Original Paper

Construction of Physician Group Profiles in Online Medical Consultation Platforms: A Tripartite Physician-Patient-Platform Perspective

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Abstract

Constructing physician group profiles within online medical consultation platforms enables the precise characterization of multi-dimensional features of physician cohorts. This approach facilitates a better understanding of physicians' behavioral patterns and service quality on these platforms, thereby providing support for service optimization. Drawing upon existing research on factors influencing patients' physician selection behavior, a conceptual model for physician profiling was established from three dimensions: physician, patient, and platform. Using the concept lattice method, profiles for dermatology and venereology physicians on the Haodf.com platform were constructed. Based on the Hasse diagram, the physician cohort was categorized into four distinct types: high-value elite, multi-domain active, high-efficiency interaction, and potential-to-be-explored. Furthermore, implicit dependencies among attribute tags were uncovered through association rule mining. Adopting a tripartite "physician-patient-platform" perspective, we developed a group profile for physicians on online consultation platforms, which validates the efficacy of the concept lattice method for such profiling. The mined association rules further reveal the interrelationships within the "physician-patient-platform" data, offering data-driven support for optimizing physician management, enhancing service quality, and enabling precise recommendations on these platforms.

Keywords

concept lattice method, online medical consultation platform, physician group profiles, association rule mining

As of June 2025, the number of Chinese Internet healthcare users reached 393 million (China Internet Network Information Center, 2025). In China's Internet hospitals, the utilization rates of online consultation and appointment registration functions remain high. As an important user group on online medical consultation platforms, physicians play a central role in the platform's consultation services, and their responses to users' health inquiries directly impact platform service quality and user experience (He, Zhao, Liu et al., 2025). In light of issues such as imperfect incentive mechanisms, and limited physician activity and willingness to continue providing services on these platforms, constructing the physician's user profiles has become particularly crucial for enhancing service precision and promoting the healthy development of the platform. Constructing physician profiles not only helps optimize resource allocation but also deepens the platform's understanding of physician' needs, thereby facilitating more personalized and efficient service delivery. As a powerful tool, formal concept analysis can not only essentially explore the relationships between objects and attributes but also visually reveal the inclusion relationships and hierarchical structures among concepts, thus providing strong support for constructing physician profiles (Wang, Pan, Yang et al., 2020).

Focusing on constructing profiles of online physician groups, we integrate multi-source information from the perspectives of physician, patient, and the platform, and it systematically summarizes and deeply analyzes the attribute characteristics of physicians, establishing a well-structured and internally coherent conceptual model of physician profiles. Based on this model, the concept lattice method is employed to conduct multi-dimensional and multi-level clustering of physician groups, forming well-differentiated typified group profiles that clearly present the distribution of commonalities and differences in service models, professional characteristics, and behavioral patterns. Through the mining of association rules, potential connections and regularities among physician attributes are further revealed, providing a basis for precise service delivery and personalized recommendations of online medical consultation platforms. The research findings offer references for the refined management of physician groups and contribute to enhancing the user experience of consultation platform services.

1. Data and Methods

1.1 Data Source

Haodf.com is one of China's leading online medical consultation platforms, possessing a large number of medical information and expert resources. Data on this website typically originates from professional physicians or medical institutions, demonstrating considerable credibility and authority. The online consultation service model is well-suited to assist users with minor ailments and chronic diseases, and the research indicates that users generally show a high level of concern about diseases such as gastroenterology, dermatology, and mental stress. In light of this, we utilize data from the department of dermatology and venereology on the Haodf.com website as its data source. The relevant information of 1905 physicians in the department of dermatology and venereology was obtained through the Internet, including their affiliated hospitals, professional title, fellow patient

recommendation rate, total numbers of patients, and token of appreciation.

