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ABSTRACT

Background: The current healthcare model is challenged by fewer concerns with healthcare quality and its sustainable development, affecting all participants involved in the healthcare system.Value-based healthcare (VBHC) delivery refers to a new management paradigm that prioritizes patients' health outcomes at lower healthcare costs.The use of value payments can effectively control the increases in medical costs and reduces the cost of health systems, presenting pieces of evidence in improving the diagnosis and treatment results as well as creating value for patients. Extant studies have investigated VBHC preparation and formulated a set of evaluation indices in the West context. However, a dearth of VBHC-related research conducted in China was noted wherein the VBHC's evaluation system has not yet been explored. Thus, this study aims at developing China's medical service attitude appraisal evaluation framework by adopting VBHC delivery.

Results: Two rounds of surveys found the authority degree coefficient of experts (0.805 and 0.812), degree of positivity (93.75% and 100%), the range of arithmetic means for the importance (3.30–5.0 and 4.05–5.0), the range of full-score frequency (16%–94% and 23%–100%), the range of variable coefficient (0.11–0.29 and 0.0–0.12), and the coordination coefficient (0.39 and 0.79; $p<0.5$ for all). The final evaluation index system comprises 35 items with three, nine, and 23 first-, second-, and third-level indicators, respectively. The three first-level indicators and their weight coefficients are data collection and sharing of treatment cost and curative effect for specific diseases (0.409), medical expense payers (0.245), and healthcare providers (0.346).

Conclusions: This study constructs an evaluation index system on the basis of the VBHC delivery, the study methods are reasonable, the experts representativeness are high, the positivity degree and authority degree of experts are high, the concentration degree and coordination degree of experts' opinions are good, and the weight of the indicators was calculated, which is scientific and can be used as a tool to evaluate the implementation of the VBHC delivery in China.

Keywords: Value-based healthcare; medical service attitude; hospital management

Strengths and limitations of this study

This is the first study that constructs an evaluation index system on the basis of the VBHC delivery from healthcare experts' opinions. Under the VBHC principle of ensuring better curative effect and lower cost, we have explored a path to realize the VBHC model, which is to improve the medical service model under the guidance of the index system.

This study uses Delphi method design to explore the medical service attitude towards VBHC model among Chinese health practitioners. The findings enrich the VBHC delivery literature with an evidence from China.

The major limitation is that the index system in this study is constructed only from the doctor's point of view, and the patient is absent.

Introduction

Lifestyle changes lead to an increase in people's life expectancy and make healthcare more complex and expensive[1-2]. The current healthcare model is challenged by fewer concerns with healthcare quality and its sustainable development, affecting all participants involved in the healthcare system[3]. Value-based healthcare (VBHC) delivery refers to a new management paradigm that prioritizes patients' health outcomes at lower healthcare costs. Referring to a numeric equation, VBHC can be interpreted as value = curative effect/cost; quality = (correlation × results)/waste[4-5,7-10]. The curative effect here is the clinical result of each complete nursing cycle; the cost is the sum of the indirect and direct costs of each complete nursing cycle; correlation refers to the correlation degree in which action is taken

throughout the nursing cycle; and waste refers to the resources that are ineffective throughout the nursing cycle[6]:506,[8]. On the basis of the model, some key aspects of VBHC development can be identified, including healthcare centrality, which is a patient-centered preventive, primary, and integrated healthcare service; a shift from individual physician diagnosis to a multidisciplinary model; and conversion from a patient- to curative-based payment, medical data integration, measurement and sharing of diagnosis and treatment results, and publication of the cost of diagnosis and treatment of various diseases [10].

