of the effect of the new mode. The IE tool is used to verify that the process reengineering mode of medical service based on the evaluation system of perceived value index of specialty treatment for remote patients can help reduce the cost of time and money that patients spend on medical treatment.

3.4 Chapter summary

This chapter explains the keywords of this research topic, including medical treatment partnership, medical treatment partnership for specialties, online medical service, customer value theory, process management and process reengineering. In addition, this chapter reviews the theoretical model basis that is used in the research, including synergy theory, the theory of Maslow’s hierarchy of needs, customer perception theory, customer delivered value theory,

process reengineering theory, TAM and ACSIM. Based on the study of theory, the model construction of remote patient perceived value satisfaction with online medical service for specialties is hypothesized. In order to ensure that the proposed variable hypotheses are scientific and basic, the author studies the literature on the relationship among variables assumed in the designed model. The results are that perceived usefulness and perceived ease of use are important variables of technology measurement, and the combination of TAM and ACSIM can significantly affect perceived value and satisfaction. In the study of related literature on synergy capabilities, it can be found that the level of synergy can be conducive to the performance of an organization and can improve the perception of patients. In this thesis, the author proposes three-dimension hypotheses and seven direct impact hypotheses, as well as three mediation effect hypotheses. AMOS 24.0 and SPSS 24.0 will be used for verification.

[This page is deliberately left blank.]

Chapter 4: Proposal and Analysis of Online Medical Services Expansion Mode for Specialties

4.1 Questionnaire analysis of the perceived value needs of remote patients

In order to establish a more accurate indicator system of the perceived value of remote patients based on the Customer Value Theory and develop the corresponding remote diagnosis and treatment information platform for the medical alliance of specialties, it is necessary to carry out the research on the needs of remote patients to understand their value needs, thus obtaining the authentic data of the status quo. Based on such data, better preparation will be done to deliver a more comprehensive and accurate analysis of the indicator system of patients' perceived value.

1. Investigation plan

(i) Purpose of investigation

To understand the value needs of remote patients

(ii) Time of investigation

2020.12.15-2020.12.20

(iii) Subject of investigation

The subjects of this study are remote patients in Shanghai Pulmonary Hospital

(iv) Methods of investigation

①Questionnaire based on the scale method: the questionnaire on the value needs of remote patients is completed based on the 5-Point Likert scale (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree).

②Interview: through the interview with remote patients in the manner of open questions, to understand their further value needs, degree of urgency and problems.

(v) Questionnaire design

The questionnaire on the value needs of remote patients is designed according to Maslow's hierarchy of needs and combined with the related indicators of customer perceived value concluded in the literature review, so as to find out the specific needs of remote patients.

(1) A review of customer value indicators in the literature research

In the theoretical research of the second chapter, we have learned the definition of customer

perceived value, that is, the overall evaluation of the utility of the product or service after weighing the perceived benefits of the customer with the cost of obtaining the product or service. Similarly, in the field of medical services, the extension of patient perceived value has brought new inspiration to the effective diagnosis and treatment of hospitals and the improvement of the effect of diagnosis and treatment. Thus, the patient perceived value can be defined as the difference between patients' expectation of medical services and the medical effect during the process of seeking medical services, which is also the difference between gains and losses.

Maslow proposed in 1943 the hierarchy of needs, in which he divided human needs into five kinds from low to high: physiological needs, safety needs, love and belonging, esteem, and self-actualization.

Teke et al. (2012) divides customer value indicators into: functional value, emotional value and social value. Its specific contents include facilities, service quality, price, professionalism, novelty, control and enjoyment. In addition, some other scholars divide perceived value into functional value, technical value and human value (Peng & Zhang, 2013).

Professor Woodruff of the University of Tennessee in the United States, from an outside-in perspective, divides customer value into the value of product attributes, the value of application results and the value of customer goals (Shen, 2006).

The customer delivered value also provides ideas for the research on the needs of patient perceived value. Customer delivered value refers to the difference between the total customer value and the total customer cost. Total customer value refers to a set of benefits that customers expect to obtain when buying a product or service, including product value, service value, personnel value and image value (Kotler, 2011). Total customer cost refers to the time, energy, physical strength and money paid by the customer to buy a product.

(2) Preliminarily determine the level I and level II indicators of perceived value of remote patients based on Maslow's hierarchy of needs and related research.

According to Maslow's hierarchy of needs and related research, the indicators of the perceived value of remote patients are determined as follows: level I indicators include survival (SU), safety (S), social needs (SC), respect and love (R), and self-value (V). According to the level I needs, ten level II needs are set up: reputation value (V1), sense of autonomy during treatment (V2), spiritual value (R1), privacy value (R2), personnel value (SC1), cost losses (S1), response value (S2), tangible value (S3), standardization value (S4), and technical value (SU1). Specific explanations are shown in Annex B, Table B2.

(3) A questionnaire with scales designed to assess the perceived value needs of remote patients according to the preliminary indicators

According to the preliminary level I and level II indicators, corresponding questions are formulated to carry out the investigation. In this study, the five-point Likert scale was used in a total of 26 questions based on 10 level II indicators. According to the data collected by the questionnaire, the scores of remote patients' value needs at different levels will be counted, which will lay a better foundation for the construction of the subsequent evaluation system of the value indicators. Annex A, Questionnaire I shows questionnaire on the value needs of remote patients based on related theories and literature review.

2. Statistical data of questionnaires

The questionnaires were distributed in the form of QR Code picture at an online crowdsourcing platform in mainland China, which provides functions equivalent to Amazon Mechanical Turk. A total of 230 questionnaires were collected with a recovery rate of 100%. The range values of 230 samples of 26 questions were gotten by analyzing the observation data. After excluding, finally, 214 samples were retained for subsequent research and analysis.

(1) Statistics of the category of research objects

According to the category of the returned questionnaires, SPSS24.0 was used to analyze the categorical variables. The subjects of the questionnaires are basically composed of five dimensions, including gender, age, province and city, occupation and industry. Valid value is 214 and missing data is 0, which indicate that the data is intact. Meanwhile, with the modes of the five categorical variables, it is clear that there are more males than females in the research objects; most patients are over 60 years old; most patients are from Jiangsu; the largest category group is the occupation of sales personnel; and most of patients are from the industries of education, training and scientific research institutions.

In addition, it can be seen from the following table that middle-aged and elderly people in the age group account for a relatively large proportion, with the proportion of 41 to 50 years old, 51 to 60 years old and above 60 years old accounting for 71%. The patients surveyed are from all over the country, with Jiangsu accounting for 33.2%, the highest proportion, followed by Zhejiang and Anhui with 17.3% and 15.9% respectively.

In terms of occupation, the highest proportion is sales personnel at 14%, followed by management personnel at 13.1%, production personnel at 12.1% and teachers at 11.7%. As for the industries of patients, among the 29 categories, education, training and scientific research institutions account for the highest proportion of 9.8%, followed by wholesale and retail industries at 8.9%, agriculture, fishery and forestry at 8.4%, and manufacturing industry at 6.5%. Please see Annex B, Table B3 for more details.

(2) Statistical description of items in the questionnaire

After the basic analysis of the categories of research objects, the scores of the questionnaire items were basically described. The scores are basically above 4.8, with a total of 214 cases, and the standard deviation is within a reasonable range.

(3) Principal component analysis and test of reliability and validity

The reliability of a questionnaire depends on whether unreasonable items are excluded and whether the dimension is reasonable. In the early stage of this study, range values were excluded to ensure the initial quality of the questionnaire. Now, principal component analysis is used to obtain the reasonably presupposed questionnaire dimension, calculate its reliability and validity, and ensure the correctness of its results.

1) Principal component analysis

Firstly, according to the questions made in advance, principal component analysis was carried out, and the analysis and exploration function of SPSS24.0 was used to find out the principal component factors of 26 items in 5 dimensions (survival (SU), safety (S), social contact (SC), respect and love (R) and self-value (V)). KMO is 0.907, which is suitable for factor analysis, and the significance of Bartlett's Test of Sphericity is less than 0.001. At the same time, the four components of rotation variance of squared loadings have a good cumulative interpretation rate of 81.475%.

From the rotated component matrix, it can be seen that in the five dimensions of the questionnaire for specialized treatment value needs of remote patients, the characteristics of needs at individual levels can be combined. For example, safety value can be combined with survival value, and social contact value can be combined with respect value. S1, S2, S3 and S4 in the original safety value needs are not in the same component. Among them, S1 cost losses is listed separately as a component, and finally the conclusion is "factor 1-safety and survival", "factor 2-social contact and respect", "factor 3-self-value", and "factor 4-cost losses".

Here, the "factor 4-cost loss" is used as the "sacrifices" dimension, while the three factors, factor 1, factor 2 and factor 3, are used as the "benefits" dimension to facilitate the subsequent data analysis and the construction of the perceived value system of remote patients. Meanwhile, the research based on the four factors of the principal component can also better verify the reliability and validity of the questionnaire. Please see Annex B，Table B4 for more details.

2) Reliability and validity analysis

In order to test the reliability of the questionnaire items and ensure the questionnaire's quality, a pre-test was conducted at the beginning of the distribution to test the reliability of each item. SPSS24.0 was used to analyze the reliability and validity of the four factors in principal component analysis. At the same time, the reliability test of level II indicators would

also be conducted from the five levels of the Theory of Maslow's Hierarchy of Needs survival (SU), safety (S), social contact (SC), respect and love (R) and self-value (V)).

According to the Cronbach's alpha

$$\textbf{Formula: } a = (n / (n - 1)) * (1 - (\sum Si2) / ST2) \quad \textbf{(4.1)}$$

the detected alpha values are all greater than 0.7. The alpha value of "factor 1-safety and survival" is 0.969, the alpha value of "factor 2-social contact and respect" is 0.961, the alpha value of "factor 3-self-value" is 0.862, and the alpha value of "factor 4-cost losses" is 0.964. Each dimension has good reliability and validity.

At the same time, the correlation of items at the dimension of each factor is greater than 0.3, and both the corrected item-total correlation and the item-total correlation are greater than 0.5, which shows good reliability. From Table 4.1 and Table 4.2, here lists the table of the relevant calculation data of "factor 1-safety and survival", indicating that the items of this dimension has good reliability.

Table 4.1 Correlation matrix of the items at the dimension of "factor 1: safety and survival"

	1	2	3	4	5	6	7	8	9	10
S21	1									
S22	0.862	1								
S31	0.649	0.696	1							
S32	0.691	0.796	0.714	1						
S41	0.771	0.79	0.801	0.81	1					
S42	0.706	0.756	0.869	0.827	0.923	1				
SU11	0.664	0.672	0.78	0.693	0.829	0.846	1			
SU12	0.641	0.676	0.786	0.747	0.786	0.852	0.873	1		
SU13	0.662	0.705	0.815	0.724	0.815	0.884	0.846	0.852	1	
SU14	0.59	0.63	0.732	0.742	0.781	0.847	0.808	0.82	0.9	1

Table 4.2 Total statistics of the items at the dimension of "factor 1: safety and survival"

	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Alpha if item deleted
S21	44.1262	6.036	0.771	0.97
S22	44.0888	6.175	0.823	0.967
S31	44.0654	6.202	0.848	0.966
S32	44.0748	6.163	0.838	0.967
S41	44.0654	6.108	0.916	0.964
S42	44.0607	6.179	0.942	0.963
SU11	44.0794	6.158	0.87	0.965
SU12	44.0561	6.297	0.874	0.966
SU13	44.0607	6.236	0.898	0.965
SU14	44.0701	6.178	0.846	0.966

In the meantime, the correlation matrix of the items of "factor 4-cost value" and the total statistics were listed. The correlation of items at the dimension of factor 4 are greater than 0.3, and both the corrected item-total correlation and the item-total correlation are greater than 0.5, indicating good reliability (the other two dimensions will not be listed, but they were confirmed to meet the corresponding indicators). Thus, the Cronbach's alpha of the four different dimensions was sorted into a table for viewing convenience. In order to better explain names of the four dimensions of principal components, new names were set instead of combining the old variables, which are self-value (V), respect and social contact (RSC), safety and survival (SSU), and cost losses (C), so as to better analyze the subsequent dimensions, discriminant validity and convergent validity. At the same time, the reliability of the five sub dimensions based on the Theory of Maslow's Hierarchy of Needs was tested respectively, and the following Cronbach's alpha was obtained. Please see Table 4.3 for more details.

Table 4.3 Table of reliability at each dimension and total reliability of four principal components

Four dimensions of principal component	Cronbach's alpha	Items	Five dimensions of Maslow's hierarchy of needs	Cronbach's alpha	Items
Total reliability				0.849	26
V	0.862	3	V	0.862	3
RSC	0.961	9	R	0.952	5
			SC	0.925	4
SSU	0.969	10	S2、S3、S4	0.952	6
			SU	0.957	4
C	0.964	4	S1	0.964	4

It can be observed from the Table 4.3 that the Cronbach's alpha of the four dimensions (V-RSC-SSU-C) of the principal component are all above 0.862, and the Cronbach's alpha of the

five dimensions (V-R-SC-S-SU) of Maslow's hierarchy of needs are all above 0.8, indicating good reliability. Meanwhile, the correlation between items in each dimension is greater than 0.3, and the corrected item-total correlation is greater than 0.5, which conforms to the standard of reliability test of the questionnaire items, so the sample data can be further analyzed.

3) Analysis of convergent validity

According to the AVE convergence validity formula (average variance extracted (AVE) values),

$$\mathbf{AVE = (\sum \lambda 2) / n} \qquad (4.2)$$

and by using the factor loading to calculate, the corresponding AVE "SSU" is 0.648, AVE "RSC" is 0.501, AVE "V" is 0.657, and AVE "C" is 0.905, which are all greater than 0.5. It shows that convergent validity exists.

3. Questionnaire data analysis: analysis of the status quo of remote patients' perceived value during treatment

(1) Ranking of the four dimensions of remote patients' perceived value during treatment: esteem and social contact (RSC) > safety and survival (SSU) > self-value (V) > cost value (C)

The four means of RSC, SSU, V and C were gotten by averaging the items of the four dimensions that had carried out principal component analysis and then compare the four means to find out the ranking of the four dimensions of remote patients' perceived value during treatment. From the following figures and tables, it can be seen that besides the cost losses (C) dimension, the means of the other three dimensions are relatively high, over 4.8 points, while the average score of respect and social contact (RSC) dimension is the highest, 4.9169 points. Clearly, the esteem and social value perceived by remote patients in F Hospital is more obvious, and the value needs can be better met. Moreover, the scores of the dimensions of safety and survival (SSU) and self-value (V) are also relatively high, 4.8972 and 4.8816 points respectively, which suggest that remote patients are more satisfied with the value of medical services perceived in F Hospital.

It is worth noting that the mean of cost losses (C) is not high in the survey, only 3.6846 points from Figure 4.1, but it is also more than 2.5 points and above the medium level, indicating that remote patients in F Hospital do cost a lot in travel, time, energy and expenses.

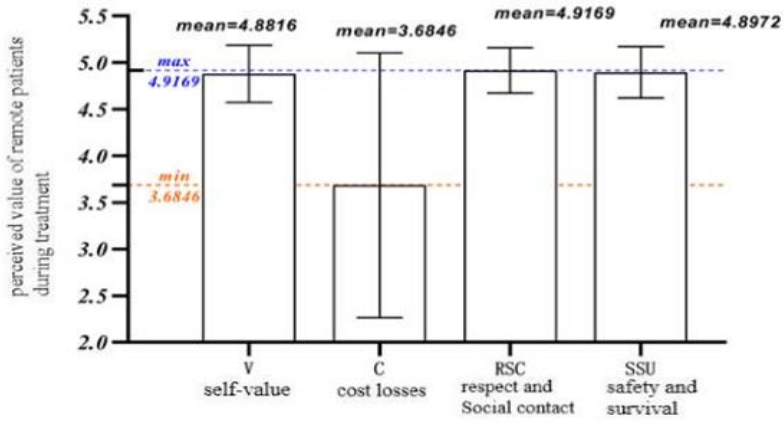

Figure 4.1 An overview of remote patients' perceived value during treatment and cost losses

In order to better explain and compare the value differences between the items, the cost losses were converted into a reverse question and became the cost value. The mean of cost value is 2.225 points, which indicates that on the whole, remote patients did not experience a good sense of value when spending various costs on treatment.

Therefore, statistical data show that the basic ranking is RSC (respect and social contact) > SSU (safety and survival) >V (self-value) > C (cost value), which suggests that remote patients are relatively satisfied with the overall value of medical services perceived in F Hospital.

(2) Perceived status of self-value (V) dimension: The perceived value of hospital reputation and sense of autonomy during treatment are relatively strong

According to the data of self-value (V) dimension, the mean of each item was calculated. It was found that the three items of V dimension scored higher, above 4.8 points, among which the scores of V11 and V12 were both 4.888 points. It means that remote patients have a strong perception of hospital reputation when they go to F Hospital for treatment. In contrast, the score of the sense of autonomy during treatment was slightly lower, with a mean of 4.869 points. It shows that remote patients also value treatment autonomy, which can be satisfied in F Hospital. This conclusion is also more in line with the reality. In the physical F Hospital, the treatment process can be completed independently through appointment, online registration, report query and face-to-face medical treatment. There is no significant difference among V11, V12 and V21.

(3) Perceived status of respect and social contact (RSC) dimension: Admiration for doctors' professional skills and value for privacy matter

In the RSC dimension, all items also have high means, about 4.9 points, which shows that the esteem and social values are satisfied when remote patients come to F Hospital for treatment. The means of spiritual value (R1), privacy value (R2) and personnel value (SC1) are 4.9143, 4.9065 and 4.9241 points respectively. It is clear that personnel value (SC1) dimension has the

highest score, which indicates that remote patients have the highest perceived value and they are very satisfied with doctors' attitude and communication.

In terms of the items, item SC13 in the RSC dimension has the highest score, 4.9346 points, which shows that remote patients admire the medical skills shown by the doctors during the specialized medical treatment in F Hospital and have a strong sense of value.

What's more, SC11, SC12 and SC14 respectively analyze the communication and patience of doctors and compliance with doctors. Compared with SC13, the sense of value brought by exquisite and admirable medical skills, the patient's sense of value brought by doctor's patience and communication are not as strong as SC13. That is to say, the exquisite and admirable medical skill is the factor that makes patients' perception higher. Still, though the patient's compliance with doctors is relatively high, it is slightly lower than the perceived value of SC13.

It can also be noted that the score of R21-7 is 4.8972 points which is also relatively high. Although it is lower than the scores of other items in the R dimension, it still shows that patients have begun to pay attention to their own privacy, which is also worthy of attention in the research group.

(4) Perceived status of safety and survival (SSU) dimension: Perception of standardization value and medical technology are higher than that of response value

Statistics show that there are a total of 10 items in the SSU dimension, classified according to four level II indicators. The scores of the sub dimension, response value (S2), tangible value (S3), standardization value (S4) and technical value (SU1) are 4.8645, 4.9019, 4.9089 and 4.9054 points respectively. Among them, standardization value (S4) has the highest score, 4.9054 points, which indicates that remote patients are very satisfied with the medical standards and other systems that they feel in the treatment process in F Hospital, and the perceived value is relatively strong.

Secondly, remote patients also have strong perceived value and sense of satisfaction for the advanced medical technology and equipment in F Hospital. However, the score of the items of SU11-23 is slightly lower than that of the items of SU12 and SU13, which indicates that remote patients have stronger perceived value for medical technology and advanced testing equipment.

From the two items of tangible value (S3), remote patient value face-to-face communication with doctors. They feel more reassured and they can also see the complete facilities of physical hospitals with their own eyes, which make their perceived value satisfied in the treatment process in F Hospital.

However, it should be noted that though the score of the perceived value of response value (S2) dimension is 4.8645 points, compared with the score of the items of other dimension, it

decreased slightly. The perceived value of remote patients in the timely attention and response from doctors is not as strong as that of other items in this dimension.

(5) Perceived status of cost losses (C) dimension: The medical expenses is less than the costs of patients' time, travel and energy

Since C dimension has been obtained by principal component analysis above, which is composed of S11, S12, S13 and S14 in the original questionnaire, and there is no other sub-dimension, it can be directly named as item C1, C2, C3 and C4, or the original item S1, S2, S3 and S4 can be used for analysis.

It can be observed that remote patients have the highest sense of loss in terms of travel for the treatment in F Hospital, followed by the cost of time, and the third is the sense of loss caused by energy and strength, while the last is the sense of loss caused by medical expenses. That is to say, comparing the medical expenses of getting treatment in Shanghai with that in a different place, the sense of loss of the former is relatively lower, but it also reaches 3.5374 points, more than the average level of 2.5 points, which suggests that medical cost is also an important loss, but patients feel that their costs of time, travel, energy and strength are bigger.

In order to view the cost value of treatment of remote patients more conveniently, the questions in C dimension were reversed to obtain the cost value, so as to compare the sense of value brought by the costs of time, travel, expenses, energy and strength. The highest factor of perceived cost value is C value 3-expenses, 2.3466 points, close to the average level of 2.5 points, which means that remote patients spend less on treatment in Shanghai, and the satisfaction of perceived value brought by this is higher than that of other cost value factors.

What's more, the lowest mean of C value 2-travel is only 2 points, that is to say, the travel to Shanghai for treatment brought the lowest sense of value to remote patients. And the sense of cost value of the time and energy is slightly higher than that of travel.

4.2 Construction of the perceived value index system of online treatment for remote patients

The previous section has preliminarily determined the level I and II indicators of the value of online treatment of remote patients of the customer perceived value theory based on the Customer Value Theory, the Theory of Maslow's Hierarchy of Needs and literature research method, and it has investigated and analyzed the needs of perceived value of online treatment of remote patients on the basis of the Customer Value Theory (research object: remote patients in F Hospital). The results show that most remote patients have strong acceptance of the level

I and II indicators proposed by the research group, indicating that the patients care about these indicators of perceived value, which are also the perceived value point of the patients.

This section would preliminarily set up the index system of perceived value of remote patients of the Customer Value Theory (designing indicators at three levels), based on the survey on the value needs of online treatment of remote patients and combining the literature research results.

On this basis, the research group used the Delphi method to screen the established preliminary index system. After two rounds of expert consultation, experts were invited to set the weight of each indicator (Analytic Hierarchy Process (AHP)), and finally the demonstrated evaluation index system of perceived value of treatment for remote patients based on Customer Value Theory was determined.

The final establishment of this index system provides strong support for the future development of the corresponding remote diagnosis and treatment information platform for specialized medical alliance.

The logical results of basic research at this section are as Figure 4.2:

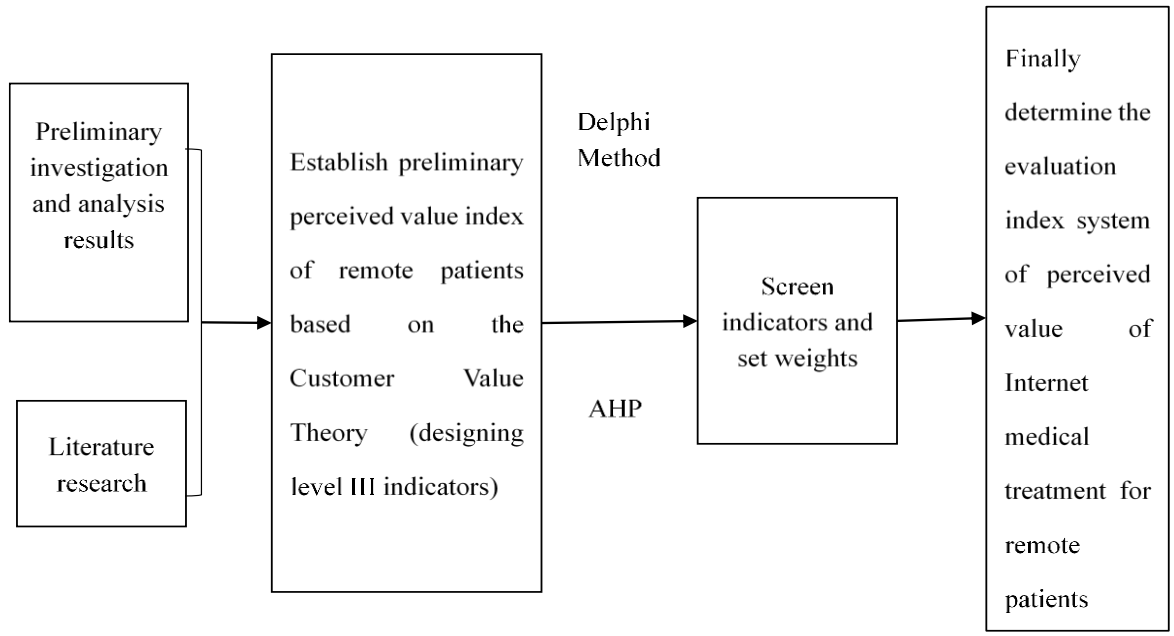

Figure 4.2 Logical diagram for the study of the construction of the value index system of online treatment for remote patients

4.2.1 Establish preliminary perceived value index of remote patients (designing indicators of three levels)

According to the previous investigation and analysis of the perceived value needs of remote

patients during treatment in F Hospital, and by referring to the contents of items of the questionnaire and literature research, the indicators in each dimension and three-level indicators of remote patients can be obtained. Specific indicators are designed as Annex B, Table B5.

4.2.2 Expert consultation method is used to determine the index of perceived value of remote patients during treatment

In order to more accurately understand and grasp the index system of perceived value of remote patients during treatment based on customer value, this study conducted expert consultation on these preliminary index systems and introduced authoritative experts in the industry or at the academic field for evaluation, so as to obtain a scientific and reasonable value index system objectively.

The expert consultation activities at this section will be divided into three rounds. In the first and second rounds, the Delphi method is used to determine reasonable and scientific indicators of perceived value of remote patients during treatment. In the third round, the AHP method is used to complete the setting and calculation of index weights in the index system.

1. The Delphi concept of expert consultation

Delphi method, also known as expert opinion method, used in the first and second rounds of expert consultation, was originally conceived by the Rand Corporation of the United States in 1946. In essence, it is a kind of anonymous feedback consultation method. Its general process is to solicit experts' opinions of the problems to be predicted and then sort out, summarize and count these problems, and then give anonymous feedback to experts and solicit their opinions again, and group the opinions and give further feedback, until a consensus is reached. The method is that the enterprise sets up a special forecasting organization, including a number of experts and enterprise forecasting organizers, and according to the prescribed procedures, the experts' opinions or judgments on the future market are solicited back to back, and then the forecasting is made.

2. Research design principles of expert consultation

Both the Delphi method at the first and second rounds of expert consultation and the AHP at the third round of consultation, the corresponding research design should be carried out before implementing expert consultation, mainly considering the design principles, including comprehensiveness, authority and quantity.

(1) Geographical comprehensiveness of experts

The geographical comprehensiveness of experts reflects the objectivity of sample selection.

The final results of this research need to be recognized and affirmed by a wide range of medical fields, so it needs to be evaluated by hospital experts from different regions in the early stage to achieve wide radiation.

In this first round, 35 questionnaires would be sent to the first-tier, second-tier and even third-tier urban areas in all provinces nationwide, including Jiangsu, Jiangxi, Shaanxi, Xinjiang and Sichuan. The expert units that filled in the questionnaire include Xinjiang Uygur Autonomous Region Chest Hospital, Xi'an Chest Hospital, Nanxiang Hospital of Shanghai Jiading Dist., Guhua Hospital of Shanghai Fengxian Dist., Shanghai Pulmonary Hospital, Shanghai Mengxin Hulian Medical Technology Co., Ltd., Fifth People's Hospital of Jingdezhen, Jiangxi, and the Third People's Hospital of Zhenjiang, Jiangsu.

(2) Authority of experts' personal basic information

Experts' authority in related fields is the key to determine research indicators. The objects of expert consultation should be authoritative in terms of theoretical level, practical experience and sense of responsibility, so as to ensure that the consulting results are scientific and reasonable. In this study, the design of expert consultation questionnaire would consider education background, major, job title, position and tenure. In this way, the details of experts' authority could be reflected more comprehensively, so as to guarantee the scientific consulting results. Annex B, Table B6 shows descriptive statistics of the selected objects in the expert consultation questionnaire.

(3) Experts' academic authority over consultation

In addition to ensuring the authority of experts' personal basic information (job title, education background, major and position) in the expert consultation process, experts are also required to have a certain academic level in the consulting field, so as to ensure that the consulting results obtained are reliable and authoritative. Therefore, in the expert consultation process, this study specially designed relevant topics to learn about the experts' familiarity in the field of "evaluation indicators of perceived value of treatment for remote patients" and their relevant theoretical level. It is hoped that the consultation can ensure that the experts give play to academic authority in the following index setting and suggestions, and also guarantee the scientificity of the research results.

Based on relevant research results, experts' academic authority can be measured by the expert authority coefficient (Ca). The higher the authority coefficient (Ca) is, the more valuable the expert's opinion will be. And the higher the authority is, the more reliable the result will be. Generally speaking, the authority coefficient (Ca) above 0.7 is the acceptable reliability. The calculation formula is:

$$Ca = (Ci + Cs) / 2 \quad (4.3)$$

where Ci is the basis for experts to judge a certain indicator or category, and Cs is the degree of experts' familiarity with the indicator or category (Yang, Dang, & Zhang, 2010).

For the convenience of statistics, the survey results are quantified. Quantifying the judgment basis and giving 3 points to those with great influence, 2 points to those with medium influence, and 1 point to those with small influence. By calculating the number of people multiplied by the score given to each item by each person and using the weighted average method, the following results are obtained. Among the four kinds of judgment basis that influence experts to judge the rationality of evaluation indicators of perceived value of treatment for remote patients, "actual experience" has the greatest influence on experts' judgment, accounting for 0.87, followed by "theoretical analysis", accounting for 0.74. And the proportion of bibliography as the judgment basis is also not small, accounting for 0.71, while the proportion of intuitive judgment is small, only accounting for 0.05. We averaged the influence coefficient Ci of authority judgment basis to get the acceptable reliability Ci = (0.74 + 0.87 + 0.71) / 3 = 0.7737 > 0.7.

Moreover, we also calculated the frequency distribution of expert authority coefficient according to the expert's familiarity with the research indicators. As can be seen from the following table, the overall samples are close to the degree of "familiar" and "relatively familiar", and their familiarity coefficients are 1 and 0.8 respectively.

According to the statistical data by using the expert consultation method, we can know the "total familiarity" of experts on research indicators = (the number of experts familiar with indicators*1 + the number of experts relatively familiar with indicators*0.8 + the number of experts general familiar with indicators*0.5 + the number of experts unfamiliar with indicators*0.2 + the number of experts who do not know indicators*0) ÷ 35 sample number. After calculation, the total familiarity of reputation value V1 is 0.837, and the total familiarity of hospital reputation V11 is 0.897. By analogy, the total familiarity is always greater than 0.7. And by averaging the total familiarity of all indicators, average value = 0.828 > 0.7 can be obtained, which shows the reliability and authority of expert consultation.

In the meantime, we also calculated the proportion of experts with the familiarity greater than "the relative familiarity 0.8", which also exceeded 80%, with a mean at 81.9%, so 81.9% of experts are "relatively familiar" with these research indicators.