1.2 Methods for Constructing Physician Profiles

The research adopts a "conceptual model construction, attribute tagging, formal concept analysis" pathway to construct physician profiles for online medical consultation platforms. First, based on relevant theoretical support and literature analysis, a three-dimensional "physician–patient–platform" conceptual model for physician profiles is constructed. Then, the RFM model is introduced to screen typical physician users, and the characteristic attributes of physicians are tagged. Finally, formal concept analysis is applied to construct a concept lattice structure of physician profiles, realizing the portrayal of physician group profiles.

1.2.1 Construction of the Conceptual Model for Physician Profiles

Content generated by physicians, patients, and the platform serves as an important metric for assessing physician quality and significantly influences the patient's physician selection process[4]. Referring to current studies regarding "the factors influencing patients' physician selection behavior on online medical consultation platforms", see Table 1. We construct a conceptual model for physician profiles from three dimensions: physician, patient, and platform ,see Figure 1.

Table 1. the factors influencing patients' physician selection behavior on online medical consultation platforms

DIMENSION	THEORY	INFLUENCE FACTOR	LITERATURE RESOURCES
Physician	Trust theory, perceived value, social exchange theory	Professional title	Wei & Yang, n.d.; Zeng & Guo, 2018
		Service type	Wei & Yang, n.d.; Zeng & Guo, 2018; Xiang &Yang, 2023; Cao Xianye, Liu, 2021
		Service price	Xiang & Yang, 2023; HONG & Lu, 2018
		Number of articles	Wei & Yang, n.d.; LIU, ZHANG, LI et al., 2023; Xiang & Yang, 2023; Du, Huang, & Xu, 2024
		Level of information disclosure	Wei & Yang, n.d.; Zeng & Guo, 2018
		Photo	Yi, Wu, Cai et al., 2021; Tang, Li, Wang et al., n.d.
		The city where the hospital is located	Lu, n.d.
Patient	Trust source theory, perception theory, online reputation	Number of tokens of appreciation	Wei & Yang, n.d.; Xiang & Yang, 2023; Du, Huang, & Xu, 2024; Yi, Wu, Cai et al., 2021; Tang, Li, Wang et al., n.d.

	feedback	After-service star rating	Xiang & Yang, 2023; Tang, Li, Wang et al., n.d.
		Number of post-consultation reviews	Xiang & Yang, 2023
platform	Conformity, perception theory, online trust feedback	Total number of patients	LIU, ZHANG, LI et al., 2023; Tang, Li, Wang et al., n.d.
		Patients with post-visit follow-up	Xiang & Yang, 2023; Du, Huang, & Xu, 2024
		Recommendation popularity	Wei & Yang, n.d.

(1) Physician dimensions

Based on the content and themes of the information, physician-related information can be categorized into basic information and behavioral information. Physicians establish an initial foundation of trust by presenting basic information such as name, professional title, and gender. Behavioral information focuses on reflecting physicians' dynamic performance and contribution during medical consultation services, which is specifically manifested through medical contribution behaviors, such as publishing popular science articles and participating in live-streamed free medical consultations, as well as through services type and the set service price.

(2) Patient dimension

In online medical consultation platforms, the interactions between patients and physicians are crucial in shaping the physician's image. New patients often rely on post-consultation reviews from other patients as a key reference for evaluating physicians (Deng & Hong, 2017). The "disease category tags" in these reviews quantify the physician's specialized fields and clinical experience. Followers of a physician reflect their influence and create a virtuous cycle. Additionally, token of appreciation further reinforces the physician's positive image.

