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RESEARCH REPORT ON CENTRALIZED PROCUREMENT OF HEALTHCARE EQUIPMENT AND INDUSTRY TRENDS

YuZe Chen
International Department, Hefei 168 High School, Hefei 230009, Anhui, China.
Corresponding Email: chen_jason329@icloud.com

Abstract: The Centralized Procurement System of Medical Consumables results in a drastic price reduction of numerous high-value medical consumables and has long-term effects on public hospitals that cannot be overlooked. This study employs both descriptive statistics and qualitative analysis methods to investigate some practical issues arising from the CPSMC from an economic perspective. The conclusions of this study are as follows: 1) Since 2010, China's per capita health expenditure, per capita healthcare expenditure, and basic medical insurance fund expenditure have been growing rapidly. Seeking a more sustainable approach to medical consumables procurement is a prevailing trend. 2) The proportion of medical materials income within the medical income of public hospitals is increasing year by year. The promotion of zero markup for consumables and the Centralized Procurement System (CPS) may negatively impact the profitability of certain public hospitals. 3) Chinese doctors in public hospitals have faced long-term underpayment. Due to the combined effects of the COVID-19 epidemic and the CPS, the salaries of some doctors are also experiencing a significant decline in the short term. 4) Doctors are unable to receive reasonable income compensation for their long-term heavy medical workloads, which may lead to negative consequences such as decreased work enthusiasm and changes in medical types and processes. The conclusions of this paper will assist decision-making departments and relevant groups in deepening their comprehensive understanding and assessment of the impacts of the CPS, improving the corresponding compensation mechanisms and regulatory systems, and promoting a sustainable and healthy development of the CPS.
Keywords: Centralized Procurement System (CPS); Public hospitals; Medical consumables; Doctor compensation

1 INTRODUCTION

The advancement of China's medical and health sectors fails to meet the demands of public health and the requirements for coordinated economic and social development. To address the significant contradictions arising from this imbalance and to guide medical and health efforts in facing a series of new challenges, the CPC Central Committee and the State Council issued the Opinions on Deepening the Reform of the Medical Security System on February 25, 2020. The Opinions explicitly stated that governments and public hospitals at all levels should manage the inflated prices of drugs and high-value medical consumables, insisting on the integration of bidding and procurement, linking quantity with price, and fully implementing the bulk procurement of drugs and medical consumables. Since then, a considerable number of high-value medical consumables have entered an era of steep price reductions. This shift has profound and lasting effects on the profitability of public hospitals and the actual salary levels of medical staff. One of the most notable and widely discussed instances is the sharp decline in the median price of third-generation coronary drug-eluting stents, which fell from 14,000 yuan to 700 yuan during the first centralized bulk procurement of high-value coronary stents organized by the state on November 5, 2020[1,2].

Numerous scholars have conducted extensive research on the effects of the CPS on the medical system. This paper investigates the reform of the medical system in public hospitals under the CPS using PEST theory, focusing on public hospitals as the research subjects. PEST encompasses four types of factors that influence strategic development and management: politics, economy, society, and technology [3]. This analytical tool is utilized to assess the impacts of the macro environment on strategy.

While existing literature includes studies on the positive effects of the CPS on medical system reform, research on its negative consequences remains limited. Therefore, this paper will preliminarily examine the issues arising from the reform and propose corresponding solutions. The analysis incorporates comprehensive information, including per capita income and healthcare expenditure in China, changes and the current status of public hospitals' income structure, and the salary levels of doctors. The conclusions drawn from this paper aim to assist decision-making bodies and relevant groups in enhancing their understanding and assessment of the CPS's impacts, promoting sustainable and healthy development of the CPS, and contributing to the overall landscape of future healthcare reform in China[4].

2 DATA AND METHODS

2.1 Data

The data utilized in this paper can be categorized into four types. The national per capita income data is sourced from the Statistical Yearbook of China, covering the sample period from 2010 to 2019. The primary data includes national

per capita income, per capita healthcare expenditure, per capita health expenditure, and the ratio of total health expenditure to GDP. Additionally, the national public hospital income data is obtained from the China Health Yearbook for the same period, focusing on the overall income composition and medical income composition of public hospitals. Furthermore, the salary levels of doctors and other relevant information are derived from the "Third-party Evaluation of the Action Plan for Improving Medical Services," commissioned by the National Health Commission, with a sample period from 2016 to 2019. This data encompasses the overall salary levels of doctors and the disparity between doctors' salaries and their expected incomes. Other literature and data are sourced from CNKI, Wanfang, Google Scholar, and various other databases.

