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Research article

Keywords: new health reform, prospect theory, policy evaluation

Posted Date: March 11th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-16835/v1>

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Evaluation of the Effect of New Health Reform Policy of China Based on Prospect Theory

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Abstract

Background: New health reform policy of China has gone through more than ten years from 2009 to 2019, it has come a critical period. It is important to evaluate the effect of health system reform policy, but there are a few existing studies and the researchers have not considered the impact of psychological factors on person decision-making. This study using the prospect theory can overcome this defect. Let the evaluation of the effect of new medical reform policy of China more scientific and reasonable.

Methods: Data on the effect of the new health reform from *China Health Statistics Yearbook* and *National Bureau of Statistics of China* were obtained. And the indicators were selected by Corrected Item Total Correlation and Cronbach's α reliability coefficient. The selected indicator data were calculated by the prospect theory model. Meanwhile the gray relation analysis method is introduced to enlarge the difference between the advantages and disadvantages to making the comprehensive evaluation result more obvious.

Results: The results of comprehensive evaluation of the effects of health reform policies in China fluctuated from 2000 to 2017. From 2000 to 2004, the fluctuation range of the comprehensive prospect value is large; from 2004 to 2009, the comprehensive prospect value shows a slow downward trend; from 2009 to 2012, the comprehensive prospect value has decreased slightly, and then it has rebounded substantially; from 2012 to 2014, the comprehensive prospect value is stable; and from 2014 to 2017, the comprehensive prospect value is declining.

Conclusions: This study showed that the implementation of new health reform policy of China has a significant impact on China's medical and health system. The new health reform advanced hard in exploration. It is worth affirming that the overall goal and direction of the new health reform are correct, but the practice is unsatisfactory. The releasing and implementation of supporting policy have the important influence on the progress of the new health reform. And the effect of the policy will decrease with the increase of the total amount. Therefore, scientific and effective late management can ensure that the policy continues to play its role.

Keywords: new health reform; prospect theory; policy evaluation

Background

With the publication of the document on *Deepening the Reform of the Medical and Health System* in March 2009, China has begun a new health reform[1]. A sound basic medical and health system has been established by the new health reform of covering urban and rural residents, to ensure the safety, effectiveness, quality and

low cost of medical treatment for Chinese[2,3]. New health reform policy of China has gone through more than ten years from 2009 to 2019. In the past ten years, health system of China has been continuously improved. The public hospital reform, hierarchical medical system and essential drugs system have been improved steadily [4]. But there are still some difficult problems remain unresolved, Chinese have been puzzled by "difficulty and high cost of getting medical service ". Nowadays, health reform policy of China has come a critical period. At this point, evaluating the effect of health system reform policy by using scientific methods is critical to its continued advancement.

Since the new health reform policy launched by China, there are a large number of researchers have analyzed and discussed the new health reform policy from different perspectives, and they have been seeking scientific and effective evaluation methods. The data related to health system reform policy from 2000 to 2017 will be analyzed in this study, the scientific and reasonable models and evaluation indicators will be selected. And then try to explore the variation of effects before and after the implementation of the new health reform policies, so as to analyze various new health reform policies and provide suggestions and references for further improvement of the new health reform policies in China.

After reform and opening up, China has accelerated the pace of economic development[5 - 7]. In order to develop the health services with Chinese characteristics, China has began a long-term health system reform[8]. Health system

of China has undergone a transformation from government-led to market-led mode before 2009[9,10]. Through the "marketization" to stimulate medical enterprises, which has led to the rapid development of the health system of China. However, the drawbacks of the market-oriented model have become increasingly prominent. The primary health institutions have been weak gradually[11], because of the government's investment in health was seriously inadequate and medical service institutions generally pursued economic interests ,and the public health system has been vulnerable[12]. "difficulty and high cost of getting medical service" has become a livelihood problem puzzled Chinese. In view of the various problems, the community began to doubt the "marketization" of the health system. Therefore, in order to break the original health system and build a new scientific health system, health reform must begin as soon as possible, which will solve the historical problem of "difficulty and high cost of getting medical service " thoroughly[13,14].

The problem of "getting medical service difficulty" is mainly caused by unreasonable allocation of medical resources. High quality medical resources are concentrated in the tertiary public hospitals of the city, and the shortage of primary medical resources has become a common phenomenon in China[15,16]. Therefore, how to make medical resources go to the primary health institutions, which has undoubtedly become a major challenge to the new health reform policy[17]. Based on this point, the reform of regional health system has been focusing on adjusting the allocation of medical resources, " Integrated Health System "is the major method

to promote the rational allocation of regional medical resources and the implementation of the policy of hierarchical medical system[18]. At the same time, China has been attaching importance to training high-level general practitioners and let them go down to the grass-roots unit [19]. China hopes that these measures can divert patients, make the allocation of medical resources more reasonable, and then solve the problem of " getting medical service difficulty ".

