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Analysis and Measurement of China's Population Health Informatization Development Strategy

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Abstract

This paper analyzes the development strategy of population health informatization in China, and summarizes the measurement direction and evaluation elements of population health informatization. ***Methods:*** *Literature and field investigation, expert consultation and PEST analysis were used to determine the development level measurement and evaluation framework.* ***Results:*** *Based on the PEST analysis framework, the development level measurement and evaluation factors were defined, and the evaluation framework was established, which included system construction, IT application, information financing, information personnel, information policy and management, and information application effect. The information from hospitals and grass-roots medical and health institutions was also provided. From the perspective of the level of development, the framework of informatization evaluation is further refined.*

Keywords:

Health Information Management, Population Health, China

Introduction

Population health informatization is a general designation of the process that the organizations in health and family planning system use modern network and computer technology to collect, organize, store, use and provide services for population health information, further which rationally organizes and controls the information activities and factors in the field of health and family planning in order to realize the rational allocation of information and related resources so as to meet the information service and management needs of the health and family planning industry[1]. At present, the construction of population health informatization in China has been greatly developed, and will play a more important role in the development of health and family planning in the future [2]. The planning, input, policy and output of population health informatization should be supported by appropriate evaluation theory and practice [3, 4]. The evaluation theory of population health informatization in China is not feasible, and there is only a few evaluation system applied to practicing and guiding informatization construction [5, 6]. Especially with the government as the main body of evaluation, there are few studies on the evaluation of the development level of regional population health informatization [7]. This study combines the actual and future situation of population health informatization development, comprehensively applies multiple scientific research methods, analyzes the development strategy of population health information in China, and summarizes the measurement direction and evaluation factors of population health informatization to provide reference for the measurement of population health information development level in China and different provinces.

Methods

Research object

This paper determined the weight of the indicator system by the analytic hierarchy process. This study focuses on the development level of population health informatization in the province and below, including the basis of population health information, information resources, technology application, talents, financing and policies, planning, standards, etc. The above are the core elements of the regional population health information construction and the key links involved in the implementation process, as well as the application effects.

Research methods

Literature research

Through systematicly reviewing Wanfang, Tsinghua Tongfang, PubMed, OVID and other domestic and foreign full-text databases, relevant institutions' websites and other network resources, we collect domestic and foreign informationization evaluation theories, indicators and methods, including regional informationization, enterprise informationization, and education informationization, health information, e-health, information systems, etc. we collect and sort out foreign population health assessment frameworks and indicator systems, providing reference for China's population health informationization evaluation framework.

Site investigation

This study conduct on-the-spot investigations on some provinces with more developed population health informatization like Beijing, Jiangsu, Zhejiang and Shanghai. Meanwhile, this paper researches on the development status of informatization, review relevant data, and conduct interviews with insiders. The interviewees mainly include the head of the health administrative department, the person in charge of the information center, and the medical staff at the grassroots level.

Expert advice

In this study, 16 experts were selected to determine the comprehensive evaluation index of population health informationization construction level through letter or expert consultation. Expert selection criteria: leaders of health and family planning administrations, experts and scholars in the field of population health information management, and researchers and business personnel in other related fields; leaders with intermediate or intermediate titles or above; work there in professional field for more than 5 years; be interested in this research and willing to cooperate with expert consultation. Main consultation content: guide and consult on

project design and implementation such as value judgment criteria, determination of evaluation framework and selection of evaluation indicators, weight calculation of indicators, and recommendations for research reports, etc.

PEST analysis

PEST analysis is often used to analyze the background of a company, which evaluates the strategic formulation of a company from the four aspects of politics, economics, society, and technology. This method is increasingly applied to various research fields. This study uses PEST analysis to analyze population health information from four environments: policy (P), economy (E), social culture (W) and technology (T). It will help to grasp the development trend of population health informationization, clarify current obstacles and problems, and propose future development strategies.

Delphi expert consultation

After two rounds of Delphi expert consultation, experts were asked to score the importance of primary indicators. In the third round, experts were invited to measure the weight and combination weight of each index according to the steps of analytic hierarchy process. And then comprehensive index method were used to construct and improve the evaluation framework and index system of population health informatization.

Results

Analysis of population health informationization development strategy

PEST analysis of development strategy

As an important support for the development of health cause, population health informationization is also the inevitable application result of information technology in the field of health care. Its own construction and development is affected by many factors, such as politics, economy, culture, society and technology. Analysis of its influencing factors will help to grasp the development trend of population health informationization, clarify current obstacles and problems, and propose future development strategies. This section analyzes population health informationization from the four environments of policy (P), economy (E), social culture (S) and technology (T) by PEST analysis.