2.2 Methods

This paper employs two analytical approaches:
Descriptive statistics is a scientific research technique that involves examining phenomena and organizing and summarizing data. Through descriptive statistics, key data indicators such as per capita healthcare expenditure and its proportion, per capita health expenditure and its proportion, as well as the sources and structure of public hospital income during a specific timeframe were primarily investigated. The variations in these indicators were analyzed and discussed through comparative methods in this study.
Additionally, the ratio of per capita healthcare expenditure to per capita disposable income for each year was calculated using the formula: per capita healthcare expenditure / per capita disposable income. This analysis provided insights into the current state of residents' income and expenditure.
Qualitative analysis is a method that relies on the subjective judgment and analytical skills of researchers to deduce the nature and developmental trends of phenomena. This paper leverages the internal mechanisms and social context of the CPS within the ongoing healthcare reform, utilizing the researchers' experiential knowledge and comprehensive judgment to conduct factual analysis, logical reasoning, and scientific elaboration on the impact of the CPS from four perspectives: politics, economy, society, and technology, employing qualitative analysis techniques.

3 RESULTS AND DISCUSSION

In this section, both qualitative and quantitative analysis methods were utilized to examine the background, development process, and various practical issues related to healthcare reform and the CPS. The necessity for healthcare reform and the effects of the CPS on the salary levels of public hospitals and medical professionals were explored through quantitative analysis. Meanwhile, the political, economic, social, and technological development processes and the environment surrounding the CPS were investigated using qualitative analysis.

3.1 Variations in Per Capita Healthcare Expenditure and Health Expenditure in China

This section examines the fluctuations in national per capita disposable income and per capita healthcare expenditure from 2013 to 2019 (refer to Table 1). The analysis reveals that the ratio of per capita healthcare expenditure to per capita disposable income rose significantly, increasing from 4.98% to 6.19%. Over the span of seven years, per capita healthcare expenditure escalated by 208.55%, indicating that healthcare costs have progressively become a vital segment of citizens' overall spending.
Additionally, the shifts in per capita health expenditure and its share of GDP (see Table 2) demonstrate that per capita health expenditure surged from 1,490.06 yuan to 4,702.79 yuan over the decade, representing an increase exceeding 300%. Concurrently, the share of per capita health expenditure in GDP grew from 4.84% to 6.64%, reflecting an approximate rise of 37%. In light of the swift increase in per capita healthcare expenditure, per capita health expenditure, and certain government spending in China, there is an urgent necessity to undertake healthcare reform and discover more sustainable approaches for acquiring medications and high-value medical supplies.

Table 1 The National Per Capita Disposable Income and Per Capita Healthcare Expenditure

Year	The Per Capita Disposable Income Nationwide	National Per Capita healthcare expenditure	The Proportion of Healthcare expenditure to Disposable Income
2013	18,311 yuan	912 yuan	4.98%
2014	20,167 yuan	1,045 yuan	5.18%
2015	21,966 yuan	1,165 yuan	5.30%
2016	23,821 yuan	1,307 yuan	5.49%
2017	25,974 yuan	1,451 yuan	5.58%
2018	28,228 yuan	1,685 yuan	5.97%
2019	30,733 yuan	1,902 yuan	6.19%

(Data source: China National Bureau of Statistics)

Table 2 Health Expenditure and Its Corresponding Proportion of GDP in Different Years

Year	Per Capita Health Expenditure(Unit: yuan)	The Proportion in GDP Per Capita(Unit: percent)
2010	1,490.96	4.84
2011	1,806.95	4.98
2012	2,076.67	5.20
2013	2,327.37	5.32
2014	2,581.66	5.48
2015	2,980.80	5.95
2016	3,351.74	6.23
2017	3,783.83	6.36
2018	4,236.98	6.43
2019	4,702.79	6.64

(Data source: China National Bureau of Statistics)

3.2 Alterations in the Revenue Composition of Public Hospitals

The China Health Statistics Yearbook reveals that the overall revenue composition of public hospitals in China has not experienced substantial changes over the decade from 2010 to 2019. Although the share of medical income from public hospitals has seen a slight decline, it remains the dominant source of revenue, accounting for more than 85% (see Table 3).

