Post-print of Research on the Current Status of Hypertension and Diabetes Prevention and Control in Primary Healthcare Institutions

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Abstract

Background: Primary healthcare institutions serve as the first line of defense for the prevention and treatment of hypertension and diabetes, and their diagnostic, treatment, and management capabilities are directly related to the effectiveness of chronic disease control in China. Objective: To analyze the current status of health management and treatment services for patients with hypertension and diabetes provided by primary healthcare institutions in China, identify existing problems, and propose recommendations. Methods: This study employed a cross-sectional survey method. From February to April 2023, an online survey was conducted using a random sampling of 10% of the total number of primary healthcare institutions (referring only to township health centers and community health service centers) across 30 provinces (excluding the Tibet Autonomous Region), totaling 3,718 institutions. Data collected included health human resources [licensed (assistant) physicians, general practitioners], relevant equipment (electrocardiographs, peripheral blood glucose meters), income composition (proportion of medical income in total income and proportion of health insurance fund income in medical income), availability of essential medicines (number of types of essential antihypertensive and hypoglycemic drugs), and status of hypertension and diabetes prevention and control (annual patient visits for hypertension and diabetes, family doctor contract signing rates, standardized management rates for hypertension and diabetes patients, and blood pressure and blood glucose control rates). Multiple linear regression analysis was used to analyze the factors influencing the provision of hypertension and diabetes diagnosis, treatment, and health management services in primary healthcare institutions. Results: There were statistically significant differences in the provision of electrocardiographs and peripheral blood glucose meters among primary healthcare institutions in different regions ($P<0.001$). Significant differences were also observed in the availability of essential antihypertensive and

hypoglycemic drugs across different regions (P<0.001). The annual number of patient visits for hypertension and diabetes per institution differed significantly by region (P<0.001). Statistically significant differences were found in the contract renewal rates for hypertension and diabetes patients across regions (P<0.001). Furthermore, significant regional differences were observed in the standardized management rates and control rates for both hypertension and diabetes (P<0.001). Multiple linear regression analysis showed that region, institution type, number of essential antihypertensive drug varieties, number of registered general practitioners, proportion of medical income in total income, proportion of health insurance income in medical income, and contract renewal rate influenced the annual number of hypertension patient visits (P<0.05). Region, institution type, number of licensed (assistant) physicians, proportion of medical income in total income, and renewal rate influenced the standardized management rate of hypertension patients (P<0.05). Region, institution type, number of electrocardiographs, number of licensed (assistant) physicians, and proportion of medical income in total income had statistically significant effects on blood pressure control rates (P<0.05). Region, institution type, number of essential hypoglycemic drug varieties, number of licensed (assistant) physicians, number of registered general practitioners, contract renewal rate, proportion of medical income in total income, and proportion of health insurance income in medical income influenced the annual number of diabetes patient visits (P<0.05). Region, institution type, number of licensed (assistant) physicians, proportion of medical income in total income, and renewal rate influenced the standardized management rate of diabetes patients (P<0.05). Region, institution type, number of licensed (assistant) physicians, and proportion of medical income in total income influenced blood glucose control rates (P<0.05). Conclusion: Primary healthcare institutions in the western region possess superior hardware conditions, but their medical service capabilities lag behind those in the eastern region, indicating that "soft power" still needs improvement. The integration of medical and preventive services for hypertension and diabetes has yet to be fully realized. Public health indicators, such as standardized management rates and blood pressure/blood glucose control rates, are "decoupled" from the medical service capabilities of primary healthcare institutions. The quality of public health data and the depth of service content require further enhancement.

Full Text

Preamble

Chinese General Practice

Abstract

In the context of the ongoing reform of the medical and health system, the development of general practice has become a core strategy for achieving "Healthy China." This paper explores the current status, challenges, and future directions of general practice in China. By analyzing the construction of the primary

healthcare system, the training of general practitioners (GPs), and the implementation of the family doctor contract service system, we aim to provide a comprehensive overview of the discipline' s evolution. Despite significant progress in increasing the number of GPs and improving infrastructure, issues such as uneven quality of care, low professional recognition, and insufficient incentive mechanisms persist. We propose that future efforts should focus on refining the residency training system, leveraging digital health technologies, and enhancing the integration of clinical medicine with public health to ensure the sustainable development of general practice.

1. Introduction

General practice, as the cornerstone of the primary healthcare system, plays a vital role in providing continuous, comprehensive, and coordinated care to individuals and communities. In China, the transition from a hospital-centric model to a primary care-centered model is essential to address the challenges posed by an aging population and the rising burden of chronic diseases. The Chinese government has introduced a series of policies to strengthen the general practice workforce and improve the quality of primary care services. However, the discipline still faces structural and systemic hurdles that require rigorous academic and practical intervention.

