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ORIGINAL RESEARCH

# Informing Hospital Formulary Decisions in China: A Multi-Criteria Value Framework for GLP-1 Receptor Agonists

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**Purpose:** GLP-1 receptor agonists have attracted increasing attention due to their dual efficacy in glycemic control and weight reduction. Although several GLP-1 receptor agonists have been included in China's National Reimbursement Drug List, their actual adoption at the hospital level still faces multiple challenges. A well-structured evaluation framework is urgently needed to facilitate their integration into hospital formularies. This study aims to develop a clinically comprehensive evaluation system for GLP-1 receptor agonists in public hospital drug selection, based on multicriteria decision analysis (MCDA). The goal is to provide a systematic and quantifiable tool to support the rational selection and implementation of GLP-1RAs in public hospitals, thereby enhancing the scientific basis of hospital formulary decisions.

**Patients and Methods:** The study integrates the Delphi method and multi-criteria decision analysis (MCDA), utilizing literature review, expert consultations, and questionnaire surveys to select and assign weights to evaluation indicators.

**Results:** A three-tier evaluation system was established, comprising four primary indicators, eight secondary indicators, and seventeen tertiary indicators. Among them, "Clinical Value" had the highest weight (0.5373), followed by "Hospital Admission Demand" (0.1924) and "Hospital Management" (0.1379), while "Economic Value" had the lowest weight (0.1324). At the tertiary level, "Cost-Effectiveness Advantage", "Glycosylated Hemoglobin", "Cardiovascular, Hepatic, and Renal Benefits", "Addressing Unmet Clinical Needs", and "Hypoglycemia Incidence" contributed most to decision-making.

**Conclusion:** This study fills the gap in clinical evaluation research on GLP-1RA drugs in China. The proposed evaluation system provides scientific support for hospital pharmaceutical management, medical insurance inclusion, and drug procurement, promoting value-based hospital drug selection strategies.

**Keywords:** GLP-1RA, clinical comprehensive evaluation, health technology assessment, MCDA

## Introduction

According to the International Diabetes Federation (IDF) Diabetes Atlas 2021, 537 million adults aged 20–79 globally have diabetes, accounting for 10.5% of this age group. By 2030, the number is expected to rise to 643 million (11.3%), reaching 783 million (12.2%) by 2045.[1] China has the highest number of diabetes cases in the world, with 140.9 million cases, projected to increase to 174.4 million by 2024. Diabetes and its complications significantly impact life expectancy and quality of life, imposing a heavy medical and economic burden on individuals, families, and society. IDF reports that China's diabetes-related healthcare expenditure in 2021 reached $165.3 billion, second only to the United States ($379.5 billion).[2] The Chinese government has prioritized diabetes prevention and control, incorporating it into the "Healthy China Initiative (2019–2030)".[3]

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To address this public health challenge, various glucose-lowering agents have been developed and introduced to the market. Among them, glucagon-like peptide-1 receptor agonists (GLP-1 RAs) have emerged in recent years as a novel and widely adopted class of antidiabetic agents.[4] Accumulating evidence demonstrates that GLP-1 RAs not only improve glycemic control effectively, but also facilitate weight management and reduce cardiovascular risk, thus playing a comprehensive role in diabetes prevention and management.[5,6]

On the policy front, access to GLP-1 RAs has garnered increasing attention. Since the establishment of the National Healthcare Security Administration (NHSA) in 2018, China has implemented a dynamic negotiation mechanism for the reimbursement of innovative drugs.The dynamic negotiation mechanism for innovative drug medical insurance reimbursement has a significant effect on improving the accessibility of innovative drugs, specifically manifested in the shortened access cycle for innovative drugs, with particularly notable acceleration in the access speed for oncology drugs and rare disease drugs (Figure 1). Several GLP-1 RA products have since been included in the National Reimbursement Drug List (NRDL), including regular listings such as exenatide, liraglutide, and lixisenatide, as well as negotiated listings like benaglutide, dulaglutide, polyethylene glycol loxenatide, and semaglutide.[7]

However, inclusion in the NRDL is merely the first step toward accessibility and does not guarantee timely availability in clinical settings. In practice, many GLP-1 RA products face the common dilemma of being "reimbursed but not admitted" at the hospital level. Hospital-level drug adoption requires comprehensive evaluation of clinical effectiveness, safety profile, cost-effectiveness, procurement price, and budget impact.[8] Bridging the "last mile" from reimbursement to hospital inclusion has become a critical bottleneck hindering the broader uptake of GLP-1 RA therapies.

As China's healthcare system continues to undergo reforms and formulary inclusion mechanisms become increasingly standardized, the practical implementation of formulary adoption in hospitals still encounters substantial obstacles. High-priced innovative drugs, in particular, often face resistance due to limited hospital budgets and intense performance evaluation pressures.Public hospitals face significant pressure from stringent performance assessments and budget constraints, making the formulary inclusion of GLP-1 receptor agonists particularly difficult. Despite their proven efficacy and safety in managing diabetes and obesity, there is an urgent need for a rational and practical evaluation framework to support their formulary adoption.

To address this need, we conducted a systematic review of current research on evaluation systems for GLP-1 RA drugs in hospital formulary contexts. Our findings reveal that although some progress has been made, existing studies remain fragmented and lack a comprehensive, quantitative framework. Most evaluations are conducted from a pharmaceutical-centric perspective, with limited attention to hospitals' actual needs and decision-making processes.