The use of value payments can effectively control the increases in medical costs and reduces the cost of health systems, presenting pieces of evidence in improving the diagnosis and treatment results as well as creating value for patients[11-12]. Extant studies have investigated VBHC preparation and formulated a set of evaluation indices in the West context[13]. However, a dearth of VBHC-related research conducted in China was noted wherein the VBHC's evaluation system has not yet been explored. Thus, this study aims at developing China's medical service attitude appraisal evaluation framework by adopting VBHC delivery[14-19]. The present study contributes to the literature through the following: First, given that few existing studies focus on VBHC in emerging economies, the present study particularly sheds light on a country with a substantial imbalance between an excessive number of patients and insufficient medical resources. Second, the construction of medical service attitude evaluation indices has been focused on, which was less discussed in prior researches. The formulation of the VBHC-based assessment framework enables to provide implications to patient-centered humanistic care, and practically alleviates the conflicts between doctors and patients in China.

Sample and Methodology

Sample

Sixteen experts participate in the survey. The selecting criteria of experts includes[20-21]: (1) initial knowledge about VBHC; (2) work experiences in hospitals, medical higher education institutions, and health administrative institutions or pharmaceutical companies; (3) work experiences of more than 5 years in healthcare sector; and (4) interests in the present study without compensation.

Methodology

Survey Development

The questionnaire was developed by an extensive literature review of VBHC. Keyword searches were conducted across multiple extant studies published in highly ranked journals. Keywords included "Competing on Outcomes," "Sharing Therapeutic Data," "Medical Payment," "Medical Service Attitude," "Measurement Tools," "Evaluation Index System," "Patient-centered," "Hospital Management," and "General Medicine." Two professors in the healthcare or business administration fields were asked to preliminarily examine whether the designed content meets the goal of the questionnaire to validate it. Some comments were received from them, and the questionnaire was modified as per advice. The pilot survey was then delivered to five healthcare-related experts who have Ph.D. degree, and worked in hospitals to check whether the questionnaire was interpreted in fair and clear meanings. Consequently, some minor changes were made on the basis of the experts'

responses during the pilot survey.

Patient and Public Involvement

Patients and the public were not involved in the research.

Data Collection

This study uses the Delphi method to collect data through face-to-face consultation with experts. Two rounds of consultation were made between January and March 2021. Experts were asked to provide their basic personal information, and the 5-point Likert scale was used to score the VBHC-based medical service attitude evaluation indices for the first round. 3, 10, and 15, first-, second-, and third-level indicators, respectively, were scored by experts on the basis of their perceived importance on indicators. The experts' familiarity with these indicators was also examined, and certain changes of indicators were conducted after the first round of consultation. The results of the first round were initially assessed in the second round by using four widely used indices including concentration level of expert opinions, coordination level of expert opinions, expert authority coefficient, and positive coefficient[22-25].

Methods

Concentration Level of Experts' Opinions The concentration level of the experts' opinions is assessed using the arithmetic mean (M_j) and the full-score frequency (K_j). The M_j and K_j can reflect the extent of experts' perception of the importance of relevant indicators[21].

Coordination Level of Experts' Opinions The coordination level is expressed using variation coefficient (V_j) and coordination coefficient (W). And the V_j represents the degree of coordination of experts' evaluation of the relative importance of indicators. The variation coefficient is inversely proportional to the degree of coordination (range, 0–1); the greater the variation coefficient, the lower the degree of coordination, and vice versa[26]. The coordination coefficient indicates the degree of consistency or credibility of the expert's evaluation of the index (between 0 and 1), and the value is proportional to the degree of consistency or credibility of the expert's coordination opinion. The greater the value, the higher the degree of coordination. The significance of the coordination coefficient after the test ($P < 0.05$) indicates that the coordination of experts' opinions is good and the result is desirable. Otherwise, it cannot be obtained[27].

Expert Authority Coefficient The expert's familiarity with the indicator and the judgment basis for the indicator are decided using the expert authority coefficient[27]. The equation is expressed as $Cr = (Cs + Ca)/2$. C_r is used to represent the authoritative indicator level. Moreover, C_s and C_a refer to the familiarity with the indicator and the judgment basis, respectively. The more authoritative the expert is, the more reliant the evaluation will be. An acceptable result is indicated when the expert authoritative level is ≥0.70[28]. The expert's degree of familiarity with the indicator should be measured first to obtain the authoritative level of the expert. This research categorizes the expert's degree of familiarity with an indicator into five grades[29-30], ranging from very familiar, relatively familiar, generally familiar, unfamiliar, to fairly unfamiliar, correspondingly valued as 1.0, 0.75, 0.5, 0.25, and 0, respectively. The judgment basis includes the experts' practical experience,

theoretical knowledge, understanding of counterparts, and instinctive judgment, which are also given corresponding values of 0.8, 0.6, 0.4, and 0.2, respectively. The sum of the judgment basis indicators that equals to 1, 0.8, and 0.6 suggests a strong, medium, and small influence, respectively, by the judgment of the experts[31].