Therefore, with the formula Ca = (Ci + CS) / 2, the authority degree Ca = (0.7737 + 0.828) / 2 = 0.80085 could be obtained by substituting the expert judgment coefficient Ci = 0.7737 and Cs = 0.828 into the formula.

(4) The reasonable number of experts selected

Relevant research shows that the number of experts determines the accuracy of the final index analysis. Generally speaking, the more people participate in the expert consultation, the higher the reliability of the analysis results will be, but the increase of the number will also be limited by the accuracy of analysis. Therefore, generally, the number of experts selected is between 15 and 50 (Shi, 2001). Based on the actual situation, the study selected 35 experts to form an advisory group.

3. The first round of expert consultation

The first round of expert consultation needs to further screen out reasonable and scientific indicators for the perceived value indicators of online medical service for remote patients based on the preliminarily constructed Customer Value Theory. The preliminary indicator system consists of 5 level I indicators (self-value, respect and love, social contact, safety, and survival), 10 level II indicators, and 26 level III indicators. This study designed a questionnaire in the first round of expert consultation, listed various indicators, and marked the supported theories or literature sources, so as to illustrate the scientific nature of the setting of various indicators. Meanwhile, the questionnaire also attached the explanation of relevant core concepts (such as medical treatment partnership, specialized medical treatment partnership, online medical care, process reengineering and Customer Value Theory.), and explained the background and intention of this expert consultation at the beginning of the questionnaire.

The designed questionnaires of the first-round expert consultation were sent to all experts through Wenjuanxing. A total of 35 questionnaires were sent out. After 3 days, all the questionnaires were collected with a response rate of 100%.

(1) Statistics of indicator support rate

The results of 35 questionnaires collected were statistically analyzed. Because the Likert's five-point scale was used to measure the support rate of the questionnaires, and 5 points, 4 points, 3 points, 2 points, and 1 point respectively indicate "strongly agree", "agree", "undecided", "disagree", and "strongly disagree", the SPSS24.0 was used to conduct the frequency statistics of support of different levels for each indicator to understand the support rate.

As can be observed from Annex B, Table B7, the overall support rates are relatively high, among which the support rates of the 10 indicators of demand value characteristics are basically over 84%. In addition to the 74.3% support rate of the S2 response value, the support rates of 26 third-level measurement indicators range from 74.4% to 97.1%, most of which are above 88%. And the very few indicators (S15 risk) are 71.4%, which is also more than 70%.

(2) The modification suggestions of experts on demand value characteristics and measurement indicators and research group description

Through the first round of expert consultation, experts' feedback opinions on the initial 5 level I indicators, 10 level II indicators and 26 level III indicators of the perceived value of online medical service for remote patients based on the Customer Value Theory can be obtained. Through summary analysis, the explanations and reasons for the support rates of indicators are listed as follows. Meanwhile, according to the summary of experts' opinions and the actual research, the research group also explains the following revision plan of indicators, including retention, exclusion, modification or increase. Moreover, indicators that have received a high level of support rate are not listed in the table below. For details, please refer to Annex A, Questionnaire I (The Analyses and Explanations of the First-round Expert Consultation).

To be specific, it can be seen that the indicators with feedback include V1 reputation value, V11 value the hospital's reputation, V21 autonomy of medical consultation, R21 diagnostic process, R22 diagnostic results, S11 time, S12 space, S13 economic currency, S14 energy, S15 risk, S2 response value, and S31 medical entity (Annex B, Table B8).

4. The second round of expert consultation

After the first round of expert consultation feedback and in-depth research, we know the recognition degree of experts on the initial 5 level I indicators, 10 level II indicators, and 26 level III indicators based on the perceived value of Internet medical service for remote patients based on the perceived value of online medical service for remote patients based on the Customer Value Theory. Meanwhile, the revisions are integrated into the questionnaire design in the second round of expert consultation, and some indicators are deleted, modified and retained (Annex A, Questionnaire III). The 35 designed questionnaires of the second-round expert consultation were sent to all experts through Wenjuanxing. After 3 workdays, all the questionnaires were collected with a response rate of 100%.

(1) Statistics of indicator support rate

The Likert's five-point scale was used to measure the support rate of the questionnaires and 5 points, 4 points, 3 points, 2 points, and 1 point respectively indicate "strongly agree", "agree", "undecided", "disagree", "strongly disagree". The SPSS24.0 was used to conduct frequency statistics of support of different levels for each indicator to understand the support rate. We can see from Annex B, table B9 that the support rates of the second round of expert consultation have increased significantly, and tend to be high.

(2) To determine the characteristics and measurement indicators of final value needs by the

coefficient of variation

According to the statistical results, we take the arithmetic mean >3.5 and coefficient of variation <0.25 based on the data collected in the second round of expert consultation as the screening criteria (coefficient of variation = standard deviation of original data/mean of original data) to screen and modify the indicator system. It can be seen from the table below that the arithmetic mean of each level II and level III indicator is above 4, and the coefficient of variation is below 0.2, indicating that the expert opinions are basically consistent. After two rounds of expert consultation, 5 level I indicators, 10 level II indicators and 26 level III indicators are finally established to form the indicator evaluation system of perceived value of online medical service for remote patients based on Customer Value Theory. The details are shown in Annex B, table B10.

5. The third round of expert consultation

After the evaluation indicators of perceived value are determined, the third round of expert consultation should be conducted to obtain the experts' scores on the importance of each indicator, namely, the weight of each indicator. In order to ensure the objectivity of the comprehensive evaluation result, the Analytic Hierarchy Process (AHP) is used to complete it.

(1) The definition of the Analytic Hierarchy Process (AHP)

The Analytic Hierarchy Process was put forward by Professor Saaty in the early 1970s. AHP is a simple, flexible and practical multi-criteria decision method for quantitative analysis of qualitative problems. It is characterized by making various factors in a complex problem organized by dividing them into interrelated ordered levels. According to the subjective judgment structure of certain objective reality (mainly pairwise comparison), it directly and effectively combines the expert opinions with the objective judgment results of the analysts, and quantitatively describes the importance of pairwise comparison of each hierarchy element. Then, the weights reflecting the order of relative importance of each hierarchy element are calculated by mathematical methods, and the relative weights of all elements are calculated and sorted by the total ordering among all levels. Since the method was introduced to China in 1982, with its combination of qualitative and quantitative processing of all kinds of decision factors, and the advantages of flexible and concise system, it has been quickly valued and applied in our country in the social and economic fields, such as energy systems analysis, urban planning, economic management, and scientific research evaluation (Saaty, 2006).

The following five steps should be taken to analyze problems with AHP :(1) establish the hierarchical structure model; (2) construct judgment matrix; (3) hierarchical single sorting; (4) total order sorting; (5) consistency test. The last three steps need to be carried out layer by layer

in the whole process.

(2) The design of AHP

1) The construction of hierarchy models

According to the established indicator system of perceived value of online medical service for remote patients based on Customer Value Theory, a hierarchical structure model is constructed by organizing, hierarchizing and visualizing the research indicators, as shown in Annex C, Figure C6.

The model has four levels: the highest level (goal level) is the quantitative evaluation of perceived value of online medical service based on the Customer Value Theory; the middle level (criterion level) includes the intermediate links involved in the realization of the goal, which is level I indicators of the five dimensions of the hierarchy of needs in the evaluation system; the middle level (sub-criterion level) includes the level I indicators that represent the characteristics of the five demand dimensions; the lowest level (scheme level) is the most specific measurement and evaluation indicators, which is the level III indicators in the evaluation system of perceived value of online medical service in the Customer Value Theory in this study.

2) The construction of judgement matrix

The AHP is used to compare pairwise the priorities of factors at each level based on the 1 to 9 scale proposed by Thomas L. Saaty. Scale1, 3, 5, 7 and 9 correspond to five different degree of importance: equally important, moderately important, very important, strongly important and extremely important, while those between the above intensity of importance are indicated on the scale of 2, 4, 6 and 8. See details in Table 4.4. Pairwise comparison of the importance of each indicator is to determine the Saaty scale, which means “the importance of indicator i is a multiple of the importance of the indicator j”. Experts will make comparative judgments on the importance of factors at each level in the hierarchy structure, and express them with a certain number, which is listed in the form of a matrix. The matrix is the judgment matrix (recorded as A, and A= means conforming to judgment matrix), which is called the reciprocal judgment matrix.

Table 4.4 Saaty's hierarchy table of relative importance

Scale	Definition	Scale	Definition
1	Horizontal factors are as important as vertical factors		
3	The horizontal is slightly important more than the vertical	1/3	The horizontal is slightly less important than the vertical
5	The horizontal is significantly more important than the vertical	1/5	The horizontal is significantly less important than the vertical
7	The horizontal is strongly important more than the vertical	1/7	The horizontal is strongly less important than the vertical
9	The horizontal is extremely more important than the vertical	1/9	The horizontal is extremely less important than the vertical
2,4,6, and 8 are the median values of the above adjacent judgments			

For example, assuming you think "A2" is significantly more important than "A1", fill in "5" in the first blank in the third line of Table 4.5.

Table 4.5 Example of Saaty's method of scaling assignment

A (judgment matrix)	A1	A2	A3
A1	1	Not fill	Not fill
A2	**5**	1	Not fill
A3			1

Therefore, according to the principle of constructing the judgment matrix and the measurement indicators of the characteristics of the value needs of remote patients determined by the second round of expert consultation, a total of 14 judgment matrices of different levels and dimensions are constructed (see Annex A, Questionnaires IV). And pairwise comparison is conducted among the matrices, namely which are five demand judgment matrices for the highest level of level I indicators, level II indicator self-value realization need judgment matrix, level II indicator respect and love need judgment matrix, level II indicator safety demand judgment matrix, level III indicator reputation value judgment matrix, level III indicator autonomous medical consultation value judgment matrix, level III indicator spiritual value judgment matrix, level III indicator privacy value judgment matrix, level III indicator medical personnel value judgment matrix, level III indicator cost value judgment matrix, level III indicator response value judgment matrix, level III indicator tangible value judgment matrix, level III indicator normative value judgment matrix, and level III indicator technical value judgment matrix.

3) Experts set pairwise comparison between two indicators to calculate weight vectors and maximum eigenvalues

Firstly, questionnaires are issued according to the constructed 14 judgment matrices (see

Annex A, Questionnaires IV), 38 experts are invited to compare the weights of each judgment matrix in pairs (using the 1 to 9 scale method proposed by Saaty, with scales 1, 3, 5, 7 and 9 respectively being equally important; see Table 5.2 for the specific filling method). Scoring according to the relative importance, the weight of each indicator of the perceived value of medical treatment in the online specialist medical partnership for remote patients is calculated. The importance of pairwise comparison of the 14 judgment matrices is summarized as Annex B, Table B11.

Secondly, the importance ratio data of the judgment matrix factors collected from the questionnaires is used to calculate the weight of each factor of each hierarchy and the maximum eigenvalue. The matrix weight method used in AHP of this study is the root method to determine the weight vector W and the corresponding maximum eigenvalue $\lambda_{\max}$. The specific process is as follows: calculate the geometric mean value G_i of the matrix row by row (i is row, i=1,2,3,...n), and the formula is used to normalize the geometric average value obtained G,

$$G_i = \sqrt[n]{a_{i1} \times a_{i2} \times a_{i3} \times \cdots a_{in}} \quad (4.4)$$

in other words, calculate the weight W_i. The formula is

$$W_i = G_i \Big/ \sum_{i=1}^{n} G_i \quad (4.5)$$

Meanwhile, the calculation method of the maximum eigenvalue is

$$\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(AW)_i}{W_i} \quad (4.6)$$

among which the $(AW)_i$ represents the ith component of the AW. Therefore, the practice is as follows (taking the level I as an example):

The weight calculation of the level I organization indicators

Therefore, the geometric mean value and weight value of the judgment matrix of the five demand levels are calculated according to the above formula: the geometric square root of "V: self-value realization need" $= G_1 = \sqrt[n]{a_{11} \times a_{12} \times a_{13} \times \cdots a_{1n}} =$

$\sqrt[5]{1 \times 0.43 \times 0.58 \times 0.29 \times 0.26} = 0.45$

The geometric square root of "R: respect and love need"

$= G_2 = \sqrt[n]{a_{21} \times a_{22} \times a_{23} \times \cdots a_{2n}} = \sqrt[5]{2.3 \times 1 \times 0.5 \times 0.3 \times 0.29} = 0.63$

The geometric square root of "SC: social contact"

$$= G_3 = \sqrt[n]{a_{31} \times a_{32} \times a_{33} \times \cdots a_{3n}} = \sqrt[5]{1.73 \times 2 \times 1 \times 0.29 \times 0.26} = 0.77$$

The geometric square root of "S: safety need"

$$= G_4 = \sqrt[n]{a_{41} \times a_{42} \times a_{43} \times \cdots a_{4n}} = \sqrt[5]{3.42 \times 3.35 \times 3.4 \times 1 \times 0.36} = 1.69$$

The geometric square root of "SU: survival need"

$$= G_5 = \sqrt[n]{a_{51} \times a_{52} \times a_{53} \times \cdots a_{5n}} = \sqrt[5]{3.89 \times 3.49 \times 3.82 \times 2.8 \times 1} = 2.71$$

Based on this, normalization is carried out according to the geometric average G_i, which is to calculate the weight W_i. The formula is $W_i = G_i \Big/ \sum_{i=1}^{n} G_i$.

$$W_1 = G_1 / (G_1 + G_2 + G_3 + G_4 + G_5) = 0.45 / (0.45 + 0.63 + 0.77 + 1.69 + 2.71) = 0.07$$

$$W_2 = G_2 / (G_1 + G_2 + G_3 + G_4 + G_5) = 0.63 / (0.45 + 0.63 + 0.77 + 1.69 + 2.71) = 0.1$$

$$W_3 = G_3 / (G_1 + G_2 + G_3 + G_4 + G_5) = 0.77 / (0.45 + 0.63 + 0.77 + 1.69 + 2.71) = 0.12$$

$$W_4 = G_4 / (G_1 + G_2 + G_3 + G_4 + G_5) = 1.69 / (0.45 + 0.63 + 0.77 + 1.69 + 2.71) = 0.27$$

$$W_5 = G_5 / (G_1 + G_2 + G_3 + G_4 + G_5) = 2.71 / (0.45 + 0.63 + 0.77 + 1.69 + 2.71) = 0.43$$

Therefore, the weight of the five demands of remote patients' perceived value dimension of telemedicine is as follows:

"V: self-value realization need" has the lowest weight of 0.07, "R: respect and love need" has the weight of 0.1, "SC: social contact" has the weight of 0.12, "S: safety need" has the weight of 0.27, ranking the second, "SU: survival need" has the highest weight of 0.43. See details in Table 4.6.

Table 4.6 Weight calculation of the five demand judgment matrices for the level I indicators

Perceived value of telemedicine for remote patients	V	R	SC	S	SU	Geometric mean(G)	Normalized weight(W)
V	1.00	0.43	0.58	0.29	0.26	0.45	0.07236
R	2.30	1.00	0.50	0.30	0.29	0.63	0.10065
SC	1.73	2.00	1.00	0.29	0.26	0.77	0.12285
S	3.42	3.35	3.40	1.00	0.36	1.69	0.27098
SU	3.89	3.49	3.82	2.80	1.00	2.71	0.43316

At the same time, on this basis of the obtained geometric mean value G_i (i is row, i=1,2,3...n) and weight W_i, the maximum eigenvalue is calculated. The calculation method for the maximum eigenvalue is $\lambda_{\max} = \frac{1}{n} \sum_{i=1}^{n} \frac{(AW)_i}{W_i}$,and the specific process is as follows:

$$AW_1 = (1\times 0.07236+ 0.43\times 0.10065+ 0.58\times 0.12285+ 0.29\times 0.27098+ 0.26\times 0.43316) = 0.3778$$

$$AW_2 = (2.3\times 0.07236+1\times 0.10065+ 0.5\times 0.12285+ 0.3\times 0.27098+ 0.29\times 0.43316) = 0.5335$$

$$AW_3 = (1.73\times 0.07236+ 2\times 0.10065+1\times 0.12285+ 0.29\times 0.27098+ 0.26\times 0.43316) = 0.6424$$

$$AW_4 = (3.42\times 0.07236+ 3.35\times 0.10065+ 3.4\times 0.12285+1\times 0.27098+ 0.36\times 0.43316) = 1.4280$$

$$AW_5 = (3.89\times 0.07236+ 3.49\times 0.10065+ 3.82\times 0.12285+ 2.8\times 0.27098+1\times 0.43316) = 2.2939$$

$$\lambda_{\max} = \frac{1}{\mathrm{n}}\sum_{i=1}^{n}\frac{(AW)_i}{W_i} = \frac{1}{5}(\frac{AW_1}{W_1}+\frac{AW_2}{W_2}+\frac{AW_3}{W_3}+\frac{AW_4}{W_4}+\frac{AW_5}{W_5})$$

$$= \frac{1}{5}(\frac{0.3778}{0.07}+\frac{0.5335}{0.1}+\frac{0.6424}{0.12}+\frac{1.4280}{0.27}+\frac{2.2939}{0.43}) = 5.2631$$

The above judgment matrix is checked by consistency test indicators:

$$CI = \frac{\lambda_{\max}-n}{n-1} = \frac{5.2631-5}{5-1} = 0.0657$$

By analogy, the weights of the level II and level III indicators are calculated.

4) Hierarchical single sorting and consistency test

When the judgment matrix cannot achieve complete consistency, the eigen root of the corresponding judgment matrix will also change, so consistency test should be carried out when constructing the judgment matrix. According to matrix theory, when the positive reciprocal matrix satisfies the consistency, its maximum eigen root is equal to the order of the matrix, which is $\lambda_{\max} = \mathrm{n}$. Saaty uses CI to judge the consistency of the matrix (n is the order of the judgment matrix), and the formula is

$$CI = (\lambda_{\max} - \mathrm{n})/(\mathrm{n}\text{-}1) \quad \textbf{(4.7)}$$

Based on the consistency principle of judgment matrix, if CI=0, it means that the judgment matrix has complete consistency. The larger the CI value is, the worse the consistency of the judgment matrix is. The smaller the CI value is, the better the consistency is. In addition, the average random consistency indicator RI of the judgment matrix should be used to calculate the random consistency ratio CR of the judgment matrix by querying the value of the judgment matrix RI. The formula is

$$\mathrm{CR} = \mathrm{CI}/\mathrm{RI} \quad \textbf{(4.8)}$$

value of judgment matrix of 1 to 9 order is shown in Table 4.7:

Table 4.7 Random average consistency indicator of judgment matrix

Order	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

Generally speaking, the order 1 or order 2 of the judgment matrix RI is equal to 0, which means it has complete consistency. If the order of judgment matrix is about 2, the random average consistency indicator of the judgment matrix needs to be queried. The calculated CI value (the consistency indicator) is compared with the average random consistency indicator RI of the same order to obtain the randomness ratio of the judgment matrix, which is CR, and CR=CI/RI. If CR<0.1, it means that the judgment matrix has satisfactory consistency. If it is not up to the standard, the value of the judgment matrix needs to be adjusted to achieve satisfactory consistency

According to the indicator weight of level I indicators (five factors at need level) and CI indicator calculated above, CR=CI/RI=0.0657/1.12=0.0587<0.1 is calculated, which represents the consistency of the judgment matrix of level I.

5) Total level of sorting and consistency check

The ranking value of the importance or the advantages and disadvantages of the lowest factor relative to the highest level is calculated from top to bottom along the hierarchical structure of the design successively, that is, the total order sorting, and the consistency check is also carried out from top to bottom. Assuming the consistency indicator of the single ranking of some factors at the lower level (assuming level B) to the factor A_j (j=1,2,3,…m) at the upper level (assuming level A) is CI_j, and the corresponding random consistency indicator is RI_j, then the proportion formula of the total ranking random consistency indicator in the level is

$$CR = (\alpha_1 CI_1 + \alpha_2 CI_2 + \cdots \alpha_m CI_m) / (\alpha_1 RI_1 + \alpha_2 RI_2 + \cdots \alpha_m RI_m) \quad \textbf{(4.9)}$$

If CR<0.1, it is considered that the consistency test of the total level ranking is passed. Otherwise, the elements of judgment matrices need to be readjusted.

According to the calculated weights of the level I indicators, the normalized weights of the level II indicators are calculated, and the corresponding maximum eigenvalues are calculated, which can be seen as Table 4.8:

Table 4.8 Total level ranking and consistency check

Level I indicator		V 0.07236	R 0.10065	SC 0.12285	S 0.27098	SU 0.43316
Normalized weight of the level II indicator	V1	0.29070				
	V2	0.70930				
	R1		0.29070			
	R2		0.70930			
	SC1			1		
	S1				0.09995	
	S2				0.17576	
	S3				0.29395	
	S4				0.43034	
	SU1					1
	λ_{max}	2	2	1	4.2528	1
	CI	0	0	0	0.08	0
	RI	0	0	0	0.9	0

Therefore, the consistency test formula and calculation process of level II indicators to the level I indicators are as follows:

$$CR = (\alpha_1 CI_1 + \alpha_2 CI_2 + \cdots \alpha_m CI_m) / (\alpha_1 RI_1 + \alpha_2 RI_2 + \cdots \alpha_m RI_m)$$

$$= \frac{0.07236\times 0 + 0.10065\times 0 + 0.12285\times 0 + 0.27098\times 0.08 + 0.43316\times 0}{0.07236\times 0 + 0.10065\times 0 + 0.12285\times 0 + 0.27098\times 0.9 + 0.43316\times 0} = \frac{0.27\times 0.08}{0.27\times 0.9}$$

$$= 0.089 < 0.1$$

The consistency CR of the level II indicator against the level I indicator is 0.089, less than 0.1, thereby passing the consistency check of the total order ranking.

Similarly, the calculation process of the consistency check of the level III indicator against the level II indicator is (the total ranking of numerical reference order weight is shown in Annex B, Table B12):

$$CR = (\alpha_1 CI_1 + \alpha_2 CI_2 + \cdots \alpha_m CI_m) / (\alpha_1 RI_1 + \alpha_2 RI_2 + \cdots \alpha_m RI_m)$$

$$= \frac{0.02926\times 0.0278 + 0.07139\times 0.0388 + 0.12\times 0.07903 + 0.02708\times 0.06848 + 0.04763\times 0.0311}{0.02926\times 0.58 + 0.07139\times 0.58 + 0.12\times 0.9 + 0.02708\times 1.12 + 0.04763\times 0.58}$$

$$= \frac{0.000813428 + 0.002769932 + 0.0094836 + 0.001854438 + 0.001481293}{0.0169708 + 0.0414062 + 0.108 + 0.0303296 + 0.0276254}$$

$$= \frac{0.016402691}{0.224332} = 0.07311793 < 0.1$$

The consistency CR of level III indicators against the level II indicators equals 0.07311793, less than 0.1, hence passing the consistency check of total order sorting. Annex B, Table 12 shows Individual weight and consistency check of indicators at all levels.

In addition, according to the consistency test table of the single indicator in Annex B, Table B12, the level III indicators are ranked from largest to smallest as Annex B, Table B13.

4.3 Development of information platform and formation of online medical services expansion mode

In the last section, through three rounds of expert consultation, Delphi method and analytic hierarchy process were used to determine the evaluation system of Internet perceived value of remote patients. The establishment of the index system provides a strong support for the process reengineering and the development of information platform of remote medical service of the specialized medical association. Therefore, this section will be based on the evaluation system of Internet perceived value of remote patients, reengineer the remote treatment process of remote patients, describe the idea and logical structure of the development of information platform, and accumulate typical practice cases after putting into use, so as to pave the way for the follow-up empirical research.

4.3.1 The process of traditional remote patients receiving expert consultation and treatment in the F hospital

In the traditional process of remote patients receiving expert consultation in the F hospital, the local hospital determines the consultation time of experts in the F hospital, once a month, and the experts are not fixed. For patients who need surgery, the operation time is often determined by the local doctors. The patients cannot communicate with the experts of the F hospital face to face before surgery, nor can they choose the operation experts. On the day of surgery, the experts of the F hospital and the doctors of the local hospital cooperate to complete the operation. After surgery, the experts of the F hospital leave the local area, and the doctors of the local hospital will perfume a follow-up visit, which cannot reflect the continuation of the expert treatment technology of the F hospital. The specific consultation process is shown in Annex C, Figure C7.

4.3.2 The process of remote patient visits to the F hospital

In the traditional process of remote patients visiting the F hospital, patients generally visited local hospitals. They tend to be attracted by larger hospital’s reputation and come with examination materials and diagnostic results. They make an appointment at the outpatient clinic of the F hospital on the Internet, visit the F hospital on the same day or the previous day by various transportation vehicles, and leave after outpatient examination, expert diagnosis and processing in the F hospital. Some patients are required to have an appointment for inpatient

care or surgery and to be followed up in the outpatient clinic in the F hospital or for recurrent readmissions. It is more positive and recognized in terms of the effect of seeking medical care and the psychological effect, which may be inseparable from the authority of the hospital with superb technical level. But the time that patients spend on the road, with more energy and economic burden, also brings a gratifying phenomenon to the operation of the business in the F hospital. The flow of specific visits is shown in Annex C, Figure C8.

4.3.3 Process reconstruction of online medical services expansion mode

4.3.3.1 The purpose of the process reconstruction

The aim and purpose of the reconstruction of the remote diagnosis and treatment process of the specialized medical association is to keep patients in the local area, give them the autonomy of consultation, and make them enjoy the homogeneous medical services of the core hospitals. All processes are reconstructed and designed with the convenience and perceived value of consultation for remote patients as the starting point, thus saving patients' time and economic costs, making them choose core hospital specialists independently for consultation, and implementing the whole process of intervention and tracking from registration, consultation process, post-operative check-ups and follow-ups in the core hospitals of the medical association to achieve the same quality of medical services as those in the F hospital.

4.3.3.2 Reconstruction design of Internet medical process using IE theory

This study will adopt IE procedure analysis method to reconstruct the process of traditional visiting to the F hospital for medical treatment. The emergence of IE theory was then coined with the idea of process redevelopment proposed by American scholars Michael Hammer and Jame Champy, which was primarily applied with industrial engineering and later with medical and health systems. IE theory is also currently a common method of modifying processes in many medical institutions abroad, mainly to solve management problems. Its current application field has also been expanded from production to service class. So, this topic research is based on patients to improve the perceived value and satisfaction of patients' medical treatment, and to recreate the process of visiting the F hospital.

The specific basic process reconstruction key points are to reframe the original traditional receiving consultation treatment process with the goals of reducing time costs and economic costs, increasing customer satisfaction, and improving the efficiency of visits, in a way that includes incorporating, deleting, optimizing, and simplifying (Wang, 2011). For example, the Internet outpatient process can be adjusted and optimized so as to delete the inefficiency or

ineffectiveness link, reframe the function similarity link, enhance the awareness of artificial intelligence, and integrate it into the process to achieve smooth and safe and high efficiency visiting goals. The specific process reconstruction and design steps are as follows.

Identify goals to be achieved by process reconstruction (oriented to patient perceptions of medical care) - make clear the problems with diagnosis service processes (meetings for consultation specialists are difficult and lack direct communication as well as full follow-up) - design the environment and the various links, and identify protocols (optimized consultation model, time-saving, and communication accessible) - implement and adapt improvement.

The earliest application of the IE procedure analysis method was the process reconstruction that served the manufacturing industry, with symbols in its icons being specific to those used by the manufacturing industry. This study is aimed at recreating the process of medical care in the hospital field, so by applying IE procedure analysis, these symbols can be used for a new definition of the hospital field (Xu, 2014).

○: It indicates operations, such as processing, construction et al. Here it is defined as the process by which a nurse or doctor serves patients, including the corresponding treatment processes such as examinations, laboratory tests, and diagnoses, and the main feature is to provide value activities for patients.

⇨: It indicates handling and shipping work. Here it is defined as the process of patient movement and movement in the hospital.

D: This is defined as the process of waiting required during the patient's visit.

□: It indicates test. Here we define it as various ancillary activities for patients, including sign registration, cost saving, and charging.

So, the process of remote patients being treated by specialists in the F hospital is listed according to the symbols redefined by IE procedures analysis method, as detailed in Annex B, Table B14.

Through a series of process design of IE theory, the new model of access to the F hospital for remote patients is appropriately improved by simplifying, merging, sequencing, and eliminating.

It can be seen that in the new Internet medical model, remote patients can enjoy the same treatment as those who go to the outpatient clinic of the F hospital. They can register, visit and examine locally, and communicate face to face with the specialists of the F hospital. Patients can experience multiple audio and video audio-visual examinations, which can clarify the diagnosis results in real time. Doctors in the F hospital and alliance hospital can also

communicate with each other in real time, synchronously obtain patients' images and other information, generate electronic medical records, and arrange surgery on a selective date. The most important highlight is that after the surgery, through the telemedicine system, specialists from the F hospital can track the patients' recovery and check in with the local hospital doctors, and the patients have a good feeling.

The transformed process is shown in Figure 4.3.

