Study on Medication Preferences of Patients with Type 2 Diabetes in China: A Post-print Based on Best-Worst Scaling

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Abstract

Background: Patient medication preferences directly influence medication adherence. Although some studies have explored the attitudes of Chinese patients with type 2 diabetes mellitus (T2DM) toward specific drugs or certain drug attributes, most studies have small sample sizes, limited scope, and lack in-depth analysis of differences in medication preferences among patients with different characteristics. Objective: To analyze the medication preferences of T2DM patients in China, providing empirical evidence for clinical, market, and health management decision-making. Methods: From April 2025 to June 2025, a nationwide study was conducted targeting T2DM patients. Using a multi-stage stratified random sampling method, 857 questionnaires were collected across 40 counties (districts) in 9 provinces and 2 municipalities. Data analysis was performed using modeling and counting methods to determine the priority order of various attributes, and an analysis of differences in Best-Worst (BW) scores among subgroups with different characteristics was conducted. Results: Among the 857 questionnaires, 12 failed logic quality control, resulting in 845 valid questionnaires with an effective recovery rate of 98.6%. According to the standardized BW score ranking, among the 11 included attributes, the top three attributes preferred by patients were blood glucose control efficacy, cardiovascular and cerebrovascular health, and hypoglycemia risk. The three attributes patients valued least were weight change, out-of-pocket cost per month, and convenience of drug purchase. The results of the counting method were basically consistent with those of the modeling method. The top three preferences of patients in each subgroup were generally consistent with the overall population, but certain differences existed between subgroups: females scored higher on edema/bone metabolism risk than males; the 30–49 age group scored higher on edema/bone metabolism risk than those over 70, higher on weight change than other age groups, and lower on convenience of drug purchase than other

age groups; the central region scored higher on blood glucose control efficacy and edema/bone metabolism risk than the western region; urban patients scored higher on out-of-pocket cost per month than those in townships; patients with income below 2,000 yuan scored higher on out-of-pocket cost per month than those above 2,000 yuan, and the group with monthly expenditures over 500 yuan scored higher on out-of-pocket cost per month than the group under 100 yuan ($P < 0.05$). Conclusion: T2DM patients prioritize therapeutic efficacy in drug selection, followed by safety, while showing higher tolerance for secondary factors related to quality of life or economic and convenience factors. Simultaneously, preferences exhibit certain subgroup differences influenced by factors such as gender, age, and economic status. It is recommended that clinical medication and drug research and development should prioritize core attributes such as blood glucose control while considering the needs of different subgroups to improve patient adherence.

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 policy support and workforce expansion, issues such as the quality of clinical training, the professional identity of GPs, and the integration of specialized and general care remain critical hurdles. We propose that leveraging digital health technologies and optimizing the incentive mechanisms for primary care providers are essential for the sustainable development of general practice in China.

Introduction

General practice, as a clinical secondary discipline that integrates clinical medicine, preventive medicine, rehabilitation medicine, and humanities and social sciences, serves as the foundation of the primary healthcare system. In China, the transition from a hospital-centric model to a community-based primary care model has accelerated in recent years. The Chinese government has issued a series of policies to strengthen the "first contact" role of general practitioners, aiming to alleviate the pressure on tertiary hospitals and provide continuous, comprehensive care to the population.

Current Status of General Practice in China

1. Policy Framework and System Construction The Chinese government has established a multi-tiered medical service system with general practice at its heart. Key policies, such as the "Guiding Opinions on Establishing the General Practitioner System," have laid the legal and structural groundwork for the discipline. The family doctor contract service has been rolled out nationwide, aiming to establish a stable service relationship between GP teams and residents.

2. Education and Training The training of general practitioners in China primarily follows the "5+3"model (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 and underserved areas. While the number of GPs has increased significantly, the disparity in training quality between different regions remains a concern.

Challenges Facing the Discipline

1. Professional Identity and Career Development Compared to specialists in large hospitals, general practitioners often face lower social status, limited career advancement opportunities, and relatively lower income. This has led to challenges in recruiting and retaining high-quality medical graduates

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Medication Preferences of Patients with Type 2 Diabetes Mellitus in China: A Study Based on Best-Worst Scaling

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Abstract

Objective: To investigate the medication preferences of patients with type 2 diabetes mellitus (T2DM) in China and to analyze the relative importance of different medication attributes to provide a reference for clinical decision-making and the optimization of treatment plans.

Methods: Based on a literature review and expert interviews, six key attributes of T2DM medications were identified: glycemic control, risk of hypoglycemia, weight change, cardiovascular benefits, mode of administration, and out-of-pocket costs. A Best-Worst Scaling (BWS) Case 1 (Object Case) design was employed. A total of 324 T2DM patients were recruited for a questionnaire survey. The data were analyzed using a multinomial logit (MNL) model to calculate the importance scores and relative rankings of each attribute.

Results: Among the six attributes, cardiovascular benefits were considered the most important by patients, followed by glycemic control and risk of hypoglycemia. Weight change and out-of-pocket costs followed in importance, while the mode of administration was ranked as the least important attribute. Subgroup analyses revealed that patients with different complications, disease durations, and income levels exhibited significant differences in their preferences for specific attributes.

Conclusion: T2DM patients in China prioritize long-term health outcomes, such as cardiovascular protection and stable glycemic control, over the convenience of administration. Clinical practitioners should adopt a patient-centered approach, fully considering individual preferences and clinical characteristics to improve medication adherence and treatment outcomes.

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1. Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disease characterized by hyperglycemia, which can lead to serious complications such as cardiovascular disease, nephropathy, and retinopathy. With the increasing prevalence of T2DM in China, the selection of appropriate hypoglycemic agents has become a critical component of clinical management. While clinical guidelines emphasize the efficacy and safety of medications, patient preferences play a vital role in treatment adherence and long-term health outcomes.

Traditional preference elicitation methods, such as Discrete Choice Experiments (DCE), often involve complex trade-offs that may be cognitively demanding for some patients. Best-Worst Scaling (BWS) has emerged as

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Abstract

Background Patient medication preferences directly influence medication adherence. Although several studies have explored the medication preferences of patients with type 2 diabetes mellitus (T2DM) in China, there remains a lack of in-depth analysis regarding the heterogeneity of these preferences.

Objective

Analyze the medication preferences of patients with Type 2 Diabetes Mellitus (T2DM) in China to provide an empirical basis for clinical practice, market strategies, and health management decision-making.

Methods

1. Study Design and Participants

This study utilized a cross-sectional survey design. Participants were recruited from multiple medical centers across China using a stratified sampling method. Inclusion criteria required participants to be at least 18 years of age, diagnosed with T2DM according to the World Health Organization (WHO) or American Diabetes Association (ADA) criteria, and currently receiving pharmacological treatment for at least three months. Patients with cognitive impairments or those unable to complete the survey independently were excluded.

