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Analysis of User Social Support Network in Online Tumor Community

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Abstract: With the development of Internet technology, online health forums have become indispensable for people who seek non-professional health support. This research focuses on the content posted by cancer patients and their relatives in online health forums and social networks to raise the following research questions: What is the overall view of the social support network in the online tumor community? What are the information behaviors of the online tumor community in different identities of users? How users interact in this community and build this network of social support? What are the topics users would like to share and talk about? What kinds of users could be the key users in this community? Method: Using the post and comment data of the Oncology Forum of Tianya Hospital in 2019, combined with social network analysis and word co-occurrence network analysis, the following conclusions are obtained: (1) There are some central points in the overall social support network, and there are central users consistent with other social networks. (2) Positive users are more likely to comment on others, and it is easier to get others' comments, while negative users are more likely to share personal information and do not want to participate more in social interaction. (3) Users focus on posting emotional and emotional content in content sharing. Information-based social support information. The social support experience that this type of information brings to users can be positive and negative. (4) The most active group in the patients' online health community, followed by the patients' children. (5) The relationship between users and

patients is diverse and there are two types of singularity. Users with diverse relationships are more likely to be commented on, and they are more willing to comment on users who also have diverse relationships.

Keywords: online tumor community, cancer survivor, social support network

1 Introduction

With the improvement of living standards, people pay more and more attention to health. In addition to regular visits to the hospital for consultations, the use of mobile Internet technology to query health-related information online is becoming more and more frequent, which has also promoted the demand for health information research. From the perspective of health information content, health information needs can be divided into knowledge type, news type, data facts, and data type information. Through individual information queries, people can obtain more types of health information, which can make up for people and professional medical services. The knowledge gap between personnel serves as a knowledge supplement for medical information. The sources and channels for people to obtain health information mainly included authoritative resource databases, related health websites, discussions, and consultations resulting in the social circulation of health information, interpersonal communication, organizational communication, and mass communication. With the help of social media, the interpersonal communication of health information has developed rapidly.

The development of online communities and social platforms and the continuous improvement of citizens' health awareness have promoted the rise and development of online health communities. Faced with diseases that require long-term care, people who are left with only a limited number of exchanges with professional medical

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personnel, and also because of various problems faced in the nursing cycle, their health information needs are not met in time. Under the imbalance of supply and demand, the online health community provides an effective informal communication and interaction platform. People can obtain health information more quickly through the online health community, and at the same time can share their experience and exchange information with users with similar experiences to meet health information needs.

Social support is an important part of users health needs in online health communities. The theory of social support was born in the 1970s. It is a part of the relationship between the individual and the social environment. It helps individuals adapt to the environment. This model can be integrated into ecological theories and life models, focusing on obtaining resources from personal relationships. With the circulation of various resources in the social system, including formal social resources and informal social resources, formal social resources come from various institutional support from the government and formal social organizations, whereas informal support mainly comes from family, relatives, and friends, and some informal organizations who come forward to guide with a comprehensive support network for the vulnerable groups. Huang (2013) mentioned in the research on the social support network of cancer patients from the perspective of social work that the current social support network provided for cancer patients has a lack of institutional guarantees, lack of professionalism, single-sided support content, and insufficient degree of socialization of support forces. The existing social network is far from enough to help cancer patients cope with multiple pressures.

Based on this, this article raises the following research questions: What is the overall view of the social support network in the online tumor community? What are the information behaviors of the online tumor community in different identities of users? How users interact in this community and build this network of social support? What are the topics users would like to share and talk about? What kinds of users could be the key users in this community?

2 Literature Review

Reviewing users information behaviors in online health communities, there are several kinds of behaviors by Zhang and Xue (2020), their literature review of influencing factors of user participation behavior in the

online health community, such as information privacy concerns, seeking, asking, hiding, sharing, acceptance, using, responding, patients choosing doctors and social support behaviors. These behaviors of users in online health communities are researched by a number of scholars who are repeatedly analyzing data from a single aspect. But personal activities in online health communities are various. We could not think of research questions from one side, but it should be many-sided. Just like information sharing behaviors, it's about information flowing from person to person, but this is essentially a one-way output of information. As social support behaviors, these are interactions in networks of people, which include the multi-directional flow of energy, such as information, emotion, and so on.

