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ANALYSIS OF THE THEMATIC STRUCTURE AND INTENSITY DIFFERENCES IN CHINA'S NUCLEAR MEDICINE POLICY

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Background and Objective

- The nuclear medicine industry is an emerging industry with significant strategic value. Policy guidance and support are crucial for its development, and accurately grasping the core focus of policies is a vital foundation for promoting high-quality development in the nuclear medicine sector. In recent years, as China's national and provincial-level policies related to nuclear medicine have been continuously introduced, there may be differences in the key focuses and support directions of policies at different levels.
- Latent Dirichlet Allocation (LDA) topic models, as an unsupervised machine learning tool, have been widely used in policy text mining. This study aims to identify potential topics of nuclear medicine policies based on the LDA topic model, compare the differences between national and provincial policies in terms of topic structure and focus intensity, and provide references for strengthening the connection between national and local policies, optimizing policy structure, and enhancing policy coordination.

Methods

Policy selection

Using “nuclear medicine,” “nuclear pharmaceuticals,” “radiopharmaceuticals,” and related terms as keywords, title-based searches were conducted on official government websites, supplemented by full-text searches of the PKU Law Policy Database. National- and provincial-level policy documents related to nuclear medicine were screened based on the principles of authoritativeness, representativeness, and relevance.

Data Preprocessing and Policy Intensity Analysis

- The jieba library was used for word segmentation of the policy corpus.
- Stop words were removed using general-purpose stop-word lists, including the Harbin Institute of Technology Stop Word List and the Baidu Stop Word List, together with a customized stop-word list specific to nuclear medicine policy.
- A domain-specific dictionary was constructed to preserve technical terms.

LDA Topic Modeling

A Latent Dirichlet Allocation (LDA) model was constructed to identify the underlying topics of nuclear medicine policies. Differences in topic intensity between national- and provincial-level policies were compared, and cosine similarity between topics was calculated based on the topic–word probability matrix.

$$\text{Topic Intensity} = \frac{1}{D_t}\sum_{d=1}^{D_t}\theta_{zd}$$

$$\text{Cosine Similarity} = \frac{\sum_{k=1}^{V}\phi_{zk}\,\phi_{z'k}}{\sqrt{\sum_{k=1}^{V}\phi_{zk}^2}\sqrt{\sum_{k=1}^{V}\phi_{z'k}^2}}$$

Results

A total of 93 nuclear medicine–related policy documents were included, comprising 24 national-level policies and 69 provincial-level policies.

➢ Optimal Number of Topics

The coherence score reached its highest value when the number of topics was set to five. Combined with the visualization results from pyLDAvis, the optimal number of topics was therefore determined to be five.