(3) Platform dimension

The information provided by the platform dimension is based on deep data mining and analysis results of physician-patient interactions on online medical consultation platforms. Taking the Haodf.com online platform as an example, metrics such as after-service star rating, fellow patient recommendation rate, satisfaction with medical care, satisfaction with physician attitude, and post-visit follow-up rate are generated based on the platform's data resources, and the comprehensive evaluation of various physician behavioral data of and patient feedback. The platform updates physicians' online status in real time. Patients can know physicians' response speed by checking their last online time, thereby improving consultation efficiency.
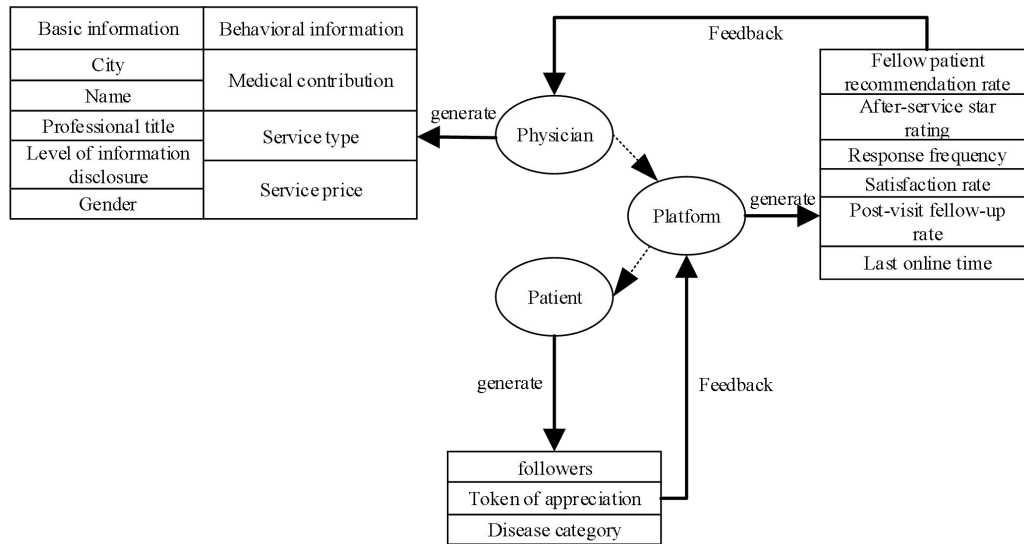
Basic information	Behavioral information
City	Medical contribution
Name	
Professional title	Service type
Level of information disclosure	
Gender	Service price

Fellow patient recommendation rate
After-service star rating
Response frequency
Satisfaction rate
Post-visit fellow-up rate
Last online time

followers
Token of appreciation
Disease category

Figure 1. The Conceptual Model for Physician Profiles for Online Medical Consultation Platforms

1.2.2 Introduction of the RFM Model

The RFM model, a typical analytical tool in user segmentation study, focuses on extracting three key metrics from user transaction behaviors: recency, frequency, and monetary. However, within online health platforms, since physicians do not engage in consumption behaviors, we adaptively reconstruct the original measurement dimensions of the RFM model based on existing research results and the characteristics of online medical platforms. Specifically, recency is redefined as the time difference (measured in days) between a physician's last visit to the Haodf.com website and the statistical date. Frequency is defined as the total historical number of patients that the physician has consulted on the platform, serving as a metric for measuring the frequency of services. Monetary is defined as the number of patients who actually visited a medical institution for offline treatment after online consultation, reflecting the actual conversion effect of the healthcare services. Based on the mean values of the above three assessment dimensions, the physician cohort is segmented into eight distinct groups with different characteristics. From each group, two physicians who have typical features of that category were selected, forming a sample set comprising sixteen representative cases, as shown in Table 2.

Table 2. RFM User Table

METRIC			NAME	METRIC			NAME
R	F	M		R	F	M	
1	1	1	Chen*	1	1	0	Wang*ping
			Tan*feng				Li*hong

1	0	1	Shao*	1	0	0	Yu*yan
			Zhang*xia				Fan*bin
0	1	1	Mu*	0	1	0	Shi*ling
			Wu*cai				Zheng*
0	0	1	Wang*yang	0	0	0	Liu*ming
			Yu*				Zhang*ping