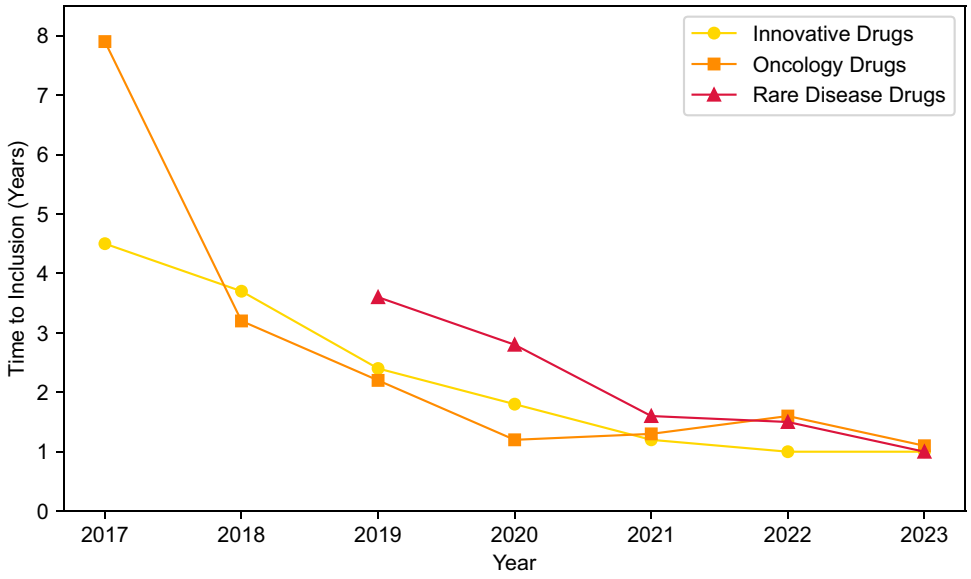


**Figure 1** Average Time to Inclusion in National Reimbursement Drug List (2017–2023).


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Although there is a growing body of literature on GLP-1 RA drug evaluation, most studies[9–14] focus on single dimensions such as clinical value, cost-effectiveness, or safety, often overlooking the real-world decision-making context of hospitals (Figure 2). Furthermore, existing studies tend to be fragmented, lacking systematic and structured frameworks. From a hospital's perspective, formulary inclusion decisions involve not only evaluating drug attributes but also considering departmental needs, budgetary impact, and alignment with clinical pathways—factors often neglected in prior research.

In summary, there is currently no established comprehensive clinical evaluation framework for GLP-1 receptor agonists (GLP-1RAs) from a hospital formulary inclusion perspective. Therefore, this study aims to develop a hospital-oriented evaluation system tailored to formulary decision-making needs. The framework is designed to align with hospital performance assessment criteria while incorporating the clinical characteristics of diabetes management and the unique therapeutic features of GLP-1RAs.

Building upon current status analysis, expert interviews, and Delphi validation, the study will construct a multidimensional indicator system and corresponding weights to quantitatively assess the overall clinical value of different GLP-1RAs. Hospitals can apply this system by inviting multidisciplinary experts in clinical medicine, pharmacy, and medical insurance to rate candidate drugs according to the established indicators. Weighted composite scores can then guide the ranking and selection of GLP-1RAs, enabling hospitals to make evidence-based, context-specific formulary decisions in line with their functional positioning, disease spectrum, and patient population characteristics.

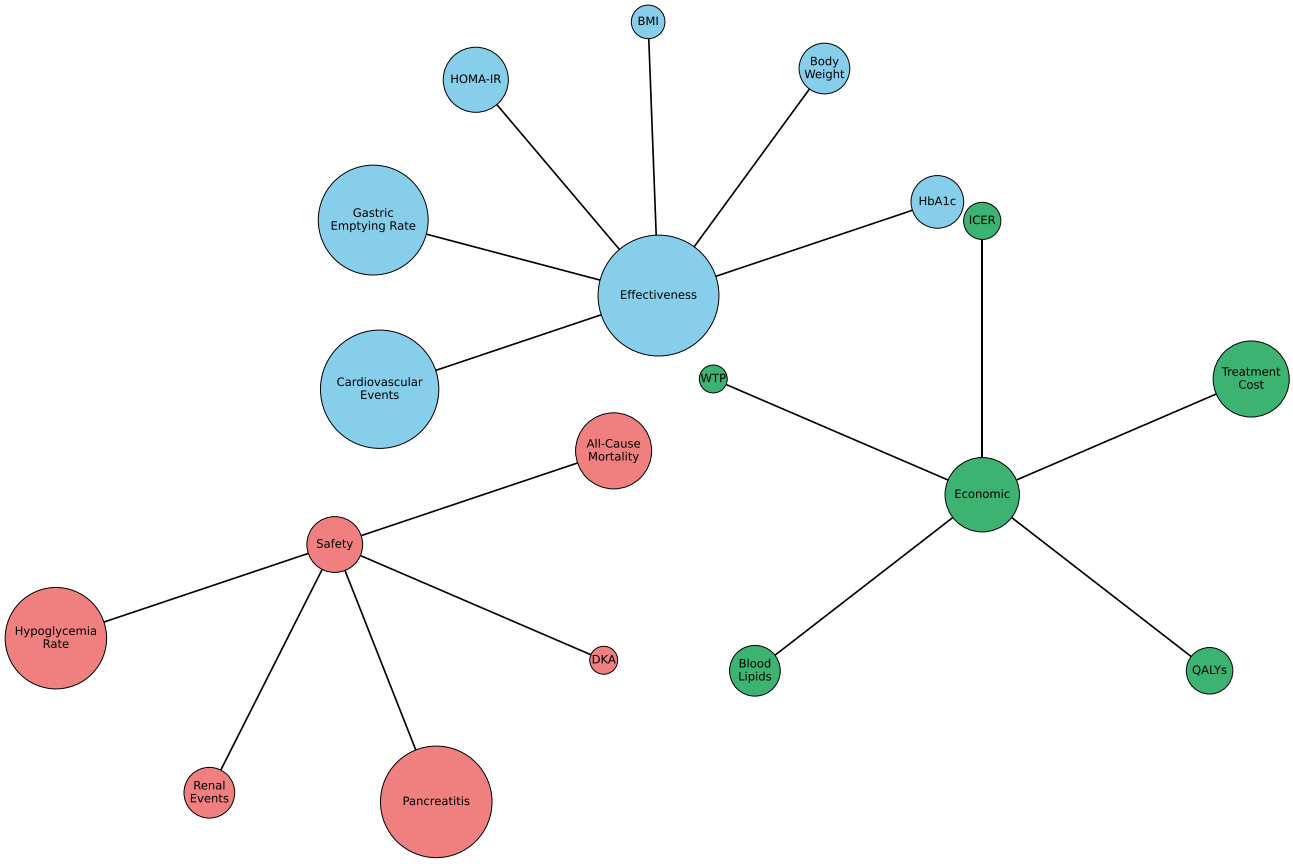


**Figure 2** Colored Network Bubble Diagram of GLP-1 RA Evaluation Indicators.


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# Material and Methods

## Preliminary Basis

### Literature Review

A systematic search was conducted in CNKI, VIP, Wanfang Data, PubMed, and Web of Science using keywords such as "GLP-1RA", "Glucagon-Like Peptide-1 Receptor Agonists", "multiple criteria", "MCDA", "Hospital-Based Health Technology Assessment", "HB-HTA", "value evaluation", "framework". The literature included RCTs, meta-analyses, systematic reviews, pharmacoeconomic evaluations, HTA studies, multidimensional value assessments, and MCDA-related decision frameworks (Figure 3). The search covered publications up to March 1, 2024.