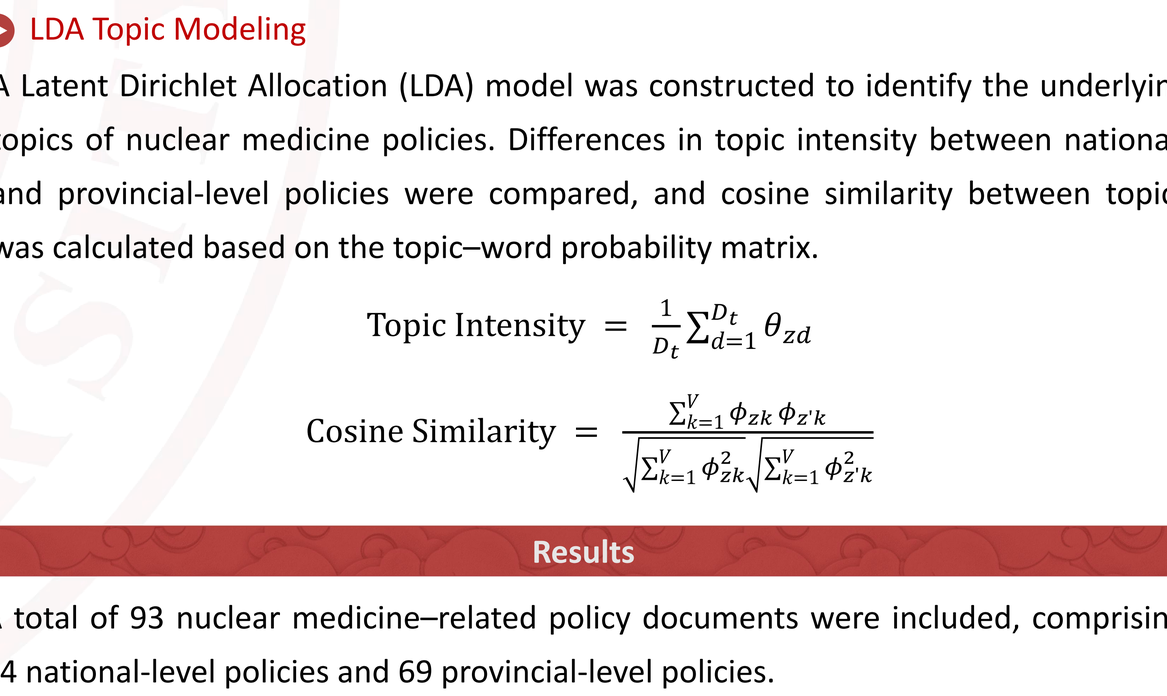

Figure 1. pyLDAvis Visualization

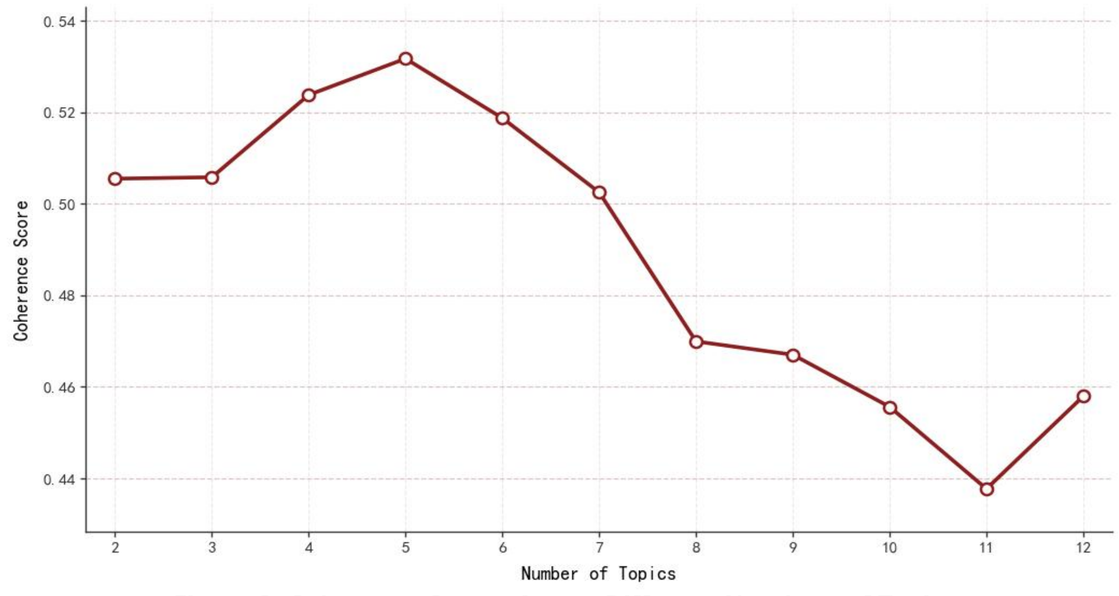

Figure 2. Coherence Scores Across Different Numbers of Topics

➢ LDA Topic Identification

Topic categories were identified based on high-probability feature words and topic-related texts, with consideration of the context of nuclear medicine policies.

Table 1. Topic Categories and Keywords of Nuclear Medicine Policies

Topic Number	Topic Category	Top 20 High-Probability Feature Words
Topic0	Medical Equipment Manufacturing	Equipment, Industry, High-end, Technology, Field, Health, Science and Technology, Development, Manufacturing, Medical Devices, Drugs, Pharmaceuticals, Healthcare, Cultivation, Innovation, Cluster, Biological, Emerging, Intelligent, Construction
Topic1	Pharmaceutical Quality Regulation	Drugs, Radioactive, Production, Management, Supervision and Administration, Testing, Enterprises, Quality, Departments, Work, Healthcare, Inspection, Institutions, Psychotropic Drugs, Narcotic Drugs, Operations, Review, Toxicity, Clinical, National
Topic2	Medical Technology Translation	Industry, R&D, Technology, Construction, Research, Development, Healthcare, Innovation, Science and Technology, Projects, Enterprises, Health, Translation, Support, Evaluation, Health Services, Laboratory, Industrial Chain, Achievements, Isotopes
Topic3	Medical Industry Support	Healthcare, Development, Support, Industry, Construction, Field, Health, Drugs, Projects, National, Enterprises, Hospitals, R&D, Pharmaceuticals, Centers, Innovation, Encouragement, Treatment, Clinical, Medical Use
Topic4	Radiopharmaceutical Management	Radioactive, Drugs, License, Institutions, Radiation, Medical Institutions, Filing, Production, Isotopes, Sales, Preparation, Renewal, Approval, Management, Protection, Transfer, Nuclear Medicine Department, Positron, Validity Period, Requirements