The causes of the problem of " high cost of getting medical service" are complex, which mainly include: (1) unreasonable operation mechanism of medical institutions[20]; (2) unbalanced development of health services; (3) irregular order of medicine production and circulation. In view of the above problems, China government has been committing to letting medical institutions more public welfare, so as to make health services more equitable and accessible to public. In order to break down the phenomenon of "to increase the revenue of hospital by excessive sales of drugs", China has been implementing the policy of canceling medicine markups in public hospitals, reconstructing the scientific compensation mechanism, medical service price system and doctor's personnel salary system. Reforming the payment mode of medical insurance in order to avoid excessive medical treatment and increase medical insurance financial subsidies[21].And China government has implemented "Major Disease Protection Policy"to reduce the burden of medical treatment for patients, to prevent patients becoming or returning poverty due to illness. In the aspect of drug price reduction, China government has also introduced

relevant supporting policies such as "Two Invoice System", "Centralized Procurement with Target Quantity " and "Price Negotiation" to support it[22].

Evaluating policies can analyze whether these are scientific and the implementation is effective, which is important for functioning smoothly[23,24]. In recent years, there are some researchers in various industries have conducted in-depth research on policy evaluation[25-29]. The main research methods are the use of theoretical tools and construction models. Hongsoo Kim and Boyoung Jeon established a policy evaluation framework based on the six-step method to evaluate the care system effect in Korean[30]. Pengfei G and Yingnan Z have put forward three key factors of the policy evaluation system, analyzed their relationship, and built an evaluation system accordingly, so as to evaluate the green transformation policy of the city[31]. Xiaoshan C et al. have used the Keynes DSGE model to assess euro monetary policy and pointed out effective ways to increase policy returns[32]. Haiqun M and Chang F have evaluated the information policy of China, introduced the S-CAD method to systematically test the policy documents, and excavated the problems in the process of policy formulation and implementation[33].

To sum up, there are various methods for policy evaluation, but few researchers evaluate the evaluation of the effect of health reform policy[34,35]. And the existing studies have evaluated the policy mainly by giving weights subjectively, the impact of psychological factors on person decision-making has not been fully considered. However, the prospect theory can avoid this shortcoming. At the same time, the gray

relation analysis method is introduced to enlarge the difference between the advantages and disadvantages, making the comprehensive evaluation result more obvious. Therefore, based on the prospect theory, this paper will take the effect evaluation of the new health reform policy as the research object, and establish a set of scientific and feasible indicators system of the effect of the new health reform policy, in order to provide reference for the implementation and improvement of the new health reform policy.

Methods

Theory brief

Prospect theory, also known as the expectation theory, is proposed by Nobel Laureate Kahneman and cognitive psychologist Amos Tversky[36]. It is used to predict the individual's decision-making in the face of risk, which is different from the traditional theory of expectancy[37]. Prospect theory divides the risk decision-making process into two stages: editing and evaluation. In the editing stage, decision makers collect and process information according to frame and reference point; in the evaluation stage, decision makers make decisions based on value function and weighting function[38,39]. Therefore, the prospect value function $v(x)$ and the probability weight function $\omega(p)$ will influence the prospect value together, the prospect value can be expressed by the following formula: $U = \sum \omega(p) v(x)$.

Grey System Theory originated from the Control Theory, which was put forward by Julong D, a famous Chinese Control Scientist in 1981[40]. Grey Relation Analysis

(GRA), as a multi-factor system analysis method, is based on the grey system theory. The core of GRA is to explore the geometric correspondence among the factors by relying on the data series of each factor[41]. It is important to quantitatively determine the primary and secondary factors affecting dependent variables according to the size of grey relation coefficient. Compared with other analysis methods, the grey relational analysis method has a lower requirement on the sample size of each factor in the system, which can reduce the loss caused by information asymmetry to a large extent, and is suitable for solving the problem of determining the relation degree of less sample size[42].The grey relation analysis method can be expressed by the following formula:

$$\xi_i(k) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}$$

Indicators and data screening

Scientific and representative are particularly important for the evaluation indicators of the new health reform. Based on the research and analysis of literatures and the actual situation of new health reform policy of China, the evaluation of the effect of the new health reform policy should involve the national economic situation, government health expenditure, health expenditure and health service efficiency, so as to establish a comprehensive multi-indication evaluation system[43-45]

In this paper, the data of various indicators related to the effect of the new health reform policy from 2000 to 2017 are obtained from *China Health Statistics Yearbook* and *National Bureau of Statistics of China* (Table 1)[46,47]. In order to

purify the indicators system, SPSS19.0 is used for data analysis, and the Corrected Item-Total Correlation (CITC) is used as the standard of purifying indicators, and Cronbach's alpha reliability coefficient is used to test the consistency of the Indicators system. The results showed that the CITC of “*average hospitalization days*”, “*natural growth rate of population*”, “*number of health institutions*” and “*number of medical and health institutions*” was less than 0.5, so it was excluded. Generally, the internal consistency of the Indicators of $\alpha > 0.7$ is good, and two Indicators—“*the number of health personnel*” and “*the number of medical postgraduates*”, are excluded in turn. Finally, we get the evaluation Indicators system of the effect of the new health care reform policy after purification (Table 2).

