Medication Preferences and Evidence-Based Decision Aids for Patients with Diabetes: A Post-print Study

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Abstract

Background: Diabetes has become a significant public health concern due to its high prevalence and associated disability and mortality rates. Research evidence provides effective information for improving patient health outcomes, and decision aids facilitate patients' access to evidence and enhance physician-patient interaction. Objective: To obtain medication preferences of diabetic patients and develop an evidence-based decision aid to achieve the integration of evidence, patient values, and decision context, thereby facilitating patient-centered evidence-based decision-making. Methods: PubMed, Web of Science Core Collection, Embase, Cochrane Library, CINAHL, CNKI, VIP Chinese Science and Technology Journals Database, and Wanfang Data Knowledge Service Platform were searched to determine the value assessment dimensions and attributes of hypoglycemic drugs. The Best-Worst Scaling method was used to design a medication preference questionnaire for diabetic patients, and an empirical study was conducted in five hospitals in Jiangsu Province. Based on the analysis of patient preferences, an evidence-based decision aid was developed using technologies such as Vue+Element UI, Spring Boot, Spring Security, and Java. Results: The five attributes of macrovascular complication incidence, life years gained, changes in quality of life, microvascular complication incidence, and glycated hemoglobin control were the most important in clinical decision-making for diabetic patients. The evidence-based decision aid provides structured evidence summaries on the relative effectiveness, relative safety, convenience, and affordability of new hypoglycemic drugs. The multi-dimensional value assessment module for new hypoglycemic drugs is the core component of the tool, supporting patients' evidence-based evaluation of drug value. Conclusion: The evidence-based decision aid integrates research evidence, patient preferences, and values for new hypoglycemic drugs, thereby facilitating shared decision-making between physicians and patients.

Full Text

Introduction

Diabetes mellitus is a chronic disease characterized by hyperglycemia, with features of multiple complications, relatively high mortality, and no known cure. In recent years, new anti-diabetic drugs have provided patients with diverse treatment options. These medications possess multi-dimensional attributes, including effectiveness, safety, and affordability [1]. Some drugs effectively control blood glucose but impose high out-of-pocket costs on patients, while others provide cardiovascular protection but carry risks such as hypoglycemia. In the context of global health reform, high-quality research evidence offers valuable information for scientific decision-making and improved patient health outcomes [2]. Evidence-based medicine, as a scientific approach to solving clinical problems, integrates the best available research evidence with clinicians' expertise and patients' values and preferences, thereby promoting scientific clinical decision-making [3]. However, effectively incorporating patient values and preferences into clinical decisions remains a significant challenge for evidence-based medicine [4]. Shared decision-making represents the optimal practice pathway for "patient-centered" healthcare services [5], and decision aids, as effective tools for facilitating shared decision-making, are increasingly being implemented in clinical practice.

Methods

Determination of Multi-dimensional Value Assessment Criteria for Anti-diabetic Drugs

The determination of decision criteria and weights constitutes a critical component of Multi-Criteria Decision Analysis (MCDA). To identify criteria for new anti-diabetic drugs recently marketed in China, we conducted a comprehensive literature search of PubMed, Web of Science Core Collection, Embase, Cochrane Library, CINAHL, China National Knowledge Infrastructure (CNKI), VIP Chinese Science Journals Database, and Wanfang Data. The search timeframe spanned from database inception to December 31, 2021. English search terms included "diabetes," "value assessment framework," "value framework," "multi-criteria decision analysis," "best-worst scaling," and "discrete choice experiment," while Chinese search terms comprised "糖尿病" (diabetes), "价值评估框架" (value assessment framework), "价值框架" (value framework), "多准则决策分析" (multi-criteria decision analysis), "优劣尺度法" (best-worst scaling), "最大差异测量" (maximum difference measurement), and "离散选择实验" (discrete choice experiment). Following the search, we designed a data extraction form to capture study settings, research objectives, value assessment dimensions and attributes of anti-diabetic drugs, and the basis for their definitions. Criteria were finalized through literature analysis and focus group discussions.