In the breakdown of medical income, particularly since 2015, the percentage of income from drugs in public hospitals has significantly diminished (refer to Table 4). Further examination indicates that since 2015, China has released policy documents such as the "Opinions on Further Standardizing the Centralized Drug Procurement of Medical Institutions," mandating local governments and public hospitals to abandon the traditional approach of supplementing income through drug sales, reform the entire drug procurement system, and eliminate drug markups in public hospitals. The notable decrease in the share of drug income in public hospitals reflects the enactment and impact of these policies.

In contrast, the proportion of income from medical supplies has surged by over 60% concurrently with the reduction in drug income within public hospitals. This implies that the decrease in drug markups may not have been fully leveraged to lower overall medical expenses; instead, public hospitals might be offsetting the loss of income by increasing revenue from medical supplies (including consumables) during their operational activities. In essence, the income generated from medical supplies and consumables has emerged as a vital element of the revenue structure, supplanting that of drug markups.

The promotion of zero markup for medical consumables and the implementation of the Centralized Procurement System are likely to adversely affect the medical income and profitability of public hospitals in the short term.Moreover, the data presented in Table 3 indicate that the share of examination income within the medical revenue of public hospitals has consistently risen over the past decade, as treatment income has also significantly increased during this time. In actual medical practice, some healthcare professionals often require patients to undergo more extensive physical examinations to mitigate medical liability or enhance their own earnings. For instance, in cases of coronary angiography and stent surgeries, certain doctors may insist that patients pay thousands of yuan for additional coronary angiography, whereas previously, alternative methods or the doctors' expertise could have been utilized to assess the necessity for coronary stent procedures. While this approach may enhance medical precision, it simultaneously raises the financial burden on patients. This trend may become increasingly prevalent following the cancellation of consumable markups and the complete implementation of the centralized procurement system.

Table 3 Overall Income Structure of Public Hospitals from 2012 to 2019 (Unit: percent)

Year	Medical Income	Financial Subsidy	Income from Science and Education	Others
2012	89.46	8.16	0.46	1,94
2013	89.69	7.94	0.42	1.92
2014	90.00	7.71	0.41	1.89
2015	88.57	8.97	0.45	2.01
2016	88.40	9.13	0.41	2.06
2017	88.14	9.24	0.47	2.15
2018	87.67	9.54	0.53	2.27
2019	87.69	9.69	0.42	2.20

(Data source: China Health Statistics Yearbook from 2013 to 2020)

Table 4 Medical Income Structure of Public Hospitals from 2012 to 2019

Year	Registration Income	Examination Income	Operation Income	Materials Income	Medicine Income	Bed Income	NURSING Income	Treatment Income	Others
2012	0.35	11.55	4.88	8.57	44.79	2.67	1.26	12.44	13.49
2013	0.33	11.69	4.69	9.79	43.31	2.62	1.36	12.23	13.98
2014	0.30	11.93	4.58	10.71	42.19	2.54	1.42	11.99	14.34
2015	0.29	12.09	4.54	11.51	40.86	2.49	1.49	12.02	14.71
2016	0.29	12.24	4.71	12.42	38.75	2.49	1.67	12.17	15.26
2017	0.24	12.50	5.18	13.16	35.33	2.55	1.96	12.80	16.28
2018	0.21	12.84	5.49	13.63	32.71	2.55	2.13	13.42	17.03
2019	0.19	13.05	5.72	13.95	32.26	2.39	2.05	13.31	17.08

(Data source: China Health Statistics Yearbook from 2013 to 2020)

3.3 Alterations in Doctors' Income in Public Hospitals

The "Third-party Evaluation of the Action Plan for Enhancing Medical Services," conducted from 2016 to 2019 by the School of Public Health at Peking Union Medical College, commissioned by the National Health Commission, focused on physicians from major tertiary hospitals in 31 provincial capitals and 43 affiliated universities. The findings revealed that the average salary of doctors in tertiary hospitals in China rose from 99,700 yuan in 2016 to 129,800 yuan in 2017, before declining to 111,800 yuan in 2018. Although it increased again to 122,200 yuan in 2019, it still did not surpass the peak reached in 2017. However, the ratio of the average salary of doctors in tertiary hospitals to the income of urban employees decreased for two consecutive years after 2017, falling to 1.48 in 2019 (see Figure 1). In contrast, the income of physicians globally is typically 2-3 times that of the general population, indicating that the salary levels of doctors in China have remained below international standards for an extended period.