### Brainstorming

Based on HB-HTA principles and the *Guidelines*,[15] the research team initially developed an evaluation framework for GLP-1RA drugs. Key clinical features, treatment needs, and hospital management requirements were discussed and refined, forming a preliminary pre-investigation evaluation index system.

### Expert Investigation

Three experts from the fields of clinical medicine, pharmacy, and medical insurance were invited for a preliminary investigation. These experts possess extensive clinical experience and a background in drug management, with in-depth

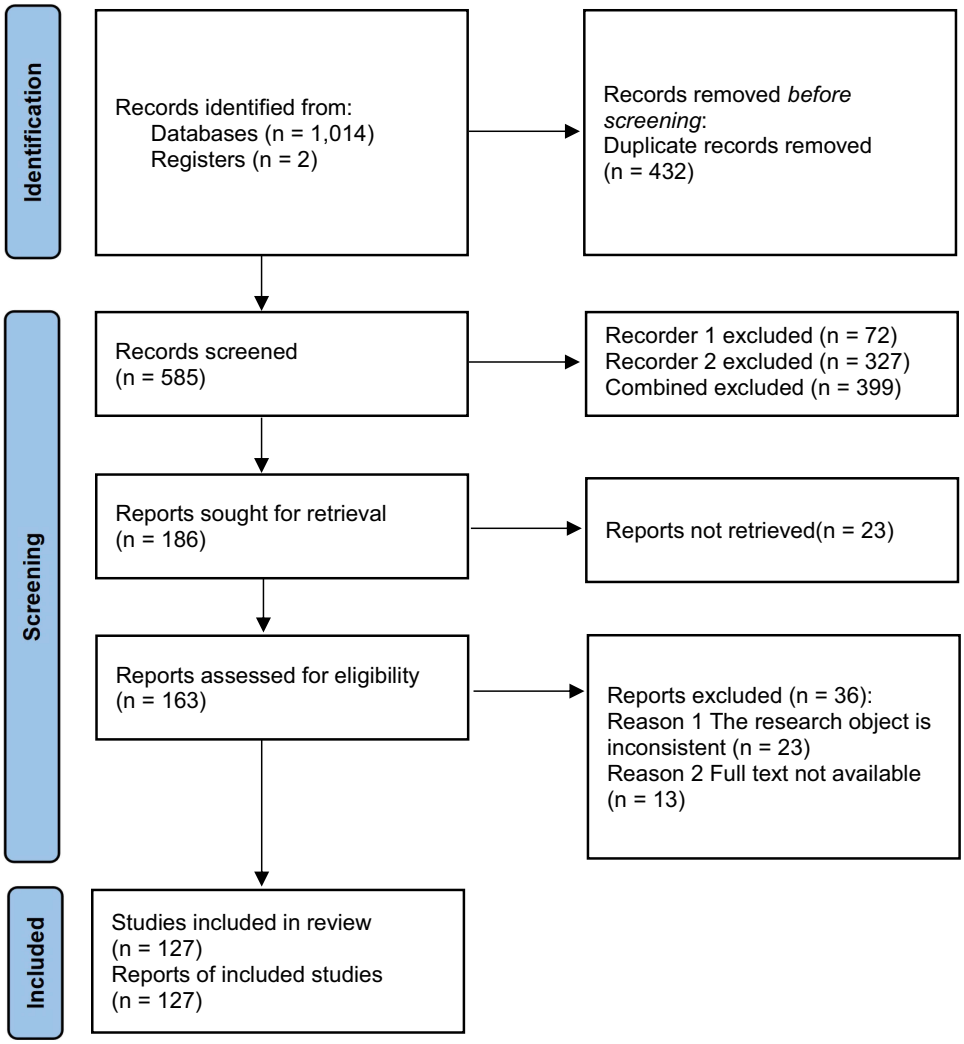


**Figure 3** Flow chart of evidence selection.

knowledge of GLP-1 RA usage. Based on their input, the first version of the indicator system was developed, including four primary evaluation indicators, eight secondary indicators, and twenty tertiary indicators. This preliminary version will be used in the subsequent questionnaire survey.

## Delphi Method

### Expert Selection

A total of 22 experts were included in this study. The selection criteria were as follows:

1. Key managers involved in the hospital admission of GLP-1 RA, including clinical, pharmacy, and medical insurance experts.
2. Experience in the hospital admission process of GLP-1 RA.
3. Bachelor's degree or higher.
4. Intermediate or senior professional title.
5. Interest in the study and willingness to participate in the investigation.

Experts were identified through professional networks of the study team and recommendations from national academic societies in endocrinology, pharmacy, and medical insurance. Formal invitation letters were sent via email, outlining the study objectives, procedures, and voluntary participation requirements.The 22 experts represented tertiary hospitals across seven provinces and municipalities in China, including eastern, central, and western regions, ensuring geographic and institutional diversity. All participating hospitals were tertiary-level institutions, with 81.8% being general hospitals, 13.6% western medicine hospitals, and 4.5% traditional Chinese medicine hospitals.To minimize potential bias and encourage independent judgment, all questionnaires were completed anonymously. Experts were identified by code numbers during analysis, and no individual responses were disclosed to other participants.A summary of the round-one consultation results is provided in Supplementary Table 1.

### Questionnaire Design and Distribution

The first-round questionnaire consisted of three parts:

1. Expert background information form: This included basic details about the experts and their familiarity with the comprehensive clinical evaluation of GLP-1 RA.
2. Instructions and consultation form: This included explanations on how to fill out the questionnaire, as well as scoring tables for the importance and data availability of primary, secondary, and tertiary indicators. Experts were also asked to provide opinions on retaining, modifying, or removing each indicator. A 5-point Likert scale was used, where higher scores indicated greater importance and data availability.
3. Self-assessment form on familiarity and judgment basis: Familiarity levels included "very familiar," "familiar," "moderate," "unfamiliar," and "very unfamiliar." Judgment basis categories included theoretical analysis, practical experience, reference literature, and intuitive perception, with three levels of influence: high, medium, and low.

The second-round questionnaire also consisted of three parts:

1. Feedback on first-round expert consultation results: This summarized the modifications made to the indicators, including additions, deletions, and changes in names or definitions.
2. Second-round expert scoring form: This included the mean, standard deviation, and coefficient of variation for the first-round indicators, along with updated importance and data availability scoring tables, as well as retention, modification, or deletion suggestions.
3. Pairwise comparison scoring form: Experts compared the importance of each indicator in pairs to calculate their relative weights.

The questionnaire was distributed to selected experts via Email or WeChat. Responses from all experts were collected within two weeks for each round.