Investigation of Patient Preferences for Anti-diabetic Drugs

Best-worst scaling (BWS), a stated preference research method, has gained considerable attention in the healthcare field. Compared with traditional preference elicitation methods such as ranking, BWS effectively reduces respondents' cognitive burden while collecting more detailed information [8]. This study employed BWS to elicit patient preferences for anti-diabetic drugs. Using R version 4.2.0, a balanced incomplete block design was implemented to determine scenarios and choice sets. Respondents selected the best (most important) and worst (least important) attributes from each combination of attribute options. For each attribute, the frequency of being selected as most important was divided by the frequency of being selected as least important, and the square root of this ratio served as the ratio estimate. This estimate was then standardized by dividing by the maximum ratio, and weights were derived from these standardized ratios to reflect the relative importance of each attribute in treatment decisions for diabetic patients [9]. The BWS empirical study was conducted from January to April 2022 across five hospitals in Jiangsu Province: Affiliated Hospital of Nantong University, Affiliated Hospital of Xuzhou Medical University, Taicang First People' s Hospital, Wuxi Second People' s Hospital, and Taizhou People' s Hospital. Consecutive patients aged 18 years or older with type 2 diabetes mellitus for at least one year who regularly used anti-diabetic medications were enrolled. Patients with gestational diabetes were excluded. Trained investigators conducted face-to-face surveys using a one-on-one approach.

Evidence Acquisition and Analysis of New Anti-diabetic Drugs

We retrieved evidence on new anti-diabetic drugs recently introduced to the Chinese market, including dipeptidyl peptidase-4 inhibitors (DPP-4i), glucagon-like peptide-1 receptor agonists (GLP-1RA), and sodium-glucose cotransporter 2 inhibitors (SGLT2i). A literature search of PubMed, Web of Science Core Collection, Embase, Cochrane Library, CINAHL, CNKI, VIP Chinese Science Journals Database, and Wanfang Data was performed to obtain evidence on the comparative effectiveness and safety of these new agents. The search covered publications from database inception to December 31, 2022, yielding 62 references. Evidence priority was given to high-quality systematic reviews and meta-analyses, followed by randomized controlled trials. We also searched medical institution drug price databases to obtain information on single doses, dosing frequency, and drug prices for these three drug classes. Finally, structured evidence summaries for new anti-diabetic drugs were developed based on the decision criteria. These structured evidence summaries in the tool are updated semi-annually as new research emerges.

Design and Development of the Evidence-Based Decision Aid

We designed the overall layout and functional architecture of the evidence-based decision aid. The tool, presented as a website, integrates criteria weights with research evidence across multiple dimensions to support patient assessment of

drug value. Key computer technologies were selected, and a front-end/back-end separation approach was adopted for development. The front-end utilized the Vue + Element UI framework, while the back-end was developed using Java. Website interface prototypes were built using Spring Boot, Spring Security, Redis, and JWT technologies, with MySQL database development employed to implement various module functions. Subsequently, ten patients with type 2 diabetes were invited to trial the decision aid and provide feedback on interface and functional design improvements. The empirical study for tool optimization was conducted at Rugao People' s Hospital from April to May 2023.

Results

Value Assessment Dimensions and Attributes of Anti-diabetic Drugs

The evidence-based decision support tool integrates four value assessment dimensions for anti-diabetic drugs: comparative effectiveness, comparative safety, convenience, and affordability (Table 1). The definition of assessment criteria in the tool references the EVIDEM framework [10-11].

Patient Preferences for Anti-diabetic Drugs

A total of 556 diabetic patients were surveyed, with 17 excluded due to ineligibility or incomplete responses. The mean age of included patients was 58.6 years (range 28-93), and 41.6% were female. Patients aged 65 years or older accounted for 35.6% of the sample. Regarding household monthly income, 9.9% earned less than 2,000 RMB, 41.9% earned 2,000-6,000 RMB, and 48.2% earned more than 6,000 RMB. A total of 336 patients (62.3%) had developed diabetes-related complications. Only 30.2% of patients fully understood their anti-diabetic treatment regimens, while the majority (79.0%) wished to actively participate in shared decision-making with their physicians. Preference analysis revealed that five attributes were most important in patients' clinical decision-making: incidence of macrovascular complications, extended life years, change in quality of life, incidence of microvascular complications, and HbA1c control (Table 2).