Table 1 Data related to indicators to evaluate the effects of new health reform policy of China

Year	Number of medical and health institutions	Number of health personnel	Number of medical postgraduates	Total health expenses (billion CNY)	Personal health expenditure/total health expenses (%)	Government expenditure on medical and health services (billion CNY)	Government spending on health care (billion CNY)	Person times of visits to hospitals (billion times)	Hospital bed utilization rate (%)	Hospital average hospital day	Natural population growth rate (%)	Per capita GDP (CNY)	Health price index	Per capita disposable income of urban residents (CNY)
2000	1034229	6910383	128484	4586.63	58.98	407.21	211.00	12.86	60.6	12.2	7.58	7902	100.3	6255.7
2001	1029314	6874527	165197	5025.93	59.97	450.11	235.75	12.5	61.1	11.8	6.95	8670	100.3	6824.0
2002	1005004	6528674	203000	5790.03	57.72	497.41	251.66	12.43	64.6	10.9	6.45	9450	98.5	7652.4
2003	806243	6216971	268925	6584.10	55.87	603.02	320.54	12.13	65.3	11.0	6.01	10600	101.2	8405.5
2004	849140	6332739	326286	7590.39	53.64	679.72	371.60	13.05	68.4	10.8	5.87	12400	99.1	9334.8
2005	882206	6447246	364831	8659.91	52.21	805.52	453.31	13.87	70.3	10.9	5.89	14259	99.5	10382.3
2006	918097	6681184	397925	9843.34	49.31	834.82	602.53	14.71	72.4	10.9	5.28	16602	100.2	11619.7
2007	912263	6964389	418612	11573.97	44.05	1153.30	957.02	16.38	78.2	10.8	5.17	20337	102.1	13602.5
2008	891480	7251803	446422	14535.40	40.42	1397.23	1577.10	17.82	81.5	10.7	5.08	23912	102.9	15549.4
2009	916571	7781448	510953	17541.92	37.46	2081.09	2001.51	19.22	84.7	10.5	4.87	25963	101.4	16900.5
2010	936927	8207502	538177	19980.39	35.29	2565.60	2331.12	20.4	86.7	10.5	4.79	30567	103.3	18779.1
2011	954389	8616040	560168	24345.91	34.80	3125.16	3360.78	22.59	88.5	10.3	4.79	36018	102.9	21426.9
2012	950297	9115705	589673	28119.00	34.34	3506.70	3789.14	25.42	90.1	10.0	4.95	39544	101.7	24126.7
2013	974398	9790483	611381	31668.95	33.90	3838.93	4428.82	27.42	89.0	9.8	4.92	43320	101.5	26467.0
2014	981432	10234213	621323	35312.40	31.99	4288.70	4958.53	29.72	88.0	9.6	5.21	46629	101.7	28843.9
2015	983528	10693881	645055	40974.64	29.27	5191.25	5822.99	30.84	85.4	9.6	4.96	49351	102.7	31194.8
2016	983394	11172945	667064	46344.88	28.78	5867.38	6497.20	32.7	85.3	9.4	5.86	53935	103.8	33616.2
2017	986649	11748972	806103	52598.28	28.77	6550.45	7007.51	34.39	85.0	9.3	5.32	59660	106.0	36396.2

Table 2 New health reform policy of China effect evaluation indicator system

Target layer	Standard layer	Indicator layer	
		Indicator variable	Indicator type
New health reform policy of China effect evaluation	National economic situation	Per capita GDP (CNY)	Benefit type
		Health price index	Cost type
	Government expenditure on health	Per capita disposable income of urban residents (CNY)	Benefit type
		Government expenditure on medical and health services (billion CNY)	Cost type
		Government spending on health care (billion CNY)	Cost type
	Medical and health expenses	Total health expenses (billion CNY)	Cost type
		Person times of visits to hospitals (billion times)	Benefit type
	Health service efficiency	Hospital bed utilization rate (%)	Benefit type

Use of indicators

Based on the prospect theory, this paper uses grey relational analysis method to enlarge the difference between the advantages and disadvantages of the indicators, and then calculates the weight of the indicators by using the entropy weight method.

The specific steps are given below.

Dimensionalization of indicators:

According to the principle of reward and punishment, the range of indicators value is limited to [-1,1]. If the indicator value is greater than the average value, it is positive; if the indicator value is less than the average value, it is negative. The formula can be expressed as follows:

$$x_{ij} = \begin{cases} \frac{a_{ij} - \frac{\sum_{i=1}^n a_{ij}}{n}}{\max\left\{\max_j(a_{ij}) - \frac{\sum_{i=1}^n a_{ij}}{n}, \frac{\sum_{i=1}^n a_{ij}}{n} - \min_j(a_{ij})\right\}}, & \text{If } a_{ij} \text{ is a benefit indicator,} \\ \frac{\frac{\sum_{i=1}^n a_{ij}}{n} - a_{ij}}{\max\left\{\max_j(a_{ij}) - \frac{\sum_{i=1}^n a_{ij}}{n}, \frac{\sum_{i=1}^n a_{ij}}{n} - \min_j(a_{ij})\right\}}, & \text{If } a_{ij} \text{ is a cost indicator.} \end{cases} \quad (1)$$

The decision matrix can be simplified as follow:

$$X = (x_{ij})_{n \times m} = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2m} \\ \cdots & \cdots & \cdots & \cdots \\ x_{n1} & x_{n2} & \cdots & x_{nm} \end{bmatrix} \quad (2)$$