(1) Policy environment: In the field of health care, health departments and other ministries and commissions issued policy documents one after another, or stressed the importance of health information construction, or directly encouraged the construction of health information. From the perspective of policies and regulations at the national level, the health sector has guided, encouraged and regulated population health informationization from the aspects of strategic planning, system construction, and system function norms. In addition to the policies promulgated by the health department, the State Council has also promoted the construction and application of information technology in the field of health care from the perspectives of "big data", "internet+" and "information benefiting the people" [8].

(2) Economic environment: In 2008, the total cost of health in China was 1,435.54 billion yuan, three times that of 2000. The total health expenditure in China in 2016 was 4,414.5 billion yuan, nearly three times that of 2008.Since the new century, the growth rate of total health expenditure has been higher than that of GDP growth, and the proportion of the former in the latter has also increased year by year. It is worth mentioning that the proportion of government health expenditure to total health expenditure has increased from less than 10% to more than 30% in 2016, and the proportion of personal health expenditure has declined year after year. These conditions have put forward new requirements for health care industry to expand supply, optimize service, improve quality and improve management level. However, the reality is that the supply of health care services in China is generally inadequate, and the distribution of quality medical resources is uneven, while the training and establishment of medical institutions is relatively slow. In this case, the use of information technology to extend services, improve efficiency, and improve quality is a very reasonable choice. Corresponding to the rapid growth of the medical industry, China's information industry has also grown rapidly.

(3) Social and cultural environment: In 2014, China's elderly population aged 60 and over reached 212 million, accounting for 15.5% of the total population. This size is comparable to the current population of the three major European countries (Germany, France, and the United Kingdom). Scholars predict that the peak population will appear in the 2030s and 2040s, and the aging rate will accelerate significantly in the next three or four decades. Especially until around 2040, the proportion of the elderly over 65 years old in China will exceed 20%, and this proportion will continue to increase by 2050, reaching 20%-24%. The changes of disease spectrum, health demand and dependency ratio brought about by population aging will bring challenges to the future health care service supply. The rigidity of demand for chronic disease management, remote monitoring, health file management, and combination of medical care and maintenance will become more and more strong, and will become an important development direction of population health informatization [9].

(4)Technical environment: Benefiting from the rapid development and application of information technology, population health information technology has also undergone different technical stages. Technologies such as the Internet of Things and cloud computing have stepped onto the stage, and today the society has entered the era of big data. Telemedicine, teleconsultation, cloud hospital, cloud medical are constantly developing to realize convenient and efficient technical exchanges and cooperation in different time and space. The connotation of medical services is very broad, and it needs to rely on high-quality equipment, a wealth of sample banks and doctors to meet the needs of patients from prevention, medical care, health care to rehabilitation, as well as the experience of patients. "Internet + medical" has become an important breakthrough in the development of hospitals. "Wearable mobile medical devices" have had an important impact on people's lives and work [10].

Analysis of development measures and evaluation factors

Through PEST analysis and strategic analysis of the future development of population health information in China, this study considers that the development level of population health informatization involves multiple dimensions such as information technology utilization and its own business development. Considering the multiple dimensions involved in the development level of population health information, the evaluation elements should include seven aspects: information resource construction, China Unicom and information technology application, information financing, informationized talents, information policy and management, and information application effects.

Improve the measurement index system of the population health information development level

Through PEST analysis and evaluation factors of China's population health information development strategy, the evaluation framework of population health information

development level is formulated, and the measurement index system of development level is further improved according to the optimization strategy. Based on the principle of "measurable and comparable", the measurement index system of population health informationization development level is revised and improved through the method of expert consultation. The evaluation index system optimization focus: continue to optimize the adjustment index weight setting; improve the score differentiation of some indicators; appropriately update the indicator content; simplify some indicators calculation formula. Finally, a three-level structure model including seven primary indicators, 16 secondary indicators and 38 tertiary indicators is established, which includes system construction, unicom and information technology application, information financing, information personnel, information policy and management, and information application effect. Defining the evaluation subject: the competent department of population health informationization; the evaluation target: the level of regional population health informationization development, including the software and hardware level, technology application and output from the perspective of information technology, and the coverage and protection of the population from the perspective of population health development level and information resource sharing.

Table 1–Measurement and evaluation system of population health informationization development level.