1.2.3 Tag Attribute Processing

The essence of user profiles lies in comprehensively depicting user characteristics through tagging method. For this reason, we utilize data from physician profile pages on the Haodf.com online platform to design a comprehensive attribute tag framework including three dimensions: physician, patient, and platform. The physician basic information attribute tags comprise level-1 tags: name, professional title, city, level of information disclosure, and gender. The level of information disclosure is further detailed through three level-2 tags: profile photo, resume, and certification. The physician behavioral information attribute tags focus on three level-1 tags: medical contribution, service type, and service price, which characterize physicians' online behavioral patterns. The patient attribute tags establish three level-1 tags: token of appreciation, disease category, and followers. From these, two level-2 tags are derived: post-consultation review and treatment experience, reflecting feedback and characteristics from the patient side. The platform attribute tags encompass six level-1 tags: fellow patient recommendation rate, after-service star rating, response frequency, post-visit follow-up rate, satisfaction rate and last online time. To enhance analytical depth for more precise measurement, six level-2 tags are also defined: satisfaction rate with medical care, satisfaction rate with physician attitude, number of physician replies, number of patient replies, total number of patients, and number of patients with post-visit follow-up. Before utilizing these tags to construct a formal context for subsequent analysis, the aforementioned physician-related attribute tags require merging and simplification processes.

1.2.4 Construction of Physician Profiles for Online Medical Consultation Platforms Based on Concept Lattices

The aforementioned tables are all multi-valued two-dimensional tables, and some of the attribute tags contain quantitative data, making it impossible to construct a concept lattice. Conceptual Conversion (Zhang, Cui, Wang et al., 2018) is required to convert the quantitative data into qualitative data and transform the multi-valued context into the formal context. The result is shown in Table 3. The software ConExp1.3 was used to construct the formal context for physician sub-tags, the number of the "level of information disclosure < AVG" tag was too small among these tags, which would affect the presentation of the concept lattice; therefore, this tag was deleted. Furthermore, since the group attribute tag "disease category: Inflammatory skin diseases" was small, it was also deleted. Consequently, four distinct types of physician groups were identified: high-value elite, multi-domain

active, high-efficiency interaction, and potential-to-be-explored.

Table 3. Physician Attribute Scaling Table

The physician basic information attribute tags		
Professional title	A1	Senior professional title
	A2	Junior professional title
City	B1	Provincial capital city
	B2	Non-provincial capital city
Level of information disclosure	C1	Level of information disclosure > AVG:(2,+∞)
	C2	Level of information disclosure < AVG:[0,2]
Gender	X1	Male
	X2	Female
The physician behavioral information attribute tags		
Medical contribution	D1	Medical contribution > AVG:(14.9,+∞)
	D2	Medical contribution < AVG:[0,14.9]
Service type	F1	Service type > AVG:(2,+∞)
	F2	Service type < AVG:[0,2]
Service price	G1	Service price > AVG:(84,+∞)
	G2	Service price < AVG:[0,84]
The patient-generated attribute tags		
Token of appreciation	H1	Token of appreciation > AVG:(50,+∞)
	H2	Token of appreciation < AVG:[0,50]
Disease category	M1	Inflammatory skin diseases
	M2	Skin tumors and pigmented skin disorders
	M3	Infectious skin diseases
	M4	Medical aesthetics and other
Followers	E1	Followers > AVG:(1129,+∞)
	E2	Followers < AVG:[0,1129]
The platform-generated attribute tags		
Fellow patient recommendation rate	R1	Fellow patient recommendation rate > AVG:(3.6,+∞)
	R2	Fellow patient recommendation rate < AVG:[0,3.6]
After-service star rating	J1	After-service star rating > AVG:(1,+∞)
	J2	After-service star rating < AVG:[0,1]
Response frequency	P1	Response frequency > AVG:(0.38,+∞)
	P2	Response frequency < AVG:[0,0.38]

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Post-visit follow-up rate	S1	Post-visit follow-up rate > AVG:(0.32,+∞)
	S2	Post-visit follow-up rate < AVG:[0,0.32]
Satisfaction rate	K1	Satisfaction rate > AVG:(0.20,+∞)
	K2	Satisfaction rate < AVG:[0,0.20]
Last online time	Y1	Last online time > avg:(15,+∞)
	Y2	Last online time < avg: [0,15]

