ISCTE IUL
Instituto Universitário de Lisboa

Value Based Healthcare Delivery in China: an Exploratory Study

WANG Canghong

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

Doctor of Management

Supervisor:

Prof. Alvaro Rosa, Assistant Professor, ISCTE University Institute of Lisbon

July, 2018

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Attitude towards Value-based Healthcare Delivery in Chinese Hospitals

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Jury:
President: Luís Martins, Assistant Professor, ISCTE-IUL
Prof. Paulo Resende da Silva, Assistant Professor, Universidade de Évora
Prof. Fernanda Andrade, Assistant Professor, Instituto Politecnico de Setubal
Prof. Álvaro Rosa, Assistant Professor, ISCTE-IUL
Prof. Marina Andrade, Assistant Professor, ISCTE-IUL

July, 2018

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Declaration

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

Signed: 王仓红 Date: 2018.4.4

Name: Wang Canghong

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作者签名：王仓红 日期：2018.4.4

姓名(拼音)：Wang Canghong

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Abstract

The aim of this thesis is to focus on the attitude of medical services based on the Value-based Medical Model, and to construct a medical service attitude index evaluation system based on the Value-based Medical Model, guiding hospitals of China to achieve better diagnosis and treatment effect as well as lower cost of medical service.

The Value-based Medical Model continues to develop in China, and the medical service capacity and quality have improved year by year. However, at present, there is not yet a set of scientific evaluation index system suitable for China's national conditions to evaluate the attitude of medical service based on the Value-based Medical Model.

In our empirical study, the Delphi expert consultation method has been used and we have launched three rounds of expert consultation surveys and discussed on the rational of the experts, concentration degree of the expert advice, active degree, coordination degree, and authority in order to evaluate the effectiveness of which diseases shall be considered, the healthcare providers and payers perceptions for understanding the attitudes toward value-base medicine.

Finally, a set indicators was established and modified by using boundary value method according to experts' opinions, thus forming an evaluation system on value-based medical service.

Keywords: Value-based Healthcare; Medical Service Attitude; Hospitals Management; China

JEL: I10; I12

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Resumo

Este trabalho de investigação procura explorar como os hospitais chineses poderão melhorar a sua eficácia e diminuir os custos de diagnóstico e de tratamento através do foco na atitude de serviço médico e no modelo de saúde com base no valor. Adicionalmente, estabelecemos um sistema de avaliação de atitude de serviço médico.

Atualmente, não existe nenhuma implementação do modelo de saúde baseado no valor na China, um modelo centrado no próprio paciente e onde lhe permite um menor dispêndio para o tratamento que se quer realizar.

No trabalho empírico, usámos o sistema de avaliação de Delphi e fizemos três iterações de consulta ao painel de peritos e analisámos os racionais de decisão dos peritos, do nível de concentração das decisões, os graus de coordenação e de autoridade a fim de avaliar quais doenças e as perceções dos prestadores de cuidados de saúde bem como dos beneficiários no quadro de medicina baseado no valor.

Por fim, foi construído um conjunto de indicadores - estabelecidos com base no *método de valor fronteia,* em função da opinião dos peritos para avaliação da atitude de serviço médico baseado no valor.

Palavras-chave: modelo de saúde com base no valor; atitude de serviço médico; gestão hospitalar; China

JEL: I10; I12

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摘要

本文研究的目的是基于价值医疗模式下，聚焦医疗服务态度，构建一套基于价值医疗模式的医疗服务态度指标评价体系，指导中国医院实现更好的诊疗效果的同时降低诊疗费用。

价值医疗模式在中国持续发展，医疗服务能力和质量逐年提高，但目前尚未形成一套适合中国国情的、用以评价基于价值医疗模式的医疗服务态度的科学评价指标体系。

本文运用德尔斐专家咨询法，在确定选择专家和专家人数后发起了 3 轮专家咨询调查，并对研究方法合理性、专家的代表性、专家意见的集中程度、专家的积极程度、专家意见的协调程度和专家的权威程度依次进行了统计和讨论，获得了可靠的调查结果。

最后，使用界值法和根据专家意见对指标分别进行了筛选和修改，形成了一套比较科学的基于价值医疗模式的医疗服务态度的指标评价体系。本研究建立了基于价值医疗模式的医疗服务态度指标评价体系，可以作为基于价值医疗模式的医疗服务态度状况的评价工具。

关键词：价值医疗；医疗服务态度；医院管理；中国

JEL：I10；I12

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Chapter 1: Research Background

Looking at the global medical care industry, they are currently facing the trends of the rising costs of medical services year by year, the continuous intensification of industrial integration, and the constant evolution of medical organization structures with continuous complexity, the transparency of medical efficacy and the diversification of medical needs of patients. These trends are subverting the traditional medical models, putting various pressures on the medical service institutions. Based on this, some leading medical service providers advocate establishing a value-based healthcare delivery. This new medical management model is in line with the times trend, and will lead the transformation of management model of medical service institutions. For example, the advanced medical service providers of the highly developed countries including the United States, Sweden, Germany, etc., as well as the developing countries including India, have taken the lead in adopting this management model (Baumhauer & Bozic, 2016). Under this value-based medical care model, the medical service institutions must obtain higher medical service value through better diagnosis and treatment efficacy and lower diagnosis and treatment cost to enable itself to stand out from the fierce competition environment. And using "value" to promote organization transformation is already a common consensus in the medical care industry, as the medical care institutions that can create greater value for patients will have continuous competitive advantages. Therefore, the medical service institutions start to pay attention to "value" in the industry competition, and take "value" as the focus of competition. Of course, the medical service process needs mutual collaboration between the medical staff, which requires a common value mission between them. And this value-based medical service model focusing on diagnosis and treatment efficacy and cost can more effectively guide work direction of medical staff. Practice has proved that the value-based medical service model not only can more effectively operate medical service organizations, but also can make the medical services more effective (Su & Wang, 2018). Based on this, it has become an urgent need for medical service institutions to establish an assessment index system that can effectively guide medical

institutions to improve the value of medical services. At the same time, it has become a core issue for the transformation of global medical service institutions of how to continuously enhance the "value" of medical services through the constant rising of efficacy and the constant decline of cost. Meanwhile, the disclosure and sharing of efficacy data, medical care providers and the medical fee payers shall correspond to the value-based medical model. The efficacy data shall be shared in a timely manner to facilitate the medical care choice of patients and the medical service institutions to find more effective diagnosis and treatment pathway; The medical service providers use value to measure their positions in the industry instead of scale and quantity, so that those who create more value will obtain more rewards; The medical care cost is paid according to the value created by the medical institutions, instead of quantity.

As medical cost keeps rising in today, using "value" for payment will be able to effectively control the unreasonable rise of medical cost and help to solve the social problem of “being expensive to get medical care”. The value-based medical care is a new type of medical management strategy for medical service institutions to continuously improve treatment methods through constantly monitoring the efficacy of specific patients, analyzing the medical resources and costs for achieving this efficacy, obtaining medical effects (value = efficacy/cost) in the clinical pathway in monetary unit and regarding value as guidance. Therefore, the control of "value" is the key for value-based medical care model, in order to grasp the "value", we have to work on improving outcomes and lowering costs. Of course, there is little doubt that medical institutions around the world are working on controlling their medical costs (Thorpe & Ogden, 2010). Medical practitioners and policymakers pay more and more attention to “valued-based healthcare delivery” and define it as a type of cost-effective medical treatment, namely providing “lower price but better therapeutic effect”, ultimately turning into a definition as the following formula: the value of medical services equals the efficacy acquired by patients / fees paid for the treatment (Porter & Teisberg, 2006). Patient-centered care is the important content of Value-Based Healthcare delivery. Practices have proven that it is of great significance to improve patients’ satisfaction, cut medical costs, reduce medical complaints, strengthen the relationship between doctors and patients, and

elevate patients' dependence on doctors (Stewart et al., 1995; Lv & Guo, 2010). Some foreign scholars have already made in-depth studies concerning the patient-centered care, and evaluation tools have become relatively mature (Hudon, Fortin, Haggerty, Lambert, & Poitras, 2011). However, evaluation tools based on the value-based medical model have not yet been formed, as it is still in its exploratory phase and patient-centered care is mainly applied in grassroots medical care evaluation in China (He, 2009).

1.1 Value-based healthcare in China

The practice of Value-based healthcare should be centered on the needs of patients, and it is committed to maximizing patient value, which can help improve the quality of life of patients, enhance patients' sense of achievement, improve the doctor-patient's relationship and improve the effectiveness of medical resources utilization, and improve the survival rate of tumor patients, so as to achieve the service upgrade of Chinese tumor patients (Wu, 2017; Zeng & Liu, 2016).

In 2017, under the guidance of China Population Communication Center (CPCC) and the support of Bristol-Myers Squibb (a global bio pharmaceutical company, leading the industry in disease areas of hepatitis, tumors, and immune tumors, whose mission is to develop and deliver innovative drugs to help patients overcome serious diseases), Health point (a new media of medical health in the medical health industry from the perspective of family finance and new media), together with the China Cancer Rehabilitation Society (CCRS), jointly launched the project of "The Change of Value-Based Healthcare -- The Service Upgrading of Chinese Tumor Patients". This project has lasted for six months and carried out a qualitative investigation of 300 cases of patients and their families in 15 cities; and 28 subject researches for industry professionals in medical related fields have been conducted (Wang, 2017; Wu, 2017). The research focuses on the tumor diagnosis, treatment and prognosis of patients with full course of management, as well as comprehensively looking into the multilevel demand of tumor patients in different areas, with different kinds of cancers and different levels of income in the four dimensions of accessibility, affordability, sustainability and convenience. The

investigation found that 73 per cent of patients hoped to set up an integrated medical center so that tumor patients did not have to see doctors everywhere; even after the innovative drugs were approved for sale, 33 percent of respondents said many hospitals were not equipped with the new drugs; financial stress was the biggest difficulty, with 51 percent of respondents saying the drugs used by patients were not covered by medical insurance, 53 percent saying reimbursement was too low and 49 percent saying outpatient drugs could not be reimbursed (Wu, 2017; Wang, 2017).According to the results of the investigation, the *Chinese Tumor Patients Services Upgrade Report (CTPSUR)* was finally formed.Meanwhile, according to Chinese conditions, the *CTPSUR* also proposes the 5E directions of Value-Based Healthcare, namely, Efficacy, Efficiency, Effectiveness, Empowerment and Empathy (Wang, 2017). The 5Edirections have a guiding role in the availability of medical information of Chinese tumor patients found in investigation, the innovative drug availability, the improvement of medical service upgrade, medical payment improvement, patient care, and other improvement of needs, and even have reference significance for the application of non-tumor areas.

Therefore, on the needs of patients and healthy people, multiple key topic discussions have been carried out from various perspectives such as the level of medical application of new technology, service level, management level, payment of medical expense, aiming to seek methods and models to improve medical services. Shi Qi, deputy director of CPCC, said: "The incidence of malignant tumors is still on the rise and it brings heavy disease burden and economic burden to the country, society, patients, and their families, cancer patients and their families have a huge and urgent need for medical and health services, therefore, the application of Value-Based Healthcare in this field is in line with the development direction of ‘Focus on People's Health’, which is of great significance for exploration" (Healthpoint, 2017). Professor Shen Lin, Vice President of Peking University Tumor Hospital, said: "Since we advocate ‘Patient-Centered’, we need to change the mode of providing one-way service to patients from a single doctor to a Patient-Centered, multi-disciplinary cooperation for some incurable and acute diseases; and we need to explore the integrated diagnosis and treatment services for tumor patients through Multiple Disciplinary Team (MDT) with limited medical resources" (Wu, 2017). In response to the need for innovative drug accessibility, President Shi

Anli said: "China has been accelerating the review and approval of innovative drugs and achieved remarkable results, but in terms of hospital drugs availability, perhaps we can consider opening a green channel for innovative drugs against tumors." (Healthpoint, 2017). The Strategy of Healthy China was once again highlighted in reports of the 19th National Congress, in which it's pointed out that the national health policy should be improved to provide the people with all-round and full-cycle health services (Zeng & Liu, 2016). According to the *"Healthy China 2030" Program Outline*, the health management of chronic diseases in the whole population should be realized by 2030, and the overall five-year survival rate of cancer should be increased by 15% (Wu, 2017; Zeng & Liu, 2016). In the future, for the supply system which is based on "People-Centered Integrated Care (PCIC)", its final objective is to realize "Healthy China 2030 Program" and the "Dream of Healthy China" (Wu, 2017; Zeng & Liu, 2016).

Value-based healthcare delivery requires not only high medical quality and an ideal therapeutic effect, but also a reduction in medical costs, which means hospitals should adopt delicate medical cost management and accurate calculation of costs - a great challenge to Chinese hospitals featured by an extensive management mode (Shi & Zhang, 2010). Under the guidance of China's 13th Five-Year Plan, furthering the computerization of hospitals has been high on the agenda, and with the help of technology, hospitals are able to achieve meticulous cost accounting so that hospitals can reduce medical costs while ensuring therapeutic effects, thereby meeting the requirements of modern, value-based hospital management (Zhang & Wang, 2014). The development of genetic testing, however, is closely linked to interdisciplinary integration and cooperation - especially the profound integration amongst information technology, life science and medical technology (Tang, 2016). Such integration facilitates the conversion of genetic testing from single-gene to polygene and the assessment of a drug's therapeutic effect, which takes responsibility for patients' health and helps realize the goal of value-based healthcare delivery (Tang, 2016).

1.2 Current situation of valued-based healthcare around the world

The new value-based healthcare delivery, as put forward by Michael Porter, a professor at Harvard Business School, is a solution to problems identified in the American healthcare system (Porter & Teisberg, 2006). For example, Kaiser Permanente and Cleveland Clinic in the United States (US) have adopted value-based hospital management systems, and the effects of treatment for a specific patient are being monitored in this system (Hansson et al., 2014). Subsequently, the consumed resources and cost are compared with the effect; namely in the form of value equals effect/cost, so as to promote the continuous improvement of medical organizations, and thereby facilitating the enthusiasm of the medical staff so as to create a sense of value for their work (Hansson et al., 2014).

The Patient Protection and Affordable Care Act (PPACA) aimed for medical reform which was centered on value-based healthcare delivery and was carried out in US in 2010. Value-based healthcare delivery regards payment based on therapeutic effect as the final standard for compensation, which replaces the old medical payment mode which was based on clinic visiting times, and henceforth promotes American medical institutions to take precautions and make recoveries (BasePair, 2017). In 2015, President Obama announced his precision medicine plan and released the Precision Medicine Initiative white paper. From then on, precision medicine has aimed to reduce medical costs and improve therapeutic effects, and has aroused wide attention in the medical circle and represented the development direction of clinical medicine (BasePair, 2017). Doctors who charge medical fees based on clinical visiting times hope to earn increased income by increasing outpatients (BasePair, 2017). It requires doctors to provide comprehensive treatment, namely, overall treatment, which leads to the popularity of general practitioners (Cun, 2015a). Cun (2015a) found that the promotion of value-based healthcare delivery completely overturns traditional charging models and deals a knock-out blow to specialist physicians. The primary source of their income rests not on clinic visiting times but at value, which will drive specialist physicians to find another way of earning their means. Therefore, some specialists are moving to large hospitalsin the United States, and others are forced to choose to merge with other clinics to survive, bringing the greatest crisis of their careers to them.

After 4 years of healthcare reform in the United States, value-based healthcare delivery in the area of American basic healthcare has developed steadily and gained remarkable achievement (Cun, 2015b). For example, six million dollars has been saved in the town of McAllen in Texas in 2013 after 13 family doctors adopted valued-based models of medical compensation, as established by the Federal government of the US, while additionally the 13 family doctors earned 1.6 million dollars (Cun, 2015b).

Cun (2015b) argues that, in short, value-based healthcare delivery is popular among general practitioners of the United States. However, it is hard to effectively measure specialist physicians' service quality, which means that they should keep pace with the ongoing reform and the medical market and thereby adjust their charging modes. Specifically, what adjustments should be made? Specialist physicians can charge fees by means of providing package services or one-stop services, which are performed in some regions of the US (Cun, 2015a). For example, some tumor treatment hospitals in US provide remote medical services, and doctors can provide general and one-stop services for their patients in the terminal stages of cancer via remote medical equipment, which can reduce not only the amount of emergency room use, but also the proportion of hospitalization (Cun, 2015a). During the time when remote healthcare was not available due to the lack of corresponding compensation policies, patients had to see doctors in hospitals only. However, at present the value-based healthcare model in US makes mobile healthcare or remote healthcare accessible (Cun, 2015b). For example, the Act passed in April 2015 clearly defines the legality of tele-monitoring and tele-healthcare, and additionally states that the US Centers for Medicare and Medicaid Services (CMS) also recognizes the technology, which renders medical services not merely available in hospitals (Numerof & Abrams, 2016). Patients can readily obtain medical services as the time of diagnosis and treatment are reduced greatly, while doctors are willing to offer medical services through modern network technology (Numerof & Abrams, 2016).

Although American specialist physicians' package services are still on trial and how they may develop is still largely unknown, this round of medical reform in US does impact specialist physicians significantly. For example, the number of self-employed specialist physicians has decreased sharply year by year to the point where almost no specialist

physicians work among the American countryside and remote areas (Cun, 2015b). The rocketing development of digital healthcare in US can indeed be attributed to value-based healthcare, since without the emergence of a value-based healthcare model driven by the medical market in America and its resulting policies, such remarkable achievements could not have been made in digital healthcare (Cun, 2015b).

Around the globe, a rising group of medical providers attach great importance to high-quality value-based medical services (Hansson et al., 2014). In 2012, an NGO called International Consortium for Health Measurement (ICHOM) was established by Michael E. Porter's Institute for Strategy & Competitiveness under the Harvard Business School, the Sweden Karolinska Institute, and the Boston Consulting Group (BCG). Gathering together patient representatives, specialists and disease registration centers, the organization designed KMI as a set of indicators for global medical treatment (Hansson et al., 2014). In November 2013, ICHOM published standard indicators for cataracts, coronary artery disease (CAD), localized prostate cancer and lower back pain, which raised the great interest of approximately 200 hospitals (Hansson et al., 2014). Later in 2014, another set of standardized measuring indicators for eight diseases was published, which indicated the development of this trend (Hansson et al., 2014).

In Sweden, two Swedish hospitals, originally ranked 43th and 68th respectively in the ranking of 77 Swedish hospitals, rose to 22th and 45th respectively and reduced mortality rate from myocardial infarction by more than 50% in a year through improvement in medical quality (Yao, 2013). Other countries followed the example of Sweden by publicizing their data concerning the effects of medical treatment. For instance, US Consumer Reports and the Society of Thoracic Surgery together evaluated and compared patients' complications, survival rate and other indicators in 363 surgical organizations offering coronary bypass operations, and the England branch of the British National Health Service released data regarding medical quality and survival rate of ten diseases, among which 96% of the surgeons were willing to release the data of their medical performance (Batty, 2013).

From this information, patients who are to receive operations could compare the survival rate, complications and additional indices concerning medical quality, providing further

benefits for medical institutions with outstanding outcomes (Clawson, Lawyer, Schweizer, & Larsson, 2014). One example of this data disclosure in action is the prostatic cancer treatment center, Hamburg's Martini-Klinik, which is attached to the University Medical Center Hamburg-Eppendorf. The number of people that went to the treatment center increased by 3 times over the span of 2005 to 2013, as two thirds of the patients came from places outside of Hamburg and other far-away countries, making Martini-Klinik the largest prostatic treatment center in the world and also ranking among the top (Clawson et al., 2014). This clinic requires every surgeon to record specific patient data, including complications, during the treatment process. They found that the number of patients suffering from severe erectile dysfunction within one year of surgery was less than half of the average level of that of Germany and that cases of urinary incontinence only accounted for one seventh of that of Germany (Clawson et al., 2014).

In India, the Narayana Hrudayalaya (NH) Center for Cardiac Surgery, as established by Devi Shetty, a famous Indian general surgeon, opened up in the suburb of Bangalore in 2001. Focusing on cardiac surgery, the NH hospital has rapidly expanded over ten years spanning from 2005 to 2015. On November, 2015, located in 19 cities in India, the NH Hospital Group had 57 hospitals with 57 surgery centers and was comprised of the Department of Ophthalmology, Department of Traumatology, Department of Oncology, Urology Surgery Center and Gastrointestinal Surgery Center, as well as specialized and comprehensive departments, as there were over 5,600 beds in the 57 surgery centers (Han, 2016). The NH Center for Cardiac Surgery now becomes a typical example promoting value-based healthcare in the world (Lao, 2014).

The NH Center for Cardiac Surgery in India, as a paradigm of value-based healthcare in the world, interprets the relationship between price and value. Identical cardiac surgeries such as coronary bypass operations cost between 5,000 to 7,000 dollars in other places in India and 50,000 dollars in America, although only 3,000 dollars at the NH Center for Cardiac Surgery (Chen, 2015). Such great price reduction relies not on jerry-building but on a great number of patients, optimized procedures and economical large-sized purchasing. The Center gains patients not by advertisements but by superb medical skill and a good reputation. At the NH

Hospital, all the cardiologists perform 2 – 3 cardiovascular operations every day, and work 60 – 70 hours a week, while performing over 700 surgeries in a year (Chen, 2015). Certified by JCI, NH welcomes patients from about 76 countries in the world, and as a leader in cardiac surgery with the success rate of 98%, it rivals some best hospitals in the world like the Mayo Clinic in America (Chen, 2015).

Why is India's NH Hospital so successful? The answer is its value-based healthcare delivery featured by better therapeutic effect at a lower price. However, Han (2016) has stated that existing private hospitals in China emphasize advertisement-based low price marketing strategies, in that they first attract patients by means of low price and then make patients spend more. Comparatively, the NH Hospital benefits patients a lot, and patients are diagnosed and treated with a relatively small quantity of funds required. This raises the question of why Chinese hospitals do not follow the example of the NH Center? Han (2016) argues that since Chinese hospital managers are strangers to value-based healthcare delivery and even the whole medical circle lacks recognition for value-based healthcare delivery, this hospital model has not yet been implemented.

Nowadays, competition in the medical industry is fierce (Clawson et al., 2014). For example, some hospitals pursue lower costs at the expense of therapeutic effect, some try to increase income by adding checking items, also some make use of their advantage in certain areas to control or dominate the price (Clawson et al., 2014). However, the ultimate goal of saving lives and providing cost-effective medical services is realized only by value-based healthcare delivery (Clawson et al., 2014). Moreover, Clawson et al. (2014) consider that making data related to therapeutic effect public can not only award individuals and hospitals with excellent therapeutic effect but likewise encourage all the participants in medical services - including medical service providers, payers, medical equipment manufacturers and patients alike - to work together towards the common goal of value-based healthcare delivery.

It is no doubt that there are both winners and losers in market competition when value-based healthcare delivery is promoted. The principle of competition will not change fundamentally. Losers in competition are manufacturers and hospitals which cannot create valuable medicine, or medical products, and provide less effective medical equipment for

patients, while winners in the competition are competitive institutions that can get access to and carefully analyze clinical data and can resort to effective partnership to innovate value-based healthcare delivery (Thorpe & Ogden, 2010). As the development of the medical industry value chain asks for further resource integration and the realization of networks, the roles of participants, competitors and cooperators will intermingle with each other (Thorpe & Ogden, 2010). Additionally, forerunners of value-based healthcare delivery will gain an advantage over competition because they can get access to the most optimized information, data and the best partners, as well as learning new knowledge and inspiring thoughts in innovation - which may not available for late comers (Clawson et al., 2014). Up until now, no country in the world has clearly established a medical system comprising of value-based healthcare delivery. This model, however, has already shown up in medical institutions under different medical systems worldwide (Thorpe & Ogden, 2010).

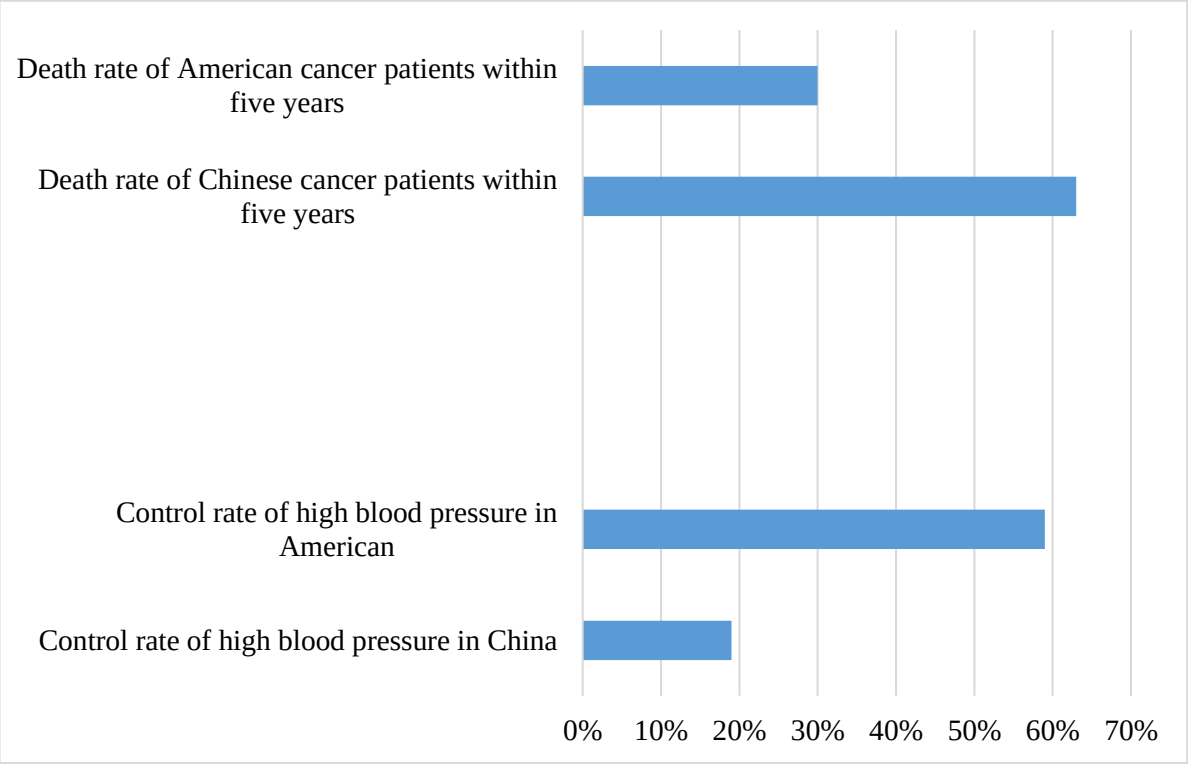
1.3 Significance of the value-based medical model for the development of the China’s medical system and healthcare

The report *Medical Value: Laying the Foundation for the Transformation of Medical System*, jointly released by the World Economic Forum and the BCG on November 8, 2017 points out that medical providers, medical expense payers and policy makers are always haunted by the issue of how to control medical costs (Chinese Journal of Health Care Nutrition, 2017). With the unsustainable rapid growth of global health care expenditures and significant differences in efficacy among major medical service providers in recent years, the value-based medical care is on the way under the context of controlling medical costs and seeking the best therapeutic effects by various countries around the world.

Now, China’s medical and health industry is facing two severe challenges: huge, increasing disease diagnosis and a treatment burden, as well as significant increase in medical service quality and efficacy compared with Western developed countries. In terms of the country’s disease burden, the Ministry of Health predicts that China's total medical expenditure will reach 600 million RMB in 2020 (World Natural Medicine Organization

Health Promotion Association, 2016). The proportion of total medical expenditure in GDP will also increase from 4.9% in 2010 to 6.5%-7.0% in 2020 (World Natural Medicine Organization Health Promotion Association, 2016). Such rapid increase in medical expenditure is the result of several factors, including an aging of Chinese population, the increase in the prevalence rate of chronic diseases and major diseases such as high blood pressure, diabetes and cancer, as well as poor medical treatment. In terms of population aging, the Chinese population over 65 years old has already accounted for 10.5% of the total population by the end of 2015 (Ministry of Civil Affairs of PRC, 2016). This proportion continues to rise. There are great differences in medical quality between China and developed countries (see Figure 1-1). For instance, China's treatment rate for chronic diseases (such as diabetes and hypertension) and cancer mortality are significantly different from those in the United States; the control rate for hypertension in China is 19%, while the rate in the United States reaches up to 59% (World Bank, 2016); the mortality rate of cancer patients in China is 63% within 5 years and while the rate in the United States approaches 30% (Chen et al., 2016; Siegel, Miller, & Jemal, 2015). Moreover, significant differences also exist at the medical level among hospitals at different levels or at same level in China. For example, only 26% of clinical diagnoses are correct in township hospitals, while the ratio of invalid or harmful drugs prescribed by doctors is up to 64% (Sylvia et al., 2015). The in-hospital mortality rate following coronary artery bypass grafts is ranged from 0.7% to 5.8% amongst the same grade of top three hospitals (Xia, Wong, & Larsson, 2017).

Figure 1-1 Medical Quality Comparison Chart between Sino-US Cancer and High Blood Pressure



Source: World Bank. (2016); Chen et al. (2016); Siegel et al. (2015)

Due to an ever-increasing gap between the medical expense burden and curative effect, China also needs to control medical costs while improving the quality of medical services. Value-based medical care is devoted to addressing the issue. Based on the achievements of value-based medical care in other countries, the development of value-based medical care becomes increasingly urgent and important in China. By making good use of the value-based medical model, China's medical service providers can achieve better development, and doctor-patient conflicts can be alleviated.

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Chapter 2: Problem and Question of Research

2.1 Objective of research

The objective of this study is to construct a set of evaluation system of medical service attitude index on the basis of the value-based medical model, and provide reference for the promotion and implementation of value medical model in China. It is guided by the theory of value medical treatment, based on the attitude towards value-based medical model and combined with the characteristics of medical providers, medical expense payers and curative effect data sharing. It is expected to provide reference basis for evaluating the implementation of the value-based medical model, and promote the value medical model to be more patient-centered in the process of consultation, so as to improve the quality of medical service and reduce the cost of medical treatment, achieving a win-win situation for both doctors and patients.

2.2 Problem of research

The value-based medical model can solve the problem of improving medical quality while reducing medical costs. With the continuous development of the value-based medical model, the application of this model has achieved remarkable results. 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.

2.3 Research questions

Concerning the problem of the necessity to improve the medical quality through reducing medical costs, in our thesis we would evaluate possible attitude toward value-based

medicine through the three approaches:

1. How are the treatment costs and curative effect for specific diseases are perceived?
2. How are the medical expenses from the providers point of view are regarded?
3. How are the medical expenses from the payers point of view are regarded?