Determine the ideal scheme and the grey relation coefficient:

Let $x_j^+ = \max\{x_{ij}, 1 \leq i \leq n\}$, $x_j^- = \min\{x_{ij}, 1 \leq i \leq n\}$, the ideal solution is:

$S^+ = \{x_1^+, x_2^+, \dots, x_m^+\}$, $S^- = \{x_1^-, x_2^-, \dots, x_m^-\}$. Then obtain the gray relation

coefficient as follow:

$$\xi_{ij}^+ = \frac{\min_i \min_j |x_{ij} - x_j^+| + \rho \max_i \max_j |x_{ij} - x_j^+|}{|x_{ij} - x_j^+| + \rho \max_i \max_j |x_{ij} - x_j^+|} \quad (3)$$

$$\xi_{ij}^- = \frac{\min_i \min_j |x_{ij} - x_j^-| + \rho \max_i \max_j |x_{ij} - x_j^-|}{|x_{ij} - x_j^-| + \rho \max_i \max_j |x_{ij} - x_j^-|} \quad (4)$$

Where, $\rho = 0.5$.

Entropy weight method to determine indicators weight:

$$p_j = \frac{1 + \sum_{i=1}^n [(x'_{ij} / \sum_{i=1}^n x'_{ij}) \times \ln(x'_{ij} / \sum_{i=1}^n x'_{ij})] / \ln n}{\sum_{j=1}^n \{1 + \sum_{i=1}^n [(x'_{ij} / \sum_{i=1}^n x'_{ij}) \times \ln(x'_{ij} / \sum_{i=1}^n x'_{ij})] / \ln n\}} \quad (5)$$

Where, $x'_{ij} = \frac{x_{ij} - \min_i x_j}{\max_i x_j - \min_i x_j}$;

If $x'_{ij} / \sum_{i=1}^n x'_{ij} = 0$,

Then define $\lim_{x'_{ij} / \sum_{i=1}^n x'_{ij} \rightarrow 0} (x'_{ij} / \sum_{i=1}^n x'_{ij}) \times \ln(x'_{ij} / \sum_{i=1}^n x'_{ij}) = 0$.

Calculate the comprehensive prospect value:

If the scheme i is inferior to the positive ideal solution, the scheme is loss-type; if

the scheme i is better than the positive ideal solution, the scheme is a benefit-type.

Therefore, the value function $v(x_{ij})$ as follow:

$$\begin{cases} v^+(x_{ij}) = (1 - \xi_{ij}^-)^\alpha \\ v^-(x_{ij}) = -\lambda(1 - \xi_{ij}^+)^\alpha \end{cases} \quad (6)$$

The decision weight function $\omega(p_j)$ as follow:

$$\begin{cases} \omega^+(p_j) = \frac{p_j^{\gamma^+}}{[p_j^{\gamma^+} + (1-p_j)^{\gamma^+}]^{\frac{1}{\gamma^+}}} \\ \omega^-(p_j) = \frac{p_j^{\gamma^-}}{[p_j^{\gamma^-} + (1-p_j)^{\gamma^-}]^{\frac{1}{\gamma^-}}} \end{cases} \quad (7)$$

Then the comprehensive prospect value of the scheme S_i as follow:

$$U_i = \sum_{j=1}^m \omega^+(p_j) v^+(x_{ij}) + \sum_{j=1}^m \omega^-(p_j) v^-(x_{ij}) \quad (8)$$

Where $\gamma^+ = 0.61$, $\gamma^- = 0.69$, $\alpha = 0.88$, $\lambda = 2.25$.

Results

The results of comprehensive evaluation of the effects of health reform policies in

China fluctuated from 2000 to 2017 (Figure 1). According to the trend of the curve, it can be divided into five stages: from 2000 to 2004, the fluctuation range of the comprehensive prospect value of the effect of health reform policy is large; from 2004 to 2009, the comprehensive prospect value of the effect of health reform policy shows a slow downward trend; from 2009 to 2012, the comprehensive prospect value of the effect of health reform policy decreases slightly, and then it rebounds substantially; from 2012 to 2014, the comprehensive prospect value of the effect of health reform policy is stable; and from 2014 to 2017, the comprehensive prospect value of the effect of health reform policy is declining.