Furthermore, there continues to be a significant disparity between the actual average income and the anticipated earnings of doctors in public tertiary hospitals. The same research from the School of Public Health at Peking Union Medical College indicated that the actual income of doctors in China was only about half of the expected income during the four years from 2016 to 2019, with little change over the years.

The outbreak of the COVID-19 pandemic has also adversely affected the salary levels of doctors, the income of medical institutions at all tiers, and the regular operations of certain hospitals. For instance, the Affiliated Hospital of Jining Medical College experienced a year-on-year decline of 72% in outpatient numbers, a 51% drop in inpatient numbers, and a 56% decrease in business income following the onset of the COVID-19 pandemic. The overall business activity of the hospital plummeted sharply. Concurrently, some hospital expenditures related to epidemic prevention and control rose significantly, and prompt implementation of subsidies for staff assisting Hubei and local infectious disease shelter hospitals was necessary. In addition to the 4.42 million yuan provided through financial subsidies, the remaining 10.9 million yuan of the aforementioned expenses were covered by the hospital's self-raised funds. Ultimately, during the pandemic, the income of this hospital could not offset its expenditures, leading to a 371% year-on-year decrease in its medical surplus. Its normal operations faced considerable challenges, and the benefits were severely impacted. The salary levels of doctors in the hospital also encountered a significant decline in the current year.

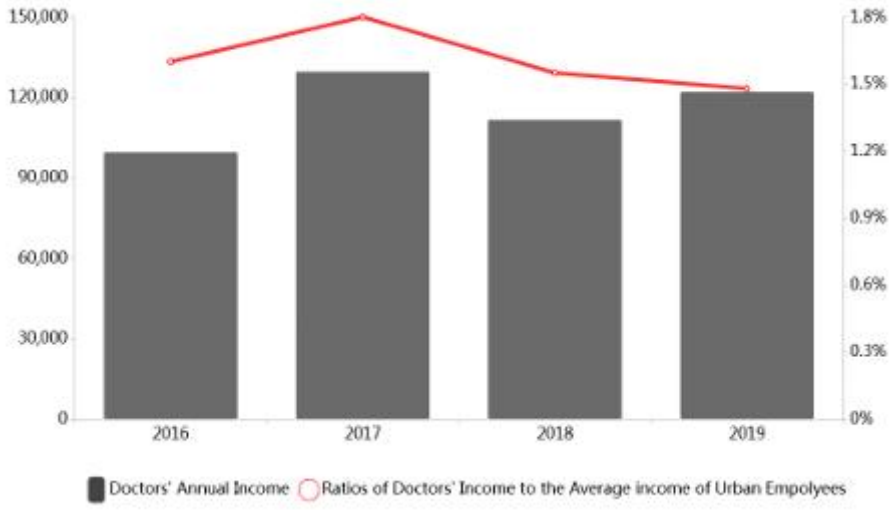

Figure 1 Doctors' Annual Income in Level-three Public Hospitals

Additionally, the reform of the salary structure in public hospitals encounters specific challenges. The central government issued guidance on initiating pilot projects for salary system reform in public hospitals on January 24, 2017. As the pilot projects commenced in accordance with the guidance, the policy regarding hospital salary reform has been emphasized and refined by the central authorities. Unfortunately, by mid-2018, even in regions like Sanming in Fujian province, Chengdu in Sichuan province, Shanghai, and others where pilot projects were implemented earlier, the overall

salary levels have only seen minor advancements and remain in the exploratory phase. For instance, in Sichuan province, the reform of medical service pricing introduced by various regions and cities that officially launched reform plans is relatively limited, compensating only 70% of the income lost due to the elimination of drug markups in public hospitals. This makes it challenging for public hospitals to sustain their current profit levels, and even more difficult to enhance the salary levels of their medical personnel[5,6].