Based on value-based medically-relevant theories, this study uses the Delphi consultation method to establish a set of value-based medical service attitude indicator evaluation systems from efficacy data sharing, medical providers and medical expense payment providers in order to guide the Chinese medical community to realize the worth of the value medical model and vigorously remove factors which have constrained the implementation of such a model in China. In terms of efficacy data sharing, such as the popularization and application of emerging medical and healthcare technologies, medical computerization, therapeutic medical policies, and data collection and sharing of treatment costs, which allow for a curative effect for specific diseases of poor execution. Clawson et al. (2014) from the BCG team argue that medical research institutions are able to acquire data for processing and integration, forming medical big data, promoting efficacy improvement and cost reduction only when medical data is disclosed and shared. Dai Tao (Deputy Director of the Medical Science and Technology Development Research Center of the NHFMC and committee member of the Medical Information Commission of the Chinese Medical Association) pointed out: "medical health big data is related to the health and livelihood of the people, is related to healthcare services, health policy and medical research data, such as personalized treatment, prevention and medicine - medical data supports all our health needs" (Deng, 2018).

In terms of medical providers, a specific evaluation indicator for medical service attitude is lacking for Chinese medical providers for the implementation of value-based healthcare delivery in China, and this results in Chinese medical providers lacking recognition of value-based healthcare delivery altogether. Peng, Chang, and Ruan (1982) believe that the feelings and emotional needs of patients is an important part of value-based healthcare, such that its requirements are to turn the traditional biomedical model into bio-psycho-social model. This new model requires professional skills, as well as the sociological and psychological

knowledge of doctors, such that it is a challenge for doctors and calling for the redefining of a doctor's role (Zhao, 2017). Valued-based healthcare delivery advocates the participation of patients in the whole medical treatment process, causing it to be labeled as "participatory medical treatment" (DeBronkart, 2015). According to Health Point research on tumor patients, almost 60% patients are overly stressed, and they seek psychological consultation and care from their families and the medical staff (Zhao, 2017).

Martin J. Murphy, the honorary president of the American Society of Clinical Oncology (ASCO) and the founder of *The Oncologist* magazine, has commented that every year, ASCO invites patients to attend the annual tutor treatment conference and holds discussion with patients about how to provide care to tumor patients; however, at the Chinese Society of Clinical Oncology (CSCO) conference, only the "unilateral" voice of the medical field is heard, while voices of patients have been absent until now (Yu, 2016). This goes against the People-Centered Integrated Care (PCIC) promoted by the World Health Organization (Liang, 2017). According to the PCIC, it is emphasized that people participate in health management, and patients have the right to know and the right to make decisions during the medical process (Liang, 2017). There is a lack of innovation in treatment in China, and a good example is how current tumor treatment and medicine in China are still being performed under a traditional style (Zhao, 2017). These traditional therapies may not be so valuable for patients since they tend to be accompanied with side effects, high expenses and physical pains. China performs poorly medicine introduction to new patients, so new medicines cannot be delivered to those in need in time (Tang, 2017). For example, according to the research of Health Point, a new media source in the medical health industry, 36% of patients generally believe it is challenging to obtain new medicine, while the rate rises to 43% in terms of patients in small and medium-sized cities (Tang, 2017).

In terms of medical expenses payment providers, the Chinese medical payment system restrains the promotion of value-based healthcare delivery, seeing as how the payment system also lacks a specific evaluation indicator for medical service attitude for the implementation of value-based healthcare delivery in China. Zhao (2017) believes that China has completed the procedure of including new medicine into healthcare insurance system, however the

implementation of policies are not so effective; meanwhile patients have still not truly benefited from the policies in place since it remains difficult for them to obtain reimbursement for new medicine. At the same time, Zhao (2017) also believes that a possible solution lies in establishing a multi-layered medical payment system encompassing social healthcare insurance, business insurance and special assistance, which will help with insufficient payment ability. Professor Liu Guo'en believes that business insurance should not be regarded as a supplement to medical payment, but rather should be granted the same importance as social insurance (Zhao, 2017).

2.4 Research design

First of all, the literature research method is adopted. Search for relevant literature in major authoritative journals at home and abroadand on the Internet with keywords such as value medicine, medical service attitude, index evaluation system and Delphi method. The goal is to search for literature on all aspects related to the topic. The literature is sequenced and organized, and is read through and the review notes are taken.

Second, the Delphi method is used. According to the expert's working years, professional field, knowledge structure, workplace, and academic qualifications and professional titles, this study selects 30 experts as the object of consultation for 3 rounds of consultation. The design of the questionnaire questions is very important in this consultation, and the questionnaire questions must be supported by the literature. In order to ensure the results are scientific and logical, when designing the questionnaire, several entries were designed, including problem importance evaluation, operability, full mark rate, judging basis, and familiarity, while each entry was given a value domain, and options were provided for marking and evaluation. At the same time, in the evaluation and suggestion entry, a qualitative method was adopted for experts to express their views freely according to their own experience.

Third, the statistical method is accepted. Organize and analyze the results of the survey and draw conclusions based on expert opinions. At the same time, we shall discuss from the following six aspects when carrying out the statistical analysis on the survey results:

1. Calculate the authority degree coefficient of the expert according to the familiarity degree coefficient on index and judgement degree coefficient of the expert, and discuss it.

2. Calculate the coordination degree coefficient of the expert opinions on index and discuss it.

3. Calculate the motivation coefficient of the expert through the return rate of each round of questionnaire and discuss it.

4. Calculate the concentration rate of expert opinions on index through arithmetic mean and full score frequency and discuss it.

5. Discuss the representativeness of the experts in the survey.

6. Select the index by using the boundary value method and combining with the expert opinions to form the final index system.

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Chapter 3: Theoretical Background

The following three main theories were employed throughout the investigation of this thesis: Delivered value, Value-based healthcare, Competing on outcomes and Patient satisfaction.

3.1 Delivered value

Following an extensive review of literature, the customer delivered value theory was proposed in 1994 by the American marketing professor Kotler, who analyzed the business behavior of enterprises from the perspective of consumers. Kotler believes that in modern marketing, the reason why customers buy a product or service is that the seller provides the product or service with the maximum customer delivered value to the buyer (Kotler & Keller, 2012). Here, Kotler defines the customer delivered value as the difference between the total value of a customer's acquisition of a product or service and the total cost paid by the customer for the purchase of the product or service. Then, what is the total customer value? What is the total customer cost? Kotler argues that total customer value is the total benefit that the customer receives from a product or service, such as product value, service value, personnel value, and image value, while the total customer cost is the various costs of money, time, psychic and energy that a customer pays when using a product or service (Kotler & Keller, 2012). This theory tells us that if we want to get more customers, we shall make an analysis of the total customer value and total customer cost, that is, higher total customer value and lower total customer cost, which is also the basis of customer delivered value. Applying this theory to the medical system of China will effectively solve the current problem of "being difficult and expensive to get medical care". Han (2010) believes that the current difficulty in getting medical care in China is due to the unreasonable allocation of medical resources, and excessive concentration of high-quality medical resources. All of these cause

the excessive concentration of patients, and so many patients do not choose to seek medical care nearby but go to large-scale and high-quality hospitals far away, causing the crowding of these high-quality hospitals. And the crowding phenomenon then leads to the forced compression of doctors' diagnosis and treatment time for individual patient, causing the phenomenon of "being difficult to get medical care". As for the reason of "being expensive to get medical care", part of it is due to "being difficult to get medical care", and the other part is to seek answers from the process of drug production, circulation and reaching patients (Han & Wang, 2009). Presently, except some large scale and high-quality hospitals (e.g. Tertiary A Hospital), most public and private hospitals in China are free and lack of patients, causing the medical resources to be idle and wasted. Therefore, to solve these difficulties, hospitals need to attract more patients to get medical care in them as well as enterprises do. Then, how to attract patients? We shall use the customer delivered value theory well to make hospitals think from the perspective of patients that how can make the patients receive more delivered value. Thereby, hospitals can also get more patients. This is because the best way for an enterprise to attract customers is to make them receive the maximum delivered value (Han, 2009). In short, it is to let customers get the most satisfied products or services with the least money. Similarly, in the medical process, patients will also choose those medical service institutions that are cheaper but have better medical services. Therefore, increasing the total value of patients and reducing the total cost of them can attract more patients to come to get medical care. According to the total customer value in the theory of customer delivered value, the total value of patients is the medical product value, medical service value, medical staff value and hospital image value; the total cost of the patients is the cost of money, time, psychic and energy spent by them when getting medical care. However, these cost elements of patients can not be measured except for the currency cost, and there is no measurement reference, which is not operable in reality.

It was found that although China had explored delivered value, relevant documents concerning the topic remain few in number. Some research addressing the subject will be discussed. In Medical Institution Marketing, Ding (2005) put forward the concept of delivered value of a patient, which is the total medical value minus the total medical cost of a patient.

Zhang, Sun, and Zhao (2007), who work in the central hospital of the 60th People's Liberation Army (PLA) Hospital in Dali, Yunnan elaborated how can people increase the delivered value of a patient in their essay entitled *Measures to Increase Patient Delivered Value*. In the book, they believe that medical workers can improve a patient's total medical value by improving the value of a hospital's medical technology, patient service quality, the general skill level of all staff, and its brand image; on the contrary, they can reduce a patient's total medical cost by lowering a patient's cost for treatment, as well as time and energy cost during the treatment. It was found that after introducing the delivered value in the central hospital of the 60th PLA Hospital in Dali, patients' satisfaction and the market share of the hospital has increased dramatically (Zhang et al., 2007). The number of patients who received medical treatment in the hospital had increased and the hospital's revenue had also increased year by year (Zhang et al., 2007).

Concerning the delivered value, Han (2016) believes that if a patient's total medical value is lower than his/her medical cost, the patient must be very unsatisfied and they would feel they have suffered losses or would make a complaint directly; if the total medical value is equal to the cost, the patient will consider that the medical service quality of the hospital is mediocre and they may go to another hospital to receive better medical treatment when they are sick next time; if the gap between the value and cost is considerable, the patient may sue the hospital and ask for compensation when medical negligence happens or medical disputes occur, resulting in the intensified conflicts between doctors and patients. Han (2016) has stated that the number of hospitals in every city is substantial and patients' demands can be met easily now, therefore if a patient's total medical value is higher than the cost, he will be satisfied. For example, if a patient who suffers from gonitis could walk without pain after receiving short-term medical treatment on the knee, and they do not need to spend a lot of money on the treatment, the patient will be satisfied with the treatment effect, allowing the hospital to generate public praise (Han, 2016).

The gap between the value and the cost of a patient is the delivered value (Han, 2016). Han (2016) believes that the idea of delivered value is very good, although it is unquantifiable,

and problems often occur when delivered value is applied to medical institutions due to a lack of standards. For example, it is difficult to know how a patient might be satisfied with a hospital's medical environment; additionally, in consideration of the difference between varying patients' financial situations, although patients spend an identical amount on medical treatment, they may have different expectations regarding the treatment effect of the same disease, which means that not all of them would necessarily be satisfied with the treatment (Han, 2016). Therefore, replacing the delivered value system with the patient-centered value-based healthcare delivery is well received in the healthcare industry (Han, 2016).

In July 2016, a research report *Deepening Health Reform jn China: Building High-Quality And Value-Based Service Delivery* was released in Beijing, China. The report points out that the current hospital-centered model laying particular emphasis on the number of services and drug sales should be transformed into an integrated value-based healthcare delivery that focuses on health outcomes and places greater emphasis on improving the quality of basic health services and establishing an integrated high-value-based healthcare delivery system (World Bank, 2016). It is a great stride forward for medical awareness in China from focusing on the number of medical treatments provide to the outcomes of treatment, and it also serves as an embodiment of value-based healthcare services. However, as for concrete suggestions put forward in the report, such as creating a new model of People-Centered Integrated Care (PCIC) and how to create it, the concrete measures and indicators concerned are not yet provided. Numerof and Abrams (2016) argue that people-centered care firstly lies above all in the transparency of healthcare, which includes not only the transparency of price, but also that of treatment effectiveness. In this respect, Priority Health has taken the lead. As early as August in 2013, it has put forward a plan of publishing healthcare quality and costs, which aims to make it easier and faster for patients to review and compare the prices and treatment effectiveness of more than 300 medical services that are most common to people (Fronstin, 2013).

Needless to say, treatment effectiveness is somewhat conspicuously crucial to the patients. However, why does Priority Health so transparently release the price of its medical

services to the public? This is due to the fact that insurance data provided by employers in the United States shows that 20% of the total US insurance coverage in 2014 came from costly self-paid insurance schemes, and this means that these patients bear the cost of their own medical treatment (Claxton et al., 2014). In this case, when they choose a physician and a medical institution, the data will provide a reference for their decision-making (Claxton et al., 2014). In this way, patients can be well aware of what kinds of medical services they can purchase and their corresponding healthcare value.

In 2013, a study conducted by the University of Chicago showed that the overall cost of selective surgery was reduced by 7% after the prices for medical services in various states were forced to be publicized (Christensen, Floyd, & Maffett, 2013). Based on this, every state in the United States is required to establish regulations regarding healthcare transparency so that patients can obtain valid information concerning treatment effectiveness and the corresponding price of healthcare services (Numerof, 2014). Meanwhile, Numerof (2014) believes that the report was merely binding healthcare providers without introducing penalties for the unhealthy behavior of medical treatment recipients, nor with measures to motivate employers (providers of medical insurance premiums) to punish the unhealthy behavior of medical treatment recipients. Why should smokers be punished, after all? It is because their spending on medical services is 25 percent more than that of non-smokers (Numerof & Abrams, 2016).

3.2 Value-based healthcare

Value-based Medical was first proposed by American scholars Brown et al. (2004). It is defined as a type of practice medical, which represents the difference between the patients' expectation of their own life value and the treatment cost of their disease on the basis of evidence-based medicine. All patients concern about improving life quality and prolonging lifespan, but the treatment cost also gathers their attention. Only the medical treatment that improves life quality at the cost of acceptable treatment expense for patients is the medical treatment with value (Hirneiss, Neubauer, Tribus, & Kampik, 2006). Value-based Medical

inherits the advantages of evidence-based medicine (the medicine which is based on the best medical evidence), and uses medical interventions to improve patients' quality of life, which will help improve modern medical level. (Brown, Brown, & Sharma, 2003). Value-based Medical not only emphasizes on prolonging the lifespan of patients, but also pays attention to the patients' life quality, as well as their interests and concerns. It continuously reduces the cost of diagnosis and treatment while improving the quality of the two, the objective of which is to improve the life quality of patients after treatment, not just to prolong their life (Brown, 2005). In other words, if patients have to suffer from inhuman pain to prolong life, it is not called Value-based Medical. However, if some hospitals barely maintain patients' lives with the help of new medical technologies, which leads to double pressures of economy and psychology for their family; or if they give up the traditional medical treatment method with low price but the same therapeutic effect just in order to pursue new and expensive medical technology, which causes more economic losses for patients. These are not called the Value-based Medical as well. The purpose of patients and medical insurance centers paying is to prolong patients' lifespan in the premise of improving their life quality. To realize the Value-based Medical, it is necessary not only to protect the interests of patients, but also to take into account the interests of the public. The blind over medical treatment and over examination are contrary to the value principle of medical technology. For example, one study found that outpatient prescriptions in China contain up to 50.3% of antibiotics, of which more than one quarter use two antibiotics; the rate of intravenous infusion is more than 53%, far higher than the medication reference level of the World Health Organization (WHO); the rate of cesarean section is as high as 46%, half of which is not necessary; the positive rate of CT is 10%, while the global average is 50%, etc. Excessive medical problems like these big prescriptions and big examinations are serious, which leads to that medical expenses have increased by almost 14 times in the past 20 years, from RMB 220 billion to 3.17 trillion yuan, and which has also led to outstanding drug resistance problems. As a result, the medical services purchased by patients are not only worthless, but harmful to their health. Therefore, it is imperative for medical insurance centers and patients to purchase valuable medical services (Xu, 2016).

It was Harvard professor Michael Porter who first proposed the framework of value-based healthcare delivery. In his book *Redefining Health Care, as* co-authored by Prof. Teisberg, Porter outlined the belief that such medical issues as surging healthcare costs, high frequency of medical events, and the declining level of citizens' healthcare coverage all result from vicious competition, which is the consequence of deviating from value-based healthcare delivery (Porter & Teisberg, 2006). The two authors contend that for some time, medical organizations in the US have competed against each other with the aim to reduce services or transfer costs, compete for well-trained physicians and patients, as well as limit patients' choices in healthcare services and thus improve their bargaining power, although this kind of competition is unable to fundamentally improve healthcare services and the efficiency of healthcare cost expenditure (Porter & Teisberg, 2006).

Value-based medical care is a widely-recognized medical service model. Under this model, medical service providers mainly calculate the value formula between the diagnosis and treatment efficacy of specific diseases of specific patients and the total cost of diagnosis and treatment spent for obtaining the effect, namely, value = efficacy/cost. The continuous improvement in therapeutic schedule will finally achieve the ultimate goal of value. According to the formula, there are two ways to improve the value, and one is to improve the efficacy while the cost is unchanged, which requires a clear definition of the efficacy. With regard to the definition of efficacy, Donabedian (1980) argues that efficacy is a change in current and future health conditions brought by past medical services. And Porter (2010) believes that efficacy is the improvement in health conditions of the patients brought by medical services in a specified period of time. Both the definitions given by Donabedian and Porter are ambiguous, while the International Consortium for Health Measurement (ICHOM) gives a clear definition of efficacy, believing that efficacy is the medical effect that people care about in medical services. And the effect includes the improvement of the patient's body and the improvement of the patient's independent living ability brought by medical services (Su & Wang, 2018; Kelley, 2015). To define the value of medical services, efficacy is a prerequisite, and specific efficacy indicators can only reflect the effectiveness of medical services for specific diseases, and there is no single indicator can comprehensively reflect the

effects of medical services (Lee, 2012). What Porter concerned are the efficacy results, which has a creative value for the comprehensive assessment of medical service providers. And he divided the efficacy results of medical services into three levels: The first is the maintenance of the patients' health condition, the patients' survival or the recovery degree of the diseases; The second is the recovery process of the diseases, in short, the time required for the patients to return to normal life after receiving medical services, which also takes into account the side effects of the diagnosis and treatment; The third is the health sustainability brought to the patients by medical services, which takes into account the recurrence possibility of the disease and the long-term health results brought to the patients by medical services. With regard to the definition of cost, Woo and Skarsgard (2015) believe that the cost here is the sum of the investment during the process that medical institutions deliver medical services to the patients. As an important component of the definition of the value of medical services, when measuring the cost of medical services, the cost of the whole process or the cost of the complete period measured under the specific medical conditions is the total cost spent for obtaining specific efficacy. The combination of cost analysis and efficacy will help medical institutions improve medical pathways, optimize medical processes, eliminate non-value-added services and better utilize existing resources to provide better diagnosis and treatment services, thus obtaining added value (Lee & Enzmann, 2012). The value-based medical model faces the challenges of both efficacy and cost measurement in the practice. The drawbacks of efficacy measurement in the traditional medical service industry are obvious. For example, too much attention on the process index has led to insufficient emphasis on the medical treatment improvement. Meanwhile, there is insufficient attention on the various functions, physical conditions and life quality of patients, as improving their functional conditions and life quality are the purposes for patients seeking medical treatment. These indexes are less recorded and used (Andrawis, Chenok, & Bozic, 2013); There is excessive attention on the single treatment measures, and the whole process efficacy of disease treatment has been neglected (Porter, 2010); The efficacy index is inconsistent and the efficacy data can not be obtained and shared, leading to the incomparable efficacy of different medical institutions (Martin et al., 2015). However, the good news is that ICHOM has

advanced the standardized action of efficacy measurements throughout the world, providing a reliable clinical pathway for efficacy measurement. So far, this organization has issued 21 sets of standardized measurement indexes of efficacy. These index standardizations take patients as their core, pay attention to the health conditions of patients, and judge whether diagnosis and treatment services have truly brought good results for patients according to the report. In terms of the cost measurement, traditional cost calculation methods will not be able to accurately calculate medical costs. Time-Driven Activity-Based Costing (TDABC) can replace traditional methods to optimize clinical pathways and improve medical service value from the perspective of cost. TDABC has been adopted by multiple hospitals in the United States, and the effects are obvious (Kaplan & Porter, 2011). Because TDABC takes time as a cost driver when measuring cost. It firstly establishes a value stream mapping, and then identifies the resources and costs of each process in the value stream mapping (Kaplan & Anderson, 2007). A great number of foreign scholars have also used TDABC to study cost measurement. For example, Laviana et al. (2016) has measured the short-term and long-term diagnosis and treatment cost of low-risk local prostate cancer, and achieved good measurement results. At the same time, he also believes that TDABC is a feasible tool for designing value-based medical model. Iii, Greenhouse, Giarrusso, and Kress (2015) has used TDABC to accurately calculate the full-cycle costs of the treatments of knee and hip joint, and pointed out that TDABC is conducive to promoting the realization of value-based medical payment model.

The topic has likewise been studied a vast amount in other countries. For example, in his speech entitled *How to offer better healthcare services: value-based healthcare delivery* in Sweden, Prof. Martin Ingvar from the Karolinska Institute pointed out that the two factors playing a key role in the successful application of a value-based healthcare delivery in Sweden are the measurement of the value of medical services and the announcement of health outcomes (Yao, 2013). When measuring the value of medical services, we measure patients' individual and social values and the entire process of medical service at a multilevel and multi-step manner, and reliable data is obtained from measurement and is used to continually improve the quality of medical services and thus create more values for patients (Yao, 2013).

Prof. Martin Ingvaralso stressed the importance of announcing health outcomes to the public, and likewise pointed out that it could promote innovation among medical organizations and physicians (Yao, 2013).

Ultimately then, what is the value of medical service? The report quoted the definition of the value of medical service from Porter and Teisberg's (2006) work: the value of medical service equals the treatment effect a patient received / the cost of a patient. He (2016) argues that this definition ignores the value of a doctor. He (2016) claims that if patient-centered value-based healthcare delivery is applied in medical institutions, how we are to realize a doctor's true value should be clarified. In the essay, He (2016) states that in China, the medical system prefers to motivate doctors by financial incentives, resulting in an upsurge in patients' medical costs, which thereby harms patient's interests. Besides, these incentives have their limitation in that alongside the accumulation of fortune, the effect of the incentives upon doctors will gradually reduce until it eventually becomes zero (He, 2016).

He (2016) argues that the research results of Professor Porter show that if hospitals and doctors are motivated by patients' understanding of medical services, then hospitals and doctors should always try their best to outshine their competitors in order to reduce patients' medical costs by increasing the number of patients. It seems that this could not only help hospitals gain an increased profit but likewise would also benefit patients a great deal. However, the practice of China's healthcare reform shows that hospitals and doctors cannot always be motivated by a large number of patients, for when the number of patients exceed the limits imposed, the incentive will become negative rapidly.

For example, in most of China's first-class hospitals, doctors often complain that their hard work is not in proportion to the harvest produced (He, 2016). How about patients' reaction? If a hospital can treat many more patients over a certain time span, it seems that patients could benefit from it. However, the quality of medical services provided to an particular patient declines and the treatment effect of a patient also declines because the number of patients that are examined by a doctor continues to increase over a certain time (He, 2016). Due to specific characteristics of the healthcare sector, the marginal cost of a single

patient's medical service, as provided by a doctor, will not decrease when the number of patients increases. From this understanding, He (2016) argues that to help doctors gain more financial incentives by merely increasing the number of patients is not effective enough or that it may even harm patients' interests, and that a more precise system should be designed to motivate doctors.

In order to explore how to motivate doctors effectively, a doctor's value should be clarified. With his research in reference to Professor Porter's definition, He (2016) defines a doctor's value as: the value of medical service by a doctor provided equals a patient's cost for the medical service / the cost of a doctor's service for the patient. This kind of doctor's value is similar to the delivered value mentioned above. However, the delivered value system is based on the hypothesis that there is no limit for patients' medical costs, which is illogical because this system costs patients a substantial amount.

Moreover, by introducing value-based healthcare delivery, a patient's medical cost will be inversely proportional to the value of medical service (He, 2016). It can be formulated such as the following: the total value of value-based healthcare delivery equals the value of medical service / a patient's medical cost (He, 2016). This shows that patients' medical cost must have a cap; therefore, hospitals need to reduce the cost. Nonetheless, hospitals cannot decrease the treatment effect for patients when they reduce the cost. He (2016) argues that this system which shows a doctor's value is feasible, although additional measures including hierarchical diagnosis and treatment, the standardization of medical services in medical institutions at all levels, diagnosis related group (DRG)-based payment and the utilization of information technology should also be applied to medical institutions.

Hierarchical diagnosis and treatment mean that the medical service in large hospitals and small hospitals should be identical (He, 2016). Not unexpectedly, there could be some differences between patients' medical costs. When it comes to the value of the medical services, the value provided by large hospitals will be lower than that provided by small hospitals, so patients will tend to choose small medical institutions. Nevertheless, there is a premise that the service capacity of small medical institutions should equal that of large

medical institutions, although this is currently impossible. In fact, there are few visitors who will go to small hospitals, and therefore excellent doctors are unwilling to work in small hospitals. He (2016) considers that the reason why excellent doctors complain that their income is not in proportion to their effort exerted is that they do not obtain higher pay in comparison to other ordinary doctors when they treat ordinary disease, so the author holds that hierarchical diagnosis and treatment is an essential part of value-based healthcare delivery.

He (2016) considers that when the hierarchical diagnosis and treatment system is promoted, general doctors can treat ordinary diseases in small medical institutions and receive satisfactory pay, while excellent doctors can treat complex diseases in large hospitals and obtain satisfactory compensation, likewise. In this way, doctors with different professional titles can treat different diseases, realizing the goal of making the best possible use of manpower and material. Although the compensation for diagnosing a single patient's ordinary disease is rather low, the number of patients with ordinary diseases is larger than that with complex diseases. Therefore, the income of general doctors can actually be compensated adequately Moreover, general doctors can become more experienced in diagnosis and treatment by treating a large number of patients, so they can improve their ability rapidly and become excellent doctors at last.

At this time, the standardization of medical service in medical institutions at all levels needs be elaborated. Seeing as how the number of patients with ordinary disease is huge, standardization becomes a possible option (He, 2016). He (2016) has stated that standardization can standardize the scale of medicine, medical facilities and experimental materials alike, which can continuously decrease the medical cost. Standardization also helps to train doctors and increase the number of doctors rapidly. Besides, standardized service helps to reduce risks effectively or transfer risks by means of insurance mechanisms. Standardized service can improve the service capability of medical institutions effectively and increase a doctor's value, as well as the value of medical service, by allocating human resources rationally, and ultimately helping promote value-based healthcare delivery.

DRG-based payment is a system requiring some additional clarification. He (2016) has explained that in order to implement a DRG-based payment system, the price of medical service in the DRG-based payment system should be determined, which requires healthcare insurance departments and medical institutions to negotiate and determine the medical service price of each disease. Healthcare insurance departments need to calculate insurance premiums of policy holders and the total amount of policy holders to ensure the realization of a DRG-based payment system. Medical institutions need to publicize disease categories and data of treatment effects on a regular basis. Although value-based healthcare delivery is patient-centered, the core role of doctors in the medical treatment process does not change. The system needs to transform from an extensive form to a meticulous one, setting higher criteria for doctors' capability, standardization of the medical service and the medical service system. However, as Numerof and Ott (2010) have stated, defining a healthcare route and the corresponding price does not necessarily promote growth or increase profits. Information transparency is a necessity for the development of packaged charges in order to meet the demand of patients who do not have sufficient time to waste but do worry considerably about the value provided - all because patients hope to compare the effectiveness of fixed-price treatments in the future (Numerof & Abrams, 2016).

Ultimately, it comes down to an improvement of the accuracy of medical diagnosis and treatment and the convenience of medical service by taking advantage of modern information technology. The development of Internet of Things (IoT) networks enables medical apparatuses and instruments of every manufacturing factory to have their own identity and every part of them can be identified. These apparatuses and instruments will be ranked in terms of their accuracy in examining the same disease and doctors will choose the best performing instruments to realize optimal diagnosis. The development of the Internet and artificial intelligence makes remote diagnosis and treatment a reality. Doctors can diagnose patients and guide their operations from a distant place. Meanwhile, the Internet also provides platforms for the release of treatment effect data so that medical methods with the best curative data can be promoted rapidly and applied widely. The release of treatment effect data can also facilitate hospitals, doctors, pharmaceutical factories and manufacturers of medical

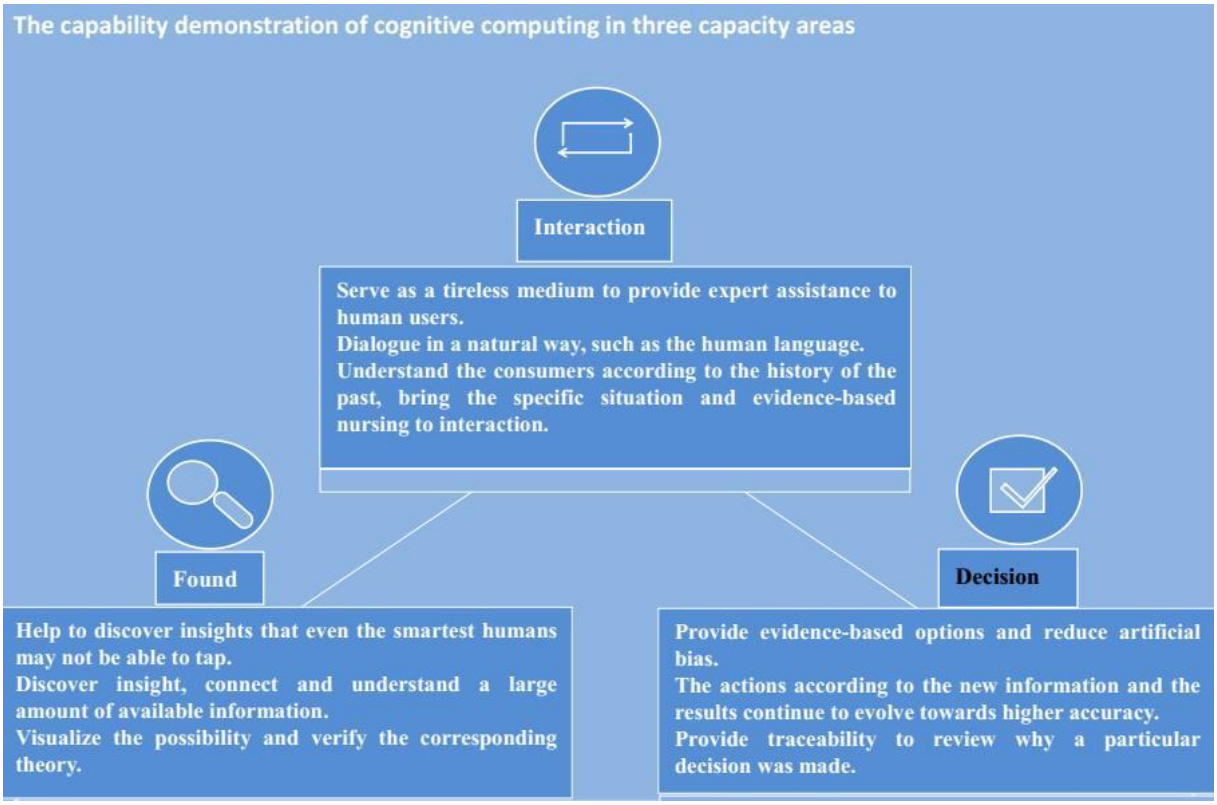
apparatuses and instruments innovate continuously (He, 2016). For example, interoperability can achieve seamless health data, and only to the health of data integration, the healthcare industry will change to interoperability. The interoperability platform will play a key role in transformation and upgrading in medical institutions, and play an increasingly important role (TIMEDOO, 2018). Blockchain technology will be used for drug recognition, and the reasonable arrangement of medical services and treatment, although it can not have falsified records, and must involve the transfer process of a transparent and quality credit system - all which will ultimately lead to changes in the medical field (Wang, 2017a). It can therefore be concluded that information technology provides impetus for value-based healthcare delivery.

