US-China Foreign Language, December 2025, Vol. 23, No. 12, 486-492
doi:10.17265/1539-8080/2025.12.006

AI-Assisted Management of Herbal Terminology

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With the globalization of Chinese and Western medicine, the standardization and intelligent management of herbal terminology have become important drivers of the field. Herbal terminology is characterized by diverse origins, cultural specificity, and technical complexity. This paper, based on the Chinese-to-English translation of texts which mainly talks about preparation methods and applications of herbal tinctures, explores how artificial intelligence (AI) technologies can assist the systematic management of herbal terminology.

Keywords: artificial intelligence (AI), terminology management, herbal medicine terminology repository

Introduction

With the acceleration of globalization and the growing urgency for international exchange of traditional Chinese medicine culture, the standardization and intelligent management of herbal terminology have become pivotal to advance the field. Confronted with the characteristics of multi-origins, strong cultural connotations, and high specialization, traditional terminology management approaches are no longer entirely suitable. In this context, systematic, and standardized terminology management—as the foundation for constructing the herbal medicine knowledge system—ensures conceptual consistency, information accuracy, and the integrity of knowledge structures, thereby influencing the efficiency of technical exchanges in herbal medicine. Artificial intelligence (AI), with its robust natural language processing and machine learning capabilities, has brought significant changes to terminology management. This paper focuses on exploring the applications of AI in terminology management. Through empirical analysis, it will examine the potential and limitations of AI-assisted models in enhancing the consistency, accuracy, and efficiency of terminology management.

The Development of Terminology Management

With the continuous advancement of information technology and digitalization, the technical practice of terminology management has progressively evolved from traditional manual methods toward computer-assisted standardization and intelligent processing. Zheng Anwen and Wang Min (2023) proposed the innovative theory of “morphological motivation”, emphasizing that it primarily triggers cognitive connections rather than subjective associations in semantic interpretation, which demonstrates a relatively objective nature in terminology comprehension. They further advocated analyzing it in systematic detail from the comprehensive perspective of the conceptual system and accordingly proposed a coherent translation strategy characterized by “literal translation as the primary approach”. This methodology aims to systematically retain the morphological

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motivation of the source language in translated terminology while ensuring conceptual accuracy and cross-linguistic consistency across different cultural and linguistic contexts.

Early research on AI-assisted translation primarily focused on the overall improvement of neural machine translation quality. Wang Huashu and Liu Shijie (2022) constructed a post-editing competence model for professional translators, clearly defining the connotations and requirements of each competence and elaborating on the development of post-editing skills from multiple dimensions. Wang Hesi and Ma Kexin (2023), by comparing the performance of engines, such as ChatGPT and Google Translate in biomedical texts, pointed out that although AI demonstrates relative advantages in handling specialized terminology, the translation quality of these engines varies, with risks such as term mistranslation and conceptual confusion. Their research identified the inherent limitations of general AI models in processing highly specialized texts, particularly the challenges to accuracy posed by a lack of domain-specific knowledge.

Terminology Characteristics

Terminology refers to specialized vocabulary created and employed by various disciplines, such as science, technology, literature, and art, to precisely express concepts within their respective fields. Its meaning must reflect the essential characteristics of the subject under study, thus requiring consistency with scientific concepts. Scientific terminology is characterized by unambiguity and uniformity—It cannot be polysemous and should not have synonyms, as this would cause significant inconvenience in scientific research. Among these, scientific terminology—particularly herbal medicine terminology—exhibits unique characteristics beyond basic features like unambiguity and standardization. It requires systematic integration and precise description of medicinal plants' multidimensional attributes, such as morphology, pharmacology, efficacy, and processing methods. Simultaneously, these terms often carry profound historical and cultural connotations, necessitating a balance between respecting traditional knowledge and aligning with modern scientific paradigms. Consequently, their standardization is particularly complex, with the core challenge lying in constructing a rigorous conceptual framework that both preserves their origins and enables precise contemporary academic communication.

Multi-sources Nature

Herbal terminology derives from diverse origins and exhibits significant professional complexity. A specific term may be associated with multiple conceptual systems, and the same designation can refer to different plants depending on the context. This inherent ambiguity manifests primarily as homonymy (different concepts sharing the same name) and synonymy (multiple names referring to "the same concept"). Latin scientific names, as standardized identifiers for species, must strictly adhere to the International Code of Nomenclature. They serve to precisely designate plant species, such as Echinacea purpurea. The corresponding Chinese nomenclature must align with authoritative references like Botany to prevent referential ambiguity. Chemical component terms demand even greater specialization.