2. Results

2.1 Analysis of Four Types of Physician Profiles

2.1.1 High- value Elite Type

The tags associated with this type include: provincial capital city, after-service star rating < average, service price > average, satisfaction rate < average, medical contribution > average, female, senior professional title, post-visit follow-up rate < average, response frequency < average, token of appreciation > average, followers > average, last online time > average. This physician group consists primarily of chief physicians with senior professional titles, affiliated with hospitals located in provincial capital cities, and is predominantly female. Their consultation service prices are mostly above the average level, and they make relatively high contributions to disseminating medical knowledge, gaining a large number of followers. Although the number of tokens of appreciation exceeds the average level, their last online time is generally more than two weeks ago, their response frequency is low, and their overall platform activity is relatively poor. The post-visit follow-up rate and satisfaction (3601/896) are below average, and the platform's fellow patient recommendation rate is correspondingly lower.

2.1.2 Multi-domain Active Type

This physician group is characterized by the following tags: level of information disclosure > average, medical aesthetics and other, skin tumors and pigmented skin disorders, post-visit fellow-up rate < average, followers > average, medical contribution > average, service type > average, and token of appreciation > average. This physician group has a high level of information disclosure. They have completed full verification of their physician qualification certificate, physician practice certificate, facial recognition, and provide their authentic personal profile photo, and maintain relatively comprehensive resume information. The main disease category treated include dermatological oncology and pigmentation disorders, and medical aesthetics and other. They demonstrate a high level of contribution to medical science popularization and possess a substantial number of followers. In addition to providing the services of online consultation and appointment registration, the majority of these physicians also offer private physician or team-based services. Although the post-visit follow-up rate is below the platform average, the number of tokens of appreciation they receive exceeds the average level.

2.1.3 High-efficiency Interaction Type

This group is characterized by the following tags: non-provincial capital city, response frequency > average, junior professional title, post-visit fellow-up rate > average, medical contribution > average, satisfaction rate> average, followers > average, service type > average, token of appreciation > average, after-service star rating > average. This physician group mostly comes from non-provincial capital cities and mostly has junior professional titles. Their high contribution to medical science popularization, wide range of service types, and high frequency of consultation reply indicate a generally positive service attitude. They possess a relatively large number of followers and token of appreciation, and patients report a high satisfaction rate. Additionally, both the post-visit follow-up rate and after-service star rating are above average.

2.1.4 Potential-to-be-explored Type

This group is characterized by the following tags: token of appreciation < average, followers < average, medical contribution < average, satisfaction rate< average, post-visit fellow-up rate < average, response frequency < average, service price < average, non-provincial-capital city, senior professional title, and fellow patient recommendation rate < average. This physician group primarily consists of those with senior medical professional titles but working in hospitals which located in non-provincial-capital cities. Although their consultation prices are relatively low, their lower response frequency, limited contributions to medical science popularization, and smaller follower base may lead to lower patient satisfaction, fewer tokens of appreciation from patients, a lower post-visit follow-up rate, and consequently a lower fellow patient recommendation rate.

2.2 Association Rule Mining Analysis

2.2.1 Association Rule Mining between Patients and Platform-provided Information

With the minimum support set to 2 and confidence to 60%, association rules were screened to include only those whose prerequisites contain the "infectious skin diseases" tag and whose conclusions contain the tag "response frequency > average". All six rules were obtained, as shown in Table 4. Among them, rule 5 indicates that, with a support degree of 7, patients who are suffering from infectious and inflammatory skin diseases have an 86% probability of preferring physicians with response frequency higher than the average during the physician selection process. Rule 6 shows that, with a support degree of 3, male patients with infectious skin diseases have a 67% probability of choosing physicians with junior professional title, and post-visit follow-up rate and satisfaction rate of these physicians are both above average, and they provide detailed consultation responses.

