Global Consortium for Study on Prevention, Control and Management of Major Infectious Diseases

Report: Analysis of the development trend of the coordination level for medical-prevention integration of China from 2004 to 2020

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Report Writing Team

Editor-in-Chief:

Jue Liu, Research Fellow, School of Public Health, Peking University

Editorial Board:

Wenxin Yan, Research Assistant, School of Public Health, Peking University

Chenyuan Qin, Research Assistant, School of Public Health, Peking University

Qiao Liu, Research Assistant, School of Public Health, Peking University

Min Du, Research Assistant, School of Public Health, Peking University

Yaping Wang, Research Assistant, School of Public Health, Peking University

Jie Deng, Research Assistant, School of Public Health, Peking University

Advisor:

Liang Wannian, Professor and Director, Institute of Health China, Tsinghua University

Liu Min, Professor and Deputy Director, School of Public Health, Peking University

Guo Xin, Director of the Department of Institutional Reform, National Health Commission

Liu Xia, Deputy Secretary General, Chinese Society of Preventive Medicine

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Executive Summary

Objective： To identify the development of coordination level of medical-prevention integration in 31 provinces (autonomous regions and municipalities directly under the central government) in China from 2004 to 2020, and provide informative suggestions to promote the integration of medicine and prevention in the construction of a healthy China in the new era.

Methods: We collected the 2004-2020 *China Health Statistical Yearbook* and the *China Statistical Yearbook*, and compiled relevant indicators to measure the comprehensive development level of the health care system and the public health system. We constructed a coupling coordination model and an interrupted time series model to test the instantaneous and continuous impact of the "New Medical System Reform Policy" policy on the development level and the degree of coupling and coordination of the medical-prevention integration subsystem.

Results: Between 2004 and 2020, the comprehensive development level of Chinese medical system (S_Y) increased from 0.560 in 2004 to 0.692 in 2020, and the S_Y of each province (autonomous regions and municipalities directly under the central government) increased from 0.385-0.655 in 2004 to 0.524-0.758 in 2020. The comprehensive development level of Chinese public health system (S_G) increased from 0.747 in 2004 to 0.875 in 2020, and the S_G of each province (autonomous regions and municipalities directly under the central government) increased from 0.501-0.846 in 2004 to 0.696-0.995 in 2020. From 2004 to 2020, the coupling degree (C) of the national and provincial (autonomous regions and municipalities directly under the central government) medical-prevention systems were all above 0.9, which was at a high level of coupling, and the national medical-prevention integration coupling coordination degree (D) increased from 0.805 in 2004 to 0.880 in 2020, and the D of each province (autonomous region and municipality directly under the central government) increased from 0.663-0.852 in 2004 to 0.777-0.930 in 2020. In 2020, in the Eastern region, S_Y ranged from 0.573 to 0.703 and S_G ranged from 0.764 to 0.901, both S_Y and S_G were the

highest in the eastern region. The results of ITSA showed that the “New Medical System Reform Policy” had a significant transient impact (β_2=0.024-0.145, P<0.05) and lasting (β_3=0.004-0.032, P<0.05) on the development of health care systems in most provinces, but not on public health system (S_G).

Conclusion: The comprehensive development level of medical-prevention integration subsystems in China had been improving between 2004 and 2020, and the degree of coupling coordination of medical-prevention integration had been gradually strengthened, but regional differences still existed.

Keywords: Medical-prevention integration; Level of coordination; Development; China

关键词：医防融合；协调水平；发展情况；中国

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Text of the report

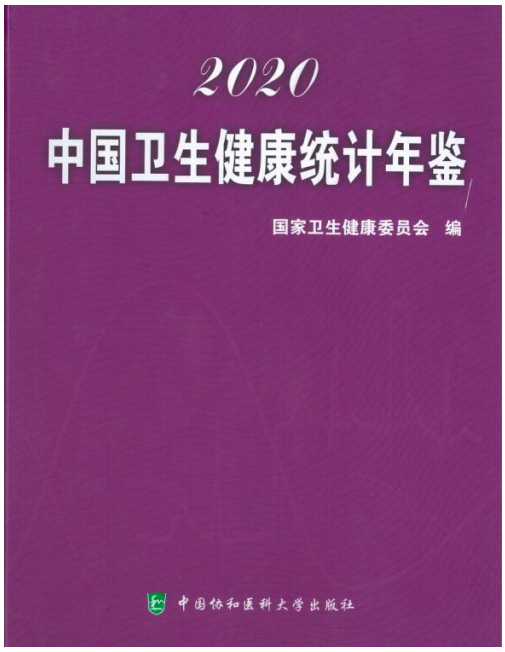
1. Preface

The integration of medical prevention refers to the coordinated operation of the clinical diagnosis and treatment system and the disease prevention system to jointly provide systematic services covering disease prevention, diagnosis, control, treatment and rehabilitation, to achieve a full range of continuous health services and to enhance the overall effectiveness of the medical and health system[2]. The connotation mainly includes the core idea of people-oriented, health-centered service concept and multi-system coordination promotion mechanism. 2021 government work report once again proposed "innovation of medical prevention coordination mechanism"[3], medical prevention integration has become an important way to guarantee people's health in all aspects and cycles in the construction of Health China in the new era. The important way. For example, Wang et al.[4] distributed questionnaires in nine sample counties in Shandong Province to evaluate the degree of coupling and coordination between the development of primary care and public health systems in Shandong Province and to explore the key constraints, and Fang et al.[5] constructed an evaluation index system and measured the level of coupling and coordination between health care and prevention in Guangdong Province for 10 years after the health care reform. However, there are few studies on the comprehensive and coordinated development of medical-defense integration at the national level, multi-province comparisons and time trend tests. To understand the development of the coordination level of medical-defense integration in 31 provinces (autonomous regions and municipalities directly under the central government) in China from 2004 to 2020, and to provide reference suggestions for promoting medical-defense integration in the construction of a healthy China in the new era, this study collected relevant information from the China Health and Health Statistical Yearbook and the China Statistical Yearbook from 2004 to 2020. By collecting data from 2004 to 2020, the study compiled relevant indicators to measure the comprehensive development level of medical system and public health system, and constructed a coupled coordination model and an interrupted time series model to test the instantaneous and sustained effects of the "new medical reform" policy on the development level and

2. Data and Methods

2.1 Source

Panel data for China and 31 provinces (autonomous regions and municipalities directly under the central government) from 2004 to 2020 were selected, and the data were mainly obtained from the annual China Health and Health Statistical Yearbook and China Statistical Yearbook. The collected indicators include: the number of practicing (assistant) physicians, hospital financial subsidy income, the number of medical institutions, the number of medical beds, bed utilization rate The indicators collected include: the number of practicing (assistant) physicians, hospital financial subsidy income, number of medical institutions, number of medical beds, bed utilization rate, annual burden of inpatient bed days, average inpatient days, number of consultations, number of hospitalizations, average medical cost per consultation, average hospital discharge cost, number of public health practicing (assistant) physicians, number of specialized public health institutions, maternal system management rate, number of rural health checkups, maternal mortality rate and infectious disease incidence rate, etc.



2.2 Statistical analysis

2.2.1 Coupled coordination model construction (Table 1)

The data were normalized by the logarithmic function normalization method to calculate the integrated development level of the health care system (S_Y) and the integrated development level of the public health system (S_G), respectively. The equations for S_Y and S_G are:

$$S_i = \sum_{i=1}^{n}(W_j * X_{ij}),$$

where *i* denotes the *ith* year, *j* denotes the *jth* indicator, *n* is the number of indicators to be evaluated, W_j is the indicator weight, and X_{ij} is the standardized data[5]. In this study, the evaluation index system of the level of coordination of medical-defense integration established by Fang et al.[5] was applied, and the weights were calculated separately for the available provincial medical and public health system indicators, and the adjusted indicators and weights for measuring the level of coordination of medical-defense system are shown in Table 1. The median of the indicators of 31 provinces (autonomous regions and municipalities directly under the central government) was used for the national comprehensive development level; the median of the indicators of each sub-regional province was used for the development level of the eastern, central and western regions, where The eastern region includes 11 provinces (municipalities directly under the central government): Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; the central region includes 8 provinces: Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan; the western region includes 12 provinces (autonomous regions and municipalities directly under the central government): Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang.