Terminology involving various compounds, such as "hypericin", must comply with standardized chemical nomenclature principles to ensure rigorous accuracy. Terms related to therapeutic effects and body systems, such as "adaptogen" and "nervine", possess rich conceptual connotations. These terms do not exist in isolation but function within comprehensive theoretical frameworks. Consequently, during cross-system knowledge integration and articulation, particular attention must be paid to maintaining definitional completeness and considering contextual factors to prevent terminological ambiguity.

Cultural Load

Herbal terminology exhibits distinct cultural load, as its conceptual system is deeply rooted within specific medical traditions and philosophical frameworks. Western herbalism draws from European folk traditions and classical medical systems, inheriting Graeco-Roman medical knowledge while also incorporating influences from other civilizations. This includes not only the introduction of many Eastern botanicals, but also the integration of knowledge concerning these plants. Within Western herbalism, terms, such as “carminative” and “demulcent” are not isolated lexemes. They collectively form a coherent system related to digestive tract regulation, precisely describing distinct mechanisms of action. These terms embody a unique understanding of vital activities, pathological mechanisms, and therapeutic logic. This cultural load means that when terminology is separated from its original cultural context, its full conceptual depth and systematic interrelationships can be compromised. Therefore, accurately understanding and applying such terms requires identifying their cultural origins and situating them within their complete knowledge network. This approach prevents mere literal translation and ensures the preservation of their intended meaning.

Specialization

The specialized nature of herbal terminology is manifested in multiple dimensions. Firstly, it involves the precise definition of medicinal parts, “Root Bark” literally refers to the root and bark of a plant, but it specifically denotes the active periderm layer of the root, where the concentration of active constituents is significantly higher than in other parts. “Vinegar-frying” describes a processing technique where herbal materials are mixed with a specified quantity of rice vinegar until a standardized degree of integration is achieved. It transcends the simplistic notion of “processing with vinegar”, as its purpose is to leverage acid-base reactions and thermal effects to promote chemical interactions between alkaloids and acetic acid. This process facilitates the formation of water-soluble salts, a chemical transformation that markedly enhances the analgesic efficacy of the herb. This represents a comprehensive procedure encompassing material selection, physical operations, and chemical reactions. Consequently, the management of specialized terminology is inherently a process of scientific precision. It necessitates the construction of terminology databases that not only provide equivalent translations, but also integrate these precise scientific definitions, classification criteria, and technical parameters.

Terminology Management

Terminology management is a specialized activity that involves the systematic collection, definition, storage, maintenance, and promotion of terminology resources. Its core objective is to ensure consistency in concepts and designations within a specific field, thereby enabling efficient and accurate knowledge dissemination and innovation. Effective terminology management requires establishing standardized processes covering identification, standardized review, authoritative publication, and dynamic updates. In interdisciplinary or global contexts, it particularly necessitates coordinating differences between systems, leveraging tools like databases to achieve collaborative construction and sharing of terminology resources. Ultimately, it serves diverse needs including standard setting, academic exchange, technology transfer, and professional education.

Terminology management is the core systematic approach to solving the challenge of terminology standardization. Through standardized processes, it collects, defines, maintains, and disseminates terms to ensure unique correspondence between concepts and names within a field, thereby guaranteeing the accuracy and efficiency of knowledge transfer.

Foundational Structure

Establishing a standardized terminology database is fundamental to construct an intelligent terminology management system. Utilizing generic terminology management software, such as MultiTerm or Trados, a structured termbase template is created. This template typically includes the following core fields, standard Chinese name, Latin scientific name, English name, term type (e.g., species name, chemical component, and efficacy description), definition/description, context, and reference sources. Taking Scutellaria baicalensis (Huángqín) as an example, its terminological entry not only records basic nomenclature, but also uses AI technology to automatically associate and verify its specialized attributes. These include its Latin name (Scutellaria baicalensis), therapeutic category (e.g., clearing damp-heat and purging fire and detoxifying), and main chemical components (e.g., flavonoids), thereby ensuring data accuracy and completeness. The AI system is capable of automatically identifying, extracting, and categorizing new terms from vast amounts of text. Machine learning algorithms assist in tasks, such as term deduplication, conflict detection, and concept mapping. When processing terms like “Skullcap”, which can have multiple referents, the AI system can intelligently recommend the most appropriate Chinese translation based on the context and automatically present its complete attribute definitions and usage conventions.