### Indicator Selection

At the end of each Delphi round, the mean, standard deviation, coefficient of variation, and full-score rate of each indicator's importance and data availability were calculated. The selection criteria for indicators were as follows: Indicators with a mean importance or data availability score of <3.50, standard deviation >1%, coefficient of variation >0.25, or full-score rate <10% were considered for removal or modification.[16,17] Indicators proposed by experts for addition, deletion, or modification were also reviewed. The final decision on whether to adopt modifications was made through literature review and group discussion (Figure 4).

## Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is a systematic decision-making method that decomposes complex multi-objective problems into hierarchical structures. First, the overall goal is broken down into sub-goals or criteria, which are further refined into specific indicators. Then, qualitative indicators are converted into numerical values using fuzzy quantification, and the weights of each hierarchical element and the entire system are calculated. This provides a quantitative basis for multi-objective, multi-scheme optimization decisions.[18] In this study, the Saaty 1–9 scale method was used to design pairwise judgment matrices for each level in the second-round questionnaire. The weighting evaluation was conducted by independently filling out the forms. The pairwise comparison matrices were aggregated using the arithmetic mean method (element-wise) to maintain consistency with the previous Delphi round. After collecting the questionnaires, Yaahp software (version12.11) was used to automatically adjust consistency and compute the final indicator weights. Consistency checks were performed, and all consistency ratios (CR) were below 0.10, indicating acceptable consistency across the matrices (see Supplementary Table 2). Previous study has shown that when CR values are within acceptable thresholds, the difference between using the arithmetic mean and geometric mean for aggregation is minimal and does not significantly affect the ranking of the indicators.[19,20]

## Data Sources and Statistical Analysis

Excel 2019 and SPSS 27.0 were used for data entry and statistical analysis. Frequency and percentage were used for descriptive statistics of expert background information. Yaahp software was used to calculate indicator framework weight coefficients. To assess the reliability of the questionnaire, expert enthusiasm, authority, and opinion coordination were calculated.[21,22]

The calculation methods were as follows:

Expert enthusiasm coefficient = (number of experts participating in indicator evaluation / total selected experts) × 100%. A response rate above 70% was considered optimal.[23]

Expert authority coefficient = (judgment basis coefficient + familiarity coefficient) / 2. A higher value indicated greater expert authority and improved predictive accuracy.[24]

Expert opinion coordination was measured using Kendall's W coefficient. When $P<0.05$, it means that the difference is statistically significant, and the larger the W value, the better the coordination degree of all experts' evaluation opinions on all indicators.[21,23,25]

# Results

## Basic Information of Experts

This study used the Delphi method for expert consultation, involving a total of 22 experts, with 20 completing both rounds of surveys. Among them, females accounted for 63.64%, higher than males (36.36%). Most experts were aged 30–50 years (63.64%). More than 50% held a doctoral degree, and over 70% had more than 10 years of work experience. Senior professional titles were the most common, accounting for 63.64%. Clinical medicine experts made up 27.27%, medical insurance experts 22.73%, and pharmacy experts were the largest group, comprising 50%. See Table 1 for details.

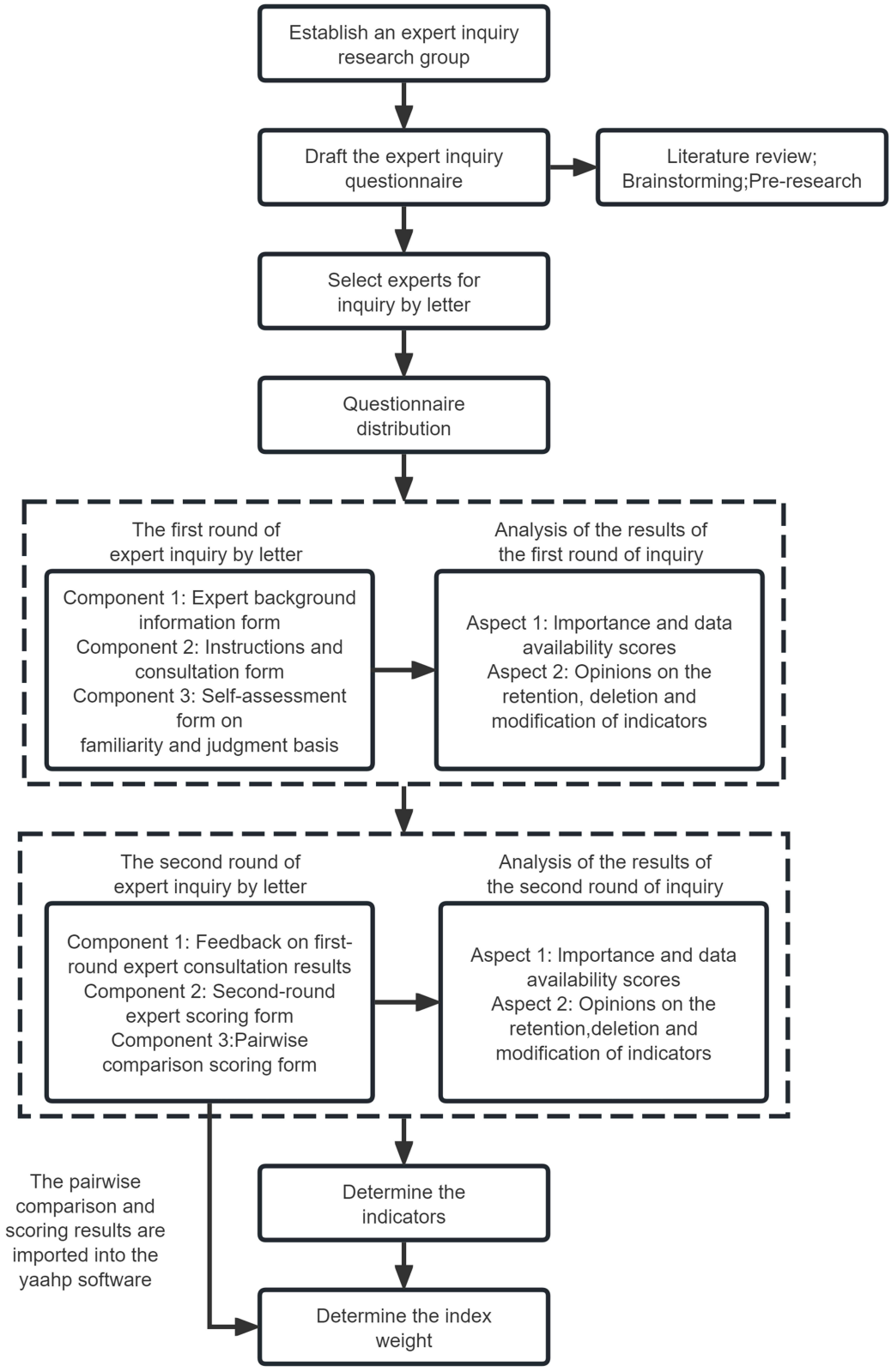


**Figure 4** Workflow of the Delphi Method for Indicator Development.


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**Table 1** Basic Information of Experts