Research on the categories of information participants in online health communities. Huh et al. (2016) found that there are four main types of roles in online health communities: Caretakers, Opportunities, Scientists, and Adventurers. Zhang and Xue (2020) believe that the information subjects in the online health community can be roughly divided into two categories. One is the non-professional knowledge of patients and their families, and their information needs and participating behaviors are relatively similar. The second category is professional users such as doctors and nurses, who are the main source of community expertise. There are various types of participating behaviors: diving behaviors, information seeking or searching behaviors, information disclosure behaviors, sharing behaviors, adoption behaviors, usage behaviors, and social behaviors among users. The above behaviors are different types of user behaviors, contributing behaviors, social support behaviors, and patients' doctor selection behavior, etc.. Yang and Zhu (2020) believe that based on the information ecosystem, online health communities mainly include information people, information, information environment, and information technology. Research by Sharma and Khadka (2019) showed that information support is the main type of support people seek from online social health support communities. Realizing the complexities of information behavior and the needs in the online health community, it makes us to ask more and more questions. In our data set, how much information needs to be focused on? How many people keep connections with others? When people were commended by others what topics they wanted to discuss? When they commended others, what topics they wanted to ask?

Now that we have paid a lot of attention to information behaviors and information participants, let's discuss these themes more specifically in social support backgrounds.

Reviewing the related literature on the types of social support, Liu, Li and Wang (2004) defined social support as three dimensions in the survey of the social support status of cancer chemotherapy patients: objective support, subjective support, and support utilization. Bambina (2005) proposed that the types of social support in online support groups mainly include emotional support, information, and partnership. The social network of the online community forms an effective combination, consisting of a dominant actor, responsible for connecting the highly forked network. Shi, Li, Qian, Zhou and Zhang (2019) proposed that the main types of users' social support needs in health question-and-answer communities at home and abroad are: information support, emotional support, and practical support. Wang (2015) found through an investigation of a health group on Douban.com that the network structure formed by information support is relatively loose, and though members participate in topic discussions the interaction between the network members is not high, and the network formed by emotional support and companion support has closer membership; in the network formed by the topic initiated by the dentist, all that the network members exchanged are information support content, and the patient in addition to information support, members of the initiated network will also provide emotional support and companionship support, and the patient network will be more closely connected. Besides, a study on Baidu "HIV Bar" found that the demand for social support is far greater than the supply of social support; and compared with emotional and realistic social support, information-based social support is the most frequently sought and provided type.

Those studies of social support focus on categories and structures of social support and its network. How about the people's behaviors in online health communities? As we all know that as users in one community, they must have information exchange and build some connection with others. When we dig deeper, we could find that people have different roles to play in the online health community.

Recalling the important role of social support networks in online health communities, Yang, Zhong, Kumar, Chow and Ouyang (2018) proposed that in online health forums, both the provision and acceptance of social support by users greatly encourage continuous social support exchanges. Liu, Fan, Ji and Jiang (2019) proposed that community support has a positive effect on the interaction between health topics and general topics. Yang, Du, Wang and Wu (2019) proposed that the scale of social support networks and the activities of individual and group

members within the network are positively correlated with the level of users participating in online health tasks, and the interactive relationship between social support networks, individual user activities, and user participation are complementary. Fullwood, Chadwick, Keep, Attrill-Smith, Asbury and Kirwan (2019) explained that the people lurking in the online health support group may get more benefits than those who actively participate, and achieve their goals without contributing.

We have already done more work to review others works about information behaviors and social support related topics. What about those research in specific populations such as cancer patients and their caregivers?

In response to related research on cancer patients in online health communities, Westmaas, Fallon, McDonald, Driscoll, Richardson, Portier and Smith (2020) investigated the behavior of American cancer survivors in online support communities and found that Conclusions Engagement in online survivor communities may increase support perceptions that promote well-being, but benefits may accrue more to survivors reporting low offline social support. Research by Weiss, Berner, Johnson, Giuse, Murphy and Lorenzi (2013) suggests that the online support community for cancer survivors should resolve the interdependence between online support and actual support, reduce social isolation and enhance people's social interaction in the real-world a sense of control of activities and the reintegration into the social environment may require the use of larger loosely connected networks. One should also simultaneously handle personal existing social networks such as family and friends at the same time. Social support in the existing social networks has shown a positive impact on health, while negative support in social networks is related to the negative impact on health.

From the above literature reading, it can be found that although the existing research has covered user reviews and behaviors in online health communities and research on user social support, there is a lack of research combining multiple perspectives. This research is based on a cross perspective study. Set out with the user comments and the commented behaviors of users in social support groups. At the same time, while constructing the user social support network, it further explores the relationship between users and patients, the overall structure of the social support network, and user comments and comments, the influence of behavior and content.