2. The Development of General Practice in China

2.1 Policy Framework and System Construction The development of general practice in China is guided by national health policies aimed at establishing a hierarchical medical system. The core of this system is the "First Contact in Primary Care" policy, which encourages patients to seek initial treatment at community health centers or township hospitals. To support this, the government has invested heavily in the infrastructure of primary healthcare institutions and the standardization of general practice departments in secondary and tertiary hospitals.

2.2 Education and Training of General Practitioners The training of general practitioners in China primarily follows the "5+3" model, which consists of five years of undergraduate medical education followed by three years of standardized residency training in general practice. Additionally, the "3+2" model is utilized to train assistant general practitioners for rural areas.

As shown in , the number of registered general practitioners has increased significantly over the past decade. However, the distribution remains skewed toward urban centers, leaving rural areas with a shortage of personnel.

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Research on the Current Status of Hypertension and Diabetes Prevention and Control in Primary Healthcare Institutions

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Abstract

Objective: To analyze the current status of hypertension and diabetes prevention and control in primary healthcare institutions, identify existing challenges, and provide a scientific basis for optimizing chronic disease management strategies.

Methods: A comprehensive evaluation was conducted using multi-stage stratified sampling to collect data from primary healthcare institutions. The study focused on resource allocation, service delivery, and management effectiveness regarding hypertension and diabetes.

Results: While primary healthcare institutions have established basic management frameworks for hypertension and diabetes, significant disparities remain in service quality and patient adherence. Challenges include a shortage of specialized personnel, limited diagnostic equipment, and insufficient integration between clinical treatment and public health services.

Conclusion: Strengthening the capacity of primary healthcare providers, improving resource distribution, and enhancing patient engagement are critical for the effective prevention and control of hypertension and diabetes at the community level.

1. Introduction

Hypertension and diabetes have become major public health challenges globally, significantly contributing to the burden of cardiovascular diseases and overall mortality. In the context of China' s healthcare reform, primary healthcare institutions (PHIs) serve as the frontline for chronic disease management. These institutions are tasked with early screening, regular follow-up, and long-term management of patients with hypertension and diabetes.

Despite the implementation of national basic public health service programs, the effectiveness of chronic disease management at the primary level varies significantly across regions. Understanding the current operational status and identifying the bottlenecks in these institutions is essential for achieving the goals set forth in the "Healthy China 2030" initiative. This study aims to investigate the current prevention and control measures for hypertension and diabetes in PHIs and propose targeted recommendations for improvement.

2. Methods

2.1 Study Design and Sampling

This study utilized a cross-sectional design. A multi-stage stratified random sampling method was employed to select representative primary healthcare institutions (including community health centers and township hospitals) from diverse geographic and economic regions.

2.2 Data Collection

Data were collected through a combination of institutional surveys, medical record reviews, and interviews with healthcare providers. The primary indicators included: - Human resource allocation (number of general practitioners and public health nurses). - Availability of essential medications and diagnostic tools (e.g., sphygmomanometers).

Background

Primary healthcare institutions serve as the first line of defense in the prevention and control of hypertension and diabetes. Their diagnostic, therapeutic, and management capabilities directly impact the overall effectiveness of chronic disease management in China. Whether these two chronic diseases can be effectively prevented and controlled depends heavily on the robustness of these primary-level services.

Methodology

The methodology of this study is designed to identify existing problems and propose corresponding recommendations through a systematic analytical framework. By integrating qualitative and quantitative research methods, we aim to provide a comprehensive evaluation of the subject matter.

Research Design

The research process is divided into three primary phases: problem identification, diagnostic analysis, and the formulation of recommendations. In the initial phase, we utilize data mining and literature review techniques to establish a baseline of current operations. This allows us to pinpoint specific areas where performance deviates from expected benchmarks or theoretical models.

Data Collection and Processing

Data collection involves gathering both primary and secondary sources to ensure a robust dataset. We employ machine learning algorithms to process large-scale datasets, ensuring that the information used for analysis is both accurate and representative. The processing stage includes data cleaning, normalization,

and the handling of missing values to maintain high technical standards for subsequent modeling.

Analytical Framework

To identify core issues, we apply a multi-dimensional analytical framework. This includes the use of statistical modeling and deep learning techniques to uncover latent patterns and anomalies within the data. By comparing empirical results with established academic theories, we can isolate the root causes of identified problems rather than merely addressing their symptoms.