In healthcare industry, the cognitive computing (a brand-new computational model that provides a variety of capabilities) will thoroughly change the entire medical industry. The promotion and realization of cognitive computing are able to overcome many obstacles hindering the development of medical industry. For instance, in overcoming the shortage of skilled medical staff, the cognitive computing ability can improve the intellectualization level, communication ability, and work efficiency of all employees, and can build a convenient working environment to improve the retention rate of medical staff. This will effectively compensate for the shortage of medical staff who leave the medical industry due to unbearable work pressure (Fraser, 2015). The resolution of this problem will become even more urgent, as estimated by WHO, there will be a shortage of 12.9 million medical personnel globally by 2035 (World Health Organization, 2013); In overcoming the patients' changing expectations, it is also becoming increasingly urgent to gain insights into their needs, explore new service models, and provide smart patients with needed medical experience. Because today's patients want to obtain and enjoy more convenient and transparent as well as high-quality medical service solutions of personalization just like other services; With the continuous increase in medical demand, especially the growing and ageing population in the third world countries, and the spread of various new viruses, the demand for the medical industry continues to increase (Wu & Jacobson, 2015).

In order to avoid the subverted fate of medical enterprise, the IBM Business Research

team makes three suggestions: interaction, discovery, and decision-making. Because the more interactions between medical providers, patients, and medical expenses payers are, the stronger the interaction ability will be, and the more helpfully it will improve the effectiveness of communication and the ability of collaboration, thus better promoting the effectiveness of medical care. The continuous discovery of new tools and new functions helps to uncover the new ideas and insights hidden in the massive data, such ability of discovering can effectively enhance research and innovation. Better decision-making and decision-making ability can provide recommendations based on reliable evidence and personalized medical services, so as to continuously improve the medical service quality. Big data has become the new natural resource (Picciano, 2014). Similarly, in the medical industry, the number of such resources is exploding, and the variety and complexity of such resources are also undergoing rapid changes. For example, the genome of a cancer patient is equivalent to half of a TB data (Palmer, 2014). IBM Wastson has the three capabilities above and it can solve these problems (see Figure 3-1).

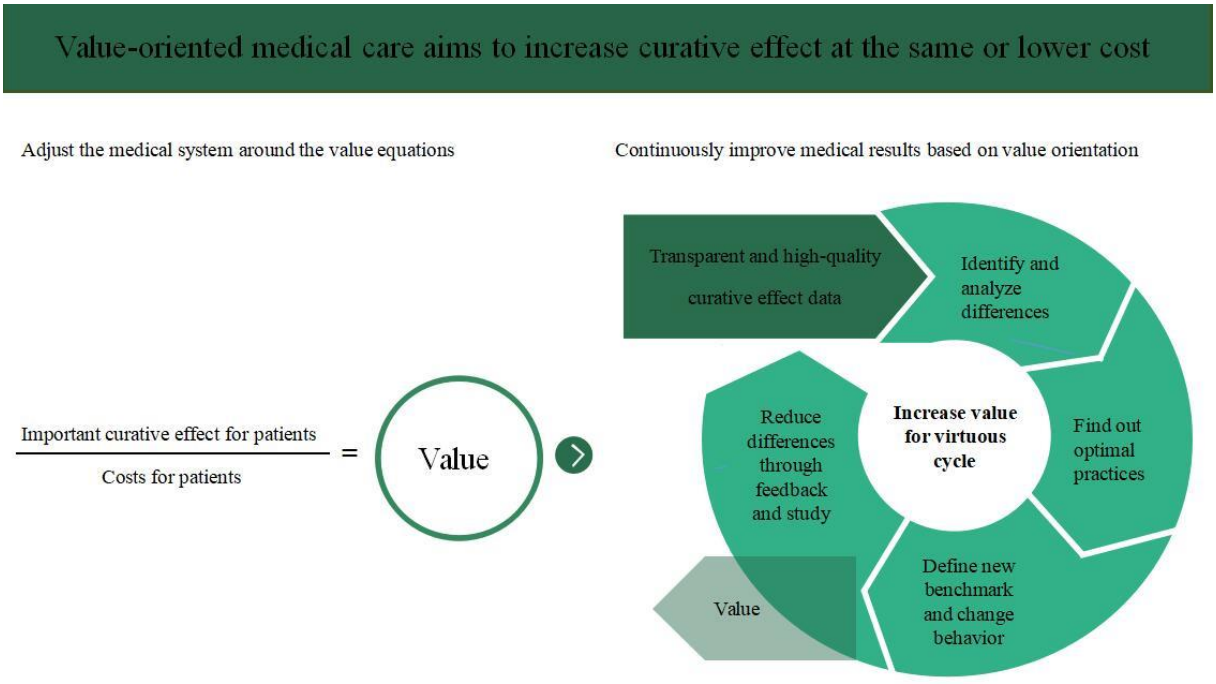
Figure 3-1 Three Ability of the Cognitive Computing



Source: Fraser. (2015)

Xia, Wong, and Larsson (2017) have introduced the value-oriented medical report, which focuses on the optimization of "value equations" and emphasizes the adjustment of the medical system around value equations to form a virtuous circle for the improvement of medical conditions (see Figure 3-2). In the virtuous circle of value-oriented medical care, major medical service providers rely on transparent and high-quality curative data, analyze differences in this data and form reference indicators in order to determine the best treatment plan, improve clinical practice and diagnosis, as well as treatment behavior, ultimately raising the medical value based on continuous feedback and study, and thereby realizing value-based medical care.

Figure 3-2 Virtuous Cycle of Value Equations



Source: Xia et al. (2017)

On the measurement of curative effect, in the article entitled *What is value in health care?*, Porter (2010) pointed out that value evaluation of medical service outcomes can be classified according to importance into three tiers - top, middle and bottom - and that each tier can be divided into two levels. During the evaluation, due to the different types of diseases and features of patients, differentiated methods are required. Meanwhile, comprehensiveness of the measuring indicators must be guaranteed. One representative indicator should be selected from each of the 6 levels to evaluate and collect data, and all levels are interdependent (Porter, 2010). Although the measurement proposed by Porter may lead to an increase in the cost to medical institutions, as the information derived from this measurement is akin to public goods and it is for everyone's benefit, the property of information as public goods - while potentially attractive - can be exploited by competitors who "take a lift". As for

this point, Porter does not give an answer to who pays for the information. However, transparency, accountability and competition are necessary conditions for the healthcare industry to be based on the core of the market model and to achieve lower costs for better health outcomes (Numerof & Abrams, 2016). Nevertheless, Tilburt, Montori, and Shah (2011) have given such comments in their rebuttal to Porter's arguments about the concept of 'value', in that Porter's value definition represents the viewpoints of medical expenses payment providers rather than that of patients; if value is defined according to Porter's viewpoint, then reducing the cost can enhance the value effectively, and in this case, "a mediocre result" in the medical treatment may be caused. By such a definition, payers have the right for bargaining, yet patients do not; however from the patients' viewpoint, doctors and medical institutions providing high quality and affordable medical services should be rewarded, and this kind of reward is not only on the basis of lower costs, but on comparatively better healthcare outcomes. If this letter is patient-centered, it will receive no readers at all, thus it turns a blind eye to patients (Tilburt et al., 2011). In a reply letter written by Cohen to Tilburt et al., he argues that patients' satisfaction, sociocultural background, and family or work status shall also be taken into account in that these factors are all related to survival (Cohen, 2011a). In the *Value-based Medicine and Realization Route of Value-based Medical,* Ling (2016) put forward three suggestions on the medical reform path based on value-based medical, respectively including that enhancing the humanization of medical process, taking care of the interests of patients, and building modern medical insurance systems to enhance medical efficiency. In a word, value-based medical is patient-centered and patient-oriented. It improves the quality of diagnosis and treatment while reducing the cost of the two. It has realized the transformation from simple biological treatment to the interests of patients. It not only embodies the people-oriented spirit, which emphasizes the interests of patients and improves their life quality, it also pays attention to obtaining the best medical results with the lowest cost, effectively guaranteeing the smooth realization of the medical reform goal of health reform of Health for All.

The core of value-based medical is to value and respect patient expectations, and its ultimate goal is to improve patients' quality of life through medical intervention and reflect

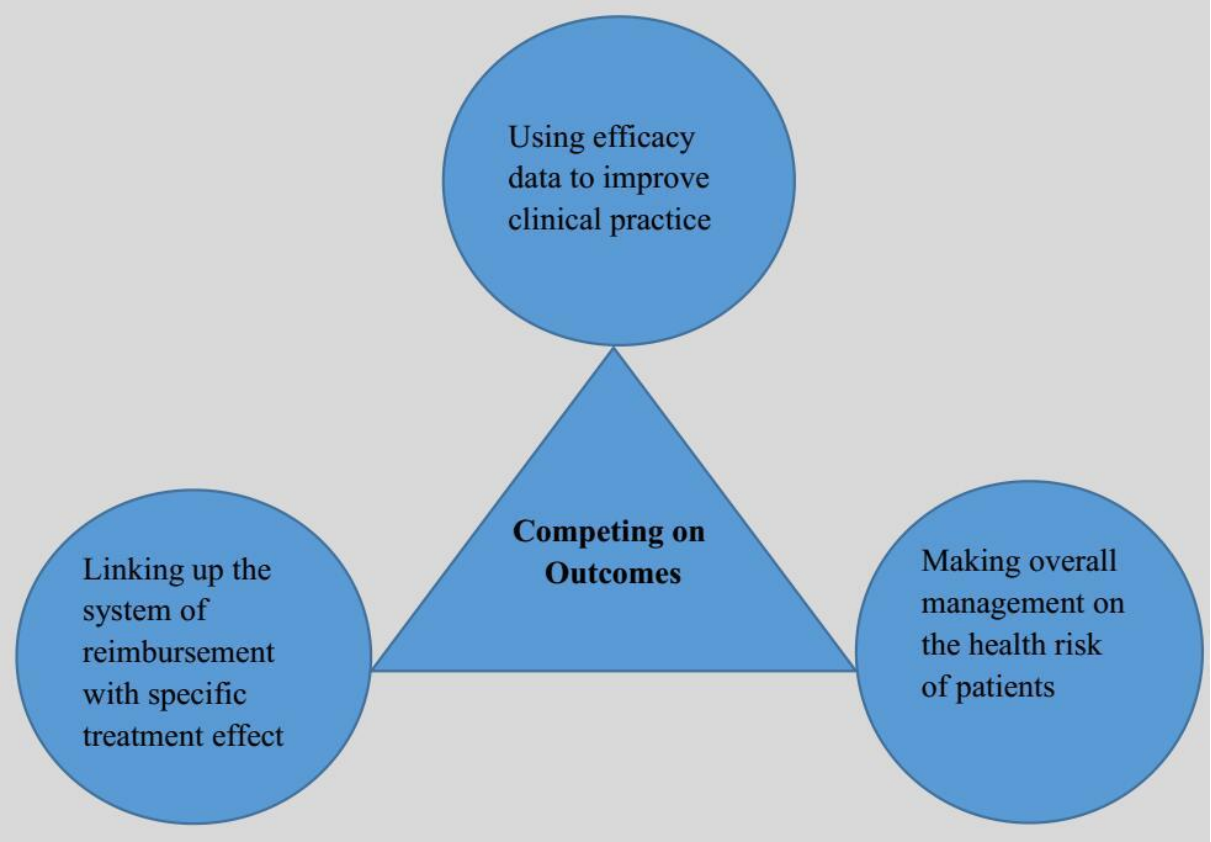
the human-centered spirit. Such as, for female complete hysterectomy, opinions on the choice of surgical treatment (transabdominal hysterectomy (TAH), transvaginal hysteredtomy (TVH), and total laparoscopic hysteredtomy (TLH)) present different perspectives. Some are of good effect, some costs are low, and some are cost-effective, which type should the hospital choose (Xu, 2013a)? The reality is that the choice between patients and patients, patients and doctors, doctors and doctors differs from each other due to many factors such as fear, level of understanding and family economy. However, under the guidance of value-based medical, doctors should not only consider the purpose of diagnosis and treatment, the value of diagnosis and treatment as well as moral principles, but also should understand the impact of each diagnosis and treatment scheme on the postoperative life quality of patients. They must respect the psychological needs of patients and consider the interests of patients and the value of medical treatment in the decision-making of surgical schemes. Value-based medical also focuses on patients and protects the interests of them. Doctors are affected by many factors when making clinical decisions, such as the local medical insurance reimbursement system, ethics, customs, medical technology and health regulations, etc. Under the traditional performance-centered system of China, many drawbacks such as over examination and over treatment have severely constrained the vision of healthy China (Xu, 2013b). All these disadvantages have seriously deviated from the core of value-based medical, and have deviated from the essence of doctors' kindheartedness.

However, promoted by the concept of better effect and lower cost of diagnosis and treatment effect and lower diagnosis and treatment costs, value-based medical has taken into account patients' affordability and expectations when making clinical decisions, optimizing the allocation of medical resources and reflecting the medical value. At present, China is vigorously advancing the model of hierarchical diagnosis and treatment. Patients are encouraged to go to nearby hospitals, treat minor illnesses in grassroots community hospitals, and treat major illnesses in large hospitals. This model will effectively slow the overcrowding status quo in China's top three hospitals, and effectively distribute medical resources through the two-way referral system, reducing the burden of medical expenses for patients.

3.3 Competing on outcomes

Associate Director Clawson et al. (2014) of the BCG put forward a new value-based healthcare delivery “based on medical effect competition", which means from the three perspectives regarding the collection and sharing of efficacy data, medical expenses payers, and medical service providers (including medical institutions, physician and medical equipment manufacturers), they put forward three levels of competition respectively using efficacy data to improve clinical practice, linking up the system of reimbursement with specific treatment effect, and making overall management on the health risk of patients (see Figure 3-3).

Figure 3-3 Three Levels of Competition of Competing on Outcomes



Source: Clawson et al. (2014)

In an article published by Wang (2016), she summarized the theory of *Competing on*

Outcomes, which was put forward by Jennifer Clawson et al., a joint director of the Boston Consulting Group, and pointed out the following: first, make the data transparent to facilitate the development of clinical practice. This can reduce the difference of treatment methods and improve the average effect. It has been put into practice in Sweden, the United States and Australia for years and gained good results. Subsequently, connect the reimbursement system with specific treatment effect. This can provide incentives to those pharmaceutical companies and medical organizations with superior treatment effect. It can target both a specific period of medical treatment and specific medicine and diseases, which ultimately makes it easier to identify the improvement of the treatment. Some front runners have been collecting real data and conducting statistical analysis to prove the value of a new drug to the payer, which is supported and encouraged by the Occident. Lastly, the highest stage of treatment effect-based competition needs be put forward, i.e. managing patient's health risks in a comprehensive way. This requires the advanced ability of data transfer and analysis, in-depth observation into patients and effective control over risks, as well as likewise obtaining effective treatment within a limited cost.

The improvement of clinical practice by taking advantage of the transparency of data concerning treatment effect comes into play, since the prerequisite of value-based healthcare delivery competing on outcomes is the transparency of data concerning treatment effect (Clawson et al., 2014). Clawson with others (2014) believe that improving the transparency of data and analyzing and recognizing data helps to discover and encourage the development of the best clinical practices and reduce any variance in treatment of the same disease, which is conducive to the improvement of the average treatment effect of the same disease. This requires clinicians shift their way of thinking into regarding the release of clinical treatment effect data as their obligation. On the other hand, we can force medical institutions to form a professional data collection group to ensure the reliability and completeness of the treatment effect data. In order to make the release of clinical data a part of doctors' obligations, top-level design of the policy should be carried out so that doctors can be constrained by institutions and swift their obligations into responsibilities.

Even if releasing data becomes doctors' duties, would they be willing to perform this duty? Normally, when patients obtain good treatment effect, doctors are willing to release the data involved. However, when patients do not come by adequate treatment effect or there is medical negligence, both doctors and hospitals alike are not willing to release the data. How is it then that doctors and medical institutions would become willing to release all data? The BCG team provided some strategies which are not necessarily practical nor feasible. Moreover, it proves challenging to form an authorized data collection group. Only professional medical workers can collect the treatment effect data required, however they are very few in number, and collecting this data is a time-consuming and energy-consuming process. Another problem is regarding how can we ensure that all data collected by the group is reliable? Bribery, data fraud and collusion between government and businessmen may appear intertwined in the process.

Here, the BCG proposed to improve clinical practice by disclosing treatment effectiveness data (Clawson et al., 2014), although transparency of the cost was not mentioned in this proposal. In other words, if the published treatment effectiveness data shows very good results although alongside a very high price, it may not be applicable to the medical field despite being in line with the general laws of commodities; let alone that this runs counter to value-based healthcare, and needless to say, does not meet the value appeals of healthcare payers such as health insurance centers and insurance companies. If we compare patients to consumers, they should have the right to bargain and have general knowledge and understanding when making purchases. However, under the current medical system, if healthcare providers do not publicize the price of healthcare products with certain treatment effectiveness, more often than not patients cannot obtain the exact answer when they ask doctors cost-related questions since the doctor himself is not aware of the actual costs of treatment. It is undeniable that open and transparent price information could help regulate medical expenses, although it remains very difficult to make healthcare providers publicize price in a real sense since most healthcare providers do not price medical services and a host of them do not know the actual cost of a certain medical treatment. Based on this, since treatment effectiveness has never been linked to the cost (healthcare expenditure), it is clear

that costs, accessibility, the accuracy of diagnosis and treatment, as well as the quality of treatment effectiveness of the medical services purchased by patients are not comparable.

Finally, when the publicized price does not reflect the actual cost paid by an individual patient, it is then that the price difference is the rate agreed on by healthcare providers and health insurance companies, insurance companies or individual patients. Numerof and Abrams (2016) believe that the transparency of price in medical services is the trend of the current times and patients will eventually come to obtaining comprehensive and reliable medical service prices. The United States has already taken the lead in this respect, as the US Center for Medicare and Medicaid Services (CMS) regulations have required healthcare providers to disclose prices of medical services, which not only serves as a deterrent in law, but also signals change to come (Numerof & Abrams, 2016). By now, more than a dozen healthcare organizations have started publicizing prices (Numerof & Abrams, 2016). Even the American Board of Internal Medicine (ABIM) Foundation has facilitated a dialogue between patients and healthcare providers through their *Choosing Wisely* initiative with the purpose of focusing on the necessity of treatments, so as to avoid duplicate diagnosis and repetitive medical services (American Board of Internal Medicine Foundation, 2012). At the same time, this can also help encourage the research and development of medical projects which reflect healthcare costs.

With the advent of an era consisting of costly self-payment, there emerge some new medical forces in the United States fighting on the side of patients by offering lower healthcare costs and more accessible places for medical treatment (Liss, 2013). For example, Wal-Mart Greens, which provides basic medical services, as well as CVS pharmacies and Schnuck's have established retail infusion centers (Liss, 2013). There are also about 10,000 emergency medical clinics which receive about 160 million patients annually and these clinics directly provide the patients with high-quality and fixed-price medical services (Numerof, 2014). Additionally, Lab Corp, a company in the US, also claims to provide diagnostic testing services to patients, and selects sites of greater accessibility for retailing (Koons, 2015). To sum up, companies should not only ensure the openness and transparency of the treatment

effectiveness data but also the cost data, and availability of medical services should likewise be taken into account.

Following extensive literature review, it was discovered that some surgeons from Switzerland, Australia, the US and other countries took advantage of patients' treatment effect data in 2012 and released this data to get a big picture of their results such that they could recognize some abnormal data and improve the treatment effect (Larsson, Lubkeman, Clawson, & Lawyer, 2012). This ultimately allowed the release and sharing of treatment effect data to be widely respected. For example, the International Society of Arthroplasty Registers (ISAR) is discussing establishing unified measure standards regarding treatment effect for the replacement of hip joints and knee-joints. They have collected all kinds of treatment effect data regarding artificial knee-joints made up of all kinds of apparatuses and instruments around the world, having shared this data in order to form a reliable evaluation system to evaluate the safety and reliability of recent joint constituents produced by 3D printing, as well as that of a variety of artificial joints (Larsson et al., 2012). By means of this method, doctors who are adept concerning knee-joint disease around the world can recognize defects of all kinds of artificial knee-joints rapidly, thereby choosing more suitable products for patients. This progression would make it easier to sell an increased number of products which directly benefit patients, stimulates market innovation, and bring patients to obtain more valuable medical services.

China has also implemented pilot actions to collect curative effect data in specific disease areas. For example, in 2011 Beijing evaluated the quality of medical care (including mortality, rehospitalization rate and other indicators) for 108 diagnostic-related groups in 6 hospitals, and ranked the hospitals by reference to diagnostic groups (Xia et al., 2017). GlaxoSmithKline, a British pharmaceutical company, developed cooperation with the Guangzhou Institute of Respiratory Diseases to carry out patient registration of asthma and chronic obstructive pulmonary disease (COPD) in the field of respiratory therapy, and achieve data collection and sharing for asthma-isolated disease information through *Smooth Breathing* (an asthma patient online management platform) in 2017 (Xia et al., 2017).

This model which shares treatment effect data from all over the world has brought values to Australian patients (Cohen, 2011b). For example, De Steiger and other scholars of the University of Adelaide discovered problems among orthopaedic provider DePuy's ASR metal and metallic hip replacement implants (Cohen, 2011b). De Steiger, an orthopaedic surgeon based in Epworth Hospital, warned surgeons not to use this product again, resulting in that the manufacturer recalled all products from the Australian market on its own accord in December 2009, but its recall by the Food and Drug Administration (FDA) was delayed nearly seven months (Cohen, 2011b).

Fung, Lim, Mattke, Damberg, and Shekelle (2008) claim that establishing transparent and shared treatment effect data is conducive to competition and it helps select superior treatment and products, while eliminating the inferior, and ultimately encouraging the superior to continue to innovate. For example, the Swedish Heart Failure Registry (SwedeHF) started to release patients' survival rate in 74 hospitals that focused on heart disease around the country and published a quality index which checked and tracked whether every hospital follows the guidelines for diagnosis and treatment in the European Union (Fung et al., 2008). Following releasing the data and index obtained, the improvement rate upon the average score of the quality index increased from 13% per year to 22% per year (Fung et al., 2008). Additionally, the score of the quality index for hospitals with the highest death rates increased 40%, dramatically narrowing the gap between the best and worse hospitals (Fung et al., 2008). There are many examples where countries around the world have released treatment effect data to stimulate hospitals to improve their treatment effect regarding diseases including coronary artery disease, cataract surgery, hip arthroplasty, and localized prostate cancer (Larsson et al., 2012).

The study conducted by Clawson et al. (2014) found that medical payers of Stockholm have utilized shared data to guide patients to hospitals with best outcomes, shifting STEMI (ST-elevated acute myocardial infarctions) patients from the traditionally well-reputed Karolinska hospital to the nearby Danderyd hospital on behalf of the latter's documented higher survival rate of patients. Additionally, the Health Plan of Walmart had decided to send all employees who are in need of transplant, heart or spine surgery to the top six medical

centers in the US since medical costs will be decreased when patients receive treatment at institutions with best outcomes (Chatterji, 2013). Numerof and Wolff (2013) argue that if a healthcare institution does not follow the trend of publishing data regarding treatment effectiveness and price, patients may not choose it, so that healthcare providers will lose 'customers' unless patients can observe data that can justify the providers' statements. Otherwise, it may be difficult for them to avoid the fate of losing patients albeit once having an excellent reputation. Furthermore, a lack of transparency will limit patients' capability to compare and choose treatments, since even though healthcare providers do not end up publishing treatment effectiveness and price, patients can continue to make a smarter choice as they are able to obtain the information demanded through an increasing number of channels than currently available at the present time.

Allow us to consider the possibility of linking the reimbursement system with specific outcomes. This would mean that China's social security institutions and insurance companies can decline unmet medical reimbursement claims and that they are required to continue learning. As for measuring and quantifying patients' life cycle value, corresponding indicators for reference shall be required. Of course, Evans and Herman (2015) have also advised that reimbursement agencies should impose the most stringent sanctions upon medical service providers accused of medical negligence and excessive medical treatment to prevent healthcare facilities from defrauding health-care funds. In early 2015, the US CMS announced a plan, in which by 2018, half of the non-regulatory medical costs are expected to be transferred to risk contracts, or about 362 billion US dollars transferred to medical organizations with responsibility systems (Evans & Herman, 2015). The purpose is to control medical costs, improve treatment effectiveness and implement a system of reward and punishment. Although the effect is unclear right now and likewise is the attention drawn by it, this plan at least shows that healthcare services are undergoing a revolution. Under this trend, the US has already set up a working group for medical service transformation covering 20 states (Wilkerson, 2015). However, when we transfer to a pay-for-therapeutic effect model, it is clear that healthcare providers are included among the rank of risk-sharers, which naturally renders them somewhat reluctant. Although social insurance centers and insurance companies

keep paying attention to excessive medical treatment and false declarations of medical expenses, healthcare providers continue to gaining profit for themselves by utilizing these methods. Based on this, Clawson et al. (2014) believe that social security centers and insurance companies should cooperate with healthcare providers, and that selected healthcare providers for cooperation shall not only continue to innovate, but likewise assume the risks of medical innovation in the cooperative process.

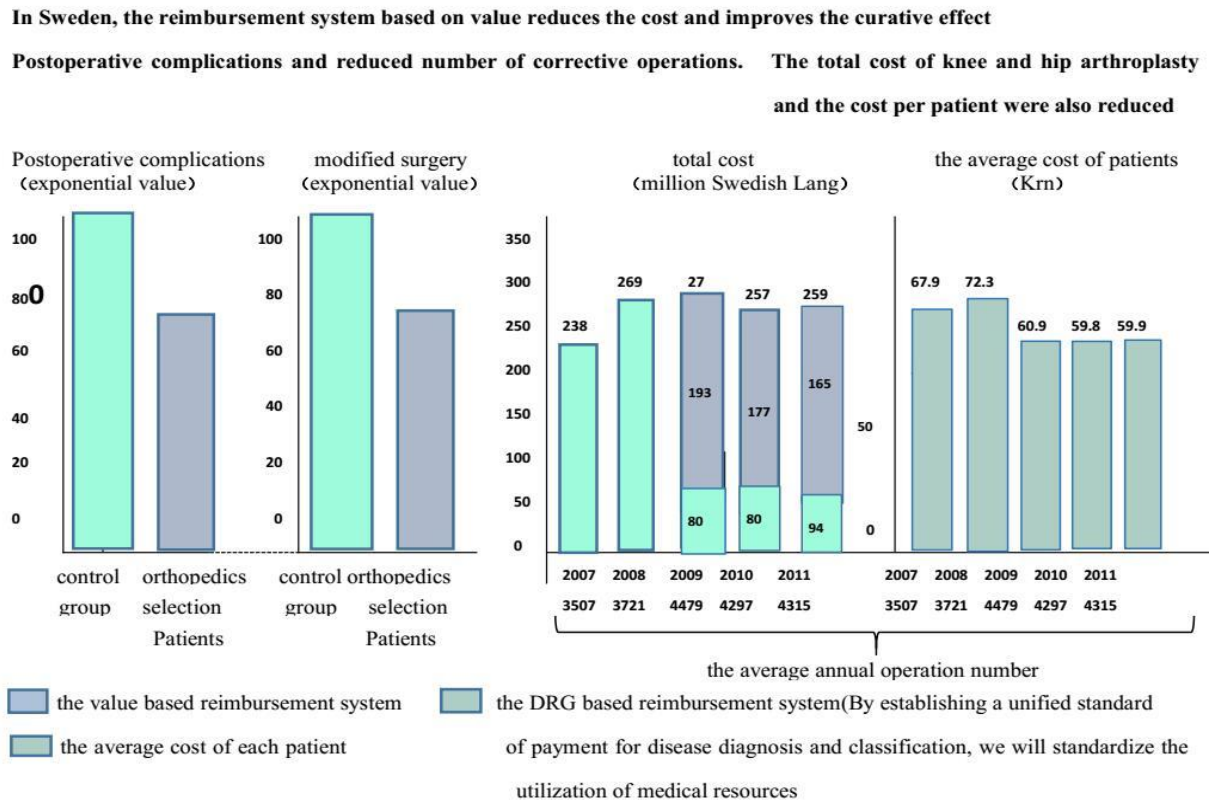
Clawson et al. (2014) have stated that the value-based health-care model aims to realize the combination of medical payment and outcome, attach payment on the basis of this premise, and award medical institutions and apparatus producers with the best outcomes. Of course, specific outcomes refer to a certain disease, medication and a single stage of treatment. It is relatively easy to identify the outcomes, and therefore its linking with reimbursement is easy to achieve. For example, the HTA (health, technology, assessment) of many European countries is increasingly in favor of measuring the relationship between clinical effects of medication and the overall treatment expenditure so as to judge whether the cost is reasonable based on the outcomes (Clawson et al., 2014). This assessment can dictate the sales volume of certain new medication to some extend and pose a huge impact upon the prescription of doctors. This method reflects a more realistic understanding behind the essence of drug innovation from assessment institutions so as to further comprehend the challenge of promoting clinical trials to the public. With data being more transparent, and the value chain of the medical industry more integrated, the system can be measured through testing the outcome of new products and therapy.

Stockholm's provincial parliament in Sweden set up a reimbursement system called *Orthopedic Options* in 2009 (see Figure 3-4). This reimbursement system focuses on efficacy to provide reimbursement for hip and knee arthroplasty, and also provides a fixed bundled claim for the entire treatment process (first visit, diagnosis, surgery, rehabilitation and follow-up treatment). However, any additional treatment resulting from complications, including revision of replacement surgery, is carried out by treatment institutions. At the same time, the provincial parliament also agreed to temporarily detain about 3.2% of the bundling

fees until medical institutions achieve the desired effect (Clawson et al., 2014). Two years following the implementation of this reimbursement mode, data analysis found that the total and per-capita costs of such arthroplasty have been reduced by 20% throughout the whole province, and additionally that complication and revision surgery for patients covered by the reimbursement has also been reduced by 20% (Clawson et al., 2014), which successfully constrained doctors' medical attitudes and enabled them to perform surgery more carefully.

According to the illustration (see Figure 3-4), this model was successful in Sweden, although further research needs to be done to test its feasibility in China. This model has not provided a reliable method concerning how to ensure the authenticity of data and how to prevent the forging of fake data from medical institutions and businesses. Moreover, it is a dynamic process to observe the outcome. The best effect would be replaced when new medication is invented. Besides, each individual has varying levels of bodily and mental health, which results in different outcomes when using the same medicine on different patients. This model does not give a clear range of differences which can be ignored – namely, the acceptable percentage error.