Table 1 Indicator settings and weights of the adjusted index system for the level of coupling and coordination of medical-defense integration

Target System	Tier 1 Indicators	Tier 2 Indicators	Indicator Direction	Unit	Average weight
Medical Systems (Y)	Medical service input	Number of licensed (assistant) physicians	+	People/100,000	0.082
		Hospital financial assistance income	+	Billion	0.175
		Number of medical institutions	+	Individual	0.099
		Number of medical beds	+	10,000 sheets	0.080
	Medical Service Process	Bed utilization rate	+	%	0.077
		Physicians cover inpatient bed days throughout the year	+	Bed Day	0.077
		Average hospitalization days	-	Day	0.078
	Medical service output	Number of consultations	+	Millions of visits	0.112
		Number of hospitalizations	+	10,000 visits	0.078
		Average medical cost per visit	-	Yuan	0.066
		Discharge average cost	-	Yuan	0.077
Public Health System (G)	Public health system input	Number of practicing (assistant) physicians in public health	+	People	0.152
		Number of specialized public health institutions	+	Individual	0.277
	Public Health Service Process	Maternal system management rate	+	%	0.117
		Rural health check-ups	+	Million people	0.151
	Public health service output	Maternal mortality rate	-	1/100,000	0.117
		Incidence of infectious diseases	-	1/million	0.187

2.2.2 Coupling model

The interaction between the medical system and the public health system can be established as a coupling model:

$$C = 2 \times \frac{\sqrt{S_Y \times S_G}}{S_Y + S_G}$$ [5],

where C is the coupling degree, and the value range is 0≤C≤1. C=0 means the 2 subsystems are split, and C=1 can be considered as the synergistic development of the 2 systems. C value can be specifically divided into 4 stage levels of low level coupling (0~0.3), fly down (0.3~0.5), grinding (0.5~0.8), and high level coupling (0.8~1.0) according to the high level.

2.2.3 Comprehensive coordination index

Comprehensive coordination index is used to describe the overall development level of medical defense integration, which is obtained by weighting S_Y and S_G. The larger the comprehensive coordination index is, the greater the contribution of the development of the two to the coupled coordination model. The formula is:

$$T = \alpha S_Y + \beta S_G$$ [5],

where T is the comprehensive coordination index and takes a value range of $0 \leq T \leq 1$. The sum of system weights α and β *is* equal to 1. The medical and public health systems are considered equally important, so it is set to $\alpha = \beta = 0.5$.

2.2.4 Coupling coordination degree model

The coupling coordination degree model is used to describe the degree of interaction and mutual influence between the system or elements within the system[5] , which can fully reflect the coordination relationship between the integrated development of our healthcare system and public health system, therefore, the coupling coordination model is introduced as: $D = \sqrt{C \times T}$ [5]. Where, D is the coupling coordination degree, taking the value range $0 \leq D \leq 1$, coupling coordination level evaluation criteria[7] see Table 2.

Table 2 Evaluation criteria for the level of coordination of the development coupling between the medical system and the public health system

Coordination Type	Coupling coordination value	Coupling coordination level	Subsystem Comparison
Dysfunctional decline type	[0，0.1]	Extreme disorders	If $S_Y < S_G$, it is the lagging type of medical system; vice versa, it is the lagging type of public health system; when the relative difference between S_Y and S_G is < 0.05, it is the synchronous type.
	（0.1，0.2]	Severe disorders	
	（0.2，0.3]	Moderate disorders	
	（0.3，0.4]	Mild disorders	
Overblending type	（0.4，0.5]	On the verge of disorder	
	（0.5，0.6]	Barely coordination	
Coordinated development type	（0.6，0.7]	Primary coordination	
	（0.7，0.8]	Intermediate coordination	
	（0.8，0.9]	Good coordination	
	（0.9，1.0]	Premium coordination	

2.2.5 Interrupted time series model

The interrupted time series model[7] was constructed to analyze the change in level and slope of the intervention effect of the "new health care reform" policy. The dependent variables (Y) are S_Y, S_G, C, and D for each year from 2004 to 2020 for the whole country and each province respectively, and the cut-off point of intervention is 2009 for the "new health care reform" policy, and the independent variables include time variables (T) with the values of 1, 2, ..., 17. The independent variables include time variables (T) with values of 1, 2, ..., 17, indicating each year; interventions (X) indicating the implementation of the "new health care reform" policy with values of 0 before implementation and 1 after implementation (2009); and XT indicating the slope with values of 0 before implementation (including 2009) and 1, 2, ..., 11 in the second year after implementation (2010 onwards). ..., 11. The fit and slope change models are: $Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + \varepsilon_t$, where β_1 is the pre-intervention slope, i.e., the average annual trend of S_Y, S_G, C and D before the implementation of the "new health care reform"; β_2 is the level change due to the intervention method, reflecting the instantaneous impact of the policy; β_3 is the slope change, reflecting the continuous impact of the policy on the development level and coupling coordination of each subsystem; ($\beta_1 + \beta_3$) is the post-intervention slope, i.e., the slope of the policy after the

implementation of the policy due to the coupling coordination. ($\beta_1 + \beta_3$) is the post-intervention slope, i.e., the annual trend of the dependent variable after the implementation of the policy; ε is the error, and the hypothesis test is to test whether the difference between the change in level and the change in slope is statistically significant.

3. Results

3.1 China's comprehensive development level of medical and public health system, 2004-2020

China's national S_Y increased from 0.560 in 2004 to 0.692 in 2020, an increase of 0.132; the eastern region had the highest overall development level (0.573~0.703), the central region (0.560~0.686) and the Western region (0.526~0.688) are the next highest. in 2004, the provinces (autonomous regions and municipalities directly under the Central Government) S_Y is 0.385~0.655, and in 2020 the provinces (autonomous regions and municipalities directly under the Central Government) S_Y reaches 0.524~0.758. (See Figure 1). See Appendix 1 for details.

One year after the implementation of the "new health care reform" policy (2010), the national S_Y increased by 0.036 (β_2=0.036, P<0.05) compared with the pre-policy period; the overall effect was more pronounced in the western region, which increased by 0.059 (β_2=0.059, P<0.001). Nationwide, 19 provinces (autonomous regions and municipalities directly under the central government) showed significant transient effects after the implementation of the "new medical reform", with an increase in S_Y (β_2=0.024-0.145, P<0.05); 13 provinces (autonomous regions and municipalities directly under the central government) showed significant transient effects after the implementation of the "new medical reform", with an increase in S_Y (β_2=0.024-0.145, P<0.05). (Autonomous regions and municipalities directly under the central government), and the average growth rate of S_Y increased compared with that of S_Y before the policy implementation (β_3=0.004-0.032, P<0.05). (See Figure 2)