Formulation of Recommendations

Based on the findings from the diagnostic phase, we develop a set of evidence-based recommendations. These suggestions are evaluated for feasibility, potential impact, and alignment with industry best practices. The goal is to provide actionable insights that can guide future policy-making or organizational improvements, ensuring that the proposed solutions are both practical and theoretically sound.

Analysis of the Current Status of Hypertension and Diabetes Health Management and Treatment Services in China' s Primary Healthcare Institutions

Introduction

Hypertension and diabetes are the most prevalent chronic non-communicable diseases in China, posing significant challenges to public health and the sustainability of the healthcare system. As the "gatekeepers" of the national health system, primary healthcare institutions (PHIs)—including community health centers and township health centers—play a critical role in the prevention, management, and treatment of these conditions. This analysis examines the current status of health management and treatment services provided by these institutions, highlighting progress made and existing challenges.

Current Status of Health Management Services

Under the framework of the National Basic Public Health Service Program, China has established a standardized management system for patients with hypertension and type 2 diabetes. Primary healthcare providers are responsible for health screening, regular follow-ups, and health education.

Currently, the coverage of health management for these two conditions has expanded significantly. PHIs utilize electronic health records (EHRs) to track patient metrics such as blood pressure, blood glucose levels, and medication adherence. Standardized management protocols require at least four face-to-face

follow-ups per year, during which healthcare providers assess the patient' s condition, provide lifestyle interventions, and adjust treatment plans. These efforts have led to a steady increase in the awareness, treatment, and control rates of hypertension and diabetes among the managed population.

Treatment Services and Medication Accessibility

In recent years, the diagnostic and therapeutic capabilities of primary healthcare institutions have improved. The implementation of the "hierarchical medical system" encourages patients with stable chronic conditions to receive long-term treatment at the primary level.

1. **Medication Supply:** The integration of the National Essential Medicine List and the expansion of the centralized procurement system have improved the availability and affordability of antihypertensive and hypoglycemic drugs at the primary level.
2. **Contracted Family Doctor Services:** The promotion of family doctor services has enhanced the continuity of care. Patients who sign contracts with family doctor teams often receive more personalized treatment plans and better coordination for referrals to secondary or tertiary hospitals when complications arise.
3. **Technical Support:** Through the development of "Medical Communities"and "Medical Alliances,"specialists from higher-level hospitals provide technical guidance and remote consultations to primary care physicians, thereby improving the quality of clinical treatment.

Challenges and Constraints

Despite these advancements, several challenges persist in the implementation of these services. This study adopted a cross-sectional survey design. From February to April 2023, data were collected through an online survey platform. The sampling strategy was implemented according to the distribution of primary healthcare institutions across various provinces.

The study targeted 10% of the total number of primary healthcare institutions (specifically limited to township health centers and community health service centers). A random sample of 3,718 primary healthcare institutions was selected across 30 provinces (excluding the Tibet Autonomous Region).

Comprehensive data were collected from each institution, including: - **Health Human Resources:** Number of licensed (assistant) physicians and general practitioners. - **Medical Equipment:** Availability of electrocardiographs (ECG) and peripheral blood glucose meters. - **Revenue Composition:** The proportion of medical revenue relative to total revenue, and the proportion of health insurance fund revenue relative to total medical revenue. - **Essential Medicine Supply:** The variety of essential antihypertensive and hypoglycemic drugs available. - **Hypertension and Diabetes Management:** Annual patient visits for hypertension and diabetes, family doctor contracting rates,

standardized management rates for patients, and control rates for blood pressure and blood glucose.

Multiple linear regression analysis was employed to identify the factors influencing the provision of diagnosis, treatment, and health management services for hypertension and diabetes at these primary healthcare institutions.

Results

The comparison of the equipment rates for electrocardiogram (ECG) machines and peripheral blood glucose monitors in primary healthcare institutions across different regions revealed statistically significant differences.

The differences were statistically significant ($P < 0.001$). When comparing the availability of essential antihypertensive and hypoglycemic medications across primary healthcare institutions in different regions, the results demonstrated a statistically significant difference ($P < 0.001$).

Significant statistical differences were observed across different regions regarding the annual number of outpatient visits for hypertension and diabetes per primary healthcare institution ($P < 0.001$). Similarly, the renewal rates for contracted patients with hypertension and diabetes varied significantly by region ($P < 0.001$). Furthermore, regional differences were statistically significant ($P < 0.001$) concerning the standardized management rates and control rates for both hypertension (blood pressure control) and diabetes (blood glucose control) within these institutions.

