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Research on the Current Status and Challenges of the Dissemination of the *Compendium of Materia Medica* Based on Digital Technology

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Abstract

This paper strives to investigate the status and difficulties of the dissemination of the *Compendium of Materia Medica* (Bencao Gangmu) in the information age and proposes corresponding optimization strategies. Through means such as literature analysis, case studies, and field studies, the paper systematically analyzes the digital dissemination status of *Compendium of Materia Medica*, including digital collections, online databases, knowledge graphs, etc., and other forms etc. The findings indicate that digital dissemination has significantly enhanced the accessibility and influence of the *Compendium of Materia Medica*, but there are problems such as uneven quality of content, inconsistency between types of dissemination and depth, and absence of internationalization. The finding suggests that digital technology brings new opportunities to the dissemination of the *Compendium of Materia Medica*, but optimization of content quality, dissemination depth, and internationalization is needed. As indicated by these findings, this paper recommends the following strategies: strengthening content review, stimulating serious content development, making use of AI and big data technology for optimizing user experience, and enhancing international cooperation in order to foster digital dissemination and the cultural heritage of the *Compendium of Materia Medica*.

Keywords

Compendium of Materia Medica (Bencao Gangmu); Digital Communication; Current State of Communication

1. Introduction

The *Compendium of Materia Medica* is a classic of ancient Chinese medicine. It is not merely a pharmacological giant but also a crucial part of Chinese traditional culture. The book comprehensively summarizes the achievements of ancient Chinese medicine and has exerted a great impact on subsequent medical research. With the rapid development of digital technology, how to make use of modern technological tools in promoting the dissemination and inheritance of the *Compendium of Materia Medica* has been a trendy topic in today's academic and cultural communities. The aim of this study is to explore the current situation of dissemination of the *Compendium of Materia Medica* in the digital age and the problems faced, and to propose relevant optimization measures.

2. An Overview and Value of the *Compendium of Materia Medica*

2.1 The Author of the *Compendium of Materia Medica* and Its Compilation Background

Qizhou, Hubei. He was born into a family of physicians and was once an Imperial Medical Institute judge. Due to

the errors and disorder of categorization in the ancient herbal works of past dynasties, Li Shizhen, using the "Zhenlei Bencao" as a sample, took nearly 30 years, referred to over 800 ancient books, combined field investigations and masses' experience, and completed this pharmacological monumental work. The first draft was completed in 1578 and printed out as the Nanjing edition in 1596 (Li Shaolin, Chai Jihong, & Liang Fei, 2024).

2.2 Content and Scale

The treatise consists of 52 volumes, spread over 16 sections and 60 categories, containing 1,892 kinds of medicines (including 374 new ones), 11,096 prescriptions, and over 1,100 illustrations. It discusses the classification of plants, animals, minerals, etc., and consists of a total of approximately 1.9 million words. It is recognized as the "Oriental Pharmacological Canon" and the culmination of ancient Chinese pharmacology (Liu Yuhan & Yang Cheng, 2025).

2.3 The Multi-dimensional Embodiment of Value

2.3.1 Innovative Classification System and Interdisciplinary Integration

In pharmacology, a new system of classification emerged, which brought in the new "Compendium" style. Drugs were categorized into different categories such as water, fire, earth, metals and stones, herbs, and trees according to their natural properties. This approach to classification is fully 150 years in advance of Linnaeus' Systema Naturae and can be referred to as the "pioneer of modern biological taxonomy." Not only does it emphasize the adaptability of biological forms to the environment, but it also represents the earliest cognition of biological diversity and ecological adaptability, with the primitive form of evolutionary thought.

In the view of pharmacy and medicine integration, this system synoptically summarizes the pharmacological knowledge before the Ming Dynasty and rectifies many confusions of the predecessors. For example, it distinguishes Arisaema heterophyllum Blume from Pinellia pedatisecta Schott clearly. It also vividly describes the origin, morphology, processing methods, and efficacy of drugs, providing more accurate and complete information for pharmacological research. In addition, this system absorbs a large number of folk empirical prescriptions and medical cases, achieving inter-disciplinary integration, embracing a number of disciplines like mineralogy, botany, astronomy, agronomy, and meteorology, greatly enriching the content of pharmacological research and promoting the development of relevant disciplines.

2.3.2 Modern Applications and International Recognition

The *Compendium of Materia Medica* plays an immense role in its application and popularity at home and abroad. Domestically, more than one hundred kinds of drugs and preparations in the Pharmacopoeia of the People's Republic of China originate from the *Compendium of Materia Medica*, and its recipes and treatments are still in widespread application in TCM clinical practice. Additionally, the *Compendium of Materia Medica* has also promoted the development of traditional Chinese medicine culture and industry. For example, Qichun County in Hubei Province has developed the mugwort industry based on the *Compendium of Materia Medica*, which further enhances the economic value of traditional Chinese medicine. Abroad, the *Compendium of Materia Medica* has also been well recognized.