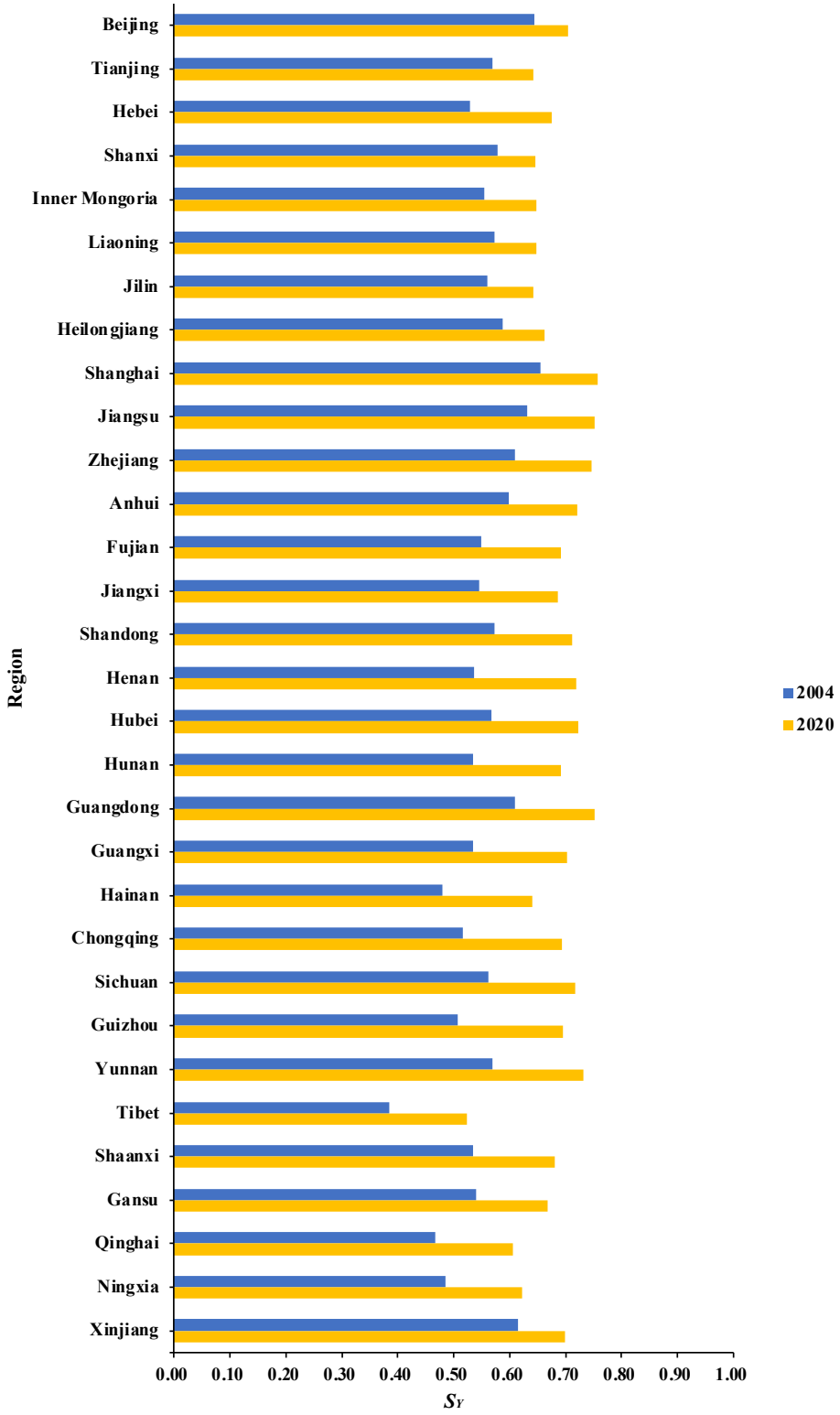


Figure 1 Changes in the comprehensive development level of medical systems in 31 provinces (autonomous regions and municipalities directly under the central government) in China from 2004 to 2020

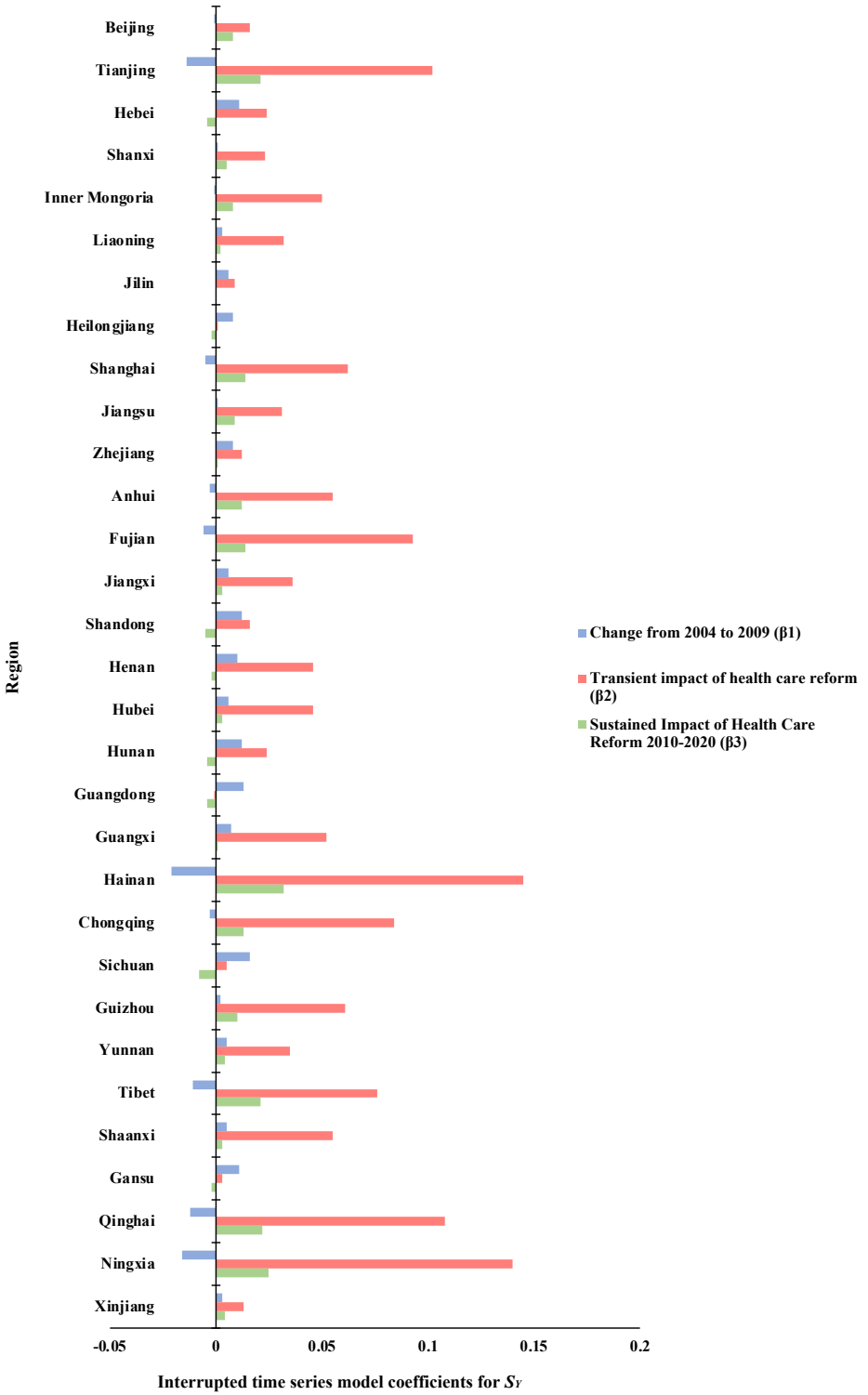


Figure 2 Impact of the implementation of the "new medical reform" policy on the comprehensive development level of the medical system in 31 provinces (autonomous regions and municipalities directly under the central government) in China

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China's national S_G has increased from 0.747 in 2004 to 0.875 in 2020, an increase of 0.128; the eastern region has the highest overall development level (0.764-0.901), followed by the central region (0.763-0.875) and the western region (0.675-0.850). In 2004, the S_G of provinces (autonomous regions and municipalities directly under the central government) ranged from 0.501~0.846, and in 2020, the S of provinces (autonomous regions and municipalities directly under the central government) reached 0.696-0.995. 0.846, and in 2020, the S_G of each province (autonomous region and municipality directly under the central government) reaches 0.696-0.995. (See Figure 3)

One year after the implementation of the "new health care reform" policy (2010), the national S_G increased (β_2=0.043) and the policy changed the growth rate by (β_3=0.001), but the differences were not statistically significant (all P>0.05). In terms of regional development differences, the "new health care reform" showed significant instantaneous (β_2=0.033-0.077, P<0.05) and sustained (β_3=0.008-0.010, P<0.05) effects in only a few provinces in the western and central regions. (See Figure 4)

From 2004 to 2020, the health care system of the whole country and all provinces (autonomous regions and municipalities directly under the central government) was lagging, but after the implementation of the "new health care reform" policy, the S_Y of several provinces (autonomous regions and municipalities directly under the central government) improved significantly and consistently, while the growth of S_G did not change significantly.