Implementation of the Evidence-Based Decision Aid

The evidence-based decision aid employs computer-assisted decision-making technology and operates as a web-based application. The tool comprises five modules: (1) Introduction (clinical knowledge, patient information, tool overview); (2) Multi-dimensional Attribute Description (comparative effectiveness, comparative safety, convenience, affordability); (3) Indications for Anti-diabetic Drugs; (4) Multi-dimensional Value Assessment of New Anti-diabetic Drugs; and (5) Drug Selection Results (Figure 1 [Figure 1: see original paper]). The tool uses a wizard-based approach to guide users step-by-step in selecting anti-diabetic drugs that align with their values.

The "Introduction" module provides clinical knowledge about diabetes [12-14],

patient information (e.g., years since diagnosis, current glycemic control status, complications), and an overview of the tool. The "Multi-dimensional Attribute Description" module uses text and images to describe the decision dimensions and attributes related to effectiveness, comparative safety, convenience, and affordability. The "Indications for Anti-diabetic Drugs" module presents indications and precautions for both traditional and new anti-diabetic drugs, allowing patients to decide whether they need further information about new agents.

The "Multi-dimensional Value Assessment of New Anti-diabetic Drugs" module represents the core of the tool, presenting structured evidence summaries for three classes of new anti-diabetic drugs with source citations. These evidence summaries are dynamically updated as new evidence emerges. Figure 2 [Figure 2: see original paper] illustrates the evidence summary for four GLP-1RAs (liraglutide injection, dulaglutide injection, semaglutide injection, and exenatide injection). During evidence-based clinical practice, physicians and patients communicate to ensure patients fully understand the research evidence on anti-diabetic drugs, enabling informed decision-making.

The tool supports patients' evidence-based assessment of drug value through linear weighting of attribute weights and scores. Upon completion of value assessments for all drugs, the evaluation results for each dimension and overall value are presented in list format to inform clinical treatment decisions (Figure 3 [Figure 3: see original paper]). The system records and saves assessment results, automatically recommending the drug with the highest score. Pilot testing with diabetic patients demonstrated the tool's clinical feasibility, showing it can enhance physician-patient communication, improve patient knowledge about diabetes and anti-diabetic drugs, and increase overall satisfaction with the treatment process.

Discussion

Patients Need Decision Aids to Participate in Clinical Decision-Making

Decision aids help meet patients' decision-making needs, improve decision quality, and lead to better health outcomes [15]. Health technologies possess multi-dimensional value attributes that carry different relative importance in patients' clinical decisions [6,16]. Previous research found that traditional decision aids primarily display evidence on a single drug attribute without incorporating patient preferences or weighting of health technology attributes. The innovation of this study lies in using best-worst scaling to investigate medication preferences among diabetic patients, thereby assessing the relative importance of drug attributes in treatment decisions and applying these findings to tool development. Our study population, comprising patients using anti-diabetic medications for glycemic control—most of whom required new anti-diabetic drugs due to complications and few of whom fully understood their treatment regimens—represents the target population for decision aids. We found that comparative effectiveness

held significant priority in patients' clinical decisions, a finding consistent with similar studies demonstrating that effectiveness determines medication preferences. For instance, one survey of Chinese diabetic patients showed that cardiovascular health benefits and clinical efficacy were more important than weight changes and dosing frequency [17], while U.S. research indicated that patients value HbA1c control, glycemic stability, and cardiovascular event rates [18]. These findings underscore that patients need decision aids to access evidence on anti-diabetic drugs, particularly regarding comparative effectiveness, to make clinical decisions that reflect their preferences.

Decision Aids Providing Evidence on Anti-diabetic Drugs Help Meet Patient Information Needs

Evidence-based decision aids help patients make informed clinical decisions by providing relevant evidence on anti-diabetic drugs. This study demonstrates that diabetic patients weigh multi-dimensional value attributes—including comparative effectiveness, comparative safety, convenience, and affordability—when making clinical decisions. Therefore, evidence-based decision aids should meet patients'information needs to ensure they fully understand drug values. Decision aids have become an important pathway for promoting shared decision-making. The Mayo Clinic has developed decision aids for medication selection in type 2 diabetes, and other researchers are developing tools for diabetes treatment and health management [19-20]. However, existing tools focus on different subsets of drug attributes and lack comprehensive, evidence-based decision aids that fully reflect multi-dimensional value. Our evidence-based decision aid considers the multi-dimensional value of anti-diabetic drugs and integrates patient preferences for these attributes, thereby better meeting patients' clinical medication information needs.