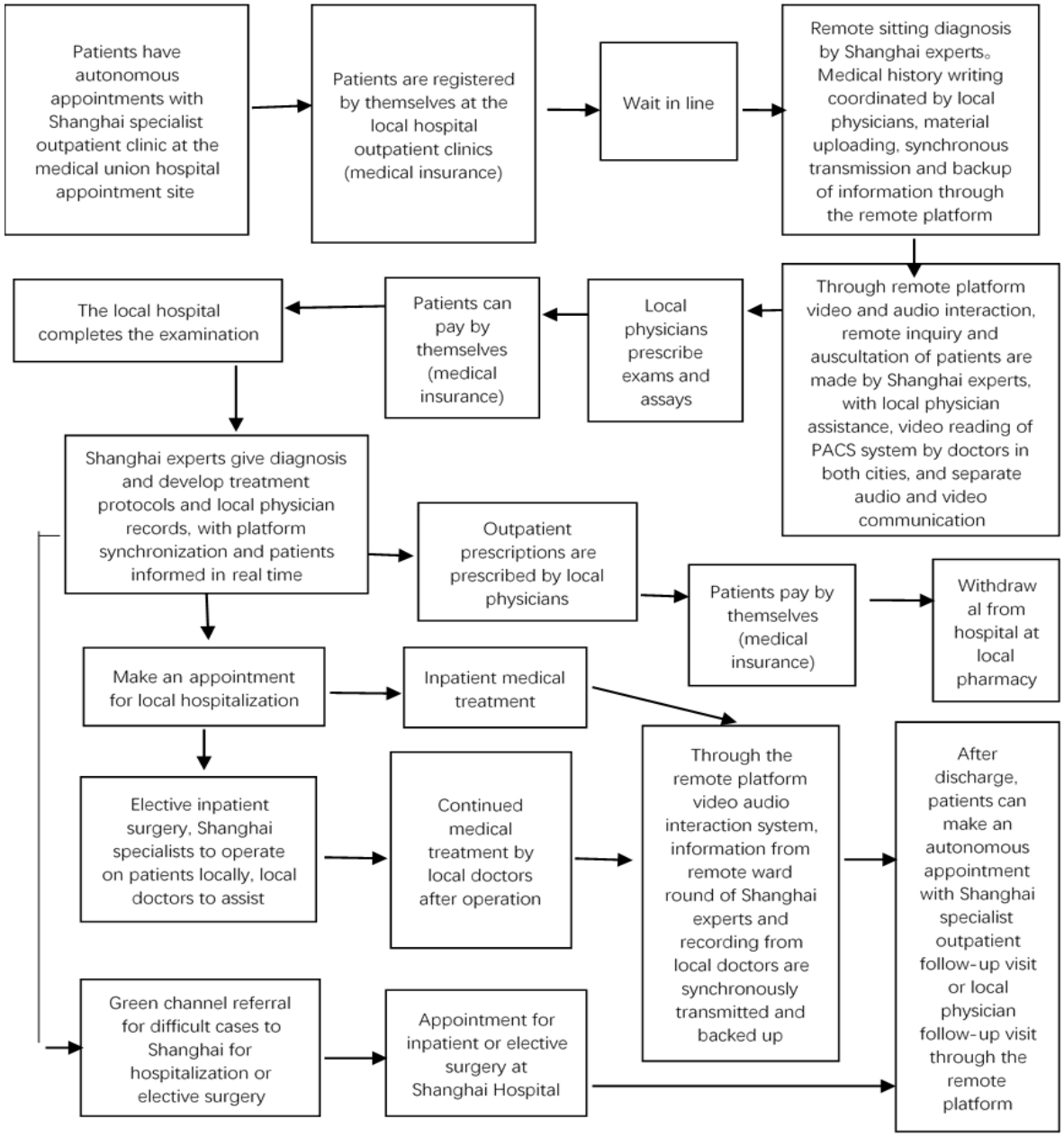

Figure 4.3 Reconstruction of medical access processes based on perceived value indicators of Internet access for remote patients

4.3.4 Design of information platform of online medical services expansion mode

According to the evaluation system of perceived value of online medical service for remote patients as demonstrated in the previous studies, the medical treatment process was reformed and redesigned to develop a remote diagnosis and treatment information platform, highlight the application function for remote patients. It can help retain patients in the local area to enjoy the homogeneous medical care service of F hospital, respond to the patients' needs, improve the patients' perceived value of medical care and satisfaction, and reduce patients' various costs. Details are shown in Annex B, Table B15.

4.3.5 Construction and presentation of online medical information platform

The above-mentioned design and functional elements of the medical information platform based on the perceived value of medical services for remote patients will ultimately be achieved by various equipment parameters. Designing the system structure diagram (Annex C, Figure C9) and building up the platform network structure, and combining the platform hardware with software will make the remote diagnosis and treatment of remote patients more convenient, and the patient's autonomy stronger.

1. Characteristics of the information platform

(1) F hospital sets up the information platform, obtains the data uploaded by alliance hospitals to and carry out remote diagnosis and treatment.

(2) The cost of the construction of remote consulting rooms on both sides is low. And the number of consulting rooms is scalable on demand. The original outpatient information platform can be used in the union hospital.

(3) The software reacts more immediate and is more stable. It supports remote outpatient consultation as well as remote ward round.

(4) Electronic medical records can be kept synchronously at both sites.

(5) The product develops its core business according to Article 3, paragraph 3 of the Code of Telemedicine Service Management.

(6) Organizations using the platform can achieve full interconnection of information, and sign online contract according to Article 3, paragraph 1 of the Code of Telemedicine Service Management, and carry out immediate and free pairing cooperation of remote diagnosis and treatment.

2. Software and hardware configuration of remote consulting room

The consulting rooms should be equipped with front-end servers and software, server host

and software of remote consultation system, cloud storage system, high-definition camera, video call robot, the server host of remote outpatient system, medical imaging display monitor, high-definition and high-speed photographic apparatus, headphone, and keyboard mouse set, as shown in Annex C, Figures C10, C11 and C12.

4.4 Chapter Summary

This chapter provides an empirical study on the process rebuilding and redesigning specialized online health services based on the perceived value of remote patients. To obtain the perceived value needs of remote patients' visits, this study carries out questionnaire survey to understand the main needs of remote patients visiting. The results show that: social contact and respect value need > safety and survival value need > self-value need > cost losses value. Meanwhile, the preliminary evaluation indicators of patients' perceived value are derived based on the results of the questionnaire. Three rounds of expert consultation are adopted to eliminate indicators of ineligibility, and an index system for the value of online visits for remote patients is established. Among them, the weights of indicators such as external attributes, internal attributes, medical technological specification, face-to-face medical care, and professional skills are ranked top, which illustrates that patients' needs for safety and survival value are strong, and communication of feelings is also a very important indicator in the evaluation of patients' medical treatment. In contrast, among the perceived values of remote patients, the spatial distance and economic currency are not the most valued ones to patients, with low weights, implying that remote patients' visits can ignore these objectively incurred cost expenses if they can achieve satisfaction and treatment effects during the process. The sorting and ranking of these indicators are conducive to the design and construction of the information platform.

Then the telemedicine platform is designed based on these indicators, and put into practice. The realization of the function of the information platform in the implementation process depends on the penetration of original perceptual value indicators, which can improve process modification for medical treatment and the application effect.

Chapter 5: Evaluation and Discussion of Online Medical Service Mode for Specialties

Along with the design and validation of the indicator system of the perceived value of medical treatment for remote patients, as well as the statistics of the scores of the previous perceived value questionnaires, the online medical platform for the medical treatment partnership of specialties is constructed and put into use in accordance with the indicator system. Based on the above work and the preliminary empirical data, a Satisfaction Questionnaire for Remote Patients on the Use of the Online Diagnosis and Treatment Mode for the Medical Treatment Partnership of Specialties is designed to obtain more objective empirical data and to verify the effectiveness of the research.

5.1 Questionnaire plan on the online medical service mode

1. Investigation purpose

(1) To understand the comparative changes in the perceived value level of patients after the use of the online diagnosis and treatment mode for remote patients, that is, whether there are significant changes in the perceived value level compared with the traditional mode of visiting F Hospital. These overall perceived value levels include perceived survival value, perceived safety value, perceived society level, perceived respect value, and self-perceived value. These dimensions echo the previous analysis of the *Questionnaire of the Perceived Value Needs of Remote Patients* to prove the effectiveness of constructing and implementing the online diagnosis and treatment mode for remote patients.

(2) To understand the perception level of each variable of the "model of remote patient perceived value satisfaction with online medical services for specialties" proposed in Chapter 3, including perceived usefulness level, perceived ease of use level, overall perceived value level, satisfaction level, and the patients' perception of the synergy of various aspects while using the platform, so as to understand the overall level of remote patients' perception of the new medical service mode.

(3) To test the effectiveness of the new model by examining the changes in costs, including time, money, distance, and energy costs, after the implementation of the online specialty

treatment mode for remote patients.

(4) To verify the seven direct effects hypotheses and three mediation effect hypotheses of the "model of remote patient perceived value satisfaction with online medical service for specialties" proposed in Chapter 3, namely Figure 3.7.

2. Investigation time

2021.3.1-2021.4.1

3. Investigation subject

The questionnaire was conducted on patients who received the online specialty treatment mode for remote patients and had previously been to F Hospital for medical treatment.

4. Investigation methods

(1) Questionnaire method is applied for the design of the Satisfaction Questionnaire for Remote Patients on the Use of the Online Diagnosis and Treatment Mode for the Medical Treatment Partnership of Specialties based on the 5-Point Likert scale.

(2) Interview method is adopted to further understand the details of the perceived value, such as the shortcomings of the online diagnosis and treatment mode for the medical treatment partnership of specialties.

5. Questionnaire design

Based on the structure of "model of remote patient perceived value satisfaction with online medical services for specialties" presented in Chapter 3, questions related to each dimension are listed in the questionnaire, among which the questions about the perceived value are similar to the those in the previous questionnaire, both designed according to Maslow's hierarchy of needs, while questions of other dimensions (usefulness, ease of use, synergy, satisfaction) are based on the TAM and the ACSI. The questionnaire covers five dimensions and contains a total of 69 questionnaire questions, including ten questions about usefulness, nine questions about ease of use, eight questions about satisfaction, 16 questions on 4 secondary dimensions of synergy, and 26 questions on 5 secondary dimensions of perceived value. See Annex A, Questionnaire V for details.

5.2 Basic data analysis of the questionnaire

5.2.1 Reliability prediction through random sampling of questionnaire

The questionnaire was distributed in the form of a QR code through the questionnaire software WJX. A pre-questionnaire of 60 samples was first conducted to test whether the questionnaire

questions had a certain degree of reliability, and whether there was a statistical significance between the high-score group and low-score group. The predictive results were shown in Table 5.1.

Table 5.1 Predicted questionnaire results for remote patient satisfaction on the use of the online diagnosis and treatment mode for the medical treatment partnership of specialties

	t	Df	Sig.	Mean deviation	UHand	Cases	Average value	Standard deviation.
U1	-6.892	38	0.000	-1.667	low	4	3	0
					high	36	4.67	0.478
U2	-6.102	38	0.000	-1.556	low	4	3	0
					high	36	4.56	0.504
U3	-5.749	38	0.000	-1.472	low	4	3	0
					high	36	4.47	0.506
U4	-5.966	38	0.000	-1.528	low	4	3	0
					high	36	4.53	0.506
U5	-5.12	38	0.000	-1.444	low	4	3	0
					high	36	4.44	0.558
U6	-5.667	38	0.000	-1.444	low	4	3	0
					high	36	4.44	0.504
U7	-6.261	38	0.000	-1.583	low	4	3	0
					high	36	4.58	0.5
U8	-4.918	38	0.000	-1.306	low	4	3	0
					high	36	4.31	0.525
U9	-5.054	38	0.000	-1.417	low	4	3	0
					high	36	4.42	0.554
U10	-4.258	38	0.000	-1.389	low	4	3	0
					high	36	4.39	0.645

As can be seen from the table above, there is a statistical significance between the high-score and low-score groups with p-values all less than 0.001, representing good reliability of these 60 questionnaire samples. The same approach was then performed on the other dimensions for prediction, which resulted in the same statistical significance.

Subsequently, questionnaires were distributed again in the form of QR code. Through back-end statistics, a total of 257 questionnaires were recovered, with a recovery rate of 100%. On this basis, a preliminary descriptive analysis of the data was made.

5.2.2 Research subject category statistics

Based on the category information of the collected questionnaires, SPSS24.0 was used to obtain statistics of the category variables. The basic composition of the questionnaire respondents was 7 dimensions: gender, age group, education, the first visited hospital, province and city, years of smoking, and severity of lung disease. The valid value is 257, and the missing value is 0,

meaning the data is intact.

It is observed from the Table 5.2 below that the proportion of men and women in the research subjects is close with a slightly higher proportion of men. Most subjects graduate from senior high schools or colleges between the age of 41-50 years old. While the average year of smoking is 8 years, most patients have slightly serious lung disease.

Table 5.2 Statistics of category variables of research subjects

		Gender	Education	Age group	Years of smoking	Severity of lung disease
Cases	Valid	257	257	257	257	257
	Missing	0	0	0	0	0
Average value		1.45	2.37	5.09	8.05	1.77
Median		1	2	5=41-50	0	2
Mode		1=male	2= senior high schools or colleges	7= over 60	0	2=moderate
Minimum		1=male	1= junior high school and below	1= under 18	0	1=mild
Maximum		2=female	5= master's degree or above	7=over 60	55 years	3=severe

Also, below shows that the proportion of each category variable is greater than 5% and lower than four times among samples, which is acceptable. In addition, people with more serious lung diseases are mainly over 60 years old, but the majority of people with lung diseases in this questionnaire are middle-aged and old people with moderate lung problems. Besides, according to the specific frequencies of other category variables in the statistical table below, the main educational background of the research subjects is senior high schools or colleges and below. The specific category variable statistics are as follows in Table 5.3.

Table 5.3 Statistics of category variables of research subjects

		Frequency	Percentage	Valid percentage	Cumulative percentage
Gender	Male	142	55.3	55.3	55.3
	Female	115	44.7	44.7	100
	Total	257	100	100	
Age group	Under 18	3	1.2	1.2	1.2
	18-25	16	6.2	6.2	7.4
	26-30	33	12.8	12.8	20.2
	31-40	37	14.4	14.4	34.6
	41-50	47	18.3	18.3	52.9
	51-60	56	21.8	21.8	74.7
	Over 60	65	25.3	25.3	100
	Total	257	100	100	
Education	Junior high school or below	73	28.4	28.4	28.4
	Senior high schools or colleges	74	28.8	28.8	57.2
	Junior college	55	21.4	21.4	78.6
	University	51	19.8	19.8	98.4
	Master’s degree or above	4	1.6	1.6	100
	Total	257	100	100	
Severity of lung disease	Mild	81	31.5	31.5	31.5
	Moderate	155	60.3	60.3	91.8
	Severe	21	8.2	8.2	100

In addition, the statistics show that the years of smoking in the samples are different. Except for 165 non-smokers, among the 92 remaining smokers, 49 of them smoke more than 20 years, and only 10 people smoke less than 8 years, which means most of the smokers has smoked for more than 8 years, with an average age of 8.05 years.

It is also found that the subjects of this questionnaire come from different regions in China, indicating that the objects of this new online specialty treatment model for remote patients are mainly from Shanghai, Xinjiang, Jiangsu Province, Zhejiang Province and Jiangxi Province. These regions have close cooperation with F Hospital and help pave the way for subsequent problem identification and resolution through the practical exploration of collaborative access models.

5.2.3 Statistical description of questionnaire items

After a general analysis of the categories of research subjects, the questionnaire item scores were described. In a total of 257 samples with 69 questions per sample questionnaire, the class width of 5-3=2 is found. The results obtained by dividing the variable by the standard deviation are all less than 5, which is within the reasonable indicator range. In addition, the absolute value

of skewness is less than 1 and the kurtosis is less than 7, which corresponds with the normal distribution. Moreover, the average score of each item is above 4, which is a relatively satisfactory score. The standard deviations are relatively even without particular dispersion.

5.2.4 Analysis of the reliability and validity of the questionnaire

According to the data collected in this questionnaire, the overall reliability of the questions of the questionnaire was tested. Firstly, each piece of data was observed, and extreme values were identified and eliminated by using SPSS 24.0. The original 257 pieces of data are censored to 239 pieces of data.

Secondly, according to the reliability analysis formula

$$\textbf{Cronbach alpha} = (n/(n-1))*(1-(\sum Si2)/ST2) \quad (5.1)$$

Cronbach alpha was calculated with SPSS 24.0 to be 0.912, which is greater than 0.8 and has good overall reliability.

Thirdly, the AMOS24.0 tool was used to test the reliability of each question of each dimension (perceived value, synergy, ease of use, usefulness, satisfaction), including the estimated factor loadings, significance, and question reliability. The items whose reliability is lower than 0.36 are eliminated. The formula for composing reliability is

$$CR = (\sum \lambda 2)/((\sum \lambda 2)+ \sum \delta) \quad (5.2)$$

After inspection, the questions that do not meet the requirements of the indicators are removed. The EA3, EA6 and EA7 questions of the ease of use dimension were eliminated; the secondary dimension of the perceived value, namely FR15.1 and FR16.1 of the respect dimension were eliminated; and S123.1 and S124.1 of the secondary dimension safety value dimension were eliminated. The number of other dimensions remains unchanged.

Fourthly, the average value of the data of the secondary dimensions (knowledge synergy, institutional synergy, process synergy, and resource system) of the synergy dimension was taken as the observed data. In the same way, the average value of the data of the secondary dimensions (perceived survival value, perceived safety value, perceived society level, perceived respect value, and self-perceived value) of the perceived value dimension was taken as the observed data for the subsequent model construction path analysis and research.

Fifthly, AMOS24.0 was used to calculate the AVE convergent validity of five dimensions (ease of use, usefulness, perceived value, satisfaction, and synergy). The AVE is calculated as = AVE = $(\sum \lambda 2)/n$. The calculated AVE values are all greater than 0.5, which conforms to the standard value 0.5 of AVE recommended by Bagozzi, R. P., Fornell, C., & Larcker, D. F.,

indicating that the convergence effect is good (Bagozzi, Fornell, & Larcker, 1981).

According to data analysis, each non-standardized value is positive. For each dimension, the question loading is above 0.6; the question reliability is above 0.36; and the composite reliability is above 0.7. They all reach the acceptable threshold of 0.7 for the composition reliability of the criteria of multivariate data analysis proposed by Hair in 1997. The recommended value proposed by Bagozzi, Fornell and Larcker (1981) is above 0.6, so the composite reliability of each dimension in this research meets the requirements, indicating that there is sufficient internal consistency.

5.3 Statistical analysis of the perception level of each dimension

5.3.1 Overall level of patients' perception of online medical services: highest perceived usefulness

After excluding relevant unqualified questions, five new dimensions with better reliability and validity were built, namely, perceived ease of use, perceived usefulness, perceived value, satisfaction, and perceived synergy. According to the AVE formula, the results are greater than 0.5 with a better convergent validity. On this basis, the average value of each dimension is calculated separately.

Through the statistical analysis of the questionnaire, it is found that the difference between the perception levels of various dimensions of the model of remote patient perceived value satisfaction with online medical service for specialties is slight, and they are almost above 4 points, which is a relatively high level of perception. In addition, perceived usefulness is the one with the highest score of 4.7059 among the five dimensions, indicating that remote patients think the online medical service mode is very useful.

The scores of perceived ease of use (4.152 points), perceived value (4.1597 points) and perceived synergy (4.0772 points) are lower than the perceived usefulness score (4.7059 points). Among the three, it is worth noting that the score of perceived synergy indicates that remote patients are more satisfied with this dimension when the new online medical service mode is implemented. The score statistics for the secondary indicators are also relatively positive, mainly including system synergy, process synergy, resource synergy, and knowledge synergy among various departments, indicating higher patient satisfaction. The statistical results of synergy mean scores of the four dimensions will be described specifically below.

5.3.2 Perceived synergy level of remote patients in online medical services

Based on the statistics of the five dimensions, the scores of the secondary indicators of the perceived synergy dimension: system synergy, process synergy, resource synergy, and knowledge synergy were calculated. The highest score 4.1423 was obtained for perceived knowledge synergy, indicating that remote patients recognize that even if they are not in the local hospital, they can still feel the knowledge synergy brought about by the medical treatment process. The secondary indicator with the lowest score is the perceived process synergy. The score exceeds 4 points, which means that the overall process synergy performance is still relatively good with a mean value of 4.0014 points but weaker compared with other secondary indicators, which means that remote patients do not have a strong feeling about the process integration and cooperation between the two hospitals. This phenomenon also enlightens the follow-up suggestions for improvement.

In addition, the scores of perceived resource synergy and perceived system synergy are 4.0586 points and 4.1067 points respectively, implying an optimistic cooperation between resources and systems in the case of promoting the online diagnosis and treatment mode of the medical treatment partnership for specialties.

5.4 Statistical analysis on the comparative changes of remote patients' perceived value levels

SPSS24.0 was used to analyze the paired data of post-test level and pre-test level of patients' perceived value. In the original data, the questionnaire for the new mode of online diagnosis and treatment is named F*.1 and that for visiting F Hospital is signified F*.2.

5.4.1 Higher overall level of remote patients' perceived value of online medical services than traditional medical treatment model with slightly lower individual scores

Through comparison, as shown in Annex B, Table B16, the average score of perceived value of the new online diagnosis and treatment model is greater than the average score of the perceived value of visiting F Hospital. That is to say, the implementation of the new online model can increase the overall perceived value of remote patients.

There were also statistically significant increases in individual perception indicators with P-values less than 0.05. For example, in Pairing 6, the P-value of 0.001 indicates that the new online medical service model allows patients to trust doctors and receive treatment; in Pairing

11, its P-value 0.042 indicates that patients feel more respectful to the medical technology demonstrated by the doctors under this new model; Pairing 23, Pairing 24, Pairing 25 and Pairing 26 all show significant savings in time cost, distance cost, expense, energy and physical strength with P-values less than 0.001, indicating a significant improvement in the medical efficiency for patients.

The overall perceived value (five dimensions) of online medical services for remote patients is 4.1431 points on average, while the overall perceived value of the model of visiting F Hospital is 3.8178 points on average. Obviously, the former value is significantly higher than the latter. And according to the output of SPSS24.0, P-value is less than 0.001, indicating that there is a statistical significance between the previous and the latter data. This means that the implementation of online diagnosis and treatment mode of the medical treatment partnership for specialties has a remarkable positive impact on improving the perceived value of medical treatment by remote patients. The effectiveness of this research practice is obvious.

5.4.2 Comparison of scores of five dimensions of patients' perceived value of online medical service

Prism is employed to draw a comparison diagram of the total scores and specific item score of the five dimensions of self-perceived value, perceived society value, perceived respect value, perceived safety value and perceived survival value, in order to better see the level of patient perceived value.

5.4.2.1 Relatively high level of remote patients' perceived value of the new model of online medical service, with survival value scoring highest

The 26 items of perceived value in the questionnaire are screened out, and the mean values of the five dimensions (self-worth, respect, society, safety, and survival) are calculated. It is found that the overall score is greater than 4, which is at a good level, as is shown in Figure 5.1 below. The scores of self-realization value and survival value are the highest, 4.198 and 4.199 respectively, followed by respect value and society value, with mean values of 4.163 and 4.157 respectively. The lowest score is 4.093 for safety value. It shows that the new model of online medical service in this study will significantly enhance patients' perceived survival and self-realization value, and effectively solve the actual needs and psychological concerns of patients seeking medical treatment.

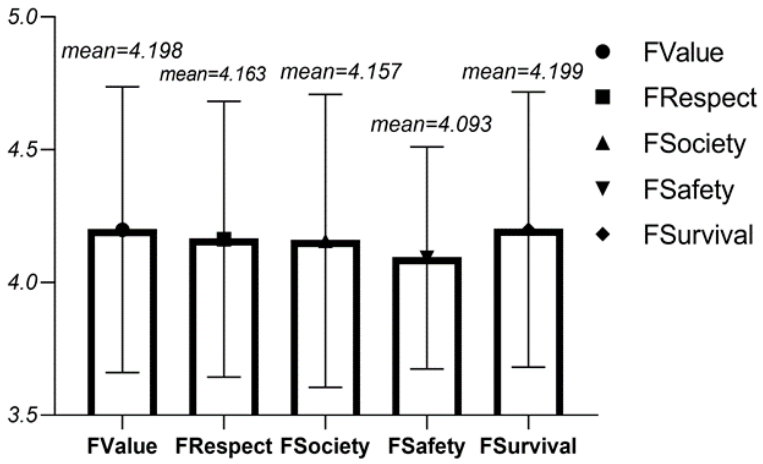

Figure 5.1 Comparison among different dimensions of remote patients' perceived value of online medical services

5.4.2.2 An improvement in the remote patients' self-realization value of the new model of online medical service

For remote patients, the overall score of the dimension of perceived self-realization value of the new model of online medical service is higher than that of the traditional model of going to F hospital for medical treatment in person. In addition, given the scores of the three pairings, pairing 1 gets the highest score of 4.28, indicating that remote patients pay more attention to the reputation of the hospital during the medical treatment process, and that the corresponding value satisfaction is stronger. Secondly, the reason why patients are more likely to choose the online specialized medical partnership of F Hospital for medical treatment is also because they take into account doctors' superb skills, which also has a certain impact on patients, with a score of 4.23.

It is worth noting that although the score of pairing 3 in this regard is not as high as that of pairing 1 and pairing 2, the implementation of the online hospital medical service model does allow remote patients to independently choose doctors and get online medical treatment. As it is similar to the real offline model of outpatient service registration to obtain medical service, the data feedback on the sense of gain is also close to that of the offline medical treatment situation of F Hospital, and even exceeds the score, reaching 4.14. This means that the implementation of the model of obtaining medical treatment in the online specialized medical partnership has indeed effectively promoted remote patients' medical service behaviors.

5.4.2.3 Increased respect value of the new model of online medical service

The data shows that the perceived value score brought by the online medical service model to

patients (4.16) is higher than that of visiting F hospital (4.118). Among them, the scores of pairing 4, pairing 5, and pairing 6 all represent the spiritual value dimension R1 (refer to Appendix 1 Questionnaire IV for specific corresponding dimension identifiers, similarly hereinafter), with an average score of 4.1; the average score of the privacy value R2 constituted by pairing 7 and pairing 8 is slightly higher by 4.15.

In addition, pairing 6 shows statistics significance with $P<0.05$, which means that for remote patients, choosing the online medical service model can bring increasingly significant trust in doctors' professional skills and medical ethics.

5.4.2.4 Analysis of the level of remote patients' society value of the new model of online medical service

The society value score of the online medical service model is higher than that of the traditional medical treatment model of visiting F hospital in person, which are 4.1575 and 4.1175 respectively. Especially in the item of pairing 11, the scores of the two are significantly different, which are 4.11 and 4.18 respectively, with the P value less than 0.05. This means that remote patients choosing online medical service model have a stronger society value perception, and more likely to be aware of the professional skills of doctors and thus feel respected during the diagnosis and treatment. It can also be inferred from this that, compared with the model of going to F hospital for medical treatment, the online medical service model allows patients to feel doctors' attentiveness more deeply, and a sense of trust brought by the communication between doctors and patients via Internet. This is a positive aspect of online medical service model.

The scores of other items show patients' recognition and trust in the doctors' patience, enthusiasm, communication, follow-up, and medical ethics, and thus the safety value score obtained is also relatively optimistic.

5.4.2.5 Declined safety value of the new model of online medical service: remote patients are more inclined to visit physical hospitals

From Annex B, Table B16 and the pairing scores, we also observed a phenomenon: the numerical difference of the four pairing items of pairing 15, pairing 16, pairing 17 and pairing 18 is negative, which is inconsistent with other pairings whose numerical difference is positive. This signifies that in these four paired comparison items, the perceived value of going to F hospital for medical treatment is slightly greater than the that of online medical service model. This phenomenon will need to be further studied to think about how to improve in the future, which also reflects the actual status quo of perceived needs of remote patients.

We can see that the perceived value score of pairing 15 is 4.17, higher than that of the online medical service model of 4.13, indicating that patients still prefer the physical medical environment. Pairing 16 shows that the remote patients' perceived value of going to F hospital for treatment is greater than the perceived value of online medical service, whose scores are 4.16 and 4.08 respectively, indicating patients believe that the visible medical treatment and communication in physical hospitals give them a stronger value perception. In the same way, the items of pairing 17 and pairing 18 also show that remote patients are more inclined to the medical treatment model of visiting the physical F hospital, which makes the patients feel more reassured, as the scores are higher than that of choosing an online hospital for treatment.

It should be noted that the safety value scores also derive from pairing 23, 24, 25, and 26. Since these four items are related to cost calculation and before and after comparison in the research purpose, the data will not be listed in this part for the time being. Instead, it will be listed in the cost calculation and comparative analysis part, which will include time, distance, expense, and energy.

5.4.2.6 Increased survival value of the new model of online medical service

Survival value is the most basic demand value among patients' perceived values. From the collected questionnaire data statistics, it can be found that the survival value of the online medical service model is higher than that of the traditional F hospital medical treatment model. Its score is higher than the latter (4.21>4.185), but not too much. However, it is able to reach the survival satisfaction level equivalent to seeing a doctor in F hospital under normal circumstances, and the achieved medical effect can replace that of the original traditional model.

After interviews, we learned that some patients believe that "one can be treated locally as safely as at F Hospital". This online medical service at specialized medical partnership is novel, and also saves patients from the trouble of travelling and unnecessary time spending and monetary expenses. From this point of view, this model can give a strong sense of gain to remote patients who seek medical service, and effectively solve the problem of diagnosis and treatment of lung diseases. It also enables patients to choose famous doctors, meeting the needs of the survival value of medical treatment.

5.5 Statistical analysis of the comparative changes in the level of various cost of remote patients

5.5.1 Significantly increased cost value of the online medical service model

From the statistical analysis of the collected questionnaires, it can be seen that there are obvious comparative changes in the level of various cost spent by remote patients when they choose different medical treatment models. That is to say, the various costs of the online medical service model are less than that of the traditional model of going to F hospital for medical treatment, including time, distance, expense, and energy. On the contrary, its corresponding cost value perception level is just the opposite. The perceived value of various costs of the online medical service model is greater than that of the traditional model of going to F hospital for medical treatment. In addition, samples of four pairing items of pairing 23, pairing 24, pairing 25 and pairing 26 show statistics significance with $P<0.05$, indicating that the reduction in cost has delivered noticeable effect.

5.5.2 A relatively small increase in monetary cost value, which is mainly concentrated in non-medical expenses

The perceived cost value score of the online medical service model is 4.0425, greater than that of the F hospital medical treatment model of 2.035, indicating that the cost saving effect is still very noticeable, especially in terms of time, distance, expense, and energy. However, the savings in expenditures are not very large, from the perception score of 2.21 to 4.01, whose margin is not as big as that of the other three cost items. This means that in terms of expenditures, the feeling of remote patients is not very strong. Especially in terms of medical expenses, there is not much change. The reason behind the increase in perceived value is just the convenience brought by online outpatient service. However, the reimbursement mechanism of medical expenses or medical expenses has not changed too much. The reduced cost here lies mainly in traffic and accommodation.

5.6 Validation of the satisfaction model of remote patients' perceived value of online medical services

According to the results of the "Questionnaire Reliability and Validity Analysis" in the second part of the "Questionnaire Basic Data Analysis", the overall reliability of the questionnaire is

0.912, which is relatively good. In addition, AMOS24.0 is used to eliminate items with low and insignificant factor loading capacity. Item 3, 6, and 7 of the ease of use (Easy) construct are eliminated, FR15.1 and FR16.1, the level II construct of the respect dimension (Respect) of perceived value (Value), are deleted and S123.1 and S124.1, the level II construct of the safety dimension, are also excluded. The number of other constructs remain unchanged. Therefore, five constructs constituting reliability and validity are formed, namely, perceived ease of use, perceived usefulness, perceived value, satisfaction, and perceived synergy. After being processed by the AVE calculation formula, the results are all greater than 0.5, and the convergence effect is good. Hence, the verification of hypothesis about discriminant validity, model modification, direct action hypothesis and mediation effect is made according to the existing constructs.

5.6.1 Analysis of the discriminant validity of each dimension

According to the data information in the above tables, the AVEs of five constructs are rooted out, and the discriminant validity values of the five constructs of synergy, usefulness, ease of use, perceived value, and satisfaction are obtained, which will be compared with the Pearson correlation coefficient of other constructs. From the table below, it can be concluded that the correlation coefficient of the five constructs is almost larger than that of the other constructs, but there are also individual data that do not meet the criterion, as shown in Table 5.4 below.