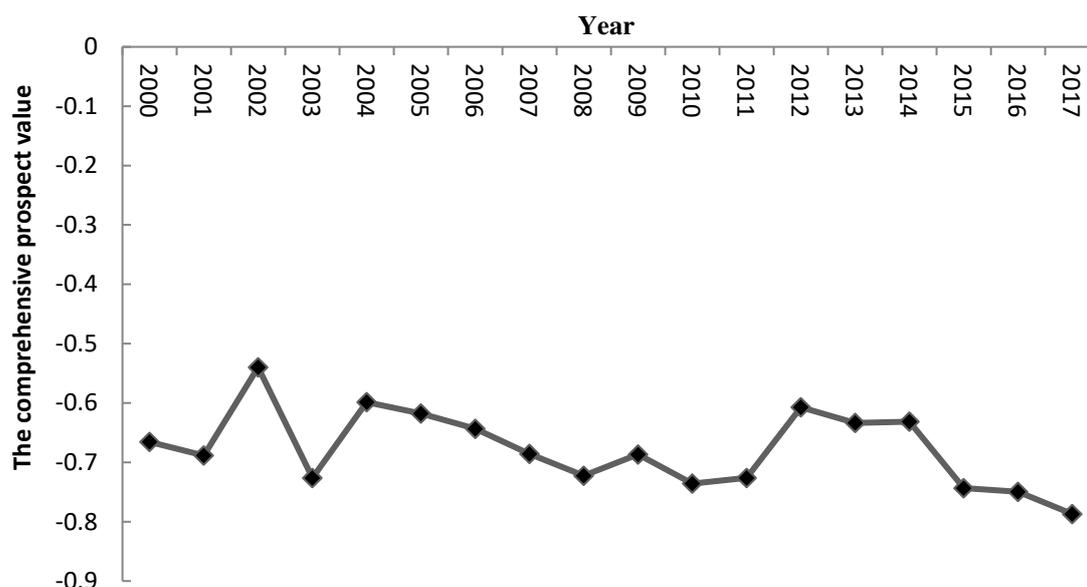


Figure 1 Evaluation results the effect of health reform policy of China from 2000 to 2017

Discussion

Comparing the comprehensive evaluation results of the effect of health reform policy with the development process of health reform policy of China, we can see that the implementation of new health reform policy in 2009 has a significant impact

on health system of China.

From 2000 to 2004, China began to promote the process of "marketization" of the medical system in an all-round way[48]. Although the government have increased health investment year by year, it still could not afford the rapid growth of total health expenditure. The government's financial input was seriously insufficient and the market was not regulated reasonably in time, which led to the failure of the health service market. Therefore, the comprehensive prospect value of the health reform policy effect fluctuates greatly from 2000 to 2004. The attack of SARS virus in 2003 led to a sharp decline in the comprehensive prospect value of the health reform policy effect, which also exposed the loopholes of the public health emergency mechanism and the weakness of the prevention system of China[49]. From 2004 to 2009, due to the inherent drawbacks of the "marketization" mechanism, the phenomenon of chasing interest has spreaded in the health industry in China, and various problems began to appear, such as imbalance of medical resources allocation, rapid growth of drug fees, imperfect medical insurance system and chaotic circulation links[50]. In view of the above problems, the government has tried to alleviate them by increasing the proportion of health finance, but it only cured the symptoms, not cured the root causes for health system of China. It can only be relieved temporarily, and it is impossible to fundamentally alleviate the burden of medical expenditures for the citizens. Therefore, the comprehensive prospect value of the health reform policy effect from 2004 to 2009 shows a slow

downward trend.

At the beginning of the implementation of the new health reform policy, China government puts the implementation of the essential drug system, the improvement of grass-roots medical services, the training of suitable talents and the promotion of basic medical security system in the first place[51]. From the trend of the comprehensive prospect value from 2009 to 2012, it can be seen that the pre-investment led to a small decline in the comprehensive prospect value of the effect of the new health reform policy, but the subsequent sharp recovery shows that the pre-reform policy effects are significant. During the period of 2012 to 2014, the investment of several supporting policies, including the reform of public hospitals, the training of general practitioners, and the mechanism of protect and rescue for major diseases, coupled with the superposition of the diminishing marginal effect of the early policies, which led to a short plateau of the comprehensive prospect value of the effect of the new health reform policy of China. From the comprehensive prospect value of the effect of the new health reform policy in China from 2014 to 2017, the effect of the policy implementation is not obvious during this period, and the comprehensive prospect value shows a downward trend. By analyzing the implementation of various policies, we can see that the relatively easy content of the new health reform has been basically completed so far, and has entered a critical stage. During this period, the formulation and pilot stage of the new policy, including "hierarchical medical system", "canceling medicine markups " and "Two

Invoice System", has not yet fully played its effectiveness, and its development is very slow. For example, the system of "hierarchical medical system" was proposed in 2013, and related documents were issued in 2015 to establish its general program. It was not until the end of 2018 that the trial of "hierarchical medical system" was launched[52]. Another example, public hospitals have been the focus of the new health reform since 2012, and the "canceling medicine markups" is the main key point, but until 2017, it was fully implemented in public hospitals[53]. Due to the time lag of nearly five years between policy formulation and implementation, the comprehensive prospect value of health reform policy effect of China shows a downward trend from 2014 to 2017.

Conclusion

From the calculation results of the effect of the new health reform policy of China, the new health reform is difficult to promote in the exploration. It is worth affirming that the overall goal and direction of the new health reform are correct, but the practice is unsatisfactory. Timeliness and sustainability are crucial to the effective implementation of policies. As an important measure to rebuild the health service system of China, the releasing and implementation of the new health reform policies are related to the smooth progress of the new health reform. In addition, the effect of any policy will decrease with the increase of the total amount. Therefore, we should focus on the following three aspects to ensure that the new health reform policy is scientific and effective, and can continue to exert its effectiveness. First, policy

makers should combine theory with practice to formulate new health reform supporting policies adapted to national conditions of China. Second, the administrative departments should cooperate closely, clarify the division of tasks and strengthen supervision to provide guarantees for the implementation of policies. Third, a reasonable incentive mechanism should be gradually established during the implementation process to ensure that the new health reform policy can continue to exert its effects and enable the citizens to obtain long-term benefits.

