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Insights Into the Relationships Between Health Communication and Doctor-patient Relationship: A Scientometric Analysis Based on CiteSpace and Validation of Questionnaires

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Abstract

In order to understand the research status of the relationship between health communication and doctor-patient relationship, and to explore a new path of the impact of health communication on doctor-patient relationship, this paper adopted qualitative methods to quantize the literature over the past 10 years in the Web of Science database and carried out Co-Authorship Analysis, Co-Citation Analysis and Co-Occurrence Analysis based on CiteSpace. In addition, according to the results of bibliometric research, self-designed questionnaires were used to verify the result. A convenience sampling survey was conducted through the online "Questionnaire Star" platform (https://www.wjx.cn) on May 8, 2022, and a total of 254 questionnaires were collected. Interviewees were asked to use social software to acquire health knowledge. Participants come from 21 provinces, 4 municipalities, and 4 autonomous regions across the country, which is geographically representative. The results show that uncertainty of social media information and the particularity of the epidemic make the research on health communication and doctor-patient relationship in social media become a new hot spot. Social media health information quality (source credibility and content trust perception), information asymmetry perception, doctor-patient communication, doctor-patient consistency, doctor-patient trust, doctor-patient relationship may be the key variables for constructing theoretical models.

Keywords

health communication, doctor-patient relationship, CiteSpace, social media, doctor-patient communication

What we have known about this topic?

Adults are increasingly searching and using health information during the process of seeing a doctor to increase their knowledge of disease self-management. The intention of health communication is consistent with the efforts of both doctors and patients to maintain a healthy state. During the COVID-19 pandemic, social media has become the major tool for obtaining information because people's movements are restricted. Social media has gradually replaced conventional websites as a channel for the public to rapidly search for information and obtain knowledge. Based on the same goal of doctors and patients, health communication should increase public health knowledge and eliminate the asymmetry of medical knowledge between doctors and patients, playing a positive role in the doctor-patient relationship.

How does your research contribute to the field?

Public health literacy is different in regions, and there are significant differences in health communication preferences and medical systems in terms of countries. It is important to strengthen cooperation with other countries to avoid "silos" in research. Communication is a necessary link to establish the relationship between health communication and doctor-patient relationship. And health communication is a way to solve or alleviate problems in the healthcare sector and to improve the doctor-patient relationship. In recent years, social media platforms as a new technology for health communication has become a global trend. Researchers should not ignore the impact of social media platforms to health communication, and the use of social media to implement health communication effect evaluation and risk aversion.

What are your research's implications toward theory, practice, or policy?
Health communication is ultimately used to serve medical treatment. The uncertainty of social media information and the particularity of the epidemic make the research on health communication and doctor-patient relationship in the social media become a new hot spot. Health information quality in social media (source credibility and content trust perception), information asymmetry perception, doctor-patient communication, doctor-patient consistency, doctor-patient trust, doctor-patient relationship may be the key variables for constructing theoretical models.

Introduction

The Stanford Heart Disease Prevention Program is regarded as a crucial starting point in the field of health communication.[1] In 1996, Rogers proposed that health communication included media agenda-setting process for health issues, media promotion of health, scientific communication among biomedical scientists, doctor-patient communication, and the design and evaluation of preventive health communication campaigns.[2] The development of health communication is closely related to the development of media technology. Distributing pamphlets and improving communication skills were traditionally effective practices during the period when media communication was not developed.[3] In 1990, paid-for high-quality radio and television advertising were considered to be essential to the success of mass media campaigns.[4] In the 21st century, the Internet has entered a rapid development stage. The Internet has persuasive characteristics, which is a combination of interpersonal communication and mass communication.[5] In recent years, social media has gradually replaced conventional websites as a channel for the public to rapidly search for information and obtain knowledge. Although the information disseminated on the CDC website during the SARS period was more extensive[6] than the traditional way of distributing thousands of materials during the plague outbreak in 1994,[6] it still does not rush the speed of healthy transmission during the COVID-19. During the COVID-19, social media has become the major tool for obtaining information because people's movements are restricted. As of July 12th, 2020, videos tagged covid-19, covid19 and coronavirus on TikTok had reached 4.4, 33.3, and 93.1 billion views respectively.[7] This sustained development of media technology provided a strong guarantee for faster and wider health communication. The academic community has also reconsidered health communication, making it as a recent research hotspot.[8]

According to the analysis of previous studies, global health communication research mainly focuses on several topics, including doctor-patient relationship,[9] media interference,[10,11] health promotion, health education, and health literacy.[8,12-14] Among them, the core of health communication is to establish effective communication between communicators and audiences. Communication involves the interchange of information between message recipients, professionals, and the mass media.[15] Increasingly, adults are searching and using health information in the medical process, and patients are searching health information to increase their understanding of disease causes or treatment options, improve patient-physician communication, and increase their knowledge of disease self-management.[16] The intention of health communication is consistent with the efforts of both doctors and patients to maintain a healthy state. Based on the same goal of doctors and patients, health communication should increase public health knowledge, and eliminate the asymmetry of medical knowledge between doctors and patients,[17] which plays a positive role in the doctor-patient relationship. For example, social media enables patients to become more positive in the treatment.[18] In as early as 1981, some scholars proposed that the study of communication effectiveness mainly focused on 3 issues: the question of physical reception of messages by the audience; interpretation or understanding of messages on the part of the audience

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in accordance with the intention of the communicator; effectiveness of communication on the cognitive, affective, and behavioral dimensions of the audience.[19] Nowadays, it seems to be a difficult problem to deal with the accuracy, authenticity, privacy of social media information and the mass amount of information. For example, when patients bring inaccurate information to the clinic, it will affect the trust between doctors and patients.[20] Therefore, the implementation of health communication without the goal of a doctor-patient relationship may lead to the content of communication deviating from the public's needs and even being resisted by doctors and patients.

In view of the existing literature on the use of CiteSpace software to carry out systematic review of health communication in China. And the literature also pointed out the limitations that this study did not include the global data.[8] At the same time, in order to understand the research status of the relationship between health communication and doctor-patient relationship and explore the new path of the impact of health communication on doctor-patient relationship. This paper adopts qualitative methods to quantize the literature in the Web of Science database and carry out Co-Authorship Analysis, Co-Citation Analysis, and Co-Occurrence Analysis. Qualitative Analysis was used to review the contents of the literature by theme, summarize the research experience and shortcomings and explore a new path of the impact of health communication on doctor-patient relations. In China, the tension in doctor-patient relationship is a long-standing problem.[21] Studies have shown that after the outbreak of COVID-19, patients' attitudes and tolerance toward doctors or hospitals have been improved.[22] And during the COVID-19 blockade in China, social media (especially the Wechat public platform) is considered to be the most popular platform for disseminating health knowledge.[8] Therefore, this study also conducted a quantitative analysis of a questionnaire survey in China. This is the innovation that distinguishes this study from other metrology literatures. It is not only a verification of the existing literature,[8] but also a confirmatory analysis of the applicability of the research results in China.

Methods

Visual Analysis Based on CiteSpace

Data source. This study selected the web of science core collection in the web of science database, with "Science Citation Index Expanded (SCI-Expanded)—2004 present" as the citation index, "topic = health communication and topic = physical patient relationship or doctor-patient relationship" as the retrieval formula. The documents should be published from January 1, 2012 to April 30, 2022 (nearly 10 years), and a total of 1613 original documents were retrieved on May 17, 2022. Document types are limited to articles and reviews, excluding online publications, letters, conference proceedings, editorial materials and conference abstracts, and a total of 1535 documents were obtained. In the search process, 2 authors independently searched, checked, screened and confirmed through the resources database of their units to ensure the accuracy of the literature data.1535 articles were added to the list of marked results, before exporting to plain text file in the format of full records and cited references. The exported information included author, the research institution, title, the publication year, keywords, abstract, journal, reference, volume and start and end page numbers. The format file of full records was converted to download_***.txt format using CiteSpace 6.1R1 software's format converter and imported the retrieved document data into CiteSpace. Before formal analysis, the obtained data was pre-processed first. After de-duplication, a total of 1380 documents were obtained as analysis data samples of CiteSpace, a visual analysis tool.

Research methods. CiteSpace is a Java-based software application for identifying and displaying new trends and developments in the scientific literature, using Co-Citation Analysis theory and pathfinding network algorithms to visualize the organization, layout, patterns, and development of the field. In CiteSpace software, the visual knowledge map has a variety of nodes and links, and these analyses can be used to reveal collaborations among authors, institutions, and countries, identify influential researchers, research hotspots, trends, and more. Three main core concepts are included, including burst detection, mediated centrality, and heterogeneous networks, which help identify the nature of a research frontier, mark a specialty, and detect emerging trends and mutations in a timely manner, and are suitable for finding research advances and current research hotspots, frontiers, and corresponding knowledge bases in a subject area.[23] Identification of research hotspots in the field is usually performed using Co-Occurrence analysis of keywords. Keywords are highly concise and generalized, the core and essence of an article, and are usually used to identify hot topics in research fields.[24] Mainly by examining the temporal distribution of word frequencies, the emergent words with high frequency occurrences and fast frequency growth rate are monitored from a large number of commonly used words in the title list, and the trend and centrality of word frequency changes, not only the word frequency, are used to analyze the hot areas and trends of science. Co-Authorship Analysis, Co-Citation Analysis and Co-Occurrence Analysis were mainly carried out. In this paper, 1380 pieces of literature were visually analyzed by Citespace6.1R1 software, and some data were plotted with Excel.