Table 5.4 The construct discriminant validity of the satisfaction model of remote patients' perceived value of online medical services

	AVE	SYNERGY	USEFULNESS	EASE OF USE	VALUE	SATISFACTION
SYNERGY	.700	**.837**				
USEFULNESS	.642	.878	**.801**			
EASE OF USE	.669	.838	.857	**.818**		
VALUE	.741	.869	.799	.816	**.861**	
SATISFACTION	.627	.863	.929	.833	.843	**.792**

5.6.2 Analysis and revision of the fit index of questionnaire structure model

On the basis of the reliability and validity analysis of each construct, AMOS24.0 tool is used to try to run the SEM model to find out the fit index of the model. In SEM analysis, chi-square is usually used to change model fit, while literature review shows that sample size will affect its size (Bentler & Bonett, 1980). Therefore, in addition to the sample size, we also consider chi-square (X^2/DF) to analyze the fit index of the model, Chin and Todd (1995) recommend a

standard chi-square value of no more than 3. Running through AMOS24.0,It is found that because the value of chi-square/DF is between 1-3, the chi-square value is relatively large, and there are 239 samples, although the report shows GFI is 0.731, AGFI 0.689, RMSEA 0.081, and CFI 0.899, IFI 0.899, PCLOSE 0, TLI 0.899, and Hoelter's critical N 104, these values do not meet the index values recommended by the SEM model. Therefore, the model needs to be revised.

The Bollen-Stine Bootstrap 5000 iterations of AMOS24.0 is adopted to revise the model, and the revised chi-square value is 609.701 and the standard error SE, 1.091.

In addition, according to the output report, the degree of freedom (DF) of the estimated model is 488, the chi-square value of independent model is 7974.59, the estimated parameter 73, the DF of independent model 528, and the number of samples 238. To achieve better results, the fit index of the model should be revised, specifically: GFI is 0.92, AGFI 0.91, which meets the standards; RMSEA is 0.03<0.08, which meets the standards; the three indexes of CFI, IFI, and TLI are revised to 0.98, all> 0.9, which meets the index requirements, and SRMR is 0.0462, which also meets the standards. The specific index data are as follows in Table 5.5:

Table 5.5 Analysis of original and revised fit index of remote patients' perceived value model of online medical services

Model Fit Index	**Criterion**	**Model Fit of Research Model**	**Modified Model Fit**	**Whether it meets the criterion after revision or not**
DF	The higher the better	485	488	Yes
Chi-square	The lower the better	1239.748	**609.7**	**Yes**
Chi-square（X^2/DF）	1<1X^2/DF< 3	2.556	1.25	Yes
GFI	>0.9	**0.731**	**0.92**	Yes
AGFI	>0.9	**0.689**	**0.91**	Yes
RMSEA	<0.08	**0.081**	**0.03**	Yes
SRMR	<0.08	0.0455	0.0462	Yes
CFI	>0.9	**0.899**	**0.98**	Yes
IFI	>0.9	**0.899**	**0.98**	Yes
TLI	>0.9	**0.899**	**0.98**	Yes

5.6.3 Validation of the hypothesis about the direct effect of the SEM structure model

It can be found that there is a better degree of fitness on the basis of the revised model. According to the existing new revised model, the significance estimation of the non-

standardized data is carried out to find the significant path and the insignificant path, and the model can be improved. Bootstrap is used 5000 times to revise the standard error, the Z value is calculated based on the non-standardized data report output, and the path greater than 1.96 is shown in Table 5.6

Table 5.6 Non-standardized statistical significance of the revised model path based on the remote patients' perceived value of online medical services

Hypothesis	Model path			Estimate	Revised SE	Z	P	SE-SE	Mean	SE-Bias
H1	**VALUE**	<--	**EASE OF USE**	**.236**	**.107**	**2.206**	.008	.001	.245	.002
H2	SATISFACTION	<--	EASE OF USE	.074	.136	.544	.408	.001	.074	.002
H3	VALUE	<--	USEFULNESS	.091	.101	.901	.224	.001	.086	.001
H4	**SATISFACTION**	<--	**USEFULNESS**	**.508**	**.102**	**4.980**	***	.001	.517	.001
H5	**SATISFACTION**	<--	**VALUE**	**.195**	**.108**	**1.806**	.032	.001	.194	.002
H6	**VALUE**	<--	**SYNERGY**	**.521**	**.116**	**4.491**	***	.001	.519	.002
H7	SATISFACTION	<--	SYNERGY	.213	.134	1.590	.054	.001	.203	.002

Note: boldface indicates significant direct path

From this table, it is found that most of the paths between latent variables in the model path are significant, or Z value is higher than 1.96, including EASE OF USE-->VALUE, SYNERGY-->VALUE, USEFULNESS-->SATISFACTION and VALUE-->SATISFACTION, whose Z value is very close to 1.96.

Likewise, the standardized data is used to calculate the significance of the model path, which is consistent with the results obtained from the above non-standardized data calculation. Meanwhile, the corresponding impact coefficient Estimate is obtained, as shown in Annex B, Table B17.

It can be seen from the above table that there are also four significant path relations in the model path, which are EASE OF USE-->VALUE, SYNERGY-->VALUE, USEFULNESS-->SATISFACTION, and VALUE-->SATISFACTION. Their Z values are all greater than 1.96, indicating the path relationship is established and significantly affects the dependent variable. It is proved that the four path correlations are significant, and the original hypothesis is reasonable, which is consistent with the results of the previous hypothesis of using Z values to report paths. The SMC in the output report is all greater than 0.33, and each dimension of the

model is explainable.

For other non-significant paths, it is recommended to delete them or indicate them with pink arrows, which are USEFULNESS-->VALUE, SYNERGY-->SATISFACTION, EASE OF USE--> SATISFACTION. The specific AMOS model is shown in Figure 5.2:

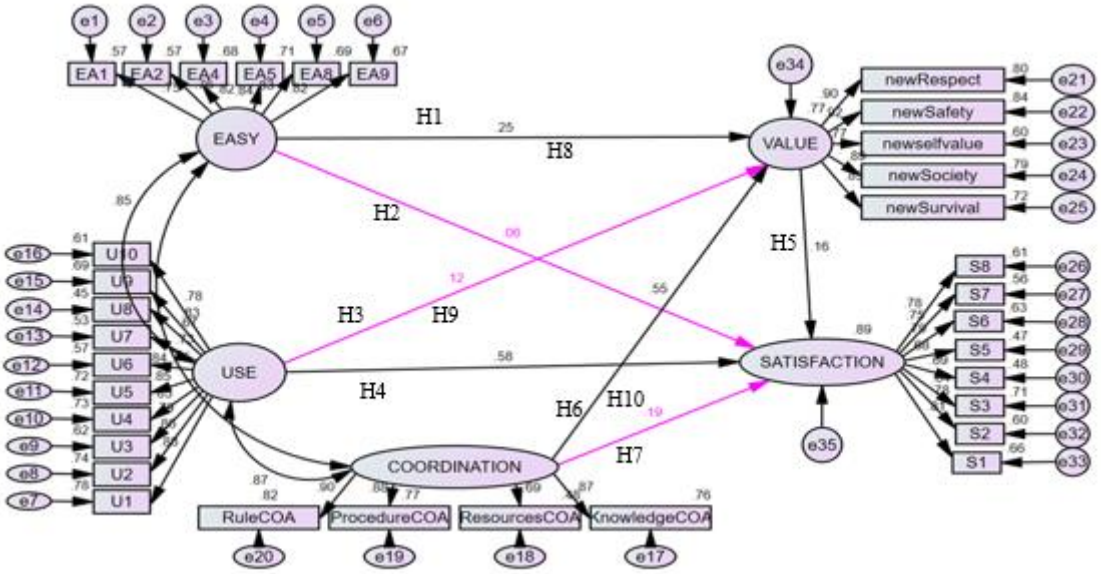

Figure 5.2 The revised model of remote patients' perceived value of online medical services

From the above data, the significance and impact coefficient of the direct path of the revised model can be reported. Most of the direct paths are significant, and only the direct paths in H2, H3, and H7 are not valid.

Details are as follows:

H1 is valid, that is, the perceived ease of use has a significantly positive impact on remote patients' perceived value of medical treatment, with P<0.05, the impact coefficient being 0.248;

H2 is not valid, that is, the ease of use has no significant effect on the satisfaction of remote patients, with P>0.05;

H3 is not valid, that is, the perceived usefulness has no significant impact on remote patients' perceived value of medical treatment, with P>0.05;

H4 is valid, that is, perceived usefulness has a significantly positive impact on the satisfaction of remote patients seeking medical services, with P<0.05 and the impact coefficient being 0.577;

H5 is valid, that is, perceived value has a significantly positive impact on satisfaction, with P<0.05 and the impact coefficient being 0.163.

H6 is valid, that is, the perceived synergy has a significantly positive impact on remote patients' perceived value of medical services, with an impact coefficient of 0.547.

H7 is not valid, that is, the perceived synergy has no significant effect on the satisfaction of remote patients, with P>0.05.

5.6.4 Verification of the mediation hypothesis of the SEM structural model

The indirect path effect of the model is obtained through using bootstrap 5000 times. As shown in Table 5.7, the upper and lower confidence limits of SYNERGY-->SATISFACTION and EASE OF USE-->SATISFACTION do not contain 0, which means that the two kinds of mediation exist. That is to say:

Table 5.7 Verification of the mediation hypothesis based on the revised model of remote patients' perceived value of online medical service

			Product of Coefficients (Multiplying coefficients)		Bias-Revised 95%CI		Percentile 95%CI	
	Variables	Estimate	SE	Z	lower	upper	lower	upper
	Total Effects							
H8+H2	EASE OF USE-->SATISFACTION	0.094	0.039	2.410	.035	.197	.031	.182
H10+H7	SYNERGY-->SATISFACTION	0.196	0.06	3.267	.093	.332	.093	.318
	Indirect Effects							
H8	EASE OF USE-->SATISFACTION	0.094	0.039	2.410	0.035	0.197	0.031	0.182
H10	SYNERGY-->SATISFACTION	0.196	0.06	3.267	0.093	0.332	0.093	0.318
	Direct Effects							
H2	EASE OF USE-->SATISFACTION	0	0	/	0	0	0	0
H7	SYNERGY-->SATISFACTION	0	0	/	0	0	0	0

H8 is valid, meaning that the perceived ease of use will have a significantly positive impact on satisfaction through patients' perceived value variable. The coefficient of mediation is 0.094, which is interpreted as "when the satisfaction of EASE OF USE increases by one unit, the independent variable will cause the slope of SATISFACTION increases by 0.094 units through VALUE."

H10 is valid. Perceived synergy has a significant impact on patients' satisfaction through remote patients perceived value of medical treatment. The mediation coefficient is 0.196, which is interpreted as "When SYNERGY increases by one unit, the independent variable will increase the slope of SATISFACTION by 0.196 units through VALUE".

The USEFULNESS-->VALUE path mentioned above is not significant, so there is no need

to verify the mediation of USEFULNESS-->SATISFACTION. Therefore, H9 is not valid (that is, the Hypothesis that the perceived usefulness will have a significantly positive effect on satisfaction by patients' perceived value variable is not true).

5.7 Chapter summary

Firstly, this chapter is mainly to verify the effect of the implementation of the Internet-based specialized medical partnership medical service access model for remote patients. The post-test questionnaire is designed to understand the overall level of remote patients' perceived value of online medical services, including the level of perceived ease of use, the level of perceived usefulness, the level of perceived value, the level of satisfaction, and the level of synergy. Among them, the perceived usefulness scores the highest, with a score of 4.7059. The level of perceived satisfaction stands 3.217.

Secondly, the statistics collected from the questionnaire also analyzed the significant improvement of the level of patients' perceived value after the implementation of the online medical treatment model, including the survival value, safety value, society value, respect value, and self-worth value.

Thirdly, the analysis of the post-test questionnaire also compared the costs of the new model of online medical treatment with the traditional model of going to F hospital for medical treatment. It is found that the cost of the new model in terms of time, distance, expense, and energy has been significantly reduced with $P<0.05$, which means that the gained perceived value in terms of cost is improved.

Fourthly, the post-test questionnaire design employed the SEM model to verify the path correlations and the mediation of relevant constructs of the satisfaction model of remote patients' perceived value of online medical service. According to the data analysis, H1 is valid, that is, the perceived ease of use has a significantly positive impact on remote patients' perceived value of medical treatment, with $P<0.05$, the impact coefficient being 0.248; H2 is not valid, that is, the ease of use has no significant effect on the satisfaction of remote patients, with $P>0.05$; H3 is not valid, that is, the perceived usefulness has no significant impact on remote patients' perceived value of medical treatment, with $P>0.05$; H4 is valid, that is, perceived usefulness has a significantly positive impact on the satisfaction of remote patients seeking medical services, with $P<0.05$, the impact coefficient being 0.577; H5 is valid, that is, perceived value has a significantly positive impact on satisfaction, with $P<0.05$, the impact coefficient being 0.163. H6 is valid, that is, the perceived synergy has a significantly positive impact on remote

patients' perceived value of medical services, with an impact coefficient of 0.547. H8 is valid, meaning that the perceived ease of use will have a significantly positive impact on satisfaction through patients' perceived value variable. The coefficient of mediation is 0.094, which is interpreted as "when the satisfaction of EASE OF USE increases by one unit, the independent variable will cause the slope of SATISFACTION increases by 0.094 units through VALUE"; H9 is not valid, that is, the Hypothesis that the perceived usefulness will have a significantly positive effect on satisfaction by patients' perceived value variable is not true; H10 is valid. Perceived synergy has a significant impact on patients' satisfaction through remote patients perceived value of medical treatment. The mediation coefficient is 0.196, which is interpreted as "When SYNERGY increases by one unit, the independent variable will increase the slope of SATISFACTION by 0.196 units through VALUE".

Chapter 6: Conclusion, Suggestion, and Outlook

Based on the theory of Maslow's hierarchy of needs, customer perception theory, customer delivered value theory, process reengineering theory, coordination theory, TAM and ACSIM, the model building of remote patients' perceived value satisfaction with online medical services for specialties is hypothesized. In view of the difficulties that remote patients encounter in seeing doctors such as the increasing number of remote patients, longer waiting time and lack of independent right to choose the platforms of online diagnosis and treatment, the research purpose is established, that is, to explore and establish the online diagnosis and treatment model of specialized medical association based on the perceived value of remote patients, to develop a specialized online remote platform, and to build a system for online consultation services and rounds, so as to improve the patient satisfaction. Moreover, according to the empirical research on the online diagnosis and treatment between F Hospital and its union entities, the questionnaire design applies SEM model to test the path relationships of relevant dimensions and mediating effect of the model of remote patients' perceived value satisfaction with online medical services for specialties.

6.1 Conclusions

Based on the empirical research in F Hospital, the conclusions of the research group are as follow:

(1) The model of online medical services for specialties significantly increases the perceived value of remote patients, and improves the medical services for remote patients. Data analysis shows that the promotion of perceived value includes survival value, social value, respect value and self-value, but fall in safety value shows that patients are more willing to go to offline hospital for medical care. However, the model of online medical services for specialties contributes to a significant fall in costs of time, money, distance and energy, and an obvious sense of value.

(2) The indicator system of remote patients' perceived value indicates the need for online medical services. Data analysis shows that the system presents better results concerning five aspects including perceived ease of use, perceived usefulness, perceived value, satisfaction, and perceived synergy of the platform, with the highest score for the perceived ease of use and

lowest score for the satisfaction.

(3) The research, through building the SEM model, tests the path relationships of relevant dimensions and mediating effect of the model of remote patients' perceived value satisfaction with online medical services for specialties. Data analysis shows that the perceived usefulness has a significantly positive impact on the remote patients' perceived value about online medical services, the perceived value has a significantly positive impact on satisfaction, and the perceived ease of use has a significantly positive impact on satisfaction through patients' perceived value variables.

(4) The impact of cooperation with union hospitals of specialties on remote patients' perceived value and satisfaction is reflected. The data analysis shows that the perceived synergy has a significantly positive impact on the remote patients' perceived value about online medical services, and the perceived value of perceived synergy for online medical treatment has a significant effect on patient satisfaction.

6.2 Contributions

This research reviews the current situation of Chinese online medical services and finds out its shortcomings and problems. Skyrocketing development of internet technology makes high-quality medical resource accessible. According to different sponsors and business models, Internet plus Medicare now is divided into two models of online consultation services and online hospital, and relevant regulations are carried out. Online medical consultations focus on solving medical problems rising from difficult and complicated cases among hospitals through initiating consultation request from the primary hospital to the superior hospital, which fails to show the rights of patients to independently seek medical care. Online hospital makes patients' medical care accessible, satisfies their independence on hospitals where they seek medical care, and aims at providing services like return visit and prescription. The research integrates online remote consultation with online hospital in accordance with the provisions of three documents in the Measures for the Administration of Internet Diagnosis and Treatment of the People's Republic of China, and rebuilding the procedure of online medical services enables Chinese remote patients to seek high-quality medical services, which presents a method to solve the difficulties in seeking doctors for remote patients. The research contributions are as follows:

(1) Patients feel at ease to seek the local medical treatment by breaking the time and space limit to enjoy equal medical services.

The most valuable finding of the research and practice is that the medical model makes

patients feel at ease to seek local medical treatment and enjoy the same medical services as received in F Hospital. Meanwhile, the implementation of the model has reached the directive goal concerning Internet plus Medicare proposed by General Secretary Xi that people should run fewer errands by seeking online medical services, and convenient and high-quality medical services should be provided.

(2) Subverting the traditional model of remote diagnosis and treatment empowers remote patients to have more independence on choosing medical care.

The union of F Hospital for specialties at present covers 13 provinces, municipalities, and autonomous regions with a total of 33 union entities. The platform is based on the union of specialties and through the building of information platform for embedded remote outpatient service and ward rounds, and thus medical treatment is equal to the outpatient process of local hospitals, and meets the standard requirements, so that F Hospital has become the first hospital in Shanghai that directly provides high-quality medical services to patients, and has won a good social reputation.

The newly medical procedure is shown in Figure 4.3.

(3) The union of specialties fosters innovation of the cooperation model among hospitals of the union.

Hospitals and medical staff are supposed to take care of patients' psychological needs while meeting their medical needs. The model fixes the experts' scheduling in core hospitals, and makes online announcement and appointments, which enables patients to have more independence on choosing medical services. The doctor-patient interaction and inter-hospital communication between doctors are barrage-free, and the medical records are exchanged and stored, which greatly improves the quality and efficiency of online medical services and enhances patients' online medical experience. Besides, the model contributes to remote ward rounds and medical treatment, and innovation of the medical cooperation model among hospitals of the union.

(4) This model can be replicated and popularized for the medical cooperation of other unions of specialties and medical confederations.

6.3 Suggestions

(1) Pay attention to the safety value needs of patients, and carry out the model combined by online and offline diagnosis and treatment

Based on the above data results collected by the questionnaires, although the model of

seeking medical care for remote patients presents new changes by adopting new model of online medical services, such a model fails to improve safety value for patients but makes them more willing to go to offline hospitals. Through data analysis, we found that patients felt more at ease when choosing offline hospitals and face-to-face communication with doctors, and that those medical procedures and technical norms brought patients a sense of trust and security. Therefore, hospitals should pay attention to offline medical needs of some patients while promoting online medical services. Patients with complicated or serious diseases should be suggested to go directly to the superior hospital and it is necessary to establish a green channel for referral to achieve guaranteed medical treatment. For patients with non-major lung diseases, remote diagnosis and treatment can be carried out to provide preliminary diagnosis and treatment suggestions. As for patients who need surgery, patients can be screened through remote outpatient service, and surgery can be conducted at a selected time. Experts can guide surgery at the community level. After surgery, remote ward rounds between experts and local doctors can be conducted, and green channel referral for difficult surgery can be performed. At the same time, it is necessary to strengthen the social publicity of this model and enhance the recognition and trust of patients to the hospital to enhance their sense of safety value.

(2) Enhance hospitals' the concept of modern medical model and improve collaboration among medical confederacies

In this research, the model of medical services for remote patients has new changes and patients feels satisfied, but patients' perceived synergy needs to be further improved. And the data scores show that they are all about 4 points without any high score. Moreover, in terms of the experience of the actual application platform of the medical staff in the hospital, there are also the problems of insufficient cooperation and insufficient coordination between hospitals, mainly reflected in the coordination of the process and the system.

Therefore, in view of the above problems, it is suggested that the hospital managers at all levels should first strengthen the guidance and education of the concept of modern medical model, walk out of the traditional medical model, and at the same time, strengthen the process training of the new model for professional and technical personnel, so as to make the coordination among hospitals smoother with the decided system. Moreover, as for patients, the application of the new medical model makes patients the owners of their own medical treatment. Patients know how to register online through social publicity, popular science education and other ways. Only when the newly online medical treatment model is integrated into the normal work can we truly achieve greater results in the medical treatment services for remote patients.

6.4 Limitation and outlook

The research objects in the latter questionnaire are patients going to the F Hospital and patients seeking medical services online, and a comparison is made between the two models to achieve effective inspection. As for the process of obtaining data, it is not convenient for the research group to obtain data when selecting the research samples of the traditional experts' consultation model. Therefore, the sample collection for the comparative analysis of the effectiveness of the latter questionnaire was mainly concentrated on the patients in F Hospital who later received the samples of the new mode of online medical services for specialties, so the data collection was relatively easier. However, if the sample collection objects of effectiveness test can be further expanded to the samples of remote patients receiving traditional experts' consultation treatment locally, then the comparison between various medical treatment models and online medical treatment models will be more comprehensive and the verification of effectiveness will be more convincing.

Therefore, new medical models should be promoted in the future practice course of online medical model. While the advantages of hospital confederacy enable researchers to obtain more data from the local hospitals where patients receive diagnosis and treatment of experts and then received the diagnosis and treatment provided by the online medical model, the effectiveness of this model is verified from more dimensions and the relevant details of the new medical treatment model are further optimized by looking for problems while practicing.

[This page is deliberately left blank.]

Bibliography

Ajzen, I. & Fishbein, M. (1975). *Belieef, attitude, intention and behavior：An introduction to theory and research*. England: Reading, Mass: Addison-Wesley.

Alturas, B. (2021). Models of acceptance and use of technology research trends: Literature review and exploratory bibliometric study in "Recent Advances in Technology Acceptance Models and Theories", ed. Al-Emran, Mostafa & Shaalan, Khaled, by Springer book series. *Studies in Systems, Decision and Control*, (335), 13-28.

Ansoff, H. I. (1987). *Corparate strategy*. England: Penguin Books.

Bagozzi, R. P., Fornell, C., & Larcker, D. F. (1981). Canonical correlation analysis as a special case of a structural relations model. *Multivariate Behav Res*, *16* (4), 437-454.

Baker, M. (2016). Maureen Baker family doctor,UK. *New Scientist*, *230* (3071), 17.

Bakken, S., Grullon-Figueroa, L., Izquierdo, R., Lee, N. J., Morin, P., & Palmas, W., et al. (2006). Development, validation, and use of English and Spanish versions of the telemedicine satisfaction and usefulness questionnaire. *Journal of the American Medical Informatics Association*, *13* (6), 660-667.

Balto, D. (2012). Rhetoric vs. reality: the myths of hospital consolidation. *Hospitals & Health Networks*, *86* (1), 2-12, 2.

Bartos, C. E., Butler, B. S., & Crowley, R. S. (2011). Ranked Levels of Influence model: Selecting influence techniques to minimize IT resistance. *Journal of Biomedical informatics*, *44* (3SI), 497-504.

Bentler, P. M. & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88* (3), 588-606.

Bhattacherjee, A. & Hikmet, N. (2007). Physicians' resistance to ward healthcare information technology: a theoretical model and empirical test. *European Journal of Information Systems*, *16* (6), 725-737.

Bisseling, E., Cillessen, L., Spinhoven, P., Schellekens, M., Compen, F., & van der Lee, M., et al. (2019). Development of the Therapeutic Alliance and its Association With Internet-Based Mindfulness-Based Cognitive Therapy for Distressed Cancer Patients: Secondary Analysis of a Multicenter Randomized Controlled Trial. *Journal of Medical Internet Research*, *21* (10), e14065.

Bo, H. L., Hong, S. L., & Yu, P. H. (2019). Practice and consideration on the construction of telemedicine platform based on the consortium of specialist medicine. *Smart Healthcare*, *5* (02), 11-13. (in Chinese)

Buzzell, R. D. & Gale, B. T. (1999). *The PIMS principles-linking strategy to performance*. Beijing: The Free Press.

Cai, D. Q. (2015). *Model construction and empirical research of online shopping customer satisfaction based on technology acceptance model.* Master Dissertation, Harbin Institute of Technology. (in Chinese)

Cai, Y. H., Zhang, H. W., & Wang, W. J. (2018). The change and optimization path of medical and health service mode in China. *Administration Reform*, (12), 100-107. (in Chinese)

Chadha, R., Singh, A., & Kalra, J. (2012). Lean and Queuing Integration for the Transformation of Health Care Processes: A Lean Health Care Model. *Clinical Governance: An International Journal*, 173.

Chen, B. (2009). Research on hospital physical examination management system based on

queuing theory. *Software Guide, 8* (09), 107-108. (in Chinese)

Chen, S. J. (2010). *Study on the rural tourism development based on the theory of tourist perceived value.* Master Dissertation, Southwest University of Finance and Economics. (in Chinese)

Chen, W., Yang, B., Zhou, X. Y., & Fu, H. (2018). Practice and exploration of internet service system of dental specialized hospital based on "Internet+medical". *Medical Information, 31* (24), 10-14.

Chin, W. W. & Todd, P. A. (1995). On the use, usefulness, and ease of use of structural equation modeling in mis research-a note of caution. *Mis Quarterly, 19* (2), 237-246.

Compeau, D. R. & Higgins, C. A. (1995). Computer self-efficacy-development of a measure and initial test. *Mis Quarterly, 19* (2), 189-211.

Coughlan, J., Eatock, J., & Eldabi, T. (2006). Evaluating telemedicine: A focus on patient pathways.

Cu, T. Y. (2012). *Development research of Chinese medical insurance system.* Doctoral Thesis, Dongbei University of Finance and Economics. (in Chinese)

Dai, T., Chen, Y., & Wei, X. (2012). Integrated healthcare system: International perspective and Chinese practices. *Chinese Journal of Health Policy, 5* (09), 1-9.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly, 13* (3), 319-340.

Devaraj, S., Fan, M., & Kohli, R. (2002). Antecedents of B2C channel satisfaction and preference: Validating e-commerce metrics. *Information Systems Research, 13* (3), 316-333.

Dranove, D., Durkac, A., & Shanley, M. (1996). Are multihospital systems more efficient? *Health Affairs, 15* (1), 100-104.

Eichelberg, M., Aden, T., Riesmeier, J., Dogac, A., & Laleci, G. B. (2006). Electronic health record standards - A brief overview. In M. H. Salem & M. T. ElHadidi (Eds.), *Information Processing in the Service of Mankind and Health* (pp. 7). New York: IEEE.

Enthoven, A. C. & Tollen, L. A. (2005). Competition in health care: It takes systems to pursue quality and efficiency. *Health Affairs, 24* (5), W5420-W5433.

Enthoven, A. C., Crosson, F. J., & Shortell, S. M. (2007). 'Redefining health care': Medical homes or archipelagos to navigate? *Health Affairs, 26* (5), 1366-1372.

Fang, Y., He, W. J., Yang, Y. N., & Huang, Z. W. (2019). User perceived value of online information consultation service for medical care communities. *Chin J Med Libr Inf Sci, 28* (12), 13-18.

Feng, Y. & Wu, C. (2009). Reflections on the integration and allocation of medical resources in Shanghai. *Chinese Hospitals, 13* (02), 23-27. (in Chinese)

Fornell, C., Johnson, M. D., Anderson, E. W., Cha, J. S., & Bryant, B. E. (1996). The American customer satisfaction index: Nature, purpose, and findings. *Journal of Marketing, 60* (4), 7-18.

Gallarza, M. G. & Saura, I. G. (2006). Value dimensions, perceived value, satisfaction and loyalty: an investigation of university students' travel behavior. *Tourism Management, 27* (3), 437-452.

Gao, S. S., Gu, S. H., He, Y., Wang, X., Yang, H., & Zhao, R. (2020). Improvement of co-training model for general practitioners and specialists driven by EPAs-DOC theory and information technology platform in the regional medical consortium led by tertiary hospitals. *Chinese General Practice, 23* (13), 1632-1639.

Gospodarevskaya, E. & Churilov, L. (2011). Process performance indicators in redesigning the patient care process. *Business Process Management Journal, 17* (6), 1012-1038.