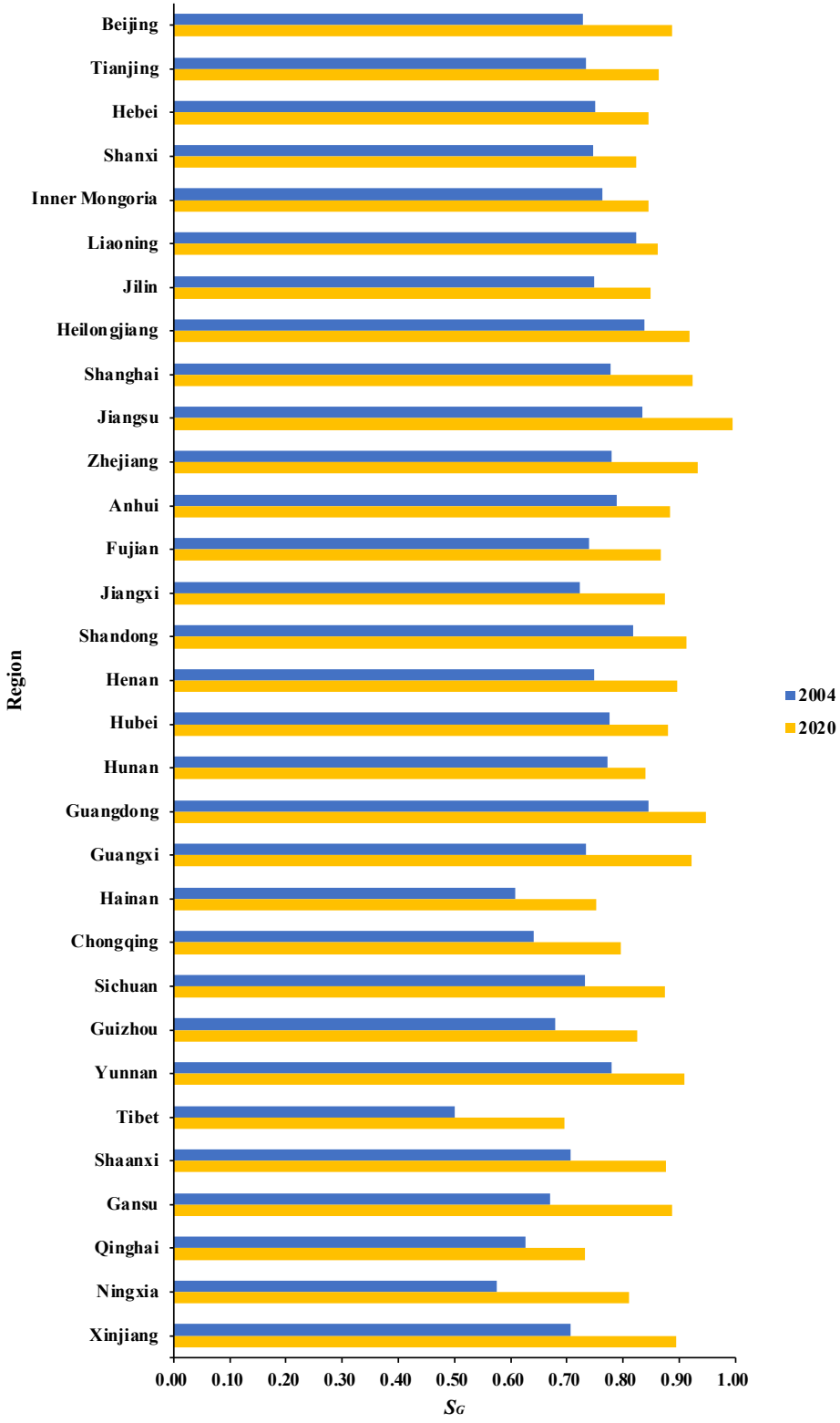

Figure 3 Changes in the comprehensive development level of public health systems in 31 provinces (autonomous regions and municipalities directly under the central government) in China, 2004-2020

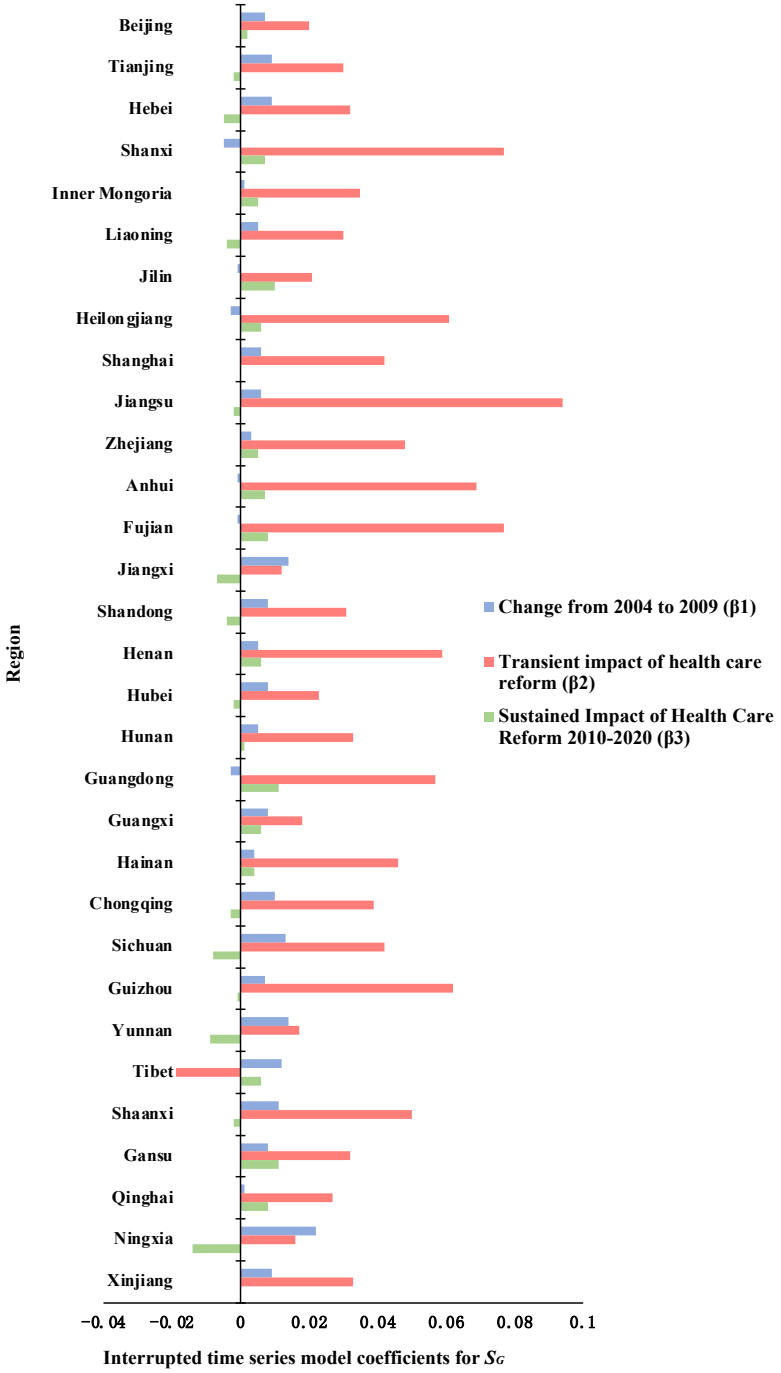

Figure 4 Impact of the implementation of the "new medical reform" policy on the comprehensive development level of the public health system in 31 provinces (autonomous regions and municipalities directly under the central government) in China

3.2 Coupling degree and coupling coordination of medical-defense integration in China, 2004-2020

The *C* value of medical-defense integration in 2004-2020 for the whole country and all provinces (autonomous regions and municipalities directly under the central government) is > 0.9, which is at a high level of coupling. (See Figure 5). See Appendix 2 for details.