The corresponding analysis parameters are set, and the starting point of the Time slicing of the study is set to January 2012 and the end point is set to April 2022. The year of "Year Per Slice" is set to 1, the Node Types are set to author/institution/country/keyword/CO-Citation Analysis, the threshold selection criteria are set to the top 25, the node keywords,

journals, and pruning are set to pathfinder, pruning sliced words, pruning the merged networds, and the author and country pruning are set to none/MST; other parameters are set by default, as shown in Supplemental Appendix 1.

Evaluation indicators. Each node in the map represented an element to be analyzed. The size of the node represented the frequency of the citation, and the larger the diameter of the circle represents the higher the frequency of the node. The color level and width of the circle represent the frequency of related content nodes in different periods. The change in the color level of the circle from a cold blue tone to a warm red tone indicates the different years from early to recent. The purple ring indicates high Betweenness Centrality, and the thickness of a purple betweenness centrality trim indicates how strong its betweenness centrality is. The connection lines between nodes were regarded as the Co-Occurrence or Co-Citation relationship; the lines' thickness meant the strength of the relationship, and the color scale of the line and the node corresponds to the time year of the first Co-Occurrence. These definitions will be used for all network graph analysis.

The Modularity value is the evaluation index of network modularization. The higher the value is, the better the clustering is. The value interval of Q is [0, 1], and $Q > 0.3$ means that the network community structure obtained is significant. The Silhouette value is used to measure the homogeneity of the network, and the value range is [0, 1]. The higher the value of silhouette, the better the homogeneity of the network. When the value is 0.7, the clustering result has high reliability. Above 0.5, it can be considered that the clustering result is reasonable.

Further Verification Based on Questionnaire Survey

Questionnaire design. This study also designed a questionnaire on social media health communication and the doctor-patient relationship. Considering that the purpose of using the questionnaire analysis is to verify the bibliometric research results, the item design of the questionnaire mainly comes from the bibliometric research conclusions in addition to the basic information. The topic is similar to the interview outline, and the questionnaire is equivalent to the second verification of the interview results. Health administrative department managers, doctors, nurses and students participated in the design of the questionnaire items to ensure that the meaning of the items was clear. Considering the risk of contact transmission of COVID-19 in China[25] and the high rate of Internet coverage and social media usage in China, the study adopted electronic questionnaires and distributed through the online "Questionnaire Star" platform (https://www.wjx.cn)). Every online questionnaire filler is a potential social media user. This ensures that every survey respondent is a social media user. In view of the fact that the dissemination of health knowledge on social media is not limited by regions and groups, the research objects can be netizens from all over the country. Filling out the questionnaire must be with the acceptance of interviewees. The questionnaire is to be voluntarily filled in in an anonymous form. Respondents who are object to the terms of informed consent will be suspended by the system. For the purpose of verification, the survey group is considered to cover a wide area, and the number of distribution and item design is properly controlled. The questionnaire utilizes convenience sampling method to be distributed to 21 provinces (23 provinces in China), 4 municipalities directly under the Central Government (4 municipalities directly under the Central Government), and 4 autonomous regions (5 autonomous regions in China), which included Hebei, Henan, Hubei, Hunan, Fujian, Guangdong, Hainan, Liaoning, Shanxi, Guizhou, Shanxi, Shandong, Heilongjiang, Jilin, Yunnan, Sichuan, Jiangsu, Zhejiang, Anhui, Inner Mongolia, Tibet, Guangxi, Jiangxi, Ningxia, Tianjin, Beijing, Chongqing and Shanghai. The survey was conducted on May 8, 2022, and a total of 254 questionnaires were distributed and returned. In strict accordance with quality control standards, 222 questionnaires were evaluated strictly according to the quality control standards, with an effective rate of 87%. Under the premise of protecting personal privacy, random surveys were conducted on the Internet among respondents in various cities in China. Respondents were not restricted by age, city, etc. And the informed consent of the interviewees is required before filling out the questionnaire. People who use social software to obtain health knowledge can fill out the questionnaire. All respondents voluntarily fill out the questionnaire, and those who object to the terms of informed consent will be suspended.

Quality control. In general, the answer time is more than 5 s per question. All the items in the questionnaire have a total of 22 questions. we carry out the simulation and find that the total filling time $\geq$110 s is in line with reality. Therefore, we evaluate the questionnaires with answer time $\geq$110 s as valid questionnaires, and those with less than 110 s are excluded. The first letter of the interviewee's name and the last 4 digits of the mobile phone number are used as the personal identification number, together with the IP address and the answer to the question, as a criterion to evaluate whether it is repeated by the same person. Common sense questions were set as screening items (ambulance emergency calls), and the questionnaires of those who filled out the wrong questions were removed.

Statistical methods. The results of the questionnaire are used to verify the conclusion. Therefore, this study uses the table function and prop. table function in R4.2.1 software to make a descriptive analysis of the relevant variables in the questionnaire. All variables in the questionnaire were classified and counted and the constituent ratio of each variable was calculated.

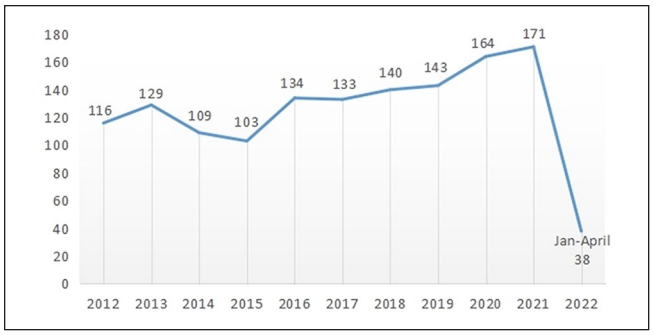

Figure 1. Annual number of the literature on health communication and doctor-patient relationship issued in Web of Science (from 2012 to 2022).

Result

Analysis of the Present Situation

Analysis of the number of articles published. One of the metrics used to gauge the shift in research heart on a certain scientific topic is the volume of papers that are published each year. This paper makes statistics on the annual distribution of the literature retrieved from 2012 to 2022, as shown in Figure 1. Since 2015, the number of articles published each year has increased, with a total of 1026 articles published, accounting for 74.35% of the total. Two significant increases were in 2016 and 2020, with 134 articles published in 2016, an increase of 30.10% over 2015, and 164 articles in 2020, an increase of 14.69% over 2019. This study speculated that the 2 increases may be related to changes in the external environment. The sudden increase in global scholars' attention to a certain field is bound to be a common problem, such as human infection with H7N9 avian influenza (2016) and COVID-19 (2020).

Author Co-Authorship Analysis. A Co-Author identity is a connection between 2 or more researchers who jointly report on research results on a particular subject. The corresponding analysis parameters is set: author for Node types is selected, and the author Co-Authorship network map is drawn, as shown in Figure 2a. According to Price's law, if the number of papers published by the most published authors in this field is nmax, the authors who have published more than [m] (m = nmax/2) in this field are considered to be the core authors in the field. In the field of research on the relationship between health communication and doctor-patient relationship, the scholar with the highest volume of publication is MARYBEACH, and the volume of publication is 12, that is, nmax = 12, which means that the author whose volume of publication is more than 6 is the core author in this field, a total of 6 [MARYBEACH (12), BEACHMC (12), DEBRAROTER (11), COOPERLA (10), LISACOOPER (10), PHYLLISBUTOW (8)]. These 6 scholars all have continuous and in-depth research in this field, but there are fewer collaborative publications between authors across disciplines and countries.

Institution Co-Authorship Analysis. The corresponding analysis parameters were set: Institution was selected for Node types, the node data extraction criterion was set to "Top50," and the rest of the parameters remained unchanged. The institution Co-Authorship network map, explore the cooperation relationship between institutions and identify influential institutions, as shown in Figure 2b. Of the top 11 institutions with the largest number of posts, the United States has the largest number, as shown in Table 1. The network density is 0.0084. Although there is cooperation among institutions, there is less cooperation. Academic institutions in the United States have published the most papers, and Univ Toronto in Canada has the highest centrality.

Country Co-Authorship Analysis. The corresponding analysis parameters is set: "Country" is selected for Node types, and "Top50" is set to the node data extraction criteria, and the rest of the parameters is left unchanged. The United States has been doing continuous research in this field, with the most significant number of articles (661), followed by Canada (121), China (99), England (94), and Australia (88), as shown in Figure 2. The United States has a high national centrality (0.67) and plays an intermediary role in the national cooperation network, followed by Spain (0.21) and Canada (0.19).

Research Theme and Evolution

Journal Co-Citation Analysis. Co-Citation Analysis includes Journal Co-Citation, Literature Co-Citation and Author Co-Citation. When 2 journals, literature or authors appear in the references of a literature at the same time, they are considered to have a Co-Citation relationship. If the frequency of Co-Citation is high, the academic relationship between the 2 is close. The corresponding analysis parameters is set: "Cite Journal" is selected for Node types, "Top50" is set to the node data extraction criteria, and the rest of the parameters is left unchanged. JGENINTERNMED is the most frequently cited journal (422 times), followed by JAMA - J AM MED ASSOC (410 times) and PATIENT EDUC COUNS (393 times). ANN FAMMED has the strongest intermediary centrality (0.63) and has a great influence on other journals, as is shown in Figure 3 and Supplemental Appendix 3. Among the top 10 journals, the United States has the largest number of journals. Research in this field is closely related to health care and services, internal medicine, public health, environmental health, and occupational health disciplines.