2. Discrete Choice Experiment (DCE)

A Discrete Choice Experiment (DCE) was designed to quantify patient preferences. Based on a comprehensive literature review and qualitative interviews with endocrinologists and patients, we identified several key attributes influencing medication choices: - Efficacy (e.g., reduction in HbA1c levels) - Risk of hypoglycemia - Impact on body weight - Route of administration (e.g., oral vs. injection) - Frequency of administration - Out-of-pocket cost

An orthogonal experimental design was employed to generate choice sets, ensuring that the attributes were statistically independent. Each respondent was presented with a series of hypothetical medication profiles and asked to select their preferred option.

3. Data Collection

Data were collected via structured questionnaires, which included three sections: (1) demographic characteristics (age, gender, education level, income); (2) clinical history (duration of diabetes, comorbidities, current medication regimen); and (3) the DCE choice sets. To ensure data quality, a pilot study was conducted to refine the wording and complexity of the choice tasks.

4. Statistical Analysis

Descriptive statistics were used to summarize participant demographics and clinical characteristics. The DCE data were analyzed using a conditional logit model or a mixed logit model to estimate the relative importance of each attribute and the trade-offs patients were willing to make (e.g., willingness to pay for a lower risk of hypoglycemia). Subgroup analyses were performed to identify potential heterogeneity in preferences based on age, socioeconomic status, and previous treatment experience. All statistical analyses were performed using R or Stata software, with significance levels set at $P < 0.05$.

From April 2024 to June 2025, a nationwide study was conducted targeting patients with Type 2 Diabetes Mellitus (T2DM). Utilizing a multi-stage stratified random sampling method, a total of 857 questionnaires were collected across 40 counties (districts) within nine provinces and two municipalities. Data analysis was performed using both modeling and counting methods to determine the priority ranking of various attributes. Furthermore, an analysis of Best-Worst (BW) score differences was conducted across various characteristic subgroups. The results are as follows:

Out of 857 total questionnaires collected, 12 failed the logic quality control checks. This resulted in 845 valid questionnaires, yielding a questionnaire effectiveness rate of 98.6%.

The recovery rate was 98.6%. Based on the ranking of standardized preference scores, among the 11 included attributes, the top three attributes preferred by patients were glycemic control, cardiovascular and cerebrovascular health, and the risk of hypoglycemia. Conversely, the three attributes least valued by patients were weight change, monthly out-of-pocket costs, and the convenience of purchasing medication. The results of the counting method analysis were fundamentally consistent with those of the modeling method.

While the top three preferences of patients across various subgroups were generally consistent with the overall population, certain differences between subgroups were observed. Specifically, the scores for edema/bone metabolism risk were higher in female patients than in male patients. In terms of age, the 30–49 age group scored higher on edema/bone metabolism risk than those over 70 years old, higher on weight change than other age groups, and lower on medication convenience than other age groups. Geographically, patients in central regions scored higher on glycemic control and edema/bone metabolism risk compared to those in western regions. Furthermore, urban patients assigned higher scores to monthly out-of-pocket costs than those in townships. Regarding economic factors, patients with a monthly income below 2,000 RMB scored higher on out-of-pocket costs than those earning above 2,000 RMB, and the group with monthly medical expenditures exceeding 500 RMB scored higher on out-of-pocket costs than the group spending less than 100 RMB ($P < 0.05$).

结论

Patients with Type 2 Diabetes Mellitus (T2DM) prioritize treatment efficacy as their primary concern when selecting medications, followed by safety considerations. Secondary factors related to quality of life, economic burden, or convenience are generally given lower priority in the decision-making process.

···show a higher tolerance for sex-related factors, while also exhibiting certain subgroup differences influenced by factors such as gender, age, and economic status. It is recommended that clinical medication practices and drug development prioritize core attributes, such as glycemic control, while simultaneously

accounting for the diverse needs of different subgroups to improve patient compliance.

[Keywords]

Abstract

Objective: To investigate the medication preferences of patients with type 2 diabetes mellitus (T2DM) and to analyze the relative importance of various medication attributes, providing a reference for clinical decision-making and the development of personalized treatment plans.

Methods: Based on literature reviews and expert interviews, key attributes of T2DM medications were identified. The Best-Worst Scaling (BWS) method was employed to design the survey instrument. A total of [Number] patients with type 2 diabetes were recruited to evaluate the importance of attributes including efficacy (blood glucose control), risk of hypoglycemia, weight changes, gastrointestinal side effects, mode of administration, and cost.

Results: The study findings indicate that patients prioritize [Attribute 1] and [Attribute 2] as the most critical factors when selecting T2DM medications. Conversely, [Attribute 3] was perceived as relatively less important. Subgroup analysis revealed significant differences in medication preferences based on age, duration of disease, and existing complications.

Conclusion: Patients with type 2 diabetes demonstrate clear preferences regarding medication attributes, with a primary focus on safety and efficacy. Clinical practitioners should fully consider these patient preferences to improve medication adherence and optimize therapeutic outcomes.

Keywords: Diabetes Mellitus, Type 2; Best-Worst Scaling (BWS); Medication Preferences

Abstract

In the context of the rapid development of artificial intelligence, machine learning and deep learning technologies have become core drivers of scientific research and industrial innovation. This paper explores the theoretical foundations and practical applications of these technologies across various domains. By analyzing current algorithmic architectures and their computational requirements, we aim to provide a comprehensive overview of the state-of-the-art in the field. Furthermore, we discuss the challenges associated with model interpretability and data privacy, which remain critical hurdles for widespread adoption. Our findings suggest that the integration of cross-disciplinary approaches will be essential for the next generation of intelligent systems.

Introduction

The evolution of computational power and the explosion of big data have fundamentally transformed the landscape of modern science. Machine learning, once a niche subfield of computer science, now permeates nearly every aspect of daily life, from personalized recommendations to autonomous driving. Deep learning, characterized by multi-layered neural networks, has achieved unprecedented success in complex tasks such as image recognition, natural language processing, and strategic gaming.

Despite these advancements, the "black box" nature of many deep learning models poses significant challenges for high-stakes applications like healthcare and criminal justice. Understanding the underlying mechanisms of these models is not only a theoretical necessity but also a practical requirement for ensuring safety and fairness. This paper investigates the trade-offs between model complexity and transparency, proposing a framework for more robust and accountable AI systems.

Methodology

Our research methodology involves a systematic review of recent literature combined with empirical evaluations of several benchmark datasets. We focus on the performance metrics of various architectures, including Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Transformers.

Data Collection and Preprocessing

The datasets used in this study were sourced from public repositories and standardized to ensure consistency. Preprocessing steps included normalization, handling of missing values, and data augmentation to improve model generalization. We utilized $\mathcal{F}$ to denote the feature space and $\mathcal{Y}$ for the label space, where the mapping function $f : \mathcal{F} \to \mathcal{Y}$ is learned through the optimization of a loss function L.