Figure 3-4 Value-based Reimbursement Has Improved Quality and Reduced Cost in Sweden



Source: Clawson et al. (2014)

In consideration of the individual differences discussed above, Numerof and Abrams (2016) put forth that comparative effectiveness studies (comparing treatment methods, in which effectiveness replaces ineffectiveness; comparing treatment costs, in which expensive medical costs are replaced by cheap ones, or costly and expensive treatments are replaced by more effective and less expensive ones to lower medical costs) and Evidence-based Medicine (EBM) should be taken seriously. In 2009, the American Recovery and Reinvestment Act (ARRA) appropriated 1.1 billion US dollars for comparative utility studies and promised strong support for innovations in medical products, research and development of services, the supply and payment of healthcare products - although the results were unclear (Numerof, 2009), nevertheless it represented a change in the industry. In 1996, the *British Medical Journal* also defined EBM as "carefully and explicitly using the best evidence available when deciding on medical services for individual patients" (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996). In other words, we need to systematically evaluate the evidence obtained from clinical research and observe whether it is suitable for a certain patient, rather than

directly applying it undiscerningly to particular patients without consideration of individual needs. We should not only inquire about the patient's past medical history, social relationships, emotion, cognition and affordability, but also continuously encourage patients to participate in their own medical services.

The overall health risk management of patients is another important factor to be discussed, since management is the most advanced application of value-based medical care based on the competition of curative effect (Clawson et al., 2014). Stakeholders will shoulder increased risks in the overall health management of patients, which stems from the transparency of health data and a change towards value-based methods of reimbursement. Clawson et al. (2014) believe that the complexity of managing the overall health of a large number of patients, which is certainly the ultimate goal of value-based healthcare, poses more challenges to medical institutions concerned. If one is to win in this competition, an advanced ability to process and analyze data must first be acquired; subsequently the profound understanding of patients and the ability to minimize risks are needed, and finally the ability to provide quality outcomes at a relatively low medical cost to patients is required. All these are the core of value-based healthcare (Clawson et al., 2014).

Some organizations have become front-runners in the world for value-based healthcare, such as Kaiser Permanente, Intermountain Healthcare and Geisinger Health System in the US. As organizations with the dual role of being medical expense payment providers and medical service providers, they will give priority to preventive treatment seeing how disease prevention costs less than acute treatment, which also drives them to abandon trial and error therapy and apply more reliable therapies which have achieved better results and are relatively inexpensive. At its core market in the west coast of the US, Kaiser can provide healthcare services for companies with a price that is 30% less than that of the traditional healthcare management plans on the basis of ensuring quality (Silverstein, Rao, & Noble, 2013). The National Committee for Quality Assurance (NCQA) of the US ranks healthcare plans based on the patient's satisfaction and quality every year. Kaiser's health program has been ranked in the top three in NCQA's healthcare program since 2012 (Silverstein et al., 2013).

Song et al. (2012) considered how no integrated medical payers nor providers can manage the overall health of patients.In terms of comprehensive medical service needs covering patients, Blue Cross Blue Shield, an American insurance company, is at the forefront. It introduces a risk-based insurance contract payment budget scheme for Alternative Quality Contract (AQC) to provide 18 medical service organizations with the total budget in purchasing its insurance products (Song et al., 2012). If the medical service quality and financial goals set by such medical institutions are achieved in advance, they will receive corresponding rewards; on the contrary, if the expenditure arising from the treatment of specific diseases exceeds budget, financial risks of the excess amount will be borne by medical institutions (Song et al., 2012). In the second year, the compared results between use and non-use of AQC show that the average expenditure growth rate of medical institutions using AQC is lower than 3.3%. Institutions which have transformed on from the traditional fee-for-service model to AQC can save even more expenditure. The rates are 6.3% and 9.9% in the first and second year of the implementation of the plan, respectively (Song et al., 2012).

In the US, most medical organizations continue to adopt the free-for-service model. However, ever since the PPACA was implemented on January 1, 2014, an increasing number of new medical service organizations have been encouraged to be established. Some medical institutions which coordinate with each other and have consistent incentive mechanisms are called Accountable Care Organizations (ACOs). The incentive mechanism is used to encourage medical institutions to reduce cost and achieve better curative effects, thereby enabling participants to benefit from shared risks. On October 2013, 250 ACOs were established (Silverstein et al., 2013).

In Germany, there are similarly some organizations at the forefront. For instance, the development of Fresenius Medical Care in Germany reveals that traditional medical device manufacturers have advantages over the management of the health risks of specific patient groups under certain situations (Clawson et al., 2014). The study of BCG found thatFresenius Medical Care started as a manufacturer of dialysis instruments, and with 20 years experience in the market, grew itself into a global leading provider of dialysis-related treatment

outcomesfor dialysis services, dialysis medication, and dialysis patient disease management services. Meanwhile, Fresenius Medical Care also began to treat the diseases from which dialysis patients are prone to suffer, such as cardiovascular disease, foot ulcers and depression. This establishes the leading steadfast position of Fresenius Medical Care in dialysis treatment, as Clawson et al. (2014) point out that an unwavering ability to innovate is essential to be victoriousamong highlycompetitive situations with highly integrated resources and networking in today's medical industry. They also argue that in order to continuously improve performance, first of all, it is indispensable to gather treatment effects from patient populations and their corresponding expenditure data. Based on this data, the needs of medical payers can be analyzed.

Payment providers also pay attention to value-based healthcare with good outcome, such that governments and private insurers around the world are prone to pay on the mere basis of outcomes, and they are changing the mindset of competition increasingly towards the value-based healthcare model (Clawson et al., 2014). Traditional models of medical payment have been rendered obsolete, while the major standard of medical payment is value-based medical care. Producers of medical instruments and apparatuses are subject to handle an increased amount, if not all the responsibilities at hand, in order to make sure that they lead to increased innovation, better quality care, and lower costs while ensuring value-based healthcare. Hence, medical expense payment providers will assume greater responsibilities, since they can not only ensure value-based medical care but also inspire innovation, thus leading to lower cost and an improved curative effect. As a result, payers have a greater chance for creating a new reimbursement model which improves on the traditional one through providing greater value to patients. Medical expense payment providers should consider a key issue, which is whether or not the medical industry should become a competitive market similar to other industries, or what kind of competitive market might be suitable for the medical industry. Numerof and Abrams (2016) believe that a platform of collecting and publishing health-outcomes data which could be compared alongside on another should be pushed forward by public and private payers, and that medical payment agencies should be encouraged to cooperate with hospitals to ensure the validity of adopted

metrics and data which can be universally accepted and recognized by all parties.

It is unavoidable that managers of some medical institutions have held narrow views towards market competition, believing that it might break down highly integrated resources of a comparatively thorough medical system which is funded by the government.In Sweden, they conducted healthcare reform by means of establishing private healthcare and providing patient choices to ensure better results (McClellan et al., 2013). In spite of high similarity to the traditional fee-for-service model, most countries have verified the fact that the highly-integrated healthcare model which Sweden is now implementing has far more value output than that of the traditional fee-for-service model (McClellan et al., 2013).

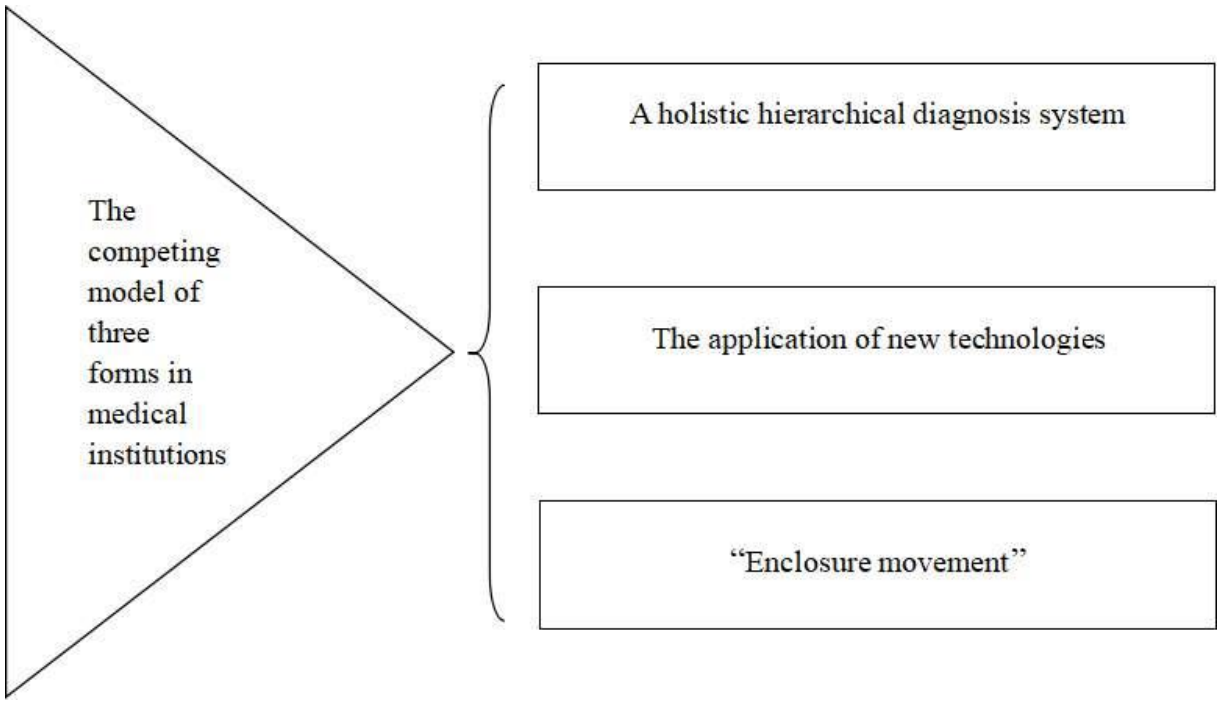
In the US, where the healthcare market is much more subdivided, Clawson et al. (2014) of the BCG team believe that a rationalized medical system should be achieved and that the integration of the industrial chain of the medical system should be positively promoted. This trend provides insurance companies with the opportunity to fully utilize clinical information to coordinate medical services and improve efficacy. For example, a recent study of BCG finds that compared with the traditional fee-for-service model, private insurance companies which provide financial incentives for medical institutions with high-quality curative effects establish a curative effect result announcement network and continuously pay attention to medical management initiatives, which can coordinate medical institutions for optimal curative effect (Kaplan, Kuenen, Pykosz, & Larsson, 2013).

However, all new reimbursement models should avoid the occurrence of relying upon pay-for-performance bonuses, as Morieux (2011) argues that this model would make data sharing more difficult and undermine the central principle, which is to benefit patients with data sharing and putting the interests of patients first as the foundation for value-based medical care. An unscientific design of incentives would lead to perverse incentives. For example, in order to make the outcome data look more appealing, medical institutions might report data selectively or select particular patients to provide treatment to (Morieux, 2011). The value-based medical care model can solve this problem by setting up a collection of outcome-focused, transparent and cooperative codes of conduct in order to conduct individual

and organizational design, whose results are far better than that of the financial incentives (Morieux, 2011).

Throughout the literature investigated, it was discovered that the competing model of medical institutions consists of three forms (see Figure 3-5). The first is a holistic hierarchical diagnosis system that China is advancing at the present moment, which covers different levels of disease, including all major diseases and all levels of rehabilitation, and it also includes the integration of systems at all levels, and shoulders management responsibilities for the overall health of targeted patients. However, there have also been controversial cases in the integration of healthcare facilities, such as the consolidation of Partner Healthcare and the Hallmark Health System, since the Massachusetts Medical Council believed the consolidation would not necessarily increase treatment effectiveness but rather raise the costs involved (Commonwealth of Massachusetts Health Policy Commission, 2014). Meanwhile, the US Health Financial Management Association (HFMA) found that 80% of financial executives are in favor of mergers and acquisitions or affiliations and at the same time report that they have signed an affiliation agreement (Health Financial Management Association, 2014).

Figure 3-5 The Competing Model of Medical Institutions Consists of Three Forms

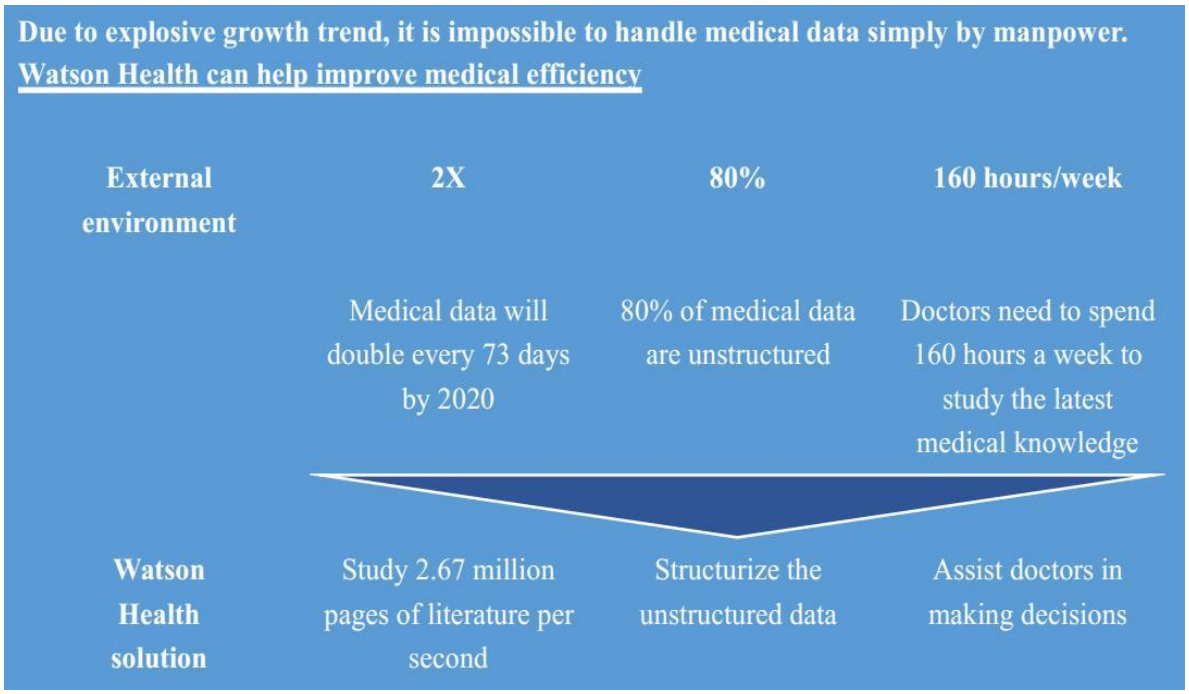


The second type of model involves the application of new technologies, such as AI, EMR and Block, in medical treatment. Due to a heavy reliance on the experience of doctors, the traditional Chinese medical treatment process is difficult to be quantified. Fortunately, artificial intelligence can effectively make up for shortcomings (Zhou, 2017; Vcbeat, 2016a), although this may not be enough in the diagnosis stage when patients likewise pursue good curative effect, and so both diagnosis and treatment are elements which should be addressed by these new technologies. In terms of the application of artificial intelligence in the medical field, the Medical Imaging Division of Central South Hospital at Wuhan University has introduced artificial intelligence aided diagnostic imaging system – as manufactured by YITU Company. The system has a sensitivity up to 96% in pulmonary nodule diagnosis, which is currently the highest level of lung CT diagnosis in China, and the system can not only effectively reduce the risks of missing a diagnosis, but also automatically generate reports, thus greatly improving diagnostic efficiency (Wang & Wang, 2017). Furthermore, the system provides high diagnostic accuracy and effectively reduces the physician's workload. For example, the diagnostic accuracy of the AI-assisted diagnosis system developed by Ankon Medical and IBM reaches higher than 90%, which greatly relieves the workload of doctors, so that the number of images to be seen by doctors is decreased from 20,000 to merely dozens (Yang, 2017; Vcbeat, 2016a).

VCBeat Research, which examines trends related to medical health in the future, has stated that based on *2016 artificial intelligence + medical health innovation trend report 2, IBM Watson artificial intelligence medical application details analysis*. As medical data presents an explosive growth momentum, it is difficult to handle and learn everything by means of sheer manpower. This is where AI comes in, and how Watson Health can help improve medical efficiency (see Figure 3-6). IBM predicts that medical data will double every 73 days by 2020 (Vcbeat, 2016b), in which this large increase of data will make it impossible for humans to browse and process all information. More specifically, if doctors were to browse through the data in order to apprehend the latest medical knowledge, it would take

160 hours per week on average (Vcbeat, 2016b). About 80% of data is unstructured, which is to say that this data cannot be expressed with a fixed structural logic, such as pictures, audio and video, and that computers themselves cannot recognize the data. IBM Watson's learning speed is also very fast, it can read 4,000 play files within 15 seconds (Vcbeat, 2016b).

Figure 3-6 IBM Watson Improves Medical Efficiency



Source: Vcbeat. (2016b)

Wang (2017b) has stated that EMR enable data exchange between healthcare providers and healthcare payers' insurers, improves service quality and streamlines processes. Besides,

EMR data also effectively reduces healthcare costs and provides drug analysis data. However, data security within data exchange and patient privacy are subject to many limitations. To achieve medical data sharing, the Obama administration spent more than $ 50 billion on EMR, although it still could not fully guarantee data security (Wang, 2017a). Fortunately, blockchain technology will effectively overcome this limitation, as IBM's Watson Health and the FDA have signed a blockchain joint development agreement to improve medical data sharing. Wang (2017a) has stated that since blockchain technology can safely share patient health data, organizations can collaborate with each other in trust.

Blockchain technology enables the exchange of medical data more securely and conveniently, making it easier and more secure for providers and payers to acquire information, and it increases mutual interoperability and engagement so that patients can have access to their own health data. This is thanks to the distributed network layer encryption technology of blockchain, which reduces the risk of network threats and data tampering. Kamaljit Behera, an analyst for Transformational Health Industry, has commented that: " blockchain will lead to unprecedented collaboration, innovative medical research, precise medicine, high level of security, improved medical workflow, as well as advanced healthcare interoperability and health management" (Chen, 2017; Woonsocket & Armonk, 2015). In terms of cost saving, blockchain technology can effectively prevent the inflow of counterfeit drugs and unqualified drugs into the market through workflow optimization, intermediate link costs and source traceability elimination. Blockchain technology will also be a future investment hot spot for healthcare organizations. An IBM survey has found that about 16% of healthcare institutions around the world, including payers and healthcare providers, will use blockchain tools in the coming 12 months; by 2020, about 56% of global healthcare institutions will invest in the blockchain technology (Chen, 2017).

Finally, the third type of model involved is the "enclosure movement", which is a turf war. For example, Kent, Rich, and Loppov (2013) argue that the reason the Martini-Klinik developed into an international professional institution for prostate cancer so quickly is because it puts patients at its core under the value-based medical care model in order to create

a better outcome and realize sustained growth of patient numbers. Medical institutions of this kind have highly professionalized clinical practices, as well as an advanced research and development ability regarding certain diseases so that they can become leaders in one sector with no competitors in the way.

There will be a very critical issue in the future which regards who will operate the integrated healthcare network. Although these medical institutions enjoy obvious advantages on behalf of their operation, mere dependence on their own decision-making process behind various issues will drive them to take up quite a passive or even subordinating role if their decisions are not made swiftly or efficiently enough. In such a case, medical institutions will be replaced by these medical payers, pharmaceutical product manufacturers and relevant medical network integrators. Therefore, Clawson and others (2014) from the BCG team believe that those integrators will undertake a role within this system which should have been taken on by medical institutions, and their products and services will be superimposed on medical services to create value for patients. In this way, although medical institutions continue to serve these patients, they do not actually own them.

At present, producers' market access will be determined by their product value. In reality, some widely used data can also exert a significant impact upon the R&D of medical products. Recently, some tests based on disease registration data have demonstrated that when compared to traditional prospective double-blind experiments, new product evaluation and comparison with existing products, made on the basis of real-world data, can be faster and less costly (Lauer & D'Agostino, 2013). Based on this, Clawson and others from the BCG team (2014) believe that pharmaceutical companies should prioritize and take account of the role of data in improving products and developing a product portfolio strategy. Additionally, they should work closely with regulating institutions to develop some convenient data application models in order to make their products accessible to the market and seize the market share as soon as possible.

Hunt, Manson, and Morgan (2014) believe that pharmaceutical companies need to strengthen their insights into pharmaceutical trends and make rapid changes at the company

strategic level, so as to minimize burdens and overcome crises in new drug development and structural issues, making efforts to eliminate fixed expenses to deal with the revenue reduction caused by structural adjustments. In terms of reducing burdens, pharmaceutical companies have to divorce themselves from their original business structure, focusing on their core business and relying more on the outsourcing, thus making the organization more streamlined. At the specific operational level, they also believe that, first of all, the inefficient R&D assets must be divested. They have to formulate more competitive drug R&D strategies. If a mature market can no longer maintain a large number of sales force in terms of the insights into pharmaceutical commerce, it is necessary to withdraw early. At the same time, it is necessary to strengthen the allocation of financial resources and financial discipline so as to improve the management capabilities of enterprises in fund allocation, external resource management, market access, communication, and financial planning.

Practice has shown that it is only value-based healthcare delivery which provides patients with better outcomes that can enable healthcare providers to make a medical product more accurate in diagnosis, better in treatment effectiveness, and compatible with other medical products so that they can stand out and win amongst the competition (Larsson et al., 2012). The strategic focus of pharmaceutical companies will witness a fundamental shift from the previous encouragement, where patients and doctors would discuss a suitable product, towards a new horizon fully centered upon patients, meaning that pharmaceutical companies must fundamentally change the way in which they communicate with patients and acknowledge the status of patients as legitimate medical decision-makers - ultimately "treating the patient as a partner" (Numerof, 2014). Over the past few years, medical equipment companies have been faced with difficulties and continue struggling on, persevering despite investigations into improper marketing behaviors from salespeople of medical equipment (Numerof & Abrams, 2016). Additionally, the rate of product recalls for medical devices increased dramatically by 97% merely in the decade between 2003 and 2012, with 1,190 recalls occurring in 2012 alone (US Food and Drug Administration, 2015).

Numerof and Abrams (2016) believe that the world's healthcare industry will usher in a brand new market layout. Healthcare is one of the largest industries among developed

countries, yet it is also one of the industries with the lowest maturity and most stringent rules and regulations, which has led to very low operation efficiency throughout the whole industry. Taking a comprehensive look upon the current global healthcare industry and market, we can discover that due to unreasonable incentive mechanisms, and there will be an unsustainable rise of cost in the years to come, causing the currently existing model to meet a dead end in the near future. Therefore, the problem of how to create increasing value for patients is of urgent need for medical policy makers and responsible industry leaders, and it requires timely solutions. Of course, they can promote innovation and development of the industry with competition so as to establish a new market structure and to shape more market segments which have been taken into consideration by them, seeing as how each time the market is segmented, a lot of business opportunities are engendered to create greater value for the community and patients. This can bring about great profits and a fair return for shareholders investing in medical businesses, for taxpayers which all support the payment of healthcare system, and for citizens as well.

As for the realization of value-based healthcare, Zhao (2015) has conducted extensive literature research in reference to the formation of the US government's more comprehensive value concept behind its medical philosophy and combining it with the first value-based healthcare fees originally introduced by US Medicare. First, value-based healthcare was implemented through strict supervision of the re-admission and re-treatment rate of patients in medical institutions following an initial implementation of the Evaluation Act in the US. Such an outcome-oriented approach only focuses on consequences, while giving no clear guidance to medical payments. However, it is on this basis that US Medicare designed a payment code—CPT code 9940 in 2015—which was entirely designed in compliance with the value-based healthcare concept. It designed a plan where each patient should pay $34.6 per month and personal payment amounts to $8, equaling a total of $ 42.6 (Zhao, 2015).

In his essay, Zhao (2015) has argued that the US federal health insurance strictly stipulates this charge. First of all, it limits doctors' authority and privilege, namely, only the general practitioners are eligible; secondly, the patients should be only those who have previously received treatment from the doctor. The medical insurance companies also places

limitations concerning the patient's disease, which means that patients eligible must be those suffering from two or more diseases, and additional conditions must also be satisfied in order to bear eligibility. For instance, doctors should use EHR to share their care records and document information with their colleagues, thus ensuring collaboration and the continuous sharing of medical care information with the patient's physiotherapy every month.

Some conclusions have been reached considering the recognition of this standard - firstly, the standard ultimately tries to control the increase of healthcare costs before or after the occurrence of medical expenses, and it takes the grassroots as the primary goal to regard the prevention and disease control as a core concept; secondly, it also emphasizes the transparency and flow of information, which is one of the means towards value-based healthcare, for it can effectively resolve the predicament of information enclosure and can also effectively allocate medical resources in order to bring a natural benefit to reduce the medical expenses; thirdly, full-service for patients and the patient-centric value-based healthcare concept will be universally recognized and enforced; fourthly, in such an information technology abundant age, information systems can also be effective in rapidly assisting and accelerating the development of value-based healthcare due to their important role in this model, as well as their ability facilitate the rapid growth of digital medicine.

Concerning the first conclusion, Zhao (2015) argues that this proposal strictly controls basic healthcare and the concept that prevention comes first serves as a crucial part of value-based healthcare, alongside the notion that prevention and treatment can be combined together to effectively control medical expenses. However, this conclusion ignores incentives for medical practitioners to prevent and control disease and neglects some essential questions, such as why should they actively prevent the disease and what personal interests are at stake? Furthermore, what incentives are provided for this change of attitude? The answers to those questions were not provided in the aforementioned proposal and it can be concluded that this proposal is but a temporary solution which addresses only superficial targets instead of the roots of the problem. A person's attitude toward what they are doing is actually rooted in his internal value orientation and such patient-centric attitudes can initially be driven and modified by medical practitioners' personal interests. However, when these interests decrease

and near exhaustion, the lasting enthusiasm of medical practitioners can only be nurtured with the values in their heart.

As for the second conclusion, Zhao (2015) argues that information transparency and flow is only one of the means of value-based healthcare and that through this instrument, one can indeed effectively eliminate the predicament of information enclosure and facilitate the effective allocation of medical resources which can effectively reduce the medical costs. Notwithstanding, through analyzing the fact that doctors and hospitals are reluctant to share medical records, we can find that reasons behind such hesitation, in that they may have the intention to keep patients with in their own hospitals or departments in order to gain increased benefits for themselves through the system of charging according to frequencies and times. Zhao (2015) believes that once medical records are shared, the patient is increasingly likely to move on to better hospitals or seek better doctors for superior treatment, and patients will benefit from reducing the likelihood of huge costs and obtaining increased efficacy, while doctors in hospitals with relatively insignificant treatment effects might obtain less benefits. The author believes that this explanation indicates that the hospital and medical staff do not place the patient at the foundation of their efforts and therefore do not have the mindset of value-based healthcare. Doctors become profit-chasing businessmen with greedy intentions while patients may resemble lambs who await to be slaughtered. In reality, this framework is ultimately not sustainable and it is incompatible with civilized society, suggesting that it must eventually be ruled out and replaced with more reasonable methods.

In consideration of the third conclusion, Zhao (2015) argues that the enforcement of value-based healthcare can also effectively constrain medical practitioners' behavior and it can, to a certain extent, enable doctors to strengthen awareness. However, the future of medical services appears to be a combination of medical treatment and reimbursement, which is patient-centered and provides a full range of treatment for the patients. This model requires the collaboration and cooperation of medical and other medical management personnel at different levels among different departments and doctors can only serve as one of the links. Therefore, Zhao (2015) contends that the future of hospitals will show a multi-level form in

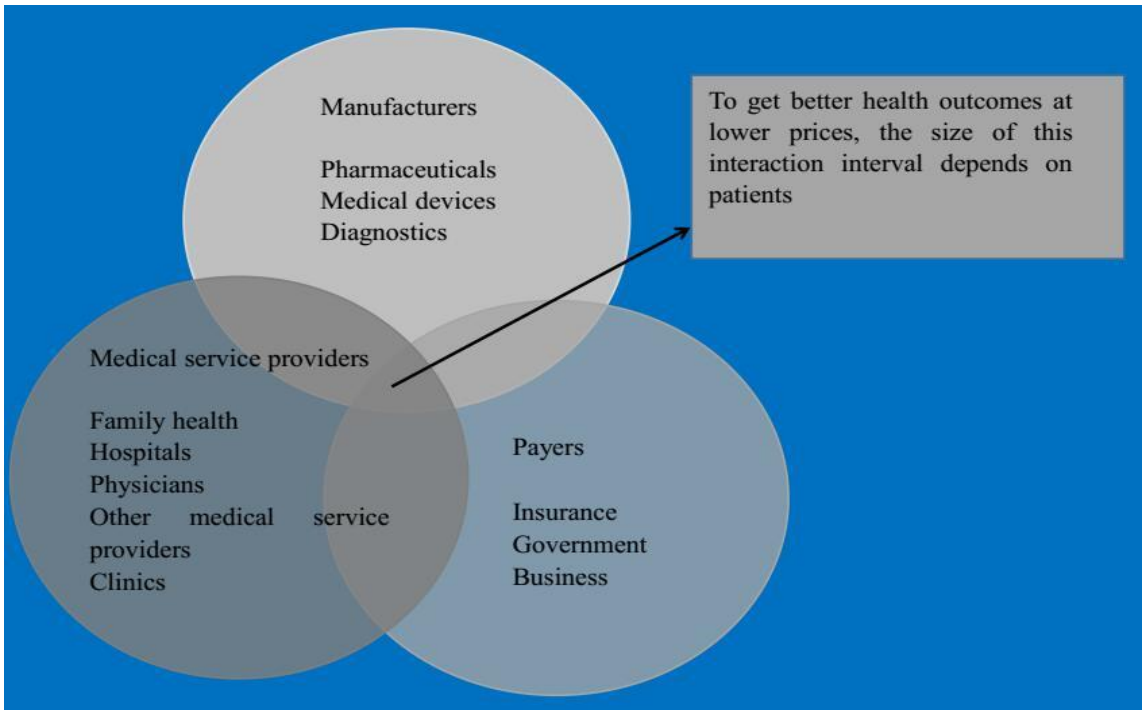
which the entire medical team includes doctors, nurses and health advisers, and if hospitals can effectively combine medical treatment with healthcare, and every team member can be effectively placed in their appropriate position; additionally, if the medical ethics of medical personnel can be strengthened and their attitude towards medical care can be converted, then hospitals will increase their popularity among patients and the win-win situation between doctors and patients can be ultimately attained.

As for the fourth conclusion, Zhao (2015) argues that information technology will definitely be conducive to the rapid realization of effective value-based healthcare. However, users of information technology tools are still not mainstream among medical practitioners, and so the question of how to promote their willingness to actively use information technology still requires a change in attitude towards value-based healthcare. The traditional medical service capacity will be rapidly improved by digital medical care, which meets the positioning of value-based healthcare so as to provide a full range of service. Telemedicine and artificial intelligence can assist remote surgery, the medical community overall, as well as EMR, and they will completely subvert the existing medical system. As described by the Center for American Progress, the effective use of information technology will ultimately depend on its coordination with a new payment model (Park & Basch, 2009). George Halvorson, former chief executive of Kaiser Permanente, noted that information technology can spread medical knowledge, improve coordination between medical services, as well as obtain and track medical outcomes in support of EBM (Halvorson, 2007). Value-based healthcare has a higher demand for information systems, and this has rendered medical institutions under great pressure and difficulty due to their deficient purchasing power for such a system. However, in the face of huge business opportunities, information technology providers will take on methods of leasing to meet the needs of basic medical institutions.