Literature Co-Citation Analysis. The corresponding analysis parameters is set: "Reference" is selected for Node types, "Top50" is set to the node data extraction criteria, and other parameters are left unchanged. The articles published by

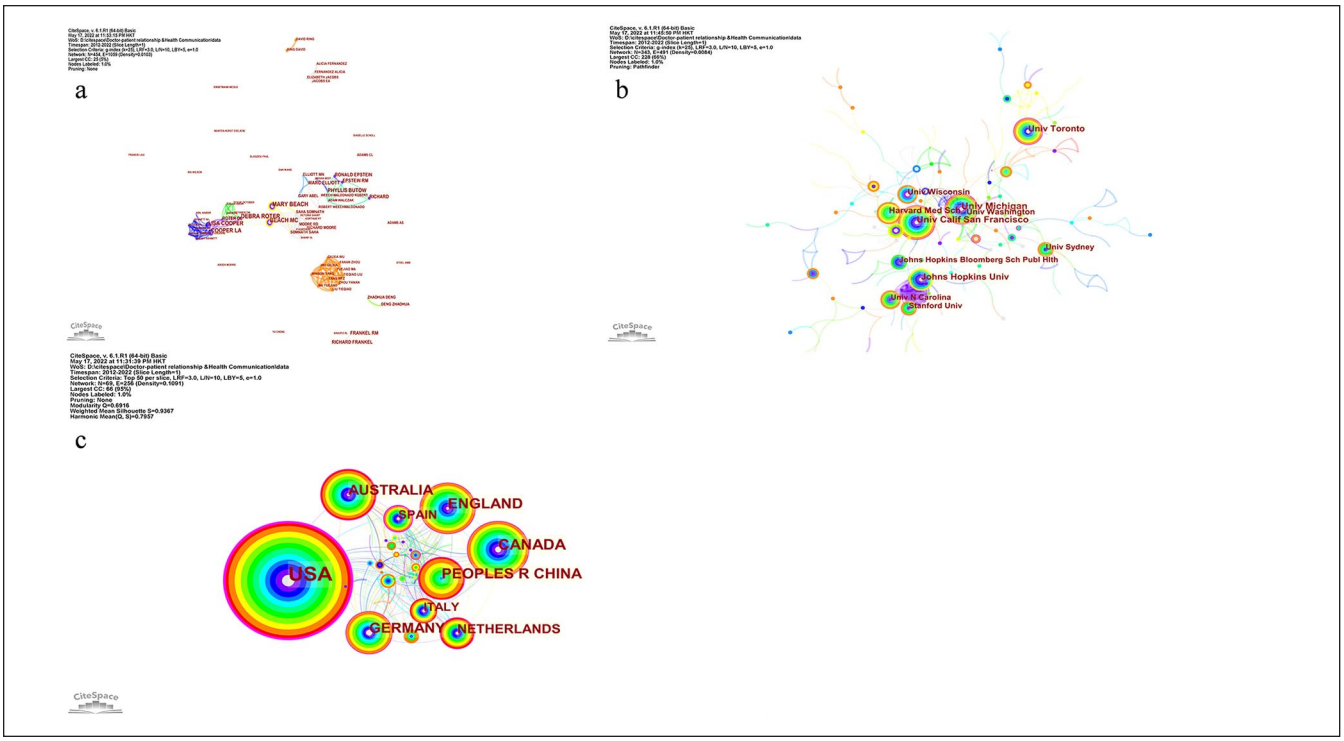

Figure 2. Co-Authorship Analysis of health communication and doctor-patient relationship: (a) Author Co-Authorship network map, (b) Institution Co-Authorship network map, and (c) Country Co-Authorship network map. The Change in the color level of the circle from a cold blue tone to a warn red tone indicates the different years from early to recent. The purple ring indicates high Betweenness Centrality, and the thickness of a purple betweenness centrality trim indicates how strong its betweenness centrality is.

Table 1. The top 11 organizations that published articles on health communication related on doctor-patient relationship.

Ranking	Institution	Counts	Betweenness centrality	Country
1	Univ Michigan	39	0.10	USA
2	Univ Calif San Francisco	36	0.15	USA
3	Univ Toronto	32	0.19	Canada
4	Johns Hopkins Univ	32	0.11	USA
5	Harvard Med Sch	27	0.11	USA
6	Univ Washington	24	0.07	USA
7	Univ Wisconsin	23	0.08	USA
8	Stanford Univ	20	0.04	USA
9	UNLY Sydney	19	0.08	Australia
10	Johns Hopkins Bloomberg Sch Public Health	19	0.03	USA
11	Univ N Carolina	19	0.06	USA

Street R and Hojat M are the most frequently cited, while those published by Krasner M are the most intermediary-centered and have a great impact on other journals, as shown in Figure 4. The frequently cited literatures are mainly related to doctor-patient communication, joint participation in decision-making, health promotion and job burnout, as shown in Table 2.

Through cluster analysis, the 4 maximum clusters are retained as analysis objects, as shown in Table 3. The maximum cluster (# 0) has 42 members with an outline value of 0.889. It is marked by LLR as doctors' empathy. The most relevant citation for this cluster is Kelm et al.[26] Cluster # 0 shows the role of doctor's empathy in the relationship between health communication and doctor-patient relationship. Increasing doctors' empathy can improve patients' health outcomes and practitioners' satisfaction.[26] The second largest cluster (# 2) has 25 members with an outline value of 0.968. It is marked by LLR as a complex decision. The most relevant citation for this cluster is Epstein and Gramling.[27] Cluster # 2 shows the role of patient parameters

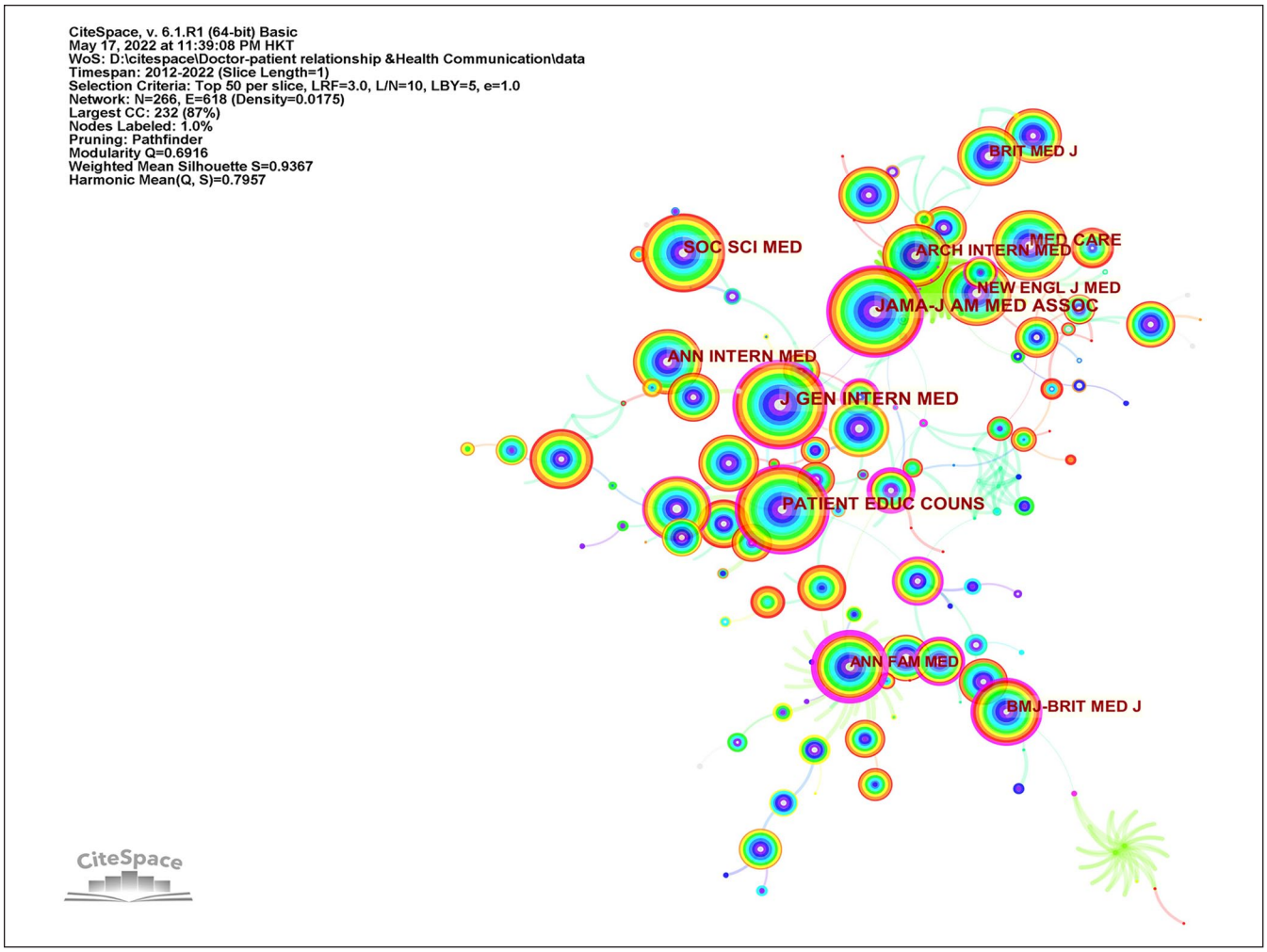

Figure 3. Journal Co-Citation network map on health communication related on doctor-patient relationship.