Positive Coefficient Experts' attention on the indicator is positively correlated with the participation index: therefore, the collection rate reflects the activeness of the experts[27]. A response rate of >70% indicates that experts are very positive toward these consultations[32-33].

Statistical Analysis

This study uses Excel 2011 and SPSS 24.0(IBM,USA) statistical software for data entry and analysis. The authority coefficient, coordination coefficient, variation coefficient, arithmetic mean, and full-score frequency of each index are calculated. When evaluating the coordination, the value is used for testing. Additionally, $p < 0.05$ is considered statistically significant. The expert scoring method and the combined weight product method are adopted to calculate the weight of each index[26].

Index Screening Methods

The critical value (CV) method is applied to this study as an index screening method[25]. The arithmetic mean (M_j), variation coefficient (V_j), and full-score frequency (K_j) of each index are calculated according to the expert's score of each item of importance. CV = AVG (Average Value) − SD (Standard Deviation) is a formula of the CV calculation method of

full-score frequency and arithmetic mean. Moreover, the method of index screening is similar because the CV calculation method of full-score frequency and arithmetic mean are the same. Furthermore, CV = SD + AVG is the CV calculation method of the coefficient of variation. Consequently, only three indices that do not meet the criteria are deleted to prevent important indices from being deleted. If one or two measures meet the requirements, a decision is made after the discussion, and the minutes of the discussion should consider the opinions of experts and the principles of feasibility, comprehensiveness, and science. Inclusion criteria using the CV method are as follows: the CV of arithmetic mean is >3.22 points, the CV of full-score frequency is >23.58%, and the CV of the coefficient of variation is <18.65%[34].

Results

Concentration Level of Experts' Opinions

Arithmetic Mean The results in the first and second rounds show that the arithmetic means of importance for all indicators range from 3.30 to 5.0 and 4.05 to 5.0, respectively.

Full-score Frequency Importance is considered in the scoring of full-score frequency for all indicators. With the full-score frequency in the first and second rounds, it is between 16% and 94%, and 23% and 100%, respectively.

Coordination Level of Experts' Opinions

Variation Coefficient The variation coefficients of experts' opinions on indicator importance range from 0.11 to 0.29 and 0.0 to 0.12, respectively, at the first and second rounds of

consultation.

Coordination Coefficient The coordination coefficient is 0.39 (χ^2=124.21, p = 0.01) and 0.79 (χ^2=135.16, p = 0.00) at the first and second rounds of consultation, respectively. The p values in the χ^2 test of coordination coefficient in the two rounds of consultation are all lower than 5%, suggesting that the confidence degree of the coordination of experts' opinions is higher than 95%.

Expert Authority Coefficient

After two rounds of expert survey and consultation toward the three first-level indicators in the study, the experts' average familiarity coefficients toward the three first-level indicators are found to be 0.807 and 0.814; the experts' average judgment basis coefficients are 0.803 and 0.810, respectively; and the experts' average authority coefficients are 0.805 and 0.812.

Positive Coefficient

In the first round, 16 questionnaires were distributed and 15 were retrieved, presenting a response rate of 93.75%. In the second round, 15 questionnaires were distributed and all of them were received, presenting a response rate of 100%.

Index Revising Results

The initial indicator system is composed of 3, 10, and 25 first-, second-, and third-level indicators, respectively. After the first round of consultation, these indicators are deleted, added, screened, and modified on the basis of the statistical results and experts' opinions

with CV analysis.