Term Extraction

In the term extraction phase, general-purpose AI tools are effectively integrated with systematic human review to substantially enhance workflow efficiency and accuracy. Initially, the advanced text comprehension capabilities of large language models, such as ChatGPT and DeepSeek are leveraged to extract candidate terms and their contextual usage in bulk from diverse herbal medicine texts. Through carefully designed and iteratively refined prompts, these models are guided to automatically identify and extract specialized terminology while simultaneously capturing relevant contextual settings and usage patterns. Subsequently, the extracted terms undergo preliminary automated classification and attribute annotation, with each term receiving a foundational definition or explanatory note. The automation features of modern terminology management software are then employed to perform intelligent deduplication and identify complex linguistic phenomena, such as homonymy and synonymy. Finally, a rigorous multi-stage review process is conducted, with particular emphasis placed on verifying the accuracy and nuance of culturally loaded terms. This integrated approach successfully capitalizes on the processing efficiency of AI while ensuring the professional reliability and conceptual accuracy of the final terminology resource.

Terminology Application

In practical application, this system effectively establishes connectivity between the centralized termbase and commonly used office software platforms—such as Microsoft Word—through a streamlined and user-friendly interface. When a user enters a specific term like “Skullcap” while composing a document, the system promptly recognizes the input and automatically displays corresponding Chinese equivalents in an intuitive pop-up interface. This display is accompanied by synchronized key attribute information, comprehensively presenting the term’s Latin scientific name, its position within relevant classification systems, and well-documented primary functions or therapeutic applications. For handling newly emerging terminology or evolving usage patterns, the system incorporates a straightforward yet efficient feedback mechanism. Through an integrated intelligent annotation feature, users can conveniently submit modification suggestions or addition requests with a single click operation. These valuable suggestions then enter a structured automated review workflow and, following

necessary verification and confirmation, are systematically incorporated into the master termbase to maintain its currentness and completeness. Simultaneously, the system consistently generates detailed terminology usage analysis reports, automatically detects inconsistencies in term application across documentation, and consequently enables data-driven optimization of terminology management strategies and operational guidelines, thereby ensuring continuous improvement in terminology standardization and application accuracy.

Quality Control

A multi-layered quality assurance mechanism is systematically established to uphold the integrity and usability of the terminology database: Firstly, in the terminology entry phase, mandatory fields and automated format validation are rigorously implemented, while advanced natural language processing techniques are strategically employed to verify the structural standardization and naming consistency of terms in an intelligent manner. Secondly, throughout the application phase, automated terminology consistency checks are seamlessly integrated into the workflow, enabling real-time detection and systematic flagging of any terminology deviations or inconsistencies encountered within documents. Finally, regular and structured termbase health assessments are conducted on a scheduled basis, focusing on the comprehensive evaluation of key performance indicators such as term duplication rates, attribute completeness, and update timeliness. Based on the detailed findings derived from these assessments, centralized and well-documented revisions are systematically executed, ensuring that the termbase dynamically aligns with and accurately reflects the latest domain developments and emerging requirements. Through this carefully designed, closed-loop management approach, the entire mechanism effectively guarantees that the termbase not only maintains robust structural stability but also cultivates a sustainable and adaptive capacity for ongoing refinement and optimization.

Case Study

The term “Skullcap” exemplifies the typical phenomena of “multiple names for one entity” and “one name for multiple entities” in herbal terminology. Within the Western herbal system, Scutellaria lateriflora (commonly referred to as Blue Skullcap) is primarily used as a nervine sedative. In contrast, in traditional Chinese medicine, Scutellaria baicalensis (known as Huángqín) functions to clear heat and dry dampness. Although both belong to the Scutellaria genus, their pharmacological actions and clinical applications differ significantly. Simply classifying both under the single designation Huángqín would lead to conceptual confusion and practical difficulties in application. AI technology offers a novel approach for systematically addressing such terminological challenges. By constructing a comprehensive intelligent termbase, separate entries corresponding to Měi Huángqín and Huángqín can be created for Skullcap. Each entry is bound to its unique Latin scientific name and annotated with its respective system attribute (“Western Herb” or “Traditional Chinese Medicine”). Key efficacy descriptions (e.g., “sedative nervine”) are also included as foundational data. During actual terminology processing, when the system detects the term “Skullcap” in a text, it automatically queries this termbase. If the source text includes a Latin scientific name, the system can directly match the correct entry. If a clear scientific name is absent, the AI can analyze the contextual semantics and efficacy attributes within the termbase to infer the most probable reference. This enables the system to provide users with precise terminology recommendations or support accurate decision-making based on sufficient information.