and decision-making in the relationship between health communication and doctor-patient relationship. Patients' preferences can be constructed by the joint efforts of clinicians, patients and their families, and put forward the concept of holistic thinking and shared thinking.[27] The third largest cluster (# 3) has 21 members with an outline value of 0.923. It is marked by LLR as the attitude of intensive care clinicians. The most relevant citation for this cluster is Sulmasy et al.[28] Cluster # 3 shows the role of doctors' attitudes toward patients in the relationship between health communication and doctor-patient relationship.[28] criticized the electronic health record (EHR) of electronic medical records (EMR). Although EMR can promote patients' education during medical treatment, it may distract doctors from patients more than paper records, resulting in difficulties in communication between doctors and patients and reduced patient satisfaction. The fourth largest cluster (# 4) has 18 members with a profile value of 0.94. It is marked by LLR as capable of care. The most relevant citation for this cluster is Slean et al.[29] Cluster # 4 shows the role of competent care in the relationship between health communication and doctor-patient relationships. Cultural ability is the ability of a person to interact effectively, work and develop meaningful relationships with people of different cultural backgrounds. Better doctor communication behavior and higher trust in doctors were negatively correlated with the high emotional burden of patients with diabetes.[29] We speculate that empathy, common decision-making, clinical attitude and cultural ability are important factors in establishing the path between health communication and doctor-patient relationship.

In this paper, Burst Detection Algorithm of Kleinberg is used to analyze those literature which have been cited more and more frequently in a specific period of time, that is, burst literature. The burst literature contains 2 dimensions: the burst value and the burst time. The literature with high burst indicates its research frontier at the corresponding time, reflecting the hot changes in a research field. Red indicates the term explosive period, while blue indicates time.

Street et al[30] and other literature have a frequency of 4.4, suggesting that communication can improve the treatment effect by improving health-related intermediate results (such as trust, mutual understanding, compliance, social support

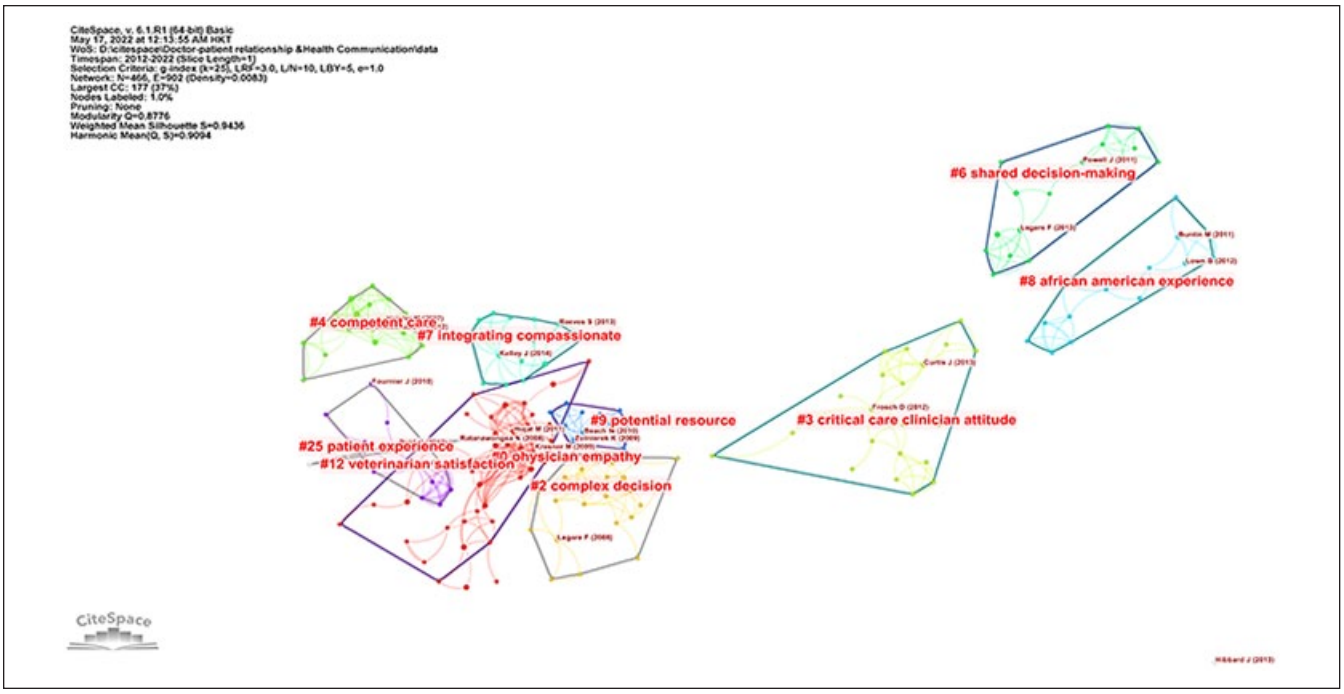

Figure 4. Literature Co-Citation network map on health communication related on doctor-patient relationship.

Table 2. The top 10 Co-Cited Literature with high frequency on health communication related on doctor-patient relationship.

Ranking	Counts	Betweenness	Author	Year	Journals
1	12	0.08	Hojat M	2011	ACAD MED
2	11	0.08	Street R	2009	PATIENT EDUC COUNS
3	10	0.02	Zolnierek K	2009	MED CARE
4	7	0.09	Krasner M	2009	JAMA-J AM MED ASSOC
5	6	0.01	Shanafelt T	2015	MAYO CLIN PROC
6	5	0.01	Alkureishi M	2016	J GEN INTERN MED
7	5	0	Legare F	2013	HEALTH AFFAIR
8	5	0.03	Legare F	2008	PATIENT EDUC COUNS
9	5	0.01	Palinkas L	2015	ADM POLICY MENT HLTH
10	5	0	Jagosh J	2011	PATIENT EDUC COUNS

Table 3. Literature clustering analysis results on health communication related on doctor-patient relationship.

Cluster ID	Size	Silhouette	Abel (LLR)	Average year
0	42	0.889	Physician empathy	2013
2	25	0.968	Complex decision	2012
3	21	0.923	Critical care clinician attitude	2016
4	18	0.94	Competent care (culturally competent care)	2012

and self-efficacy). The emergence frequency of Zolnierek and Dimatteo[31] and other literature was 4.04, which confirmed that there was a positive correlation between doctor-patient communication and patient compliance. Training in communication skills for doctors can significantly improve patients' compliance. Jagosh et al[32] suggested that listening is helpful for case collection and disease diagnosis, and can effectively improve the psychological status of patients and strengthen the relationship between doctors and patients. The occurrence frequency of Shanafelt et al[33] is 2.91, which confirms that job burnout and decreased satisfaction with work-life balance can show negative emotions such as impatience,

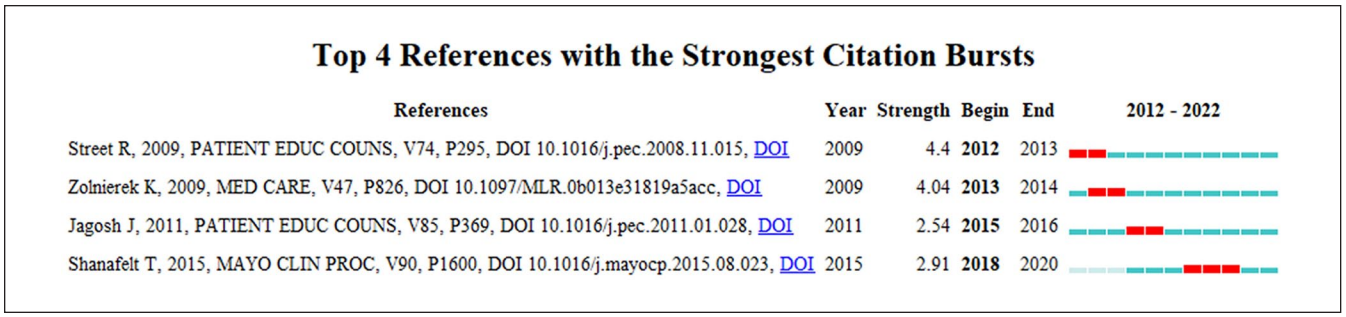

Figure 5. Top 4 references with the strongest citation bursts on health communication related on doctor-patient relationship.

fatigue, pain and depression at work. These emotions may weaken the quality of medical care and worsen the doctor-patient relationship, as shown in Figure 5.

Through the analysis of these 4 articles, we speculate that there are some potential factors in the path between health communication and doctor-patient relationship. We speculate that: firstly, obtaining accurate health knowledge before seeing a doctor may be conducive to accurately describing disease symptoms, treatment needs and prognosis expectations; secondly, listening before communication can evaluate patients' health knowledge reserve and may make it easier to reach treatment consensus; thirdly, different time and frequency of doctor-patient communication may promote doctor-patient trust and affect health outcomes, and trust and health outcomes are cause and effect.

Keyword Co-Occurrence Analysis. Key words are the core generalization of a document. If a keyword appears repeatedly in the literature in a certain field, it means that the research represented by the keyword is a hot spot in this field. Keywords with high intensity can be identified as the research frontier in this field. The corresponding analysis parameters is set: Keyword is chosen for Node Types, 20 for Top N, and the rest of the parameters is left unchanged. Data cleaning on keywords is performed and some keywords are merged. Clustering noun selects keyword clustering, and extraction selects LLR algorithm.