The new health reform has gone through more than 10 years under the situation of interest game and fierce confrontation among all parties. Although it is faced with numerous obstacles in this process, it has always been moving forward in the midst of contradictions. It can be predicted from the progress status that the new health reform policy is expected to look up successfully in the next few years. When health reform is only in progress, but not completed, China should make full use of its institution advantages, combine with innovative ideas, and explore a new health reform road which is scientific, beneficial and sustainable.

References

1 Communist Party China Cent. Comm., State Counc. 2009. Guidelines for deepening the reform of health care system. Xinhua April 6.

http://www.gov.cn/jrzq/2009-04/06/content_1278721.htm

2 Fan, X., Zhou, Z., Dang, S. et al. Exploring status and determinants of prenatal and postnatal visits in western China: in the background of the new health system

- reform. *BMC Public Health*. 2018; 10.1186/s12889-017-4601-4.
- 3 Yip W, Fu H, Chen A T, et al. 10 years of health-care reform in China: progress and gaps in Universal Health Coverage. *The Lancet*. 2019; 394(10204): 1192-1204.
 - 4 Wang S, Xu W. Exploration of the Effect of Implementing the Essential Medicine System on Rational Drugs Use of Primary Medical Institutions in Shaanxi Province. *Western Journal of Traditional Chinese Medicine*. 2017; (3): 29.
 - 5 Li F, Zhang S, Yang J, et al. Effects of land use change on ecosystem services value in West Jilin since the reform and opening of China. *Ecosystem Services*. 2018; 31: 12-20.
 - 6 Wang H, Ye K, Zhong K. Accounting research in China: commemorating the 40th anniversary of reform and opening up. *Frontiers of Business Research in China*. 2018; 10.1186/s11782-018-0046-6.
 - 7 Ding J, Hu X, Zhang X. et al. Equity and efficiency of medical service systems at the provincial level of China's mainland: a comparative study from 2009 to 2014. *BMC Public Health*. 2018; 10.1186/s12889-018-5084-7.
 - 8 Cheng J M, Yuan Y X, Lu W, et al. Primary health care in China: is China's health reform reform for the whole nation?. *Primary health care research & development*. 2017; 18(4): 398-403.
 - 9 Li X, Krumholz H M .What does it take to improve nationwide healthcare quality in China?. *BMJ quality & safety*. 2019; 28(12): 955-958.
 - 10 Li X, Lu J, Hu S, et al. The primary health-care system in China. *The Lancet*. 2017; 390(10112):2584-2594.
 - 11 Liu Y, Zhong L, Yuan S, et al. Why patients prefer high-level healthcare facilities: a qualitative study using focus groups in rural and urban China. *British Medical*

Journal Global Health. 2018; 10.1136/bmjgh-2018-000854.

12 Yuan S, Wang F, Zhao Y, et al. Assessing perceived quality of primary care under hospital - township health centre integration: A cross - sectional study in China. *The International journal of health planning and management*. 2019; 10.1002/hpm.2965.

13 Tan S Y, Wu X, Yang W. Impacts of the type of social health insurance on health service utilisation and expenditures: implications for a unified system in China. *Health Economics, Policy and Law*. 2019; 14(4): 468-486.

14 Wang, X, Jiang R, Li J. et al. What do patients care most about in China's public hospitals? Interviews with patients in Jiangsu Province. *BMC Health Services Research*. 2018; 10.1186/s12913-018-2903-6.

15 Liu C, Legge D. Challenges in China's health system reform: Lessons from other countries. *Australian Journal of Primary Health*. 2017; 10.1071/PYv23n4_ED.

16 Yue X, Lewis H, Gerald B. Evaluation and learning in complex, rapidly changing health systems: China's management of health sector reform. *Globalization and Health*. 2018; 10.1186/s12992-018-0429-7.

17 Yi J, Yuan Y, Zhao S. Differential responses to market competition by private and public hospitals in China: a longitudinal analysis. *The Lancet*, 2019; 10.1016/S0140-6736(19)32373-6.

18 Sun J, Yin M. The Dilemma and Countermeasure of the Hierarchical Diagnosis and Treatment in China. *Chinese Medical Ethics*. 2018; 31(2): 236-240.

19 Sun J, Luo H. Evaluation on equality and efficiency of health resources allocation and health services utilization in China. *Int J Equity Health*. 2017; 10.1186/s12939-017-0614-y.

20 Meng Z, Zhu M, Cai Y, et al. Effect of a typical systemic hospital reform on

inpatient expenditure for rural population: the Sanming model in China. *BMC health services research*. 2019; 10.1186/s12913-019-4048-7.

21 Yu J, Qiu Y, He Z. Is universal and uniform health insurance better for China? Evidence from the perspective of supply-induced demand. *Health Economics, Policy and Law*. 2020; 15(1): 56-71.