Nine indices for deletion were noted, including *pay ratio of medical insurance on different medicines*, *medical insurance payment on the use of different medical instruments*, *the rates of research and development on a new medicine*, *constant innovations of medical instruments*, *the total cure rate of different diseases*, *medicine manufacturers*, *the mortality rate of different diseases*, *the speed of adopting new medicines and instruments of medical institutions*, and *the speed of recovery from different diseases*.

Seven indices were added, including *employee satisfaction*, *linking payment with curative effect*, *encouraging patient-participative treatment*, *reasonable arrangement for transfer treatment*, *plan of reasonable arrangement for treatment*, *rehabilitation time*, *nosocomial infection and complication*, and *volume production of medicine and medical equipment with excellent curative effect*.

Six revised indicators were noted, in which *releasing shared therapeutic effect data* is revised into *data sharing, testing on the timeliness rate of publishing data of specific diseases on the platform* into *immediate data updating rate, patient participation in the medical treatment process* into *employee satisfaction*, *emphasis on patients' right to be informed and their right to make decisions during medical treatments* into *bargain power toward treatment results*, *timeliness of including new medicines into medical insurance* into the *speed of incorporating new medicine into the medical insurance system*, and *side effects of medicine after diagnosis and treatment* into the *reliability of medication*.

After the adjustment, the number of three first-level indicators remains unchanged; one second-level indicator is canceled, and nine remain. Moreover, nine third-level indicators are canceled, seven third-level indicators are added, six third-level indicators are revised, and 23 remain. The results are taken after screening and modification.

Similarly, the second round of consultation is conducted on the basis of the indicators after adjustment. The statistical results are analyzed, and the indicators are screened on the basis of experts' opinions with CV analysis. The numbers of first-, second-, and third-level indicators remain the same, whereas contents of indicators are modified on the basis of experts' opinions wherein *cure rate* is revised into *measurement of the cure rate by different healthcare providers*, *reasonable arrangement for transfer treatment* into *implementation of hierarchical treatment*, *plan of reasonable arrangement for treatment* into *treatment plan for specific diseases*, and *reliability of medication* into *constant measurement of reliability of medicine treatment and mechanotherapy*.

Evaluation Index System and Weight

The expert scoring and combined weight product methods are used to calculate the weight coefficient of each index[35]. The three first-level indicators are *data collection and sharing of treatment cost and curative effect for specific diseases*, *medical expense payers*, and *healthcare providers* with weight coefficients of 0.409, 0.245, and 0.346, respectively. It shows that the index with the highest score with its weight is an important position in patient-centered VBHC. However, the index with the lowest score with its weight is possibly

caused by the imperfect medical insurance or medical payment system in China or restricted payment of medical insurance.

Participants' Characteristics for Two Rounds of Consultation

Of the experts who participate in two rounds of consultation, 68% have the professor title or senior title and participate in each round of consultation. About 50% and 56% of the experts Ph.D. degree and joined in the first and second rounds of consultation. In terms of experts' working experience, 75% and 81% of the experts participating in the first and second rounds have more than 10 years of professional experiences.

Discussion

Patient-oriented, better diagnosis and treatment results and a lower price are the basic principles of the VBHC delivery. With the increasing attention given to VBHC, healthcare providers, medical expense payers, and policymakers are giving increasing attention to the VALUE under the trend of great efforts to control medical costs in all countries. This study uses the Delphi expert consultation method to initially establish a set of scientific evaluation index systems of the VBHC delivery suitable for China's national conditions to provide a reference for promoting the rapid implementation of VBHC delivery in China.

Reasonability of the Study Method:

First, this study designs a framework and indicator pool of medical service attitude evaluation index system characterized by patient-oriented, lower diagnosis and treatment price, and better diagnosis and treatment results based on the results of previous VBHC

theories. During consultation with experts, the background information is provided to them, various consultation methods (e.g., face to face consultation) are used to enable experts to complete consultation conveniently, and the scientificity of the survey is not affected.