The "new health care reform" has a transient and continuous impact on the C-value of medical defense integration in some provinces (autonomous regions and municipalities directly under the central government), but the magnitude of change is small, <0.025. (See Figure 6)

The *D* value of national medical defense integration from 2004 to 2020 increased from 0.805 to 0.880; the *D* value of each province (autonomous region and municipality directly under the central government) in 2004 was 0.663 to 0.852, and the coordination level was 7 to 9, and the *D* value of each province (autonomous region and municipality directly under the central government) in 2020 increased to 0.777 to 0.930, and the coordination level increased to 8 level and 10 level.

The results of the interrupted time series model showed that the implementation of the "new medical reform" policy had an instantaneous effect in 16 provinces (autonomous regions and municipalities directly under the central government) in 2009, and the *D* value of medical prevention integration increased in the following year (β_2=0.013-0.074, P<0.05). In 2020, the implementation of the "new medical reform" policy had a sustained effect on the *D* value of medical prevention integration in three provinces (autonomous regions and municipalities directly under the central government) in the eastern and western regions (β_3=0.010-0.014, P<0.05).

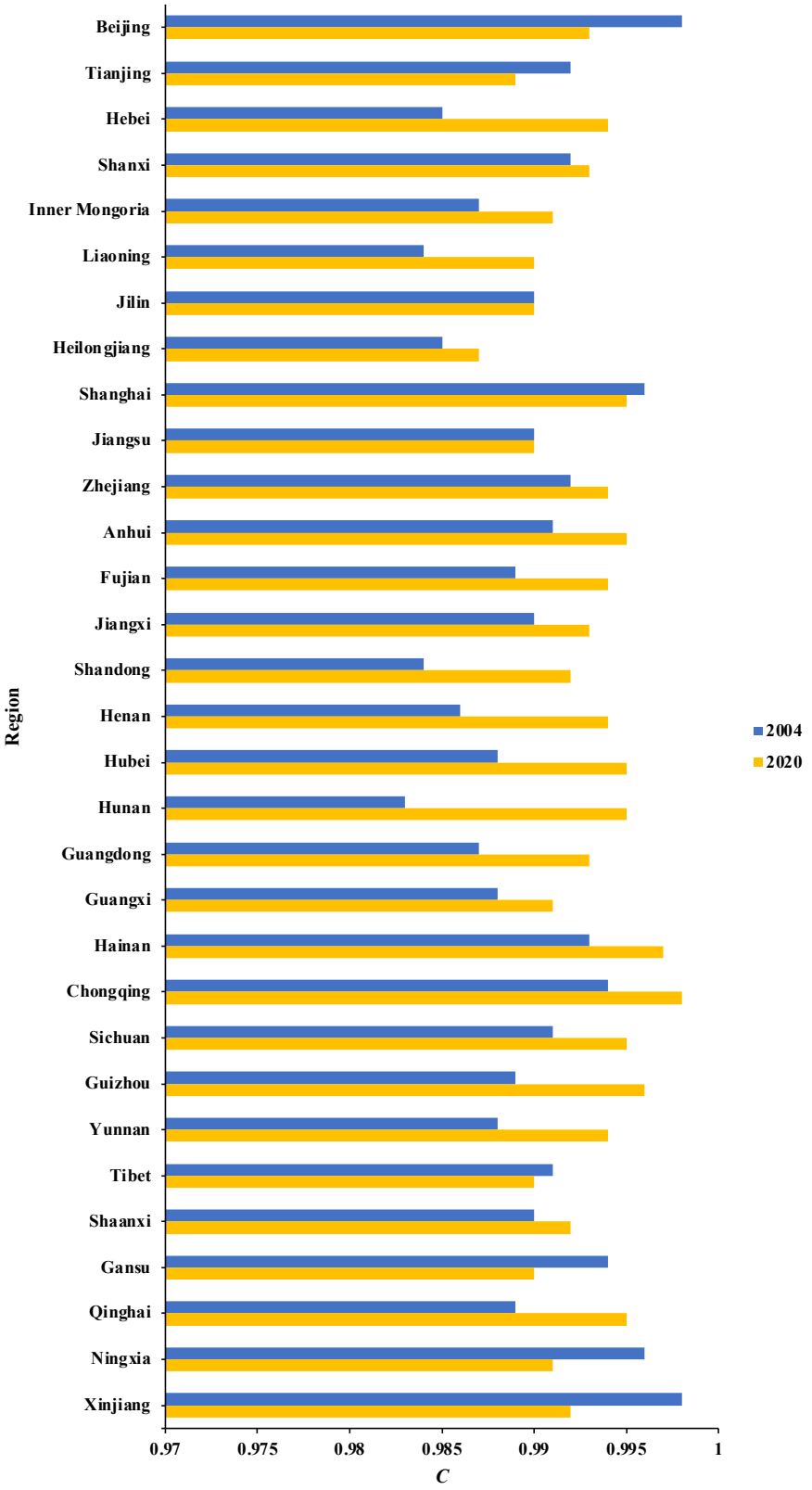

Figure 5 Changes in the coupling of medical and defense integration in 31 provinces (autonomous regions and municipalities directly under the central government) in China, 2004-2020

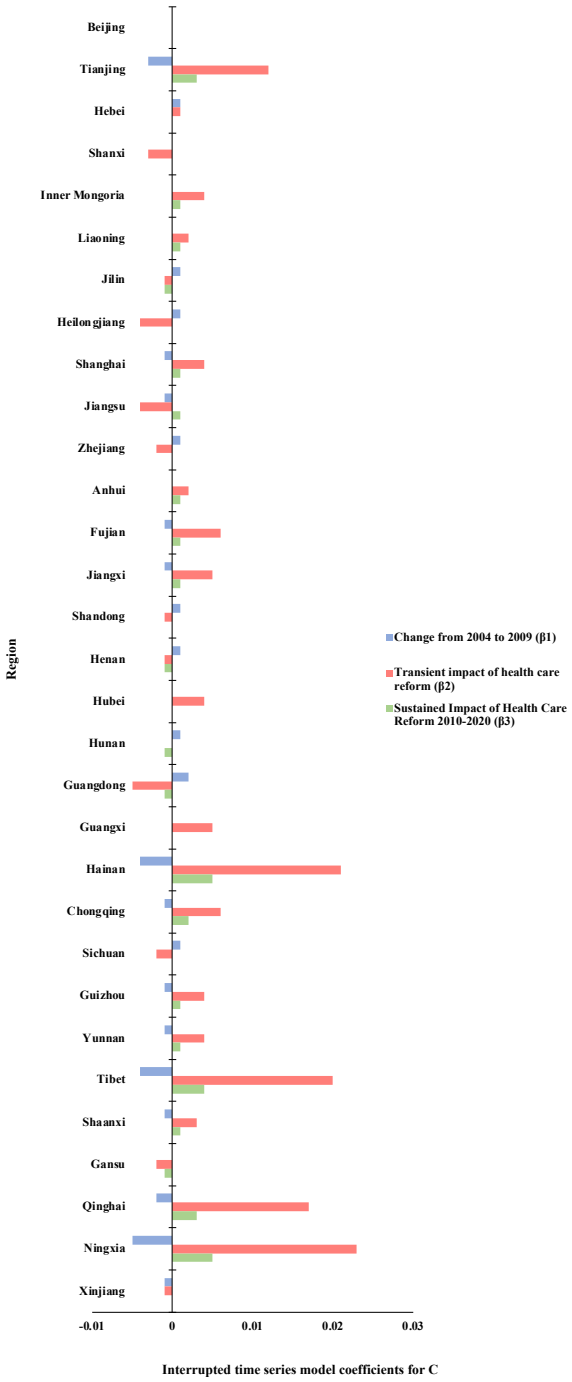

Figure 6 Impact of the implementation of the "new medical reform" policy on the coupling degree of medical defense integration in 31 provinces (autonomous regions and municipalities directly under the central government) in China