Primary indicator	Secondary indicators	Three-level indicator
1 Information resource construction	1.1 Construction and application of electronic medical record	1.1.1 Construction and coverage of electronic medical record database in the region
		1.1.2 Medical institution electronic case database usage rate
		1.1.3 Application of regional electronic medical record database in connection with other business systems
	1.2 Construction and use of resident electronic health records	1.2.1 Electronic health record data update rate
		1.2.2 Regional Electronic Health Archive Database Connection Range
		1.2.3 Business scope covered by the regional electronic health record database
		1.2.4 Application of regional electronic health record database in connection with other business systems
	1.3 Construction and use of the information database for the entire population	1.3.1 Whether the entire population information database is fully covered
		1.3.2 Frequency of update of data of the entire population information base
		1.3.3 Application of full population information database in connection with other business systems
2 Infrastructure and information system construction	2.1 Computer network facilities construction	2.1.1 Business scope covered by the health information private network
		2.1.2 Community Health Service Center / Township Health Center Network Bandwidth
	2.2 Information System Construction	2.2.1 Provincial business information system construction rate
		2.2.2 Use and availability of basic business information system functions
		2.2.3 Construction of health care big data application system
	2.3 Information Security	2.3.1 Machine room security level
		2.3.2 Information system information security and other security levels
3 Unicom and information technology applications	3.1 Unicom and data sharing	3.1.1 Repeated entry of information in primary medical institutions
		3.1.2 Communication between business information system and regional information platform
		3.1.3 Sharing health and medical data with related fields
	3.2 Internet + Medical Services	3.2.1 Proportion of open registration and inspection results of medical service institutions
		3.2.2 Proportion of medical institutions that carry out telemedicine through information systems
		3.2.3 Proportion of medical institutions that conduct two-way referrals through information systems
4 information financing	4.1 Investment scale	4.1.1 Ratio of construction funds and operation and maintenance funds to total health expenditure at the same time

	4.2 Informatization financing sustainability	4.2.1 Construction funds and operation and maintenance funds are included in the regular budget
		4.2.2 Social capital participation in information construction
5 informational talents	5.1 Informational Talents assign	5.1.1 Proportion of informationized personnel in the proportion of health technicians
	5.2 Informational Talent Structure	5.2.1 Proportion of persons with master's degree or above and intermediate titles
		5.2.2 The proportion of composite information personnel
6Information Policy and Management	6.1 policy and planning formulating	6.1.1 policy and planning implementation
	6.2 Construction and management of Information Construction Project	6.2.1 Pre-project evaluation
		6.2.2 Post-event supervision of the project
7 information application effect	7.1 National Health Information Platform Application Effect	7.1.1 Integration of information and data resources
		7.1.2 Key business synergy efficiency
		7.1.3 Data statistics and performance appraisal
	7.2 Health and medical big data application effects	7.2.1 Accurate evaluation of health data
		7.2.2 Application of supplementary medical insurance control fees
		7.2.3 Public health decision-making management capabilities

Multidimensional refinement of the evaluation framework of population health informatization development level

Although the evaluation framework of the development level of population health informationization gives a quantitative analysis to the regional population health informationization on the whole, it lacks effective research and analysis in the sub-segments of population health informationization, such as health and family planning administrative agencies, public hospitals, primary health care institutions, disease prevention and control centers [11]. For example, in the course of the investigation, the overall score of a certain area is relatively high, but the informationization of the primary health care institutions is difficult to meet the requirements of the medical reform policy of graded diagnosis and treatment. Therefore, on the basis of the overall evaluation, it is also necessary to refine the evaluation index framework from multiple angles to achieve more refined and standardized evaluation and analysis. From the perspective of the level of informatization development of hospitals and primary health care institutions, the evaluation framework of population health informationization development level is refined to make up for the shortcomings of the overall evaluation framework. First, the evaluation framework of hospital informatization was constructed with the main framework of capital input, organization and management of hospital informatization, construction of hospital informatization infrastructure, information security, construction and application of hospital information system and performance of information construction. It contains 6 first-level indicators, 20 second-level indicators and 63 third-level indicators. Secondly, this paper constructs an information-based evaluation framework for primary medical and health institutions with five dimensions: information resources and infrastructure, information system construction and application, information sharing and technology application, informationization benefits, and information security, including 5 first-level indicators, 15 second-level indicators, and 53 third-level indicators.