The introduction of the term “Adaptogen” presents a significant challenge of conceptual lacuna in contemporary herbal terminology management. Within an AI-assisted herbal terminology framework, resolving

such complex issues fundamentally relies on establishing an intelligent terminology system that transcends traditional equivalence-based translation models and adopts a more nuanced, concept-oriented approach. For the specific case of "Adaptogen", the system explicitly designates as the standardized preferred term while systematically associating it with a comprehensive set of key structured attributes: These include its precise scientific definition, clearly highlighting core conceptual characteristics, such as "non-specific response" and "balancing modulation", along with detailed usage guidelines and applicable contexts. Furthermore, to ensure immediate comprehension and proper application, upon its first occurrence in any professional text, an intelligently annotated form is automatically adopted—presented as a functional herbal component that helps the body cope with stress and restore balance—accompanied by an explanatory note specifically advising against directly substituting with culturally specific terms like "fu zheng gu ben", which carry distinct theoretical connotations and diagnostic implications within Traditional Chinese Medicine that do not fully align with the original biomedical concept. This methodology effectively bridges conceptual gaps while maintaining terminological precision across different medical systems and cultural contexts.

In Chinese, "Syrup" is commonly translated as "tang jiang", generally referring to a viscous, sweet liquid. However, in Western herbalism, "Herbal Syrup" denotes a specific dosage form. It describes a semi-liquid preparation produced by decocting or infusing herbs, combining the resulting liquid with sugar or honey in specific proportions, and concentrating the mixture. This process yields a formulation that serves both preservative and flavor-correcting purposes. If a terminology management system relies solely on general dictionaries and simply renders it as "cao yao tang jiang", while superficially correct, this overlooks its specialized attributes as a dosage form. Users might then confuse it with condiments or common syrups found in Chinese proprietary medicines, failing to grasp its essence as a professional herbal preparation. Within an AI-assisted herbal terminology management framework, such issues can be systematically resolved by constructing a deeply structured termbase. Specifically, while "cao yao tang jiang" is set as the standard Chinese term for "Herbal Syrup", the system classifies it explicitly within the "Dosage Form" attribute field. Furthermore, the "Definition" field records detailed descriptions of its preparation and function: "Specifically refers to a semi-liquid concentrate made with honey or sugar as a base, combined with herbal extracts, possessing both therapeutic effects and preservative functions". When an information processor encounters "Herbal Syrup" in a text, the AI system can not only automatically recognize the term and suggest the standard translation, but also instantly retrieve and display its complete definition and attribute information. This enables users to accurately understand the term's specialized meaning within its specific context, thereby ensuring terminological consistency and accuracy while fundamentally preventing ambiguity with general concepts.

Conclusion

This paper undertakes a systematic investigation into the AI-assisted management of herbal terminology and proposes a comprehensive and feasible framework for its practical implementation. Confronted with the distinctive and complex characteristics of herbal terminology—including its multi-origins, profound cultural load, and high degree of specialization—traditional management approaches have repeatedly proven inadequate in meeting the evolving demands of modern knowledge dissemination and application within the field. By strategically integrating contemporary terminology principles with advanced AI tools, structurally organized intelligent term bases can be effectively developed, thereby enabling a more comprehensive and systematic optimization throughout the entire workflow, from initial terminology acquisition and practical application to

final quality control, which in turn demonstrates considerable practical and theoretical value. As a foundational and integral component of the broader herbal knowledge system, enhanced intelligent terminology management is poised to significantly facilitate smoother and more accurate cross-cultural and cross-linguistic communication. Furthermore, with the ongoing and rapid technological advancements anticipated in the future, this forward-looking management model holds considerable potential for expansion into a wider array of application scenarios, thereby offering valuable insights and a solid reference for the ongoing modernization and global integration of herbal studies.

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