In this complex context, the promotion of centralized procurement of high-value medical consumables has once again had partial negative effects on hospital profitability and doctors' earnings. Some doctors are unable to receive reasonable income compensation for their long-term demanding medical work, making them more likely to be passive in the face of frequent overtime. For instance, in cardiology, a small number of doctors exhibit reluctance towards high-risk stenting procedures, which may adversely affect patient treatment processes. Meanwhile, the special subsidies for certain high-risk operations promised by responsible units at all levels have not been fully realized. Furthermore, non-economic compensations and benefits, such as paid leave, are insufficient, which further negatively impacts doctors' income and the morale of medical staff to some extent[7,8].

Moreover, under the dual pressures of the cancellation of consumable markups and centralized procurement, some medical personnel opt for high-value consumables that are not included in the centralized procurement catalog instead of those that are, hoping to partially offset the impacts of the centralized procurement policy on their earnings. In response to this situation, the State has explicitly mandated in relevant policies that hospitals at all levels should enhance the utilization rates of selected drugs and consumables, requiring medical staff to prioritize the use of these selected products while ensuring medical quality and safety, and linking the usage rates of selected items to the performance evaluation of doctors. However, due to the inherent complexities of medical work, it remains challenging to resolve this issue in a short timeframe.

3.4 PEST Analysis

3.4.1 Politics

The "Opinions of the CPC Central Committee and the State Council on Deepening the Reform of the Medical and Health System," issued in 2009, emphasized the importance of leveraging market mechanisms, implementing open bidding and procurement for essential medications, reducing intermediary links, and firmly addressing commercial bribery in pharmaceutical sales. This aims to benefit the public and safeguard their access to necessary medications. In this significant document, the central government urged all levels of government and relevant entities to actively promote the pilot reform of public hospitals and continually enhance their service quality. This year is also considered the inaugural year of China's new healthcare reform, marking the gradual commencement of public hospital reform. Since 2015, China has released several policy documents, including the "Opinions on Further Standardizing the Centralized Drug Procurement of Medical Institutions," "Guiding Opinions on Improving the Centralized Drug Procurement of Public Hospitals," and "Opinions of the CPC Central Committee and the State Council on Deepening the Reform of the Medical Security System." These documents mandated that governments and public hospitals address the issues of inflated drug prices and high-value medical consumables, fully implementing quantity-based procurement. Consequently, many high-value medical consumables have entered an era of steep price reductions, significantly impacting the actual income levels of public hospitals, medical departments, and physicians.

3.4.2 Economy

Recently, the accelerated aging of the population, a decline in the overall proportion of payers, and the continuous rise in medical demands have placed increasing pressure on China's medical insurance fund. For instance, from 2017 to 2019, the annual total expenditure of the national basic medical insurance fund surged from 1,442.2 billion yuan in 2017 to 2,085.4 billion yuan in 2019, outpacing the growth of the basic medical insurance balance significantly, with an average annual growth rate of 20%. Concurrently, the balance rate of residents' medical insurance has shown a dramatic downward trend, plummeting from 33.7% in 2009 to just 4.5%.

3.4.3 Society

The issue of "difficult and expensive access to healthcare" has long been a significant concern for the Chinese populace and remains a hot topic in public discourse. For example, during the 13th meetings of the National People's Congress (NPC) and the Chinese People's Political Consultative Conference (CPPCC) in 2019, a data research institute monitored 147,794 pieces of medical-related public opinion information. Among these, Premier Li Keqiang's government work report on enhancing residents' medical insurance standards garnered substantial public attention, receiving 16,699 relevant reports and online reprints. Additionally, mainstream media outlets like china.com established special topics on "medical reform dreamers" during the Two Sessions, attracting considerable attention from netizens and disseminating a wide range of information.

3.4.4 Technology

Centralized government procurement is a common practice globally. Some European and American nations have established national departments and institutions, such as the General Services Administration (GSA) in the United States and the Office of Government Commerce (OGC) in the United Kingdom, founded in 2000, to reduce government expenditures through procurement and negotiation. The operational models and historical experiences of these departments and institutions can provide valuable technical foundations and references for centralized procurement in China's pharmaceutical sector. However, this also presents challenges that need to be addressed.