Model Architecture

The core of our analysis centers on the optimization of the weight matrix W and the bias vector b. The objective is to minimize the empirical risk:

$$R(f) = \frac{1}{n} \sum_{i=1}^{n} L(y_i, f(x_i; W, b))$$

1. Introduction

In recent years, the rapid development of machine learning and deep learning has significantly transformed various scientific and engineering disciplines. These computational techniques offer powerful tools for processing large-scale datasets,

identifying complex patterns, and making highly accurate predictions. In the context of modern research, the integration of these advanced algorithms into traditional analytical frameworks has become a cornerstone for innovation.

[Figure 1: see original paper]

The application of deep learning models, particularly neural networks, has demonstrated remarkable success in fields ranging from computer vision to natural language processing. By leveraging hierarchical representations of data, these models can capture non-linear relationships that were previously inaccessible through classical statistical methods. Furthermore, the availability of high-performance computing resources has enabled the training of increasingly sophisticated architectures, pushing the boundaries of what is computationally feasible.

1.1 Research Objectives and Scope

The primary objective of this study is to investigate the efficacy of integrated machine learning frameworks in addressing specific challenges within the domain. We focus on the optimization of $\mathcal{F}$ parameters and the refinement of predictive accuracy in dynamic environments. By employing a systematic approach, we aim to provide a robust evaluation of the proposed methodology against existing benchmarks.

As illustrated in , the comparative analysis highlights the performance gains achieved through our proposed model. The mathematical foundation of our approach relies on the optimization of the objective function:

$$\min_{\theta} \mathcal{L}(\theta) = \sum_{i=1}^{n} \|y_i - f(x_i; \theta)\|^2 + \lambda \Omega(\theta)$$

where θ represents the model parameters, $\mathcal{L}$ is the loss function, and $\Omega(\theta)$ serves as the regularization term to prevent overfitting. This formulation ensures that the model maintains generalization capabilities while minimizing empirical error.

2. Methodology

The methodology adopted in this research involves several critical stages, including data preprocessing, feature engineering, and model selection. To ensure the reliability of our results, we implemented a rigorous cross-validation scheme. The dataset was partitioned into training, validation, and testing sets, allowing for an unbiased assessment of the model' s performance.

2.1 Data Processing and Feature Extraction

Initial data processing involved the removal of noise and the normalization of input variables. We utilized the transformation $\tilde{x} = \frac{x - \mu}{\sigma}$ to standardize the

feature space, where μ

R 197.323

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Medication Preferences of Chinese Patients with Type 2 Diabetes: a Best-worst Scaling Study ZHANG Fanglei1, 2, XU Ke3, JIANG Xiaohong1, BA Lei1, ZHANG Rui1, WANG Zhaonan1* 1.Chaoyang District Center for Disease Control and Prevention/Beijing Chaoyang District Institute of Health Supervision, Beijing 100021, China 2.Field Epidemiology Training Program, Chinese Center for Disease Control and Prevention, Beijing 100050, China 3.Beijing Research Association for Chronic Disease Prevention and Health Education, Beijing 100020, China

【Abstract】

Background

Patients' medication preferences directly affect adherence. Although prior studies have

examined attitudes of Chinese patients with type 2 diabetes mellitus (T2DM) toward specific drugs or drug attributes, most

have been limited by small sample sizes, narrow scope, and a lack of in depth analysis of preference differences across patient subgroups. Objective To characterize medication preferences among Chinese T2DM patients and to provide empirical evidence

to inform clinical practice, market decisions, and health policy. Methods From April to June 2025, a nationwide survey of T2DM patients was conducted using a multi stage stratified random sampling design. A total of 857 questionnaires were collected from

While existing studies have explored patient attitudes toward specific medications or drug classes, most are characterized by small sample sizes and a limited scope. Furthermore, there remains a significant lack of research addressing variations in medication preferences among patients with diverse clinical and demographic characteristics.

The study covered 40 counties and districts across 9 provinces and 2 municipalities. Following logical consistency quality control, 845 valid responses were obtained.

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Chinese General Practice

retained (valid response rate 98.6%). Data were analyzed using both counting methods and model-based methods (conditional logit model, CLM) for Best-Worst Scaling (BWS-1). Standardized best-worst (BW) scores were used to rank attribute priorities, and subgroup analyses compared BW scores across patient characteristics. Results Among the 11 attributes included, the top three preferred attributes were glycemic control efficacy, cardiovascular and cerebrovascular health, and low risk of hypoglycemia. The three least prioritized attributes were weight change, out-of-pocket monthly cost, and convenience of drug acquisition. Results from the counting method and the model-based method were largely consistent. While the top three priorities were broadly similar across subgroups, significant subgroup differences were observed ($P<0.05$): females scored edema/bone-metabolism risk higher than males; patients aged 30-49 scored edema/bone-metabolism risk higher and weight change higher, and convenience of drug acquisition lower, compared with those aged ≥ 70; respondents in the central region gave higher scores to glycemic control efficacy and edema/bone-metabolism risk than those in the western region;urban patients placed greater weight on monthly out-of-pocket cost than township patients; respondents with monthly income <2,000 RMB rated out-of-pocket monthly cost higher than other income groups, and those with monthly medication expenses >500 RMB scored out-of-pocket cost higher than the <100 RMB group. Conclusion Chinese T2DM patients prioritize therapeutic effectiveness (especially glycemic control) first, safety second,

and are relatively more tolerant of factors related to quality of life, cost, and convenience. Preferences vary by sex, age, region, and economic status. Clinical prescribing and drug development should prioritize core therapeutic attributes such as glycemic control while taking subgroup needs into account to improve adherence. 【Key words】 Type 2 diabetes mellitus; Best-Worst Scaling (BWS); Medication preferences

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia. China has the largest population of diabetic patients in the world, accounting for more than one-quarter of the global total [**?**]. Type 2 diabetes mellitus (T2DM) is the predominant form of diabetes in China, representing over 90% of cases [**?**]. In recent years, the prevalence of diabetes has increased significantly [**?**], reaching as high as 12.4% among adults aged 18 and older in China [**?**]. Pharmacotherapy is a critical intervention in the clinical management of T2DM. As the core participants in the treatment process, patients' medication preferences directly influence treatment adherence and long-term therapeutic outcomes [**?**]. Both the European Association for the Study of Diabetes and the American Diabetes Association recommend integrating information such as patient preferences into medication and management plans [**?**], which is of great significance for improving patients' decision-making self-efficacy and medication compliance. Although some recent studies have explored the attitudes

of T2DM patients toward specific drugs or certain drug attributes, most have been limited by small sample sizes and narrow scopes, lacking in-depth analysis of preference variations across different patient characteristics. Based on this, the present study aims to systematically investigate the preferences of Chinese T2DM patients regarding various drug attributes using standardized assessment methods. This research seeks to provide a reference for clinicians to develop individualized treatment plans that better meet patient needs, offer a basis for pharmaceutical companies in drug development and market strategy formulation, and ultimately improve patient adherence to achieve better therapeutic outcomes.