22 You X, Lyu X, Yang Y. Study on the Implementation Status of Drug Procurement with Target Quantity of Public Hospitals in China. *China Pharmacy*. 2017; 28(31): 4345-4349.

23 Mollick E, Nanda R.. Wisdom or madness? Comparing crowds with expert evaluation in funding the arts. *Management Science*. 2016; 62(6): 1533-1553.

24 Evers E R K , Inbar Y , Blanken I , et al. When Do People Prefer Carrots to Sticks? A Robust “Matching Effect” in Policy Evaluation. *Management Science*. 2016; 10.1287/mnsc.2016.2539 .

25 Yang G, Bianxia S, Chao W. Introduction Impact of Index Futures Based on Panel Data Evaluation Approach. *Operations Research and Management Science*. 2018; 27(08):162-171.

26 Xu X. Impacts of the Clean Energy Subsidy Reform on Industry Development and Environment Pollution: An Analysis Based on a Dynamic CGE Model. *Journal of Shanghai University of Finance and Economics*. 2018; 20(05):44-57+86.

27 Liu W, Shi L, Pong R W , et al. Determinants of knowledge translation from health technology assessment to policy-making in China: From the perspective of researchers. *PLoS ONE*. 2018; 10.1371/journal.pone.0190732.

28 Collste D, Pedercini M., Cornell S.E. Policy coherence to achieve the SDGs: using integrated simulation models to assess effective policies. *Sustainability*

science. 2017; 10.1007/s11625-017-0457-x.

29 Cabrales S, Bautista R., Benavides J. A model to assess the impact of employment policy and subsidized domestic fuel prices on national oil companies. *Energy Economics*. 2017; 68 (2017): 566-578.

30 Kim H, Jeon B. Developing a framework for performance assessment of the public long-term care system in Korea: methodological and policy lessons. *Health Research Policy and Systems*. 2020; 10.1186/s12961-020-0529-8.

31 Guo P, Zhou Y. A Grounded-theory-based Study on the Evaluation Index Extraction and Construction of China's City Green Transition Policy. *Management Review*. 2018; 30(08):257-267.

32 Chen X , Kirsanova T , Leith C . An empirical assessment of Optimal Monetary Policy in the Euro area. *European Economic Review*. 2017; 10.1016/j.eurocorev.2017.07.012.

33 Ma H, Feng C. Research on National Information Policy Assessment Based on the S-CAD Method. *Journal of the China Society for Scientific and Technical Information*. 2018; 37(10):1060-1076.

34 Sang S, Wang Z, Yu C. Evaluation of health care system reform in Hubei Province, China. *International Journal of Environmental Research and Public Health*. 2014; 11(2): 2262-2277.

35 Lins M P E, Netto S O A, de Castro Lobo M S. Multimethodology applied to the evaluation of Healthcare in Brazilian municipalities. *Health Care Management Science*. 2019; 22(2): 197–214.

36 Tversky K A. Prospect Theory: An Analysis of Decision under Risk. *Econometrica*. 1979; 47(2):263-292.

- 37 Dai W, Zhong Q, Qi C. Multi-stage multi-attribute decision-making method based on the prospect theory and triangular fuzzy MULTIMOORA. *Soft Computing*. 2018; 10.1007/s00500-018-3017-0.
- 38 Liu H, Song Y, Yang G. Cross-efficiency evaluation in data envelopment analysis based on prospect theory. *European Journal of Operational Research*. 2019; 273(1): 364-375.
- 39 Wang S, Qu S, Ma G. Decision Method of Supplier Selection for Online Multi-attribute Procurement Auction Based on Prospect Theory and Fuzzy Theory. *Control and Decision*. 2019; 10.13195/j.kzyjc. 2018.1768.
- 40 Zhou Y, Jia F, Lv H. Comparative Study on the Influencing Factors of GII Index in China Based on the Grey Relation Analysis of Progressive Period. *Science and Technology Management Research*. 2019; 39(02):1-7.
- 41 Tan X, Deng J. Gray Correlation Analysis: A New Method for Multi-factor Statistical Analysis. *Statistical Reserrch*. 1995;(03):46-48.
- 42 Sun G, Guan X, Yi X, et al. Grey relational analysis between hesitant fuzzy sets with applications to pattern recognition. *Expert Systems with Applications*. 2018; 92:521-532.
- 43 Liu G G, Vortherms S A, Hong X. China's health reform update. *Annual Review of Public Health*. 2017; 38(1):431-448.
- 44 Xiao Y, Husain L, Bloom G. Evaluation and learning in complex, rapidly changing health systems: China's management of health sector reform. *Global Health*. 2018; 10.1186/s12992-018-0429-714.
- 45 Shi L, Mao Y, Tang M, et al. Health technology assessment in China: challenges and opportunities. *Global Health Journal*. 2017;1(1):11-20.