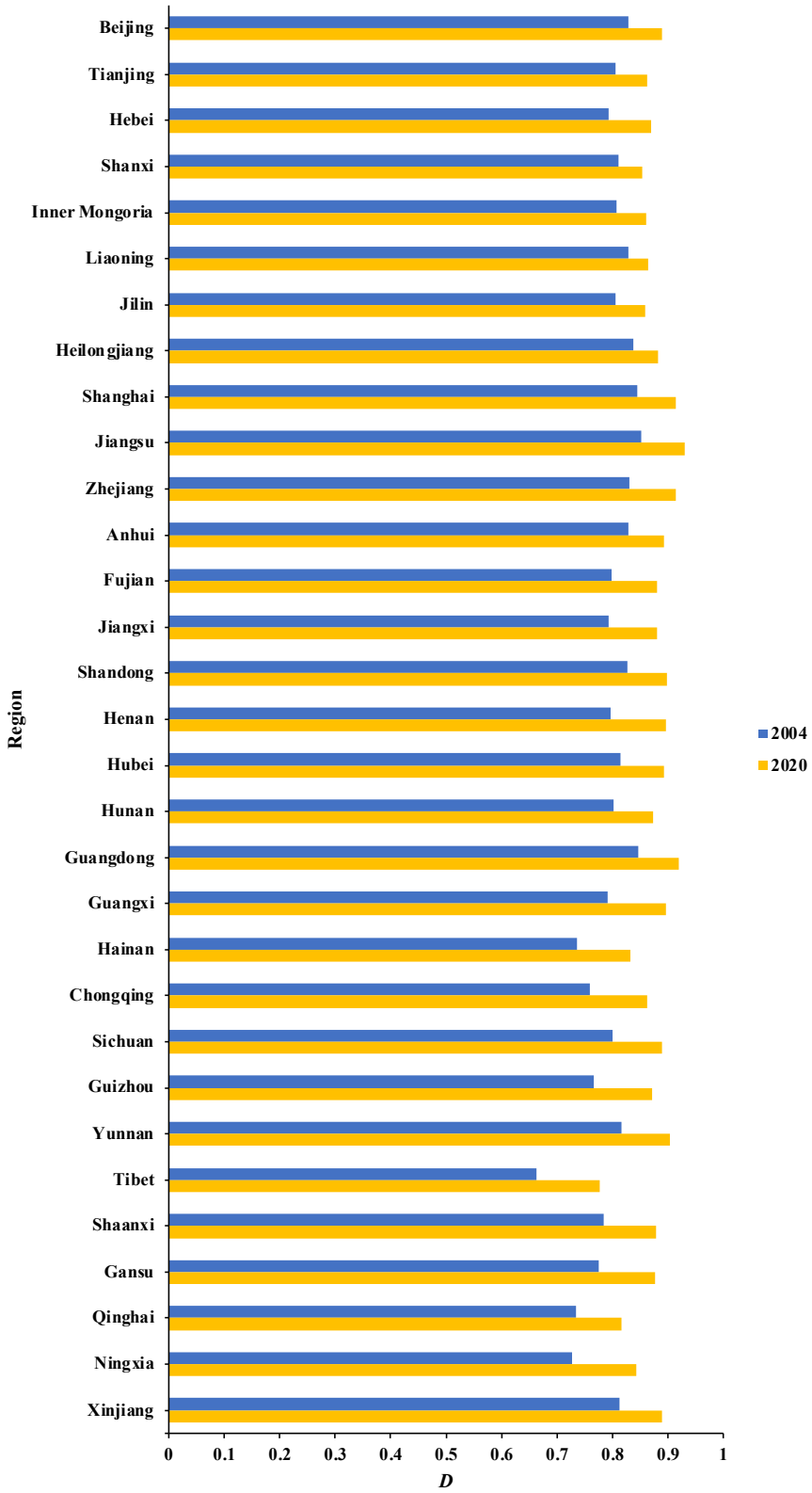

Figure 7 Changes in the degree of coordination of medical-defense integration coupling in 31 provinces (autonomous regions and municipalities directly under the central government), China, 2004-2020

Figure 8 **Impact of the implementation of the "new medical reform" policy on the degree of coordination of the coupling of medical and defense integration in 31 provinces (autonomous regions and municipalities directly under the central government) in China**

4. Discussions and suggestions

This study is the first to use coupled coordination model and interrupted time series model to empirically study the integration development of medical system and public health system in 31 provinces (autonomous regions and municipalities directly under the central government) in China from 2004 to 2020 from a long time span and provincial-level regional perspective, analyze the integration of medical and defense in the construction of a healthy China in the new era according to the differences in the level of coordination of medical and defense integration in each region We analyzed the main problems of medical-defense integration in the construction of a healthy China in the new era based on the differences in the level of coordination of medical-defense integration in each region, and put forward relevant suggestions to promote the development of medical-defense synergy in China, bridge the rift between medical-defense and people's health as the center of these problems.

From 2004 to 2020, the S_Y and S_G of all Chinese provinces (autonomous regions and municipalities directly under the central government) continue to rise, and the implementation of the "new health care reform" policy has a significant instantaneous impact in S_Y of several provinces (autonomous regions and municipalities directly under the central government), among which, the changes in some provinces (autonomous regions and municipalities directly under the central government) in the eastern and western regions are the most obvious. The most obvious changes are in the eastern and western provinces (autonomous regions and municipalities directly under the central government)[9]. For example, at the beginning of the "new medical reform", Hainan Province built health data collection terminals such as "all-in-one machines" and a health management cloud platform, so that farmers can obtain health management and remote consultation medical services from village doctors. "For the medical management department, the terminal is conducive to integrating individual data into group information, providing a basis for the evaluation and scientific decision-making of grassroots health work. At the same time, Hainan Province actively encourages social capital to enter the medical field, making up for the lack of medical resources stock, and vigorously promotes the development of health service industry, broadening the investment field for social capital[9]. Ningxia, as a pilot of the "new medical reform", has launched the "one yuan for

medical treatment" model, set the maximum price for a single disease, announced the price of essential drugs, and vigorously implemented policies to benefit the people's health[10] . However, in the process of implementing the policy initiatives, the shortage of professional human resources, the lack of inter-departmental coordination mechanism and the limited market vitality of socially run medical institutions are still exposed[9].

Interrupted time series design analysis is a segmented linear regression method that collects outcome data at multiple time points before and after a policy intervention, and has been widely used to evaluate the effects of policy interventions[12-13]. The results of this study show that some provinces (autonomous regions and municipalities directly under the central and western regions) had significant instantaneous improvement in S_G after the implementation of the "new health care reform" policy. For example, in 2010, Shanxi Province carried out work to promote the equalization of basic public health services based on both "basic public health service programs" and "major public health service programs," and made specific plans for long-term work goals, and exceeded the nine categories of Its basic public health services are developing rapidly, its management and processes are improving, it is focusing on service content, service population and service quality, it is coordinating urban and rural development, it is deepening the new rural cooperative medical system, and its framework for full coverage of the equalization system is worth learning from other regions.[14]

From 2010 to 2020, provinces across the country continued to deepen their medical system reforms, and some regions in central and western China achieved remarkable results. For example, in Jilin Province, in promoting the equalization of basic public health services, a working platform between professional public health institutions and grassroots institutions has been built, and the capacity building and functional transformation of grassroots institutions have been promoted, so that the theoretical level and service skills of grassroots medical personnel have been significantly improved, and the overall quality of the personnel team has been substantially improved. [14] ; Qinghai medical reform focuses on "strengthening the three bases and benefiting the people's livelihood", consolidating the province's new rural cooperative participation rate, raising funding standards and subsidies for outpatient expenses[16] , and over the years, by deepening the reform of the medical and health system, we have made efforts to build a medical and health care system with

urban and rural grassroots medical and health service institutions as the main body, county-level general hospitals and specialized The network system of public health service institutions as technical support, to promote the equalization of public health services.