Discussion

Comprehensiveness of evaluation perspective and pertinence of content

The construction of population health informatization in China is still the government-led mode, which is affected by the information technology level differences, policy environment support, and the level of security, so it needs to be considered as a whole. In the past, research focused on the application of information systems in a single business field, which is relatively microscopic, especially in the absence of technical considerations [12]. In the selection of indicators, this study strives to get rid of the single perspective of technology and add more macro policy indicators. At the level of evaluation operation, regional population health information evaluation mainly includes three types: "measurement of development level ", "performance evaluation" and "assessment evaluation". The horizontal measurement focuses on understanding the overall situation, and compares in the space and time; the performance evaluation pays attention to the results, and measures the information efficiency, effect and benefit; the assessment helps the evaluation object to find the lack and improve. At present, there is no unified construction mode for population health informationization construction, and the government-led information construction has a relatively strong public product attribute, and it is difficult to see actual benefits in the short term. Therefore, this study defines this evaluation as the basic regional population health informationization level measurement, appropriately highlighting development strategy at the emergence stage, and specifically reflecting the development of the main attributes in the informatization process.

Method selection of index weight assignment

In terms of the weight assignment of the index system, there are Delphi method, analytic hierarchy process, fuzzy analysis method, data envelopment analysis method, gray evaluation method, etc. Each method differs in subjective and objective assignment, qualitative and quantitative expression, and data integrity. In the measure of the development level of population health information, the subjective opinions of experts are indispensable, and some qualitative data are also inevitable. It is more appropriate to use AHP. The analytic hierarchy process describes the problems of complex systems as well-organized sets of hierarchical structural factors, qualitatively judges the elements of each level, and uses mathematical methods to obtain quantitative weight results, which achieves a

combination of quantitative and qualitative, overcoming the arbitrariness of the subjective valuation method, and avoiding the dilemma of the objective assignment method requiring long-term complete statistical data and the arbitrary judgment of throwing away from the empirical judgment. However, there are certain limitations in the actual use process. The comparison index of the two pairs is generally no more than seven, because the more the comparison, the more likely the logic confusion, the worse the consistency of the score. In order to effectively overcome the above problems, the number of indicators in the same root in each level of this study is no more than four, so that the results of expert scoring have a good logic, which ensures the scientificity of the evaluation system.

Practicability and reliability of index evaluation model

The completion of the hierarchy of the indicator system and the determination of the weight of the indicators are only part of the evaluation work. It is necessary to construct a comprehensive evaluation model, which combines the actual data with the index weight, including the conversion of the actual data into the index value and the combination of the index value and the index system. This study has developed detailed scoring rules for each of the three indicators, including indicator interpretation and calculation formulas, mainly in three cases. Firstly, qualitative indicators are converted into numerical values, and hierarchical values are assigned according to the rank. Secondly, indicators which cannot be directly calculated from the survey data are assigned to the corresponding indicators in segments for convenience, and the continuous "rate" value is converted into grade scores, and then the average calculation of the region is carried out. Thirdly, there are many administrative levels involved in the indicators, and the construction quantity, difficulty and importance of each level are not consistent. Each electronic medical record database cannot be treated equally. It must be dealt with at different levels, and the construction rate of each level corresponds to its own weight coefficient. The construction rate of each level corresponds to the respective weight coefficient. As the current population health informationization has no recognized "gold standard", the associated calibration validity cannot be measured. The content validity is generally not quantitatively measured. This research has been evaluated by experts to construct an evaluation index system, and there are detailed indicators calculation methods, which can be considered as good content validity.

Value of the research

The subjects, methods and objects of population health informationization evaluation in the world are diversified, and the goal orientation is obvious. Compared with international researches, China had carried out health informationization evaluation later than developed countries, and the early evaluation work mainly centers on the construction of hospital information system. In recent years, it has also made some progress in community health informationization, regional health informationization and comprehensive evaluation of health informationization. The evaluation of population health informationization in China is mainly based on index screening and weight testing. The evaluation object is single. It is difficult to measure the effectiveness and development level of health informationization comprehensively and scientifically because of the lack of thinking on how to evaluate and serve the government as the main body of information management. This research has filled in the gaps in this field.

Limitations

Different regions have different levels of health informatization in China, especially grass-roots institutions, which has weak foundation of informatization. Therefore, it had a certain impact on data collection from these institutions. It is necessary to further understand the detailed situation through field investigation in order to improve the accuracy of evaluation.

Conclusions

The index system is scientific and reasonable, and can be used for comprehensive evaluation of the development level of population health informatization, which has a certain guiding significance for the development of population health informatization.

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