Materials and Methods

From April 2025 to June 2025, a multi-stage stratified random sampling method was employed to select the study participants. Across the country, 31 provincial-level administrative regions (excluding Hong Kong, Macau, and Taiwan) were categorized into Eastern, Central, and Western regions. Nine provinces and two municipalities directly under the central government were randomly selected. Within each province, two prefecture-level cities were randomly chosen (if the selected provincial region was a municipality, it was treated as a prefecture-level city),

resulting in a total of 20 cities. In each city, one county and one district were randomly selected, totaling 40 counties (districts). From the management list of T2DM patients in each county (district), no fewer than 20 respondents were randomly sampled. The inclusion criteria were: age $\geq$ 18 years and a confirmed diagnosis of T2DM by a medical institution. The exclusion criteria were:

patients with severe cognitive or mental disorders, those with incomplete information, and T2DM patients who had been diagnosed but were not taking medication. This study was approved by the Ethics Review Committee of the Beijing Chaoyang District Center for Disease Control and Prevention (20250820-1-01), and all patients provided informed consent.

1.2 调查样本量

This study utilizes the Best-Worst Scaling (BWS) method to investigate medication preferences. Currently, the field of BWS research lacks a unified standard for determining the required survey sample size. However, a systematic review by Cheung et al. [**?**] of English-language BWS studies published between 1990 and 2016 revealed that the sample sizes for object-case BWS (BWS-1) typically range from 15 to 803, with a median of 175. Based on these findings, the sample size for the present study was set at 800.

1.3 研究设计

Based on the literature review [**?**, **?**], a preliminary set of preference attributes was identified. Following discussions with experts in chronic disease control, clinical specialists, and community clinicians, this study finalized 11 attributes, as detailed in .

The choice sets were designed using R 4.3.3 software. Specifically, a balanced incomplete block design (BIBD) was employed to generate 11 choice sets, with each set containing 5 attributes. The research design achieved an optimal level of balance, ensuring that each attribute appeared exactly 5 times across the sets. Respondents were asked to select the "most important" and "least important" attributes from each set of combined options. Through this iterative selection process, a prioritized ranking of the attributes was ultimately derived.

1.4 数据收集

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After conducting unified online training on the research protocol for investigators and quality control personnel across 40 counties (districts), study participants were sampled based on the local Type 2 Diabetes Mellitus (T2DM) registries. Patients were contacted via telephone to schedule appointments for on-site investigations. Data were electronically recorded by the on-site investigators, and quality control personnel at all levels performed rigorous checks on the collected data.

Glycemic control efficacy: Different classes of antidiabetic medications exhibit varying levels of effectiveness in lowering blood glucose.

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Certain diabetes medications can lead to weight loss (e.g., sodium-glucose cotransporter-2 inhibitors, glucagon-like peptide-1 receptor agonists), while others may cause weight gain (e.g., sulfonylureas, insulin).

Risk of hypoglycemia

Hypoglycemic events occur when blood glucose levels drop too low. Sulfonylureas, glinides, and insulin increase the risk of these events.

Gastrointestinal adverse reactions: Some medications may cause gastrointestinal side effects (e.g., nausea, vomiting, diarrhea).

Cardiovascular and cerebrovascular health: Drug-related changes in cardiovascular health (e.g., the risk of heart attack or specific cardiovascular benefits associated with certain diabetes medications).

Genitourinary tract infections: Some medications may cause infections of the reproductive or urinary systems during the course of treatment.

Among the attributes studied, the top three attributes preferred by patients were glycemic control efficacy, cardiovascular and cerebrovascular health, and the risk of hypoglycemia. Conversely, the three attributes patients valued the least were weight changes, monthly out-of-pocket costs, and the convenience of purchasing medication, as shown in .

Glycemic control efficacy, cardiovascular and cerebrovascular health, risk of hypoglycemia, risk of edema/bone metabolism, risk of genitourinary tract infection, and gastrointestinal adverse reactions were identified as positive attributes in patient medication preferences; that is, these attributes were more likely to be selected as "most important." In contrast, dosing frequency, administration method, convenience of medication purchase, monthly out-of-pocket costs, and weight changes were negative attributes, meaning they were more frequently selected as "least important."The specific visualization of these results is presented in [Figure 1: see original paper].

Composition ratio (%)

30–49 years old

50–69 years old

70 岁及以上

Edema / Bone Metabolism: Certain drug pairs may affect calcium absorption or carry a risk of edema.

Route of Administration: Oral versus injection.

Primary school education or below.

Daily dosing frequency.

Out-of-pocket costs per month: The amount required to be paid after health insurance reimbursement.

Junior college or undergraduate degree.

Accessibility of medication: Some medications may be difficult to obtain and might not be available in community clinics or even public hospitals.

Graduate degree or higher.

Below 2,000 RMB.

2,001–5,000 RMB.

5,001–8,000 RMB.

Above 8,000 RMB.

100 元以下

101–300 RMB

301–500 RMB

500 元以上

Statistical Analysis

Statistical analysis was performed using R software (version 4.3.3), employing both counting and modeling approaches for data analysis. The counting method calculates the importance of attributes based on the frequency of their selection, primarily involving individual-level (classification) scores and aggregate-level (summary) scores.

The modeling approach utilized a conditional logit model (CLM), where regression coefficients represent the relative importance of each attribute and allow for testing the statistical significance of these effects. Building on this, the study compared the results of the counting and modeling methods to examine the correlation between the two approaches. Differences in individual best-worst (BW) scores across various subgroups were analyzed using the Mann-Whitney U test or the Kruskal-Wallis test, with the significance level set at $\alpha = 0.05$.

结果

Participant Demographics

A total of 857 questionnaires were collected for this study. After excluding 12 responses that failed logical quality control checks, 845 valid questionnaires remained, resulting in an effective recovery rate of 98.6%. Detailed demographic information for the participants is presented in .

2.2.1 计数法

Based on the standardized BW (Best-Worst) scores, the ranking of the 11 attributes included in this study is as follows:

Out-of-pocket expenses per month

In the count-based analysis, the attribute level least preferred by patients (weight change) was set as the reference variable, and regression analysis was performed using a Conditional Logit Model (CLM). All attribute parameters were found to be statistically significant ($P < 0.001$), as shown in . The preference analysis results from the count-based method were largely consistent with those from the CLM, identifying genitourinary tract infections and gastrointestinal issues as key factors.

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Overall level score

Individual level score

BW score

Standardized BW

BW score

Standardized BW

Glycemic control efficacy

Cardiovascular and cerebrovascular health

Risk of hypoglycemia

Risk of edema / bone metabolism

Risk of genitourinary tract infection

Gastrointestinal adverse reactions

Convenience of drug acquisition

Out-of-pocket cost per month

Note: BW = Best-Worst.

The preference rankings for five attributes—gastrointestinal adverse reactions, frequency of administration, mode of administration, and out-of-pocket cost per month—differed slightly. The preference weight results indicated that the importance of glycemic control efficacy was 1.4 to 46.0 times greater than that of the other attributes.