| Item | Category | n (%) or Mean (SD) |
|---|---|---|
| Gender | Male | 8(36.36) |
| | Female | 14(63.64) |
| Education Level | Bachelor's Degree | 1(4.55) |
| | Master's Degree | 8(36.36) |
| | Doctoral Degree or above | 13(59.09) |
| Work Experience | Less than 10 years | 5(22.73) |
| | 10–30 years | 11(50.00) |
| | Over 30 years | 6(27.27) |
| Professional Field | Clinical Medicine | 6(27.27) |
| | Pharmacy | 11(50.00) |
| | Medical Insurance | 5 (22.73) |
| | Others | 0(0.00) |

## Expert Enthusiasm Coefficient and Expert Authority Coefficient

In the first round, 22 experts were selected, and 20 participated, resulting in an enthusiasm coefficient of 90.91%. In the second round, all 20 experts from the first round participated again, reaching an enthusiasm coefficient of 100%. Both rounds had an enthusiasm coefficient above 70%, indicating a high level of expert participation.The expert authority coefficient (Cr) was 0.87 in the first round and 0.85 in the second round, both exceeding 0.7, indicating a high level of expert authority and strong reliability of the consultation results (Table 2).

## Expert Opinion Coordination Coefficient

The coordination coefficient remained stable across rounds, with both rounds having a $P<0.001$, showing statistically significant differences. The first-round coordination coefficient (W) for importance and availability ratings of each primary indicator ranged from 0.193 to 0.331, with consistent results ($P<0.05$). For tertiary indicators, the coordination coefficient ranged from 0.336 to 0.347, with all results demonstrating consistency ($P<0.05$), and the differences were statistically significant (Table 3).

## Indicator Screening Results

After the first round, the number of tertiary indicators was reduced from 20 to 17. Specific changes included: Merging "Contraindications and Drug Interactions Listed in the Package Insert" and "Pharmacovigilance (CFDA Black Box Warning)" under safety into "Drug Safety Warnings". Changing "Patient Treatment Preferences" under clinical demand to "Patient Preferences". Combining "Outpatient Drug Expenditure Ratio" and "DRG/DIP Score Ratio" under performance evaluation into "Impact on Average Drug Cost per Visit". Removing "Increase in Patient Volume After Drug Inclusion" under economic indicators. Six indicators were adjusted.

**Table 2** Expert Enthusiasm Coefficient and Authority Coefficient Across Two Delphi Rounds

| Coefficient Type | Round 1 | Round 2 |
|---|---|---|
| Enthusiasm Coefficient | 90.91% | 100% |
| Authority Coefficient (Cr) | 0.87 | 0.85 |

**Table 3** Expert Opinion Coordination Coefficient Across Two Delphi Rounds

| Consultation Round | Importance Concordance Coefficient | P-value | Data Availability Concordance Coefficient | P-value |
|---|---|---|---|---|
| Round 1 | 0.234 | 0 | 0.193 | 0 |
| Round 2 | 0.336 | 0 | 0.347 | 0 |

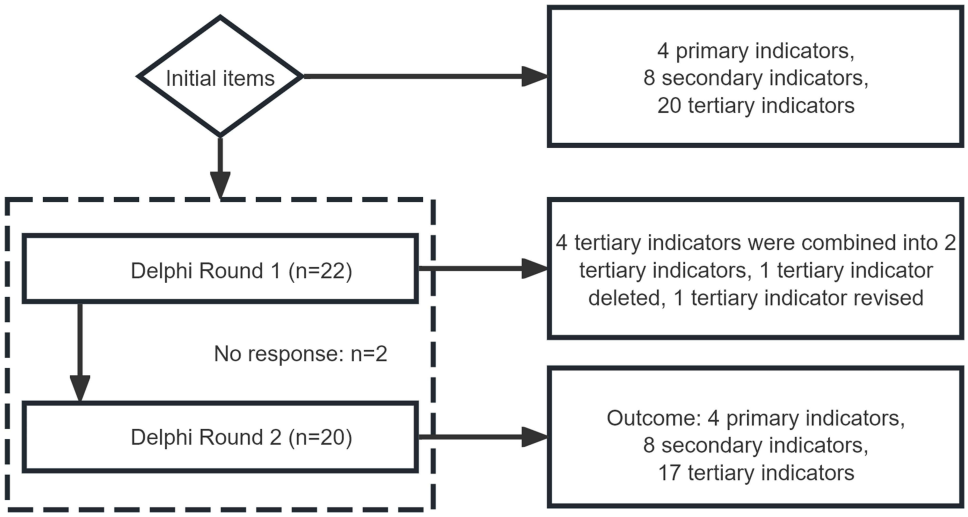


**Figure 5** Indicator Screening Results Across Two Delphi Rounds.

In the second round, the revised 17 indicators were included in the questionnaire. Further modifications included: Adjusting the ranking of tertiary indicators under "Clinical Value," prioritizing key indicators (eg, blood glucose levels) while placing weight loss as a secondary benefit. Adding " Convenience of Medication" as a new tertiary indicator. Changing "Cardiovascular, Hepatic, and Renal Benefits" to "Cardiovascular, Hepatic, Renal, and Brain Benefits". Modifying "Gastrointestinal Adverse Reactions" to "Gastrointestinal Reactions" under safety indicators. In the accessibility indicators, revise the expression of the indicator "Proximity to Hospitals" in "Accessibility". In the economic indicators, add more urgent economic considerations for hospitals, such as bed turnover rate, medical service income ratio, 30-day readmission rate, average cost per visit, etc. Six indicators were adjusted. The final framework included four primary indicators, eight secondary indicators, and seventeen tertiary indicators (Figure 5).The definition and scoring criteria of the tertiary indicators are provided in Supplementary Table 3.

## Indicator Weights

By constructing the ladder hierarchy model in Yaahp software, entering the expert matrix scoring data, testing and adjusting the consistency level and then carrying out group decision-making calculations, the indicator system and its weights were finally obtained (Table 4 and Figure 6).