In addition to health communication and doctor-patient relationship, communication, satisfaction, health, health care and outcome are high-frequency and high-centrality keywords, which are the research hotspots in this field, as shown in Table 4 and Figure 6a.

The high-frequency keywords related to this field are mainly clustered into 8 categories (# stands for clustering), which are health communication, care, satisfaction, intervention, qualitative research, primary care, doctor-patient relationship and patient safety, as shown in Figure 6b. By combing the key keywords contained under each clustering tag, we can get the clustering keywords of health communication and doctor-patient relationship, as shown in Table 5.

Table 4. Keyword Co-Occurrence Analysis results on health communication related on doctor-patient relationship.

Ranking	Keyword	Counts	Betweenness
1	communication	387	0.13
2	care	264	0
3	physician	236	0.12
4	doctor-patient relationship	221	0.09
5	health care	211	0.19
6	health	170	0.33
7	primary care	168	0.13
8	health communication	162	0.48
9	satisfaction	153	0.57
10	outcome	120	0.63

The clustering module value (Modularity Q value 0.6916) is more than 0.3, and the clustering average profile value (Mean Silhouette profile value) is more than 0.7, which indicates that the clustering structure is significant and the clustering result has high reliability. Among them, #0#2#3#4#7 reflects the importance of medical education, decision-making and communication, and#1#5 reflects the importance of quality of life and patient satisfaction. The result of Co-Occurrence Analysis is similar to that of cluster analysis, indicating that communication, satisfaction, health, health care and outcome are hotspots in the research of health communication and doctor-patient relationship, and together constitute the knowledge system in this field.

After generating the keyword clustering network map, the timeline view can be obtained by taking the cluster number as the Y axis and the citation publication year as the X axis. The timeline view can show the time span and research process of each clustering development and evolution. The location of the node is the time when the keyword appears for the first time, and the connection indicates the connection of different keywords in the same literature, as shown in Figure 7. The research hotspots from 2012 to 2015 are doctor-patient communication, quality of life, joint decision-making and patient satisfaction. At this stage, scholars mainly focus on the intermediate results of health communication and

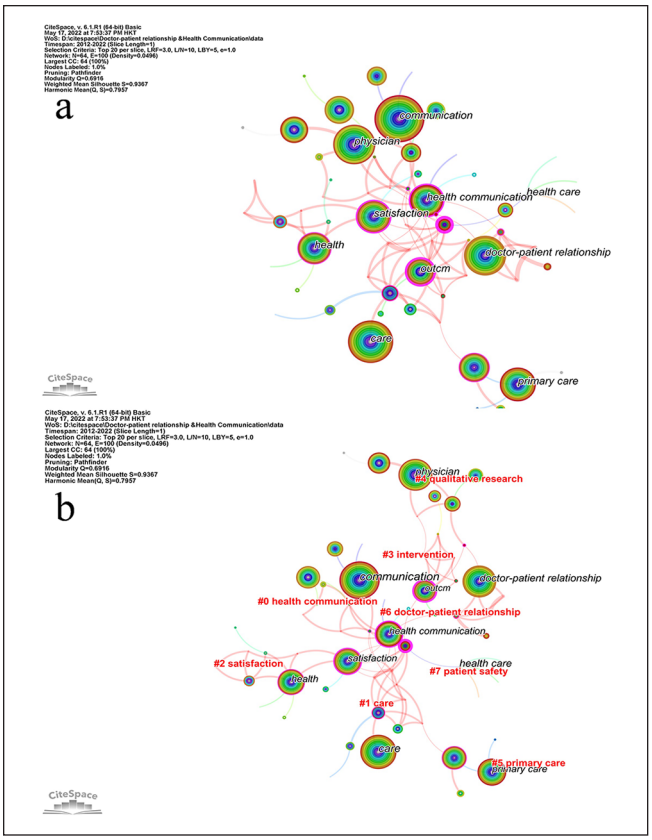

Figure 6. Co-Occurrence Analysis mapping on health communication and doctor-patient relationship: (a) Keyword Co-Occurrence network map and (b) Keyword clustering network map.

doctor-patient relationship. The research hotspots from 2016 to 2019 are intervention, elderly population, obstacles, health knowledge and trust. There are still many obstacles in the process of promoting health communication and promoting doctor-patient relationship, and solving these obstacles has become the main research at this stage. The research hotspots from 2020 to now are social media, self-efficacy and risk perception. Social media has developed rapidly before the emergence of COVID-19 in 2020, but the epidemic has led to public travel restrictions, social media has become the main way to obtain health knowledge. Not all social media information is high-quality and accurate. Individuals' risk perception and self-judgment ability of social media information have become the factors that must be considered in the research.

The analysis of burst words reveals those keywords that change rapidly or the number increases sharply in a short period of time, which can see the research hotspots and frontiers emerging in different periods of time, and may indicate the development direction of the theme, as is shown in Figure 8. Keywords with high intensity are identified as research frontiers. The corresponding analysis parameters is set: minimum duration is set to 1 year, 35 high-intensity keywords are got, and the first 20 keywords are selected. The intensity of all keywords is more than 4. The highest intensity is 11.08, and the corresponding key word is quality of life, which lasts for 4 years. Since 2020, social media, health knowledge, patient safety and trust have become pop-up words and remain hot. As mentioned earlier, these salient words are closely related to the epidemic situation. The intensity of social media is 10.63. Social media has seen the biggest increase in word frequency in recent years, with a sudden increase in attention. The particularity of the epidemic will inevitably lead to a series of new phenomena and problems in health transmission and doctor-patient relationship.

Results of Further Verification

Basic information. There were 89 males (40.09%) and 133 females (59.91%) respectively, with 103 (46.40%) married and 119 (43.60%) unmarried. Thirty-nine respondents (17.57%) are with the education of senior high school or technical secondary school or below, 107 (48.20%) of college, and 76 (34.23%) of undergraduate or above. 32 years old is the median age of interviewees, with 124 (55.86%) less than 32 years old and 98 (44.14%) more than 32 years old.

Choice of health knowledge on social media. Faced with different message contents and communication purposes, the public will choose different media to reduce uncertainty and fuzziness.[34] In China, Wechat and QQ, similar to WhatsApp and LINE, are social media that provide instant messaging services on smart terminals. It is the social media that respondents use most frequently to acquire health knowledge (26.58%). After subscribing to the Wechat official account, individuals can regularly receive messages pushed by operators like magazines, including plain text messages, picture-text combination messages, video messages and voice messages. Weibo, which is equivalent to Facebook in China, is a broadcast network platform for sharing, disseminating, obtaining and sharing short real-time information based on user relations. As is shown in Table 6, 19.82% of the respondents used Weibo to search for health knowledge. Studies have pointed out that the largest users of social media are young people, 90% of whom may trust medical information shared through the Internet.[35] In China, young people prefer Weibo to search for information. The advantage of using Wechat to spread information lies in subscribing to Wechat's official account push and acquaintance sharing. The core advantage of Weibo is that it spreads faster and more widely. The app RED (Xiaohongshu) is a product with a strong community atmosphere, and the content release is aimed at a certain group. Domestic short video social software has TikTok, bilibili, kwai, and these applications are also available overseas. In recent years, short videos have sprung up rapidly in China. The form of video communication reduces the

Table 5. Results of keyword cluster analysis on health communication related on doctor-patient relationship.

Custer ID	Size	Silhouette	Year	Abel (LLR) Keyword
0	13	0.938	2015	health communication; medical education; decision making; curriculum; communication skills
1	12	0.844	2017	care; quality of life; management; lung cancer; qualitative research
2	11	0.936	2016	satisfaction; relationship; physician-patient communication; doctor-patient communication; suicide
3	7	0.942	2017	intervention; pattern; qualitative research; barrier; outcome
4	7	1	2014	qualitative research; physician-patient relationships; patient-doctor relationship; symptom meaning; clinical decision-making
5	5	1	2013	primary care; patient satisfaction; perception; care; physician-patient relationship
6	5	0.948	2018	doctor-patient relationship; patient-physician relationship; physician-patient relationship; physician-patient relations; qualitative study
7	4	1	2015	patient safety; health care; Alzheimer disease; language barriers; physician communication