In short, Numerof and Abrams (2016) consider that in order to realize value-based healthcare, and quicken the advancement of value among medical care in China, hospitals are ultimately dependent upon the recognition of healthcare practitioners, medical equipment manufacturers and medical decision-makers for the purpose of value-based healthcare.

According to the model provided by Numerof and Abrams (2016), the patient's right to make choices is important in order to achieve lower costs and better treatment effectiveness, and only when patients have the right to make decisions, can they reap benefits from the decision-making process. The key to the development of the medical service industry in the 21st century lies in the innovation and mutual cooperation of business models among various departments. Most importantly, the impending future of the healthcare industry requires precise collaboration between medical industry players—manufacturers, payers, healthcare providers and wise consumers (see Figure 3-7).

Figure 3-7 Medical Service Industry Model in the 21st Century



Source: Numerof & Abrams. (2016)

Banben (2011) believes that recognition and awareness should be deeply rooted in a doctor's practice, and their attitude should be sincere, which is an important concept of patient-centered value-based healthcare and should also be reflected in the care of patients. Japan's Kameda Medical Center is a good example of this principle, as a large scale hospital built in Kamogawa, a city with a resident population of about 36,000, utilizing more than 850 nurses, 400 doctors and about 1,000 beds (Banben, 2011). The hospital's operation has

obtained significant effects with patients from all over Japan and some patients even travel thousands of miles to come here specifically for medical treatment (Banben, 2011). The hospital upholds a unique philosophy of putting patients first, as doctors and nurses here never say “no” to patients, whereas they carrying out a slogan to “always say yes”, which embodies respect and care to patients (Banben, 2011).

In the book *Management Lessons from Mayo Clinic*, Berry and Selman (2009) argue that the complexity and precision of medical products and services values more than infrastructural condition of hospitals and that value-based healthcare delivery differentiates superior hospitals from normal ones. For example, in the Mayo Clinic, doctors will repeatedly talk with patients’ relatives to gain detailed information about patients’ medical history, as well as family and personal habits, and only subsequently will they then assume problems which may come up during the surgery and take corresponding precautions – which ultimately lears to them completing the surgery within the shortest amount of time (Berry & Selman, 2009). This is one of the secrets behind the hospital’s success, since they are adhering to patient-centered concepts and always concerned about the patients themselves. These concepts are deeply rooted in the staff’s heart, such that seeing a doctor becomes a pleasure and the patient can always be given the respect they truthfully deserve. When we focus on treatment effectiveness, we should, at the same time, pay attention to patients’ satisfaction, which is not only reflected in the lowest cost and best outcome, but also in the respect and care given out to patients (Banben, 2011). Therefore, how to effectively promote this kind of awareness and how to efficiently promote value-based healthcare in China becomes the author’s research focus.

3.4 Patient satisfactionn

The concept of “patient satisfaction” evolves from the “customer satisfaction”, while the “customer satisfaction” originates from the concept of “satisfaction” at the earliest. According to the definition of satisfaction in Kotler and Keller’s (1994) *Marketing Management,*

satisfaction is a kind of customer perception. This perception reflects the difference function between the perceived effect after the customer has experienced a certain product or service and the customer's expectation of the product or service. Apparently, if the customer's perceived effect is greater than or equal to the expected value, the customer will be satisfied. If the perceived effect is less than the expected value, then the customer will be very dissatisfied or disappointed. The concept of customer satisfaction was first mentioned by Cardozo (1965) in the published article of *An Experimental Study of Customer Effort, Expectation and Satisfaction*. He believes that increasing customer satisfaction will lead to second purchases by the customers, which will reduce marketing costs and produce a good effect in cultivating customer loyalty. Patient satisfaction is derived from customer satisfaction. For medical providers, the patients are their customers. Because medical products are of their own particularity, patients, as the main target of receiving medical service, will have a deeper perception of the service provided by medical providers in the process of receiving specific medical service, and they are easy to form a judgment on the medical service. This judgment will be compared to their own expectation, thus forming the difference between perception and expectation. When the difference is large, the patients will be extremely dissatisfied or it will lead to doctor-patient disputes. The patient will not choose the same institution at the next time when he needs to seek medical advice, and the medical institution will lose patients (Huang, Chen, & Chen, 2015).

The research on patient satisfaction in China began in the 1980s. As it starts late, the evaluation methods and evaluation indicators of the research all lag behind the developed countries in the West, and it is also short of corresponding models. After more than 30 years of development, the domestic research has begun to take shape, having formed a large number of classical studies. For example, Chen et al. (1999) conducted a groundbreaking study on patient satisfaction scales and the compiling work of the scales in the *Pilot Study for Developing Inpatient Satisfaction Questionnaire as An Instrument for Measuring Quality of Medical Care in General Hospital*. They adopted the letter approach to investigate 900 patients from three general hospitals in Guangzhou on the patient satisfaction, and analyzed correlation factors of the survey results. The conclusion was that the factor load and structure

were basically consistent with the content of the questionnaire scales, which indicates that the content validity was relatively high. The reliability coefficient value is 0.92, indicating that the reliability is also high, and the inpatient satisfaction scale was initially formed. In the *Research on Study on Outpatient Satisfaction Assessment System*, Zhang, Zhen, and Jiang (2003) applied the theory of modern management science to establish a set of outpatient satisfaction evaluation index systems containing 131 indicators of first-level indicators, second-level indicators, third-level indicators, and fourth-level indicators. Among the indicators, there is one first-level indicator, eight second-level indicators, 28 third-level indicators, and 94 fourth-level indicators. In the *Study on Patient Satisfaction Evaluation System*, Liu, Qin, Zou, Zhen, and Zhen (2007), according to the status quo of the Chinese medical industry and the characteristics of patient behavior decisions, and with reference to the European Customer Satisfaction Index (ECSI) as well as the American Customer Satisfaction Index (ACSI), established a customer satisfaction index model with a large index of innovation in the medical service industry. Later, Gu (2008) obtained the following seven structural variables in the article of *An Empirical Study on Medical Customer Satisfaction Index of Urban Residents*: the perceived value, customer loyalty, customer expectations, perceived quality, constraint conditions, customer complaints, and customer satisfaction. He suggested that these variables should be included in the research of patient satisfaction index model.

The research on patient satisfaction abroad started earlier and was highly valued. For instance, Carey and Posavac (1982) introduced the concept of patient satisfaction in the *Using Patient Information to Identify Areas for Service Improvement*, which aims to improve the quality of medical service in the medical industry. Weisman and Nathanson (1985) mentioned in the *Professional Satisfaction and Client Outcomes: A Comparative or Generational Analysis* that as early as in 1965, the United States had first attempted to evaluate the quality of medical service using patient satisfaction. This shows that patient satisfaction is valued in the field of medical and health services, and these theories have also been put into wide development and application. Hafer and Joiner (1984) mentioned in the article *Nurses as Image Emissaries* that in the early 1970s, foreign scholars had conducted extensive

discussions and researches on the concept of patient satisfaction. Meanwhile, Cleary and Mcneil (1988) mentioned in the *Patient Satisfaction as An Indicator of Quality Care* that in the 1980s, foreign scholars paid more and more attention to patient satisfaction. They generally realized that patient satisfaction is one of the important indicators to measure the medical service quality of medical organizations. The patient-centered evaluation of medical service quality has become a major topic for scholars.

The relative classical and widely used theories abroad include the Swedish Customer Satisfaction Barometer (SCSB) Index Model, ACSI and ECSI. Among them, the SCSB measures a cumulative degree of satisfaction. The core idea of this measurement model is about the customer's overall evaluation on the overall experience of a product or service (Fornell, 1992). ACSI adds the "perceived variables" to the SCSB model and is a more general measurement model for customer satisfaction at present (Fornell, Johnson, Anderson, Cha, & Bryant, 1996). ECSI is added with the "corporate image" variables on the basis of ACSI and removed the "customer complaint" variables at the same time (Schulz, 1998).

Through the above literature research, it has been found that the measurement methods and evaluation models for patient satisfaction have received relatively mature development, and the main factor that affects patient satisfaction becomes one of the main contents of the research. While there are two types of factors that affect patient satisfaction, respectively coming from the medical service institutions and the patients themselves. Factors from the medical service institutions are mainly five indicators of waiting time, medical environment, medical expenses, diagnosis and treatment effects, and medical care attitude; while the factors from the patients themselves mainly include six indicators like physical conditions, income status, marital status, age, gender and academic qualifications.

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Chapter 4: Research Methods

Under the theory of Competing on Outcomes, Value-Based Healthcare and Delivery Value, the investigated problem was initially formed, and the Delphi method was utilized to investigate *Attitude towards Value-based Healthcare Delivery in Chinese Hospitals*.

4.1 Introduction of the Delphi Method

In 1964, the RAND Corporation of the USA put forward the Delphi Method (Wang & Si, 2011). As a decision-making method, it featured being statistical, anonymous and capable of providing feedback. In the implementation process, it can deliver feedback to all the experts following the collection of their opinion. Viewed from this perspective, the Delphi Method can be adopted to control information and provide corresponding feedback. The Delphi method collects expert opinions anonymously, and experts from different regions are grouped, with their forecasts inquired upon in a two-way anonymous manner. The key characteristics of this method are its anonymity and feedbacks, seeing how the panel of experts does not communicate nor exchange opinions. Following rounds of questionnaires, the experts' answers will converge at a certain point. Based on these features, the Delphi Method is widely applied in various fields. It has special functions especially in the realms of making predictions and evaluating, as well as further establishing index systems.

The essence of the Delphi Method is to collect wisdom and opinions from mostly experts: by utilizing their collective wisdom and experience, this method can obtain measurable conclusions for an unquantifiable and vague problem through experts' consultations. The analysis and evaluation of the Delphi Method can make use of not only standard deviations and arithmetic mean values, but also the level of authority exhibited by the experts, the positive coefficient, and the coordination coefficient towards some certain consulted problem. The reason why experts' level of authority should be taken into account is so that experts are

not authoritative towards all consulted problems; instead, they are only specialized in certain fields. However, the level of authority would exert great influences upon the reliability of the index evaluation, so this factor has to be taken into account. Based on these findings, the authoritative level coefficient should be considered when evaluating the data of the results (Zeng, 1994). Moreover, the coordination and positive coefficient of expert opinions are also crucial, which shall be incorporated when processing data.

Based on the current literature concerning the implementation of value-based healthcare delivery in and outside China, this thesis studies medical staff's perceptions of the model of value-based healthcare delivery. Several evaluation indicators have been designed in light of the theory of value-based healthcare delivery. In line with the Delphi method, three rounds of questionnaires were conducted to obtain experts' evaluations of the indexes and analyze reasons why value-based healthcare delivery is so difficult to be promoted in China. Further analysis is also carried out to find out possible solutions to the problem.

4.2 Procedures of applying the Delphi Method

The Delphi method consists of six steps, as follows (Wang & Si, 2011):

First, researchers should certify the required knowledge fields according to research objectives and further select experts in the corresponding fields for consultation. In this way, experts' level of authority can be ensured, and thereby so can the reliability of consultation results.

Second, researchers should design questionnaires for consultation purposes and clarify the detailed requirements for filling in the questionnaires. At the same time, all required background material should be sent to experts for putting the consultations into effect and experts' need of other materials shall be satisfied to meet their demand.

Third, researchers should inform all experts to give their own judgments based on their knowledge, experience, and background materials, as well as elaborate on their reasons for making these judgments, their degree of familiarity, as well as the importance of the

evaluation.

Fourth, researchers should collect the first-round questionnaires and summarize all experts' opinions. Then, questionnaires should be sent back to each expert so that judgments can be altered based on other experts' opinions, if necessary.

Fifth, researchers should collect the second-round questionnaires and conduct a statistical analysis. If only a few experts have discrepancies, these could be ignored and opinions from the majority shall be adopted. Meanwhile, if a large number of experts share discrepancies, then a third-round of consultations would be effected until their judgments tend to be consistent.

Finally, consultations shall be concluded if experts will not change their minds or only a small number of them hold differentiated views following three rounds. Researchers should summarize the final results of the consultations by means of analysis and discussion, so as to ascertain the final indices.

4.3 Selecting experts for applying the Delphi Method

The source and the number of experts are listed in Table 4-1, including authoritative experts, representative, managerial, and academic experts, who are from healthcare administrations, provincial and municipal medical institutions, research administration agencies and medical schools. The choice of the number of experts is also a key part for the Delphi method, seeing how varying numbers of experts dictate different forecasting results. The number of experts and forecasting results demonstrate a positive correlation, namely, within a certain range, the research precision will be improved with the increase of the number of experts (Hu, 1992). The appropriate number of interviewees should be 15 to 50 (Wei, Ren, Zhang, Wen, & Yang, 2013), and for the purpose of this paper, 30 experts were selected to take the questionnaire.

When selecting experts for consultations based on their length of working experience, experts with five to fifteen years' experience, sixteen to twenty-six years' experience, longer

than twenty-six years' experience in research and management should respectively be chosen. When selecting experts for consultations based on their specialized fields, experts specialized in preventive and clinical medicine, public health, sanitary inspection, health economies and management should be chosen respectively. When selecting experts for consultation based on their working places, experts who are working in affiliated hospitals of higher institutions, provincial health administrative departments, medical devices and pharmaceutical companies, and medical institutions under direct administration of provincial health departments as well as those of municipal and county levels should be considered. Additionally, when selecting experts for consultation based on their educational background, academic degrees and professional titles, the number of experts with a bachelor's degree, master's degree, doctor's degree, medium-level professional titles, and high-level professional titles should be counted respectively.

Table 4-1 The Source and the Number of Experts

Project		The number of people	Percent (%)
Workplace	Medical higher education and Affiliated Hospital	7	23.33%
	Medical institutions directly under the Provincial Department of Health	12	40%
	Provincial and municipal health administrative institutions	4	13.33%
	County-level medical institute in the city	5	16.67%
	Medical devices and pharmaceutical companies	2	6.67%
Professional field	Clinical medicine	8	26.67%
	Preventive medicine	2	6.67%
	Public Health	12	40%
	Health management	5	16.67%
	Health economy	1	3.33%
	Sanitary inspection	2	6.67%
Life of the working	More than 26 years	11	36.67%
	16 to 26 years	16	53.33%
	5 to 15 years	3	10%

Title	Intermediate	2	6.67%
	Sub high	7	23.33%
	High	21	70%
Education	Doctorate	15	50%
	Master	12	40%
	Baccalaureate	3	10%
	Other educational types	0	0.00

4.4 The design of the Delphi questionnaire

Designing a Delphi questionnaire is highly important because the experts' opinions to be collected are subjective. As a qualitative method, the questionnaire should be made as simple as possible, with no more than 50 questions, with questions categorized and sequenced logically, while the wording provided should be accurate, concise and unambiguous (Wei et al., 2013). In order to ensure the results are scientific and logical, when designing the questionnaire, several entries were designed, including problem importance evaluation, operability evaluation, full mark rate, index judging basis, and index familiarity, while each entry was given a value domain, and options were provided for marking and evaluation. At the same time, in the evaluation and suggestion entry, a qualitative method was adopted for experts to express their views freely according to their own experience.

4.5 The formation and discussion of the Delphi questionnaire

The expert consultation questionnaire is an important prediction tool for the Delphi method and is the main source of research data. The quality of the questionnaire has a great influence upon prediction results.

For the formation of expert consultation questionnaires in the first round, by using the method of literature research, relevant literature on the study of medical service attitude based on the Value-based Medical Model is searched in major authoritative journals through keywords, and the current status of the study on the Value-based Medical Model of medical service attitude and relevant theories of Value-based Medical Model at home and abroad are also learned. The searching keywords: "Valued-based Medical", "competition based on efficacy ", "sharing the therapeutic data ", "medical payment, medical service attitude", "measurement tools", "evaluation index system", "patient-centered", "hospital management", and "general medicine". At the same time, according to the basic theory and the core idea which was studied based on the medical service attitude of Value-based Medical Model, the

role and characteristics of comprehensive value of medical model in the process of medical services, is combined with the essential connotation and characteristics of Value-based Medical Model as well as the reality of Value-based Medical in China. In line with the principles of scientificity, completeness, importance and the operability, and in view of the different aspects of the Value-based Medical Model, it is preliminarily planned to build the framework and pool of entries of the medical service attitude evaluation indicator system of Value-based Medical Model, and the first round of the expert questionnaire is draw up. The formation of various indicator entries is as follows:

The formation of first-level indicators. According to the use of curative effect data to improve clinical practice based on curative effect competition theory (Clawson et al., 2014), a first-level indicator "curative effect data collection and sharing platform" is formed. The collection and sharing of curative effect data has been proved to effectively improve clinical practice and are also important contents of Value-based Medical; according to the value of re-engineering: based on the value of the service industry in medical business model change pattern in the 21st century (Numerof & ABrams, 2016), two first-level indicators of "medical service providers" and " medical expenses payers" are formed, which is also the important content of Value-based Medical Model.

The formation of second-level indicators. On the basis of the first-level indicators, each first-level indicator is subdivided according to the importance and operability, and the second-level indicators are formed according to the relevant literature. For example, Martin Ingvar, a professor of the University of Karolinska, pointed out in her speech "How to Provide Better Medical Services: Value-based Medical" that, the two key factors for the success of the Value-based Medical in Sweden respectively are measuring the value of medical service and collecting and publishing the medical results (Yao, 2013). The formed second-level indicators include "establishing a nationally integrative diagnosis and treatment cost calculation center", "establishing a nationally integrative therapeutic data collection center" and "publishing shared therapeutic data". To measure the medical service value, collect and disclose medical results, there has to be nationally integrative specialized functional departments to do such

work, to ensure the scientific nature of the data,which will also make it more operational; according to the subdivision of first-level indicators of "medical expense payers" formed by the 21st century model (Numerof & ABrams, 2016) in the medical service industry, three second-level indicators of "patient payment", "medical insurance payment" and "commercial insurance payment" are formed in this questionnaire. Through integrating the health care providers and manufacturers in the 21st century model of the health care industry by Numerof and ABrams (2016), four second-level indicators of "doctor", "drug manufacturers", "equipment manufacturers" and "medical institutions" are formed in this questionnaire, because such consolidation increases the traceability of medical accidents at each link of the health care providers.

The formation of third-level indicators. The second-level indicators are further subdivided according to the operability of the composition and with reference to relevant literature to form third-level indicators.

Based on the second-level indicator of "establishing a nationally integrative diagnosis and treatment cost measurement center", and referring to *"What Is Value in Health Care?* (Porter, 2010), four third-level indicators of "the cost of calculating the treatment of specific diseases", "the cost of calculating devices of a particular disease diagnosis and treatment ", "the cost of calculating medical service of a particular disease " and “the center should be a national team of technical experts to estimate the cost of individual projects" are formed. Because the workload of collecting all data of diseases is too large and it is not mature in terms of technology or manpower, it is possible to calculate the cost of therapeutic drugs, medical devices and services for specific diseases. According to the second-level indicator of “establishing a nationally integrative therapeutic data collection center", the reimbursement system based on curative effect competition theory and specific curative effect linkage model (Clawson et al., 2014), three third-level indicators of "collectting data and measuring the curative effect of a particular disease", "measurement standards" and "verifying the authenticity of the measured data" are formed. First of all, the measurement standard should be set. Without the standard, the measurement cannot be carried out. Second, if the measured

data is not verified for authenticity, the data will be worthless. Finally, because of the complexity of all diseases, only specific diseases can be selected for the measurement and collection of therapeutic data. Based on the second-level indicator of "publishing shared therapeutic data", and referring to 2016 *artificial intelligence + medical health innovation trend report 2*:*IBM Watson artificial intelligence medical application details analysis* (Vcbeat, 2016b),three third-level indicators are formed, namely, "To measure the patient's utilization of platform data", "the timely release rate of the corresponding disease data of the detecting platform" and "monitoring the update speed of new technology and new medical products". Therapeutic data sharing is good, but it doesn't help if patients don't understand and use therapeutic data. If the sharing is not timely or the information is published with a delay, the meaning of sharing will be lost; if the therapeutic data of a new medical product is not updated in time, the patient's right to know will be damaged.

Based on the second-level indicator of "patient payment", and referring to the "people-oriented integrated services" (Liang, 2017), three third-level indicators are formed, namely, "emphasizing the public's participation in health management", "patients have the right to know and make decision in the entire medical service process" and "the payment proportion of patients with different diseases". Patients should have the right to know and make decisions, and participate in the payment, so as to understand the payment proportion of different diseases. Based on second-level indicator of "medical insurance payments", and referring to the dilemma and choice of Value-based Medical in China (Zhao, 2017), four third-level indicators of "the speed of the medical insurance for new drugs into the health care", "the percentage of medicare payments for different drugs", "the proportion of medical insurance payment for the use of different medical devices" and "health insurance payment ratio of specific operation" are formed. Based on the second-level indicator of "commercial insurance payment", and referring to the dilemma and choice of Value-based Medical in China (Zhao, 2017), "the disease coverage rate of commercial insurance payment" and "the speed index of commercial insurance payment" are formed.

Based on the second-level indicator of "doctors", and referring to Value-based Medical:

The Crisis Moment of Specialist Doctors (Cun, 2015a), the third-level indicator of "number of general doctors" is formed. Referring to *Solving the Dilemma of Medical Product Homogenization with Value-based Medical* (Han, 2016), "the indicators of doctors' treatment behavior mode (transforming from biological medicine to biological, psychological and social medical mode) is formed". Referring to *the Trend Report of Artificial Intelligence + Medical Health Innovation 2 in 2016: Detailed Analysis of IBM Watson Artificial Intelligence Medical Application* (Vcbeat, 2016b), the "application indicator of new medical technology" is formed. Based on the second-level indicator of "Drug makers", and referring to *Ring the alarm bells for pharmaceutical tycoons* (Hunt et al., 2014), four third-level indicators of "side effects of drug treatment" "the effect of the drug treatment", "the pace of new drug development" and "drug price" are formed. It is also the important factor that drug makers must consider if medicine diagnosis and treatment effect is very good, but the price is too high, and it is not in conformity with the value of medical vision. Based on the second-level indicator of "Device manufacturer", and referring to the *Medical Device Recall Report, FY2003 to FY2012* (US Food and Grug Administration, 2015), the second-level indicators of "recovery rate of unqualified devices" and "adverse reaction rate of devices" are formed. Referring to *Ring the alarm bells for pharmaceutical tycoons* (Hunt et al., 2014), the "medical apparatus and instruments of continuous innovation index" is formed. Based on the second-level indicator of "medical institutions", and referring to *Survey using incognito standardized patients shows poor quality care in China's rural clinics* (Sylvia et al., 2015), "the mortality rate of different diseases", "the cure rate of different diseases" and "the indicator of the rate of cure for different diseases" are formed. Referring to *Solving the dilemma of medical product homogenization with Value-based Medical* (Han, 2016), "the indicator of change of attitude in medical services" is formed. Referring to *The value of medical treatment, cancer drug seeking: respiratory pain should not be sad* (Tang, 2017), "The indicator of speed of acceptance of new drug devices by medical institutions" is formed. Innovative medical devices by device manufacturers are also against Value-based Medical if they cannot be quickly accepted by hospitals for the diagnosis and treatment of diseases.

The second-round questionnaire is formulated based on modified indicators of

first-round consultation by the Delphi method (see Table 6-3 or Appendix 2). In the same way, the third-round questionnaire is formulated based on the modified indicators of second-round consultation by the Delphi method (see Table 6-4 or Appendix 3). In order to ensure that questionnaire contents are scientific and logical, this study adopted the Delphi method to consult experts. For the above three rounds, experts were invited to put forward the adding, deleting, and modifying of suggestions on the specific connotation of the indicators of the questionnaire, and give evaluation of importance of the entries.

There is no mature case for reference as to the application of the Delphi method in medical service attitude research. In the process of implementation, many contradictions of theory and practice were encountered, and there were improvements made upon the Delphi method based on actual needs, following expert group discussion, by consulting all experts participating in this survey. The improved Delphi method is applied to this standardized research concerning medical service attitude under a Value-based Medical Model, and to the drawing up of industry-recognized solutions, which proves the practicability and accessibility of the Delphi method in standardized research on medical service attitude under a Value-based Medical Model.

4.6 Consulting method of applying the Delphi

The preliminary index system in this thesis includes 3 first grade indicators, 10 second grade indicators and 34 third grade indicators (see Appendix 1: Expert Consultation Questionnaire under Delphi Method for First Round), regarding the public platform of therapeutic effect data for value-based healthcare delivery, medical treatment payers and providers. Three rounds of Delphi expert consultation will be carried out via email or WeChat. In the first round of the questionnaire, experts will be introduced to the research objectives and background behind value-based healthcare delivery, as well as the preliminary indicators and their meanings, so as to help them to understand this research. We will invite experts to evaluate the importance of all the indicators from the perspective of the importance of the questionnaire, their basis of judgment and familiarity with the indicators, and lastly, they

should provide their revision suggestions. The three first grade indicators are especially important for evaluation and revision.

In the second round of the questionnaire, results of the first round are summarized, counted, categorized, and ultimately delivered to experts as the opinion reference of the second round. Subsequently, the second-round results will be summarized and delivered to the experts as reference to obtain a final result. With three rounds of inquiry, reasons as to why value-based healthcare delivery is not promoted widely in China will be explained, as solutions and the statistical weight of the indicators will be presented. Though experts' opinions might vary following three rounds of questionnaires, the subtle difference can be ignored and thus the final indicator system should fundamentally be recognized by experts. Based on the three rounds of expert evaluation, data will be statistically analyzed to establish an indicator system for the model of value-based healthcare delivery.

4.7 The advantages and disadvantages of the Delphi Method

Weakness: During the second round of consultations, the opinions of some experts may easily be influenced by authorities, and some experts are unwilling to change their own viewpoints. This may be due to face-saving rationales, or may be due to self-esteem. In follow-up surveys, these experts are reluctant to modify their original one-sided views. The Delphi consulting method requires several rounds of investigations, which generally takes longer and costs more (Ying, Li, Duan, & Pan, 2012).

Strengths: anonymous inquiry can avoid the disadvantages of group meeting. The experts have no chance but to communicate and can only make contact with the surveyor. Following several rounds of inquiry, summary and revision, as well as expert's opinions, finally converge to form a highly representative and reliant result.

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Chapter 5: Data Processing and Presenting of the Delphi Method in the Study

When processing and expressing expert opinions,the EXCEL2011 software and SPASS 22.0 statistical software can be used for data entry and analysis and to calculate the full score frequency, arithmetic mean value,the degree of authority of an expert, coordination coefficient and positive coefficient of each indicator, using these coefficients to screen the indicators.

5.1 The authoritative level of the expert

The authoritative level of the expert is decided by the expert's familiarity with the indicator and the judgment basis for the indicator (Wei, 2011). The equation is expressed as:

$$C_r = \frac{C_s + C_a}{2} \tag{5.1}$$

C_r is employed to represent the authoritative level of the indicator. C_s refers to the familiarity to the indicator, and C_a refers to the judgment basis index. The more authoritative the expert is, the more reliant the evaluation will be, and when the expert authority coefficient is greater than or equal to 0.70, an acceptable result is indicated (Zhang, Yan, & Chen, 2016).

Of course, to obtain the authoritative level of the expert, the expert's familiarity with the indicator should be measured first. This research categorized the expert's familiarity with an indicator into 5 grades, ranging from very familiar, relatively familiar, generally familiar, unfamiliar to fairly unfamiliar, and correspondingly valued as 1.0, 0.75, 0.5, 0.25 and 0 (see Table 5-1). The judgment bases include the expert's practical experience, theoretical

knowledge, understanding of counterparts and instinctive judgment, which are also given a corresponding value as 0.8, 0.6, 0.4 and 0.2 (see Table 5-2). If the sum of the judgment indicators equals 1, it suggests strong influence by the judgment of the expert; if the sum equals 0.8, it implies a medium influence; if it equals 0.6, it advocates a small influence by the expert's judgment (Wei, 2011).

Table 5-1 Familiarity for the Index by Experts

Familiarity	Quantized value
fairly unfamiliar	0
unfamiliar	0.25
generally familiar	0.5
relatively familiar	0.75
very familiar	1

Source: Wei. (2011)

Table 5-2 Judgment Basis for the Index by Experts

Judgment basis	Quantized value
instinctive	0.2
understanding of counterparts	0.4
theoretical level	0.6
experience	0.8

Source: Wei. (2011)

5.2 The coordination degree coefficient of experts' opinions

In this study, the coordination coefficient and coefficient of variation of experts' opinions are used to calculate the coordination degree of experts' opinions, and the results obtained by calculation should be discussed.

5.2.1 Calculating the variable coefficient

The variable coefficient is indicated as V_j and the calculation formula is:

$$V_j = \frac{\sigma_j}{M_j} \quad \mathbf{j=1,2,\ldots,n} \tag{5.2}$$

The first step is to work out the value of the denominator; the denominator M_j represents the average value of all evaluation towards j, and the calculation formula of M_j is:

$$M_j = \frac{1}{m_j}\sum_{i=1}^{m_j} C_{ij} \tag{5.3}$$

m_j shows the number of experts participating in the evaluation of j; C_{ij} displays the value of the j index evaluated by the i expert.

The second step involves calculating the value of the numerator σ_j, which refers to the standard deviation of the evaluating result of index j. The calculating formula of σ_j is:

$$\sigma_j = \sqrt{D_j} \quad \mathbf{j=1,2,\ldots,n} \tag{5.4}$$

The value of D_j, which refers to the average variance of index j, should be calculated first utilizing the calculating formula:

$$D_j = \frac{1}{m_j - 1}\sum_{i=1}^{m_j}\left(C_{ij} - M_j\right)^2 \quad \mathbf{j = 1,2,\ldots,n} \tag{5.5}$$

The third step involves substituting the calculated numerator σ_j and denominator M_j

into the variable coefficient formula for calculating the value of the variable coefficient and then providing evaluations.

V_j indicates the coordination degree of experts to the evaluation through the importance index j. V_j is negatively correlated with the coordination degree. The larger the value of V_j, the lower the coordination degree of experts is - and vice versa (Wei et al., 2013).

5.2.2 Calculating the coordination coefficient

The coordination coefficient is an index measuring the credibility of the results of experts' consultation, reflecting the consistency of different expert opinions.

The coordination coefficient utilizes W and indicates the level of convergence of all m experts' evaluation on all n indicators, valued from 0 to 1, in a positive correlation with the opinion convergence. A higher value expresses higher convergence of expert opinion, and the result is acceptable; if the convergence index is not high, it represents low convergence and the result is not acceptable (Wei et al., 2013).