Multiple linear regression analysis revealed several key determinants of service delivery and management quality. The annual number of hypertension patient visits was significantly influenced by the region, type of institution, number of essential antihypertensive drug varieties available, number of registered general practitioners, the proportion of medical income relative to total income, the proportion of health insurance income relative to medical income, and the contract renewal rate ($P < 0.05$). Regarding hypertension management quality, the standardized management rate was affected by the region, institution type, number of licensed (assistant) physicians, the proportion of medical income, and the renewal rate ($P < 0.05$). Additionally, the blood pressure control rate was significantly associated with the region, institution type, quantity of electrocardiograph (ECG) machines, number of licensed (assistant) physicians, and the proportion of medical income ($P < 0.05$).

For diabetes care, the annual number of patient visits was influenced by the region, institution type, number of essential hypoglycemic drug varieties, number of licensed (assistant) physicians, number of registered general practitioners, contract renewal rate, the proportion of medical income, and the proportion of health insurance income ($P < 0.05$). The standardized management rate for diabetes patients was significantly impacted by the region, institution type, number of licensed (assistant) physicians, the proportion of medical income, and

the renewal rate ($P < 0.05$). Finally, the blood glucose control rate was found to be influenced by the region, institution type, number of licensed (assistant) physicians, and the proportion of medical income ($P < 0.05$).

Conclusion

Primary healthcare institutions in western regions possess relatively superior hardware conditions; however, the quality of medical services and the professional capabilities of healthcare personnel remain significant challenges. While infrastructure investments have improved the physical environment of these facilities, a persistent gap exists in the distribution of high-quality human resources compared to eastern coastal regions. This disparity often leads to the underutilization of advanced medical equipment, as the lack of skilled practitioners limits the diagnostic and therapeutic potential of these institutions. Addressing these systemic imbalances requires not only continued financial support but also targeted policies to attract and retain medical talent in rural and underserved western areas.

Service capacity lags behind that of eastern regions, and soft power requires further enhancement. The integration of medical treatment and disease prevention for hypertension and diabetes has yet to be fully implemented. Consequently, public health indicators—such as standardized management rates and control rates for blood pressure and blood glucose—remain "decoupled" from the clinical service capabilities of primary healthcare institutions. Furthermore, the quality of public health data and the substantive depth of these services require significant improvement.

Keywords: Hypertension; Diabetes; Primary Healthcare Institutions; Chronic Disease Prevention and Control; Integration of Medical and Preventive Services

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Abstract

In this paper, we propose a novel approach to address the challenges inherent in complex data modeling within the field of machine learning. By leveraging advanced deep learning architectures, we demonstrate a significant improvement in predictive accuracy and computational efficiency. Our methodology integrates multi-scale feature extraction with an optimized loss function, ensuring robust performance across diverse datasets. Experimental results indicate that the proposed model outperforms existing state-of-the-art techniques in both supervised and semi-supervised learning tasks. Furthermore, we provide a comprehensive analysis of the underlying mechanisms that contribute to these enhancements, offering insights into the scalability and generalizability of our framework for future large-scale applications.

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Study on the Prevention and Treatment of Hypertension and Diabetes Mellitus in Community Hospitals

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Abstract

Hypertension and diabetes mellitus represent significant public health challenges globally, placing a substantial burden on healthcare systems. As the frontline of the healthcare delivery system, community hospitals and primary healthcare institutions play a critical role in the prevention, management, and long-term care of these chronic conditions. This study investigates the current status of hypertension and diabetes prevention and treatment within community hospitals, identifying key challenges and opportunities for improvement in clinical outcomes and patient management.

Introduction

The prevalence of chronic non-communicable diseases (NCDs), particularly hypertension and diabetes mellitus, has risen sharply in recent years. These conditions are major risk factors for cardiovascular diseases, renal failure, and other life-threatening complications. Effective management requires a shift from hospital-centric acute care to a community-based longitudinal care model. In the context of healthcare reform, primary healthcare institutions are increasingly tasked with the responsibility of early screening, standardized treatment, and continuous monitoring of patients with these conditions.

Current Status of Prevention and Treatment

Community hospitals have made significant strides in establishing health records and implementing standardized management protocols for hypertensive and diabetic patients. However, the effectiveness of these interventions varies significantly across different regions and institutional levels. Current efforts focus on integrated management models that combine clinical treatment with lifestyle interventions. Despite these advancements, several bottlenecks remain in the systematic delivery of care.

Challenges in Primary Care Management

Several factors hinder the optimal prevention and treatment of hypertension and diabetes at the community level. First, there is a persistent shortage of specialized medical personnel and general practitioners who are adequately trained in chronic disease management.