This highlights the limitations of China's current strategies: Firstly, the standardization of target products is crucial for the success of centralized procurement. The scope of centralized procurement encompasses goods or services with uniform standards, making it challenging to categorize and implement centralized procurement for items with specific needs, non-standardized technical specifications, or those produced on a smaller scale. For instance, in the case of medical consumables, achieving a unified standard regarding types and specifications is problematic. Different manufacturers have varying requirements concerning technology and materials, and doctors may have distinct usage preferences. Consequently, the diversity of medical consumables far exceeds that of pharmaceuticals, complicating the establishment of a consistent technical evaluation for these items. If centralized procurement is executed based on differing standards, it may lead to increased procurement costs and decreased efficiency.

Secondly, standardizing procurement practices poses challenges. Centralized procurement carries significant social implications, legal and anti-corruption risks, and demands high levels of publicity, transparency, and standardization throughout the procurement process. At the same time, it can leverage the benefits of scale, enhance procurement efficiency, and lower costs. However, compared to individual decentralized procurement, centralized procurement faces greater difficulties in balancing various value objectives.

4 CONCLUSION

This paper conducted a quantitative analysis of the negative impacts of healthcare reform in China, integrating factors such as per capita income, healthcare expenditure, changes in public hospital income structures, and doctors' salary levels, alongside other macroeconomic data. Additionally, the PEST model was employed for qualitative analysis, examining the effects of centralized procurement in healthcare reform from political, economic, social, and technological perspectives. The key findings of the study are as follows:

The expenditures of the medical insurance fund, per capita health expenditure, and overall healthcare spending in China are rising rapidly. The adverse effects of COVID-19 on the economy and local government finances underscore the need for healthcare reform and the pursuit of a more sustainable procurement model for medical consumables.

The implementation of the zero-markup drug policy has led to a year-on-year increase in the share of sanitary materials income within the medical revenue of public hospitals, which has become a significant profit source, accounting for over 85% of the total income of public hospitals in China. In the short term, the promotion of the zero-markup policy for consumables and the Centralized Procurement System (CPS) may negatively impact the profitability of some public hospitals[8].

Doctors' salary levels in public hospitals in China have remained low for an extended period, with a substantial gap between actual and expected income. Furthermore, the financial benefits of some hospitals have declined due to COVID-19, leading to reduced medical surpluses. Local government financial subsidies in certain areas have been difficult to secure. The rapid establishment of the CPS has also resulted in significant short-term declines in the salary levels of some doctors[9].

Beyond economic compensation, public hospitals in China have not adequately addressed non-economic compensation and welfare. Many doctors are not receiving reasonable income for their long-term demanding work, which may result in negative consequences such as decreased motivation and changes in medical practices and processes.

Based on these conclusions, the following policy recommendations are proposed for consideration:

Authorities and public hospitals at all levels should expedite and deepen medical system reforms, aiming to establish a reasonable centralized procurement model and an efficient cost control system within hospitals to ensure sustainable procurement of medical consumables[10].

The long-standing low prices for medical services should be adjusted based on the actual conditions of different regions, ensuring that the technical quality of medical staff and the services they provide are more accurately reflected in service pricing.

Local authorities should fulfill their responsibilities and adopt diverse measures to ensure the smooth operation of medical institutions at all levels amidst the impacts of the epidemic, including necessary financial subsidies. Relying solely on public opinion for support in healthcare reform is not a viable approach.

Health authorities should enhance the supervision system governing hospital medical practices, standardize medical processes and types of consumables, and focus on ensuring the quality of medical services provided by public hospitals.

The findings of this paper aim to assist decision-making bodies and relevant stakeholders in gaining a comprehensive understanding of the impacts of the CPS, improving compensation mechanisms and regulatory frameworks, promoting the sustainable and healthy development of the CPS, and contributing positively to the future of healthcare reform in China[11].

This theoretical framework addresses situational demands, enhancing collaborative performance in various real-world contexts. It not only refines insights from early network studies but also provides practical tools for improving group outcomes across diverse settings.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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