It was praised by British scientist Charles Darwin as an "encyclopedia of ancient China", and its scientific achievements were rated by Joseph Needham as "comparable to those of Galileo Galilei and Andreas Vesalius". Jinling *Compendium of Materia Medica* edition and Huangdi Neijing (Inner Canon of Huangdi) were inscribed into the UNESCO Memory of the World Register in 2011 jointly and were praised as "the most valuable reference in the history of East Asian science", fully representing their important position in the history of world science.

2.3.3 Cultural Value, with Rich Details and Comprehensive Perspectives

In literature and the art of language, this book has unique values. Firstly, it skillfully interweaves allusions, poems, proverbs, and folktales. In the part of explaining names, it adopts the textual research approach, such as Shuowen Jiezi (Explaining Characters and Analyzing Components), to carefully examine the etymology and meaning of words, most fully demonstrating the richness and delicacy of the Chinese language. Secondly, the photographs in the book are extremely beautiful and of extremely high artistic value. Not only do they bring visual pleasure to readers, but they are also of great reference value for learning ancient Chinese and traditional Chinese medicine (TCM) terms, and hence, it is a model work of pictures and text (Lan Qi & Yang Ning, 2024).

2.3.4 Natural History and the Value of Intellectual History

In natural history and intellectual history, the work presents an encyclopedic view and chronologically documents

the knowledge of nature and the cosmos in Chinese society during the 16th century. The book is concerned with a wide range of topics such as phenology, geography, and folklore, graphically realizing the philosophical concept of "the unity of man and nature" and the medical concept of the "holistic concept", providing useful materials for the study of the history of ancient thought (Li Yu & Bai Songqiang, 2023).

2.3.5 Scientific Spirit and Ethical Values

On the scientific spirit side, the book emphasizes empirical evidence and discrimination against falsehoods, criticizes superstitions, but meanwhile keeps folk remedies, in fact, echoing the medical practice at that time, and the author's strict academic nature. From the value of ethical culture, this book emphasizes that physicians should be rooted in the premise of "benevolent heart and benevolent skills," carrying forward the rich ethical spirit profoundly in traditional Chinese medicine culture, and setting high moral standards for physicians in coming generations (Zuo Gang et al., 2020).

3. Analysis of the Achievements of the Digital Dissemination of the *Compendium of Materia Medica*

3.1 In Terms of Database Construction

Bencao Digital Traditional Chinese Medicine Knowledge Base: Scientific Press has developed the first complete database of *Compendium of Materia Medica* (Bencao Gangmu) drug data with authoritative and complete copyright, based on the research achievements of the "Integrated Research Series on Bencao Gangmu." The database integrates systematic and standardized research achievements related to the *Compendium of Materia Medica*, with rich content and authoritative digital resources for traditional Chinese medicine research.

Molecular Bencao Technology Platform: This platform, led by Professor Jing Cheng's team, has built a large-scale pharmacological molecular signaling pathway database that contains over 900 traditional Chinese medicines and over 300 types of food, spanning nine major human systems and diseases. It has developed various disease cell models and has large-scale gene expression profiles and signaling pathway maps. By strategies of "drug-to-target testing" and "target-to-drug testing," the platform rapidly tests and evaluates ancient prescriptions or clinical experience formulas, advancing the digital interpretation of the mechanisms of traditional Chinese medicine and its innovative development.

3.2 In Terms of Digital Tool Application

The electronic version of the *Compendium of Materia Medica* in the China Academy of Chinese Medical Sciences Library provides users with full-text, images, and a catalog digitized form, so users can access it anywhere at any time. The query software of the *Compendium of Materia Medica* has been open after the expansion in information technology. These software applications, based on scanning, image processing, optical character recognition (OCR), and electronic proofreading technologies, process the text and image contents of the *Compendium of Materia Medica* to editable and searchable digital formats, significantly enhancing the study and research efficiency of traditional Chinese medicine information.

In addition, the HerbVis: Visualization of the World of Bencao project, after the *Compendium of Materia Medica*, shows six sections through visualization, aided by tools such as Python and Excel, to build the interactive web version of The World of Bencao. The new project not only provides users with a more convenient and intuitive query experience but also offers new channels for the dissemination and promotion of traditional Chinese medicine culture.

3.3 In Terms of Digital Collections

On February 25, 2022, the Institute of Information on Traditional Chinese Medicine of China Academy of Chinese Medical Sciences approved for publication China's first digital collection of traditional Chinese medicine ancient books, Jinling Edition of *Compendium of Materia Medica*. The digital collection is derived from Hu Chenglong's engraved edition in Jinling. This edition is the earliest woodblock printing edition of the *Compendium of Materia Medica* and the sole edition compiled by the Li family, with extremely high cultural and historical value.