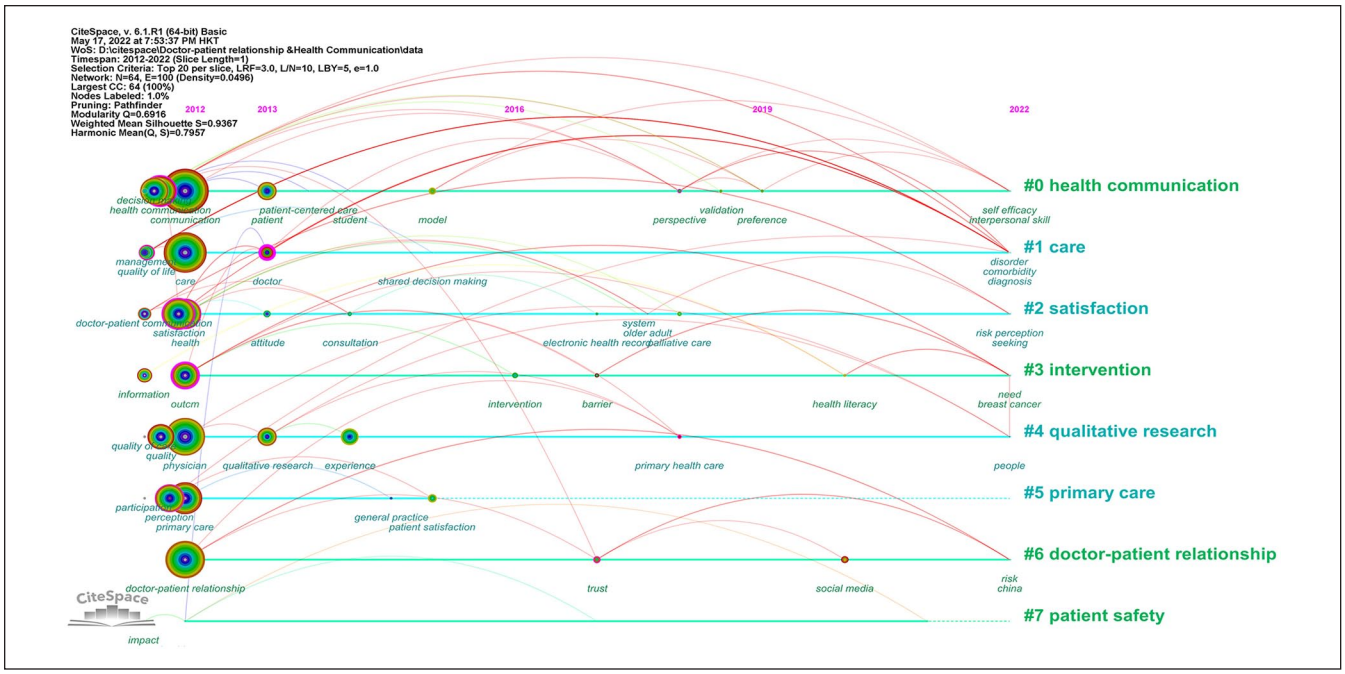

Figure 7. Keyword timeline analysis results on health communication related on doctor-patient relationship.

difficulty of reading text messages, meets the fast-paced knowledge acquisition needs of young people, and is convenient for the elderly to understand. Zhihu is an online question-and-answer community, similar to Quora in the United States. Tieba is a keyword-based topic communication community, and Zhihu both belong to the questions and answer platform. 14.86% of the respondents chose the question-and-answer platform to acquire health knowledge. Compared with Wechat, the knowledge spread by the Q & A platform mainly comes from reprinting on other platforms, personal experiences of netizens, and of course, the suggestions of some netizens with medical expertise. Waiting for answers in the question-and-answer platform can reduce the time and cost of searching for knowledge, but the information is based on others, and the credibility is low. Compared with Weibo, groups with the same health needs will gather on the question-and-answer platform to discuss the same topic, which is more targeted and professional. The more similar the information source is to the audience in attitude, cognition, activity, background, social status and lifestyle, the more it can increase the audience's love and identity.[36] Netizens' treatment experience includes recommended doctors, treatment plans and prognosis, which provide social support for patients. RED, a marketing platform that integrates social media and e-commerce, is known as China's Instagram. The respondents who preferred little red books to search for health knowledge accounted for 13.52%. The sharing of experience is also a feature of RED.

As is shown in Table 6, 77.48% of respondents search and access only when they have health needs, such as illness.

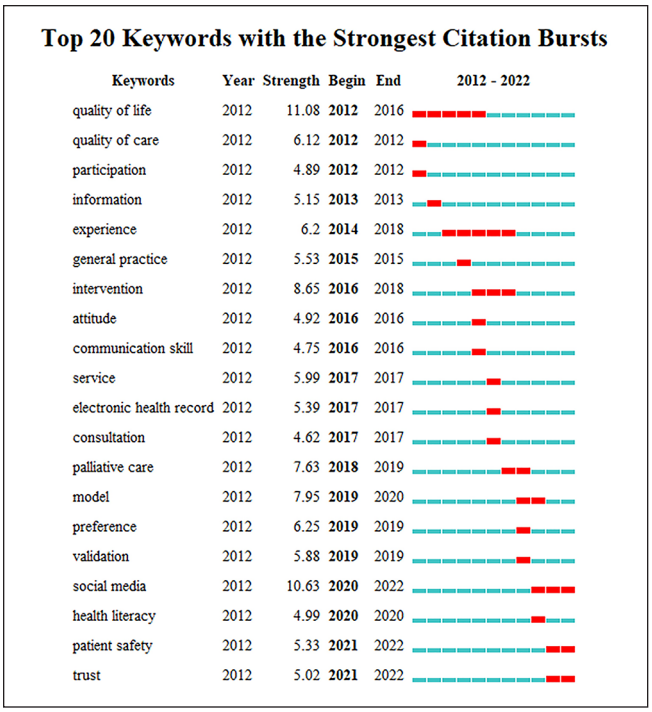

Figure 8. Analysis results of prominent words on health communication related on doctor-patient relationship.

This result accords with the cognitive theory of information needs. The demand for health information is the power to search for health information due to the demand for disease. The publishing platform and provider are the evaluation of the professionalism of the health knowledge source, and 88 (39.64%) respondents adopted the price standard. One hundred two respondents (45.94%) agree that exaggerating propaganda and violating common sense are the trustworthy evaluations of health knowledge. This result is in line with the source credibility and similarity model[37] proposed by the "Yale School" represented by the American psychology and communication scholar Hovland and Weiss. According to this theory, information acceptance is determined by the credibility of information, and information credibility is determined by 2 major factors: trustworthiness and expertise.[38] The factors of credibility source include Attractiveness, Trustworthiness, Expertise.[39] In terms of trust perception of information sources, the official platforms of government and medical institutions have strong reliability and professionalism. Medical professional commercial media usually reduce the expression of professional terms and enhance their attractiveness. The platform for medical professionals is affected by the medical knowledge reserve and expression ability of providers. Non-medical professional online celebrities often consider audience needs and preferences in content production. This kind of communication information is from the perspective of the audience, so it will increase the audience's sense of identity. However, the content is usually extracted from other platforms. In terms of trust on the content, the audience is most concerned about the authenticity and scientificity of the content (42.79%), followed by integrity (26.58%) and understandability (22.97%). It is believed that the quality evaluation of health knowledge comes from the trust perception of content and sources. Social media are spread in the form of text, pictures and videos, which are easy to understand and better improve health literacy and make health decisions. Understandability is an important peripheral cues that the audience depends on,[40] and it is also the constituent element of information quality.[41] With more and more fragmented time, users spend less and less time reading pure text. Most of the picture and text content is being replaced by more intuitive and vivid short videos and live broadcasts. Video production can use perfect audio-visual explanation with vivid pictures to convey complete and accurate information to consumers in the shortest possible time, and quickly win the favor and dependence of the audience. A short video is a video file that has been processed, while a live video is usually a real-time video. Compared with short videos, live streaming is more interactive and real-time. When users ask questions to VJs in the comment area, VJs usually give answers. When users see their questions answered, their enthusiasm for asking questions is naturally improved. Of course, the advantage of short videos is that they can be played back repeatedly to help understand and remember. Therefore, the respondents think that the knowledge transmitted by video is the easiest to remember (70.27%), followed by live broadcast (22.52%), and finally graphic (7.21%), as shown in Supplemental Appendix 3.

Differences in health knowledge acquired through social media and doctor-patient communication results. The vast majority of respondents believe that there are some similarities between the knowledge acquired on social media and doctors' answers (63.51%). We speculate that the reason why the information searched is inconsistent with the answers given by doctors may be related to the quality of information and e-health literacy. The proliferation of misinformation, false information and contradictory information will cover up the acquisition of reliable information.[42] Although the regulatory mechanism for information on social media has been improving, the professionalism and comprehensiveness of information has been a concern to the public. E-health literacy is defined as an individual's ability to find, discover, understand and evaluate health information from electronic sources.[43] Even netizens with high health literacy may lack e-health literacy.[44] Different diseases often have similar symptoms, and if the diagnosis searched by patients with one of their symptoms is wrong, it is bound to be ineffective to obtain the relevant knowledge of the "disease". Some platforms allow non-professional individuals to upload information,[45] there are differences in the quality of different social media information,[46] and there may be pseudo-health information. In addition, the health knowledge published by

Table 6. Selection of health knowledge on public social platforms.