The theoretical contribution of this research lies in the integration of a single research problem domain that has been sufficiently researched into other problem domains for cross-research, and discovering the patterns of user behavior in different contexts. In social practice, this

research can help professionals improve the personnel structure in the online cancer community, publish professional knowledge through more influential users, provide information assistance in the social support network, and promote more users who can participate in the forum and find the information you need, and get better social support through emotional expression.

3 Data Collection and Analysis

In 2020, Tianya Community announced that there were more than 130 million registered users and more than 250 million monthly users. On September 17, 2001, the Tianya Hospital section was opened in Tianya Community, with the aim of “Netizens ask questions here, and doctors popularize science here.” Tianya Hospital focuses on patient consultation posts, including internal medicine, surgery, obstetrics and gynecology, pediatrics, infectious diseases, oncology, dermatology, ENT, traditional Chinese medicine, psychology, beauty, health, urology, and laboratory. In the content section, users share their own or others’ treatment experience and open posts, and other users can follow and comment in the main post.

In the forum section of Tianya Hospital, the author used the python web crawler to crawl all the posts published by the Oncology Department in 2019. There were 476 main posts, 7,859 posts, and 1,530 participating users. Users in the forum, commenting and posting each other from the perspective of existing literature, are all types of social support, whether it is from an emotional perspective or an information perspective, in this informal communication environment, through the identification of the structure of interaction between users can produce an understanding of the overall structure of the connections between users in the online health community. Use python for data analysis, follow the posts and comments between users, call the Pychars python visualization library to build a social network graph, and view the relationship between user comments and the commented. Use the word co-occurrence network to find out the relationship between user comments and the words in the comment, and find the correlation between the words most frequently used by users, extract the words after the topic according to TF-IDF, and perform word frequency statistics, and the frequency of occurrence will be greater after selecting the user clusters with rich interaction and establish the association between user sets and words.

Automatically segment the collected text data to describe the user’s identity. An example is illustrated as follows: A father is suffering from cancer, and the user can

be judged as the patient’s child. He seeks social support in the forum. After segmentation, the user’s self-description is assessed by manually judging and determining the identity of the user, including children, parents, friends, relatives, patients, brothers, and sisters.

Among the 1530 users, 961 were thus successfully identified. The rest of the data is difficult to identify or treated as advertising information, and so it is not considered for this study. In the identification, a user can have multiple identities. This is because, in the process of description, the user may mention different members of the family or friends suffering from cancer in different replies. Based on the user’s posting data, the number of posts posted by each identity is counted, and a picture is drawn. At the same time, based on the relationship between the comments in the online health community and the commented, combined with the user ID to construct a social network, focusing on users who actively comment on others, a network is constructed, and also focusing on users commented by others, networks are built to discover the similarities and differences between the two types of networks.

4 Conclusions

4.1 User Social Support Network

4.1.1 User Social Support Network Overview

The overall user relationship network in the online health community is shown in Figure 1 below.

Among the collected users, the behaviors of users’ postings and other users’ posting comments are established. Users who have posted a large number of posts have a larger central point, but fewer posts. Every user in social support network as a red point, which big or small point means the frequencies of communication. As we can see, users in the community have built multiple central social support networks. Users with a large number of posts are often connected with others, and users with a fewer number of posts are often isolated or at the end of the network.

4.1.2 Examples of Key Users of the User Social Support Network

From the perspective of users who choose to be in the core position of the network in the social support network, as

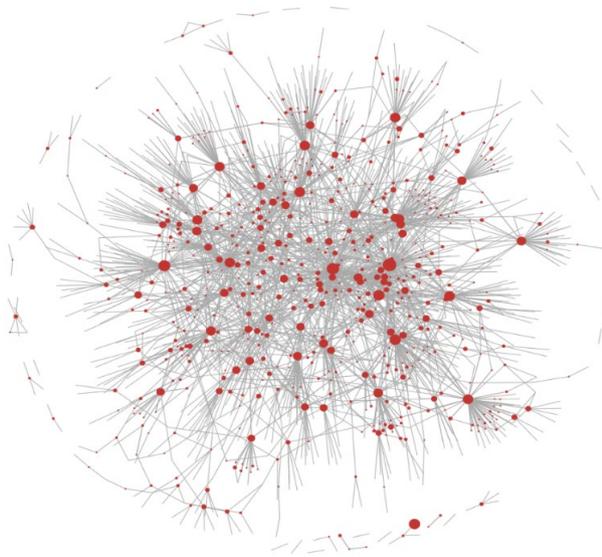


Figure 1. User social support network overview.