**Table 4** Indicator Weights Based on AHP Analysis

| Primary Indicator | Weight | Secondary Indicator | Weight | Tertiary Indicator | Weight |
|---|---|---|---|---|---|
| Clinical Value | 0.5373 | Effectiveness | 0.3094 | Glycosylated Hemoglobin | 0.1032 |
| | | | | Body Weight | 0.0429 |
| | | | | Fasting/Postprandial 2h Blood Glucose | 0.0649 |
| | | | | Cardiovascular, Hepatic, and Renal Benefits | 0.0984 |
| | | Safety | 0.2279 | Gastrointestinal Adverse Reactions | 0.0534 |
| | | | | Hypoglycemia Incidence | 0.0942 |
| | | | | Drug Safety Warnings | 0.0803 |
| Hospital Admission Demand | 0.1924 | Clinical Demand | 0.1278 | Addressing Unmet Clinical Needs | 0.0951 |
| | | | | Patient Preference | 0.0327 |
| | | Discipline Development | 0.0646 | Clinical Guideline/Specification/Consensus Recommendation Level | 0.048 |
| | | | | Categories of Newly Marketed Drugs Domestically and Internationally | 0.0165 |

(*Continued*)


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**Table 4** (Continued).

| Primary Indicator | Weight | Secondary Indicator | Weight | Tertiary Indicator | Weight |
|---|---|---|---|---|---|
| Hospital Management | 0.1379 | Performance Evaluation | 0.053 | Impact on Average Drug Cost per Visit | 0.0529 |
| | | Accessibility | 0.0473 | Availability | 0.0244 |
| | | | | Affordability | 0.0229 |
| | | Appropriateness | 0.0377 | Usage Appropriateness | 0.0253 |
| | | | | Technical Appropriateness | 0.0124 |
| Economic Value | 0.1324 | Economic Efficiency | 0.1324 | Cost-Effectiveness Advantage | 0.1324 |

## Discussion

Recently, China has been dynamically conducting annual negotiations for the inclusion of innovative drugs in the national medical insurance scheme. Currently, multiple GLP-1RA have been incorporated into the reimbursement list. To accelerate hospital adoption, the national and provincial healthcare security authorities have integrated this process into health policy frameworks, encouraging medical institutions to optimize their pharmaceutical management procedures.[21] Meanwhile, NHC has issued the *Guidelines* to standardize, regulate, and enhance the scientific and consistent approach to comprehensive clinical drug evaluation. The evaluation framework encompasses six dimensions: safety, efficacy, economic value, innovativeness, accessibility, and availability. Based on the *Guidelines*, this study establishes a comprehensive clinical evaluation index system specifically for GLP-1RA drugs, considering hospital performance assessment requirements and the unique characteristics of this drug class. This framework aims to facilitate hospital inclusion and promote the rational use of these

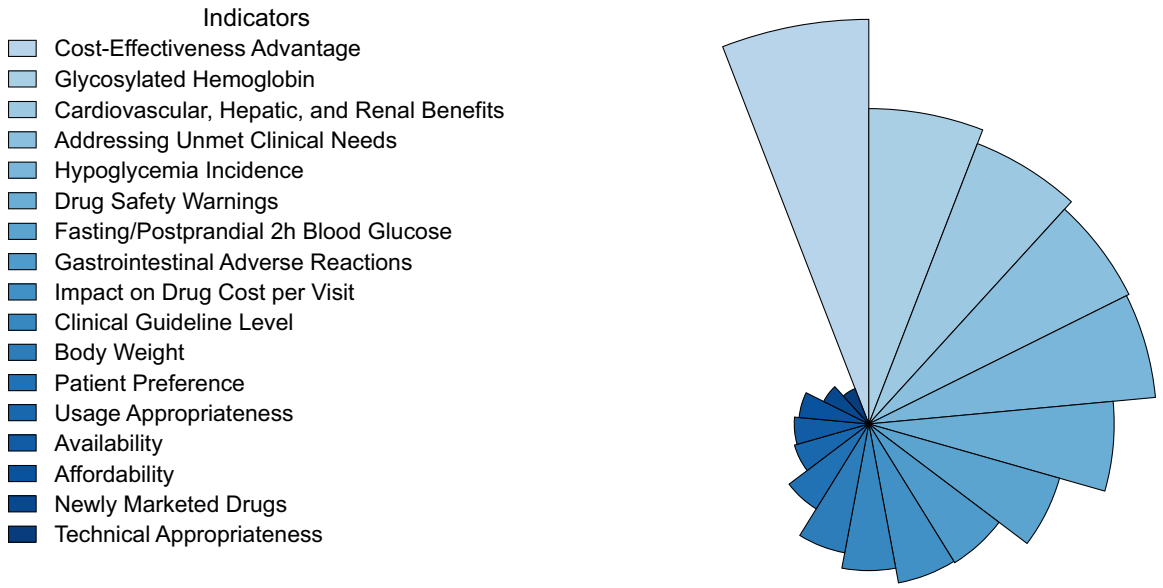


**Figure 6** Polar Area Chart Showing the Weight Distribution of Tertiary Indicators.

medications. Therefore, this study is based on the *Guidelines* and constructs a GLP-1RA-specific clinical comprehensive evaluation indicator system from the perspective of GLP-1RA hospital admission. It integrates hospital performance assessment requirements while incorporating the characteristics of diabetes and GLP-1RA drugs.

An initial indicator system was created by reviewing domestic and international studies. Experts from clinical medicine, clinical pharmacy, and health insurance sectors across China's eastern, central, and western regions participated in Delphi consultations. Both consultation rounds had enthusiasm coefficients exceeding 70% and authority coefficients above 0.7, with strong coordination, meeting the Delphi method's general requirements.[23] Therefore, the constructed GLP-1RA clinical evaluation framework has a solid scientific basis.

In the evaluation system constructed in this study, the primary evaluation indicators consist of four dimensions: "Clinical Value," "Hospital Admission Demand," "Hospital Management," and "Economic Value". Among them, "Clinical Value" (0.5373) has the highest weight, making it the most crucial factor in the selection of GLP-1RA by medical institutions. It includes the relative or absolute value of the GLP-1RA drugs under selection in terms of "Safety" and "Efficacy" compared to drugs already available in the hospital. Among these, "Efficacy" (0.3094) holds a higher weight and includes four tertiary indicators: "Glycated Hemoglobin", "Body Weight", "Fasting/Postprandial 2h Blood Glucose", and "Cardiovascular, Hepatic, and Renal Benefits". "Glycated Hemoglobin" (0.1032) is a key indicator for evaluating blood glucose control in diabetes patients. In this study, it refers to whether the efficacy of the selected drug in reducing "Glycated Hemoglobin", based on evidence from drug labels and clinical trial research, is significantly superior to that of similar drugs available in the hospital, making it the most critical indicator in efficacy assessment. The indicators "Body Weight" (0.0429), "Fasting/Postprandial 2h Blood Glucose" (0.0649), and "Cardiovascular, Hepatic, and Renal Benefits" (0.0984) assess the efficacy of GLP-1RA drugs from the perspective of diabetes management and complication reduction.