Gronholdt, L., Martensen, A., & Kristensen, K. (2000). The relationship between customer satisfaction and loyalty: cross-industry differences. *Total Quality Management, 11* (4-6SI),

S509-S514.
Hao, Y. W., Li, X. X., Zhao, Z., & Zheng, J. C. (2015). Summary of remote diagnosis system. *China Digital Medicine, 10* (10), 85-87. (in Chinese)
He, S. C. (2017). *Investigation on the development of primary medical institutions in Chengdu under the background of Classified diagnosis and treatment.* Master Dissertation, Chengdu University of Traditional Chinese Medicine. (in Chinese)
Ho, S. J., Chan, L., & Kidwell, R. J. (1999). The implementation of business process reengineering in American and Canadian hospitals. *Health Care Manage Review, 24* (2), 19-31.
Hoerthersall, D. (2011). *History of psychology* (Y. G. B., Trans. 4 ed.). Beijing: Posts and Telecom Press. (in Chinese)
Hoffman, D. L. & Novak, T. P. (1996). Marketing in hypermedia computer-mediated environments: conceptual foundations. *Journal of Marketing, 60* (3), 50-68.
Hu, P. J., Chau, P., Sheng, O., & Tam, K. Y. (1999). Examining the technology acceptance model using physician acceptance of telemedicine technology. *Journal of management information systems, 16* (2), 91-112.
Hu, R. (2018). *Research on the application of mobile medical service based on patient perceived value.* doctoral Thesis, Shanghai Jiaotong University.
Hu, X. L. (2006). Countermeasures for solving the problem of “difficult medical treatment”. *Chinese General Practice,* (13), 1089-1091. (in Chinese)
Huang, L. (2012). *Theoretical and empirical analysis of the farmers perceive the value of land ownership.* Master Dissertation, Sichuan Agricultural University. (in Chinese)
Huang, X. G., Wang, L. Z., Yu, G. L., & Wang, Q. (2016). Study on the models and development of medical alliance. *Health Economics Research,* (03), 10-12. (in Chinese)
Ji, L. (2018). Description of the current situation and countermeasures of the telemedicine development. *China Economist,* (12), 244-245. (in Chinese)
Jia, D. H. (2010). *Evaluation researches on the procedure of medical service taking military officers as an sample on the basis of customers' values.* Doctoral Thesis, Third Military Medical University of Chinese P.L.A. (in Chinese)
Jiang, J. D. (2004). The nudge on cooperation in modern management. *Science and Technology Management Research, 24* (1), 151-152. (in Chinese)
Kamal, S. A., Shafiq, M., & Kakria, P. (2020). Investigating acceptance of telemedicine services through an extended technology acceptance model (TAM). *Technology in society, 60* (101212).
Kotler, P. T. (2011). *Marketing Management[M]*. New Jersey: Prentice Hall.
Lan, Y. & Chui, L. S. (2009). Synergetics and modern enterprise management. *Modern Business,* (2), 67. (in Chinese)
Li, H., Deng, L. L., Bai, Q., Liu, H., & Xiao, C. Y. (2020). Influence of "internet plus specialized medical association" management on gout patients based on tertiary prevention. *Military Medical Journal of Southeast China, 22* (01), 88-90. (in Chinese)
Li, J., Wang, M. Y., Xu, L. M., & Tian, Y. C. (2019). The construction of digital medical information service evaluation system based on user perceived value. *Data Analysis and Knowledge Discovery, 3* (02), 118-126.
Lin, F. (2012). *The study of the enterprise managecal process design.* Doctoral Thesis, Jiangsu University. (in Chinese)
Lin, H. & Dong, J. (2017). Internet plus healthcare alliance helps implementing hierarchical healthcare system. *Chinese Hospitals, 21* (05), 52-53. (in Chinese)
Liu, D. J. (2009). Comparatively analyzing the mode of community health service at abroad and its enlightenment. *Chinese Health Service Management, 26* (09), 596-599. (in Chinese)
Liu, N. F. & Tang, S. Z. (2006). Optimization and operation management of outpatient medical

service process. *Modern Medical Journal,* (02), 123-125. (in Chinese)
Liu, X. L. & Liu, S. J. (2017). Research on telemedicine and its legal regulation. *Chinese Medical Ethics, 30* (11), 1317-1321. (in Chinese)
Liu, X. R. (2016). *An empirical analysis of the effect of hierarchical diagnosis and treatment policy.* Master Dissertation, Shanghai Jiaotong University. (in Chinese)
Luo, S. Y. (2016). *Implement lean to improve the outpatient processes of primary hospital based on hierarchical medical system: a case study of a secondary public hospital under the trusteeship of a tertiary public hospital.* Master Dissertation, Southern medical university.
Luo, Z. N. (2014). *Study on synergy capabilities of public medical group.* doctorial Thesis, Huazhong University of Science and Technology. (in Chinese)
Lv, Z. X. (2018). *Study on optimization of medical treatment process in Dalian specialized hospitals.* Master Dissertation, Dalian University of Technology.
Ma, C. Z., Li, D. F., Zhang, S. S., Zhao, M., & Fang, G. Q. (2006). Necessity and feasibility of implementing health management in the army. *People's Military Surgeon,* (11), 634-635. (in Chinese)
Ma, X. M., Yin, L. P., Zhong, J., & Zhang, D. (1999). Research on reorganization of hospitalization process for common surgical diseases and shortening average hospitalization days. *Chinese Journal of Hospital Administration,* (10), 3-5. (in Chinese)
Mao, K. Y. & Du, G. (2006). Enterprise collaborative capability and its evaluation model based on collaborative product commerce. *Journal of Inner Mongolia Agricultural University(Social Science Edition),* (02), 165-167. (in Chinese)
Marsh, G., Guanciale, T., & Simon, M. (1995). Operations improvement and reengineering at Ohio State University Medical Center. *Topics in Health Information Management, 16* (1), 41-46.
Maslow, A. H. (1943). A theory of human motivation. *Psychological Review, 50* (4), 370-396.
Ni, L., Lou, Y., Ju, B., Zhu, C. X., & Shen, Y. Q. (2016). Thoughts and conception of the network hospital development mode of Zhejiang province. *Chinese Hospitals, 20* (02), 47-49. (in Chinese)
Pan, F. C. & Chen, S. J. (2015). Exploring the stresses and health of the nurses in the psychiatric hospitals in Eastern Taiwan: Does the leisure destination location help nurses cope with stress? *Journal of Psychiatry, 18* (3), 1-6.
Patel, V. A., Jefferis, H., Spiegelberg, B., Iqbal, Q., Prabhudesai, A., & Harris, S. (2008). Jejunal diverticulosis is not always a silent spectator: a report of 4 cases and review of the literature. *World journal of gastroenterology, 14* (38), 5916-5919.
Peng, J. Y. & Zhang, D. L. (2013). Classification of patients' perceived value based on willingness to acquire medical knowledge. *World Sci-tech R & D, 35* (01), 135-137.
Qu, M. L. (2009). *Empirical research on the relationship Between quality cooperation and satisfaction of electronic manufacturering supply chain.* Master Dissertation, Shanghai Jiaotong University.
Rho, M. J., Choi, I. Y., & Lee, J. (2014). Predictive factors of telemedicine service acceptance and behavioral intention of physicians. *International Journal of Medical Informatics, 83* (8), 559-571.
Ronksley, P. E., Sanmartin, C., Quan, H., Ravani, P., Tonelli, M., & Manns, B., et al. (2013). Association between perceived unmet health care needs and risk of adverse health outcomes among patients with chronic medical conditions. *Open Medicine : a peer-reviewed, independent, open-access journal, 7* (1), e21-e30.
Ruan, X. D. (2015). Cloud hospital under the concept of "internet plus". *New Economy Weekly,* (05), 15-18.
Rubeis, G. & Ketteler, D. (2020). Who Benefits from the App? Internet- and Mobile-Based

Interventions (IMIs) and the Tension between Autonomy and Patient Well-Being. *Psychotherapie, Psychosomatik, Medizinische Psychologie, 70* (11), 467-474.

Saaty, T. L. (2006). There is no mathematical validity for using fuzzy number crunching in the analytic hierarchy process. *Journal of Systems Science and Systems Engineering*, *15* (4), 457-464.

Shen, Q. L. (2006). *Research on the composition system and application of medical service customer value.* Master Dissertation, Zhejiang University. (in Chinese)

Shi, A. G. (2001). Reflections on the difficulty of clinical pharmacist work in China. *China Pharmacist*, (02), 110-111.

Shi, W., Yang, H., Yang, J., & Yao, W. (2014). Practice and exploration of constructing regional medical consortium in Chaoyang district of Beijing. *Chinese Health Resources, 17* (06), 396-398. (in Chinese)

Shortell, S. M., Anderson, D. A., Gillies, R. R., Mitchell, J. B., & Morgan, K. L. (1993). Building integrated systems--the holographic organization. *Healthcare Forum journal, 36* (2), 20-26.

Tao, R. & Wu, H. Z. (2015). Overview of foreign research on medical consortium model. *Foreign Medicine(Health Economics), 32* (03), 97-100. (in Chinese)

Teke, A., Cengiz, E., Cetin, M., Demir, C., Kirkbir, F., & Fedai, T. (2012). Analysis of the multi-item dimensionality of patients' perceived value in hospital services. *Journal of Medical Systems, 36* (3), 1301-1307.

Tian, Y. K. (2018). *Patient perception dimension under mobile medical environment and its impact on satisfaction.* Master Dissertation, Fuyang Normal University.

Tzelepis, F., Paul, C. L., Williams, C. M., Gilligan, C., Regan, T., & Daly, J., et al. (2019). Real-time video counselling for smoking cessation. *The Cochrane Database of Systematic Reviews*, *2019* (10), D12610-D12659.

Venkatesh, V., Thong, J. Y. L., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly*, *36* (1), 157-178.

Walston, S. L., Burns, L. R., & Kimberly, J. R. (2000). Does reengineering really work? An examination of the context and outcomes of hospital reengineering initiatives. *Health Services Research*, *34* (6), 1363-1388.

Wang, C. X., Weng, B. Y., & Jiang, C. F. (2001). Service quality, consumption value, passenger satisfaction and behavioral intention. *Nan Kai Business Review,* (06), 11-15. (in Chinese)

Wang, D. B., Li, J., Lu, J. X., & Han, D. M. (2019). Development of Chinese medical partnership and countermeasures. *Chinese Hospitals, 23* (1), 47-48. (in Chinese)

Wang, D., Wang, C. Y., Fang, C., & Xie, S. R. (2018). Using special specialty advantages to promote the development of regional medical association: The predicament and thinking of a tertiary specialized hospital in shanghai. *Chinese Health Quality Management, 25* (06), 111-113. (in Chinese)

Wang, F. & Wei, J. J. (2014). Using Delphi method to establish the evaluation index system of influencing factors of hospital remote consultation. *China Journal of Pharmaceutical Economics*, *9* (02), 207-209.

Wang, J. H. (2006). Conceptual model based on system collaborative management. *China Economist*, (09), 212-213.

Wang, J. (2011). The problem of uneven allocation of medical resources in urban and rural areas. *Journal of Tangshan Teachers College, 33* (06), 108-110. (in Chinese)

Wang, K. S. & Xiao, Y. T. (2016). Thinking on medical service process reengineering from the perspective of "Internet +". *Laboratory Medicine and Clinic, 13* (16), 2402-2405.

Wang, P. (2016). *A study and empirical analysis of the management of remote medical follow-up services.* Doctorial Thesis, University of Science and Technology of China.

Wang, T. S. (2011). *Supply model of medical services and government regulation: comparison of anglo enlightenment.* Master dissertation, East China University of Political and Law. (in Chinese)

Wang, T. S. (2011). Thoughts on Optimizing Outpatient Procedure. *Journal of Traditional Chinese Medicine Management, 19* (01), 68-70. (in Chinese)

Wang, W. & Su, M. (2017). Construction of the index system of the clinical medical information service based on the user's perceived value. *Journal of Modern Information, 37* (02), 19-24.

Wang, X. Y., Meng, L. L., Gog, J., Zhu, H., Han, G., & Ding, F. H. (2014). Discussion about application of "One-stop" service information system of hospital based on BPR theory. *China Digital Medicine, 9* (08), 52-54. (in Chinese)

Wang, Z. (2012). *Crowdsourcing business model by collaborative innovation based on website platform.* Doctorial Thesis, Zhejiang University. (in Chinese)

Wilson, K. & Khansa, L. (2018). Migrating to electronic health record systems: A comparative study between the United States and the United Kingdom. *Health Policy, 122* (11), 1232-1239.

Woodruff, R. B. (1997). Customer value: The next source for competitive advantage. *Journal Of The Academy Of Marketing Science, 25* (2), 139-153.

Wu, Q. & Chen, M. (2015). Application exploration of remote outpatient system based on articulated naturality web. *Chinese Hospital Management, 35* (04), 50-52. (in Chinese)

Wu, S. (2015). *Research on Cuba's medical security system.* Master Dissertation, Yunnan University. (in Chinese)

Wu, Z. G., Han, Y. Q., & Men, Q. L. (2005). Collaborative system construction of capable modular enterprise cluster. *Science & Technology Progress and Policy,* (06), 8-10. (in Chinese)

Xiang, Y. W., Jiang, J. H., & Zhang, J. H. (2016). Development of Foreign Medical Unions and Its Enlightenment on China. *Modern Hospital Management, 14* (04), 20-22. (in Chinese)

Xiao, S. F., Xiao, X. Z., & Han, S. F. (2015). The Design and Practice on Hubei Telemedicine Service Platform Framework. *Chinese Journal of Health Informatics and Management, 12* (04), 397-399.

Xiong, S. H., Ying, H. Y., & Shan, Q. (2020). Construction and application of the intelligent image cloud collaboration platform of medical association. *China Digital Medicine, 15* (03), 95-97. (in Chinese)

Xu, C. Y., Cao, Y., Wei, W., Peng, R. H., Zeng, L. Q., & Chen, W. (2019). Satisfaction to policies for medication with cross-region reimbursement among staff in designated hospitals in Guangdong province. *China Public Health, 35* (01), 76-78. (in Chinese)

Xu, F. (2014). *Exploration on optimization of treatment process in large general hospitals based on IE theory.* Master Dissertation, Southwest Jiaotong University.

Xue, R. L. (2018). *The study on the status and countermeasures of hierarchical diagnosis and treatment of chronic disease in Chongqing under medical alliance model.* Master Dissertation, Southeast University. (in Chinese)

Xue, Y. & Liang, H. (2007). Analysis of telemedicine diffusion: the case of China. *IEEE transactions on information technology in biomedicine: a publication of the IEEE Engineering in Medicine and Biology Society, 11* (2).

Yang, G. B. (2012). Conception of the overall framework of online hospital system. *China Medical Devices, 27* (06), 127-129. (in Chinese)

Yang, H., Chen, J., Xu, F., & Chen, J. (2010). Outpatient service strategy for remote patients. *Hospital Administration Journal of Chinese People's Liberation Army, 17* (04), 328-329.

(in Chinese)

Yang, J., Dang, Y., & Zhang, L. F. (2010). Performance evaluation index system of community health service institutions in China. *Chinese Health, 29* (04), 52-54.

Yao, K. (2018). *Practical study on the internet technologies on promoting the construction of hierarchical medical treatment-The case of the first hospital of Fuzhou medical assodation.* Master Dissertation, Fujian Medical University. (in Chinese)

Yao, L. (2018). *Research on the problems and countermeasures of the development of the Medical Association in China.* Master Dissertation, Tianjin University of Finance and Economics. (in Chinese)

Yao, Z. L. (2017). How to Solve the "Inverted Pyramid" Dilemma of Primary Medical Services —— An Investigation Centered on Doctor Profession. *Exploration and Free Views,* (08), 77-84. (in Chinese)

Yi, L. H. (2017). The exploration of the four modes. *China Health,* (04), 56-57. (in Chinese)

Yi, M. Y., Jackson, J. D., Park, J. S., & Probst, J. C. (2006). Understanding information technology acceptance by individual professionals: Toward an integrative view. *Information & Management, 43* (3), 350-363.

Ying, B. & You, F. (2006). Current status and countermeasures of development of township health centers. *Strait Journal of Preventive Medicine,* (03), 72-73. (in Chinese)

Yu, G. J., Liu, B., & Huang, C. (2007). Difficult and expensive medical treatment: a survey of hospital patients. *Chinese Health Resources,* (06), 267-269. (in Chinese)

Yu, H. & Lv, Z. M. (2011). Investigation for the Influence Factors of Loyalty to the E-Commerce Web Site. *Journal of South-Central University for Nationalities(Natural Science Edition), 30* (03), 121-126. (in Chinese)

Yu, M. Y. (2009). *Marketing strategy*. Beijing: Tsinghua university press.

Yu, W. (2013). How strong is the reform and how effective is the medical association!. *Chinese Health,* (4), 40-41. (in Chinese)

Yu, X. H., Wan, L. T., Yang, Y. L., Gu, W. T., Jia, H. H., & Sun, Y. Z. (2018). Investigation on cognition of hierarchical diagnosis system among county level public hospital doctors in Jilin province. *Medicine and Society, 31* (06), 24-27. (in Chinese)

Zanaboni, P. & Wootton, R. (2016). Adoption of routine telemedicine in Norwegian hospitals: progress over 5 years. *BMC health services research*, *16*, 496.

Zeithaml, V. A. (1988). Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence. *Journal of Marketing*, *52* (3), 2-22.

Zhai, Y. K., Zhang, J., & Zhao, J. (2018). Effects of telemedicine development based on SWOT-DANP model. *Chinese Hospital Management*, *38* (02), 17-20.

Zhan, Y. Y., Xu, N. Z., & Lu, X. (2008). Discussion on super sized hospital outpatient process redesign. *Chinese Hospitals*, (06), 4-7. (in Chinese)

Zhang, C. Q. (2012). *Study on dataset and process of basic medical service.* Master Dissertation, Zhejiang University. (in Chinese)

Zhang, H. (2015). *Analysis of the status quo of external medical treatment and satisfaction of inpatients in Shanghai.* Master Dissertation, The Second Military Medical University. (in Chinese)

Zhang, J. Y., Chen, Z. N., & Lu, Q. J. (2018). Thoughts and practice of Internet+Medicine improving discipline development in primary institute. *Chinese Hospitals, 22* (01), 56-58. (in Chinese)

Zhang, J. & Wang, Y. (2008). The Market-Oriented Customer Value Management Process. *Reformation & Strategy, 24* (2), 30-33. (in Chinese)

Zhang, L. (2019). Research on the practice of "Internet+Medical Care" led by public hospitals —— taking Weifang traditional Chinese medicine hospital as an example. *Journal of Traditional Chinese Medicine Management, 27* (21), 10-12. (in Chinese)

Zhang, L. & Ai, K. X. (2019). *Annual report of Shanghai Pulmonary Hospital in 2018*. Shanghai: Yixiang Brand Agency. (in Chinese)

Zhang, M. X., Jiang, H. P., Luo, L. X., Fang, P. Q., Zhang, Y. J., & Chen, X. (2009). Analysis of the main problems of bidirectional referral of Shenzhen and suggestion to the policy. *Chinese Hospital Management, 29* (05), 40-41. (in Chinese)

Zhang, X. M. (2016). *Process reengineering of hospital outpatient services.* Master Dissertation, Suzhou University. (in Chinese)

Zhang, X. M. & Nie, Z. P. (2017). Community medical service model in Britain, America and New Zealand and its reference —— From the perspective of medical service for empty nesters in rural areas. *Lao Qu Jian She,* (18), 74-79. (in Chinese)

Zhao, Y. M., Zuo, X. R., & Yang, G. L. (2014). Research on the application of remote consultation system based on medical association. *Journal of Medical Informatics, 35* (10), 31-35. (in Chinese)

Zhen, C. (2017). *Analysis on the management model of regional medical alliance in Beijing and the effect of hierarchical medical system.* Master Dissertation, Capital Medical University. (in Chinese)

Zhou, L. J., Zhang, L. P., Tang, S. Q., & Yu, J. J. (2018). Exploration and practice of outpatient clinic of military hospitals. *Journal of Medical Informatics, 39* (05), 21-24. (in Chinese)

Zhu, S. J. (2006). Present situation, difficulties and countermeasures of telemedicine development in China. *Information China,* (04), 60-63. (in Chinese)

Zifko-Baliga, G. M. & Krampf, R. F. (1997). Managing perceptions of hospital quality. Negative emotional evaluations can undermine even the best clinical quality. *Marketing health services*, *17* (1), 1928-1997.

Webliography

Chen, H. F. (2019, May 10). *Development status of China's medical and health service system*. Retrieved May 10, 2020, from https://www.huaon.com/channel/trend/601218.html

Pan, Z. X. (2019, October 9). *National Health Commission: Shanghai Ranks First in the Outflow of Patients from Other Places for Two Consecutive Years*. Retrieved June 12, 2020, from http://sh.sina.com.cn/news/s/2019-10-09/detail-iicezzrr1005509-p2.shtml

Zhang, F. (2020, January 13). *Ma Xiaowei asked at the medical management work conference that the development of public hospitals should move towards high quality*. Retrieved Feb 26, 2020, from http://health.china.com.cn/2020-01/13/content_41031279.htm

[This page is deliberately left blank.]

Other References

CSCGO. (2015). *Guiding Opinions of the General Office of the State Council on Propelling the Building of a Hierarchical Diagnosis and Treatment System*（No.70). Beijing, The General Office of the State Council of China.

CSCGO. (2015). *Outline of the Plan for the National Medical and Health Service System (2015-2020)*（No.14). Beijing, The General Office of the State Council of China.

CSCGO. (2017). *Guiding Opinions of the General Office of the State Council on Propelling the Building and Development of Medical Treatment Partnership*（No.32). Beijing, The General Office of the State Council of China.

CSCGO. (2018). *Opinions on Promoting the Development of "Internet Plus Health Care"* (No.26). Beijing, The General Office of the State Council of China.

CNHC. (2018). *Notice on Printing and Distributing 3 Documents including Administrative Measures for Internet Diagnosis and Treatment (Trial)* (No.25). Beijing, The General Office of the State Council of China.

[This page is deliberately left blank.]

Annex A: Questionnaires

Ⅰ Questionnaire on Remote Patients' Needs of the Perceived Value in Telemedicine

Dear patients,

In order to better provide high-quality medical services for remote patients and establish the Internet medical service expansion model, we have prepared a questionnaire on "Remote Patients' Needs of the Perceived Value in Telemedicine". It aims to study remote patients' needs of the perceived value who come to visit Shanghai Pulmonary Hospital (Hospital F) for medical care, which will be used as the evaluation indicators for hospital telemedicine. Please score in the scale of 1-5 for the questions below (1 = Strongly disagree, 5 = Strongly agree). The questionnaire is completely anonymous and your personal information is strictly confidential. Please answer each question according to your own conditions.

Thank you for your support and cooperation!

1. Basic Information

Your gender: Male□ Female□

Your age: 18 years old or below□ 18~25 years old□ 26~30 years old□ 31~40 years old□ 41~50 years old□ 51~60 years old□ 60 years old or above□

Your city:

Your current job:

The industry you are involved:

2. Questionnaire on remote patients' needs of the perceived value in telemedicine

Dimension	Level II indicators	Content	Strongly agree	Agree	General	Disagree	Strongly disagree
V	V1	1. As a remote patient, you come to Hospital F to see a doctor because you value the reputation of this hospital.	5	4	3	2	1
		2. As a remote patient, you come to Hospital F for treatment because a famous doctor here has a great reputation and professional skills.	5	4	3	2	1

	V2	3. As a remote patient, you can choose the specialist whom you prefer in this hospital.	5	4	3	2	1
R	R1	4. In Hospital F, you can get personalized, targeted and effective diagnosis and treatment, so that you feel being cared and respected.	5	4	3	2	1
		5. In Hospital F, you can get a doctor's concern for remote patients like you, including concerns about both medical and mental conditions.	5	4	3	2	1
		6. You go to an authoritative hospital like Hospital F mainly because you trust the medical skills and ethics of the attending doctors here.	5	4	3	2	1
	R2	7. When you receive expert diagnosis and treatment from Hospital F, your examination and test reports are well protected from any disclosure.	5	4	3	2	1
		8. When you receive expert diagnosis and treatment from Hospital F, your treatment results are well protected.	5	4	3	2	1
SC	SC1	9. In the course of receiving expert diagnosis and treatment in Hospital F, you hope to maintain good communication with the attending doctor so as to ensure that the diagnosis and treatment can be carried out smoothly.	5	4	3	2	1
		10. When you receive expert diagnosis and treatment from Hospital F, you prefer doctors with enthusiasm, patience, good attitude and medical ethics, which can make your experience better.	5	4	3	2	1
		11. In Hospital F, the doctors' professional skills during the diagnosis and treatment have won your respect.	5	4	3	2	1
		12. When you receive diagnosis and treatment in Hospital F, you feel a sense of compliance because of the doctor's professionalism and medical ethics.	5	4	3	2	1
S	S1	13. You spend a lot of time on visiting Hospital F.	5	4	3	2	1
		14. You spend a lot of money on your way to visit Hospital F.	5	4	3	2	1
		15. In Hospital F, you spend quite a lot of money on medical expenses, including expert fees and medicine costs.	5	4	3	2	1
		16. You, or your families, spend a lot of energy on visiting Hospital F.	5	4	3	2	1
	S2	17. In Hospital F, the attending doctor can give a timely concern and response to your condition.	5	4	3	2	1
		18. During your visit and hospitalization in Hospital F, the doctor can follow your condition in time and give timely advice through rounds.	5	4	3	2	1
	S3	19. You choose Hospital F because you care and value it as a complete physical medical environment.	5	4	3	2	1
		20. You choose Hospital F because you can communicate face to face with the doctor, which is more reliable than virtual online consultation.	5	4	3	2	1
	S4	21. The medical process standards of Hospital F make you feel relieved as a remote patient.	5	4	3	2	1
		22. The medical technical specifications of Hospital F make you feel at ease as a remote	5	4	3	2	1

		patient.					
SU	SU1	23. As a remote patient, you visit Hospital F mainly because of its high cure rate of pulmonary diseases.	5	4	3	2	1
		24. As a remote patient, you visit Hospital F mainly because this hospital has superb technologies and outstanding proficiency for the diagnosis and treatment of lung diseases.	5	4	3	2	1
		25. As a remote patient, you visit Hospital F mainly because the hospital can provide advanced medical equipment, accurate medical testing and the "remedy" for specific cases quicky, thereby carrying out advanced, scientific medical treatment.	5	4	3	2	1
		26. As a remote patient, you visit Hospital F mainly because the hospital has more cases of successful treatment and a good professional reputation.	5	4	3	2	1

II Expert Consultation Questionnaire on Evaluation Indicators of the Perceived Value of Remote Patients in Telemedicine (Round 1)

Dear experts,

Hello! Thank you for participating in the expert consultation held by the research group on the theme of "Establishment and Evaluation of Online Medical Services Expansion Model for Specialties Based on the Perceived Value of Remote Patients".

Based on previous researches, we have summarized the indicators of the perceived value of remote patients in telemedicine which include five level I indicators (self-value, respect and love, social needs, safety, and survival), ten level II indicators, and 26 level III indicators. Therefore, the following questionnaire is designed to obtain more accurate results.

Given your outstanding achievements in relevant fields, we would be glad to have your valuable opinions. This survey is for academic research only and is strictly confidential.

Thank you for your great support!

[1] Basic information

Please fill in your basic information and read the instructions before the survey. Thank you for your cooperation.

Choose an option or fill in the blanks at "_____".

1. Your age:

A. 21-30 years old B. 31-40 years old C.41-50 years old D.51-60 years old E. Above 60

years old

2. The highest degree or level of education you have completed:

A. Ph.D. B. Master's degree C. Bachelor's degree D. College degree E. High school or below

3. Your academic background (Multiple choices are allowed):

A. Medical Science B. Management C. Economics D. Law E. Science and Engineering F. Other, please specify: _____

4. Your Job:_____ Years of current service:____

5. Your place of work _____

A. School or research institute B. Hospital C. Other medical institutions D. Healthcare administration E. Other

6. Basic information of the hospital you are working in (Not required if relevant option is not chosen in Question 5):

The hospital is located in ____ Province, founded in the year _____, and is categorized as Class ___; the actual number of sick beds is _____.

[2] Judgement basis and the familiarity of expert consultation

1. When judging whether a certain evaluation indicator is reasonable, which of the following criteria (theoretical analysis, practical experience, references, or intuitive judgement) will you mainly refer to? And does each criterion have a major, moderate or minor influence on your final judgement? Please tick (√) according to actual situations.

Table 1 The influence of judgement basis on expert judgement

Judgement criterion	**How much influence on your judgement: the rationality of the evaluation indicators of the perceived value of remote patients in telemedicine?**		
	Major	**Moderate**	**Minor**
Theoretical analysis			
Practical experience			
References			
Intuitive judgement			

2. How much are you familiar with the categories and indicators of the perceived value? Please tick (√) correspondingly in five columns.

Table 2 Expert's familiarity with the categories and indicators of the perceived value

Category	Familiarity				
	Familiar (1.0)	Much (0.8)	General (0.5)	Few (0.2)	Unfamiliar (0)
V1: Reputation					
V11 Value a hospital's reputation					
V1 Value the superb skills of a famous chief doctor					
V2: Sense of medical autonomy					
V21 Autonomy in medical services					
R1: Spiritual value					
R11 Personalization					
R12 Concern					
R13 Trust					
R2: Privacy					
R21 Diagnosis process					
R22 Diagnosis result					
SC1: Medical personnel					
SC11 Communication					
SC12 Attitude					
SC13 Professional skills					
SC14 Compliance					
S1: Cost					
S11 Time					
S12 Space					
S13 Economic and monetary					
S14 Energy					
S15 Risk					
S2: Response					
S21 Timeliness					
S22 Tracking and ward round					
S23 Follow-up visit					
S3: Tangible value					
S31 Physical medical care					

Category	Familiarity				
	Familiar (1.0)	Much (0.8)	General (0.5)	Few (0.2)	Unfamiliar (0)
(Through remote treatment in the alliance hospital, remote patients can feel the tangible value of the physical equipment and technology equally as in the Hospital F.)					
S32 Face-to-face medical care (Through online platform in the alliance hospital, patients can feel the tangible value of face-to-face medical care by real experts.)					
S4: Standard					
S41 Medical process standard					
S42 Medical technical specification					
SU1: Technical value					
SU11 Internal properties: Professional skills, superb technology, high proficiency, high cure rate					
SU12 External properties: advanced medical equipment, strong medical testing ability, many medical cases for reference, good reputation for medical specialty					

[3] Approval rating for indicators

1. Please tick (√) your approval attitude towards the indicators. Note your reason if you tick "Not approve" or "Strongly disapprove". Thank you for your cooperation!

Table 3 Survey on the rationality of measuring indicators of the perceived value of remote patients in telemedicine

Dimension of value needs	Level II indicators	Explanation	Strongly approve	Approve	General	Not approve	Strongly disapprove	Your reason if not approve	Level III indicators	Reason	Strongly approve	Approve	General	Not approve	Strongly disapprove	Your reason for not approving and suggestions
1. V	**V1:**	The motivation of remote patients to choose a special hospital is the hospital's reputation.							V11	Sources of support: practical experience and the results from previous questionnaire surveys.						
									V12							
	V2:	Patients can choose expert appointment, time of visit, and the way of diagnosis.							V21	Sources of support: practical experience and the results from previous questionnaire surveys.						
2. R	**R1:**	The spiritual value perceived by remote patients in remote							R11	Sources of support: practical experience and the results from previous questionnaire						
									R12							
									R13							

		diagnosis and treatment.								surveys.							
	R2:	Personal information is well protected from disclosure during remote diagnosis and treatment.							R21	Sources of support: theoretical research results. Feng (2019) proposed suggestions for improving the supervision system for Internet medical diagnosis and treatment in China. Yin & Chen (2018) studied the inspection on legal protection of patient's individual information with Internet medicine in China.						
									R22								
3. SC	**SC1**	The value generated by medical workers' thought, knowledge level, profession							SC11	Sources of support: Kotler (2011) conducted the theoretical study on the customer delivered							
									SC12								
									SC13								
									SC14								

		al ability, work efficiency and quality, work style, and adaptability.								value.							
4. S	**S1**	The value of decreased costs paid by remote patients during remote diagnosis and treatment.							S11	Sources of support: references. Kotler (2011) said that the model of customer delivered value can be divided into product value, service value, personnel value and image value. Li & Wang (2019) and other scholars incorporated the cost of conflict, time and energy, spirit, and risk into the evaluation indicators, and used the reconstructed theoretical model of						
									S12								
									S13								
									S14								
									S15								

										customer delivered value to establish the evaluation indicator system of users' medical information service.							
	S2	Satisfactory value generated when remote patients can get the doctor's timely reply and follow-up on the condition during the treatment.							S21	Sources of support: practical experience and the results from previous questionnaire surveys.							
									S22								
									S23								
	S3	The sense of value generated when remote patients choose to visit hospitals in the hope that they can see the equipment, products							S31	Sources of support: references. Shen (2006) stated that part of the customer's value needs is observable, including the hardware facilities, technology, products, and							
									S32								

		and facilities in the hospital, so as to meet their tangible needs.								the personnel image in face-to-face communication in the hospital.						
	S4	The perceived value of patients in terms of the rules and regulations as well as the level of standardization of medical services.							S41 S42	Sources of support: references. Xu & Yu (2015) and other scholars demonstrated that the improvement of initial diagnosis in community and dual referral mechanism, the establishment of information system, and the improvement of medical insurance payment mechanism play an important role in the building and development of medical						

										treatment partnership.						
5. SU	**SU1**	The technical value perceived by patients originated from patients' recognition of the core technology of the hospital, which patients also consider as an important technical standard for their recovery.							SU11	Zeithaml (1988) constructed the model of customer perceived value, which is decided by perceived giving, external attributes, essential attributes and high-level abstraction (Xu, 2009), with the essential attributes and external attributes at its core.						
									SU12							

2. In addition to the above categories, what other indicators do you think can represent and decompose the perceived value?