Representativeness of the Surveyed Experts:

Sixteen experts with certain authority are selected by the Delphi expert consultation method, and two rounds of effective consultations are conducted with them. The experts are from South China, East, Northwest, Southwest, and Northeast, with good geographical representation. More than half of the experts have professor or other senior titles, and more than 50% of the experts have Ph.D. degree, which shows a good academic representation. They are all working in medical and health fields and are highly specialized. This shows that the experts selected in this study are of good representativeness.

Reliability of the Consulting Results:

The expert self-evaluation method is adopted for criterion coefficient and familiarity degree coefficient in terms of the authority degree of experts. In the calculation of the authority degree of experts, the average value of the sum of experts' judgment basis coefficient and familiarity degree coefficient is used. In the two rounds of surveys, the average values of the authority degree coefficient of experts are 0.805 and 0.812, which are all higher than 0.70[21], indicating that the authority degree of experts is very high.

In terms of the positivity degree of experts, the questionnaire recovery rates in the two rounds of surveys are 93.75% and 100%, which are higher than 75%[20]. This shows that the

positivity level of experts is very high.

In terms of the concentration degree of the experts' opinions, the importance of various indicators is understood according to the arithmetic mean and full-score frequency of the experts' score on each indicator, which also shows the concentration of experts' opinions on the importance of an indicator[21]. Similarly, statistical analysis is conducted using arithmetic mean and full-score frequency, and the indicator that reflects the experts' concentration degree is specifically described. According to the statistical results, the arithmetic mean of the importance of the first-level indicators is relatively large in the two rounds of surveys, which indicates that the importance of the two first-level indicators is relatively high. Concerning the importance of second-level indicators, the arithmetic mean of some of the individual indicators is found to be low in the first round of surveys. According to expert opinions, second-level indicators are modified and deleted. The revised second-level indicators in the second round of survey obtaining the arithmetic mean of all the rest of the survey are bigger, which also illustrates the higher importance of the modified nine secondary indicators. Concerning the third-level indicators, more modifications and deletions are made after the first round of the survey according to the CV method and expert opinions, although the importance of individual indicators with lower arithmetic mean in the second rounds of the survey may be caused by other reasons. For example, the frequency of full scores and arithmetic mean of certain indicators in the study (e.g., *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 need demand

stimulus because pharmaceutical companies will not take any risks without such stimulus. Additionally, another medicine with a better curative effect, once putting on the market, will be reproduced quickly. In this case, the investment of pharmaceutical companies in the first new medicine will soon come to nothing.

In terms of the coordination degree of expert opinions, the variation coefficient in the experts' score on the importance of each indicator is statistically analyzed, and the coordination coefficient is calculated and analyzed. At the first round of consultation, the range of variation coefficient is 0.11 – 0.29, which are relatively high, and the coordination coefficient is 0.39, 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[25]. After the second round of consultation, the range of variation coefficient is found to be 0.00 – 0.12, which is relatively low, experiencing a sharp decrease. Moreover, the 0.79 figure of coordination coefficient depicts experiencing a sharp increase. It suggests that experts' cognition of the importance of evaluation indicators is gradually becoming consistent with each other and that the reliability is improving. The *p* values in the χ^2 test of coordination coefficient in the two rounds of consultation are all lower than 5%, suggesting that the confidence degree of coordination of experts' opinions is higher than 95%. It represents favorable results.

Finally, the indicators are selected and modified by the CV method according to experts' opinions, thus eventually forming a comparatively scientific medical service attitude indicator evaluation system based on VBHC delivery (see Table 1).

Weight Analysis:

Based on the calculation results, the weight is finally assigned to the indicators of the first, second, and third level of the indicators of VBHC. Additionally, the scoring method of the evaluation results can be determined through the evaluation organizations themselves because the indicators of VBHC are used for different purposes, and the weight determined is for reference only in this study.