"Safety" (0.2279) includes three tertiary indicators: "Gastrointestinal Adverse Reactions," "Hypoglycemia Incidence," and "Drug Safety Warnings". "Hypoglycemia Incidence" (0.0942) assesses whether the occurrence of hypoglycemia as an adverse reaction to the GLP-1RA drug under selection is controlled and whether its incidence is significantly lower than that of similar drugs currently in the hospital. Hypoglycemia is a common adverse reaction of GLP-1RA drugs and is the most critical indicator in safety assessment. Following this is "Drug Safety Warnings" (0.0803), which reflects whether medical institutions focus on contraindications and drug interactions marked in the selected drug's package insert, whether the drug regulatory authorities or adverse reaction monitoring centers have issued safety alerts, and whether it is suitable for special populations. Although "Gastrointestinal Adverse Reactions" (0.0534) is not given the same emphasis in safety assessment, it carries a relatively high weight among the tertiary indicators and remains an important dimension that cannot be ignored. During the development of the clinical value indicators, this study referred to the previously established general selection and evaluation system for national negotiated drugs in medical institutions in Shanghai.[22] The tertiary indicators under the secondary indicators of efficacy and safety were designed in combination with specific clinical treatment assessment methods for diabetes patients and the adverse reaction characteristics of GLP-1RA drugs, making them more aligned with the needs of medical institutions when selecting these drugs.

"Hospital Admission Demand" (0.1924) serves as an important supplement to clinical value, reflecting medical institutions' considerations of clinical demand and discipline development. Among them, the secondary indicator "Clinical Demand" (0.1278) carries a significantly higher weight than "Discipline Development" (0.0646), indicating that when selecting GLP-1RA drugs, medical institutions place greater emphasis on whether these drugs can meet clinical demand by "Addressing Unmet Clinical Needs" (0.0951) and addressing "Patient Preferences" (0.0327). This may be because GLP-1RA drugs generally exhibit consistency in "Clinical Guideline/Specification/Consensus Recommendation Level" (0.048) and "Categories of Newly Marketed Drugs Domestically and Internationally" (0.0165), without significant differentiation. "Addressing Unmet Clinical Needs" refers to whether the selected GLP-1RA drug can address existing clinical gaps, improve the hospital's weaker specialties, optimize the hospital formulary by enhancing the selection of similar drugs, and whether its dosing interval can improve patient medication adherence. Compared to existing similar drugs, "Patient Preference" focuses on whether the selected GLP-1RA drug can better meet the medication needs of special populations such as children and the elderly, as well as other patient preferences. Due to the potential effects of GLP-1RA drugs, such as weight loss, these drugs may become a preferred choice among patients, aligning with unmet clinical needs and enhancing the competitive advantage of medical institutions. In designing the

indicators within the hospital admission demand dimension, this study also referred to the previously established general selection and evaluation system for national negotiated drugs in medical institutions in Shanghai.[26] Based on the unique effects of GLP-1RA drugs, this study expanded the secondary indicator "Demand Level" and its corresponding tertiary indicators, incorporating additional considerations regarding the potential role of these innovative drugs in promoting hospital discipline development and meeting patient preferences. This approach aims to enhance the competitive advantage of medical institutions and incentivize them to accelerate the selection process for GLP-1RA drugs.

Considering the impact of GLP-1RA drug admission on performance evaluation and the complexity of hospital management, the "Hospital Management" dimension includes three secondary indicators: "Performance Evaluation" (0.053), "Accessibility" (0.0473), and "Appropriateness" (0.0377). "Performance Evaluation" has the highest weight, highlighting the significant influence of current performance assessment pressures on drug selection. This study designed the tertiary indicator "Impact on Average Drug Cost per Visit" (0.0529) based on the guidelines in the *National Tertiary Public Hospital Performance Evaluation Manual (2023 edition)*, which evaluates whether the selected GLP-1RA drug significantly outperforms existing similar drugs in reducing per visit drug costs. "Accessibility" includes two tertiary indicators, "Availability" (0.0244) and "Affordability" (0.0229), focusing on drug supply capacity and patient financial burden. "Availability" assesses whether the selected GLP-1RA drug's production capacity can sufficiently meet demand and outperform alternative drugs in the hospital formulary, given that some GLP-1RA drugs currently face supply shortages. This indicator ensures that medical institutions do not face drug shortages after including the selected drug. Lastly, "Appropriateness" consists of "Usage Appropriateness" (0.0253) and "Technical Appropriateness" (0.0124), mainly addressing the difficulty of medication management and storage after hospital admission. The hospital management indicators were also designed based on the Shanghai selection system for national negotiated drugs,[26] with adjustments considering existing supply issues and off-label use management of GLP-1RA drugs. This refinement emphasizes the unique features of a comprehensive clinical evaluation system for these drugs.

"Economic Value" (0.1324) is another critical dimension in the selection of GLP-1RA drugs by medical institutions. It consists of a single secondary indicator, "Economic Efficiency" (0.1324), which is assessed through the tertiary indicator "Cost-Effectiveness Advantage" (0.1324). This indicator evaluates whether the selected GLP-1RA drug demonstrates a cost-effectiveness advantage over existing hospital drugs based on pharmacoeconomic evaluation reports. It carries the highest weight among the tertiary indicators, reflecting the significant importance medical institutions place on economic considerations.Owing to its single-layer structure, the "Economic Value" dimension shows a concentrated weight distribution. In contrast, dimensions such as "Clinical Value" encompass multiple sub-indicators, resulting in more dispersed weights at the tertiary level—a normal outcome reflecting structural differences within the hierarchy.