Number		Category (level II indicators)	Reason	Level III indicator accordingly	Reason
1					
2					
3					

Ⅲ Expert Consultation Questionnaire on Evaluation Indicators of the Perceived Value of Remote Patients in Telemedicine (Round 2)

Dear experts,

Hello! Thank you again for participating in the first-round expert consultation. The research group has analyzed the received questionnaires in time, and communicated with professionals on the questions raised by some experts. Therefore, a few adjustments have been made on some categories and corresponding evaluation indicators. Now the questionnaire has been refined for the second-round expert consultation.

Thank you for your great support!

Approval rating of indicators (Round 2)

1. Please tick (√) your approval attitude towards the indicators. Note your reason if you tick "Not approve" or "Strongly disapprove". Thank you for your cooperation!

Table 4 Survey on the rationality of measuring indicators of the perceived value of remote patients in telemedicine

Dimension of value needs	Content	Explanation	Strongly	Approve	General	Not approve	Strongly disapprove	Your reason if not approve	Indicator	Reason	Strongly approve	Approve	General	Not approve	Strongly disapprove	Your reason for not approving and suggestions
6. V	**V1:**	The same as Round 1							***V11*** **The *degree of importance* to a hospital's reputation**	Sources of support: Practical experience and the results from previous questionnaire surveys						
									V12							
	V2:	The same as Round 1							***V21*** **Autonomy *during* medical**	Sources of support: Practical experience						

Dimension of value needs	Content	Explanation	Strongly	Approve	General	Not approve	Strongly disapprove	Your reason if not approve	Indicator	Reason	Strongly approve	Approve	General	Not approve	Strongly disapprove	Your reason for not approving and suggestions
									care *V22 Autonomy in the reimbursement and payment of medical care*	and the results from previous questionnaire surveys						
7. R	**R1:**	The same as Round 1							**R11**	The same as Round 1						
									R12							
									R13							
	R2:	The same as Round 1							**R21**	Sources of support: Practical experience and the results from previous questionnaire surveys. Experts suggested that the stability of network transmission should be taken account in the measuring indicators of Privacy Value (R2). It, indeed, has an impact on the security of patients' privacy in medical treatment.						
									R22							
									R23 Stability of network transmission							
8. SC-	**SC1:**	The same as Round 1							**SC11**	The same as Round 1						
									SC12							
									SC13							
									SC14							
9. S	**S1:**	The same as Round 1							***S11* Time *Span***	Sources of support: References, practical experience, and the						
									S12* Spatial *Distance							

Dimension of value needs	Content	Explanation	Strongly	Approve	General	Not approve	Strongly disapprove	Your reason if not approve	Indicator	Reason	Strongly approve	Approve	General	Not approve	Strongly disapprove	Your reason for not approving and suggestions
									S13	results from previous questionnaire surveys						
									S14							
									S15 Risk during the diagnosis and treatment							
	S2:	The same as Round 1							**S21**	Sources of support: Practical experience and the results from previous questionnaire surveys						
									S22							
									S23 Follow-up visit							
	S3:	The same as Round 1							**S31**	The same as Round 1						
									S32							
	S4:	The same as Round 1							**S41**	The same as Round 1						
									S42							
10. SU-	**SU1:**	The same as Round 1							**SU11**	The same as Round 1						
									SU12							

Ⅳ Expert Consultation Questionnaire on Evaluation Indicators of the Perceived Value of Remote Patients in Telemedicine (Round 3)

Dear experts,

Thank you again for participating in our first-round and the second-round expert consultations. Based on the results and feedback, we finally established the evaluation index system of the perceived value of remote patients in telemedicine (see Table 5). For this round of expert consultation, please assign weights to each indicator according to your own judgement. The method to be used is the Analytic Hierarchy Process (AHP), and specific instruction is described below.

Thank you for your great support!

1. Questionnaire Filling Instruction

After two rounds of the expert consultation, we can see that there is a general convergence of opinions among experts, and thus we have finally established the evaluation index system of the perceived value of remote patients in telemedicine (see Table 5). This round of the expert consultation aims to determine the weight of each indicator using the AHP. See the specific information below.

Table 5 Evaluation Index System of the Perceived Value of Remote Patients in Telemedicine

Level I Indicator	Level II Indicator	Level III Indicator
11. V-Value (Self-value)	V1: Reputation	V11 The degree of importance to a hospital's reputation
		V12 Value the superb skills of a famous chief doctor
	V2: Sense of medical autonomy	V21 Autonomy during medical care
		V22 Autonomy in the reimbursement and payment of medical care
12. R-Respect (Respect and love)	R1: Spiritual value	R11 Personalization
		R12 Concern
		R13 Trust
	R2: Privacy	R21 Diagnosis process
		R22 Diagnosis result
		R23 Stability of network transmission
13. SC-Social Contact	SC1: Medical personnel	SC11 Communication
		SC12 Attitude
		SC13 Professional skills
		SC14 Compliance
14. Safety	S1: Cost	S11 Time span
		S12 Spatial distance
		S13 Economic and monetary

Level I Indicator	Level II Indicator	Level III Indicator
		S14 Energy
		S15 Risk during the diagnosis and treatment
	S2: Response	S21 Timeliness
		S22 Tracking and ward round
		S23 Follow-up visit
	S3: Tangible value	S31 Physical medical care
		S32 Face-to-face medical care
	S4: Standard	S41 Medical process standard
		S42 Medical technical specification
15. SU-Survival	SU1: Technical value	SU11 Internal properties: professional skills, superb technology, high proficiency, high cure rate
		SU12 External properties: advanced medical equipment, strong medical testing ability, many medical reference cases, good reputation for specialty

Table 6 can help you judge the relative weights of level I, II and III indicators. Please give a score that you think matches the importance of each indicator in the evaluation system of the perceived value of remote patients in telemedicine. Table 6 by Thomas L. Saaty exhibits the scale of numbers that indicate the intensity of importance. Thomas L. Saaty is a professor at the Wharton School, University of Pennsylvania, a Distinguished University Professor at the University of Pittsburgh, and the creator of the AHP and the Analytic Network Process (ANP).

Table 6 Scale of Relative Importance by Saaty

Scale	Explanation	Scale	Explanation
1	The horizontal and vertical factors are equally important.		
3	The horizontal factor is moderately more important than the vertical one.	**1/3**	The horizontal factor is moderately less important than the vertical one.
5	The horizontal factor is significantly more important than the vertical one.	**1/5**	The horizontal factor is significantly less important than the vertical one.
7	The horizontal factor is strongly more important than the vertical one.	**1/7**	The horizontal factor is strongly less important than the vertical one.
9	The horizontal factor is extremely more important than the vertical one.	**1/9**	The horizontal factor is extremely less important than the vertical one.
The number 2, 4, 6, and 8 are median value of the above adjacent judgements.			

Example: If you think that “A2” is strongly more important than “A1”, please assign “5” in the first blank cell of the third row.

	A1	**A2**	**A3**
A1	1	\	\
A2	5	1	\
A3			1

2. Weights in Evaluation Indicator System of the Perceived Value of Remote Patients in Telemedicine

Please provide judgements about the relative importance of each indicator, and assign its weight in the table cells. Thank you for your cooperation.

Table 7 Level I Indicator

Perceived Value of Remote Patients in Telemedicine	V: Self-value	R: Respect and love	SC: Social contact	S: Safety	SU: Survival
V: Self-value	1	\	\	\	\
R: Respect and love		1	\	\	\
SC: Social contact			1	\	\
S: Safety				1	\
SU: Survival					1

Table 81 Level II Indicator (V: Self-value)

V: Self-value	V1: Reputation	V2: Sense of medical autonomy
V1: Reputation	1	\
V2: Sense of medical autonomy		1

Table 82 Level II Indicator (R: Respect and Love)

R: Respect and Love	R1: Spiritual value	R2: Privacy
R1: Spiritual value	1	\
R2: Privacy		1

Table 83 Level II Indicator (S: Safety)

S: Safety	S1: Cost	S2: Response	S3: Tangible value	S4: Standard
S1: Cost	1	\	\	\
S2: Response		1	\	\
S3: Tangible value			1	\
S4: Standard				1

Table 91 Level III Indicator (V1: Reputation)

V1: Reputation	V11: The degree of importance to a hospital's reputation	V12: Value the superb skills of a famous chief doctor
V11: The degree of importance to a hospital's reputation	1	\
V12: Value the superb skills of a famous chief doctor		1

Table 92 Level III Indicator (V2: Sense of Medical Autonomy)

V2: Sense of Medical Autonomy	V21: Autonomy during medical care	V22: Autonomy in the reimbursement and payment of medical care
V21: Autonomy during medical care	1	\
V22: Autonomy in the reimbursement and payment of medical care		1

Table 93 Level III Indicator (R1: Spiritual Value)

R1: Spiritual Value	R11: Personalization	R12: Concern	R13: Trust
R11: Personalization	1	\	\
R12: Concern		1	\
R13: Trust			1

Table 94 Level III Indicator (R2: Privacy)

R2: Privacy	R21: Diagnosis process	R22: Diagnosis result	R23: Stability of network transmission
R21: Diagnosis process	1	\	\
R22: Diagnosis result		1	\
R23: Stability of network transmission			1

Table 95 Level III Indicator (SC1: Medical Personnel)

SC1: Medical Personnel	SC11 Communication	SC12 Attitude	SC13 Professional skills	SC14 Compliance
SC11 Communication	1	\	\	\
SC12 Attitude		1	\	\
SC13 Professional skills			1	\
SC14 Compliance				1

Table 96: Level III Indicator (S1: Cost)

S1: Cost	S11: Time span	S12: Spatial distance	S13: Economic and monetary	S14: Energy
S11: Time span	1	\	\	\
S12: Spatial distance		1	\	\
S13: Economic and monetary			1	\
S14: Energy				1

Table 97 Level III Indicator (S2: Response)

S2: Response	S21: Timeliness	S22: Tracking and ward round	S23: Follow-up visit
S21: Timeliness	1	\	\
S22: Tracking and ward round		1	\
S23: Follow-up visit			1

Table 98 Level III Indicator (S3: Tangible Value)

S3: Tangible Value	S31: Physical medical care	S32: Face-to-face medical care
S31: Physical medical care	1	\
S32: Face-to-face medical care		1

Table 99 Level III Indicator (S4: Standard)

S4: Standard	S41: Medical process standard	S42: Medical technical specification
S41: Medical process standard	1	\
S42: Medical technical specification		1

Table 910 Level III Indicator (SU1: Technical Value)

SU1: Technical Value	SU11: Internal properties	SU12: External properties
SU11: Internal properties	1	\
SU12: External properties		1

∨ Remote Patient Satisfaction Questionnaire on the Internet Diagnosis and Treatment Model of Medical Alliance of Specialties

(Internet Diagnosis and Treatment Model of Medical Alliance of Specialties vs. Visit to Shanghai Pulmonary Hospital)

Dear patients,

The Internet diagnosis and treatment model of medical alliance of specialties has been put into use for a period of time. In this model, remote patients are allowed to use the remote information platform for Internet diagnosis and treatment in local hospitals, and autonomously choose experts from Shanghai Pulmonary Hospital (Hospital F) for medical treatment, including outpatient appointment, registration, expert consultation, auscultation, examination, diagnosis, treatment, prescription, medical insurance reimbursement, formation of electronic medical record, virtual round and follow-up visit. Here, the research group hopes to learn more about your feelings of this model through a questionnaire survey. The questionnaire is completely anonymous, and your personal information is strictly confidential. Pleased answer each question according to your actual conditions.

Thank you for your support and cooperation!

1. Satisfaction of remote patients with the Internet diagnosis and treatment model of medical partnership of specialties

Dimension	Content	Strongly agree	Agree	General	Disagree	Strongly disagree
Dimension 1: Perceived Usefulness	1. The efficiency of medical care can be obviously improved through the Internet healthcare information platform (hereinafter referred to as "platform").	5	4	3	2	1
	2. I can know my disease as soon as possible through this platform.	5	4	3	2	1
	3. I can autonomously choose Shanghai experts and make appointments with them on this platform.	5	4	3	2	1
	4. My disease can be well-diagnosed quickly through this platform.	5	4	3	2	1
	5. I can enjoy professional diagnosis and receive concern from experts in Hospital F through this platform.	5	4	3	2	1
	6. I can virtually have a reliable face-to-face communication with experts in Hospital F on this platform.	5	4	3	2	1
	7. I can save much cost of travelling expense, time and energy for the visit to Hospital F through this platform.	5	4	3	2	1
	8. My medical needs can be satisfied through this platform.	5	4	3	2	1
	9. The platform lives up to my expectation.	5	4	3	2	1
	10. This platform can help me establish a sense of compliance with Shanghai experts.	5	4	3	2	1
Dimension 2: Perceived Ease of Use	1. It is easy to reach medical services on this platform.	5	4	3	2	1
	2. It is convenient to make payment on this platform.	5	4	3	2	1
	3. It is easy to have outpatient appointment and registration on this platform.	5	4	3	2	1
	4. It is easy and convenient to check my electronic medical history on this platform.	5	4	3	2	1
	5. The interface is user-friendly on this platform.	5	4	3	2	1
	6. The platform boosts the connection and the data sharing between local hospitals and the Hospital F.	5	4	3	2	1
	7. The platform is stable for use, and the embedded imaging and speech recognition equipment for diagnosis and treatment is stably connected.	5	4	3	2	1
	8. It takes only a few steps to reach the page or feature that I want on this platform.	5	4	3	2	1
	9. I can quickly learn how to use the platform.	5	4	3	2	1
Dimension 3: Satisfaction	1. I am satisfied with this platform.	5	4	3	2	1
	2. I will recommend this platform to my friends.	5	4	3	2	1
	3. My expectation for medical services is satisfied by the Internet diagnosis and treatment model of medical alliance of specialties (hereinafter referred to as "model").	5	4	3	2	1

	4. In the future, I will choose to stay locally, and get medical care through this model.	5	4	3	2	1
	5. Compared to the traditional visit to hospital, I am more satisfied with the model.	5	4	3	2	1
	6. I am satisfied with the features of registration and medical care on the platform.	5	4	3	2	1
	7. I am satisfied with the features of electronic medical record query, payment and prescription on the platform.	5	4	3	2	1
	8. This platform has improved my satisfaction with doctors.	5	4	3	2	1
Dimension 4: **Perceived Coordination**	1. This platform can help store my medical information in a complete and orderly manner.	5	4	3	2	1
	2. This platform can well transmit relevant data information, while at the same time ensure the independence of information systems in different hospitals.	5	4	3	2	1
	3. This platform can provide medical staff with convenient and efficient management of hospital data.	5	4	3	2	1
	4. This platform facilitates the communication between experts from two hospitals and improves the accuracy of diagnosis and treatment.	5	4	3	2	1
	5. In the implementation of the model, I can see the coordination of medical workers and expert resources between the local hospital and Hospital F.	5	4	3	2	1
	6. In the implementation of the model, I can see the sharing and coordination of examination equipment between the local hospital and Hospital F.	5	4	3	2	1
	7. In the implementation of the model, I can see the sharing and coordination of medicine prescription between the local hospital and Hospital F.	5	4	3	2	1
	8. In the implementation of the model, I can see the coordination of medical insurance between the local hospital and Hospital F.	5	4	3	2	1
	9. This platform provides patients with the same experience of medical services in Shanghai, including medical appointment, registration, doctor visit, examination and ward round.	5	4	3	2	1
	10. It is equally convenient to make an appointment with experts in Hospital F through this platform.	5	4	3	2	1
	11. This model can provide effective information support for patient's follow-up medical services.	5	4	3	2	1
	12. This model facilitates the two-way referral procedure with the green channel and data sharing of diagnosis and treatment.	5	4	3	2	1
	13. This model establishes a good sense of mutual collaboration among all levels of alliance hospitals.	5	4	3	2	1
	14. In the implementation of this model, rules and regulations have been formulated to require collaboration between medical staff.	5	4	3	2	1
	15. The implementation and development of this model is carried out smoothly.	5	4	3	2	1
	16. The contact between medical staff and the hospital in partnership is proactive and standardized in this model.	5	4	3	2	1

2. Internet Diagnosis and Treatment Model of Medical Partnership of Specialties vs. Visit to F Hospital

Dimension	Indicator	Content	Internet Diagnosis and Treatment Model of Medical Partnership of Specialties					Direct Visit to Shanghai Pulmonary Hospital				
			Strongly agree	Agree	General	Disagree	Strongly disagree	Strongly agree	Agree	General	Disagree	Strongly disagree
Dimension 5: Perceived Value	V1	1. I value the reputation of this hospital.	5	4	3	2	1	5	4	3	2	1
		2. I value a famous doctor who has a great reputation and professional skills.	5	4	3	2	1	5	4	3	2	1
	V2	3. I can autonomously choose the specialist and hospital that I prefer.	5	4	3	2	1	5	4	3	2	1
	R1	4. I can get targeted and personalized diagnosis and treatment, so that I feel being cared and respected.	5	4	3	2	1	5	4	3	2	1
		5. I can get a doctor's concern, including concerns about both medical and mental conditions.	5	4	3	2	1	5	4	3	2	1
		6. I choose this model/hospital mainly because I trust the medical skills and ethics of the chief doctors there.	5	4	3	2	1	5	4	3	2	1
	R2	7. When I receive expert diagnosis and treatment from the local hospital and Hospital F, my examination and test reports are well protected from any disclosure.	5	4	3	2	1	5	4	3	2	1
		8. My treatment results are well protected.	5	4	3	2	1	5	4	3	2	1
	SC 1	9. In the course of receiving expert diagnosis and treatment, I hope to maintain good communication with the attending doctor so as to ensure that the diagnosis and treatment can be carried out smoothly.	5	4	3	2	1	5	4	3	2	1
		10. When I receive expert diagnosis and treatment, I prefer doctors with good attitude, enthusiasm, patience and good medical ethics, which can make my experience better.	5	4	3	2	1	5	4	3	2	1
		11. The doctors' professional skills during the diagnosis and treatment have won my respect.	5	4	3	2	1	5	4	3	2	1
		12. When I receive diagnosis and treatment, I feel a sense of compliance because of the doctor's professionalism and medical ethics.	5	4	3	2	1	5	4	3	2	1
	S2	13. My condition is timely concerned and responded by the attending doctor.	5	4	3	2	1	5	4	3	2	1

		14. During my hospitalization, the doctor can follow my condition in time and timely give advice through rounds.	5	4	3	2	1	5	4	3	2	1
	S3	15. You choose it because you care and value it as a complete physical medical environment.	5		3	2	1	5	4	3	2	1
		16. You choose it because you can communicate face to face with the doctor, which is reliable.	5	4	3	2	1	5	4	3	2	1
	S4	17. The medical process standards make me feel relieved.	5	4	3	2	1	5	4	3	2	1
		18. The medical technical specifications make me feel relieved.	5	4	3	2	1	5	4	3	2	1
	SU 1	19. I choose it because of the high cure rate of pulmonary diseases in this hospital.	5	4	3	2	1	5	4	3	2	1
		20. I choose it because this hospital has superb technologies and outstanding proficiency for the diagnosis and treatment of lung diseases.	5	4	3	2	1	5	4	3	2	1
		21. I choose it because the hospital can provide advanced medical equipment, accurate medical testing, and "remedy" for specific cases quickly, thereby carrying out advanced, scientific medical treatment.	5	4	3	2	1	5	4	3	2	1
		22. I choose it because the hospital has more cases of successful treatment and a good professional reputation.	5	4	3	2	1	5	4	3	2	1
	S1	23. The cost of time during medical care 1. Very much, 2. Much, 3. General, 4. Few, 5. Very few	5	4	3	2	1	5	4	3	2	1
		24. The journey taken by different models of medical care 1. Very long, 2. Long, 3. General, 4. Short, 5. Very short	5	4	3	2	1	5	4	3	2	1
		25. Medical expense 1. Very much, 2. Much, 3. General, 4. Few, 5. Very few	5	4	3	2	1	5	4	3	2	1
		26. The cost of energy for medical service 1. Very much, 2. Much, 3. General, 4. Few, 5. Very few	5	4	3	2	1	5	4	3	2	1

3. Other Information

1. Your gender: A. Male B. Female

2. Your age: _____

3. Years of smoking: _____

4. Severity of your lung disease: A. Moderate B. General C. Critical

5. Your choice of treatment mode:

A. Direct visit to Hospital F for expert diagnosis and treatment

1. Very unsatisfied 2. Unsatisfied 3. General 4. Satisfied 5. Very satisfied

B. Internet diagnosis and treatment platform of medical partnership of specialties

1. Very unsatisfied 2. Unsatisfied 3. General 4. Satisfied 5. Very satisfied

6. Cost of time:

1. It may cost _____(hours / minutes) for online medical care from Hospital F through the ***Internet diagnosis and treatment model of medical alliance of specialties.***

2. It may cost _____(hours / minutes) for the medical care ***through direct visit to Hospital F.***

7. Cost of distance:

1. It may cost _____ (hours / minutes) by taking _____ (transportation) on my journey to receive online medical care from Hospital F through the ***Internet diagnosis and treatment model of medical alliance of specialties.***

2. It may cost _____ (hours / minutes) by taking _____ (transportation) on my journey to receive medical care ***through direct visit to Hospital F.***

8. Cost of expense:

1. It may cost _____ (yuan), including medicine and expert fees during the online medical care from Hospital F through the ***Internet diagnosis and treatment model of medical alliance of specialties.***

2. It may cost _____ (yuan), including medicine and expert fees during the medical care ***through direct visit to Hospital F.***

9. Cost of energy:

1. It may cost _____ of my energy (choose: 1. Very few, 2. Few, 3. General, 4. Much, 5. Very much) for online medical care from Hospital F through the ***Internet diagnosis and treatment model of medical alliance of specialties.***

2. It may cost _____ of my energy (choose: 1. Very few, 2. Few, 3. General, 4. Much, 5. Very much) for the medical care ***through direct visit to Hospital F.***

[This page is deliberately left blank.]

Annex B: Tables

Table B1: Policy documents related to the Internet medical service

Title	Authority	Year	Relevant contents
Opinions of National Health Commission on Promoting Telemedicine Services in Medical Institutions	National Health Commission	August 2014	Promote the development of telemedicine services, and encourage to establish online service platform for telemedicine
Framework of Chinese Population Health Informatization	National Health Commission	May 2015	Promote the application of medical care big data, accelerate the application of information services and new information technologies, as well as the corresponding standards and safety network, and formulate a multi-party participation mechanism.
Guiding Opinions on Vigorously Advancing the "Internet Plus" Action	General Office of the State Council	July 2015	Develop Internet-based medical services, and give full play to information technologies including the Internet and big data while promoting hierarchical diagnosis and treatment
Guiding Opinions on Promoting Hierarchical Diagnosis and Treatment System	General Office of the State Council	September 2015	Accelerate the informatization project of national health security, build regional medical information platform, realize the continuity of e-health file and electronic medical record as well as the information-sharing among various medical institutions at different levels, and ensure smooth information flow in referral
Guiding Opinions on Promoting and Standardizing the Application of Medical Care Big Data	General Office of the State Council	June 2016	Offer digital security for the smart development of Internet medical services, guide the development of medical services based on Internet functions, realize the information-sharing among various medical institutions at different levels, and ensure smooth information flow in referral
Guiding Opinions on Promoting and Standardizing the Application of Medical Care Big Data	General Office of the State Council	June 2016	Offer digital security for the smart development of Internet medical services, and guide the development of medical services based on Internet functions
Outlines of Health China 2030 Initiative	State Council	October 2016	Lift the outlines related to medical and health industry to national strategic level at

			the first time, and show the state's attitude towards "Internet plus medical services"
Guidelines for the Development of Medical Industry	The six ministries of China, including Ministry of Industry and Information Technology	November 2016	Vigorously promote "Internet plus medical services", and develop smart medical products, mobile medical products and wearable devices which are equipped with cloud services and artificial intelligence
Regulations on the Application of Electronic Medical Record (Trial Implementation)	National Health Commission	February 2017	Meet clinical demand, standardize the regulations for electronic medical record (including medical record in traditional Chinese medicine) application in medical institutions, and push forward the smart development of online medical services
Opinions of the General Office of the State Council on Promoting the Development of "Internet plus Health Care"	State Council	April 2018	Improve the service system and supporting mechanism for "Internet plus health care", and strengthen industry regulation and security system
Notification on Further Carrying out Public Welfare Activities Featuring "Internet plus Medical Health"	National Health Commission	July 2018	Improve public welfare, and establish the service system for "Internet plus medical health"
Notification on Further Digitalizing Medical Institutions with Electronic Medical Record as the Core	National Administration for Medical Policy and Regulation	August 2018	Further promote the informatization of electronic medical record, and ensure data security in operation
Measures for the Administration of Internet Hospitals (Trial Implementation)	National Health Commission, National Administration of Traditional Chinese Medicine	September 2018	Categorize "Internet plus medical services", formulate operating rules and access procedures, build regulatory platforms, and clarify subject of legal responsibility
Measures for the Administration of Internet Diagnosis and Treatment (Trial Implementation)			
Specifications for the Administration of Remote Medical Services (Trial Implementation)			

Notification on Printing out the National Regulations on the Standards, Safety and Services of Medical Care Big Data (Trial Implementation)	National Health Commission	September 2018	Clear the definition, connotation and denotation of medical care big data, and clarify the responsibilities and rights of different medical institutions at different levels as well as corresponding application institutions
Assessment Indicators for the Action Plan on Further Improving Medical Treatment (2018-2020)	National Health Commission	November 2018	Mention the regulations for telemedicine, which accounts for 8 in the evaluation scores

Table B2: Preliminarily determine the level I and level II indicators of perceived value of remote patients based on Maslow's hierarchy of needs

Dimension of value needs	Content	Explanation
V	V1	The motivation of remote patients to choose a special hospital is the hospital's reputation value.
	V2	Patients can choose expert appointment, time of visit, and the way of diagnosis
R	R1	The spiritual value perceived by remote patients in remote diagnosis and treatment
	R2	Personal information is well protected from disclosure during remote diagnosis and treatment
SC	SC1	The value generated by medical workers' thought, knowledge level, professional ability, work efficiency and quality, work style, and adaptability
S	S1	Losses from various increased costs experienced by remote patients during remote diagnosis and treatment
	S2	Satisfactory value generated when remote patients can get the doctor's timely reply and follow-up on the condition during the treatment
	S3	The sense of value experienced when remote patients choose to visit hospitals in the hope that they can see the equipment, products and facilities in the hospital, so as to meet their tangible needs
	S4	The perceived value of patients in terms of the rules and regulations as well as the level of standardization of medical services
SU	SU1	The technical value perceived by patients originated from patients' recognition of the core technology of the hospital, which patients also consider as an important technical standard for their recovery.