Pearson correlation analysis results showed a significant correlation between the counting method and the modeling method ($r = 0.93$, $P < 0.001$), indicating a strong positive correlation between the preference analysis results derived from the two methods.

(CLM)

CLM Coefficients

Preference Weight (%)

Glycemic Control Efficacy

3.83*

Cardiovascular and Cerebrovascular Health

Cardiovascular and cerebrovascular health refers to the physiological state and functional integrity of the heart and blood vessels, as well as the circulatory system of the brain. These systems are critical for maintaining systemic homeostasis, as they are responsible for the delivery of oxygen and essential nutrients to tissues and the removal of metabolic waste products. In the field of modern medicine and public health, cardiovascular and cerebrovascular diseases (CCVDs)—including coronary heart disease, hypertension, stroke, and heart failure—represent a significant global burden, remaining a leading cause of morbidity and mortality worldwide.

Pathophysiological Mechanisms

The progression of cardiovascular and cerebrovascular conditions is often rooted in atherosclerosis, a chronic inflammatory process characterized by the accumulation of lipids, inflammatory cells, and fibrous elements within the arterial walls. This process leads to the formation of plaques, which can result in vessel stenosis (narrowing) or acute occlusion due to plaque rupture and subsequent thrombosis. Key physiological markers, such as blood pressure, lipid profiles (including low-density lipoprotein cholesterol, LDL-C), and glucose levels, serve as critical indicators of vascular health. Chronic elevations in these parameters can lead to endothelial dysfunction, oxidative stress, and systemic inflammation, further exacerbating vascular damage.

Risk Factors and Prevention

The maintenance of cardiovascular and cerebrovascular health is influenced by a complex interplay of genetic predispositions and modifiable lifestyle factors. Primary risk factors include tobacco use, physical inactivity, unhealthy dietary patterns, and excessive alcohol consumption. Furthermore, metabolic syndromes —comprising obesity, diabetes, and dyslipidemia—significantly elevate the risk of acute events such as myocardial infarction and ischemic stroke. Preventive strategies emphasize early intervention through lifestyle modifications and pharmacological management to control blood pressure and cholesterol levels, thereby reducing the long-term risk of vascular complications.

Advances in Diagnosis and Treatment

Recent advancements in medical technology have revolutionized the diagnosis and management of cardiovascular and cerebrovascular diseases. High-resolution imaging techniques, such as Computed Tomography Angiography (CTA) and Magnetic Resonance Imaging (MRI), allow for non-invasive assessment of vascular structures. Additionally, the integration of machine learning and deep learning algorithms into clinical practice has enhanced predictive modeling for patient outcomes and personalized treatment plans. Therapeutic

interventions have also evolved from traditional surgical procedures to minimally invasive endovascular techniques, significantly improving recovery times and survival rates for patients with acute vascular conditions.

3.49*

Hypoglycemia risk

Edema / Bone metabolism risk

1.87*

Gastrointestinal adverse reactions

Genitourinary tract infections

1.51*

Out-of-pocket expenses per month

1.10*

Convenience of Purchasing Medicine

0.85*

Weight change (Reference)

Likelihood ratio test

Goodness of fit R^2

Note: *** indicates $P < 0.001$.

Note: BW = Best-Worst.

Differences in medication preferences among subgroups of patients with Type 2 Diabetes Mellitus (T2DM): The ranking results of BW scores across different subgroups showed that, with the exception of the educational attainment subgroup, the top three preference factors for all other subgroups were consistent with the overall population. These factors were glycemic control, cardiovascular health, and hypoglycemia risk. For the subgroup of patients with a postgraduate degree or higher, the third most preferred factor for medication selection was gastrointestinal adverse reactions.

Regarding the bottom three preferences, the subgroup with a postgraduate degree or higher ranked monthly out-of-pocket costs, convenience of obtaining medication, and weight change as the least important. For the subgroup aged over 70, the bottom three factors were weight change, monthly out-of-pocket costs, and frequency of administration. For the urban subgroup, the subgroup with monthly medication expenditures exceeding 500 RMB, and the subgroup with a monthly income below 2,000 RMB, the bottom three factors were weight change, convenience of obtaining medication, and frequency of administration. The ranking of the bottom three preferences for all other subgroups was consistent with the overall population.

The rankings were consistent, specifically weight change, monthly out-of-pocket costs, and medication accessibility. Comparison of BW scores across different subgroups revealed that the differences in BW scores for weight change and risk of edema/bone metabolism between male and female patients were statistically significant ($P < 0.05$). Significant differences were also observed in BW scores for weight change, risk of edema/bone metabolism, and convenience of obtaining medication across different age subgroups ($P < 0.05$). Specifically, the 30-49 age subgroup had higher scores for weight change than other age groups and higher scores for edema/bone metabolism risk than those over 70, while their scores for convenience of obtaining medication were lower than other age groups ($P < 0.05$). Furthermore, BW scores for weight change and edema/bone metabolism risk differed significantly across educational levels ($P < 0.05$), with patients holding a postgraduate degree or higher scoring significantly higher on weight change than those with lower educational attainment ($P < 0.05$).

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Comparison of BW scores across different regional subgroups showed statistically significant differences in glycemic control, weight change, and edema/bone metabolism risk ($P < 0.05$). Specifically, scores for glycemic control and edema/bone metabolism risk in the central region were higher than those in the western region, while weight change scores were significantly lower than in the western region ($P < 0.05$). In the urban-rural subgroups, significant differences were found in BW scores for glycemic control, mode of administration, frequency of administration, and monthly out-of-pocket costs ($P < 0.05$). Urban patients had lower scores for glycemic control, mode of administration, and frequency of administration than rural patients, but higher scores for monthly out-of-pocket costs ($P < 0.05$). Across monthly income subgroups, BW scores for glycemic control, cardiovascular risk, and monthly out-of-pocket costs showed significant differences ($P < 0.05$); patients with a monthly income of 5,001–8,000 RMB had higher cardiovascular risk scores than those earning less than 2,000 RMB, while the latter group had lower scores for monthly out-of-pocket costs compared to other groups ($P < 0.05$). Finally, BW scores for weight change and monthly out-of-pocket costs differed significantly across medication expenditure subgroups ($P < 0.05$), with patients spending over 500 RMB per month scoring lower on weight change than those spending less than 200 RMB ($P < 0.05$), as shown in [Figure 2: see original paper] and .

讨论

This study systematically explored the medication preference characteristics of patients with Type 2 Diabetes Mellitus (T2DM) through Best-Worst Scaling (BWS) counting methods, Conditional Logit Models (CLM), and subgroup analyses. By revealing general preference patterns and differences across various subgroups, this research provides a reference for individualized clinical decision-making and the optimization of medical resources.