Item	N (%)
What is the most frequently used social platform when I want to acquire health knowledge?	
Wechat, QQ	59 (26.58)
micro-blog	44 (19.82)
Short video platform (Douyin, bilibili, Kuaishou, etc.)	23 (10.36)
Zhihu, Post Bar	33 (14.86)
Little Red Booklittle	30 (13.52)
Other platforms	33 (14.86)
What is your habit of acquiring health knowledge on social platforms?	
When unknown health knowledge is found, it will take the initiative to check to accumulate knowledge	50 (22.52)
Search and get only when there is a health need (such as illness)	172 (77.48)
When you judge and evaluate the quality of health knowledge on social platforms, what is the most important judgment*?*	
Whether the publishing platform is reliable?	26 (11.72)
Are content providers experts?	62 (27.92)
Has the efficacy (harm) been exaggerated by "omnipotence"?	31 (13.96)
Is it contrary to medical common sense (or most other information)?	71 (31.98)
Is the release time of the content up to date?	32 (14.42)
When you acquire health knowledge on social platforms, what kind of organizers *do you prefer?*	
Official platform of government and medical institutions (eg, healthy China, disease control in China, etc.)	57 (25.68)
Medical professional business media (eg, lilac garden, medicine, health, etc.)	54 (24.32)
Personal platform for medical experts	34 (15.31)
Influencer (non-medical professional) personal platform (eg, high number of fans, many messages)	59 (26.58)
Arbitrary keyword retrieval	18 (8.11)
When you acquire health knowledge on social platforms, what do you focus on most in terms of content?	
Whether the content is true and scientific?	95 (42.79)
Whether there is a complete description of etiology, treatment, prognosis and rehabilitation?	59 (26.58)
Is the content easy to understand?	51 (22.97)
Whether the expression is relaxed and humorous?	2 (0.90)
Does it take too long to read or play the whole content?	15 (6.76)
Which form of communication on the following social platforms do you think makes it easier for you to remember knowledge?	
Released videos (eg, Douyin, bilibili, etc.)	156 (70.27)
Pictures + text (eg, Wechat, Weibo, Zhihu, etc.)	16 (7.21)
Live broadcast (eg, Kuaishou, Douyin studio, etc.)	50 (22.52)

some medical media cites the latest literature (the purpose of marketing does not rule out), and some of the latest research results may challenge textbooks or existing traditional medical viewpoints, however, it should be noted that these studies may still be in the early experimental stage, need to be verified by larger samples, or need to be tested in different ethnic groups. The audience may lack the ability to distinguish these studies.

The gap in health knowledge between the audience and doctors was most likely in the causes of morbidity (35.59%) and examination items (39.64%), as is shown in Table 7. As mentioned above, it is inaccurate and incomplete to infer the disease only from a certain symptom. Cross-validation of various medical examination items is very important to confirm the disease and exclude the diagnosis. However, the judgment of examination results requires strong professional knowledge and rich clinical experience. In general, correct diagnosis is the most important link for doctors, but due to the influence of medical experience, simple thinking and eagerness to treat diseases, the public may not pay enough attention to the link between disease diagnosis, and the knowledge actively stored will also be insufficient. Diseases not only cause pain, but also affect their quality of life. From the perspective of patients, it is more urgent to eliminate the negative effects of diseases than to explore the causes. Therefore, the last gap in health knowledge between the public and doctors occurred in the treatment scheme (30.63%) and prognosis results (43.24%), as is shown in Table 7. Clear treatment plans can eliminate patients' fear of disease, and promising prognosis results can enhance patients' confidence in continuous treatment.

Relationship between doctor-patient consistency and doctor-patient trust. The problem of doctor-patient communication caused by medical information asymmetry will cause patients to seek medical treatment blindly or tend to be skeptical about the doctor's diagnosis. Although some doctors feel threatened by the online health information provided by

Table 7. Health knowledge gap between the audience and doctors.

Item	N (%)
In the vast majority of cases, how similar are your health knowledge acquired on social networking platforms to your doctor's *diagnosis and answers?*	
It's almost identical.	64 (28.83)
There are some similarities.	141 (63.51)
Completely inconsistent.	17 (7.66)
In general, where do you think the health knowledge gap between you and your doctor is most likely to occur?	
Cause of disease	79 (35.59)
Items checked	88 (39.64)
Treatment scheme	34 (15.31)
Prognostic result	21 (9.46)
Which part of the health knowledge gap between you and your doctor is the last thing you want?	
Cause of disease	35 (15.77)
Items checked	23 (10.36)
Treatment scheme	68 (30.63)
Prognostic result	96 (43.24)

patients and will respond defensively.[47] However, obtaining health information through search can improve information asymmetry and provide opportunities for patients to participate in their own medical decisions. As is shown in Table 8, the vast majority of respondents thought that it was easier to reach an agreement with the doctor after a full understanding and brief consultation (44.59%). 64.86% of the respondents thought that an easy agreement with the doctor on diagnosis and treatment advice would increase their trust in the doctor. Although only 29.28% of the respondents chose "significantly increased trust," it is an indisputable fact that doctor-patient consistency increases public trust in doctors. At the same time, 73.87% of the respondents believed that the diagnosis and treatment process of doctor-patient trust would extend to the favor of the whole doctor group. This suggests that doctor-patient communication is an important factor of doctor-patient trust, and good interpersonal trust may promote inter-group trust good communication not only provides health information support to patients, but also includes emotional support and joint decision-making.[48] According to the theory of media richness, face-to-face communication is the most abundant medium. Face-to-face communication can have immediate feedback and send multiple clues, such as non-verbal messages (expression, tone, body language, etc.), and use natural language. Doctors need to improve their communication skills, especially to actively discuss the online information provided by patients.[49] Patients' participation in treatment decision-making can improve patients' treatment compliance, thus improving patients' satisfaction with decision-making and quality of life,[50] and forming an optimistic attitude toward their own diseases.[51] Network health information search behavior will enrich patients' health knowledge and make up for the asymmetry of doctor-patient information. When the patient's network health knowledge is inconsistent with the doctor's diagnosis or treatment, conflicts or even disputes may occur between the doctor and the patient.[52] This may cause some patients to seek second advice, change doctors, change treatment plans,[49] or use Internet advice for self-treatment.[53] The vast majority of respondents would choose to further increase doctor-patient trust by keeping in touch or long-term follow-up (44.59%) and recommending their own doctors to patients (47.75%) When doctors and patients trust each other, patients will be more willing to contact doctors actively and shorten the emotional distance between doctors and patients. Recommending your attending doctor to potential patients is based on the full trust of the doctor, which is not only the recognition of the level of medical technology, but also the emotional identification of medical ethics, character, character and so on. Word-of-mouth is the earliest communication behavior of human beings. Even with the emergence of media communication, word-of-mouth communication still has high credibility. According to Hoffland's persuasion theory, the credibility of the communicator is based on 2 decisive factors: (1) the audience's trust in the communicator, and (2) the audience's perception of the communicator's professionalism. Individuals with group identity have convergence, and individuals who have been in a group for a long time will be guided by the common values of the group. The patient's personal medical experience and subjective views are more persuasive to the potential patient's choice of medical treatment, as shown in Supplemental Appendix 5.

Discussion

After qualitative analysis based on CiteSpace and quantitative analysis based on self-collected data, the research status of the relationship between health communication and doctor-patient relationship and the new path of the impact of health communication on doctor-patient relationship were explored. From the perspective of cooperative authors, cooperative institutions and cooperative countries, American scholars and institutions not only have a lot of research in this field for a long time, but also have a high influence on the development of research in this field. Public health literacy is different in different regions, and there are significant differences in health communication preferences and medical systems in different countries. The epidemic has also had an impact on the improvement and reform of health care systems in various countries. Research in this field should cooperate with more countries to avoid the "isolated island" state of research as far as possible. The study of health communication and doctor-patient relationship involves the disciplines of health care and service, internal medicine, public health, environmental health and occupational health. At present, the main research field is the medical discipline. We speculate that health communication is a tool or method to

Table 8. Relationship between doctor-patient consistency and doctor-patient trust.

Item	N (%)
Under which circumstances do you find it easier to agree with your doctor on diagnosis and treatment advice?	
When you can fully understand what the doctor means and briefly discuss with the doctor.	99 (44.59)
When everything is handed over to the doctor and everything is listened to by the doctor.	59 (26.58)
When you don't fully understand what the doctor means and discuss it repeatedly with the doctor.	64 (28.83)
Will you trust the doctor more when you can easily agree with the doctor on treatment advice?	
Trust will increase significantly.	65 (29.28)
Trust will increase a little bit.	144 (64.86)
Trust will not increase.	13 (5.86)
When you and your attending doctor go through a process of mutual trust, will it affect your evaluation of the doctor-patient relationship in the whole society?	
Will extend to the favor of the whole community of doctors.	164 (73.87)
Will not extend to the favor of the whole community of doctors.	34 (15.31)
The decision should be made according to the personal situation and experience of the next doctor.	24 (10.81)
When the trust between you and your attending doctor deepens, how can you further strengthen your relationship?	
Keep in touch or long-term follow-up.	99 (44.59)
Recommend to patients (or friends).	106 (47.75)
Publicly praise (send praise, banner, thank-you note, etc.).	14 (6.31)
Take the initiative to care for or bless the doctor.	3 (1.35)

solve problems in the medical field, and the doctor-patient relationship is the purpose of health communication. Doctor-patient interaction can be used as a natural and cost-effective intervention to promote public health behavior.[54] Social media as a new technology for health communication is not a local feature, but a global trend. Health communication should not ignore the impact of new media technology, and the use of social media technology to implement health communication effect evaluation and risk aversion should be the focus of research. In addition, interdisciplinary cooperative research should first consider the difference between social media and traditional media.