Decision Aids Facilitate "Patient-Centered" Care by Integrating Evidence and Values

In clinical decision-making scenarios, physicians typically inform patients about health benefits and risks based on existing experience and clinical knowledge. As passive information recipients, patients who fail to fully comprehend all available information tend to make less certain decisions, resulting in poor treatment adherence. Previous research shows that more scientific diabetes knowledge helps patients better understand treatment regimens and achieve higher adherence [21]. Decision aids must provide evidence that is understandable, authentic, important, and applicable to patients [22]. Our multi-dimensional value assessment tool for new anti-diabetic drugs efficiently screens and integrates high-quality evidence across multiple dimensions, presenting it in a concise and comprehensible format. Tool use can increase medical knowledge, improve physician-patient communication, enhance patient satisfaction with the decision-making process, and improve decision efficiency, thereby facilitating scientific and effective evidence-based clinical decision-making.

Patient-centered healthcare emphasizes providing treatments that align with individual patient preferences and needs, ensuring that patient values actively inform clinical decisions [23]. Research indicates that physicians need to understand patient preferences in practice, and involving patients in decisions improves decision quality [24-25]. To better incorporate diabetic patients' values, our evidence-based decision aid includes a value assessment function for new anti-diabetic drugs. Patients evaluate drug value based on evidence, with scores representing their value judgments for specific drug attributes. This evidence-based assessment process achieves organic integration of evidence and values, embodying a patient-centered decision-making philosophy.

Evidence-Based Decision Aids Help Implement Shared Decision-Making

Shared decision-making is a novel patient-centered medical decision model that has gained international attention in healthcare. This concept reflects the essence of evidence-based medicine by combining the best available clinical evidence with physicians' knowledge and skills and patients' values and preferences to make optimal clinical decisions [26]. Evidence-based decision aids serve as important tools for implementing shared decision-making. Research shows that decision aids offer advantages in improving patients' disease and treatment understanding, enhancing decision-making capacity, reducing decisional conflict, and optimizing treatment experiences [27-28]. Although decision aids for shared decision-making exist internationally, they require adaptation to China' s cultural traditions, healthcare policies, and physician-patient dynamics [29]. Our study developed a localized decision aid based on diabetic patients' medication preferences to help patients make informed treatment decisions. The tool presents multi-dimensional evidence on new anti-diabetic drugs in structured summary format, providing reference and information support for clinical decisions. In practice, physicians explain evidence that patients find unclear, ensuring informed decisions based on full evidence comprehension. After thorough communication, patients and physicians make joint decisions to identify treatments that align with patient preferences, thereby achieving shared decision-making.

Limitations

While our evidence-based decision aid holds practical value for implementing evidence-based clinical decisions and shared decision-making, fully embodying patient-centered and evidence-based concepts, several limitations exist. First, the best-worst scaling study was conducted in Jiangsu Province; future research should recruit a nationwide sample to enhance representativeness of diabetic patients' medication preferences. Second, we did not achieve personalized prediction of medication preferences based on individual patient characteristics; future large-scale studies should establish datasets for scientifically predicting patient preferences. Third, the multi-dimensional value evidence on anti-diabetic drugs

in the tool requires continuous updating as new research emerges, currently performed manually. Researchers should apply machine learning and deep learning technologies to decision support tool development to improve evidence update efficiency. Finally, our pilot study exploring clinical feasibility was conducted only at Rugao People' s Hospital; quantitative assessment of intervention effectiveness in other healthcare institutions is lacking.

Conclusion

The evidence-based decision aid aims to support diabetic patients' active participation in evidence-based clinical practice by providing multi-dimensional evidence on the comparative effectiveness, comparative safety, convenience, and affordability of new anti-diabetic drugs, integrated with patient preference data for these multi-dimensional value attributes. Patients' quantitative assessment of drug value based on evidence achieves organic integration of research evidence, patient values, and decision contexts. Tool application will facilitate implementation of shared decision-making, improve treatment adherence, realize patient-centered healthcare services, and promote a "people-oriented" healthcare system.

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