Table 1. Results of the evaluation indicator system for VBHC delivery and its weight

Indicators	Importance			Weight
	M_j	K_j	V_j	
1.0 Data collection and sharing of treatment cost and curative effect for specific diseases	4.62	0.61	0.07	0.409
1.1 Data calculation and collection of cost	4.59	0.31	0.10	0.130
1.1.1 Medicine costs	4.68	0.42	0.09	0.042
1.1.2 Medical equipment use costs	4.69	0.91	0.07	0.032
1.1.3 Medical service costs	4.56	0.33	0.11	0.056
1.2 Data calculation and collection of curative effect	4.53	0.80	0.08	0.136
1.2.1 30 day readmission rate of patients in different hospitals due to the same disease	4.64	0.61	0.11	0.070
1.2.2 Measurement of the cure rates by different healthcare providers	4.52	0.58	0.06	0.068
1.3 Data sharing	4.53	0.37	0.05	0.142
1.3.1 Immediate data updating rate	4.42	0.77	0.02	0.058
1.3.2 Data utilization rate	4.62	0.33	0.06	0.084
2.0 Medical expense payers	4.98	0.90	0.03	0.245
2.1 Enterprises	4.66	1.00	0.00	0.096
2.1.1 Employee satisfaction	4.50	0.34	0.05	0.032

2.1.2 Cooperating with insurance companies for finding “valuable” healthcare providers	4.45	0.58	0.11	0.030
2.1.3 Bargain power toward treatment results	4.55	0.92	0.04	0.034
2.2 Medical insurance centers	4.73	0.55	0.02	0.117
2.2.1 Rewarding healthcare providers for positive curative effect	4.72	0.23	0.07	0.046
2.2.2 Speed of incorporating new medicine into medical insurance system	4.41	0.56	0.12	0.028
2.2.3 Linking payment with curative effect	4.54	0.68	0.11	0.043
2.3 Commercial insurance agencies	4.58	0.42	0.10	0.031
2.3.1 Coverage rate of diseases under commercial insurance	4.39	0.31	0.11	0.018
2.3.2 The pay speed of commercial insurance	4.73	0.43	0.08	0.013
3.0 Healthcare providers	5.00	0.90	0.02	0.346
3.1 Doctors	4.44	0.53	0.05	0.130
3.1.1 Application of new medical technologies	4.51	0.97	0.00	0.060
3.1.2 Transformation from biomedical model to biopsychosocial medical model	4.85	0.82	0.00	0.034
3.1.3 Encouraging patient-participative treatment	4.96	1.00	0.11	0.036
3.2 Hospitals	4.88	1.00	0.03	0.132
3.2.1 Implementation of hierarchical treatment	4.45	0.46	0.02	0.051
3.2.2 Treatment plan for specific diseases	4.66	0.45	0.09	0.052
3.2.3 Rehabilitation time, nosocomial infection, and complication	4.67	0.58	0.08	0.029
3.3 Medicine and medical equipment manufacturer	4.32	0.41	0.10	0.084
3.3.1 R & D speed of new medicine	4.05	0.43	0.00	0.044
3.3.2 Constant measurement of reliability of medicine treatment and mechanotherapy	4.54	0.47	0.10	0.040

Note: This items and contents of the indicators have great consistency with the first author’s ones of doctoral thesis.

Abbreviations

VBHC: Value-based healthcare

CV: Critical value

SD: Standard deviation

AVG: Average value

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Declarations

Ethics approval and consent to participate

The study was approved by The Fourth Military Medical University (FMMU) research ethics committee. As face to face interview carried out in the study that informed consent was obtained from all interviewees in the manuscript. All methods were carried out in

accordance with relevant guidelines and regulations in the ethical approval and consent to participate section of manuscript.

Consent for publication

Not applicable.

Availability statement of data and material

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

All the authors declare that they have no completing interests.

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Author's contributors

All authors contributed to the research design, collection and analysis of data, and initial draft of the manuscript of this study. Here are the details: CW conducted the interviews. LZ refined the research design, revised, reviewed manuscript and made final editing. WC participated in data collections, analyses and manuscript draft. RW participated in data collection, analysis and translated the initial manuscript draft from Chinese to English. All authors read and approval the final manuscript and version to be submitted.

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