In terms of the degree of coordination of the coupling of the 2 subsystems of health care and prevention, there are typical areas in the east, middle and west, which have achieved remarkable results after the implementation of the "new health care reform" in 2009, creating local experiences. For example, focus on the main health problems of the residents, Hainan Province initiative to develop the "2+3" health service package project, in the overall planning, responsibility allocation, financial investment guarantee and other aspects of elaborate design and strict implementation, and achieved significant results, is expected to form by the end of 2025 to "government-led, social participation, and the formation of a comprehensive and accurate prevention system. The main feature of the "Hainan model" is the three-dimensional, digital integrated precision prevention and control; in addition, the Hainan provincial party committee manpower and health and other departments jointly explore talent policy reform, the comprehensive promotion of primary health care talent incentive reform, to key positions and general practitioners tilt, encourage "One person, multiple posts, a specialization," to guide the flow of talent to the grassroots, rooted in the grassroots[17]. It is suggested that in terms of talent incentive and talent training, while strengthening the match between job performance and job content, we should also narrow the treatment gap between general practitioners and specialists in higher-level hospitals, broaden the career development paths of the grassroots service team, stimulate the work enthusiasm of the service team, and we should aim to cultivate composite professionals, focus on the formation of a holistic medical view and the establishment of a preventive medicine mindset, increase the teaching of practical and hands-on contents, and cultivate the application ability of professionals[18].

The focus of medical prevention integration in most areas of China is still in the primary health institutions, more explored in chronic diseases such as hypertension and type 2 diabetes[19-20] , previous studies on the equity of China's human resource allocation found that the three northeastern provinces of the disease control personnel serious loss, how to maximize the effectiveness of resources need to be addressed[21] . Therefore, in the development of multi-disciplinary medical prevention integration, we should strengthen the "top-level design" awareness, so that the

government plays an important role in information technology construction, resource integration and coordination, financial security supply, personnel deployment, etc. [22], and collaborate with hospitals and public health systems to deepen the reform in tandem. In addition, we should accelerate the construction of supporting policies and facilities to ensure the coordinated operation of the systems within the medical defense integration system. In solving the problem of regional distribution differences in the coupling and coordination of the two systems of health care and defense, the central department should strengthen supervision and review, improve the coordination mechanism, improve the accessibility of the geographical distribution of medical institutions in the densely populated western region, continuously increase the investment in human resources for health and special policy support[23] , guarantee the equity of the policy to benefit the residents of a wider area, and meet the development needs of health care and defense integration.

Although the imbalance in the distribution of health care resources has been alleviated to a certain extent after the "new health care reform" in 2009, the imbalance between supply and demand still exists[24] . As people tend to seek more advanced clinical treatment services rather than primary health care, the inverse relationship between "prevention" and "treatment" leads to the inability to form a virtuous closed health service system, thus breaking the service chain between different levels of health care institutions and between health care institutions and disease control institutions. This not only fails to reduce medical costs and ensure the quality of medical and health services, but also fails to meet the people's higher demand for health in the new era. For this reason, recommends further improving the medical and public health investment mechanism, as well as optimizing and improving the disease prevention and control system, improving the diagnosis and treatment capacity of infectious diseases, and promoting the construction of public health clinical centers. In strengthening the construction of public health functions in hospitals, the positioning of hospitals in the public health system should be clarified and public health responsibilities should be undertaken[25] . The development of public health functions in hospitals should adhere to the attributes of public welfare and provide equitable and accessible health services such as prevention, treatment, rehabilitation and health promotion in a continuous and systematic manner. Government investment and supervision should be strengthened, a stable public health investment mechanism should be established, the government's purchase service mechanism should be improved, and the

funds required for medical institutions to undertake major epidemic prevention and control and public health emergency disposal should be guaranteed[26] . In the process of improving the construction of public health system all levels and types of public health institutions need to have different functional positioning, give full play to their respective advantages and build a cooperative and complementary work system structure[27] . To establish and improve public health-related laws and regulations, empower the implementation of system tasks, give full play to the functions and responsibilities of the public health system[28] , and strive to enhance the overall effectiveness of the health and health governance system.

Through the implementation of basic public health service programs, China has rapidly built up a strong public health service "network base" with limited resources, and has rapidly achieved equalization of primary health care services for some key populations[29] . In the future, it is necessary to link up the system, policies and mechanisms, rely on county medical community and other platforms to solve the problem of the "short board" of basic medical service capacity, and actively guide qualified physicians from secondary and tertiary hospitals to join the family doctor team to slow down the flow of grassroots personnel due to the siphoning effect of higher-level hospitals[18] , in order to Primary health care institutions as the bottom of the network to carry out contract services, to provide high-quality medical prevention integration services[30] , give full play to the "gatekeeper" role. At the same time, theoretical and empirical research on the integration of primary health care and prevention should be strengthened, and experience should be summarized to explore theoretical and practical innovation of the integration of health care and prevention in the light of China's actual situation, so as to serve the construction of a healthy China.

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Appendix

Supplementary Table 1 Comprehensive Development Level of Medical and Public Health Systems in 31 Provinces (Autonomous Regions and Municipalities directly under the Central Government), China, 2004-2020

Region	2004		2009		Change from 2004 to 2009 (β_1)		2010		Transient impact of health care reform (β_2)		2020		Sustained Impact of Health Care Reform 2010-2020 (β_3)	
	S_Y	S_G	S_Y	S_G	S_Y	S_G	S_Y	S_G	S_Y	S_G	S_Y	S_G	S_Y	S_G
Beijing	0.645	0.728	0.642	0.773	-0.001	0.007	0.644	0.791	0.016	0.020	0.704	0.887	0.008	0.002
Tianjing	0.570	0.735	0.575	0.789	-0.014	0.009	0.592	0.798	0.102[b]	0.030	0.643	0.864	0.021[a]	-0.002
Hebei	0.529	0.750	0.595	0.803	0.011[b]	0.009	0.608	0.797	0.024[a]	0.032	0.676	0.846	-0.004	-0.005
Shanxi	0.578	0.747	0.584	0.784	0.001	-0.005	0.582	0.796	0.023	0.077[a]	0.646	0.823	0.005	0.007
Inner Mongoria	0.555	0.763	0.581	0.786	-0.001	0.001	0.591	0.789	0.050[c]	0.035	0.648	0.846	0.008[b]	0.005
Liaoning	0.573	0.823	0.601	0.852	0.003	0.005	0.615	0.856	0.032[a]	0.030	0.648	0.862	0.002	-0.004
Jilin	0.560	0.748	0.581	0.761	0.006	-0.001	0.592	0.775	0.009	0.021	0.643	0.849	0.000	0.010[a]
Heilongjiang	0.588	0.838	0.607	0.868	0.008	-0.003	0.621	0.869	0.001	0.061	0.662	0.918	-0.002	0.006
Shanghai	0.655	0.778	0.672	0.876	-0.005	0.006	0.680	0.882	0.062[b]	0.042	0.758	0.924	0.014[a]	0.000
Jiangsu	0.632	0.834	0.644	0.918	0.001	0.006	0.659	0.937	0.031[a]	0.094	0.751	0.995	0.009[a]	-0.002
Zhejiang	0.609	0.780	0.642	0.829	0.008[b]	0.003	0.657	0.851	0.012	0.048	0.747	0.933	0.001	0.005
Anhui	0.599	0.789	0.610	0.813	-0.003	-0.001	0.624	0.818	0.055[b]	0.069	0.721	0.884	0.012[a]	0.007
Fujian	0.549	0.740	0.596	0.785	-0.006	-0.001	0.618	0.796	0.093[c]	0.077	0.692	0.867	0.014[b]	0.008
Jiangxi	0.545	0.724	0.586	0.792	0.006	0.014[b]	0.597	0.806	0.036	0.012	0.686	0.875	0.003	-0.007