Table B3: Statistics of the categorical variable frequency of research objects

		Frequency	%	Valid %	Cumulative %
Gender	Male	124	57.9	57.9	57.9
	Female	90	42.1	42.1	100
	Total	214	100	100	
Age group	Under 18 years old	1	0.5	0.5	0.5
	18 to 25 years old	14	6.5	6.5	7
	26 to 30 years old	16	7.5	7.5	14.5
	31 to 40 years old	34	15.9	15.9	30.4
	41 to 50 years old	42	19.6	19.6	50
	51 to 60 years old	48	22.4	22.4	72.4
	Over 60 years old	59	27.6	27.6	100
	Total	214	100	100	
Province	Heilongjiang	5	2.3	2.3	2.3
	Henan	11	5.1	5.1	7.5
	Jiangxi	15	7	7	14.5
	Fujian	6	2.8	2.8	17.3
	Jiangsu	71	33.2	33.2	50.5
	Zhejiang	37	17.3	17.3	67.8
	Anhui	34	15.9	15.9	83.6
	Gansu	2	0.9	0.9	84.6
	Guangxi	1	0.5	0.5	85
	Guizhou	2	0.9	0.9	86
	Tianjin	3	1.4	1.4	87.4
	Xinjiang	1	0.5	0.5	87.9
	Shanxi	1	0.5	0.5	88.3
	Liaoning	1	0.5	0.5	88.8
	Chongqing	3	1.4	1.4	90.2
	Jilin	4	1.9	1.9	92.1
	Guangdong	2	0.9	0.9	93
	Sichuan	4	1.9	1.9	94.9
	Shandong	6	2.8	2.8	97.7
	Hubei	2	0.9	0.9	98.6
	Hunan	1	0.5	0.5	99.1
	Beijing	1	0.5	0.5	99.5
	Yunnan	1	0.5	0.5	100
	Total	214	100	100	
Occupation	Full-time student	13	6.1	6.1	6.1
	Production personnel	26	12.1	12.1	18.2
	Sales personnel	30	14.0	14.0	32.2

	Marketing & PR	10	4.7	4.7	36.9
	Administrative personnel	11	5.1	5.1	42.1
	HR	8	3.7	3.7	45.8
	Financial auditor	12	5.6	5.6	51.4
	Civil personnel	10	4.7	4.7	56.1
	Technical R&D personnel	9	4.2	4.2	60.3
	Manager	28	13.1	13.1	73.4
	Teacher	25	11.7	11.7	85.0
	Consultant	10	4.7	4.7	89.7
	Professional (including lawyer, accountant, architect, medical worker and journalist)	22	10.3	10.3	100
	Total	214	100	100	
Industry	IT/hardware and software services/e-commerce/Internet operation	9	4.2	4.2	4.2
	Fast consumption food (food, beverage, cosmetics)	8	3.7	3.7	7.9
	Wholesale/retail	19	8.9	8.9	16.8
	Apparel/textiles/leather goods	12	5.6	5.6	22.4
	Furniture/crafts/toys	4	1.9	1.9	24.3
	Education, training and scientific research institutions	21	9.8	9.8	34.1
	Telecommunication network equipment/telecommunication operation	5	2.3	2.3	36.4
	Manufacturing	14	6.5	6.5	43.0
	Automobile & components	8	3.7	3.7	46.7
	Catering, entertainment, tourism, hotel/life service	10	4.7	4.7	51.4
	Office goods & facilities	4	1.9	1.9	53.3
	Accounting/auditing	4	1.9	1.9	55.1
	Law	8	3.7	3.7	58.9
	Banking, insurance, securities/investment banking/venture funds	6	2.8	2.8	61.7
	Electronic technology/semiconductor/integrated circuit	4	1.9	1.9	63.6
	Trade/import and export	5	2.3	2.3	65.9
	Machinery/equipment/heavy industry	8	3.7	3.7	69.6
	Pharmaceutical/bioengineering/ medical devices/equipment	8	3.7	3.7	73.4

Medical/nursing/health care	13	6.1	6.1	79.4
Publishing, printing and packaging	4	1.9	1.9	81.3
Real estate development/construction engineering/decoration design	7	3.3	3.3	84.6
Intermediary consulting/headhunting certification	5	2.3	2.3	86.9
Transportation/transportation/logistics	6	2.8	2.8	89.7
Aerospace/aviation/energy/chemical industry	4	1.9	1.9	91.6
Agriculture, fishery and forestry	18	8.4	8.4	100
Total	214	100.0	100	

Table B4: Rotated component matrix a

"Benefits" and "sacrifices" of customer perceived value	Principal component	Level II indicator-item number	Component 1	Component 2	Component 3	Component 4	Level I indicator
"Benefits"	1. safety and survival	S21-17	0.71				S
		S22-18	0.75				
		S31-19	0.777				
		S32-20	0.799				
		S41-22	0.869				
		S42-21	0.817				
		SU11-23	0.773				SU
		SU12-24	0.779				
		SU13-25	0.88				
		SU14-26	0.875				
	2. social contact and respect	SC11-9		0.689			SC
		SC12-10		0.696			
		SC13-11		0.681			
		SC14-12		0.648			
		R11-4		0.664			R
		R12-5		0.703			
		R13-6		0.575			
		R21-7		0.683			
		R22-8		0.739			
	3. self-value	V11-1				0.739	V
		V12-2				0.85	
		V21-3				0.838	
Sacrifices	4. cost losses	S11-13			0.953		S1
		S12-14			0.941		
		S13-15			0.939		
		S14-16			0.969		

Table B5: Establish preliminary perceived value index of remote patients based on the Customer Value Theory (designing indicators of three levels)

Dimension of needs value (Level I indicators)	Level II indicators	Explanation	Level III indicators	Reasons
1. V	**V1:** Reputation value	The motivation of remote patients to choose a superior specialized hospital lies in its reputation value	V11 Value hospital reputation V12 Value superb specialized skills of a famous chief physician in the hospital	Support source: Practical experience and results of preliminary questionnaire
	V2: Sense of autonomy during treatment	Able to actively choose the appointment of experts, time and treatment mode	V21 Treatment autonomy	Support source: Practical experience and results of preliminary questionnaire
2. R	**R1:** Spiritual value	Spiritual value perceived by remote patients during the process of remote diagnosis and treatment	R11 Individuation R12 Concern R13 Trust	Support source: Practical experience and results of preliminary questionnaire
	R2: Privacy value	Protect personal information from being leaked when receiving online diagnosis and treatment	R21 Diagnostic procedure R22 Diagnostic results	Support source: Theoretical research results Suggestions on improving the supervision system of online diagnosis and treatment activities in China (Feng, 2019). Review on the legal protection of patient information in online treatment in China (Yin & Chen, 2018).
3. SC	**SC1:** Personnel value	Value of medical personnel's thought, knowledge level, professional ability, work efficiency and quality, work style, adaptability	SC11 Communication SC12 Attitude SC13 Professional skills SC14 Compliance	Support source: Research on Customer Delivered Value Theory (Kotler, 1996)

Dimension of needs value (Level I indicators)	Level II indicators	Explanation	Level III indicators	Reasons
4. S	**S1:** Cost losses	Value of cost reduction experienced by remote patients when receiving remote diagnosis and treatment	S11 Time S12 Space S13 Economy and currency S14 Energy S15 Risks	Support source: Bibliography: Philip T Kotler's customer delivered value model is divided into product value, service value, personnel value and situational value. Adding conflict cost, time and energy cost, mental cost and risk cost into the evaluation indicators, and constructing the user's evaluation index system of medical information service by using the reconstructed customer delivered value theory model (Li et al., 2019a)
	S2: Response value	Remote patients can get the satisfactory value from doctors' timely response and follow-up to questions about the condition during treatment	S21 timeliness S22 Follow-up and ward rounds	Support source: Practical experience and results of preliminary questionnaire
	S3: Tangible value	Remote patients compare hospitals, hoping to see the tangible value of hospital equipment, products, and facilities	S31 Physical healthcare S32 Face-to-face healthcare	Support source: Bibliography: Proposing that part of customer value needs has explicit characteristics, including hospital's hardware facilities, technology,

Dimension of needs value (Level I indicators)	Level II indicators	Explanation	Level III indicators	Reasons
				products, and the image of face-to-face medical personnel. (Shen, 2006)
	S4: Standardization value	Patients' perceived value to the hospital's rules and regulations and the standardization degree	S41 Standardized medical procedures S42 Standardized medical skills	Demonstrating that the improvement of community first diagnosis and two-way referral systems, the construction of information system and the improvement of medical insurance payment system matter in the construction and development of medical alliance (Xu & Yu, 2015)
5. SU	**SU1:** Technical value	It is the patient's recognition of the core technology of the hospital, and it is an important technical standard to decide whether the disease is cured or not, and they feel the value of technology.	SU11 Internal attributes: superb and exquisite technology, high medical level and cure rate SU12 External attributes: advanced medical equipment, strong medical testing ability, many medical cases for reference, good reputation of medical specialty	Constructing the model of customer perceived value (Zeithaml, 1988), which is determined by the perceived effort, external attributes, essential attributes and high-level abstraction (Yu, 2009), and essential attributes and external attributes are the core and direct part.

Table B6: shows descriptive statistics of the selected objects in the expert consultation questionnaire

Category	Group	Frequency	%	Cumulative %
Age group	31 to 40 years old	8	22.9%	22.9%
	41 to 50 years old	21	60.0%	82.9%
	51 to 60 years old	6	17.1%	100%
	Total:	**35**	**1**	
Education level	Doctoral student	3	8.6%	8.6%
	Postgraduate student	9	25.7%	34%
	Undergraduate student	22	62.9%	97%
	Junior college student	1	2.9%	100%
	Total:	**35**	**1**	
Area	Jiangsu Province	3	8.6%	8.6%
	Jiangxi Province	6	17.1%	25.7%
	Shanxi Province	8	22.9%	48.6%
	Shanghai City	10	28.6%	77.1%
	Sichun Province	2	5.7%	82.9%
	Xinjiang Province	6	17.1%	100.0%
	Total:	**35**	**1**	
Major	Medicine	29	82.9%	82.9%
	Management	2	5.7%	88.6%
	Economy	1	2.9%	91.4%
	Law	0	0.0%	91.4%
	Science and engineering	2	5.7%	97.1%
	Others	1	2.9%	100.0%
	Total:	**35**	**1**	
Duty	President and Vice President	4	11.4%	11.4%
	Director	16	45.7%	57.1%
	Deputy director	13	37.1%	94.3%
	Physician	2	5.7%	100.0%
	Total:		**1**	

Table B7: Support rate statistics of demand value characteristics and measurement indicators

Demand value characteristics	Number of support experts	Support rate	Indictor	Number of support experts	Support rate
V1	31	88.6%	V11	33	94.3%
			V12	31	88.6%
V2	31	88.6%	V21	30	85.7%
R1	31	88.6%	R11	29	82.9%
			R12	29	82.9%
			R13	31	88.6%
R2	30	85.7%	R21	31	88.6%
			R22	33	94.3%
SC1	33	94.3%	SC11	33	94.3%
			SC12	30	85.7%
			SC13	32	91.4%
			SC14	32	91.4%
S1	31	88.6%	S11	31	88.6%
			S12	29	82.9%
			S13	28	80%
			S14	28	80%
			S15	25	71.4%
S2	26	74.3%	S21	29	82.9%
			S22	29	82.9%
			S23	28	80%
S3	30	84.3%	S31	29	82.9%
			S32	34	97.1%
S4	30	85.7%	S41	32	92.7%
			S42	32	90.9%
SU1	32	91.4%	SU11	32	91.4%
			SU12	32	91.4%

Table B8: List of indicators revision opinions and research group description of the first round of expert consultation (only including explanations of dissenting indicators)

Name of indicator	Support rate	Summary of expert feedback	Research group description and revision plan
V1：	88.6%	Most experts agree with the description of characteristics of reputation value for the treatment needs of remote patients. A few experts hold a neutral attitude, and believe that the needs of reputation value are different. The further exploration of the level and type of reputation value will be conducive to measure patients' sense of reputation value.	Reputation value (V1) is set in accordance with the needs of self-value realization which is at the highest level of the Maslow's Hierarchy of Needs, so the setting of the name of demand value has a theoretical basis. Indicators are therefore retained.
V11：	94.3%	Experts' attitude of agreement: the core hospital has an important impact on the remote patients' psychology of receiving medical treatment, and is also an important reflection of meeting the psychological needs. Few experts suggest that it would be better to describe the measurement indicator of the V11 value of hospital reputation in a more "measurable" way. Description of the research group:	Based on the advice of experts, the name of V11 measurement indicator should be changed to "V11 *the degree of valuing hospital reputation"*.
V21:	85.7%	Experts agree with measurement indicators for autonomous medical consultation, including appointment with experts, time and method. Some experts also think that the improvement of the current reimbursement mechanism has brought autonomy to local patients, which can extend the breadth of measurement indicators. Description of the research group	According to the opinions of experts, the research group found that at present some hospitals are improving their reimbursement mechanisms of medical treatment in any designated hospitals, so the group suggests that the scope of measurement indicators for autonomous medical consultation should be extended. Therefore, we change the name of the V21 measurement indicator to "*autonomy during medical consultation"*, and add the V22 measurement indicator "*autonomy in medical treatment reimbursement*".
R21: R22:	88.6% 94.3%	Experts strongly agree that the diagnostic result R22 has a stronger impact on patients compared with the diagnostic process R21. And Experts suggest that the stability of network transmission is also an important factor for patients to ensure that their privacy	The research group includes the "network transmission stability" into the measurement indicators at the technical level, and add the indicator "*R23 network transmission stability*".

		value needs are met.	
S11:	88.6%	Most experts agree with this indicator. Some experts hold that the concept of time, S11 is clearer if it is the length of time.	According to experts' suggestions, the measurement indicators should be changed to a more explicit expression. Therefore, S11 time is changed to "*time length*", and S12 space to "*spatial distance*". As for S15 risk, experts believe that the risk cost not only depend on the hospital brand, also depends on some objective and uncontrollable factors. The resulting risk is easier for patients to measure. Hence what the research group should study is not the constant value, but the measurement of risk with flexible change during the treatment process. Moreover, this indicator also reflects in the preliminary research results that risk factors are also important factors to be considered by remote patients. Therefore, S15 risk indicator should be retained. In order to better highlight the accuracy of risk measurement in the diagnosis and treatment process, it is renamed as "*S15 risk in the diagnosis and treatment process*".
S12:	82.9%	Experts agree with this indicator. The spatial measurement indicator, S12 should be described as "spatial distance", which is appropriate.	
S13:	80%	Most experts agree with this indicator. Some experts hold that the concept of time, S11 is clearer if it is the length of time.	
S14:	80%		
S15:	71.4%	Most experts agree with this indicator. Some experts believe that the setting of the risk value indicator includes the brand value of hospitals as a reference. In other words, if there is a good brand hospital, the risk of medical treatment will be reduced. Moreover, the established core hospital in this research is the Shanghai Pulmonary Hospital, so the risk coefficient should be constant.	
S2:	74.3%	Some experts hold that the indicator of the response value is not familiar, and they do not know where the response is.	The results of the preliminary research show that the response value demand of remote patients coming to Shanghai (F Hospital) is very strong, and doctors are expected to give timely replies and follow-ups.
S31:	82.9%	Experts support this indicator. But a small number of experts may doubt that how telemedicine feels the presence of physical medical care.	The physical medical treatment that patients need is that with the network platform like specialized alliances for remote medical service, patients in local hospitals can enjoy the same tangible value of physical medical equipment technology as those in Shanghai hospitals. This indicator is therefore retained.

Table B9: Statistics on the support rates of the second round of expert consultation indicators (including comparison between the first round and the second round)

Characteristics of the demand value and its measurement indicators		Including "agree" and "strongly agree"		First-round revisions
		First-round support rates	Second-round support rates	
V1: reputation value		88.6%	100%	Retain this indicator
Measurement indicators	V11: value the hospital's reputation	94.3%	*The degree of valuing the hospital's reputation*	Rename this indicator
	V12: value a famous chief doctor with professional skills in the hospital	88.6%	100%	
V2: value of autonomous medical consultation		88.6%	92.7%	
Measurement indicators	V21: autonomy in medical consultation	85.7%	*Autonomy during medical consultation 90.2%*	Rename this indicator
	V22: autonomy in medical treatment reimbursement		*82.9%*	The new indicator
R1: spiritual value		88.6%	95.1%	
Measurement indicators	R11: individuality	82.9%	92.7%	
	R12: care	82.9%	92.7%	
	R13: trust	88.6%	100%	
R2: privacy value		85.7%	95.1%	
Measurement indicators	R21: diagnostic process	88.6%	100%	
	R22: diagnostic result	94.3%	100%	
	R23: network transmission stability		90.2%	The new indicator
SC1: value of medical personnel		94.3%	100%	
Measurement indicators	SC11: communication	94.3%	100%	
	SC12: attitude	85.7%	95.1%	
	SC13: professional skills	91.4%	100%	
	SC14: compliance	91.4%	100%	
S1: cost value		88.6%	*Cost--92.7%*	Rename this indicator
Measurement indicators	S11: time	88.6%	*The length of time--91.8%*	Rename this indicator
	S12: space	82.9%	*Spatial distance--90.4%*	Rename this indicator
	S13: economic currency	80%	92.5%	
	S14: energy	80%	90.2%	
	S15: risk	71.4%	*S15 Risk in diagnosis and treatment process--78%*	Rename this indicator
S2: Response value		74.3%	89.5%	Retain this indicator
Measurement indicators	S21: timeliness	82.9%	95.1%	
	S22: follow-up and make	82.9%	92.8%	

	rounds			
	S23: follow-up visits	80%	90.9%	
S3: tangible value		84.3%	95.1%	
Measurement indicators	S31: physical medical care	82.9%	92.7%	Retain this indicator
	S32: face-to-face medical care	97.1%	97.6%	
S4: normative value		85.7%	95.1%	
Measurement indicators	S41: medical process specification	92.7%	100%	
	S42: medical technological specification	90.9%	100%	
SU1: technological value		91.4%	100%	
Measurement indicators	SU11: internal attributes: superb technology, exquisite medical level, and high cure rate	91.4%	100%	
	SU12 : External attributes: advanced medical equipment, strong medical testing ability, many medical reference cases, good reputation of the medical specialty	91.4%	100%	

Table B10: Coefficient of variation in the score of perceived value indictor of online medical service for remote patients based on Customer Value Theory

Name of indicators	Average	Standard deviation	Coefficient of variation
V1: reputation value	4.68	0.471	0.100641026
V11 the degree of valuing the hospital's reputation	4.78	0.419	0.087656904
V12 value a famous chief doctor with professional skills	4.78	0.419	0.087656904
V2: perceived value of medical consultation	4.56	0.634	0.139035088
V21 autonomy during medical consultation	4.46	0.674	0.151121076
V22 autonomy in medical treatment reimbursement	4.27	0.742	0.173770492
R1: spiritual value	4.59	0.591	0.12875817
R11 individuality	4.34	0.617	0.142165899
R12 care	4.46	0.636	0.142600897
R13 trust	4.66	0.48	0.103004292
R2: privacy value	4.59	0.591	0.12875817
R21 diagnostic process	4.63	0.488	0.105399568
R22 diagnostic result	4.71	0.461	0.097876858
R23 network transmission stability	4.59	0.67	0.145969499
SC1: value of medical personnel	4.78	0.419	0.087656904
SC11 communication	4.78	0.419	0.087656904
SC12 attitude	4.59	0.591	0.12875817
SC13 professional skill	4.76	0.435	0.091386555
SC14 compliance	4.59	0.499	0.108714597
S1: cost value	4.54	0.636	0.140088106
S11 length of time	4.51	0.711	0.157649667
S12 spatial distance	4.39	0.737	0.167881549
S13 economic currency	4.22	0.759	0.17985782
S14 energy	4.41	0.67	0.151927438
S15 risk of diagnosis and treatment process	4.32	0.756	0.175
S2: response value	4.32	0.789	0.182638889
S21 timeliness	4.41	0.591	0.134013605
S22 follow-up and make rounds	4.29	0.68	0.158508159
S23 follow-up visit	4.27	0.742	0.173770492
S3: tangible value	4.41	0.547	0.124036281
S31 physical medical care	4.54	0.636	0.140088106
S32 face-to-face medical care	4.73	0.501	0.105919662
S4: normative value	4.59	0.591	0.12875817
S41 medical process specification	4.73	0.449	0.094926004
S42 medical technological specification	4.71	0.461	0.097876858
SU1: technological value	4.83	0.381	0.078881988
SU11 internal attributes: superb technology, exquisite medical level, and high cure rate	4.83	0.381	0.078881988
SU12 external attributes: advanced medical equipment, strong medical testing ability, many medical reference cases, good reputation of the medical specialty	4.73	0.449	0.094926004

Table B11: Statistics on pair comparative importance value of each factor in the 14 judgment matrices in the questionnaires

1. (survival needs/safety needs)	2.80	6. (autonomy of reimbursement for medical treatment / autonomy during seeing a doctor)	2.18	9.(compliance/professional skill)	1.82	14、(external attribute/internal attribute)							
1. (survival needs/social needs)	3.82	5. (value a famous chief doctor with professional skills /value the hospital reputation)	3.19	9.(compliance/attitude)	2.37	13、(medical technology specification/medical process specification)							
1. (safety needs/social needs)	3.40	4. (normative value/tangible value)	2.47	9.(professional skill/attitude)	2.05	12、(face-to-face medical service/medical entity)							
1. (survival needs/respect and love needs)	3.49	4. (normative value/response value)	2.46	9.(compliance/communication)	2.12	11、(follow-up visit/ follow-up and make rounds)							
1. (safety needs/respect and love needs)	3.35	4. (tangible value/response value)	2.66	9. (attitude/communication)	2.46	11、(follow-up visit/timeliness)							
1. (social needs/respect and love needs)	2.0	4. (normative value/cost value)	2.54	8.(network transmission stability/diagnostic result)	2.45	11、(follow-up and make rounds/timeliness)							
1. (survival needs/self-actualization needs)	3.89	4. (tangible value/cost value)	3.12	8. (network transmission stability/diagnostic process)	2.54	10、(energy/economic currency)							
1. (safety needs/self-actualization needs)	3.42	4. (response value/cost value)	2.81	8. (diagnostic process/diagnostic result)	2.81	10、(energy/spatial distance)							
1. (social needs/self-actualization needs)	1.73	3. (privacy value/spiritual value)	2.44	7. (trust/care)	2.40	10、(economic currency/spatial distance)							
1. (love and respect needs/ self-actualization needs)	2.3	2. (value of autonomous medical consultation/reputation value)	2.44	7.(trust/individuality)	2.42	10、(energy/length of time)							
				7. (care/individuality)	2.17	10、(economic currency/length of time)							
					1.80	10、(spatial distance/length of time)							
							2.65	3.02	2.31	2.68	2.19	1.88	2.35	3.21	2.48	3.32	2.89	2.18

Table B12: Individual weight and consistency check of indicators at all levels

level I indicator	Weight	level II indicator	Weight relative to level I indicator	Consistency check of indictor	Synthetic weight	level III indicator	Weight relative to level II indicator	Consistency of indicators	Synthetic weight
V	0.07236	V1	0.29070	$\lambda_{max}=2$ CI=0 RI=0 CR=0	0.02103	V11	0.2387	$\lambda_{max}=2$ CI=0 RI=0 CR=0	0.00502
						V12	0.7613		0.01601
		V2	0.70930		0.05132	V21	0.3145	$\lambda_{max}=2$ CI=0 RI=0 CR=0	0.01614
						V22	0.6855		0.03519
R	0.10065	R1	0.29070	$\lambda_{max}=2$ CI=0 RI=0 CR=0	0.02925	R11	0.1446	$\lambda_{max}=3.05572$ CI=0.0278 RI=0.58 CR=0.04803	0.00423
						R12	0.3028		0.00886
						R13	0.5526		0.01617
		R2	0.70930		0.07139	R21	0.1689	$\lambda_{max}=3.07763$ CI=0.0388 RI=0.58 CR=0.0669	0.01206
						R22	0.3429		0.02448
						R23	0.4883		0.03486
SC	0.12285	SC1		1	0.12285	SC11	0.1032	$\lambda_{max}=4.237219$ CI=0.079073 RI=0.9 CR=0.08785	0.01268
						SC12	0.1510		0.01855
						SC13	0.3191		0.03920
						SC14	0.4267		0.05242
S	0.27098	S1	0.09995	$\lambda_{max}=4.528$ CI=0.08428 RI=0.9 CR=0.09	0.02708	S11	0.0871	$\lambda_{max}=5.27392$ CI=0.06848 RI=1.12 CR=0.06848	0.00236
						S12	0.1048		0.00284
						S13	0.1575		0.00427
						S14	0.2412		0.00653
						S15	0.4094		0.01109
		S2	0.17576		0.04762	S21	0.1649	$\lambda_{max}=3.062379$ CI=0.0311 RI=0.58 CR=0.05377	0.00785
						S22	0.3148		0.01500
						S23	0.5203		0.02478
		S3	0.29395		0.07965	$\lambda_{max}=2$:			
						S31	0.3279	$\lambda_{max}=2$ CI=0 RI=0 CR=0	0.02612
						S32	0.6721		0.05354

		S4	0.43034		0.11661	S41	0.2967	$\lambda_{max} = 2$ CI=0 RI=0 CR=0	0.03460
						S42	0.7033		0.08201
SU	0.43316	SU1		1	0.43316	SU11	0.3546	$\lambda_{max} = 2$ CI=0 RI=0 CR=0	0.15360
						SU12	0.6454		0.27956

Table B13: Ranking of level III indicators' synthetic weights

1. Ranking	2. Level III indicator	3. Synthetic weight
4. 1	5. SU12: external attribute	6. 0.279560326
7. 2	8. SU11: internal attribute	9. 0.153604575
10. 3	11. S42: medical technological specification	12. 0.082009107
13. 4	14. S32: face-to-face medical treatment	15. 0.05353848
16. 5	17. SC14: compliance	18. 0.05241783
19. 6	20. SC13: professional skill	21. 0.039203441
22. 7	23. V22: autonomy in medical treatment reimbursement	24. 0.035185587
25. 8	26. R23: network transmission stability	27. 0.034857996
28. 9	29. S41: medical process specification	30. 0.034602999
31. 10	32. S31: physical medical care	33. 0.026116332
34. 11	35. S23: follow-up visit	36. 0.024779679
37. 12	38. R22: diagnostic result	39. 0.024477144
40. 13	41. SC12: attitude	42. 0.018547506
43. 14	44. R13: trust	45. 0.016169667
46. 15	47. V21: autonomy during medical consultation	48. 0.016140178
49. 16	50. V12: value a famous chief doctor with professional skills	51. 0.016014827
52. 17	53. S22: follow-up and make rounds	54. 0.014995079
55. 18	56. SC11: communication	57. 0.012677143
58. 19	59. R21: diagnostic process	60. 0.012057079
61. 20	62. S15: risk of diagnosis and treatment process	63. 0.011087151
64. 21	65. R12: care	66. 0.008858756
67. 22	68. S21: timeliness	69. 0.007851843
70. 23	71. S14: energy	72. 0.006533859
73. 24	74. V11: value the reputation of the hospital	75. 0.005020322
76. 25	77. S13: economic currency	78. 0.004266445
79. 26	80. R11: individuality	81. 0.004230683
82. 27	83. S12: spatial distance	84. 0.002837721
85. 28	86. S11: length of time	87. 0.002358246
88.	89. Total	90. 1

Table B14: Before the renovation - The process of remote patients receiving diagnosis and treatment services in the F hospital

The process of remote patients in Shanghai Pulmonary Hospital (before renovation)															
Steps		Distance (m)	Currency (Yuan)	Time (min)	Physician cooperation tightness (1-5 points)	Bringing level of knowledge (1-5 points)	Symbols				Improvement points			
							Operation ○	Movement ⇨	Waiting D	Auxiliary □	Elimination	Merging	Array	Simplification
1	On the way to the hospital								①					√
2	Patient registration									①				
3	To the waiting room							①						
4	Waiting in line								②					
5	Examination by physicians at Shanghai Pulmonary Hospital						①							
6	Go to pay							②						
7	Wait in line								③					
8	Pay									②				
9	Go to the examination department							③						
10	Wait in line								④					
11	Radiographic examination						②							
12	Wait results								⑤					
13	Take the test results							④						
14	Return to the department							⑤						
15	Physician ascertainment and communication						③							√
16	Identification of treatment options by specialists and patients						④					√		√
17	Prescribed medications						⑤					√	√	
18	Go to pay							⑥						
1	Wait in line								⑥					

The process of remote patients in Shanghai Pulmonary Hospital (before renovation)														
Steps		Distance (m)	Currency (Yuan)	Time (min)	Physician cooperation tightness (1-5 points)	Bringing level of knowledge (1-5 points)	Symbols				Improvement points			
							Operation ○	Movement ⇨	Waiting D	Auxiliary □	Elimination	Merging	Array	Simplification
9														
20	Pay									③				
21	Go to the medication pick-up window							⑦						
22	Waiting for medication								⑦					
23	Taking medicines									④				
24	Waiting for pulmonary hospital to arrange surgery								⑧			√		√
25	Operation						⑥							
26	Waiting for postoperative ward round								⑨					√
27	Make the rounds of the wards							⑧						√
28	Leave the hospital						⑦							
29	Follow-up visit							⑨						√

Table B15: Design of remote service information platform based on the perceived value of remote patients and its application value

Purpose of telemedicine in medical alliance	Healthcare providers in medical alliance	Process reconstruction design for patients' local medical care	Corresponding indicators of patients' perceived value	Corresponding information platform functions developed
1. Remain patients in the local area 2. Confer patient autonomy 3. Enjoy the homogeneous medical care service of core hospital	Alliance hospital + Core hospital	1. Patients make autonomous appointments in the local area	**V1：** -V11 -V12 **V2：** -V21 **S1：** S11 S12 S13 S14 S15	1.Self-help registration function 2.Relate WeChat platform with self-help registration function 3. List of experts' information 4.Registration of personal information (geographic location included) 5.Cumulative duration of visits
		2. Examination and assist communication of doctors of accession hospitals	**S4：** -S41 -S42	1.Information storage and read of examination report 2.Update of examination result 3.Telemedicine guideline service 4.Tracking information prompt service of examination 5.Smart diagnosis
	Alliance hospital + Core hospital	3. Face to face communication with experts	**SC1：** -SC11 -SC12 -SC13 -SC14	1.Video interaction 2.Service satisfaction evaluation for patients
		4. Experience the complete process of expert diagnosis and treatment process through multi-channel sound and video	**S3：** -S31 -S32 **R2：** -R21	1.Video interaction 2.Audio transmission during remote auscultation and physical examination 3.Remote image data transmission function for teleconsultation (communication between core hospitals and alliance hospitals) 4.Standardized and authorized electronic medical record information data sharing function

	5. Clear diagnosis (The attending specialist makes a diagnosis and gives treatment opinions. Referring physician writes, prints and completes the prescription, examination list and data system archiving and gives feedback to the attending specialist)	**SU1：** **SC1：** -SC13 -R22	1.Smart diagnosis 2Entry and display of consultation results and printing of prescriptions and review results 3. File of documents and data transmission to the attending specialist
Core hospital + Alliance hospital	6. Local hospital treatment (remote ward round)	**R1：** R11 R12 R13 **S2：** S21 S22	1.Satisfaction evaluation function for patients 2.Tracking of ward round time and number of visits 3.Medical record writing system of ward visits
Core hospital	7. Green channel for referral	**SU1：** SU11 SU12	
Core hospital + Alliance hospital	8. Access to core hospital's online extension service (remote follow-up visits)	**S2：** S23	1.Information storage and read of examination report 2.Update of examination result 3.Authorized sharing of electronic medical record

Table B16: Analysis of paired samples before and after remote patients' perceived value of seeking medical treatment

Comparative items		Mean value of paired differences		Standard deviation	Mean value of standard error	Difference value 95% confidence interval		t	DF	Sig.
						Lower limit	Upper limit			
Pairing 1	V11	FV11.2-FV11.1	-.038	.529	.034	-.105	.030	-1.100	238	.272
Pairing 2	V12	FV12.2-FV12.1	-.042	.585	.038	-.116	.033	-1.105	238	.27
Pairing 3	V23	FV23.2-FV23.1	-.042	.607	.039	-.119	.035	-1.066	238	.287
Pairing 4	R14	FR14.2-FR14.1	-.021	.618	.040	-.100	.058	-.523	238	.601
Pairing 5	R15	FR15.2-FR15.1	-.029	.575	.037	-.103	.044	-.787	238	.432
Pairing 6	**R16**	**FR16.2-FR16.1**	**-.113**	**.526**	**.034**	**-.180**	**-.046**	**-3.318**	**238**	**.001**
Pairing 7	R27	FR27.2-FR27.1	-.013	.569	.037	-.085	.060	-.341	238	.733
Pairing 8	R28	FR28.2-FR28.1	-.038	.537	.035	-.106	.031	-1.084	238	.28
Pairing 9	SC19	FSC19.2-FSC19.1	.004	.605	.039	-.073	.081	.107	238	.915
Pairing 10	SC110	FSC110.2-FSC110.1	-.059	.523	.034	-.125	.008	-1.730	238	.085
Pairing 11	**SC111**	**FSC111.2-FSC111.1**	**-.067**	**.506**	**.033**	**-.131**	**-.002**	**-2.045**	**238**	**.042**
Pairing 12	SC112	FSC112.2-FSC112.1	-.029	.553	.036	-.100	.041	-.819	238	.414

Pairing 13	S213	FS213.2-FS213.1	-.067	.618	.040	-.146	.012	-1.674	238	.095
Pairing 14	S214	FS214.2-FS214.1	-.008	.642	.042	-.090	.073	-.202	238	.84
Pairing 15	S315	FS315.2-FS315.1	**.033**	.634	.041	-.047	.114	.816	238	.415
Pairing 16	S316	FS316.2-FS316.1	**.084**	.662	.043	-.001	.168	1.954	238	.052
Pairing 17	S417	FS417.2-FS417.1	**.038**	.568	.037	-.035	.110	1.026	238	.306
Pairing 18	S418	FS418.2-FS418.1	**.008**	.550	.036	-.062	.078	.235	238	.814
Pairing 19	SU119	FSU119.2-FSU119.1	-.013	.538	.035	-.081	.056	-.360	238	.719
Pairing 20	SU120	FSU120.2-FSU120.1	-.017	.550	.036	-.087	.053	-.471	238	.638
Pairing 21	SU121	FSU121.1-FSU121.2	-.046	.574	.037	-.119	.027	-1.239	238	.217
Pairing 22	SU122	FSU122.2-FSU122.1	-.042	.533	.034	-.110	.026	-1.214	238	.226
Pairing 23	**S123**	**FS123.2-FS123.1**	**-2.117**	**.752**	**.049**	**-2.213**	**-2.021**	**-43.504**	**238**	**<0.001**
Pairing 24	**S124**	**FS124.2-FS124.1**	**-2.176**	**.650**	**.042**	**-2.259**	**-2.093**	**-51.731**	**238**	**<0.001**
Pairing 25	**S125**	**FS125.2-FS125.1**	**-1.720**	**.846**	**.055**	**-1.827**	**-1.612**	**-31.436**	**238**	**<0.001**
Pairing 26	**S126**	**FS126.2-FS126.1**	**-2.021**	**.631**	**.041**	**-2.101**	**-1.940**	**-49.478**	**238**	**<0.001**

Table B17: Standardized coefficient calculation of the revised model path of remote patients' perceived value of online medical services