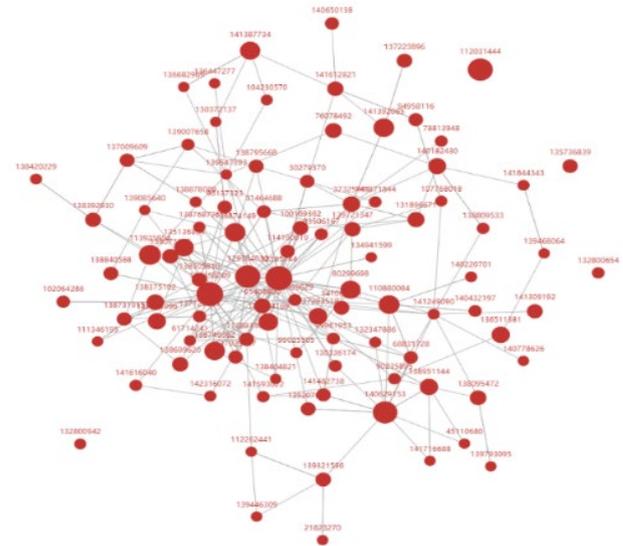


Figure 3. Users take the initiative to comment on others' posting networks.

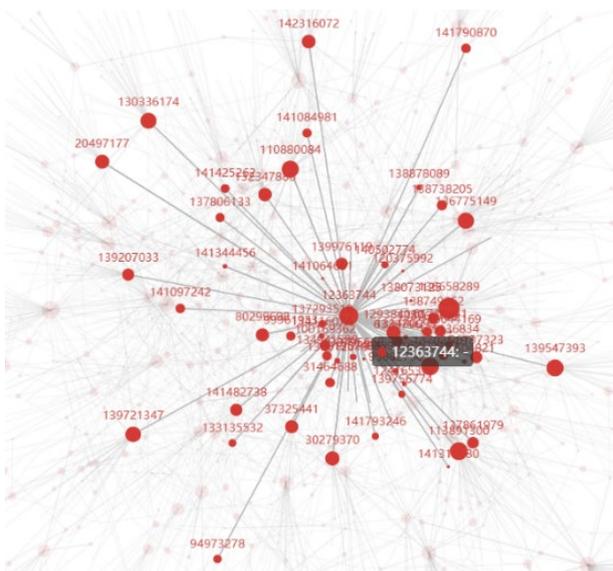


Figure 2. Some user nodes and connections in the user social network.

shown in Figure 2, the connection between users is not only directly related through postings and comments, but also through their interactive behaviors with other users who are willing to participate in the interaction establish contacts to expand their social support radiation network.

4.1.3 User Comments and Commented Networks

In the user social support network, a social network view is established for the subject of users actively commenting on

other users, as shown in Figure 3, and a social network view is established for the subject of the user being commented by other users, as shown in Figure 4. By comparing the two images, it can be found that the social support network in Figure 3 has fewer isolated points, which means that in the online health community, users who actively comment on others are more willing to actively respond to comments and establish contact with other users.

There are more isolated points in Figure 4, which indicates that such users are in a passive state when using the online health network. Although they are commented, they are unwilling to actively respond to the content of the comments and have less contact with other users.

4.2 Users Posting Content Combined with Their Social Support Network Analysis

4.2.1 User Posting Content Statistics

From the content point of view, the data collected by users in the data set is distinguished, as shown in Figure 5. The most discussed type of cancer is lung cancer. In the 2019 Cancer Report released by the National Cancer Center, lung cancer is the most susceptible cancer type for men, while breast cancer is the most susceptible cancer type for women. In terms of the number of cancer types, in 2019, the online health community in Tianya Hospital has the largest number of discussions about lung cancer, which may reflect that the forum uses more male users and their relatives and friends.

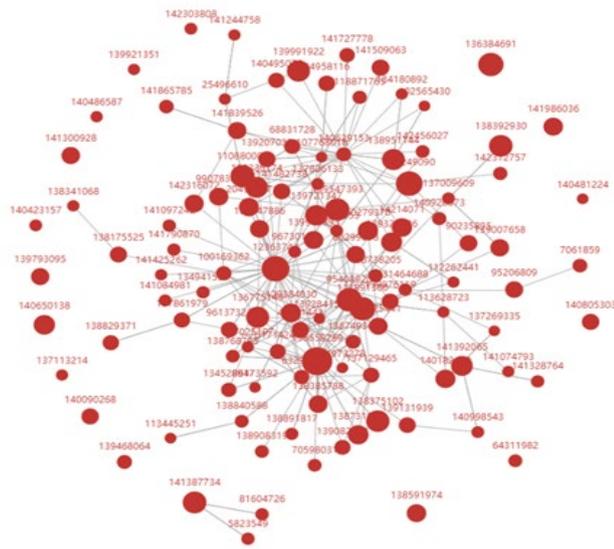


Figure 4. User posts are commented on the network by others.