Shandong	0.572	0.818	0.631	0.861	0.012^{c}	0.008	0.645	0.888	0.016	0.031	0.711	0.914	-0.005^{a}	-0.004
Henan	0.536	0.748	0.621	0.795	0.010^{c}	0.005	0.636	0.812	0.046^{c}	0.059	0.719	0.896	-0.002	0.006
Hubei	0.567	0.777	0.620	0.815	0.006	0.008	0.635	0.830	0.046^{a}	0.023	0.722	0.880	0.003	-0.002
Hunan	0.535	0.772	0.597	0.789	0.012^{a}	0.005	0.617	0.797	0.024	0.033	0.692	0.840	-0.004	0.001
Guangdong	0.610	0.846	0.662	0.860	0.013^{c}	-0.003	0.670	0.880	-0.001	0.057	0.752	0.947	-0.004	0.011
Guangxi	0.534	0.734	0.598	0.779	0.007	0.008	0.620	0.793	0.052^{b}	0.018	0.702	0.923	0.001	0.006
Hainan	0.480	0.609	0.501	0.654	-0.021^{b}	0.004	0.525	0.668	0.145^{c}	0.046	0.640	0.752	0.032^{c}	0.004
Chongqing	0.517	0.641	0.571	0.690	-0.003	0.010	0.593	0.719	0.084^{c}	0.039	0.694	0.796	0.013^{b}	-0.003
Sichuan	0.562	0.733	0.630	0.804	0.016^{c}	0.013	0.640	0.817	0.005	0.042	0.718	0.874	-0.008^{b}	-0.008
Guizhou	0.507	0.680	0.564	0.741	0.002	0.007	0.583	0.761	0.061^{c}	0.062	0.696	0.825	0.010^{b}	-0.001
Yunnan	0.570	0.779	0.620	0.840	0.005^{a}	0.014	0.639	0.851	0.035^{c}	0.017	0.732	0.910	0.004^{a}	-0.009
Tibet	0.385	0.501	0.427	0.508	-0.011	0.012	0.409	0.540	0.076^{b}	-0.019	0.524	0.696	0.021^{a}	0.006
Shaanxi	0.535	0.707	0.597	0.789	0.005	0.011	0.613	0.793	0.055^{b}	0.050	0.681	0.877	0.003	-0.002
Gansu	0.540	0.670	0.581	0.720	0.011	0.008	0.594	0.737	0.003	0.032	0.667	0.888	-0.002	0.011
Qinghai	0.467	0.626	0.494	0.624	-0.012	0.001	0.507	0.656	0.108^{b}	0.027	0.606	0.733	0.022^{b}	0.008^{a}
Ningxia	0.485	0.575	0.517	0.696	-0.016^{a}	0.022^{a}	0.546	0.701	0.140^{c}	0.016	0.622	0.811	0.025^{b}	-0.014
Xinjiang	0.614	0.706	0.616	0.785	0.003	0.009^{a}	0.633	0.792	0.013	0.033^{a}	0.698	0.894	0.004	0.000

Note：a $P<0.05$；b $P<0.01$；c $P<0.001$.

Supplement Table 2 Coupling degree and coupling coordination of medical defense integration in 31 provinces (autonomous regions and municipalities directly under the central government), China, 2004-2020

Report: Analysis of the development trend of the coordination level for medical-prevention integration of China from 2004 to 2020

Region	2004		2009		Change from 2004 to 2009 (β_1)		2010		Transient impact of health care reform (β_2)		2020		Sustained Impact of Health Care Reform 2010-2020 (β_3)	
	C	*D*	*C*	*D*	***C***	***D***	*C*	*D*	***C***	***D***	*C*	*D*	***C***	***D***
Beijing	0.998	0.828	0.996	0.839	0.000	0.002	0.995	0.845	0.000	0.011	0.993	0.889	0.000	0.003
Tianjing	0.992	0.805	0.988	0.821	-0.003	-0.003	0.989	0.829	0.012[a]	0.045[b]	0.989	0.863	0.003	0.007
Hebei	0.985	0.794	0.989	0.832	0.001	0.006[a]	0.991	0.834	0.001	0.016	0.994	0.870	0.000	-0.003
Shanxi	0.992	0.811	0.989	0.823	0.000	-0.001	0.988	0.825	-0.003	0.029[b]	0.993	0.854	0.000	0.004
Inner Mongoria	0.987	0.807	0.989	0.822	0.000	-0.001	0.990	0.826	0.004[a]	0.028[b]	0.991	0.861	0.001	0.004
Liaoning	0.984	0.829	0.985	0.846	0.000	0.002	0.987	0.852	0.002	0.019	0.990	0.864	0.001	-0.001
Jilin	0.990	0.805	0.991	0.815	0.001	0.002	0.991	0.823	-0.001	0.010	0.990	0.859	-0.001	0.003
Heilongjiang	0.985	0.838	0.984	0.852	0.001	0.002	0.986	0.857	-0.004	0.016	0.987	0.883	0.000	0.001
Shanghai	0.996	0.845	0.991	0.876	-0.001	0.000	0.992	0.880	0.004	0.031[a]	0.995	0.915	0.001	0.004
Jiangsu	0.990	0.852	0.984	0.877	-0.001	0.002	0.985	0.886	-0.004	0.033[a]	0.990	0.930	0.001	0.002
Zhejiang	0.992	0.830	0.992	0.854	0.001	0.004	0.992	0.865	-0.002	0.017	0.994	0.914	0.000	0.001
Anhui	0.991	0.829	0.990	0.839	0.000	-0.001	0.991	0.845	0.002	0.037[a]	0.995	0.893	0.001	0.006
Fujian	0.989	0.798	0.991	0.827	-0.001	-0.002	0.992	0.837	0.006	0.054[b]	0.994	0.880	0.001	0.007
Jiangxi	0.990	0.793	0.989	0.825	-0.001	0.006[a]	0.989	0.833	0.005	0.017	0.993	0.880	0.001	-0.001
Shandong	0.984	0.827	0.988	0.858	0.001	0.006[a]	0.987	0.870	-0.001	0.013	0.992	0.898	0.000	-0.003
Henan	0.986	0.796	0.992	0.838	0.001	0.005	0.993	0.848	-0.001	0.031[a]	0.994	0.896	-0.001	0.000

Hubei	0.988	0.815	0.991	0.843	0.000	0.004	0.991	0.852	0.004	0.022[a]	0.995	0.893	0.000	0.000
Hunan	0.983	0.802	0.990	0.829	0.001	0.005	0.992	0.838	0.000	0.018	0.995	0.873	-0.001	-0.001
Guangdong	0.987	0.847	0.991	0.869	0.002[a]	0.004	0.991	0.876	-0.005[a]	0.014	0.993	0.919	-0.001[a]	0.001
Guangxi	0.988	0.792	0.991	0.826	0.000	0.005	0.993	0.837	0.005	0.023	0.991	0.897	0.000	0.002
Hainan	0.993	0.736	0.991	0.757	-0.004[a]	-0.008	0.993	0.770	0.021[b]	0.074[c]	0.997	0.833	0.005[b]	0.014[b]
Chongqing	0.994	0.759	0.996	0.792	-0.001[a]	0.002	0.995	0.808	0.006[b]	0.041[c]	0.998	0.862	0.002[b]	0.003
Sichuan	0.991	0.801	0.993	0.844	0.001	0.009[a]	0.993	0.850	-0.002	0.012	0.995	0.890	0.000	-0.005
Guizhou	0.989	0.766	0.991	0.804	-0.001	0.003	0.991	0.816	0.004	0.039[a]	0.996	0.871	0.001	0.003
Yunnan	0.988	0.816	0.989	0.850	-0.001	0.005[a]	0.990	0.859	0.004	0.017	0.994	0.903	0.001	-0.001
Tibet	0.991	0.663	0.996	0.682	-0.004[a]	-0.001	0.990	0.685	0.02[a]	0.029[a]	0.990	0.777	0.004	0.010[b]
Shaanxi	0.990	0.784	0.990	0.829	-0.001	0.005	0.992	0.835	0.003	0.032	0.992	0.879	0.001	0.000
Gansu	0.994	0.776	0.994	0.804	0.000	0.006	0.994	0.813	-0.002	0.010	0.990	0.877	-0.001	0.002
Qinghai	0.989	0.735	0.993	0.745	-0.002	-0.005	0.992	0.759	0.017[a]	0.052[b]	0.995	0.816	0.003	0.011[b]
Ningxia	0.996	0.727	0.989	0.774	-0.005[b]	0.000	0.992	0.787	0.023[b]	0.059[b]	0.991	0.843	0.005[b]	0.005
Xinjiang	0.998	0.812	0.993	0.834	-0.001	0.003[a]	0.994	0.841	-0.001	0.013[a]	0.992	0.889	0.000	0.001

Note：a $P<0.05$；b $P<0.01$；c $P<0.001$.

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