Hypothesis	Model path			Estimate	Revised SE	Z	SE-SE	Mean	Bias	SE-Bias
H1	**VALUE**	**<---**	**EASE OF USE**	**.248**	.11	**2.255**	.001	.256	.008	.002
H2	SATISFACTION	<---	EASE OF USE	.064	.12	0.533	.001	.066	.002	.002
H3	VALUE	<---	USEFULNESS	.124	.137	0.905	.001	.118	-.007	.002
H4	**SATISFACTION**	**<---**	**USEFULNESS**	**.577**	.106	**5.443**	.001	.586	.009	.002
H5	**SATISFACTION**	**<---**	**VALUE**	**.163**	.088	**1.852**	.001	.161	-.002	.001
H6	**VALUE**	**<---**	**SYNERGY**	**.547**	.12	**4.558**	.001	.545	-.002	.002
H7	SATISFACTION	<---	SYNERGY	.187	.117	1.598	.001	.178	-.009	.002

Note: boldface indicates significant direct path

Annex C: Figures

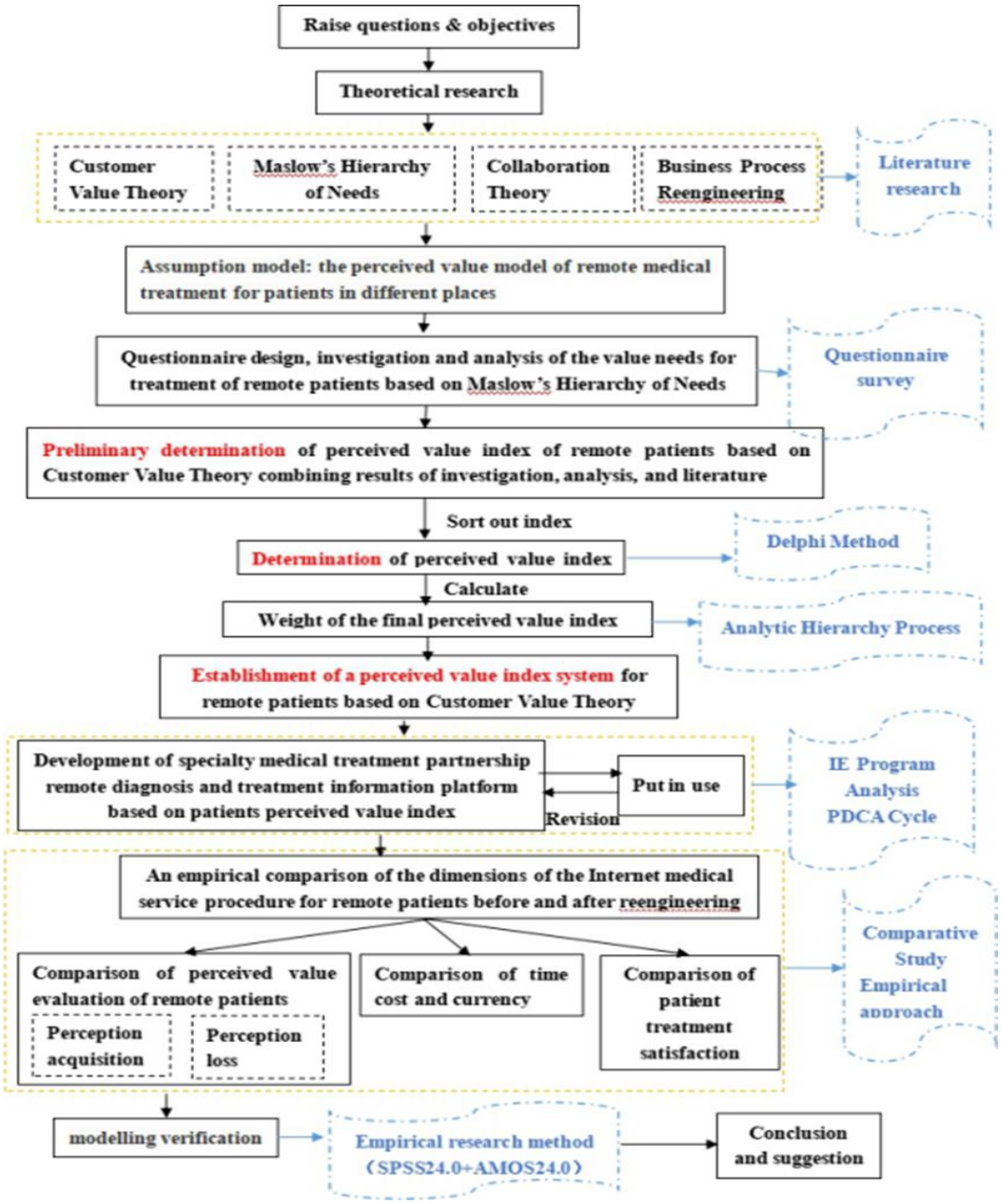

Figure C1 Technical route

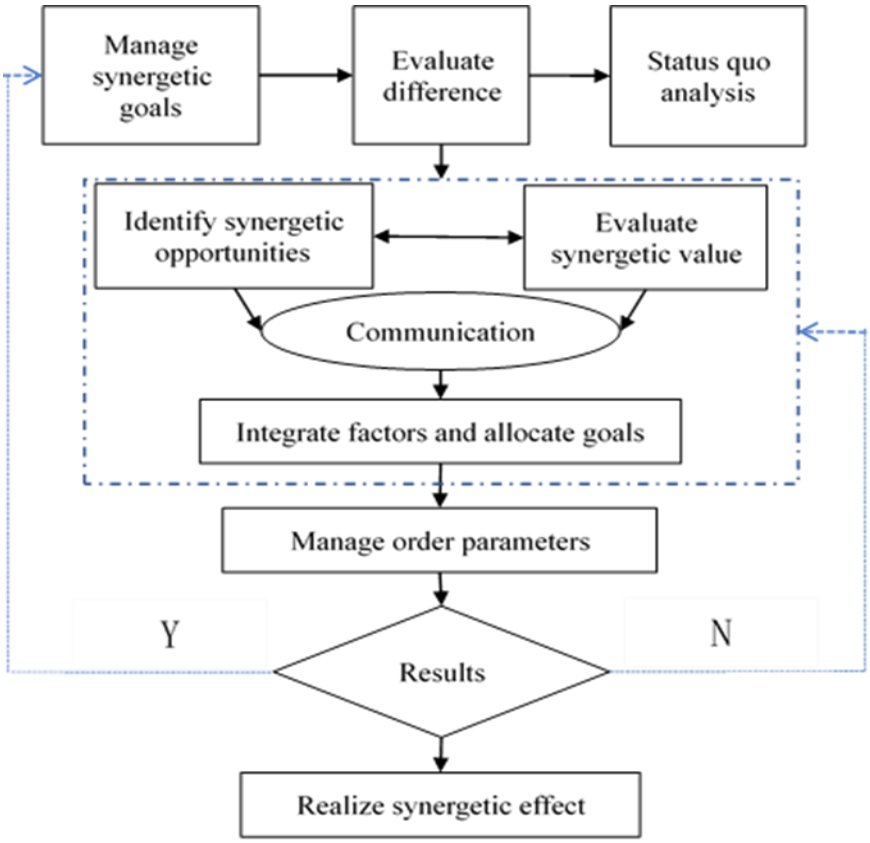

Figure C2 The model of managing synergetic process

Source: Haken (1970)

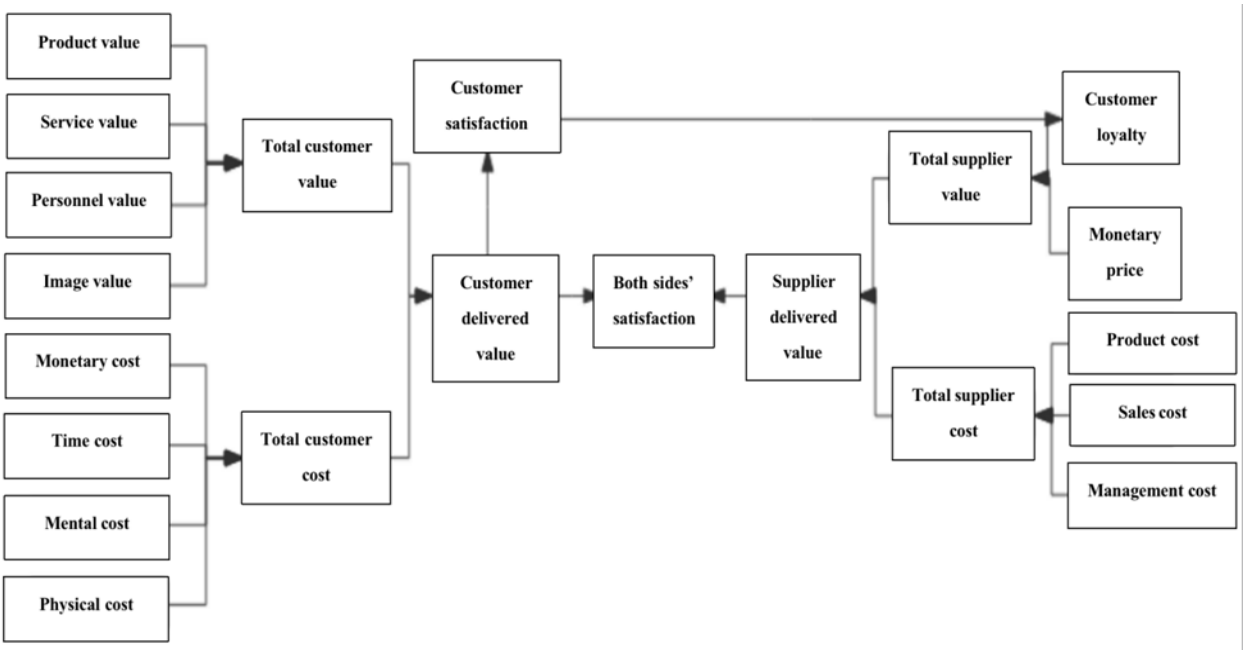

Figure C3 Model of customer delivered value

Source: Kotler (1996)

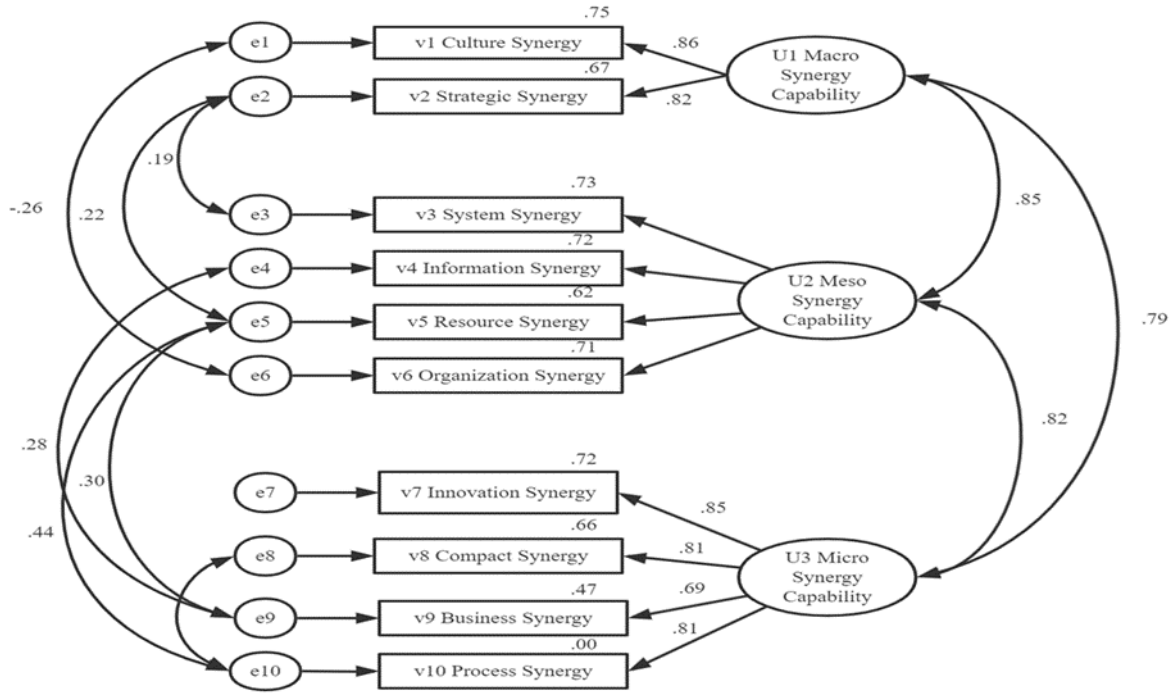

Figure C4 Research model on Synergy Capabilities of Public Medical Group in China

Source: Luo (2014)

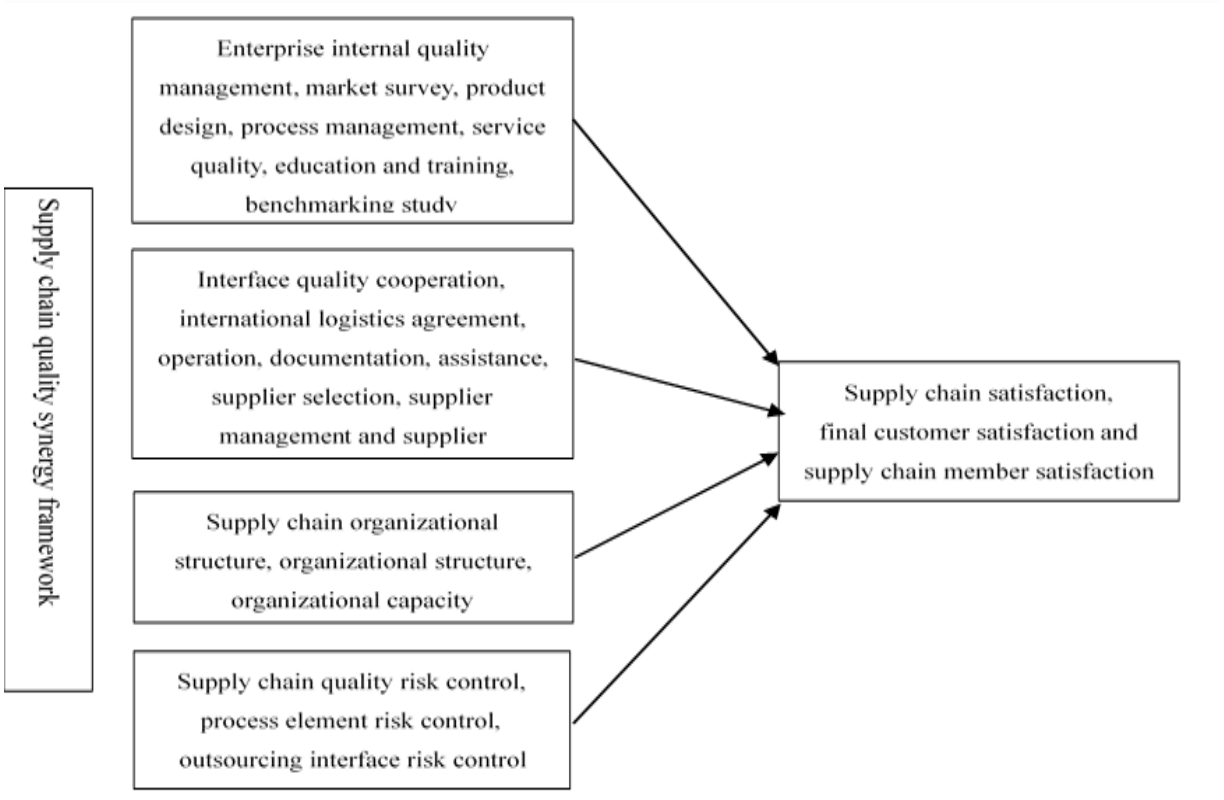

Figure C5 Model of the relationship between supply chain quality synergy and satisfaction

Source: Qu (2009)

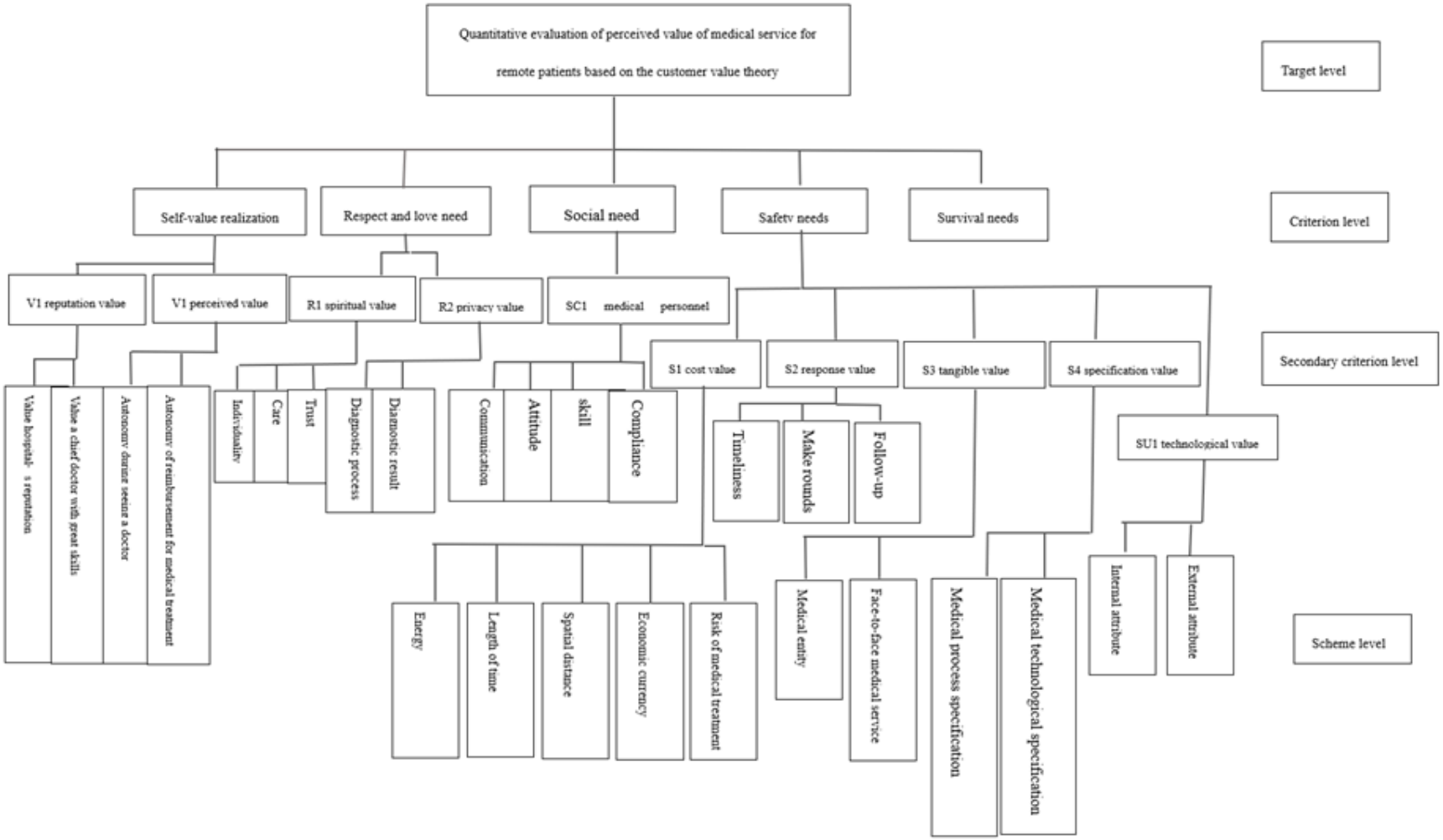

Figure C6 Hierarchical model of perceived value of online medical service for remote patients based on the customer value theory

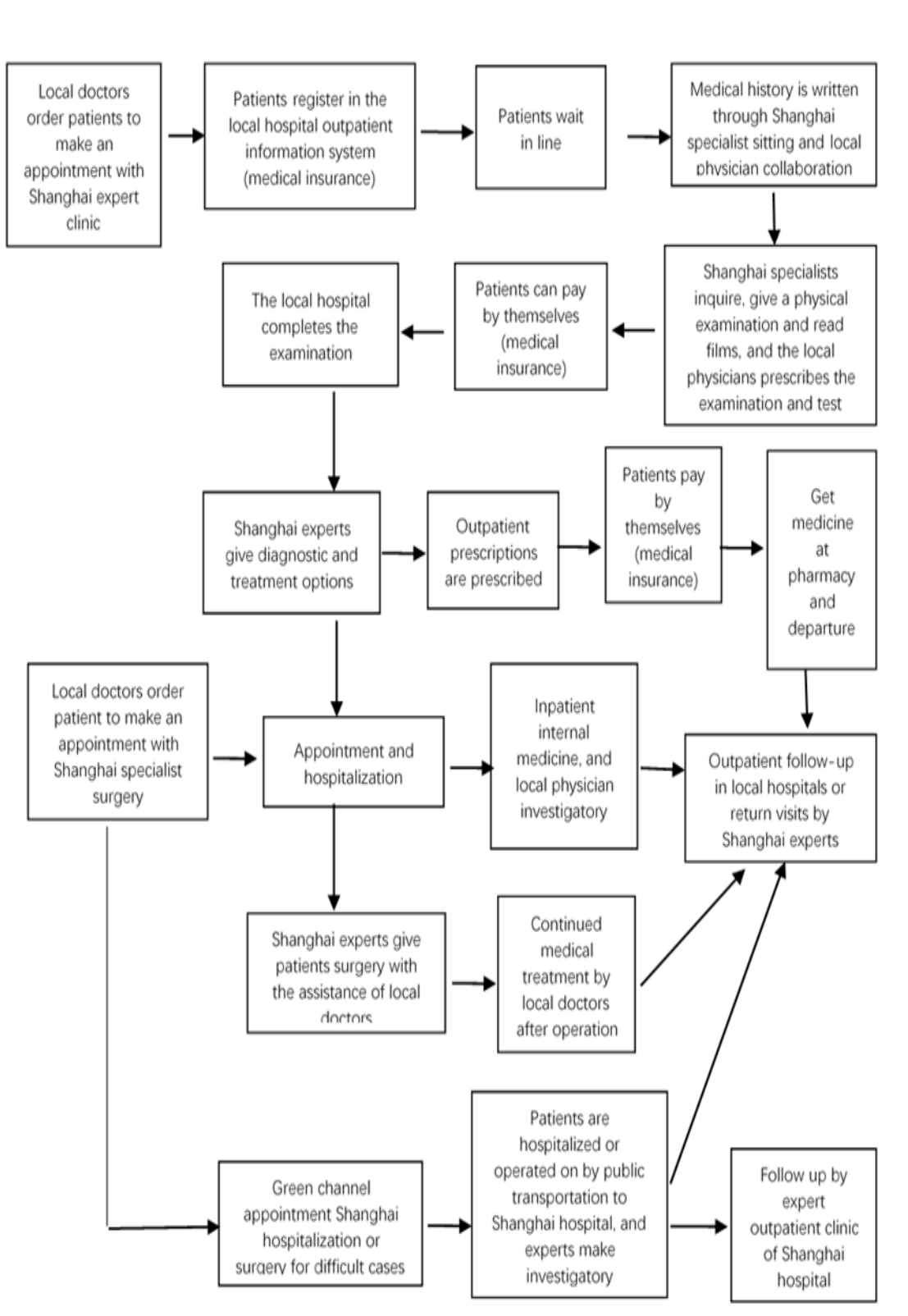

Figure C7 The process of traditional remote patients receiving expert consultation and treatment in the F hospital

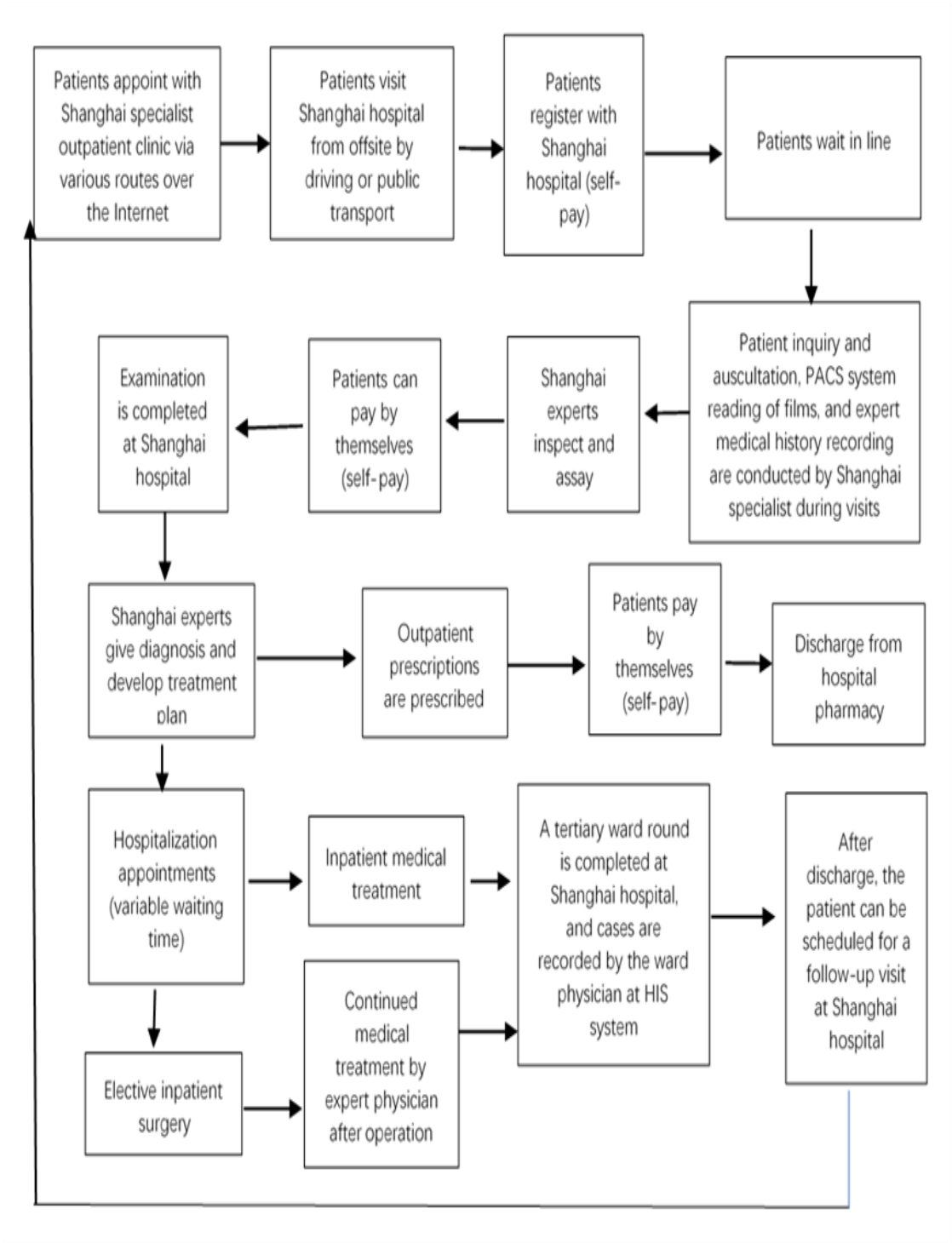

Figure C8 The process of remote patient visits to the F hospital

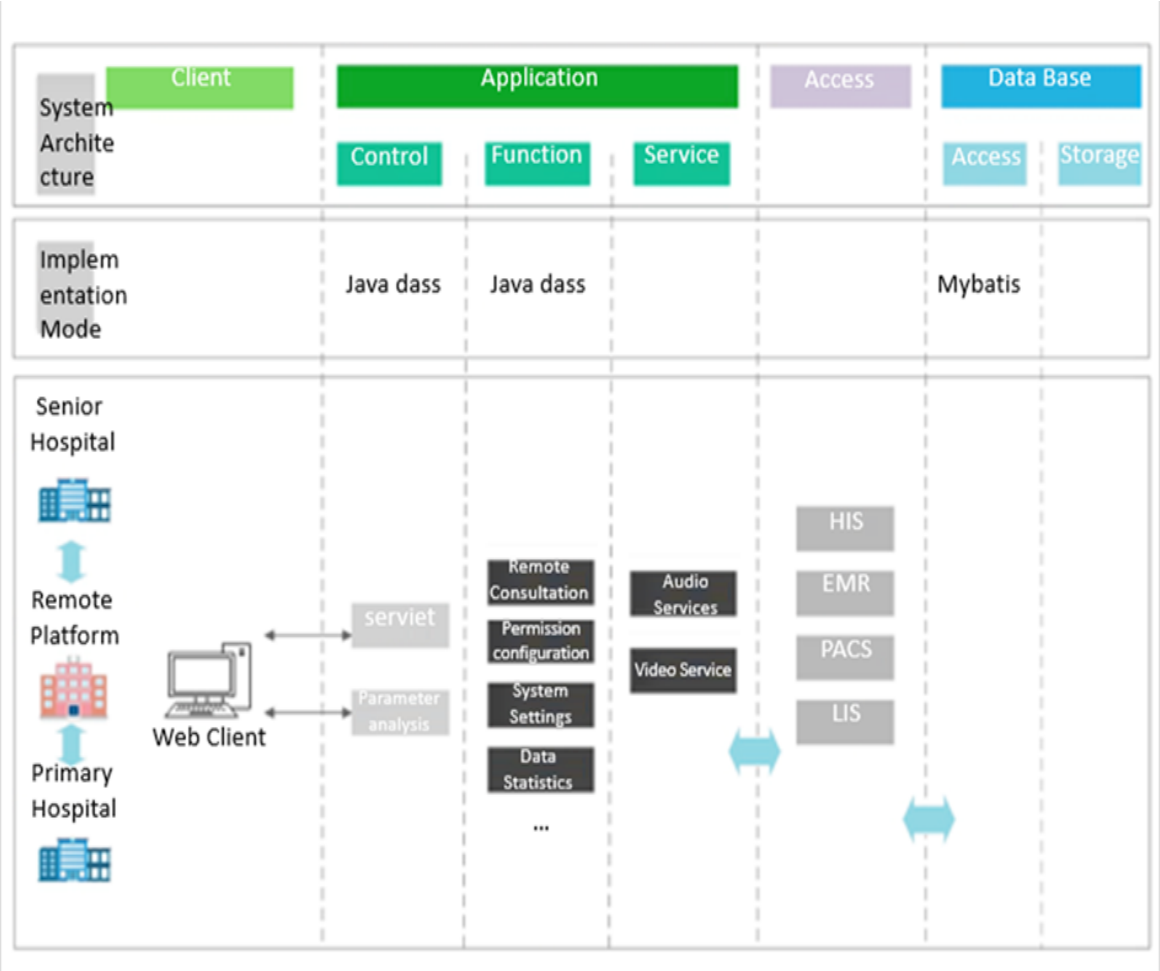

Figure C9 Diagram of the system structure

Figure C10 Expert's application of F hospital's remote service information platform

Figure C11 Outpatient's application of alliance hospital of F hospital's remote service information platform

Figure C12 Ward inspection's application of the alliance hospital of the F hospital's remote service information platform