The calculating formula should be discussed from the following three situations based on the identical level of opinions to each index given by experts:

(1) When the results show that experts' index evaluation is completely identical, the coordination coefficient will read 1, which requires no calculation.

(2) When the results show that some of the experts share the same evaluation of the indices, the formula of coordination coefficient is:

$$W = \frac{12}{m^2\left(n^3 - n\right) - m\sum_{i=1}^{m} T_i} \sum_{j=1}^{n} d_j^2 \tag{5.6}$$

m is the total number of experts and n is the number of indexes. d_j is the difference value between the sum of the grade of index j (S_j) and the arithmetic mean value ($\overline{S}_j$) of

the sum of grade of all indexes' evaluation. The formula is：

$$d_j = S_j - \overline{S}_j \tag{5.7}$$

$$\overline{S}_j = \frac{1}{n}\sum_{j=1}^{n} S_j \text{ , j=1,2,…,n ,} \tag{5.8}$$

T_i is the index indicating identical grade and the calculating formula is：

$$T_i = \sum_{i=1}^{L}\left(t_i^3 - t_i\right), \tag{5.9}$$

L refers to the set of identical evaluations of expert i ($i = 1,2,...,L$), while t_i is the sum of the grade of expert's evaluation towards indexes in the set i.

(3) When the results show that no experts share the same evaluation towards each index, the formula of coordination coefficient is:

$$W = \frac{\sum_{j=1}^{n} d_j^2}{\frac{1}{12}m^2\left(n^3 - n\right)} = \frac{12}{m^2\left(n^3 - n\right)}\sum_{j=1}^{n} d_j^2 \tag{5.10}$$

m is the total number of experts and n is the number of index.

$$d_j = S_j - \overline{S}_j \text{ , } j \text{ =1,2,…, } n \tag{5.11}$$

$$\overline{S}_j = \frac{1}{n}\sum_{j=1}^{n} S_j \text{ , } \quad j \text{ =1,2,…, } n \tag{5.12}$$

d_j is the difference value between the sum of the grades of index j (S_j) and the arithmetic mean value ($\overline{S}_j$) of the sum of grade of all indices' evaluations.

5.2.3 Discussed method of the calculated results

By utilizing the coordination degree of expert opinions, whether or not there exists a huge discrepancy among experts toward each index shall be discovered, thus picking out the expert teams with highly identical opinions or the expert teams with highly divergent opinions (Zeng, 1994). Due to the lack of communication among experts who participate in the same indicator evaluation, there is sometimes a highly-coordinated group of experts who evaluate the same indicator, although the opinions of experts of this highly coordinated group are in opposition with each other. At this time, W will approach 0 (Sun & Lu, 2017). The method to find out the expert team with highly identical opinions is to exclude one certain expert's opinion and calculate the coordination coefficient of the evaluation opinion of the other experts to obtain W_1. Ensuingly, one must compare the value of W_1 with the original expert coordination coefficient W. If W_1 is smaller than W, the selected expert shall be retained. Conversely, if W_1 is larger than W, the expert selected shall be excluded from the expert team. Following the calculation, selection and comparison of each expert, a highly identical expert team is formed. Needless to say, discussions concerning experts with totally divergent opinions should be retained rather than ignored. Circumstances do exist when the course of action does not develop alongside the majority's wish, and goes the minority's way. In order to make this research increasingly scientific, this needs be avoided. The calculating method of utilizing the coupled coefficient of rank correlation can be adopted to find out experts with divergent ideas - the formula of coefficient of rank correlation is:

$$\rho_{\alpha\beta} = 1 - \frac{\sum_{j=1}^{n} \psi_{\alpha\beta}^{2}}{\frac{1}{6}\left(n^3 - n\right) - \frac{1}{12}\left(T_\alpha + T_\beta\right)} \tag{5.13}$$

n is the number of indexes, $\psi_{\alpha\beta}$ is the differences of the evaluation grade of index j between expert α and expert β. The calculating formula of $\psi_{\alpha\beta}$ is:

$$\psi_{\alpha\beta} = \left| R_{\alpha j} - R_{\beta j} \right| \tag{5.14}$$

T_α and T_β are two identical grade indicies of the evaluation of expert α and expert β

Experts with extreme opinions are the ones whose coupled coefficient of rank correlation is lower than that of any other experts (Wang & Si, 2011; Xu, 2011).

5.2.4 Carrying out significance testing on coordination coefficient

Adopt χ_R^2 method for carrying out significance testing, that step is:

The first step: the value of χ_R^2 should be calculated, of which the calculating formula is:

$$\chi_R^2 = \frac{1}{mn(n+1) - \frac{1}{n-1}\sum_{i=1}^{m} T_i} \sum d_i^2 \tag{5.15}$$

The second step: the degree of freedom should be calculated, which is drawn by using the number of indicies n to deduct 1 when calculating the value of χ_R^2 utilizing the formula is $V = n-1$.

In the table of the value of χ_R^2, the statistical value or the critical value χ_R^2 can be discovered to be closest to χ_α^2 based on the degree of freedom. If the value of χ_R^2 is larger than that of χ_α^2, it is believed that the coordination coefficient has significant effect after testing, indicating that the coordination of expert evaluation opinions is good and the result is feasible. If the value of χ_α^2 is smaller than that of χ_α^2, it is believed that there is a high probability of non-accidental coordination of expert opinion. Subsequently, the value of p should be compared: if the value of p is more than 5% under the confidence level of 95%, it is believed that expert opinions are in bad confidence level in terms of non-accidental coordination, showcasing that the evaluation result is not credible, and the result is not desirable either (Wang & Si, 2011).

5.3 Participation index of the experts

In this research, the participation index of the experts is also evaluated by counting the number of questionnaires sent to the experts and the collected ones over three rounds, respectively, to calculate a collection percentage which evaluates the participation of the expert. Why is it included in this research? Experts' attention on the indicator has been shown to be positively correlated with the participation index, and therefore the collection rate is a reflection of the activeness of the experts (Hu, 1992). When the response rate is larger than 70%, it indicates that experts are very positive towards these consultations (Zhang et al., 2016).

5.4 Concentration degree index of expert opinion

The concentration degree of expert opinion is expressed by the number of Arithmetic mean (M_j) and the full score frequency (K_j).

5.4.1 Arithmetic mean

The formula for calculating the arithmetic mean is:

$$M_j = \frac{1}{m_j} \sum_{i=1}^{m_j} C_{ij} \tag{5.16}$$

M_j is the arithmetic mean for the total value of evaluation on the indicator " j " (j =1,2,…,n); m_j is the number of experts evaluating " j "; C_{ij} is the score given to " j " by the number "i" expert. The value of M_j ranges from 0 to 100; the bigger it is, the higher relative importance the indicator has (Wang & Si, 2011).

5.4.2 Full score frequency

The full score frequency of a certain indicator is the ratio of the number of experts giving a full score and the total number of experts evaluating the indicator (Wang & Si, 2011), represented by the equation:

$$k_j' = \frac{m_j'}{m_j} \quad (5.17)$$

k_j' refers to the full score frequency of the indicator " j "; m_j' refers to the number of experts giving a full score to the indicator " j "; and m_j represents the number of experts giving a score. The k_j' value ranges from 0 to 1; the bigger it is, the larger number of experts giving a full score, or the higher relative importance the indicator has (Wang & Si, 2011).

5.5 The index screening of the application of the Delphi Method in this study

This research makes use of the critical value method to screen the indices based on the variable coefficient, full marks frequency, and the arithmetic mean value of each index, according to the consulted experts' evaluation on their importance. The calculation method of the critical value of variable coefficient is as follows: the critical value equals standard deviation add average value. Index scores lower than the critical value can be selected. The calculation method of critical value of full marks frequency is: the critical value equals average value subtract standard deviation. Index scores higher than the critical value can be selected. The calculation method of critical value of arithmetic mean value is the same as that of the full marks frequency. Meanwhile, only three indexes in which the level of measurement is inconsistent can be deleted in order to prevent the elimination of important indexes. If one or two levels of that index are up to standard, discussions shall be held to make a final choice. When discussing, the principles of feasibility, comprehensiveness and being scientific should be stressed and full consideration should definitely be given to experts' revised opinion (Wang

& Si, 2011).

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Chapter 6: Statistics and Discussion of Survey Results

The indicator system initially developed in this study consists of 3 first-level indicators, 10 second-levelindicators and 34 third-level indicators, forming the first round of questionnaire. The formation of the second round of the consultation questionnaire is based on Delphi method to make statistics on the indicators of the first round of consultation. The statistical results are selected, deleted, added and modified by using the critical value method as well as expert opinions. Therefore, the contents and quantity of the indicator items of the second round are different from those of the first round. Similarly, the third round of consultation questionnaire is formed according to Delphi method after revising the indicators of the second round of consultation. The detailed deletion and modifications can be seen in section 6.6.1.

6.1 Statistical results and discussion of authority coefficient of experts' opinions

When analyzing the survey results through authority coefficient of experts' opinions of the Delphi Method, the strong degree of specialty may lead experts to be unfamiliar with the 10 second-class indicators and 34 third-class indicators in the study. Therefore, the authority of experts' opinions on these indicators will not be analyzed here for the moment. Instead, the analysis will focus on the three first-class indicators.

The discussion from statistical tables. After three rounds of expert survey and consultation towards the three first-class indicators in the study, it is found that experts' average familiarity coefficients towards the three first-class indicators are respectively 0.817, 0.789, and 0.787 (see Table 6-1), which are all higher than 0.75. This indicates that experts are relatively familiar with the consulted problems. Meanwhile, experts' average judgment criterion coefficients towards the three first-class indicators are respectively 0.812, 0.838, and 0.804 (see Table 6-1), which are all higher than 0.8. This suggests that the judgment criterion

largely affects experts' judgment on the indicators. Moreover, experts' average authority coefficients towards the three first-class indicators are respectively 0.815, 0.814, and 0.795 (see Table 6-1), which are all higher than 0.70. This reflects that experts in the survey are very authoritative, which contributes to a relatively high accuracy and academic value of the study.

Table 6-1 Three Rounds of Statistical Table of Experts Authoritative Degree

	First round			Second round			Third round		
Index	C_a	C_s	C_r	C_a	C_s	C_r	C_a	C_s	C_r
Collection and Sharing of therapeutic data and cost of specified disease	0.812	0.821	0.817	0.843	0.789	0.816	0.820	0.790	0.805
Healthcare providers	0.833	0.835	0.834	0.872	0.767	0.820	0.793	0.807	0.800
Medical expense payers	0.791	0.798	0.795	0.799	0.810	0.805	0.798	0.763	0.781
Mean value	0.812	0.817	0.815	0.838	0.789	0.814	0.804	0.787	0.795

According to the expert familiarity coefficients of three first-level indicators in the three-round surveys (see Figure 6-1), the highest coefficient belongs to the indicator of medical providers in the first round of survey, which is greater than 0.82; the lowest coefficient directs to the indicator of medical expenses payers in the third round of survey, which is greater than 0.76, with the lowest value exceeding 0.75 as well. It shows that the experts are very familiar with the consulted questions, and experts being consulted in this research are of great representativeness. Through statistics on expert judgment of three first-level indicators (see Figure 6-2), it finds that the lowest judgment coefficient is the indicator of medical expenses payers in the first round of survey, which is no less than 0.78; the highest value is the indicator of medical providers in the second round of survey, which is greater than 0.86. The mean value of the highest and lowest coefficient is apparently larger than 0.82, with value changes over 0.8, which shows that the judgment has affected the

experts' opinions on indicators to a large extent. The expert authority coefficients of three-round consultations show that (see Figure 6-3), the highest value is the indicator of medical providers in the first round of survey, which is greater than 0.83; the lowest coefficient is the indicator of medical expenses payers in the third round of survey, which is no less than 0.78. The mean value between the highest and lowest coefficients is greater than 0.81, far more than 0.70, which indicates that experts of the research are of high authority.

Figure 6-1 Expert Familiarity Coefficients of Three First-level Indicators in the Three Round Surveys

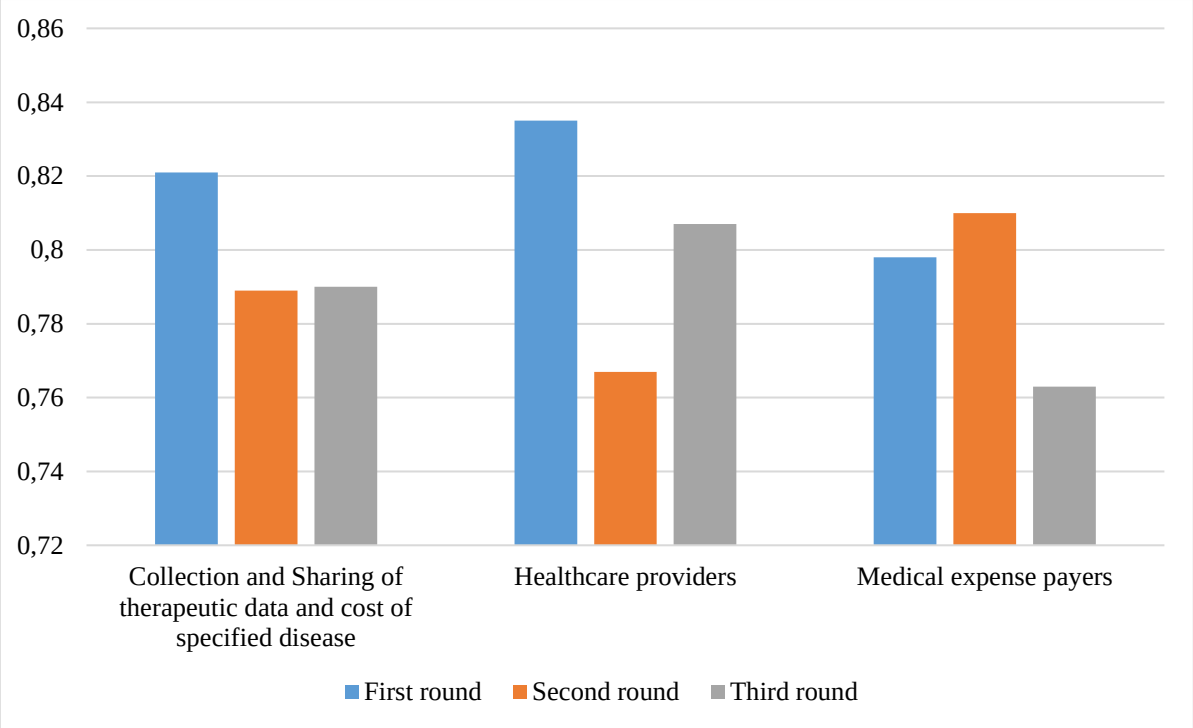


Figure 6-2 Expert Judgment Coefficients of Three First-level Indicators in the Three Round Surveys

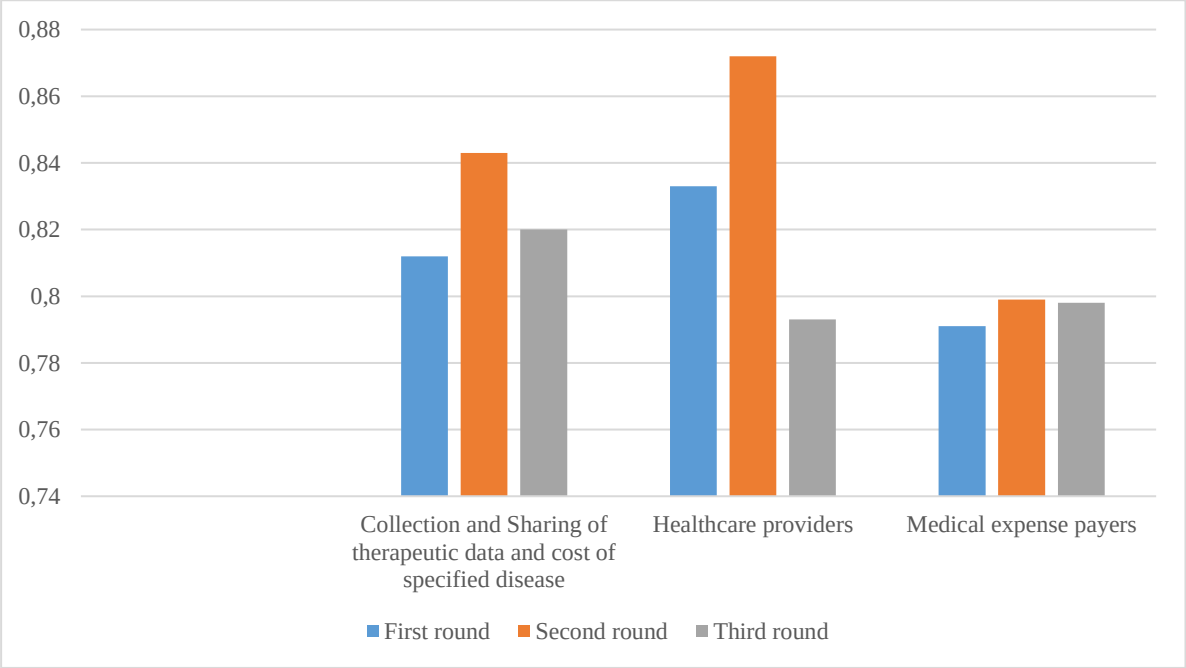
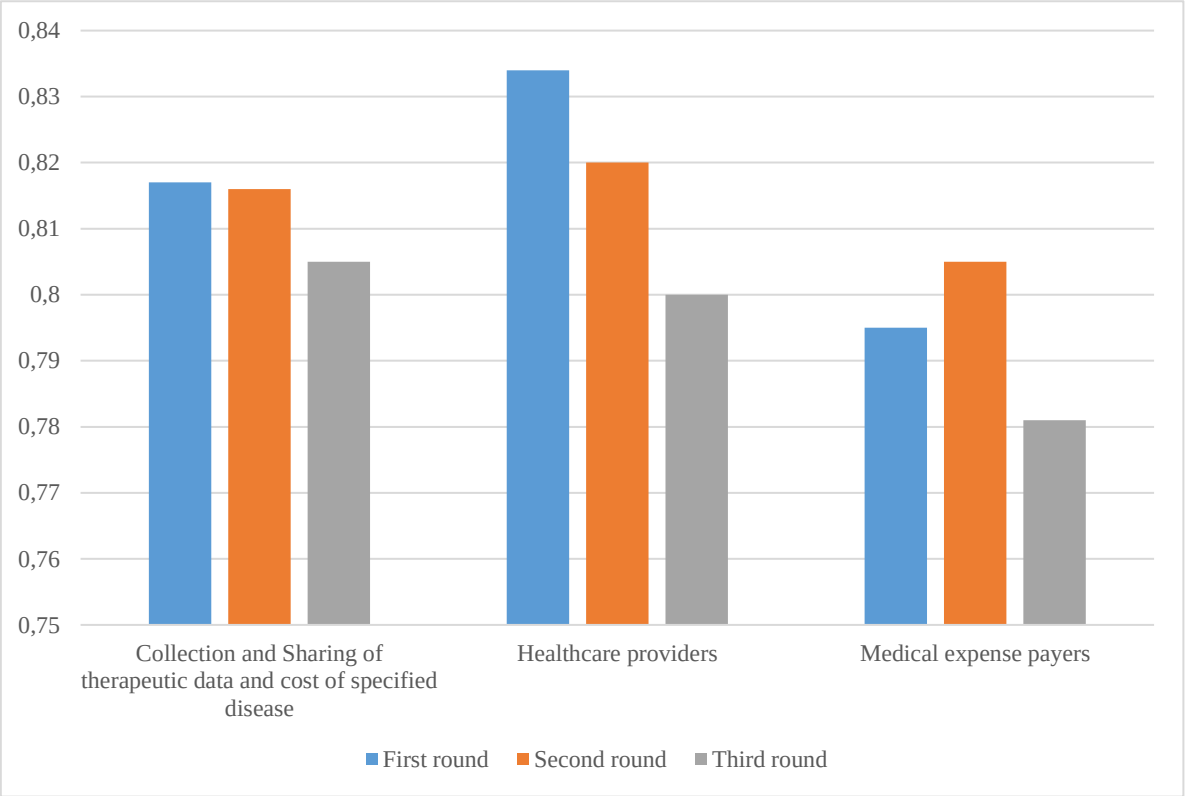


Figure 6-3 Expert Authority Coefficients of Three First-level Indicators in the Three Round Surveys



6.2 Statistical results and discussion of coordination coefficient of experts' opinions

6.2.1 Statistics results and discussion of variation coefficient

The discussion from statistical tables. Statistical results of variation coefficient. At the first round of consultation, the variation coefficients of experts' opinions on indicator importance range from 0.06 to 0.28and operability range from 0.1 to 0.32 (see Table 6-2). The larger the figure is, the poorer experts' coordination towards indicator evaluation is; however, after the second round of consultation, it is found that the variation coefficients of experts' opinions range from 0.0 to 0.15 and range from 0 to 0.27 (see Table 6-3), indicating that experts' coordination degree is improving; then after the third round of consultation, it is found that the variation coefficients of experts' opinions ranges from 0.0 to 0.14 and range

from 0.0 to 0.18 (see Table 6-4), representing a small decrease. It suggests that experts' cognition of the importance of evaluation indicators is highly in line with each other, presenting a high reliability.

After statistically averaging the variable coefficients of importance to the indicators of three-round surveys (see Figure 6-4), it finds that the overall results in the first round of survey are not very satisfactory. The variable coefficients of 14 indicators are greater than 0.15, which shows that the experts have a low degree of coordination to indicator evaluations; after the second round of consultation, only three indicators have the variable coefficient greater than 0.15, which indicates that the coordination level of experts' opinions on indicators has been greatly improved; the variable coefficients of importance evaluation to all the indicators in the third round of consultation are less than 0.15, and according to Figure 6-4, the fluctuation range of the variable coefficients of all indicators after the third round of consultation is relatively flat, which indicates that the experts' cognition of indicators has reached a consensus, and the results are credible; the variable coefficients of operability for the three-round surveys (see Figure 6-5) show that, the variable coefficient mean value of 13 indicators in the first round of survey is greater than 0.2, and the mean value for one indicator in the second round of survey is above 0.2. It shows that after the second round of survey, the coordination degree of expert opinions has been greatly improved. But the variable coefficients of all indicators in the third round of survey are less than 0.2, which suggests that the operational coordination of experts on indicators has achieved a high degree of fit, and the results of the survey are of high credibility.

Figure 6-4 Variable Coefficients of Importance to the Indicators in Three Round Surveys

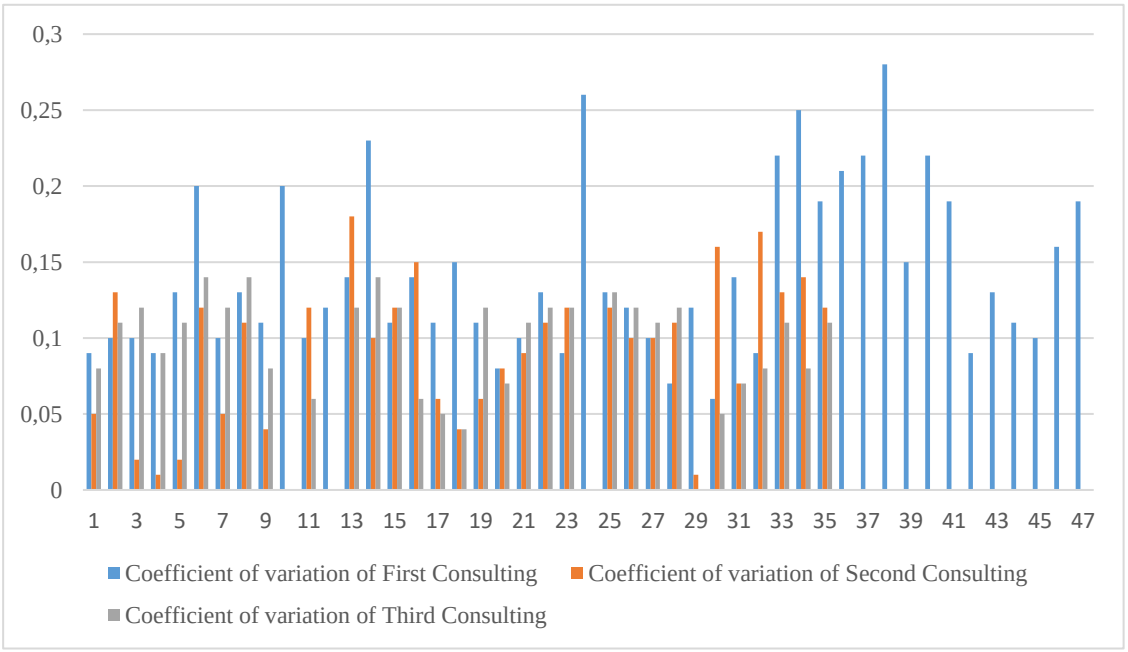


Figure 6-5 Variable Coefficients of Operability to the Indicators in Three-round Surveys

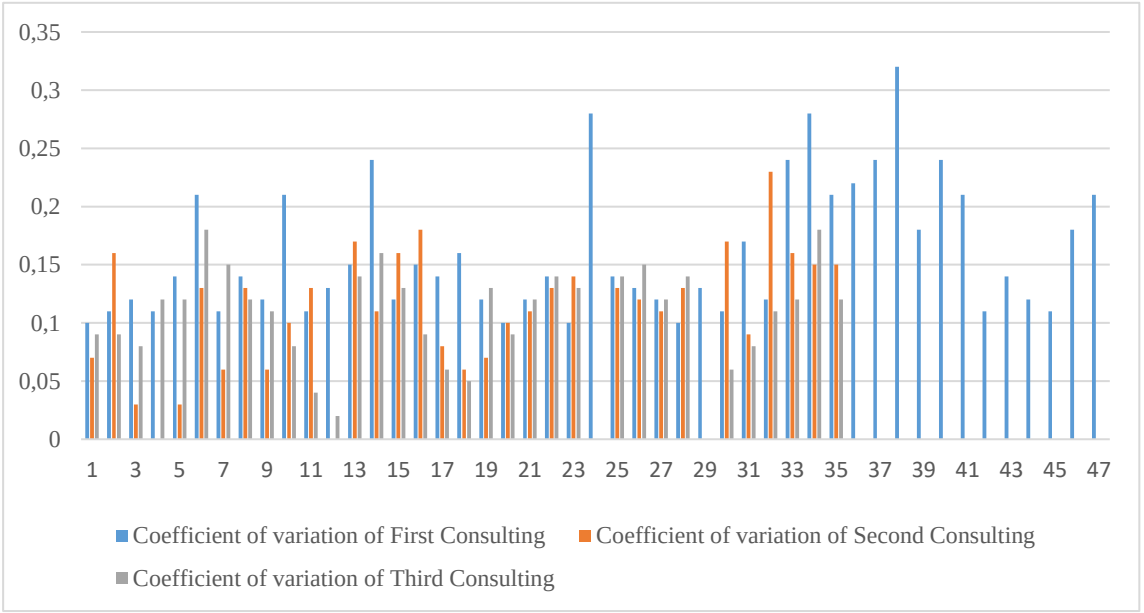


Table 6-2 The First-round Concentration Degree and Coordination Degree Coefficient Table of Delphic Expert Opinions

Index	Importance			Operability		
	Arithmetic mean	Full scores frequency	Coefficient of variation	Arithmetic mean	Full scores frequency	Coefficient of variation
1.0 Publishing platform for index of therapeutic effect data	4.52	0.67	0.09	4.18	0.36	0.10
1.1 Establishing an integrated national assessment center of diagnosis and treatment.	4.67	0.38	0.10	4.21	0.46	0.11
1.1.1 Measuring the cost of medicine for treating certain diseases	4.71	0.29	0.10	4.26	0.11	0.12
1.1.2 Measuring the cost of medical instruments for certain diseases	4.82	0.76	0.09	4.53	0.66	0.11
1.1.3 Measuring the service cost of diagnosis and treatment on certain diseases	4.81	0.28	0.13	4.32	0.21	0.14
1.1.4 Cost measurement of each program in the assessment center should be carried out by a team of experts from across the country	3.81	0.22	0.20	3.12	0.19	0.21
1.2 Establishing an integrated national data gathering center on therapeutic effect	4.62	0.91	0.10	4.51	0.48	0.11
1.2.1 Measuring and gathering data of therapeutic effect on certain diseases	4.68	0.22	0.13	4.65	0.12	0.14
1.2.2 Measurement standards	4.82	0.34	0.11	4.59	0.25	0.12

1.2.3 Test on the authenticity of data of preventive test	3.53	0.41	0.20	3.51	0.39	0.21
1.3 Releasing shared therapeutic effect data	4.42	0.21	0.10	4.27	0.16	0.11
1.3.1 Testing on the utility rate of patients towards the data on the platform	4.23	0.26	0.12	4.19	0.22	0.13
1.3.2 Testing on the timeliness rate of publishing data of certain diseases on the platform	4.43	0.32	0.14	4.23	0.27	0.15
1.3.3 Monitoring the speed of updating the data of new medical products and techniques	3.87	0.23	0.23	2.41	0.12	0.24
2.0 Indexes for medical fee payers	4.38	0.19	0.11	4.22	0.15	0.12
2.1 Patients' payment	4.68	0.28	0.14	4.12	0.23	0.15
2.1.1 Patients' payment ratio on different diseases	4.67	0.44	0.11	4.31	0.21	0.14
2.1.2 Patients' participation in the medical treatment process	4.98	0.67	0.15	4.14	0.34	0.16
2.1.3 Emphasis on patients' right to be informed and their right to make decisions during medical treatments	4.53	0.27	0.11	4.19	0.16	0.12
2.2 Medical insurance payment	5.00	0.56	0.08	4.97	0.41	0.10
2.2.1 The ratio of medical insurance payment on certain surgical fee	4.32	0.53	0.10	4.34	0.55	0.12
2.2.2 The index of timeliness of including new medicines into medical insurance	4.22	0.28	0.13	4.29	0.31	0.14
2.2.3 The index of medical insurance payment ratio on different medicines	4.34	0.65	0.09	4.21	0.55	0.10

2.2.4 The index of medical insurance payment on the use of different medical instruments	3.12	0.23	0.26	2.18	0.22	0.28
2.3 Commercial insurance payment	4.33	0.34	0.13	4.19	0.32	0.14
2.3.1 The index of the coverage ratio of disease categories in commercial insurance payment	4.76	0.43	0.12	4.61	0.38	0.13
2.3.2 The speed index of commercial insurance payment	4.38	0.29	0.10	4.21	0.25	0.12
3.0 Medical providers	5.00	0.56	0.07	4.79	0.42	0.10
3.1 Doctors	5.00	0.67	0.12	4.96	0.63	0.13
3.1.1 The application of new medical techniques	4.50	0.78	0.06	4.88	0.76	0.11
3.1.2 The number of general practitioners	4.34	0.32	0.14	4.26	0.21	0.17
3.1.3 The index of the treatment behavior model of doctors (transforming from biomedical treatment to biological, psychological and social medical treatment)	4.28	0.56	0.09	4.34	0.61	0.12
3.2 Medicine producers	3.56	0.43	0.22	3.41	0.39	0.24
3.2.1 The index of side effects of medicine after diagnosis and treatment	2.42	0.28	0.25	2.89	0.22	0.28
3.2.2 The index of diagnostic and treatment effect of medicine	2.16	0.32	0.19	2.07	0.28	0.21
3.2.3 The rates of research and development on new medicine	1.34	0.23	0.21	1.19	0.16	0.22