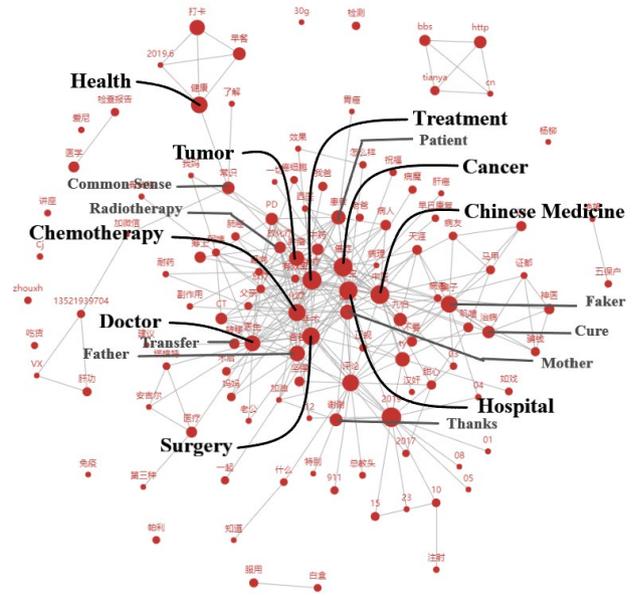


Figure 6. Co-occurrence network of user posts and comments.

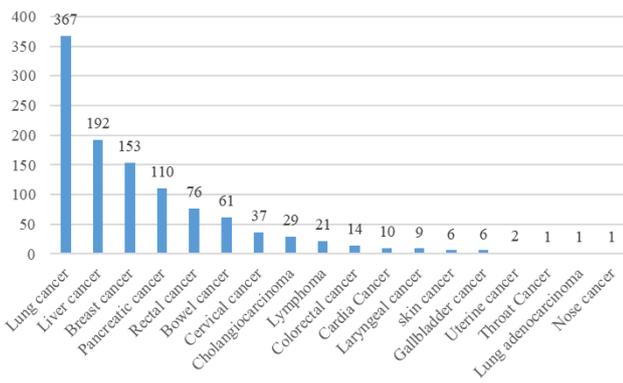


Figure 5. Cancer statistics in user posts.

4.2.2 User-posted Content Word Co-occurrence Network

A word co-occurrence network is established for the user’s posting information in Tianya Hospital, as shown in Figure 6.

In the word co-occurrence network, users discuss the treatment information of cancer itself. You can see that words with high co-occurrence rate are doctor, surgery, chemotherapy, cancer, tumor, patient, Chinese medicine, hospital, health, and other words, which is reflected online. The main type of social support in the health forum is the information support, and the words that rank second in the co-occurrence rate are transfer, father, mother, liar, patient, thank you, treatment, medical treatment, common sense, and other words, and is indicated in the online health community. In addition

to the patients themselves, their relatives, especially their children, will pay more attention to disease-related information, and the appearance of words such as liars also indicates that some information in the online health community is doubtful. The appearance of words such as thank you indicates that the user’s communication with other users in the community can meet some of their social support needs and has received a good response, indicating that there is a benign social support network in the online health community.

4.2.3 Identified Users and User-posted Content Word Co-occurrence Network in Social Networks

Combine the user and content dimensions as shown in Figure 7. It shows that the connections between users are connected with the vocabulary commonly used by the main users. You can see that the main content words of users who have been in contact with other users are Pathology, Cancer, Lung Metastasis, Western Medicine, Thank you, Help, Support, Stories, etc. These words indicate that users who actively participate in social interactions are more willing to share disease-related information, or anti-cancer stories and other contents. In this sharing, the high frequency of thank you and mutual assistance shows that users are actively contacting others in the community, which is beneficial to their acquisition of social support.