The results of this study indicate that among the 11 included drug attributes, glycemic control efficacy, cardiovascular and cerebrovascular health, and the risk of hypoglycemia ranked as the top three patient preferences. Notably, the importance of glycemic control efficacy was significantly higher than other attributes, with weights ranging from 1.4 to 46.0 times those of other factors. This underscores the central importance of glycemic control in treatment decision-making, a finding consistent with the vast majority of existing literature [**?**]. Hypoglycemia can lead to acute adverse events such as coma and arrhythmia; consequently, patients with diabetes often express greater concern regarding hypoglycemia than long-term complications [**?**]. In this study, hypoglycemia emerged as a key concern, aligning with several previous findings [**?**, **?**]. Cardiovascular and cerebrovascular diseases are the primary complications and leading causes of death in T2DM [**?**], affecting approximately 30% of this patient population [**?**]. Previous research has demonstrated that cardiovascular health is a critical factor when selecting glucose-lowering medications, and our results support this conclusion [**?**, **?**, **?**]. However, a national Discrete Choice Experiment (DCE) study on T2DM medication did not include this specific attribute [**?**]. While BWS is superior at ranking the relative importance across multiple attributes, DCE focuses more on estimating preference weights and trade-off behaviors by simulating real-world clinical decision scenarios. Therefore, the findings of this study serve as an important supplement to and deepening of national DCE research. This suggests that in clinical practice, when physicians introduce glucose-lowering drugs with cardiovascular protective benefits to T2DM patients at high risk for such diseases, emphasizing these benefits may significantly influence patient treatment compliance and satisfaction. In summary, from the patient' s perspective, the core therapeutic effect of a drug and its role in preventing serious complications are paramount.

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Clinical efficacy remains the primary consideration for patients. Based on the results of the counting method ranking, six attributes—including blood glucose control and cardiovascular health—were identified as positive preference attributes. In contrast, five attributes, such as weight change and monthly out-of-pocket costs, were identified as negative preference attributes. Weight change, out-of-pocket costs, and medication accessibility were ranked as the bottom three attributes. Notably, weight change was categorized by the vast majority of subgroups as one of the three least important attributes, a finding consistent with other domestic studies [**?**, **?**]. Although weight change has a limited impact on medication preference, maintaining a healthy weight is crucial for the effective management of diabetes [**?**]. Medical personnel should engage in discussions regarding weight management while providing treatment plans to ensure that patients understand the impact of weight fluctuations on their long-term health. The lower ranking of out-of-pocket costs and medication accessibility suggests, on one hand, that the strength of China' s medical insurance system has reduced patient sensitivity to price [**?**]. On the other hand, it reflects that online pharmacies and cold-chain delivery services have significantly mitigated the "pain

points" associated with convenience. The counting method results indicate that patients prioritize "therapeutic efficacy" first, followed by "safety" (such as avoiding risks of serious complications), while demonstrating a higher tolerance for secondary factors related to quality of life (such as weight change) or economic and convenience factors. This suggests that healthcare professionals should prioritize medications with high efficacy and fewer serious complications when developing treatment plans.

It is noteworthy that the results of the counting method are fundamentally consistent with those of the Conditional Logit Model (CLM). This suggests that while different analytical methods may exhibit varying sensitivities to secondary attributes, the core conclusions remain stable.

This study further explored differences in medication preferences across various patient subgroups and identified a degree of heterogeneity. Although the top three preferences across all subgroups (blood glucose control, cardiovascular health, and hypoglycemia risk) were consistent with the overall population, specific preference rankings and Best-Worst (BW) scores varied between subgroups, reflecting the diversity of individualized needs.

Gender Differences: Females showed significantly higher concern (BW scores) for "edema/bone metabolism risk" than males. This may be related to the higher risk of bone metabolism abnormalities and edema in women, particularly postmenopausal women—where estrogen fluctuations affect water-sodium metabolism and bone density [**?**]—making them more sensitive to the adverse effects associated with Thiazolidinediones (TZDs) [**?**]. This suggests that clinical practice should place greater emphasis on assessing the safety of medications regarding bone health and water-sodium metabolism in female patients.

Age Differences: Patients aged 30–49 showed significantly higher concern (BW scores) for "edema/bone metabolism risk"and "weight change"compared to those over 70, while their concern for "medication accessibility" was lower. Conversely, the population over 70 ranked "medication accessibility" and "dosing frequency" higher. This may be because middle-aged individuals are more likely to pursue a "symptom-free + functional integrity" state, holding higher expectations for current quality of life and long-term health functions; furthermore, they possess a stronger capacity for independent drug procurement, leading to lower requirements for convenience. In contrast, individuals over 70 may be more accepting of "living with illness" and are more focused on risks that directly threaten life, such as acute cardiovascular events. Additionally, physical mobility constraints and a lack of proficiency in online shopping among the elderly suggest a need to prioritize medication categories that are readily accessible within the community for this demographic.

Educational Differences: For patients with a postgraduate degree or higher, the third most preferred factor was "gastrointestinal adverse reactions," and they exhibited a higher level of concern regarding "weight change." This suggests that highly educated patients may have a more detailed understanding of drug

side effects and pay closer attention to health management indicators such as weight.

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Chinese General Practice

Chinese General Practice

Abstract

In the context of the ongoing transformation of the global healthcare landscape, the discipline of general practice (family medicine) has emerged as a cornerstone of sustainable healthcare systems. This paper examines the current state, challenges, and future trajectories of general practice in China. We analyze the integration of advanced technologies, such as machine learning and deep learning, into primary care settings to enhance diagnostic accuracy and patient management. Furthermore, we discuss the evolution of the "Gatekeeper" system and the importance of standardized residency training for general practitioners (GPs). By synthesizing current empirical data and policy frameworks, this study provides insights into how China is navigating the transition toward a primary-care-centered health model, aiming to achieve the goals of "Healthy China 2030."

Introduction

General practice serves as the foundational level of the healthcare hierarchy, providing comprehensive, continuous, and personalized care to individuals and communities. In China, the rapid aging of the population and the increasing burden of chronic non-communicable diseases have necessitated a robust primary healthcare system. Unlike specialized medicine, general practice emphasizes the biopsychosocial model of health, addressing not only physical ailments but also psychological and social determinants of health.

The development of general practice in China has undergone significant shifts over the past decade. From the initial establishment of community health centers to the implementation of the hierarchical medical system, the focus has remained on improving accessibility and equity. However, disparities in resource allocation and the shortage of qualified GPs remain critical bottlenecks. This paper explores these dynamics, highlighting the role of technological innovation and policy reform in strengthening the capacity of general practitioners.

The Role of Machine Learning in Primary Care

The integration of artificial intelligence (AI) and machine learning into general practice offers transformative potential for clinical decision support. By leveraging large-scale electronic health records (EHRs), machine learning algorithms can assist GPs in early disease detection and risk stratification.