This digital collection's release is the industry's first in traditional Chinese medicine. Its trailblazing gameplay, i.e., "user participation, algorithm generation, reverse casting, and complete randomness", has gained attention from a lot of users. What's more, users can co-create and cast the elements of the "Chinese Zodiac" by entering their birthdate

information, and the rarity of the final collection is collectively decided by the users.

This new model not only provides a new way for the spread and inheritance of traditional Chinese medicine culture but also provides an example for the digital transformation of traditional culture.

3.4 Foreign Projects

Japan's "National Database of Chinese Classics" is a large catalog database of Chinese classics. It contains digital materials of some ancient Chinese medicine books like *Compendium of Materia Medica*, which are searchable (Guo Chong & Yang Ping, 2023).

Canada's "Ethnic Medicine Archives—Illustrated Classified Materia Medica" contains digital content of ancient Chinese medicine books like the *Compendium of Materia Medica*.

The United States' "Yi Jing: The medicine of error" is a full-image database that attempts to collect image materials of ancient Chinese medical books. It contains the contents pertaining to the *Compendium of Materia Medica*, providing scholars with intuitive image resources of old books (Fan Xiaorui, Zhang Xuewei, & Gao Yangfan, 2025).

4. Challenges Faced by the Digital Dissemination of the *Compendium of Materia Medica*

4.1 Insufficiency in Data Integration and Sharing

The networked dissemination of the *Compendium of Materia Medica* is restricted by the insufficiency of the whole data integration and exchange of the traditional Chinese medicine industry. Data sources are scattered, and there is no standard for integrated data and platforms for exchange, which causes poor data interoperability. For example, the database of the China Academy of Chinese Medical Sciences cannot talk to the system of Amway, thereby creating the phenomenon of data silos. In addition, there exist considerable differences in the levels of digital construction of traditional Chinese medicine among different regions and institutions, and the uneven development between regions has affected the overall promotional effect of the digital assets of the *Compendium of Materia Medica*.

4.2 Technical Bottlenecks of Optical Character Recognition (OCR) and Digital Proofreading

Firstly, ancient books contain a huge quantity of variant characters, traditional Chinese characters, hand-written characters, and special fonts such as seal script and cursive script. Traditional OCR models are not effective in recognizing these characters in the context of ancient books.

Second, the page organization of old books is diverse, for example, vertical, horizontal, and compound structure, and elements such as body, annotation, illustration, and seal. Therefore, it is difficult for OCR technology to recognize and divide text, so page layout analysis methods must be used.

Third, ancient texts, due to being old, will typically experience blurring of text, stains, or page damage, which degrades the precision of OCR recognition immediately. Enhanced image quality will then have to be obtained using applying image preprocessing techniques (such as grayscaling, noise filtering, and binarization). Besides that, manual proofreading is a sheer indispensable step to be performed.

The material of antique books is frequently rich in profound cultural and historical significance. Therefore, not only should technical improvement be added to OCR recognition, but the recognition itself should also be supported by cultural research to ensure the accuracy and credibility of the recognition results (Xu Yuandong, 2023).

4.3 Challenges in the Modernization and Internationalization of Traditional Chinese Medicine

The complex ingredients and mechanism of action of *Compendium of Materia Medica* are difficult to accept by the international community, and explaining and rewriting them in the terminology of modern science are required. Presently, there are still blanks in the international standardization of the field of traditional Chinese medicine. For example, the lack of globally standardized naming norms has hindered the exchange of knowledge. Besides, there are differences in the cultural understanding of some virtual products. They simplify the pharmacological rationale, which causes the systematicness of the original work to collapse.

5. Conclusion and Prospect

The electronic spread of the *Compendium of Materia Medica* has evolved from the rudimentary phase of "preservation of documents" to the phase of "replication of knowledge". Not only does it create new possibilities for the spread

of traditional Chinese medicine culture, but it also infuses new vitality into modern research and application of traditional Chinese medicine. However, it is not without challenges, and its dissemination channels and challenges are well worth thorough discussion.

In the future, we can ensure the authority and accuracy of content in digital dissemination through the refinement of content review. We can cooperate with higher learning institutions to develop high-quality digital resources serving professional research and education. Using AI and big data technologies, we can achieve maximum user experience and improve dissemination efficiency. Simultaneously, we are to deepen international collaboration. Through multilingual publication and cultural exchange activities, we can further spread the international influence of the *Compendium of Materia Medica* and promote international development of the traditional Chinese medicine culture.

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