3.2.4 The sales price of medicine	1.30	0.23	0.22	1.63	0.26	0.24
3.3 Medical instrument producers	3.67	0.32	0.28	3.70	0.33	0.32
3.3.1 Constant innovations of medical instruments	3.66	0.23	0.15	3.85	0.33	0.18
3.3.2 The recovery ratio of sub-quality medical instruments	2.03	0.45	0.22	2.16	0.48	0.24
3.3.3 The ratio of adverse effect of medical instruments	1.30	0.34	0.19	1.58	0.43	0.21
3.4 Medical institutions	4.86	0.67	0.09	5.00	0.71	0.11
3.4.1 The total cure rate of different diseases	4.16	0.22	0.13	4.23	0.26	0.14
3.4.2 The mortality rate of different diseases	4.32	0.09	0.11	4.45	0.13	0.12
3.4.3 The speed of adopting new medicines and instruments of medical institutions	4.54	0.30	0.10	4.41	0.27	0.11
3.4.4 The speed of recovery from different diseases	3.11	0.23	0.16	1.89	0.13	0.18
3.4.5 The change of attitude towards medical services	2.65	0.32	0.19	2.91	0.34	0.21

Table 6-3 The Second-round Concentration Degree and Coordination Degree Coefficient Table of Delphic Expert Opinions

Summary of modification on repeatedly reported indicators at the second round of questionnaire	Importance			Operability		
	Arithmetic mean	Full scores frequency	Coefficient of variation	Arithmetic mean	Full scores frequency	Coefficient of variation
1. Data collection and sharing of treatment cost and curative effect for specific diseases	4.35	0.72	0.06	4.29	0.71	0.07
1.1Data calculation and collection of cost	4.55	0.28	0.04	4.34	0.27	0.06
1.1.1 Medicine costs	4.66	0.32	0.02	4.66	0.34	0.03
1.1.2 Medical equipment use costs	4.34	0.67	0.08	4.68	0.32	0.10
1.1.3 Medical service costs	4.72	0.29	0.02	4.54	0.23	0.03
1.2 Data calculation and collection of curative effect	4.83	0.28	0.14	4.78	0.22	0.21
1.2.1 30-day readmission rate of patients in different hospitals due to the same disease	4.43	0.65	0.12	4.35	0.59	0.16
1.2.2 Cure rate	4.54	0.45	0.15	4.39	0.32	0.14
1.3 Data sharing	4.68	0.32	0.09	4.60	0.31	0.12
1.3.1 Immediate data updating rate	4.89	0.29	0.00	4.66	0.38	0.00
1.3.2 Data utilization rate	4.78	0.29	0.02	4.70	0.26	0.03
2. Medical expense payers	5.00	0.23	0.00	4.97	0.23	0.01

2.1 Enterprises	4.30	0.72	0.14	4.46	0.66	0.27
2.1.1 Employee satisfaction	4.89	0.24	0.14	4.68	0.23	0.17
2.1.2 Cooperating with insurance companies for finding "valuable" medical service providers	4.19	0.62	0.05	4.33	0.52	0.06
2.1.3 Bargain power towards treatment results	4.55	0.72	0.06	4.48	0.71	0.08
2.2 Medical insurance centers	4.64	0.67	0.06	4.63	0.69	0.08
2.2.1 Rewarding medical service providers for positive curative effect	4.78	0.39	0.05	4.67	0.32	0.06
2.2.2 Speed of incorporating new medicine into medical insurance system	4.68	0.55	0.11	4.73	0.52	0.14
2.2.3 Linking payment with curative effect	4.80	0.57	0.08	4.79	0.48	0.10
2.3 Commercial insurance agencies	4.69	0.54	0.12	4.73	0.52	0.14
2.3.1 Coverage rate of diseases under commercial insurance	4.39	0.32	0.11	4.54	0.28	0.13
2.3.2 Punishing medical service providers involved in medical malpractice, overtreatment, and fraud through claims rejected	4.88	0.25	0.13	4.70	0.22	0.14
3. Medical service providers	4.96	1.00	0.00	4.96	1.00	0.00
3.1 Doctors	4.89	0.54	0.12	4.83	0.51	0.13
3.1.1 Application of new medical technologies	4.83	0.59	0.13	4.72	0.47	0.14

3.1.2 Transformation from biomedical model to biopsychosocial medical model	4.76	0.48	0.10	4.68	0.43	0.11
3.1.3 Encouraging patient-participative treatment	4.34	0.73	0.11	4.46	0.62	0.13
3.2 Hospitals	4.97	0.96	0.01	5.00	1.00	0.00
3.2.1 Reasonable arrangement for transfer treatment	4.68	0.62	0.06	4.78	0.58	0.07
3.2.2 Plan of reason able arrangement for treatment	4.43	0.52	0.08	4.55	0.41	0.09
3.2.3 Rehabilitation time, nosocomial infection, and complication	4.77	0.66	0.09	4.83	0.47	0.13
3.3 Medicine and medical equipment manufacturer	4.46	0.47	0.11	4.52	0.45	0.13
3.3.1 Volume production of medicine and medical equipment with excellent curative effect	4.63	0.39	0.06	4.66	0.38	0.14
3.3.2 Reliability of drug treatment	4.77	0.35	0.12	4.74	0.29	0.15

Table 6-4 The Third-round Concentration Degree and Coordination Degree Coefficient Table of Delphic Expert Opinions

Summary of modification on repeatedly reported indicators at the second round of questionnaire	Importance			Operability		
	Arithmetic mean	Full scores frequency	Coefficient of variation	Arithmetic mean	Full scores frequency	Coefficient of variation
1. Data collection and sharing of treatment cost and curative effect for specific diseases	4.46	0.68	0.08	4.32	0.63	0.09
1.1Data calculation and collection of cost	4.61	0.32	0.11	4.78	0.28	0.09
1.1.1 Medicine costs	4.71	0.45	0.12	4.63	0.45	0.08
1.1.2 Medical equipment use costs	4.54	0.96	0.09	4.70	1	0.12
1.1.3 Medical service costs	4.65	0.3	0.11	4.67	0.36	0.12
1.2 Data calculation and collection of curative effect	4.81	0.86	0.14	4.72	0.83	0.18
1.2.1 30-day readmission rate of patients in different hospitals due to the same disease	4.44	0.65	0.12	4.39	0.63	0.15
1.2.2 Measurement of the cure rates by different medical service providers	4.58	0.53	0.14	4.43	0.47	0.12
1.3 Data sharing	4.59	0.35	0.08	4.55	0.33	0.11
1.3.1 Immediate data updating rate	5.00	1	0.00	4.67	0.89	0.08
1.3.2 Data utilization rate	4.62	0.35	0.06	4.41	0.33	0.04

2. Medical expense payers	5.00	1	0.00	4.57	0.96	0.02
2.1 Enterprises	4.21	0.83	0.12	4.19	0.91	0.14
2.1.1 Employee satisfaction	4.55	0.37	0.14	4.51	0.43	0.16
2.1.2 Cooperating with insurance companies for finding “valuable” medical service providers	4.31	0.78	0.12	4.23	0.66	0.13
2.1.3 Bargain power towards treatment results	4.54	0.88	0.06	4.66	0.77	0.09
2.2 Medical insurance centers	4.71	0.76	0.05	4.68	0.76	0.06
2.2.1 Rewarding medical service providers for positive curative effect	4.77	0.34	0.04	4.65	0.31	0.05
2.2.2 Speed of incorporating new medicine into medical insurance system	4.46	0.65	0.12	4.43	0.67	0.13
2.2.3 Linking payment with curative effect	4.79	0.66	0.07	4.74	0.66	0.09
2.3 Commercial insurance agencies	4.55	0.47	0.11	4.53	0.51	0.12
2.3.1 Coverage rate of diseases under commercial insurance	4.33	0.36	0.12	4.29	0.4	0.14
2.3.2 Punishing medical service providers involved in medical malpractice, overtreatment, and fraud through claims rejected	4.77	0.21	0.12	4.63	0.19	0.13
3. Medical service providers	5.00	1.00	0.00	5.00	1.00	0.00
3.1 Doctors	4.49	0.58	0.13	4.44	0.56	0.14

3.1.1 Application of new medical technologies	4.46	0.79	0.12	4.57	0.76	0.15
3.1.2 Transformation from biomedical model to biopsychosocial medical model	4.66	0.68	0.11	4.55	0.65	0.12
3.1.3 Encouraging patient-participative treatment	4.46	0.88	0.12	4.37	0.93	0.14
3.2 Hospitals	5.00	0.96	0.00	5.00	1.00	0.00
3.2.1 Implementation of hierarchical treatment	4.49	0.66	0.05	4.39	0.7	0.06
3.2.2 Treatment plan for specific diseases	4.83	0.54	0.07	4.72	0.6	0.08
3.2.3 Rehabilitation time, nosocomial infection, and complication	4.87	0.83	0.08	4.73	0.85	0.11
3.3 Medicine and medical equipment manufacturer	4.39	0.48	0.11	4.34	0.51	0.12
3.3.1 Volume production of medicine and medical equipment with excellent curative effect	4.56	0.39	0.08	4.56	0.38	0.18
3.3.2 Constant measurement of reliability of drug treatment and mechanotherapy	4.68	0.35	0.11	4.63	0.29	0.12

6.2.2 Results statistics and discussion of coordination coefficient

Statistical results of coordination coefficient. At the first round of consultation, the coordination coefficient is 0.29 (see Table 6-5), which is relatively low. It indicates that experts' cognition of the importance of evaluation indicators is inconsistent with each other, which results in a relatively low coordination coefficient and low reliability. After the second round of consultation, it is found that the figure is 0.64 (see Table 6-5), experiencing a sharp increase (see Figure 6-6). It suggests that experts' cognition of the importance of evaluation indicators is becoming consistent with each other gradually and that the reliability is improving obviously. After the third round of consultation, it is found that the coefficient is 0.69 (see Table 6-5), representing a small increase (see Figure 6-6). It indicates that experts' cognition of the importance of evaluation indicators is highly in line with each other, presenting a high reliability. The p values in χ_R^2 test of coordination coefficient in the three rounds of consultation are all lower than 5% (see Table 6-5), suggesting that the confidence degree of coordination of experts' opinions is higher than 95%. It represents favorable results.

Figure 6-6 Expert Coordination Degree and P Value in Three Round Consultation

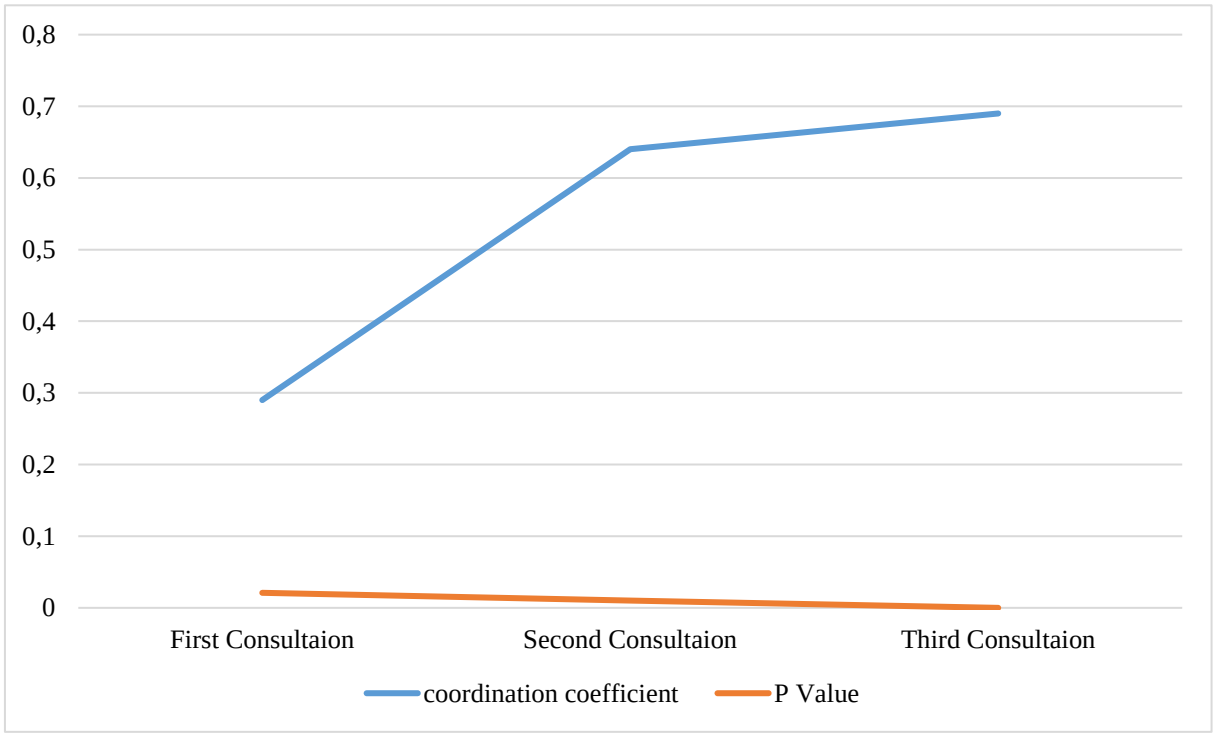


Table 6-5 Comparison of Coordination Coefficient for Three rounds of Delphi Experts' Consultation

	First round	Second round	Third round
Number of Index	47	35	35
Coefficient of coordination	0.29	0.64	0.69
Chi value	379.25	557.61	675.35
P value	0.021	0.01	0.00

6.3 Results statistics and discussion of experts' positive coefficients

Three rounds of Delphi questionnaires are conducted in the study. At the first round, 30 questionnaires are distributed and 26 received back, presenting a response rate of 86.67% (see Table 6-6). At the second round, 26 questionnaires are distributed and 24 received, presenting a response rate of 92.31% (see Table 6-6). At the final round, 24 questionnaires are distributed and all of them are received, presenting a response rate of100% (see Table 6-6). The response rates in the study are much higher than 70%, indicating experts' relatively high positivity in the study.

Table 6-6 Experts Positivity Degree Coefficients

	The number of questionnaires are distributed	The number of questionnaires are received	Rate of recovery(%)
First round consultation	30	26	86.67
Second round consultation	26	24	92.31
Third round consultation	24	24	100

6.4 Statistics and discussion of expert representativeness

The proportion of academic title of experts, the proportion of Ph.D, and the proportion of professionals engaged in this profession are higher, indicating that they have higher academic representativeness and authority, which is also an important basis for the credibility of the research results (Mo, 2009). The title, education, work areas, and the working years of the experts have been computed, and the results of first round survey show that, experts who have high titles are more than 50% of the total studied numbers, with doctorates accounting for 40%, working for more than 10 years accounting for 70%, and the expert working in the healthcare sector being 100%, this study reflects the results of this study has high reliability. The results of the second round of survey reveal that (see table 6-7), the ratio of experts with high professional titles in the total number of respondents keeps consistent with that in the first round of survey, but the ratio of experts with doctoral degree rose to 43%, and the ratio of experts with more than 10 years of work experience dropped to 67%. The ratio of experts working in the medical and health field remains unchanged. The proportion of each indicator in the third round of survey is the same as that in the second round of survey (see Table 6-7). The statistical results of the experts in this study show the high credibility of this study.

Table 6-7 Statistical Table of Experts Characteristics in Three Rounds of Consultation

Item	Ratio of various experts to the total number of experts		
	First round of consultation	Second round of consultation	Third round of consultation
Senior professional title	50%	50%	50%
Doctoral degree	40%	43%	43%
Work experience over 10 years	70%	67%	67%
Experts in medical and health field	100%	100%	100%

6.5 Statistics and discussion of results of concentration coefficient of experts' opinions

6.5.1 Statistical results of arithmetic mean

The results of the first round of consultation show that: the arithmetic mean of the importance and feasibility scores of various indicators range from 1.30 to 5.0 and from 1.19 to 5.0 respectively (see Table 6-2); the results of the second round of consultation show that: the arithmetic mean of the importance and feasibility scores of various indicators range from 4.19 to 5.0 and from 4.29 to 5.0 respectively (see Table 6-3); results of the third round of consultation show that: the arithmetic mean of the importance and feasibility scores of various indicators range from 4.21 to 5.0 and from 4.19 to 5.0 respectively (see Table 6-4).

6.5.2 Statistic results of frequency of full scores

The results of the first round of consultation show that: the frequencies of full scores for the importance and feasibility scoring of various indicators range from 9% to 91% and from 11% to 76% respectively (see Table 6-2); the results of the second round of consultation show that: the frequencies of full scores for the importance and feasibility scoring of various indicators range from 23% to 100% and from 22% to 100% respectively (see Table 6-3); results of the third round of consultation show that: the frequencies of full scores for the importance and feasibility scoring of various indicators range from 21% to 100% and from 19% to 100% respectively (see Table 6-4).

6.5.3 Discussion

The arithmetic mean and frequency of full scores of various indicators reflect not only the importance and feasibility of each indicators, but also the concentration of experts' opinions on the former (Sun & Lu, 2017). According to the statistical table 6-2, table 6-3 and table 6-4, the arithmetic mean of the importance and operability of the first-level indicators in the three rounds of surveys are relatively large, which indicates that the importance and

operability of the three first-level indicators are relatively high. Concerning the operability and the importance of second-level indicators, it's found that in the first round of survey arithmetic, the mean of some of the individual indicators are low. According to expert opinions, second-level indicators was modified and deleted. The revised second-level indicators in the second and three rounds of survey obtaining the arithmetic mean of all the rest of survey is bigger, which also illustrates the importance and operability of the modified nine secondary indicators is higher; with regard to the third-level indicators, more modifications and deletions were made after the first round of survey according to the critical value method and expert opinions, although the importance and operability of individual indicator with lower arithmetic mean in the second and third rounds of survey, which may be caused by other reasons. For example, the frequency of full scores and arithmetic mean of certain indicators in the study, such as R & D speed of new medicine, are relatively low. One of the reasons may be that successful R & D of new medicine requires tremendous experiments, which is a time-consuming process, and the results are uncontrollable. Meanwhile, the R & D of a new medicine needs demand stimulus since pharmaceutical companies will not take risks if there is not such stimulus. In addition, another medicine with better curative effect, once put on the market, will be reproduced quickly. In this case, investment of pharmaceutical companies on the first new medicine will soon come to nothing.

Through analyzing the distribution of arithmetic mean values of the importance and operability of all indicators in the three-round surveys (see Figure 6-7 and see Figure 6-8), it shows that the scores of some indicators in the first round of survey are low, thus during the second round of survey, the indicator of first-round survey with smaller arithmetic mean value in importance and operability is revised or deleted according to expert opinions. Then no indicators with smaller arithmetic mean values are found in the second and third rounds of surveys, which means that expert opinions tend to be concentrated and the results are credible; the full mark rate of expert evaluation on indicators in three rounds of surveys indicates that (see Figure 6-9 and see Figure 6-10), the expert full mark rate of second-round survey is higher than that of the first round, and the full mark frequency of third-round survey is higher than that of the second round, which also indicates that experts' opinions on the importance

and operability of various indicators tend to be concentrated.

Figure 6-7 Arithmetic Mean Value of Importance to EachIndicators in Three Rround Surveys

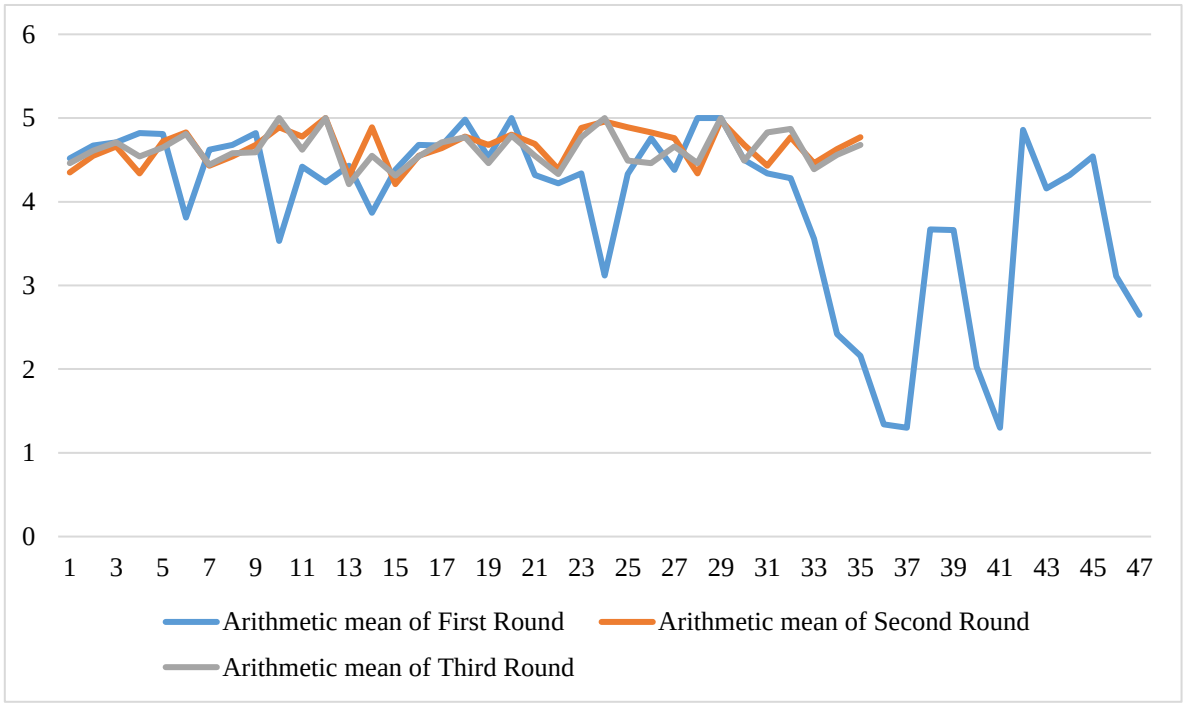


Figure 6-8 Arithmetic Mean Value of Operability to Each Indicators in Three Rround Surveys

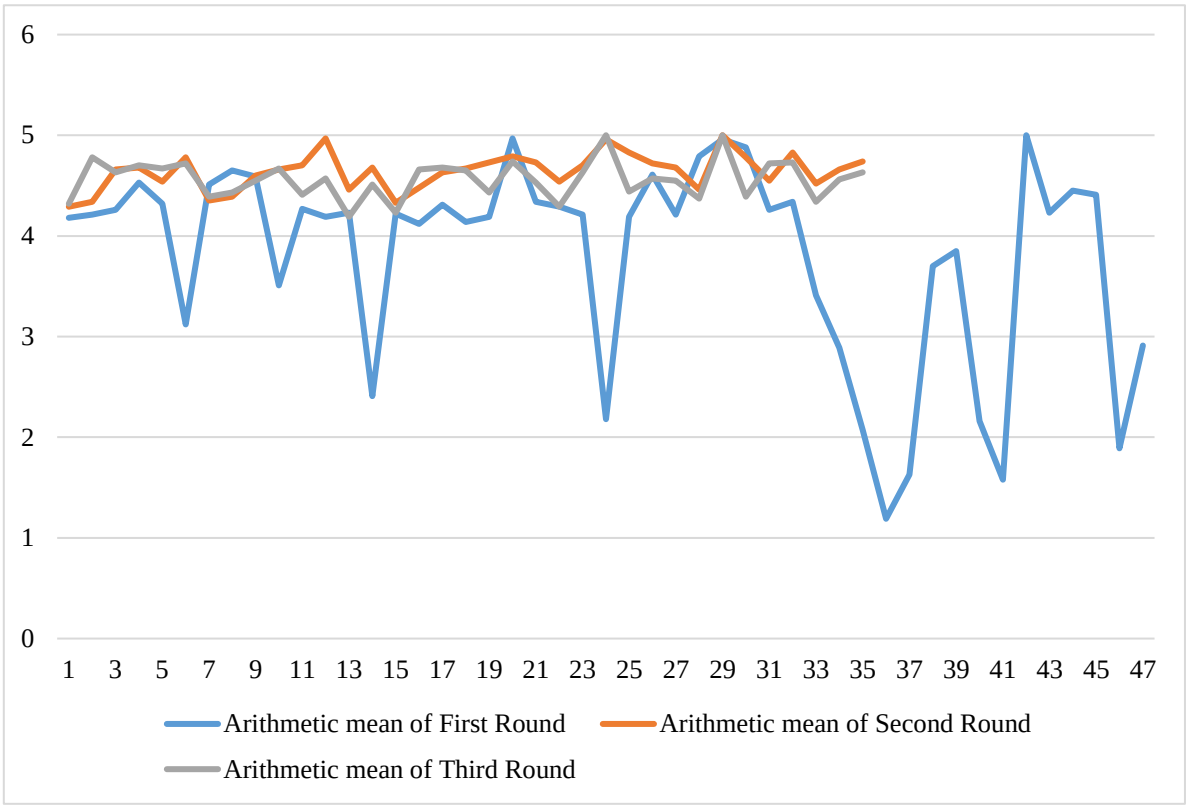


Figure 6-9 Full Scores Frequency of Importance to Each Indicators in Three Round Surveys

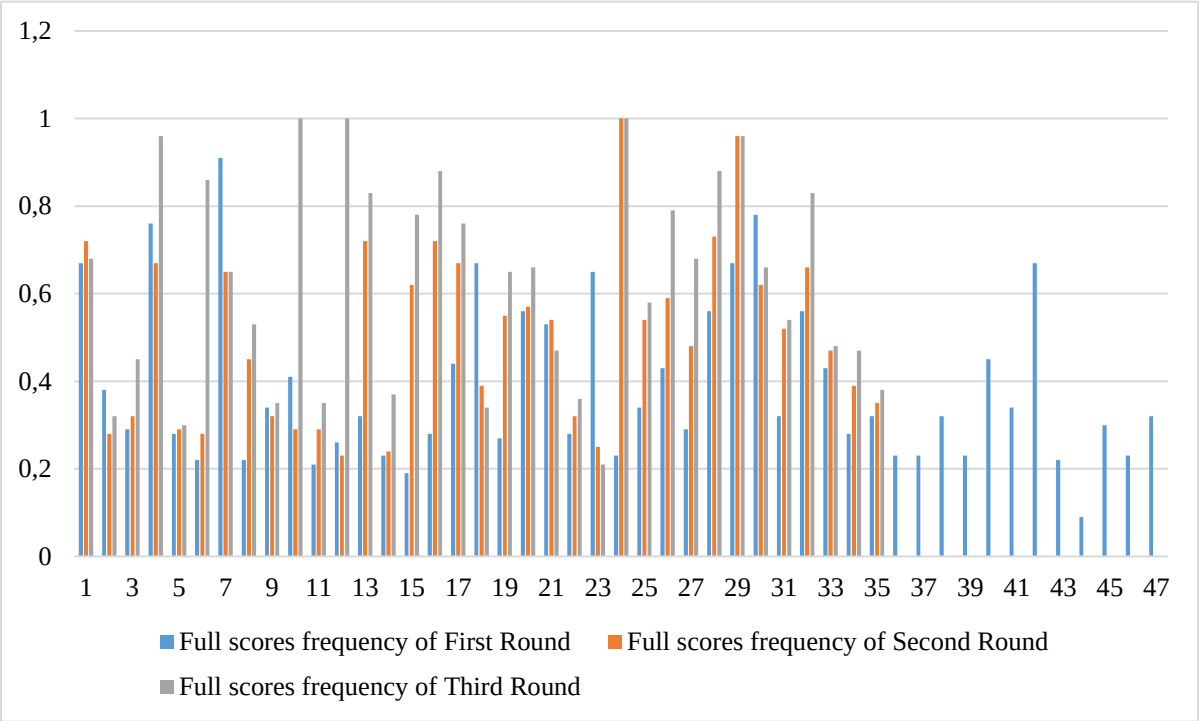
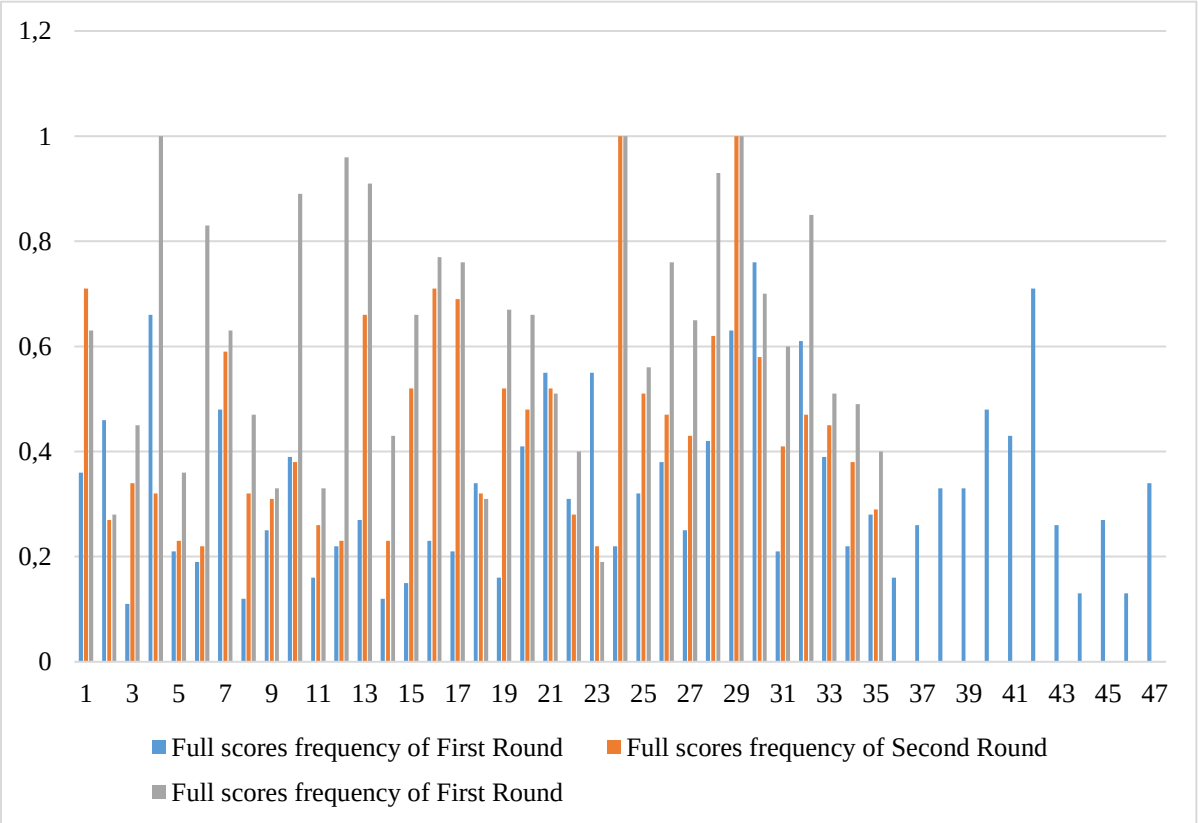


Figure 6-10 Full Scores Frequency of Operability to Each Indicators in Three Round Surveys



6.6 Screening, modification, and construction of indicator system

6.6.1 Statistical results of indicator system screening and modification

The initial indicator system in the study is composed of three first-level indicators, ten second-level indicators, and 34 third-level indicators. After the first round of consultation, these indicators are deleted, added, screened and modified based on the statistical results and experts' opinions with boundary value analysis (see Table 6-8, see Table 6-9 and see Table 6-10).The indexes for deletion are cost measurement of each program in the assessment center should be carried out by a team of experts from across the country, test on the authenticity of data of preventive test, monitoring the speed of updating the data of new medical products and techniques, the index of medical insurance payment ratio on different medicines, the index of medical insurance payment on the use of different medical instruments, the number of general practitioners, medicine producers, the index of diagnostic and treatment effect of medicine, the rates of research and development on new medicine, the sales price of medicine, constant innovations of medical instruments, the recovery ratio of sub-quality medical instruments, the ratio of adverse effect of medical instruments, the total cure rate of different diseases, the mortality rate of different diseases, the speed of adopting new medicines andinstruments of medical institutions, the speed of recovery from different diseases, and the change of attitude towards medical services; the added indexes are employee satisfaction, linking payment with curative effect, encouraging patient-participative treatment, reasonable arrangement for transfer treatment, plan of reasonable arrangement for treatment, rehabilitation time and nosocomial infectionand complication, volume production of medicine and medical equipment with excellent curative effect; there are eight indicators that have not been modified or deleted, that are medical expense payers, medical insurance centers, commercial insurance agencies, coverage rate of diseases under commercial insurance, medical service providers, doctors, and application of new medical technologies; the number of the revised indicators is 20, and the detailed revision is shown in Table 6-11.