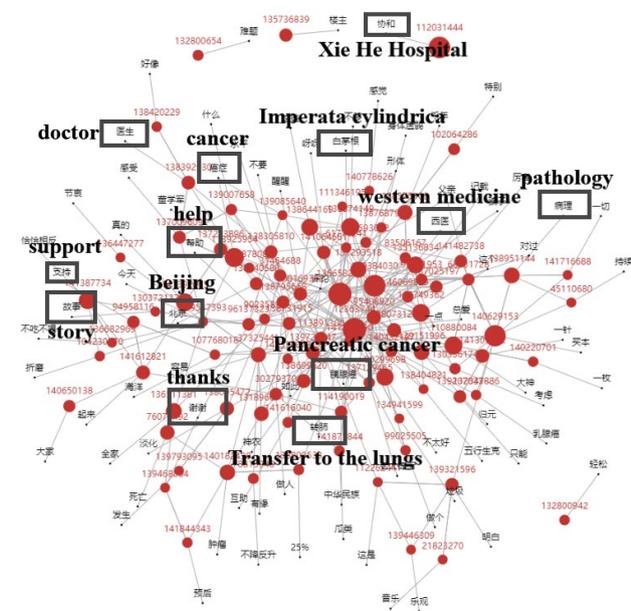


Figure 7. User-posted content word co-occurrence network.

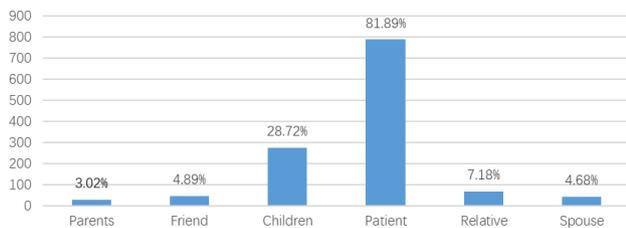


Figure 8. Statistical graph of the number of users posting to patients.

4.3 Relationships of Supporters and Patient, and Social Network Analysis

4.3.1 User-patient Relationship

From the 1,530 users posted by the Oncology Department of Tianya Hospital Forum 2019, the program was used to segment user identity description fragments, and after manual identification, 961 users who can identify the relationship with the patient were distinguished. According to the details and description in each content posted by each user, the relationship of the patient is summarized and obtained: the patient himself, the patient’s friends, the patient’s relatives, the patient’s spouse, the patient’s children, and the child’s spouse, and they belong to five main types. Count the number of users who posted, and get a classification diagram of the relationship between the users who posted and the patients, as shown in Figure 8. In the Oncology Forum of Tianya Hospital, among the users who participated, patients accounted for the most, accounting for 81.89%,

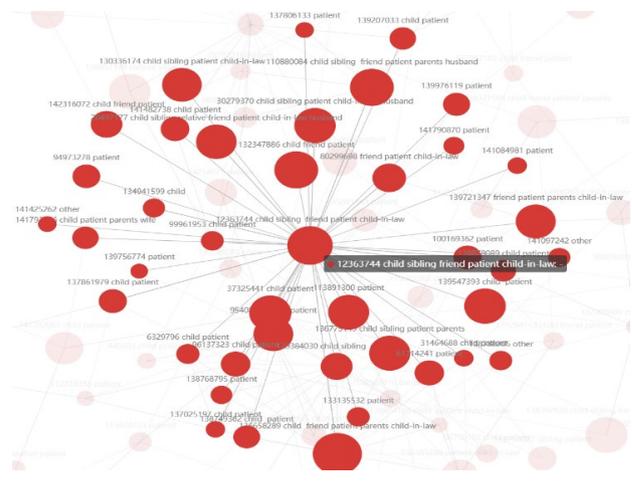


Figure 9. Example 1 image of the commented network. (Part of Figure 4)

and the patient’s parents accounted for the least, at 3.02%. It is an irony that the number of posts posted in the forum by the patient’s friends is more than those posted by the patient’s spouse.

4.3.2 Posting Users Are Commented on Network Analysis

After identifying the relationship between the poster and the patient, from the perspectives of actively commenting on others’ posts and being commented on by others, the proportion of users who are differently associated with the patient is considered. As shown in Figure 9, as shown in Figure 10.

Users who are more commented by others have diverse relationships with patients. As shown in Figure 9, the relationship between core user 12363744 and patients is follows: children, friends, patients, relatives, he is a patient, and his parents also have cancer As shown in Figure 10, the relationship between the core user 136658289 and the patient is as follows: children, friends, patients, parents, indicating that he is a patient, and his parents and children I have also experienced cancer with my friends. The size of the user’s dot in the figure represents the number of times the user has been replied to the comment. The connection with other dots indicates that the user is replied by other users and a connection is established between the two.

The selected example is the user who has received the most comments from users in the whole picture. Observing the similarities of the two, we can find that two core users have a diverse relationship with the patient, while the other non-core users associated with them often have a single relationship with the patient.