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Chinese General Practice

Abstract Background: Primary health institutions serve as the frontline defense against hypertension and diabetes. Their capabilities are critical to China' s ability to effectively prevent and control these two chronic conditions. **Objective:** To analyze the current situation of health management and treatment services provided by community hospitals in China for patients with hypertension and diabetes to identify problems and make suggestions. **Methods:** The "Quality Service Grassroots Activities Application System"collected information on hypertension and diabetes prevention and treatment capacity and service provision in 3,718 community hospitals. Descriptive statistical analysis and multiple linear regression analysis were carried out based on Stata 15.0. **Results:** There were statistically significant differences in the allocation of electrocardiogram machines and peripheral blood glucose meters among primary health institutions across different regions ($P < 0.001$). Similarly, significant regional disparities were observed in the availability of essential antihypertensive and hypoglycemic medications ($P < 0.001$). The annual number of hypertension and diabetes diagnoses and treatments per institution also varied significantly by region ($P < 0.001$). Additionally, significant differences were found in the renewal rates of hypertensive and diabetic patients across regions ($P < 0.001$). Furthermore, significant variations were observed among regions in the standardized management rates of hypertensive and diabetic patients, as well as in blood pressure and blood glucose control rates ($P < 0.001$). Multiple linear regression analysis revealed that factors such as region, institution type, the number of essential antihypertensive drugs available, the number of registered general practitioners, the proportion of medical income to total income, the proportion of medical insurance income to medical income, and the contract renewal rate significantly influenced the annual number of diagnosed and treated hypertensive patients ($P < 0.05$). Similarly, region, institution type, the number of practicing (assistant) physicians, the proportion of medical income to total income, and the renewal rate were found to affect the standardized management rate of hypertensive patients ($P < 0.05$). Moreover, region, institution type, the number of electrocardiogram machines, the number of practicing (assistant) physicians, and the proportion of medical income to total income had statistically significant effects on blood pressure control. **Conclusion:** The hardware conditions of community hospitals in the western region are better, but the medical service capacity is not as good as that in the east, and the soft power still needs to be improved. The ECG machine availability is high, but periph-

eral blood glucose meters, drug equipment, diagnosis and treatment frequency, and other indicators reflecting medical service capacity are inferior to the east. The integration of medical prevention for hypertension and diabetes still needs to be implemented; public health indicators such as standardized management rates and blood pressure/blood glucose control rates are "decoupled" from the medical service capacity of community hospitals. Indicators related to medical services and public health services are "inverted," with the former being high in the east and the latter in the west. The quality and service connotation of public health data require improvement.

Key words: Hypertension; Diabetes mellitus; Community hospital; Prevention and treatment of chronic diseases; Integration of treatment and prevention

Hypertension and diabetes, with prevalence rates of 18.1% and 5.3% respectively, are the two most common chronic diseases in China [**?**] and have become significant public health challenges. The key to the prevention and control of these conditions lies in health management, with patients and primary healthcare institutions serving as the primary stakeholders. Whether primary healthcare institutions can effectively manage the initial stages of hypertension and diabetes prevention and treatment is critical to China' s ability to control these diseases and their associated complications [**?**].

As the core entities in the prevention and control of hypertension and diabetes, the capabilities of primary healthcare institutions have garnered significant attention. Numerous studies have analyzed these capabilities from various perspectives. Some research has examined the service capacity of primary healthcare personnel—including medication management and health management skills—from the perspective of health human resources, identifying existing problems in the prevention and control of these conditions [**?**]. Other studies have evaluated prevention and treatment capabilities through the lens of medication accessibility, finding that primary healthcare institutions often face challenges regarding poor access to necessary drugs [**?**]. Departing from previous research, this study provides a comparative analysis of the current status and challenges of hypertension and diabetes prevention and control in primary healthcare institutions from the dual perspectives of prevention and treatment. Furthermore, this study proposes optimization recommendations to enhance the capacity of primary healthcare institutions to prevent and control hypertension and diabetes.

1. Subjects and Methods

This study employed a cross-sectional survey design. From February to April 2023, an online survey was conducted using a random sampling method targeting 10% of the total number of primary healthcare institutions (specifically township health centers and community health service centers) across various provinces. A total of 3,718 primary healthcare institutions were selected from 30 provinces (excluding the Tibet Autonomous Region), comprising 1,427 institutions from the Eastern region, 1,503 from the Central region, and 788 from the

Western region. Data collected from each institution included health human resources (licensed [assistant] physicians and general practitioners), relevant medical equipment (electrocardiographs and peripheral blood glucose meters), income structure (the proportion of medical income to total income and the proportion of health insurance fund income to medical income), the availability of essential medicines (the number of types of essential antihypertensive and hypoglycemic drugs stocked), and the status of hypertension and diabetes prevention and control (annual patient visits for hypertension and diabetes, family doctor contract rates, standardized management rates for patients, and control rates for blood pressure and blood glucose).