After the adjustment, the number of three first-level indicators remain unchanged; one

second-level indicator is cancelled, with nine remained; and 18 third-level indicators are cancelled and 7 third-level indicators are added, with 23 remained. Table 6-3 shows the results after screening and modification. Similarly, the second round of consultation is carried out based on the indicators after adjustment. The statistical results are analyzed and the indicators are screened based on experts' opinions with boundary value analysis. The numbers of first-level, second-level, and third-level indicators remain the same while contents of indicators are modified on the basis of experts' opinions, in which "cure rate" is revised into "measurement of the cure rate by different medical service providers", "reasonable arrangement for transfer treatment" into "implementation of hierarchical treatment", "plan of reason able arrangement for treatment" into "treatment plan for specific diseases", and "reliability of drug treatment" into "constant measurement of reliability of drug treatment and mechanotherapy". Similarly, the third round of consultation is carried out after indicators being adjusted. After boundary value analysis, the indicators are screened based on experts' opinions. The numbers of first-level, second-level, and third-level indicators remain unchanged. And based on experts' opinions, there is not indicator that has been repeatedly reported as problematic.

Table 6-8 First Round of Expert Consultation Index Screening Critical Value Table

	average value	standard deviation	critical value
Full score frequency(%)	38.74	15.16	23.58
Arithmetic mean	3.99	0.78	3.21
Coefficient of Variation (%)	14.17	4.48	18.65

Table 6-9 Second Round of Expert Consultation Index Screening Critical Value Table

	average value	standard deviation	critical value
Full score frequency(%)	50.54	20.37	30.17
Arithmetic mean	4.66	0.18	4.48

Coefficient of Variation (%)	7.94	3.89	11.83

Table 6-10 Third Round of Expert Consultation Index Screening Critical Value Table

	average value	standard deviation	critical value
Full score frequency(%)	62.57	16.87	45.50
Arithmetic mean	4.62	0.16	4.46
Coefficient of Variation (%)	8.85	4.50	12.35

6.6.2 Construction of evaluation indicator system

Based on experts' opinions, we reorganized the revised evaluation indicator system, so as toconstruct an evaluation indicator system for the Value Based Healthcare Delivery in China (see Table 6-12).

Table 6-11 Statistical Table of Revision in the First Round of Experts' Consultation

Before the revision	After the revision
Therapeutic effect data release platform indicators	Diagnosis and treatment cost of certain diseases and the collection and sharing of therapeutic effect data
Establishing the nationally integrative assessment center of diagnosis and treatment.	Cost data calculation and collection
Measuring the cost of medicine for treating certain diseases	Medicine costs
Measuring the cost of medical instruments for certain diseases	Medical equipment use costs
Measuring the service cost of diagnosis and treatment on certain diseases	Medical service costs
Establishing the nationally integrative data gathering center on therapeutic effect	Data calculation and collection of curative effect
Measuring and gathering data of therapeutic effect on certain diseases	30-day readmission rate of patients in different hospitals due to the same disease
Measurement standards	Cure rate
Releasing shared therapeutic effect data	Data sharing
Testing on the utility rate of patients towards the data on the platform	Data utilization rate
Testing on the timeliness rate of publishing data of certain diseases on the platform	Immediate data updating rate

Patient payment	Enterprise payment
Patient participation in the medical treatment process	Cooperating with insurance companies to find “valuable” medical service providers
Emphasis on patients’ right to be informed and their right to make decisions during medical treatments	Bargain power towards treatment results
The ratio of medical insurance payment on certain surgical fee	Rewarding medical service providers for positive curative effect
The index of timeliness of including new medicines into medical insurance	Speed of incorporating new medicine into medical insurance system
The index of the treatment behavior model of doctors (transforming from biomedical treatment to biological,psychological and social medical treatment)	Transformation from biomedical model to biological, social, and psychological medical model
Medical institutions	Hospitals
Medical instrument producers	Medicine and medical equipment manufacturer
Side effects of drug treatment	Reliability of medication

Table 6-12 Evaluation Indicator System for the Value Based Healthcare Delivery in China

First-area indicators	Second-area indicators	Third-area indicators
1. Data collection and sharing of treatment cost and curative effect for specific diseases	1.1Data calculation and collection of cost	1.1.1 Medicine costs
		1.1.2 Medical equipment use costs
		1.1.3 Medical service costs
	1.2 Data calculation and collection of curative effect	1.2.1 30-day readmission rate of patients in different hospitals due to the same disease
		1.2.2 Measurement of the cure rates by different medical service providers
	1.3 Data sharing	1.3.1 Immediate data updating rate
		1.3.2 Data utilization rate
2. Medical expense payers	2.1 Enterprises	2.1.1 Employee satisfaction
		2.1.2 Cooperating with insurance companies for finding “valuable” medical service providers
		2.1.3 Bargain power towards treatment results
	2.2 Medical insurance centers	2.2.1 Rewarding medical service providers for positive curative effect
		2.2.2 Speed of incorporating new medicine into medical insurance system
		2.2.3 Linking payment with curative effect
	2.3 Commercial insurance agencies	2.3.1 Coverage rate of diseases under commercial insurance
		2.3.2 Punishing medical service providers involved in medical malpractice, overtreatment, and fraud through claims rejected
3.Medical service providers	3.1 Doctors	3.1.1 Application of new medical technologies
		3.1.2 Transformation from biomedical model to biological, social, and psychological medical model

	3.1.3 Encouraging patient-participative treatment
3.2 Hospitals	3.2.1 Implementation of hierarchical treatment
	3.2.2 Treatment plan for specific diseases
	3.2.3 Rehabilitation time, nosocomial infection, and complication
3.3 Medicine and medical equipment manufacturer	3.3.1 Volume production of medicine and medical equipment with excellent curative effect
	3.3.2 Constant measurement of reliability of drug treatment and mechanotherapy

Chapter 7: Conclusion

7.1 Conclusion

Patient orientation, better diagnosis and treatment result, and lower price are the basic principles of the value medical model. With the increasing attention paid on value medical care, healthcare providers, medical expense payers and policy makers are paying more and more attention to the value, under the trend of great efforts to control medical costs by all countries. Based on this, this study uses Delphi expert consultation method to initially establish a set of scientific evaluation index system of the value based healthcare delivery suitable for China's national conditions to provide a reference for promoting the rapid implementation of value based healthcare delivery in China.

The study method is reasonable. This study firstly designs a framework and indicator pool of medical service attitude indicator evaluation system characterized by patient orientation, lower diagnosis and treatment price and better diagnosis and treatment results based on the study results of the previous value medical theories. During consultation with experts, the background information is provided to them. Various consultation methods, such as WeChat voice, QQ video, email, telephone, and face-to-face consultation, are used to enable experts to complete consultation conveniently. The scientificity of survey is not affected.

The surveyed experts are very representative. In this study, 30 experts with certain authority are selected by the Delphi expert consultation method, and three rounds of effective consultations are conducted with them. The number of experts with senior professional title accounts for 50 %, 50% and 50% of total number of respondents respectively in the first, second or third round of survey; the number of experts with doctoral degree accounts for 40%, 43% and 43% of the total number of respondents respectively in the first, second or third

round of survey; the number of experts with more than 10 years of working experience accounts for 70%, 76%, and 76% of the total number of respondents respectively in the first, second or third round of survey; the number of experts working in medical and health field accounts for 100%, 100%, and 100% of the total number of respondents respectively in the first, second or third round of survey. This shows that the experts selected in this study are of good representativeness.

Consulting results are reliable. Firstly, in terms of the authority degree of experts, expert self-evaluation method is adopted for criterion coefficient and familiarity degree coefficient. In the calculation of the authority degree of experts, the average value of the sum of experts' indicator criterion coefficient and familiarity degree coefficient is used. In the three rounds of surveys, the average values of the authority degree coefficient of experts are 0.815, 0.814, and 0.795 respectively, which are all higher than 0.70, indicating that the authority degree of experts is very high. In terms of positivity degree of experts, the questionnaire recovery rates in the three rounds of surveys are 86.67%, 92.31% and 100% respectively, which are higher than 75%. This shows that the positivity level of experts is very high. Secondly, in terms of the concentration degree of expert opinions, the importance and operability of various indicators are understood according to the arithmetic mean and full-score rate of experts' score on each indicator, which also shows the concentration of experts' opinions on the importance and operability of an indicator. At the same time, statistical analysis is performed by use of arithmetic mean and full-score frequency, and the indicator that reflects experts' concentration degree is specifically described. The arithmetic means of the importance and operability of each indicator in the three rounds of surveys are 1.30-5.0 and 1.19-5.0, 4.19-5.0 and 4.29-5.0, and 4.21-5.0 and 4.19-5.0 respectively; the full-score frequency is 9%-91% and 11%-76%, 22%-100% and 22%-100%, and 21%-100% and 19%-100% respectively. Thirdly, in terms of the coordination degree of expert opinions, the variation coefficient in the experts' score on the importance and operability of each indicator is statistically analyzed. They are 0.06-0.28 and 0.1-0.32, 0.0-0.15 and 0.0-0.27, and 0.0- 0.14 and 0.0-0.18. The range of the variation coefficient gradually becomes smaller, which indicates that the cognition level of experts in the importance of evaluation indicators tends to be consistent. The coordination

coefficient of experts' opinions is 0.29, 0.64, and 0.69 respectively. The p-value test is less than 5%, indicating no major disagreement among experts, high coordination degree of experts, and high credibility of the study. Finally, the indicators are selected and modified by the boundary value method according to experts' opinions, thus eventually forming a comparatively scientific medical service attitude indicator evaluation system based on value medical model.

To sum up, the study method is reasonable, the expert representativeness is high, the positivity degree and authority degree of experts are high, the concentration degree and coordination degree of experts' opinions are good, and the study results are reliable. Based on these, the medical service attitude evaluation indicator system established based on the value medical model in this study has a certain degree of reliability.

7.2 Contribution and limitation

7.2.1 Contribution

Although much research on value-based healthcare system has been conducted by foreign scholars, effective evaluation tool for the system has not yet been formed, and there is even a lack of specific evaluation indicator for medical service attitude in the implementation of value-based healthcare. Therefore, based on value based healthcare related theory, we designed the indicator system for medical service attitude based on value based medical model in the study. And based on experts' opinions, Delphi Method is used to construct a set of evaluation indicator system that are suitable for the background condition in Mainland China, providing reference for evaluating the patient-oriented medical service attitude of medical service providers and medical expense payers under the value-oriented medical model to medical service institutes. The indicator system greatly contributes for medical service institutes to improving medical service quality, regulating medical behaviors, reflecting medical value, and enhancing competitiveness of medical agencies with the help of value-based healthcare theory in treatment.

7.2.2 Limitation

Patients' options are very important in achieving better curative effect with lower cost. Only if patients enjoy the right to make decisions can they get returns from decision making. At a new era of medical service industry, mutual collaboration among centers of data collection and sharing of treatment cost and curative effect for specific diseases, medical expense payers, medical service providers, and patients should be conducted in business model innovation. However, patients' behaviors, which are the most uncontrollable factors, have not been analyzed in the study. The result of the study is to establish a set of evaluation index system which can effectively guide the realization of the value medical model in China. However, to what extent it can guide the rapid implementation of value healthcare in China remains to be further studied, and because this involves a wide range of aspects, such as the behavior research, culture, political system, economic development and so on, all these will affect the realization degree of the value of the medical model. In a market based on competition, government's administrative instruction can only help to achieve the goal, but not to promote the goal in a compulsory way. Obviously, the goal can only be achieved through concerted effort. However, it takes time to test that whether the goal is achieved. Of course, nothing is impossible. We should proactively embrace the trend.

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Appendix 1

The First Round Expert Consultation Questionnaire with Delphi Method

Doctoral Graduation Thesis of Public Health Policy and Management

Research on Delphi Method in Assessing Indexes of the Value Based Healthcare Delivery in China

Distinguished experts:

Hello!

This project is the research subject of my doctoral thesis and its aim is to study the difficulties and obstacles of pursuing value-based healthcare delivery in Chinese hospitals and find out the reasons behind them based on the opinions from the experts.

This questionnaire is designed on the basis of the value-based theory. In order to ensure that this questionnaire is scientific and rational, Delphi Method is adopted during the consultation with experts. And it is hoped that experts would provide suggestions on the modification, deletion, and correction of the dimensions and items of this questionnaire as well as the connotation of each item, and evaluate the importance of items.

According to the Delphi Method, three rounds of consultation with experts will be carried out to reach a more consistent answer.

The rationale of this questionnaire is to form a tentative framework for the questionnaire content from three perspectives of publishing platform for therapeutic effect data, medical provider, and medical fee payer on the basis of medical theory; to gather experts' evaluations on each index of the value-based healthcare model; to find out the difficulties and obstacles of promoting this model in China so as to solve the problem, promoting this model in China, bringing benefits for the public and achieving win-win results.

Filling Explanation	Dear experts, Please fill in the forms in accordance with the following rules: 1.Please evaluate the importance of the indexes, and then fill in the columns under “Evaluation on Importance” with the numbers of 1, 2, 3, 4, 5, each representing very important, comparatively important, important, less important, unimportant respectively. 2. In the " evaluation of operability" column on the left side of the level 1,level 2 and level 3 indicators can be evaluated respectively by the operational degree of 1, 2, 3, 4, 5 respectively without operation, operation is very small, moderate operability, maneuverability, operability is very strong. 3.Please score for the index of the level 1, level two, and level three in the "full score" column (0--100 score range) 4. Please tick a “√"in the corresponding columns under “Basis for Evaluation” in accordance with the evidence for making evaluation. 5. Please fill in the columns under “Degree of Familiarity with Indexes” with the numbers of 1, 0.75, 0.5, 0.25, 0 on the column , each representing very familiar, comparatively familiar, familiar, less familiar, unfamiliar respectively. 6. Please write down your opinions on the modification, addition or deletion in the column “Assessment and Suggestions”.

Indexes		Evaluation on Importance	Basis for Evaluation				Degree of Familiarity with Indexes	Evaluation of Operability	Evaluation of Full score
			Practical Experience	Theoretical Analysis	Learned from Peers	Instinct			
1	Publishing platform of index of therapeutic effect data								
1.1	Establishing an integrated national assessment center of diagnosis and treatment.								

1.1.1	Measuring the cost of medicine for treating certain diseases								
1.1.2	Measuring the cost of medical instruments for certain diseases								
1.1.3	Measuring the service cost of diagnosis and treatment on certain diseases								
1.1.4	Cost measurement of each program in the assessment center should be carried out by a team of experts from across the country.								
1.2	Establishing an integrated national data gathering center on therapeutic effect.								
1.2.1	Measuring and gathering data of therapeutic effect on certain diseases								
1.2.2	Measurement standards								
1.2.3	Test on the authenticity of data of preventive test								
1.3	Releasing shared therapeutic effect data								
1.3.1	Testing on the utility rate of patients towards the data on the platform								
1.3.2	Testing on the timeliness rate of publishing data of certain diseases on the platform								
1.3.3	Monitoring the speed of updating the data of new medical products and techniques								
2	Indexes for medical fee payers								

2.1	Patients' payment								
2.1.1	Patients' payment ratio on different diseases								
2.1.2	Patients' participation in the medical treatment process								
2.1.3	Emphasis on patients' right to be informed and their right to make decisions during medical treatments								
2.2	Medical insurance payment								
2.2.1	The ratio of medical insurance payment on certain surgical fee								
2.2.2	The index of timeliness of including new medicines into medical insurance								
2.2.3	The index of medical insurance payment ratio on different medicines								
2.2.4	The index of medical insurance payment on the use of different medical instruments								
2.3	Commercial insurance payment								
2.3.1	The index of the coverage ratio of disease categories in commercial insurance payment								
2.3.2	The speed index of commercial insurance payment								
3	Medical providers								
3.1	Doctors								

3.1.1	The application of new medical techniques								
3.1.2	The number of general practitioners								
3.1.3	The index of the treatment behavior model of doctors (transforming from biomedical treatment to biological, psychological and social medical treatment)								
3.2	Medicine producers								
3.2.1	The index of side effects of medicine after diagnosis and treatment								
3.2.2	The index of diagnostic and treatment effect of medicine								
3.2.3	The rates of research and development on new medicine								
3.2.4	The sales price of medicine								
3.3	Medical instrument producers								
3.3.1	Constant innovations of medical instruments								
3.3.2	The recovery ratio of sub-quality medical instruments								
3.3.3	The ratio of adverse effect of medical instruments								
3.4	Medical institutions								
3.4.1	The total cure rate of different diseases								
3.4.2	The mortality rate of different diseases								

3.4.3	The speed of adopting new medicines and instruments of medical institutions								
3.4.4	The speed of recovery from different diseases								
3.4.5	The change of attitude towards medical services								

Evaluation and Suggestions	

Basic Information of Experts					
Place of Work		Fields of Study		Types of Job	
Working experience of your fields of study		Professional Titles		Education Background and Academic Degree	

Appendix 2

The Second Round Expert Consultation Questionnaire with Delphi Method

Doctoral Graduation Thesis of Public Health Policy and Management

Research on Delphi Method in Assessing Indexes of the Value Based Healthcare Delivery in China

Distinguished experts:

Hello!

This project is the research subject of my doctoral thesis and its aim is to study the difficulties and obstacles of pursuing value-based healthcare delivery in Chinese hospitals and find out the reasons behind them based on the opinions from the experts.

This questionnaire is designed on the basis of Summary of modification on repeatedly reported indicators at the first round of questionnaire. In order to ensure that this questionnaire is scientific and rational, Delphi Method is adopted during the consultation with experts. And it is hoped that experts would provide suggestions on the modification, deletion, and correction of the dimensions and items of this questionnaire and the connotation of each item, and evaluate the importance of items.

According to the Delphi Method, three rounds of consultation with experts will be carried out to reach a more consistent answer.

The rationale of this questionnaire is to form a tentative framework for the questionnaire content from three perspectives of data collection and sharing of treatment cost and curative effect for specific diseases, medical providers and medical fee payers and to gather experts' evaluations on each index of the value-based healthcare model based on the value-based healthcare delivery theory; to find out the difficulties and obstacles of promoting this model in China. It strives to solve those problems and then

promote this model, thus bringing benefits for the public and achieving win-win results.

Filling Explanation	Dear experts, Please fill in the forms in accordance with the following rules: 1.Please evaluate the importance of the indexes, and then fill in the columns under “Evaluation on Importance” with the numbers of 1, 2, 3, 4, 5, each representing very important, comparatively important, important, less important, unimportant respectively. 2. In the " evaluation of operability" column on the left side of the level 1,level 2 and level 3 indicators can be evaluated respectively by the operational degree of 1, 2, 3, 4, 5 respectively without operation, operation is very small, moderate operability, maneuverability, operability is very strong. 3.Please score for the index of the level 1, level two, and level three in the "full score" column (0--100 score range) 4. Please tick a “√"in the corresponding columns under “Basis for Evaluation” in accordance with the evidence for making evaluation. 5. Please fill in the columns under “Degree of Familiarity with Indexes” with the numbers of 1, 0.75, 0.5, 0.25, 0 on the column , each representing very familiar, comparatively familiar, familiar, less familiar, unfamiliar respectively. 6. Please write down your opinions on the modification, addition or deletion in the column “Assessment and Suggestions”.

Indexes	Evaluation on Importance	Basis for Evaluation				Degree of Familiarity with Indexes	Evaluation of Operability	Evaluation of Full score
		Practical Experience	Theoretical Analysis	Learned from Peers	Instinct			
1. Data collection and sharing of treatment cost and curative effect for specific diseases								

1.1Data calculation and collection of cost								
1.1.1 Medicine costs								
1.1.2 Medical equipment use costs								
1.1.3 Medical service costs								
1.2 Data calculation and collection of curative effect								
1.2.1 30-day readmission rate of patients in different hospitals due to the same disease								
1.2.2 Cure rate								
1.3 Data sharing								
1.3.1 Immediate data updating rate								
1.3.2 Data utilization rate								
2. Medical expense payers								
2.1 Enterprises								
2.1.1 Employee satisfaction								
2.1.2 Cooperating with insurance companies for finding “valuable” medical service providers								

2.1.3 Bargain power towards treatment results								
2.2 Medical insurance centers								
2.2.1 Rewarding medical service providers for positive curative effect								
2.2.2 Speed of incorporating new medicine into medical insurance system								
2.2.3 Linking payment with curative effect								
2.3 Commercial insurance agencies								
2.3.1 Coverage rate of diseases under commercial insurance								
2.3.2 Punishing medical service providers involved in medical malpractice, overtreatment, and fraud through claims rejected								
3.Medical service providers								
3.1 Doctors								
3.1.1 Application of new medical technologies								
3.1.2 Transformation from biomedical model to biopsychosocial medical model								
3.1.3 Encouraging patient-participative treatment								

3.2 Hospitals								
3.2.1 Reasonable arrangement for transfer treatment								
3.2.2 Plan of reason able arrangement for treatment								
3.2.3 Rehabilitation time, nosocomial infection, and complication								
3.3 Medicine and medical equipment manufacturer								
3.3.1 Volume production of medicine and medical equipment with excellent curative effect								
3.3.2 Reliability of drug treatment								

Evaluation and Suggestions	

Basic Information of Experts

Place of Work		Fields of Study		Types of Job	
Working experience of your fields of study		Professional Titles		Education Background and Academic Degree	

Appendix 3

The Third Round Expert Consultation Questionnaire with Delphi Method

Doctoral Graduation Thesis of Public Health Policy and Management

Research on Delphi Method in Assessing Indexes of the Value Based Healthcare Delivery in China

Distinguished experts:

Hello!

This project is the research subject of my doctoral thesis and its aim is to study the difficulties and obstacles of pursuing value-based healthcare delivery in Chinese hospitals and find out the reasons behind them based on the opinions from the experts.

This questionnaire is designed on the basis of Summary of modification on repeatedly reported indicators at the second round of questionnaire. In order to ensure that this questionnaire is scientific and rational, Delphi Method is adopted during the consultation with experts. And it is hoped that experts would provide suggestions on the modification, deletion, and correction of the dimensions and items of this questionnaire and the connotation of each item, and evaluate the importance of items.

According to the Delphi Method, three rounds of consultation with experts will be carried out to reach a more consistent answer.

The rationale of this questionnaire is to form a tentative framework for the questionnaire content from three perspectives of data collection and sharing of treatment cost and curative effect for specific diseases, medical providers and medical fee payers and to gather experts' evaluations on each index of the value-based healthcare delivery model based on the value-based healthcare delivery theory; to find out the difficulties and obstacles of promoting this model in China. It strives to solve those problems and

then promote this model, thus bringing benefits for the public and achieving win-win results.

Filling Explanation	Dear experts, Please fill in the forms in accordance with the following rules: 5.Please evaluate the importance of the indexes, and then fill in the columns under “Evaluation on Importance” with the numbers of 1, 2, 3, 4, 1, each representing very important, comparatively important, important, less important, unimportant respectively. 2. In the " evaluation of operability" column on the left side of the level 1,level 2 and level 3 indicators can be evaluated respectively by the operational degree of 1, 2, 3, 4, 5 respectively without operation, operation is very small, moderate operability, maneuverability, operability is very strong. 3.Please score for the index of the level 1, level two, and level three in the "full score" column (0--100 score range) 4. Please tick a “√"in the corresponding columns under “Basis for Evaluation” in accordance with the evidence for making evaluation. 5. Please fill in the columns under “Degree of Familiarity with Indexes” with the numbers of 1, 0.75, 0.5, 0.25, 0 on the column , each representing very familiar, comparatively familiar, familiar, less familiar, unfamiliar respectively. 6. Please write down your opinions on the modification, addition or deletion in the column “Assessment and Suggestions”.

Indexes	Evaluation on Importance	Basis for Evaluation				Degree of Familiarity with Indexes	Evaluation of Operability	Evaluation of Full score
		Practical Experience	Theoretical Analysis	Learned from Peers	Instinct			
1. Data collection and sharing of treatment cost and curative effect for specific diseases								

1.1Data calculation and collection of cost								
1.1.1 Medicine costs								
1.1.2 Medical equipment use costs								
1.1.3 Medical service costs								
1.2 Data calculation and collection of curative effect								
1.2.1 30-day readmission rate of patients in different hospitals due to the same disease								
1.2.2 Measurement of the cure rates by different medical service providers								
1.3 Data sharing								
1.3.1 Immediate data updating rate								
1.3.2 Data utilization rate								
2. Medical expense payers								
2.1 Enterprises								
2.1.1 Employee satisfaction								
2.1.2 Cooperating with insurance companies for finding “valuable” medical service providers								

2.1.3 Bargain power towards treatment results								
2.2 Medical insurance centers								
2.2.1 Rewarding medical service providers for positive curative effect								
2.2.2 Speed of incorporating new medicine into medical insurance system								
2.2.3 Linking payment with curative effect								
2.3 Commercial insurance agencies								
2.3.1 Coverage rate of diseases under commercial insurance								
2.3.2 Punishing medical service providers involved in medical malpractice, overtreatment, and fraud through claims rejected								
3.Medical service providers								
3.1 Doctors								
3.1.1 Application of new medical technologies								
3.1.2 Transformation from biomedical model to biopsychosocial medical model								
3.1.3 Encouraging patient-participative treatment								
3.2 Hospitals								

3.2.1 Implementation of hierarchical treatment								
3.2.2 Treatment plan for specific diseases								
3.2.3 Rehabilitation time, nosocomial infection, and complication								
3.3 Medicine and medical equipment manufacturer								
3.3.1 Volume production of medicine and medical equipment with excellent curative effect								
3.3.2 Constant measurement of reliability of drug treatment and mechanotherapy								

Evaluation and Suggestions	

Basic Information of Experts					
Place of Work		Fields of Study		Types of Job	
Working experience of your fields of study		Professional Titles		Education Background and Academic Degree	

Appendix 4

Information of experts

Sequence	Name	Workplace	Position	Interview time	Interview method
1	Song Jie	Nanjing Drum Tower Hospitals, The Affiliated Hospital of Nanjing University Medical School	Chief physician	January 14, 2018	Face to face
2	Zhang Xiaoqi	Nanjing Drum Tower Hospitals, The Affiliated Hospital of Nanjing University Medical School	Chief physician	January 14, 2018	Face to face
3	Cao Min	Nanjing Drum Tower Hospitals, The Affiliated Hospital of Nanjing University Medical School	Chief physician	January 14, 2018	Face to face
4	Yin Kaisheng	Jiangsu Province Hospital	Chief physician	January 15, 2018	Face to face

5	Xing Changying	Jiangsu Province Hospital	Chief physician	January 15, 2018	Face to face
6	Zhou Shurong	Jiangsu Province Hospital	Chief physician	January 15, 2018	Face to face
7	Mao Xiaoming	Nanjing First Hospital	Chief physician	January 16, 2018	Face to face
8	Fu Liyuan	Nanjing First Hospital	Deputy of Chief physician	January 16, 2018	Face to face
9	Li Qian	Nanjing First Hospital	Deputy of Chief physician	January 16, 2018	Face to face
10	Ma Jianhua	Tongren Community Hospital, Nanjing City	Chief physician	January 16, 2018	Face to face
11	Wang Qingcai	The First Affiliated Hospital of Soochow University	Chief physician	January 17, 2018	Face to face
12	Chen LIli	The First Affiliated Hospital of Soochow University	Deputy of Chief physician	January 17, 2018	Face to face
13	Xu Fengpo	The First Affiliated Hospital of Soochow University	Chief physician	January 17, 2018	Face to face
14	Lan Guanghua	The First Affiliated Hospital of Soochow University	Chief physician	January 17, 2018	Face to face
15	Ma Guoning	The First Hospital of Tianshui	Deputy of Chief physician	January 18, 2018	Telephone interview
16	Wang Quansheng	The First Hospital of Tianshui	Chief physician	January 18, 2018	Telephone interview
17	Wang Ji	The First Hospital of Tianshui	Deputy of Chief physician	January 18, 2018	Telephone interview

18	Xie Mingxia	The First People's Hospital of Lixian County, Gansu Province	Deputy of Chief physician	January 18, 2018	QQ
19	Wang Hua	The First People's Hospital of Lixian County, Gansu Province	physician	January 18, 2018	QQ
20	Ma Jianbin	The First People's Hospital of Lixian County, Gansu Province	physician	January 18, 2018	QQ
21	Wang Xiong	Longlin Town Health Center, Lixian County, Gansu Province	physician	January 18, 2018	QQ
22	Zhang Li	Jiuquan City People's Hospital	Chief physician	January 19, 2018	Telephone interview
23	Gu Liping	Gansu Province Hospital of TCM	Deputy of Chief physician	January 19, 2018	Telephone interview
24	Fang Weidong	Chongqing Medical University	Master tutor	January 20, 2018	Telephone interview
25	Yang quan	Chongqing Medical University	Master tutor	January 20, 2018	Telephone interview
26	LIao Qun	Chongqing Emergency Medical Center	Chief technician	January 20, 2018	Wechat
27	Wu Zhongwei	Hainan General Hospital	Chief physician	January 20, 2018	Wechat

28	Li Qi	Hainan General Hospital	Chief physician	January 20, 2018	Wechat
29	Yang Junshan	Enpip Pharmaceutical	Professor	January 21, 2018	Telephone interview
30	Zhang Wenming	Philips Medical	Doctorate	January 21, 2018	WeChat