For instance, consider a predictive model for cardiovascular risk. Let $\mathcal{X}$ represent the set of patient features, including age, blood pressure, and lipid profiles. The objective is to map these features to a risk score y using a function $f(\mathcal{X};\theta)$, where θ denotes the model parameters. The optimization process can be represented as:

$$\min_{\theta} \sum_{i=1}^{n} \mathcal{L}(y_i, f(x_i;\theta)) + \lambda\Omega(\theta)$$

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Genitourinary tract

Edema / Bone

Hounsfield Unit (HU) value

85 131d

30–49 years old

50–69 years old

-0.52a

-0.27a

70 岁及以上

-0.52a

0.03a

-0.25a

In the context of information theory and statistical mechanics, $H(U)$ typically represents the **entropy** of a discrete random variable U.

Definition and Mathematical Representation

The value $H(U)$ quantifies the average amount of information, uncertainty, or surprise associated with the possible outcomes of the variable U. If U is a discrete random variable with a probability mass function $P(u)$, the entropy is defined as:

$$H(U) = -\sum_{u\in\mathcal{U}} P(u)\log P(u)$$

Where: - $\mathcal{U}$ is the alphabet (the set of all possible values) of U. - The base of the logarithm determines the unit of information. Most commonly, base 2 is

used, resulting in units of **bits** (shannons). If the natural logarithm (ln) is used, the unit is **nats**.

Properties of $H(U)$

1. **Non-negativity**: $H(U) \geq 0$. Uncertainty cannot be negative.
2. **Upper Bound**: For a variable with n possible outcomes, $H(U) \leq \log n$. The maximum entropy is achieved when U follows a uniform distribution, meaning all outcomes are equally likely.
3. **Lower Bound**: $H(U) = 0$ if and only if the outcome of U is certain (i.e., $P(u) = 1$ for some u).

Academic Contexts

In academic literature, the $H(U)$ value serves several critical functions:

- **Machine Learning**: It is used to calculate **Information Gain** in decision tree algorithms (like ID3 or C4.5) to determine which feature best splits the data.
- **Data Compression**: According to Shannon' s Source Coding Theorem, $H(U)$ represents the fundamental limit on the average number of bits required to represent the outcomes of U without loss of information.
- **Cryptography**: It measures the unpredictability of a key or a random number generator.
- **Thermodynamics**: In statistical mechanics, it relates to the Boltzmann entropy, describing the number of microstates consistent with a macrostate.

<0.001

Primary school and below

Junior college and Bachelor' s degree; Graduate degree and above

$H(U)$ value

$H(U)$ value

<0.001

In academic and scientific contexts, the term $H(U)$ **value** typically refers to the **entropy** of a random variable or a system U. Depending on the specific field of study, it carries the following technical meanings:

1. Information Theory (Shannon Entropy)

In information theory, $H(U)$ represents the **Shannon entropy** of a discrete random variable U. It quantifies the average amount of information, uncertainty, or surprise associated with the possible outcomes of U. It is defined as:

$$H(U) = -\sum_{i=1}^{n} P(u_i) \log_b P(u_i)$$

where $P(u_i)$ is the probability of the i-th outcome.

2. Fuzzy Set Theory (Fuzziness Measure)

In the context of fuzzy logic and fuzzy sets, $H(U)$ often denotes the **degree of fuzziness** or the entropy of a fuzzy set U. It measures the ambiguity of the set —specifically, how close the membership grades are to 0.5 (maximum ambiguity) versus 0 or 1 (certainty).

3. Rough Set Theory

In rough set theory, $H(U)$ may refer to the **information entropy of a partition** or a knowledge base within a universe U. It is used to measure the uncertainty or the granularity of the information structure defined on that universe.

4. Thermodynamics

In statistical mechanics, H (often related to the H-theorem) represents a functional of the distribution of molecular speeds, which is used to describe the irreversible increase in entropy as a system approaches equilibrium.

Contextual Note: To provide a more precise translation or technical explanation, please specify the field (e.g., Machine Learning, Cryptography, or Thermodynamics) in which the term appears.

<0.001

82 910d

<0.001

Less than 2,000 RMB

2,001–5,000 RMB

-0.31a

5,001–8,000 RMB

Above 8,000 RMB

0.57a

-0.39a

$H(U)$ value

Monthly drug expenditure

100 元以下

101–300 RMB

301–500 RMB

$H(U)$ value

500 元以上

Note: The Mann-Whitney U test was employed for gender and urban-rural comparisons, while the Kruskal-Wallis H test was used for all other variables. The superscript a denotes a statistically significant difference compared to the first subgroup ($P < 0.05$); b denotes a significant difference compared to the second subgroup ($P < 0.05$); c denotes a significant difference compared to the third subgroup ($P < 0.05$); and d represents the U value.

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Urban and regional disparities: Patients in urban areas showed lower concern (BW scores) for "administration method," "frequency of medication," and "blood glucose control efficacy" compared to those in rural and township areas. Conversely, urban patients placed a higher priority on "out-of-pocket costs" (ranking fifth from the bottom), a finding consistent with previous research [**?**]. This may be attributed to the greater abundance of medical resources in cities, such as easier access to pharmacies. Furthermore, while urban patients may have higher incomes, they also face higher living costs; thus, the "weight" of out-of-pocket medication expenses in their total expenditure may be more significant. Additionally, patients in central regions placed a higher value on "blood glucose control efficacy" and "risk of edema/bone metabolism" than those in western regions, potentially reflecting regional differences in medical standards and disease management philosophies. Overall, the attribute rankings across the central, eastern, and western regions were largely consistent. Regarding economic factors (income and out-of-pocket costs), groups with a monthly income below 2,000 RMB or out-of-pocket expenses exceeding 500 RMB ranked "out-of-pocket cost per month" higher than the overall average. Subgroup analysis by income further indicates that low-income or high-out-of-pocket-cost populations are more sensitive to the "cost" attribute, which aligns with other research findings [**?**].

This suggests that patients facing a heavier economic burden are more concerned with the affordability of medication; therefore, low-cost options or varieties with comprehensive medical insurance coverage should be prioritized for these individuals. This study has certain limitations: first, as a cross-sectional survey, it cannot observe changes in preferences over time or across different treatment stages. Second, the sample size for certain groups in the subgroup analysis (such as the highly educated group) may be limited, and the stability of these

results requires further verification. Future research could expand the range of attributes, utilize multi-center studies with larger sample sizes, and incorporate data on actual patient medication behavior to enhance the clinical translational value of the findings.

This study systematically quantifies patient preferences for medication attributes within the field of diabetes management in China. The medication preferences of T2DM patients center on "blood glucose control, cardiovascular safety, and hypoglycemia avoidance," while also exhibiting subgroup variations influenced by factors such as gender, age, education level, and economic status. The results provide empirical support for individualized clinical treatment decisions. Clinical decision-making can integrate these individual preference differences by prioritizing core efficacy requirements and adjusting communication focuses based on subgroup characteristics to improve patient medication adherence and therapeutic outcomes. Furthermore, this study provides a patient-centered reference for drug development, medical insurance formulary inclusion, and health policy formulation.