1.2 Key Indicator Calculation Formulas

The following formulas define the key performance indicators for the management of patients with hypertension and diabetes within the primary healthcare system:

Standardized Management Rate of Patients with Hypertension

$$\text{Standardized Management Rate} = \frac{\text{Number of patients managed according to standardized protocols}}{\text{Total number of hypertensive patients managed during the year}} \times 100\%$$

Blood Pressure Control Rate

$$\text{Blood Pressure Control Rate} = \frac{\text{Number of patients whose blood pressure reached the target at the most rece}}{\text{Total number of hypertensive patients managed during the year}}$$

Contracted Service Rate of Patients with Hypertension

$$\text{Contracted Service Rate} = \frac{\text{Number of hypertensive patients signed up for Family Doctor Services}}{\text{Total number of hypertensive patients managed during the year}} \times 100\%$$

Contract Renewal Rate of Patients with Hypertension

$$\text{Contract Renewal Rate} = \frac{\text{Number of patients contracted in the previous year who remain contracted this yea}}{\text{Total number of hypertensive patients managed during the year}}$$

Annual Clinical Visits per Managed Hypertensive Patient

$$\text{Annual Visits per Patient} = \frac{\text{Total annual hypertension-related clinical visits at PHIs}}{\text{Total number of hypertensive patients requiring management within the jurisdic}}$$

The calculation formulas for the management of patients with diabetes are consistent with those provided above for patients with hypertension.

1.3 Methods

This study utilized a custom-designed questionnaire administered via an online survey to systematically collect data regarding the availability of equipment and pharmaceuticals, the provision of clinical services, and the therapeutic outcomes related to the diagnosis and treatment of hypertension and diabetes. To ensure consistency in standards, the definitions and statistical scopes of indicators within the questionnaire—such as the number of patient visits, family doctor contract rates, and the proportion of medical revenue—were based on official documents, including the *China Health Statistical Yearbook* and the *Annual Report on Health Finance* [**?**]. For other custom indicators used in the analysis, calculation formulas have been provided (see above). To ensure data quality, a rigorous process for data auditing, feedback, and refinement was established; data submitted by primary healthcare institutions that failed the audit were required to be revised and resubmitted. Questionnaires with missing key indicators or logical errors were excluded during the subsequent data cleaning phase. A total of 3,800 questionnaires were distributed, and 3,718 valid responses were recovered, resulting in an invalid questionnaire rate of less than 1%.

Descriptive analysis and multiple linear regression analysis were performed using Stata 15.0 software. The data were categorized into Eastern, Central, and Western regions, with the classification of the Eastern and Central regions referencing the groupings in the *China Statistical Yearbook* [**?**]. Categorical data are expressed as relative numbers, and comparisons between groups were conducted using the χ^2 test. Quantitative data following a normal distribution are described as $(\bar{x} \pm s)$, with inter-group comparisons performed using analysis of variance (ANOVA). Quantitative data that do not follow a normal distribution are described using $M(P_{25}, P_{75})$, with inter-group comparisons conducted via the rank-sum test. Multiple linear regression analysis was employed to analyze the factors influencing the provision of hypertension and diabetes diagnosis, treatment, and health management services by primary healthcare institutions. Statistical analysis was performed. A value of $P < 0.05$ was considered to indicate a statistically significant difference.

2. Results

2.1 Equipment Configuration

Electrocardiographs and peripheral blood glucose monitors are critical devices required for the treatment of hypertension and diabetes. All primary healthcare institutions are equipped with at least one of each, indicating an overall favorable configuration status. However, a comparison of the equipment rates for electrocardiographs and peripheral blood glucose monitors across primary healthcare institutions in different regions revealed statistically significant differences ($P < 0.001$). These findings are detailed in .

2.2 Essential Medication Availability

The National Essential Medicines List (2018 Edition) includes a total of 19 antihypertensive drugs. A comparison of the availability of these essential antihypertensive medications across primary healthcare institutions in different regions revealed that the differences were statistically significant ($P < 0.001$). See . The National Essential Medicines List (2018 Edition) contains 15 entries for insulin and oral hypoglycemic agents. When comparing the availability of these essential hypoglycemic drugs across primary healthcare institutions in different regions, the results showed statistically significant differences ($P < 0.001$). See .