- 46 Ministry of Health. China's health statistical yearbook 2018. Beijing: Peking Union Medical College Press; 2018.
- 47 National Bureau of Statistics. GDP Per Capita.
<http://data.stats.gov.cn/easyquery.htm?cn=C01>
- 48 Yu M, He S, Wu D, Zhu H, Webster C. Examining the Multi-Scalar Unevenness of High-Quality Healthcare Resources Distribution in China. *International Journal of Environmental Research and Public Health*. 2019; 10.3390/ijerph16162813.
- 49 Burke, K L. SARS Virus Reservoir Is Bats. *American Scientist*. 2018; 106(2):75-75.
- 50 Deng F, Lv J, Wang H, et al. A Stage Analysis of the Main Inputs and Outputs of China's Health Reform. *Science*. 2016; 4(2):100-106.
- 51 Li X, Lu J, Hu S, et al. The primary health-care system in China. *The Lancet*. 2017; 390(10112),:2584-2594.
- 52 Ren P, Xu Z, Liao H, Zeng X J. A thermodynamic method of intuitionistic fuzzy MCDM to assist the hierarchical medical system in China. *Information Sciences*. 2017; 10.1016/j.ins.2017.08.070.
- 53 Deng J, Tian H, Guo Y, et al. A retrospective and prospective assessment of the zero-markup drug reform in China from the perspective of policy diffusion. *The International Journal of Health Planning and Management*. 2018; 33(4): e918-e929.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests

Funding

This study was supported in part by the Chinese Ministry of Education under Project (18YJCZH060).

Authors' contributions

YYG designed the study, prepared and analysed the data, performed the statistical analysis, interpreted the results and drafted the manuscript. ZH review and revised the manuscript critically. Both authors read and approved the final manuscript.

Acknowledgements

Not applicable.

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Abbreviations

CNY:Chinese Yuan Renminbi

CITC:Corrected Item-Total Correlation

GRA:Grey Relation Analysis

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Figures, tables and additional files

Table 1 Data related to indicators to evaluate the effects of new health reform policy of China

Table 2 New health reform policy of China effect evaluation indicator system

Figure 1 Evaluation results the effect of health reform policy of China from 2000 to 2017

Figures

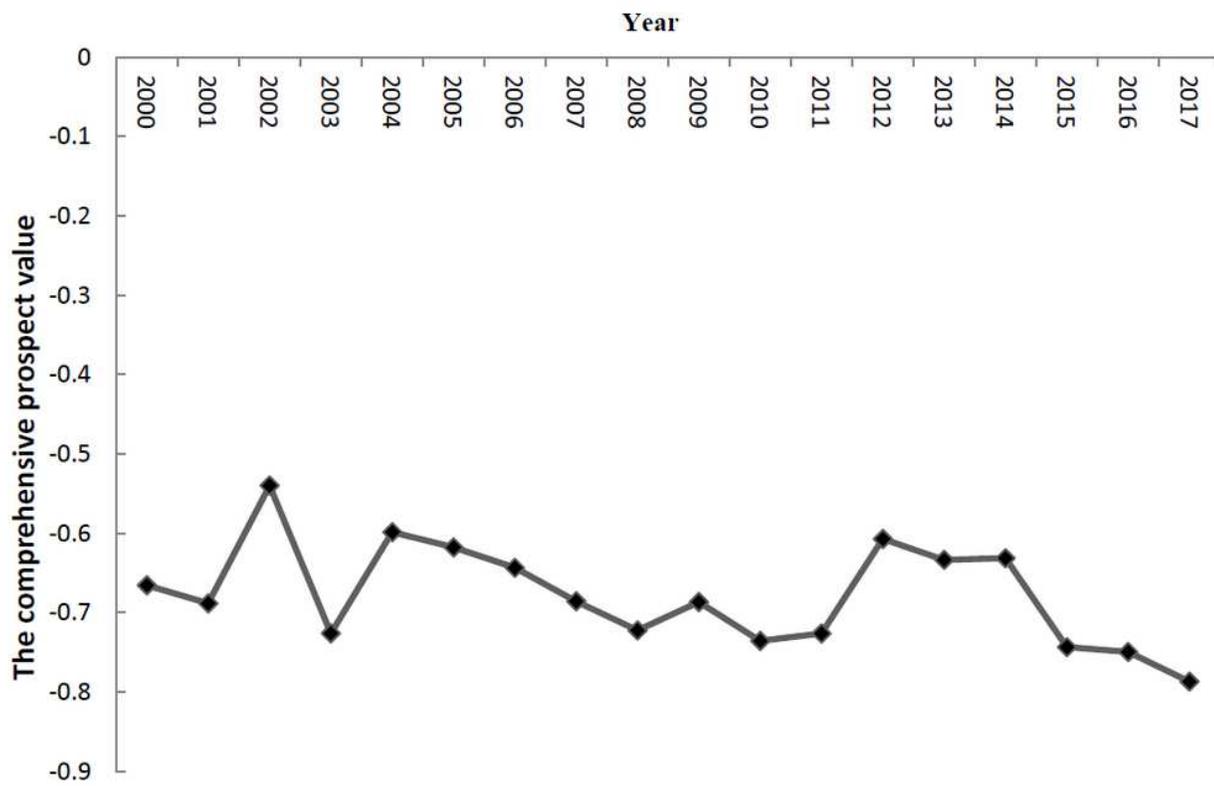


Figure 1

Evaluation results the effect of health reform policy of China from 2000 to 2017