Although the impact of communication on health outcomes is usually indirect,[30] patient-centered communication can improve patient outcomes, such as psychosocial adaptation and adherence to treatment, thus contributing to better health.[55] Effective doctor-patient communication is an important factor in patient satisfaction.[56] Doctors' attitudes toward patients include verbal and facial communication, such as listening, discussion, eye contact, and using pictures to help patients understand, as well as behavioral contacts, such as physical examination and appeasement. Effective doctor-patient communication is an important aspect of cultural competence (culturally competent).[57] Likewise, there is a disparity in patient literacy levels in response to physicians' use of patient-centered communication.[58] The medical staff needs to have the sensitivity and insight to deal with the heterogeneous culture behind the language, behavior, emotion, psychology and attitude of different patients. The empathy of doctors is crucial to the health of patients both in theory and practice.[26] The performance of doctors' empathy is that they are willing to listen and explain comprehensively, which can guide patients to communicate more actively. In medical practice, interaction with patients can promote empathy among doctors.[59] The content of listening is the premise of effective communication, and a good listening attitude of doctors will make patients think that they are respected and trusted. The higher the patient's trust in the doctor, the higher the completion rate of self-management tasks.[60] Communication and trust are cause and effect of each other. Trusting doctors will reduce communication barriers, and communication will increase trust. Therefore, communication is a necessary link to establish the relationship between health communication and the doctor-patient relationship.

The benefits of communication on health outcomes are not a single effect, but are promoted from multiple dimensions. The longer and more times you communicate, the different health outcomes may be. Communication can facilitate the exchange of information, treatment preference is also a 2-way exchange in this process, and the core of patients' participation in decision-making is the preference of patients after weighing the possible risks and benefits of treatment.[27] The premise that patients can participate in decision-making is that the information between doctors and patients is focused and symmetrical, which is a positive result of sharing information between doctors and patients, and this result is that both doctors and patients are satisfied with the treatment plan. Therefore, it is useful and necessary to train doctors in communication skills.

COVID-19 brings life threats to human health all over the world. Life safety and health have become issues of public concern. Blocking the chain of virus transmission is particularly important for health. Social media has almost become the main source of health information for the public. However, misinformation and fears associated with COVID-19 reached a "pandemic" state earlier than the disease itself.[61]

The access threshold of social media is lower than the traditional media. Due to the complex sources, uneven user literacy and a backward information audit mechanism of the social media, it is easier to make false information on social media rampant. Blind trust in social media news content can be risky.[62] Patients' acquisition of inaccurate health knowledge will become an obstacle to doctor-patient communication. One way to mitigate the impact of misleading or inaccurate content is to direct the patient to a reliable source of information or a trusted website.[63] We insist that it is impractical to prevent patients from searching for health information on the Internet in an era of advanced science and technology. Strengthening the quality of information and providing differentiated information services according to users' health literacy can maximize health empowerment.[64] We insist that standardizing the management of the platform and strengthening the supervision responsibility of the platform is the first hurdle for the accuracy of good information. Hospitals and doctors can establish a cooperative relationship with the media to popularize health knowledge and at the same time improve their image and lay the foundation for building a harmonious doctor-patient relationship.

There is also some controversy in academic circles about the trust of social media in doctors and patients. Social media is seen as a tool for educating patients and reducing the time spent on clinical re-education.[17] Social media is appropriate as a preventive health tool to support a public healthy lifestyle.[65] Providing standard medical advice can improve patients' self-management behavior.[66] For patients, increasing the reserve of health knowledge can shorten the information asymmetry between doctors and patients. We believe that the theory supporting this opinion is that information symmetry can reduce ineffective communication time. However, the challenge of keeping answers consistent goes hand in hand with the challenge of the great diversity of the physician community.[67] For doctors, doctors worry that using the Internet may lead to unrealistic expectations of patients and an increase in medical lawsuits.[68] When the doctor wants to correct or adjust the wrong knowledge searched by the patient, it will add extra time.[69] In addition, doctor-patient trust is a kind of social trust. When patients receive inaccurate information on the Internet, it may hurt doctor-patient trust.[70] The increase or decrease of the trust of one of the doctors and patients will affect the trust of the other. During the COVID-19 period, many patients expressed tolerance and gratitude to emergency workers[71] and medical staff also believed that the doctor-patient relationship had improved.[72] These results are worth publicizing. However, the doctor-patient relationship during public emergencies is special and non-sustainable. The path of social media between health transmission and the doctor-patient relationship needs to be confirmed by more evidence after the end of future outbreaks.

According to social information processing theory(SIPT),[73] the social environment provides environmental cues, such as social information, and these cues influence people's behavioral choices.[74] Especially when individuals do not have enough suitable information related to their goals, they are more likely to seek information from other sources, which may shape their attitudes, beliefs, and opinions.[75] Patient trust in physicians may change as a result of patient behavior in seeking health information. By analyzing the results of the survey, we believe that the richness of social media will enable the public to choose different channels to obtain health knowledge to meet their own needs and preferences. Source credibility and content trust perception are the key elements for the public to judge the quality of health knowledge on social media. Understandability is the advantage of short videos to spread health knowledge. E-health literacy is also an important factor affecting the differences of health knowledge among individuals. The different degree of attention to health knowledge between doctors and patients reflects the patients' thinking of "pay less attention on diagnosis and more on treatment." Doctor-patient communication is a key link in the establishment of doctor-patient health information sharing and joint decision-making. The quality of communication will determine whether the inaccurate information obtained by patients from the network can be corrected. Reaching a consensus between doctors and patients will increase interpersonal trust and inter-group trust between doctors and patients, and the promotion of doctor-patient relationship includes the increase of compliance and the spread of word-of-mouth to doctors. Although we only use descriptive analysis to explain the relationship between health communication of social media and doctor-patient relationship, it basically covers the keywords and prominence words of bibliometrics research results. Based on the research results, we speculate a path: the quality of social media health information (source credibility and content trust perception) "information asymmetry perception" doctor-patient communication "doctor-patient consistency" doctor-patient trust "doctor-patient relationship." The exploration of this path will provide reference for the construction of the theoretical model of health communication and doctor-patient relationship in the future.

The results of the present study are subjected to some limitations. Although Web of Science is the most commonly used database, there are many other literature databases. This study only analyzed the literature of Web of Science's core collection database. Future research can be considered to include more database literature for analysis. Although we have analyzed and written papers quickly after collecting data, some of the most recent important papers published during the writing time may not have been collected. Under the influence of technology, circumstances and policy factors, health communication and doctor-patient relationship change dynamically. Therefore, it is necessary to carry out bibliometric analysis at each stage. Despite we implement questionnaire verification according to the results of bibliometric analysis, but the descriptive analysis results are

limited in persuasiveness. In a word, this kind of verification method was not used in previous studies.

Conclusion

Through CiteSpace, this research has predicted that communication, social media, trust and self-efficacy are some possible variables between health communication and doctor-patient relationship, which also lays a theoretical foundation for exploring the causal relationship between them. Its contribution to the field of doctor-patient relationship is not limited to using qualitative analysis methods to review the literature content according to the theme, summarize the research experience and shortcomings and explore a new path of the impact of health communication on the doctor-patient relationship, but also selecting the Chinese public as the survey object to carry out quantitative analysis and verification of the results of qualitative analysis, which further proves that these intermediate variables are indeed relevant according to the questionnaire survey. This not only confirms the applicability of the qualitative analysis results in China, but also is the innovation of this study that distinguishes it from other metrological literature. It will gradually shift the focus of research to the discussion of mechanisms and tools to promote the construction of good doctor-patient relationship. This study uses descriptive analysis to explain the relationship between health communication of social media and doctor-patient relationship, which basically covers the key words and prominent words of bibliometric research results. And based on the research results, a new path is speculated: social media, the quality of health information (source credibility and content trust), the perception of information asymmetry, doctor-patient communication, doctor-patient consistency, doctor-patient trust and doctor-patient relationship. These variables may be the key variables to construct the theoretical model, and the exploration of this path will provide reference for the construction of the theoretical model of health communication and doctor-patient relationship in the future. In general, the research on the intermediate outcomes of health communication and the doctor-patient relationship, such as effective communication, has become a hot spot. Communication is the most important part of trust building and health knowledge is the main content of the communication. Communication is not only the process of establishing information symmetry between doctors and patients, but also the way to determine the trust relationship between doctors and patients. Listening, empathy and cultural ability are communication skills. Patients' participation in decision-making is a positive result of communication. All of these have been highly concerned by previous scholars. Affected by the epidemic, the main means of health transmission has shifted to social media, and the doctor-patient relationship has also changed. The public searching for health knowledge on social media before seeing a doctor will have a prediction of their health status, and may also have a preliminary impression of the doctor through the introduction on social media. Due to the uncertainty of social media information and the particularity of the epidemic environment, the research on health communication and the doctor-patient relationship in the social media environment may become a new hot spot in the future.

Author Contributions

Mr. LU Renjie is involved in the design of the technical route and questionnaire, data analysis and article writing. Ms. ZHAO Shenyu is responsible for the software application analysis of citespace, questionnaire creation and collection, literature review, data verification, text proofreading, and article submission. Ms. Wang Xiaoyu is involved in translation and data checking. Ms. ZHOU Jing is involved in translation and response to reviewers. Ms. Jiang Yongyi is responsible for the English translation and polishing. Ms. Ou Weiyan is responsible for the translation and proofreading. Ms. WEN Juan is involved in the review of the article content. Ms. HU Lingmin is responsible for the conceptualization of the project, identification of contributing journals, and suggestions for revisions. All authors are responsible for the entire content of this manuscript and agreed to submit it.

Data Availability Statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

Declaration of Conflicting Interests

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Ethical Approval and Consent to Participate

The study was approved by the ethics committee of Changzhou Maternity and Child Health Care Hospital (No.2022[22]), and informed consents were obtained from all participants on net before the survey.

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Supplemental Material

Supplemental material for this article is available online.

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