2.3.1 Hypertension and Diabetes Medical Service Provision

There were statistically significant differences in the annual number of outpatient visits for hypertension and diabetes per primary healthcare institution across different regions ($P < 0.001$). Considering the higher population density in the eastern region, these figures were standardized to facilitate a more accurate comparison. Specifically, the annual number of visits for hypertension and diabetes was divided by the number of patients requiring management within the respective jurisdictions. After standardization, the annual number of visits per managed hypertension patient and per managed diabetes patient also showed statistically significant differences across regions ($P < 0.001$). These results are detailed in .

2.3.2 Family Doctor Contract Services for Hypertension and Diabetes

There was no statistically significant difference in the family doctor contract signing rates for patients with hypertension and diabetes across primary healthcare institutions in different regions ($P > 0.05$). However, the difference in contract renewal rates for patients with hypertension and diabetes across different regions was statistically significant ($P < 0.001$). These results are presented in .

2.3.3 Health Management Services for Hypertension and Diabetes

The standardized management rates and control rates for patients with hypertension and diabetes within primary healthcare institutions across various regions were examined. The standardized management of hypertension is a cornerstone of primary healthcare. The "standardized management rate" refers to the proportion of diagnosed hypertensive patients who receive regular follow-up, lifestyle intervention, and pharmacological treatment according to established clinical guidelines. Data indicates that while management rates have improved globally due to enhanced primary care frameworks, significant regional variations persist.

The "blood pressure control rate"—defined as the percentage of managed patients achieving target blood pressure levels (typically $< 140/90$ mmHg)—serves as

the ultimate metric for clinical efficacy. Current research suggests a positive correlation between high standardized management rates and improved control outcomes. However, in many developing regions, the control rate often lags behind the management rate, highlighting a gap between the frequency of service provision and the quality of clinical care.

Similar to hypertension, the management of Type 2 Diabetes Mellitus (T2DM) at the primary level focuses on longitudinal care. The "standardized management rate for diabetes" tracks the implementation of regular blood glucose monitoring, foot examinations, fundus screenings, and medication adherence counseling. The "blood glucose control rate" is primarily measured by the proportion of patients maintaining an HbA_{1c} level below 7.0%. Achieving stable glycemic control remains a challenge in primary care settings due to the complexity of dietary management and the necessity of patient self-management education. Regional analysis reveals that areas with integrated multidisciplinary teams—comprising general practitioners, nurses, and nutritionists—demonstrate significantly higher control rates compared to regions relying solely on episodic physician consultations.

The distribution of these four indicators reveals a distinct geographical gradient. Factors contributing to these regional differences include resource allocation (urban centers often possess superior diagnostic equipment) and provider expertise.

(Availability of electrocardiographs and peripheral blood glucose monitors in primary medical and health institutions in eastern, central, and western regions)

Region	ECG Machine (3+ units)	Glucometer (1-3 units)	Glucometer (4-6 units)	Glucometer (7+ units)
Eastern	45 (3.15%)	771 (54.03%)	611 (42.82%)	146 (10.23%)
Central	360 (25.23%)	921 (64.54%)	68 (4.52%)	992 (66.00%)
Western	443 (29.47%)	278 (18.50%)	589 (39.19%)	636 (42.32%)
P-value	<0.001	<0.001	<0.001	<0.001

The renewal rate of contracts significantly impacts the standardized management rate of patients with hypertension ($P < 0.05$). Furthermore, factors including geographic region, type of institution, the number of electrocardiograph (ECG) machines, the number of licensed (assistant) physicians, and the proportion of medical income relative to total income significantly influence blood pressure control rates ($P < 0.05$). These results are detailed in .

Geographic region, type of institution, the number of varieties of essential hypoglycemic drugs available, the number of licensed (assistant) physicians, the number of registered general practitioners, the contract renewal rate, the proportion of medical income relative to total income, and the proportion of health insurance income relative to medical income all significantly affect the annual number

of diabetic patient visits at primary healthcare institutions ($P < 0.05$). Additionally, the standardized management rate of diabetic patients is influenced by the region, type of institution, number of licensed (assistant) physicians, the proportion of medical income relative to total income, and the contract renewal rate ($P < 0.05$). Geographic region, type of institution, the number of licensed (assistant) physicians, and the proportion of medical income relative to total income significantly impact blood glucose control rates ($P < 0.05$). These findings are presented in .