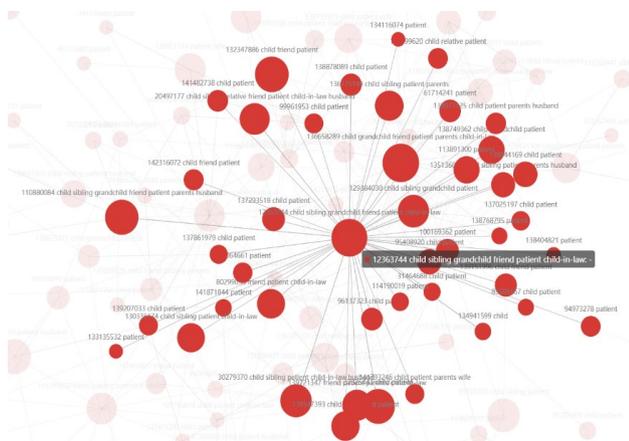


Figure 10. Example 2 image of the commented network. (Part of Figure 4)

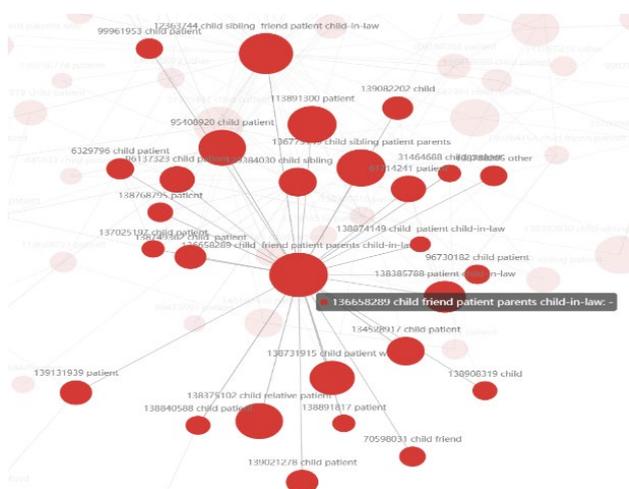


Figure 11. Example 1 of the user who posted actively commenting on others' networks. (Part of Figure 3)

4.3.3 Posting Users Actively Comment on Other People's Network Analysis.

Establish a network with users actively commenting on others, and observe how users who have different relationships with patients in this network actively contact others. As shown in Figure 11, the core user is 12363744, whose identities are as follows: children, patients, friends, relatives, that is, the user himself, his parents, and relatives and friends have all experienced cancer.

In the network of actively commenting on others, the size of the dot represents the number of times that they have actively commented on others, and the connection with other dots represents the association between the user and the user who is commenting. The difference from the network of the commented user is that among

other users commented by core users, users with diverse associations with patients account for the majority, while users with single associations with patients account for a minority. The core user characteristics in Figure 12 are the same as those in Figure 11.

5 Discussions

5.1 User Social Support Network

5.1.1 Multiple Centers

Based on the above analysis, it can be found that in the data concentration, the overall social support network has some central points, and there are central users consistent with other social networks. The posting and contact of these users improve the accessibility of the social support network, and some are at the end of the network. Users can find more social support network nodes by establishing contact with users with strong centrality.

5.1.2 Two Ways of Interaction: Positive and Negative

There are two types of user social support networks, positive and negative users. Positive users are more likely to comment on others and get comments from others, while negative users are more likely to share personal information and do not want to participate more. Social. This may be because different users have different attitudes toward online health communities. Actively participating users use online health communities more as a social platform, where they find people with similar experiences, provide social support to others, and get social support from others. Support brings more beneficial experiences to active users so that they are willing to maintain an open attitude, and the types of social support they receive are more likely to be emotional.

However, users who passively participate in social interactions use the online health community as a record-type blog platform, posting their anti-cancer experience or their relatives and friends, or publishing popular science information, etc., focusing more on the continuity of the content in the community, the online health community. The types of social support provided to such users may be more informative, which prevents such users from actively establishing contact with others. Zhu, Guan and Donovan (2020) analyzed the

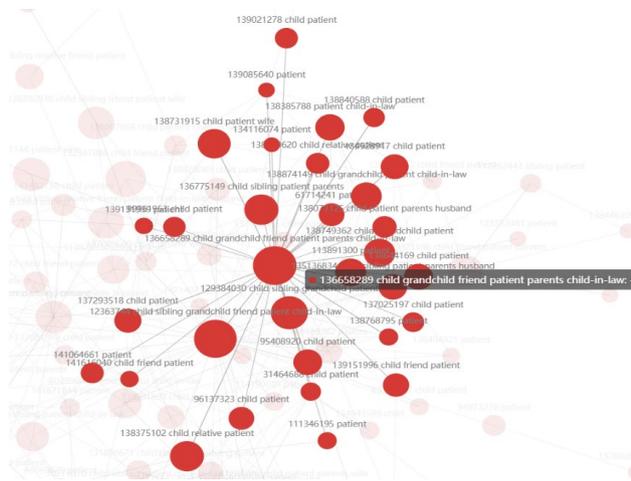


Figure 12. Example 2 of the user who posted actively commenting on others' networks. (Part of Figure 3)

communication behaviors of opinion leaders in two large cancer-centric online health communities and found that the typical responses of opinion leaders to others are often a combination of opinion support, emotional support, and network support. In this study, active users are willing to share information about cancer history and treatment options and provide positive emotional support and comfort.