Table 4. Association Rules between Patient and Platform Dimensions

No.	ASSOCIATION RULE DETAILS
1	< 5 > Infectious skin diseases Fellow patient recommendation rate > avg =[100%]= > < 5 > Provincial capital city After-service star rating < avg Response frequency > avg Inflammatory

skin diseases;

2   < 4 > Provincial capital city After-service star rating < avg Inflammatory skin diseases Infectious skin diseases Medical aesthetics and other Level of information disclosure > avg =[100%]= > < 4 > Medical contribution > avg Response frequency > avg Fellow patient recommendation rate > avg;

3   < 4 > Provincial capital city After-service star rating < avg Inflammatory skin diseases Infectious skin diseases Last online time > avg =[100%]= > < 4 > Response frequency > avg Fellow patient recommendation rate > avg Post-visit fellow-up rate > avg;

4   < 4 > Provincial capital city Service price > avg After-service star rating < avg Infectious skin diseases =[100%]= > < 4 > Response frequency > avg Inflammatory skin diseases Fellow patient recommendation rate > avg;

5   < 7 > Inflammatory skin diseases Infectious skin diseases =[86%]= > < 6 > Response frequency > avg;

6   < 3 >Male Infectious skin diseases =[67%]= > < 2 >Junior professional title Response frequency > avg Inflammatory skin diseases Post-visit fellow-up rate > avg Satisfaction rate > avg

2.2.2 Mining Association Rules between Physicians and Platform-provided Information

Taking the physician-provided information "service price > average" as an example, with the minimum confidence set to 4 and the minimum support to 80%, association rules where the prerequisites contain the tag "service price > average" and the conclusion contains tags related to platform-provided information were screened. All nine rules were obtained, as shown in Table 5. Rule 1 indicates that, with a support degree of 6, physicians who work in hospitals located in provincial capital cities, have a high level of information disclosure, make high contributions to popular science, maintain a high response frequency, specialize in medical aesthetics and other dermatological diseases, yet have higher consultation prices, have a 100% probability of also possessing a larger number of followers. Rule 7 indicates that, with a support degree of 7, physicians who work in provincial capital hospitals, offer fewer types of consultation services, but have higher consultation prices, may have an 86% satisfaction rate and a low after-service star rating, and also receive fewer tokens of appreciation.

Table 5. Association Rules between Physician and Platform Dimensions

No.	ASSOCIATION RULE DETAILS
1	< 6 > Provincial capital city Medical contribution > avg Service price > avg Response frequency > avg Medical aesthetics and other Level of information disclosure > avg =[100%]= > < 6 > Followers > avg;
2	< 6 > Provincial capital city Service type < avg Service price > avg Token of appreciation < avg After-service star rating < avg =[100%]= > < 6 > Satisfaction rate < avg;

3 < 4 > Provincial capital city Service price > avg After-service star rating < avg Infectious skin diseases =[100%]= > < 4 > Response frequency avg > Inflammatory skin diseases Fellow patient recommendation rate > avg;

4 < 5 > Provincial capital city Service price > avg After-service star rating < avg Last online time > avg =[100%]= > < 5 > Inflammatory skin diseases Fellow patient recommendation rate > avg;

5 < 8 > Provincial capital city Service price > avg Inflammatory skin diseases =[100%]= > < 8 > Fellow patient recommendation rate > avg;

6 < 8 > Provincial capital city Service type < avg Service price > avg =[88%]= > < 7 > After-service star rating < avg;

7 < 7 > Provincial capital city Service type < avg Service price > avg After-service star rating < avg =[86%]= > < 6 > Token of appreciation < avg Satisfaction rate < avg;

8 < 6 > Provincial capital city Service type < avg Service price > avg After-service star rating < avg Level of information disclosure > avg =[83%]= > < 5 > Token of appreciation < avg Post-visit fellow-up rate < avg Satisfaction rate < avg;

9 < 6 > Provincial capital city Female Service type < avg Service price > avg After-service star rating < avg =[83%]= > < 5 > Inflammatory skin diseases Fellow patient recommendation rate > avg

3. Discussion

This paper systematically constructs user profiles of physicians on online medical consultation platforms and digs deeply into the interactive rules among different perspectives. The main findings include the following two aspects.