The effectiveness indicators in this study include four tertiary indicators: "Glycosylated Hemoglobin", "Body Weight", "Fasting/Postprandial 2-Hour Blood Glucose", and "Cardiovascular, Liver, and Renal Benefits". A real-world study evaluating the clinical performance of sodium-glucose co-transporter 2 (SGLT-2) inhibitors also considered fasting blood glucose as an effectiveness indicator.[25] Most studies assessing effectiveness also included glycosylated hemoglobin, while safety evaluations considered gastrointestinal adverse reactions, the incidence of hypoglycemia, and the occurrence of serious adverse events.[26–28] In the study by Liu et al, the safety evaluation included the incidence of neurological, digestive system, and cardiovascular adverse reactions.[29] Zhang et al incorporated both safety information from drug labels and post-marketing safety evaluations.[30] Zhu et al considered indications, guideline recommendations, and clinical efficacy when evaluating effectiveness.[31] Xie et al's study on the clinical evaluation of GLP-1RA included economic indicators similar to this study, both considering cost-effectiveness advantages. Appropriateness indicators in both studies included appropriate usage appropriateness, while accessibility indicators covered availability and affordability.[32] Wang et al's study on appropriateness considered both the technical appropriateness of the drug and its appropriateness for clinical use, aligning with this study's approach.[33] In the study by Hong et al, accessibility analysis included market sales and reimbursement standards.[34] Huang et al conducted a comprehensive evaluation of four weekly GLP-1RA formulations across five dimensions: pharmaceutical properties, effectiveness, safety, economic value, and other attributes.[35]

Previous studies had earlier publication dates and smaller sample sizes, with some studies having limited Safety Indicators. This study introduces a Primary Indicator, "Hospital Admission Demand," which includes two Secondary Indicators: "Clinical Demand" and "Discipline Development". This reflects the need for medications during hospital

procurement and their contribution to medical disciplines. In contrast, established MCDA frameworks for drug evaluation, such as the value framework proposed by Angelis and Kanavos and the criteria system summarised by Su et al, mainly organise value into domains like clinical effectiveness, safety, innovation, economic and societal impact, and do not explicitly treat hospital admission demand or discipline development as separate dimensions.[36,37] Existing diabetes research frameworks have not included similar admission demand indicators.Regarding hospital management metrics, this study establishes "Hospital Management" as a primary indicator, including three secondary indicators: "Performance Evaluation", "Accessibility", and "Appropriateness", assessing drugs from a hospital management perspective. For indicator weighting, Wang et al found that effectiveness and safety dominated drug evaluations, aligning with fundamental clinical requirements. Among secondary safety indicators, contraindications and overall adverse event risk had the highest weight. Among secondary effectiveness indicators, glycosylated hemoglobin reduction and glycosylated hemoglobin target achievement rate were most significant. The top-ranked secondary indicators for economic value, appropriateness, and accessibility were cost-utility analysis, patient medication adherence, and drug availability, respectively.[38] Ji et al's framework assigned the highest weight to effectiveness and safety.[39] Wang et al emphasized four core attributes—clinical necessity, effectiveness, safety, and economic value—as essential criteria for hospital drug selection and rational use, accounting for 60% of the overall evaluation weight.[39] Compared with these frameworks, which mainly focus on drug properties and overall clinical and economic value, this study assigns greater weight to "Clinical Value" and "Hospital Admission Demand" in drug evaluation.The framework prioritizes hospital management and admission needs, particularly performance evaluation and clinical demand, while innovation and accessibility receive less emphasis.Other studies have focused more on drug characteristics and overall clinical contributions, leading to different weight distributions.

## Study Limitations

Although this study provides a comprehensive clinical evaluation framework for GLP-1RA drugs, it has certain limitations. First, the selection and design of indicators were based on existing literature and clinical experience, which may not fully meet the needs of different regions and healthcare institutions. Second, experts from clinical medicine and health insurance fields were more represented than those from pharmaceutical sciences, potentially limiting sample representativeness. The next step involves pilot testing the framework, refining it through practical application, and developing evaluation tools to enhance decision-making efficiency and improve GLP-1RA procurement in public hospitals.

### Study Innovations

Currently, there is a lack of clinical evaluation framework specifically targets GLP-1RA drugs in China. This study constructs a multidimensional value-based evaluation system for GLP-1RA drugs from a hospital admission perspective, filling a research gap in GLP-1RA clinical evaluation.

## Conclusion

Public hospitals form the backbone of healthcare systems in many countries and are the primary providers of medical services. In China, they also play a key role in drug procurement and accessibility. While existing research has developed general drug selection and evaluation tools for public hospitals, there remains a lack of precise and easily applicable evaluation tools for GLP-1RA drugs, increasing decision-making risks. Using an inappropriate GLP-1RA admission evaluation tool may lead to major issues such as healthcare inequality and inefficient resource allocation, ultimately diminishing the economic and social benefits of GLP-1RA therapies.

To address these challenges, we systematically examined existing general drug admission evaluation tools and constructed a framework for assessing GLP-1RA hospital admission. This framework serves as a valuable tool for public hospital procurement, enhancing the efficiency and effectiveness of GLP-1RA utilization while safeguarding patients' economic, clinical, and social interests.

We developed a three-tier clinical evaluation framework for GLP-1RA drugs from an admission perspective, comprising four primary indicators, eight secondary indicators, and seventeen tertiary indicators. Among the primary

indicators, “Clinical Value” is the most critical, followed by “Hospital Admission Demand” and “Hospital Management,” which together form the core evaluation criteria. “Economic Value” is relatively less emphasized.

Among secondary indicators, “Safety” and “Effectiveness” are the most influential, holding greater combined weight than any other factor. Among tertiary indicators, “Cost-Effectiveness Advantage” ranks highest, followed by “ Glycosylated Hemoglobin”, “ Cardiovascular, Liver, and Renal Benefits”, “Addressing Unmet Clinical Needs”, and “Hypoglycemia Incidence.” These five factors play a central role in the evaluation framework.

In conclusion, clinical value is at the heart of public hospital procurement, highlighting the importance of value-based purchasing for GLP-1RA drugs. Efficient allocation of medical resources to maximize social and economic benefits remains a long-term challenge for healthcare systems.

## Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Ethics

This study was approved by the Ethics Committee of Shanghai Health and Development Research Center (Shanghai Institute of Medical Science and Technology Information) (No.2025007). The study was conducted after obtaining informed consent from the participants. Participants had the right to refuse to answer any questions or withdraw from the study at any time at any stage of the study. We certify that the study was performed in accordance with the 1964 declaration of HELSINKI and later amendments. To ensure confidentiality, no personally identifiable information was collected during interviews. Data were anonymized upon collection, and access was restricted to the research team. All digital data were stored in password-protected devices following institutional data protection protocols.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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The authors have no conflicts of interest in this work. All participating experts were independent and reported no financial relationships or advisory roles with any GLP-1RA manufacturers within the past 36 months.

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