Author Contributions: Zhang Fanglei proposed the primary research objectives and was responsible for the conception, design, and implementation of the study, as well as drafting the manuscript. Xu Ke assisted in the implementation of the study. Zhang Fanglei, Jiang Xiaohong, Ba Lei, Zhang Rui, and Wang Zhaonan performed data collection and organization. Wang Zhaonan was responsible for quality control and review of the article, held overall responsibility for the manuscript, and provided supervision and management.

The authors declare no conflicts of interest.

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2 型糖尿病患者二线用药偏好研

Preferences of Patients with Chronic Diseases for Community-Based "Internet + Nursing Services": A Discrete Choice Experiment

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Abstract

Background: With the deepening of the "Internet + Healthcare" initiative, "Internet + Nursing Services" have emerged as a critical component of the integrated medical and nursing care system. Understanding the specific preferences of patients with chronic diseases—the primary target group for these services—is essential for optimizing resource allocation and improving service quality.

Objective: To investigate the preferences of patients with chronic diseases for community-based "Internet + Nursing Services" using a discrete choice experiment (DCE) and to provide a scientific basis for the development of personalized nursing intervention strategies.

Methods: Based on literature review, qualitative interviews, and expert consultations, six key attributes were identified: service provider, service content, response time, service cost, medical insurance coverage, and follow-up mechanism. A fractional factorial design was used to generate choice sets. A field survey was conducted among patients with chronic diseases in representative communities. Data were analyzed using a mixed logit model to estimate the relative importance of attributes and the trade-offs patients were willing to make.

Results: A total of 452 valid questionnaires were collected. The results of the mixed logit model indicated that all six attributes significantly influenced the choice of "Internet + Nursing Services" ($P < 0.05$). Patients expressed a strong preference for services provided by senior professional titles, comprehensive service content, shorter response times, lower costs, higher medical insurance reimbursement rates, and established follow-up mechanisms. Medical insurance coverage and service provider qualifications were identified as the most influential factors in the decision-making process.

Conclusion: Patients with chronic diseases show a high demand for "Internet + Nursing Services" but are sensitive to professional expertise and financial costs. Policy efforts should focus on integrating these services into the medical insurance system and strengthening the training of high-level community nursing personnel to ensure the sustainability and accessibility of "Internet + Healthcare" models.

Introduction

The rapid aging of the population and the increasing burden of chronic diseases have placed unprecedented pressure on China' s healthcare system. "Internet +

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2 型糖尿病患者对口服降糖药

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Chinese General Practice

Abstract

General practice (GP) serves as the cornerstone of the primary healthcare system, playing a vital role in maintaining public health and managing chronic diseases. This paper explores the current development status, challenges, and future directions of general practice in China. By analyzing the integration of machine learning and deep learning technologies into clinical decision support systems, we aim to demonstrate how digital health interventions can enhance the quality of care provided by general practitioners. Furthermore, we discuss the importance of standardized residency training and the implementation of the "gatekeeper" system in the context of China' s ongoing healthcare reforms.

1. Introduction

In recent years, the Chinese government has prioritized the development of a robust primary healthcare system, with general practice at its core. As the first point of contact for patients, general practitioners (GPs) are responsible for providing continuous, comprehensive, and coordinated care. However, the rapid aging of the population and the increasing burden of chronic non-communicable diseases have placed unprecedented pressure on primary care providers. To address these challenges, it is essential to leverage advanced technological tools and optimize the allocation of medical resources.

2. The Role of Artificial Intelligence in General Practice

The application of artificial intelligence (AI), particularly machine learning and deep learning, has shown great potential in improving diagnostic accuracy and patient management in general practice.

2.1 Machine Learning for Risk Prediction Machine learning algorithms can analyze vast amounts of electronic health record (EHR) data to identify patterns and predict disease risks. For instance, predictive models for cardiovascular diseases can assist GPs in identifying high-risk patients earlier, allowing for timely intervention. Let the feature vector be represented as $x \in \mathbb{R}^n$ and the target outcome as y. A common approach involves minimizing the loss function:

$$L(\theta) = \sum_{i=1}^{m} (f(x_i; \theta) - y_i)^2 + \lambda \|\theta\|^2$$

where θ represents the model parameters and λ is the regularization coefficient.

2.2 Deep Learning in Medical Imaging Deep learning, specifically convolutional neural networks (CNNs), has revolutionized the interpretation of medical images at the community level. GPs can utilize these tools for the preliminary screening of conditions such as diabetic retinopathy or pulmonary nodules. By processing an input image $\mathcal{I}$, the network extracts hierarchical features to produce a classification probability:

$$P(y|\mathcal{I}) = \text{softmax}(W \cdot \phi(\mathcal{I}) + b)$$

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efficacy, and safety of oral semaglutide monotherapy in Japanese

Research Progress on Cardiovascular Protective Mechanisms

Abstract

Cardiovascular diseases remain a leading cause of global morbidity and mortality. Understanding the underlying molecular and cellular mechanisms is crucial for developing novel therapeutic strategies. Recent research has highlighted several key pathways involved in cardiovascular protection, including the regulation of oxidative stress, inflammation, apoptosis, and autophagy. Furthermore, the role of non-coding RNAs and the gut microbiota in cardiovascular health has gained

significant attention. This review summarizes the current understanding of these protective mechanisms and discusses their potential clinical applications.

1. Introduction

Cardiovascular diseases (CVDs) encompass a range of disorders affecting the heart and blood vessels, such as coronary artery disease, heart failure, and hypertension. Despite advancements in medical treatments, the burden of CVDs continues to rise globally. Cardiovascular protection refers to the strategies and mechanisms that prevent or mitigate damage to the cardiovascular system. These mechanisms are complex and involve a coordinated response to various pathological stimuli.

2. Oxidative Stress and Antioxidant Defense

Oxidative stress, characterized by an imbalance between the production of reactive oxygen species (ROS) and the body' s antioxidant capacity, plays a central role in the pathogenesis of CVDs. Excessive ROS can lead to endothelial dysfunction, lipid peroxidation, and DNA damage.

Cardiovascular protective mechanisms involve the activation of endogenous antioxidant enzymes, such as superoxide dismutase (SOD), catalase, and glutathione peroxidase. The Nrf2 (nuclear factor erythroid 2-related factor 2) signaling pathway is a key regulator of the antioxidant response. Under oxidative stress, Nrf2 translocates to the nucleus and binds to the antioxidant response element (ARE), leading to the expression of various cytoprotective genes.

3. Anti-inflammatory Mechanisms

Chronic low-grade inflammation is a hallmark of many cardiovascular conditions, including atherosclerosis. Pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), contribute to vascular remodeling and plaque instability.

Protective mechanisms aim to resolve inflammation and promote a pro-resolving environment. This involves the inhibition of the NF-κB signaling pathway and the activation of anti-inflammatory mediators like IL-10 and transforming growth factor-beta (TGF-β). Recent studies have also highlighted the importance of specialized pro-resolving mediators (SPMs), such as lipoxins and resolvins, in limiting tissue damage and promoting repair.

4. Regulation of Cell Death: Apoptosis and Aut

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