➢ Comparison of Topic Intensity

As shown in **Figure 3**, significant differences were observed between national- and provincial-level policies for Topics 0–3 ($p < 0.001$), whereas the difference for Topic 4 was not statistically significant ($p = 0.19$). Among them, national-level policies showed the highest mean topic intensity for Topic 1, while provincial-level policies exhibited relatively higher topic intensities for Topics 0, 2, and 3.

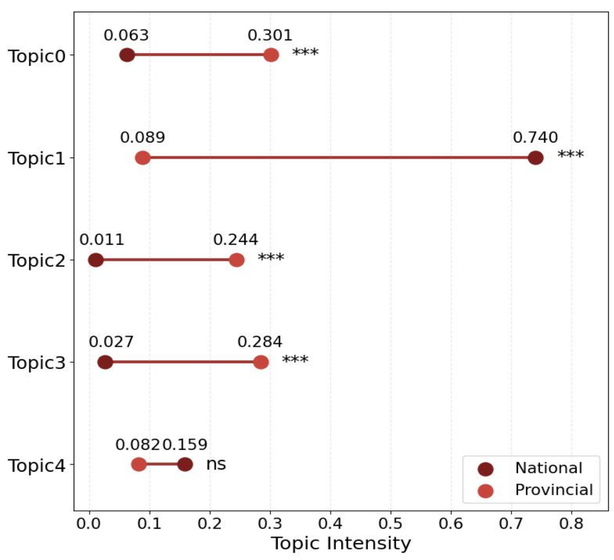

Figure 3. Comparison of Topic Intensity Between National- and Provincial-Level Policies

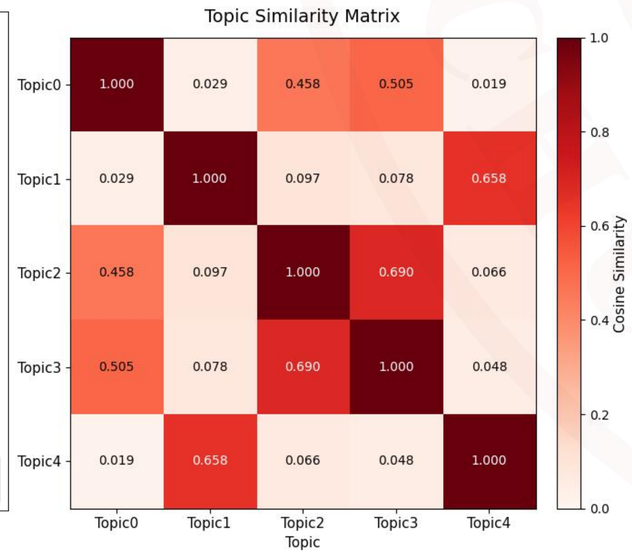

Figure 4. Heatmap of Cosine Similarity Between Topics

➢ Topic Similarity Analysis

As shown in **Figure 4**, Topic 2–Topic 3 and Topic 1–Topic 4 exhibited the highest levels of similarity. Topic 0 showed moderate similarity with Topics 2 and 3, whereas the similarities among the remaining topic pairs were relatively low. Overall, the five topics demonstrated a reasonable degree of distinctiveness, while some topics also showed semantic associations.

Conclusion

The findings indicate that national- and provincial-level nuclear medicine policies differ significantly in their thematic focus across most topics, reflecting distinct policy priorities at different administrative levels. In the future, greater coordination between national and provincial policies should be promoted, the thematic structure of nuclear medicine policies should be optimized, and policy coherence and consistency should be enhanced.

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