5.2 Analysis of User Release Information in User Social Networks

It can be seen from the content that users focus on publishing emotional and informational social support information in content sharing. The social support experience that this type of information brings to users can be positive and negative, especially in the community's treatment of Chinese medicine for cancer. Similar issues may indicate that emotional social support in online health communities is more likely to bring positive reviews, while information-based social support may cause users' bad evaluation of social support networks because of the unevenness of the information itself. Davis, Du and Wang. (2017) found that online health communities may not have a positive impact on health because anyone can provide information and the information provided may be invalid. In this study, when sorting out the posts of online health community users, we also saw many posts or comments about Chinese medicine or folk prescriptions or a doctor's treatment that have a good effect on cancer treatment, which has caused controversy.

5.3 Association Analysis between User-patient Relationship and User Social Support Network

After identifying the relationship between the user and the patient, it was found that in the Tianya Hospital Oncology Forum, the relationship between each user and the patient is diverse, indicating that this community has gathered people related to cancer patients to discuss. Patients themselves are the group that participates in the most discussions, indicating that patients are most concerned about their physical conditions and expect to receive social support from people related to their conditions in the online health community. Secondly, the children of patients have posted more posts in the health forum, indicating that caregivers of cancer patients also need to seek social support.

At the same time, because cancer patients are more common in the middle-aged and elderly people, their children have a certain degree of information and communication skills. They can use online health forums to seek social support to give better care for parents with cancer. In the course of the research, it is surprising that the patient's friends participate in discussions more frequently than the patient's parents and spouses. There are two potential possibilities. One is that the patient's friends participate in discussions in online health forums out of concern for friends and also because of their curiosity to know about cancer. The other is when patients or their family members talk about cancer in the online health community. For the protection of personal information, they usually use the identity of the patient's friend to participate in the discussion to hide their true identity. Therefore, some patients and relatives of patients may be classified as friends of patients due to textual reasons.

Recognize the relationship between user comments and the commented relationship and the relationship between users and patients, and eliminate unidentified users or users who provide advertisements. After establishing a commented network for the identified users, it is found that there is a variety of online health forums with patients. The users of the personalized relationship can often get more comments and the attention of more participants. This may be because users with diverse associations with patients have published more posts in health forums, with richer content, and more experience in cancer. Such users have more content and experience that can be of use for other users. Based on their reference and credibility, other users are more willing to reply to

messages to provide social support or seek help. However, users with a relatively single identity may not publish as much content and follow as users with diversified identities; therefore, the number of replies and comments is less compared with others.

However, users with a single relationship may be able to solve their problems after paying attention to users with diversified relationships, and therefore they are less proactive in establishing contact with others. In the network of actively commenting users, it can be found that users who have diversified relationships with patients are more willing to comment on others, which is consistent with the situation in the commented network. More comments on others may get more comments from others. Yes, the users they comment on are more users who have diverse relationships with patients. This may be because users who have diverse relationships with patients have a certain similarity, and their social support needs are similar, and so they are more likely to have connections. It may also be that such users have diversified connections with patients, who are more experienced and are willing to proactively provide help to similar users.

6 Summary and Future Works

Here, we mainly studied the content of the posts posted by users in the oncology forum of Tianya Hospital in 2019, analyzed their content and the relationship between comments and commented, and conducted research using social networks, artificial coding, and word co-occurrence network methods. The research on the association between users and patients in social support networks in online health forums has been done.

However, in the process of research, the identification and filtering of users and patients' identities is a combination of procedures and manuals. Some users that are not identified by the procedure are excluded. In the research, these users are listed as other users and have not been studied. User information includes the types of specialized science popularization and medical advertisements. In the user's social support network, specialized science popularization is also an important type of social support. In this study, this part of the data was not studied.

In the following research, we will supplement this part of the data, analyze and research the advertising information and controversial information in the online health community, and further expand the time range of the research data and expand the research platform to improve this research.

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