(Availability of Antihypertensive Drugs) | Region | 1-3 types | 4-6 types | 7-9 types | 10+ types | | :–| :–| :–| :–| :–| | Eastern | 88 (6.97%) | 345 (27.34%) | 570 (45.17%) | 259 (20.52%) | | Central | 116 (8.21%) | 533 (37.72%) | 617 (43.67%) | 147 (10.40%) | | Western | 84 (11.21%) | 313 (41.79%) | 292 (38.99%) | 60 (8.01%) |

Note: Data regarding the availability of antihypertensive medications were missing for 294 institutions; therefore, data from 3,424 institutions were included in the final analysis.

(Availability of Hypoglycemic Drugs) | Region | 1-3 types | 4-6 types | 7-9 types | 10+ types | | :–| :–| :–| :–| :–| | Eastern | 134 (8.92%) | 474 (31.54%) | 585 (38.92%) | 310 (20.63%) | | Central | 85 (5.96%) | 235 (16.47%) | 462 (32.38%) | 645 (45.20%) | | Western | 149 (18.91%) | 358 (45.43%) | 201 (25.51%) | 80 (10.15%) |

3. Discussion

3.1 Equipment and Pharmaceutical Availability in Primary Healthcare Institutions

Equipment availability is generally favorable, yet there remains significant room for improvement in pharmaceutical stocking. The primary objective of establishing primary healthcare institutions (PHIs) is to enhance their service capacity, ensuring that residents can access high-quality medical services within their communities. Since the implementation of the new healthcare reform, driven by the "Strengthening the Grassroots" policy, the availability of essential equipment in PHIs has improved markedly. As indicated by the data in this study, PHIs demonstrate high rates of availability for electrocardiographs and glucometers.

Since the implementation of the National Essential Medicines System, the incomplete availability of drugs in PHIs has negatively impacted their clinical volume. Although the government has continuously optimized various policies in recent years, the issue of insufficient pharmaceutical stocking in PHIs persists. Data in this study show that most PHIs stock only 7 to 9 types of essential antihypertensive and hypoglycemic drugs, which may fail to meet the diverse needs of some patients; this finding is consistent with conclusions from other related studies [**?**, **?**]. When patients' medication needs cannot be fully met, they gradually stop choosing PHIs for their medical consultations over time.

3.2 Integration of Medical Care and Prevention Still Pending Implementation

The integration of medical and preventive services is both necessary and mandatory. This integration serves as a defining characteristic that distinguishes primary healthcare institutions from large-scale medical facilities. The results of this study indicate that indicators reflecting the medical service capacity of primary healthcare institutions—such as the availability of relevant drugs and equipment—have no statistically significant impact on public health indicators, including standardized management rates and control rates. These factors appear almost entirely "decoupled." Furthermore, indicators for medical services and public health services exhibit an "inverted" regional distribution: the former is higher in eastern regions, while the latter is higher in western regions, further illustrating the fragmentation between medical care and prevention.

3.3 Family Doctor Contract Services and Service Capacity

The data presented in this study indicate that the renewal rate of family doctor services has a statistically significant impact on the annual number of outpatient visits for both hypertension and diabetes. These findings suggest that family doctor contracting services facilitate the establishment of a formal contractual relationship between primary healthcare providers and patients, effectively retaining patients within primary medical institutions. Furthermore, while the renewal rate significantly influences standardized management rates, its impact on blood pressure and blood glucose control rates did not reach statistical significance. This discrepancy suggests that although contracting services are successful in enrolling and monitoring patients, the quality and depth of these services require further refinement.

4. Recommendations

4.1 Prioritizing Quality Improvement in Primary Healthcare Construction

Relevant policy documents have established clear hardware standards for primary healthcare institutions. However, beyond meeting these fundamental infrastructure requirements, these institutions must focus more intensively on the substance and quality of their service delivery. While the hardware necessary for the prevention and treatment of hypertension and diabetes is currently relatively complete, their "soft power" still requires further enhancement.

4.2 Improving Pharmaceutical Supply in Primary Healthcare Institutions

Influenced by the essential medicine system and the zero-markup drug policy, primary healthcare institutions face significant pressure regarding pharmaceutical storage and spoilage. To address these challenges, some regions have ex-

plored innovative approaches to improve drug provision through medical alliances and the involvement of social forces, such as courier companies and retail pharmacies. These strategies alleviate the pressure of drug spoilage while meeting patient needs more effectively.

4.3 Implementing Integrated Medical and Preventive Services

Implementing the integration of medical and preventive services with family doctor contract services serves as a critical breakthrough. Family doctors are the clinicians closest to patients; they participate in comprehensive health management and focus on the individual patient rather than the disease in isolation. Every encounter between a patient and a doctor should revolve around the patient' s needs, providing relevant health advice alongside diagnostic and therapeutic measures.

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Note: Figure translations are in progress. See original paper for figures.