3.1 Types of Physician Group Profiles

Four distinct types of physician groups have been characterized. The first is the high-price elite type. These physicians exhibit a high level of professionalism but relatively low activity. Therefore, platforms may consider offering incentives to enhance their online activity level and response frequency, thereby improving satisfaction rate and post-visit fellow-up rate. The second type is the multi-domain active type. This group has a large follower base, which can be leveraged to increase popular science efforts in areas such as skin tumors, pigmented skin disorders, medical aesthetics, and other skin-related diseases. Initiatives such as science popularization livestreams can help strengthen follower loyalty. Next is the high-efficiency interaction type. Although these physicians hold relatively lower professional titles, they provide frequent and large amounts of services. To further maximize on their strengths, platforms can encourage them to participate in professional forums, enhance their influence through exchanges, and establish patient interaction modules to facilitate communication between physicians and patients. Lastly, the potential-to-be-explored type consists of highly specialized physicians with low consultation prices. However, their low response frequency and limited

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contributions to popular science result in a small follower base. These physicians can optimize their personal information by highlighting their senior professional titles and affordable consultation prices. Platforms can implement internal incentive mechanisms to encourage physicians to make greater contributions to medical science popularization, and offer consultation service training to motivate physicians to improve interactions with patients and satisfaction.

3.2 Cross-perspective Association Rule Mining

Association rule algorithms can uncover the latent patterns among various characteristic tags of physicians. This helps physicians identify their own shortcomings and promotes the enhancement of their expertise and services. Furthermore, it assists users to select suitable physicians, thereby improving user experience. From the patient-platform perspective, for example, rule 6 indicates that with a support degree of 3, there is a 67% probability that male patients with infectious skin diseases will choose junior-title physicians who have both a high post-visit fellow-up rate and high satisfaction rate. Therefore, the platform can recommend such physicians to patients who are searching for infectious diseases and prioritize response frequency, thereby enhancing the patient's medical experience and satisfaction. From the physician-platform perspective, for example, rule 7 shows that with a support degree of 7, physicians located in provincial capital cities who offer fewer service types at higher prices have an over 80% probability of receiving low patient satisfaction. Consequently, the platform can advise these physicians to adjust their consultation prices based on market conditions and patient feedback to improve perception of cost performance. In summary, by analyzing from both the patient and platform perspectives to identify physician attributes such as patient review, satisfaction rate, and post-consultation service, the optimization of the display and recommendation of physicians on the platform can be achieved. This helps physicians in improving their services based on patient feedback. Furthermore, the latent associations between the information provided by physicians and the platform can help physicians understand aspects for improvement through platform feedback.

4. Conclusion

Referring to relative research results on online physician selection behavior, this paper proposes a conceptual model for constructing physician profiles on online medical consultation platforms by using the concept lattice method from three dimensions: physician, patient, and the platform. An empirical analysis was conducted on dermatologists and venereologists from Haodf.com. Four distinct physician profiles types were identified: high-value elite, multi-domain active, high-efficiency interaction, and potential-to-be-explored. These profiles reveal the collective behavioral characteristics of physicians on the platform, providing support for optimizing services on online medical consultation platforms. Furthermore, association rule mining was employed to gain a better understanding of physician group characteristics. However, this paper has certain limitations. Future researches could enhance sample representativeness by expanding the sample size and subdividing the screening of typical users to more comprehensively reflect the overall situation of all physicians. Additionally, the analysis of medical

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contribution within physician behavioral information could be more detailed based on comprehensive data representation. In conclusion, the research field of user profiles for online medical consultation platforms, particularly the construction of user profiles for physician, still offers vast potential for exploration. Subsequent researches can continue to dig deeply into aspects such as dimension expansion and comprehensiveness and depth of the sample data, thereby providing strong support for groundbreaking developments in this field.

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