Discussion

The application of big data and the development of nursing science: A discussion paper

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ABSTRACT

Based on the concept and research status of big data, we analyze and examine the importance of constructing the knowledge system of nursing science for the development of the nursing discipline in the context of big data and propose that it is necessary to establish big data centers for nursing science to share resources, unify language standards, improve professional nursing databases, and establish a knowledge system structure.
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1. Introduction

We must cope with all types of data because we live in a data society. We ourselves are a part of these data; whether we want to be a part of big data or not, data will always find us and cover us. Were there no data, modern economic activities, innovations, and economic growth simply would not be possible. Recent technological advances have revolutionized how we collect, store and manage information. The digitization of the world has dramatically increased the amount of data we collect. Big data technology can be used to extract, manage, analyze, and interpret large datasets and transform them into meaningful hypotheses that can be translated into practices. With the continuous acceleration of the informationization process, the medical and health field has gradually entered the era of big data. Large-scale, multi-channel, and diverse data can provide new methods and ideas for nursing practices and have application value in many areas, including nursing evaluation, improving the level of nursing practice, monitoring disease, nursing research and clinical decision support. Therefore, how can we find knowledge from massive data, detect patterns, trends and correlations hidden in big data, reveal rules of social phenomena and social development, and identify possible business applications? To answer these questions, we need to have better big data research centers. Therefore, in the era of big data, big data research in the field of nursing has become an important trend in the development of the nursing discipline.

1.1. Big data

The concept of big data can be traced back to the 1970s. Beginning in 2009, "big data" has become a buzzword in the Internet information technology industry. In 2010, in "*Big Data: A revolution that will transform how we live, work, and think*" [1], Kenneth Neil Cukier and Viktor Mayer-Schoenberger noted that the term "big data" refers to the analysis and processing of all the data, not the stochastic analysis. The McKinsey Global Institute (MGI) [2] defined big data as large-scale data collections that traditional databases cannot obtain, store, manage and analyze; they are a large amount of data collected from different sources and the analyses thereof, often described using the 10 "Vs": volume, velocity, variety, veracity, variability, validity, vulnerability, volatility, visualization, and value. Volume refers to the sheer volume of the data; for example, according to IBM's estimate, 2.5 quintillion bytes of data are created every day (one quintillion, i.e., one million raised to the fifth power (10^{18}), is one followed by 18 zeroes); velocity refers

to the speed at which big data are generated; variety refers to the diversity of the data or resources; veracity refers to facts that data collected for one purpose may have issues involving missing information or poor data quality when put into secondary use; for example, in the field of nursing, patient data are initially recorded or acquired to provide patient care and can be used for secondary purposes; finally, value refers to the new insights derived from big data [3]. Big data represent a change in thinking, including the preference of all data over sampling, the preference of efficiency over absolute accuracy, and the preference of correlation over causality [1]. The essence of big data is an unprecedented change in the fields of thinking, business, and management. The core value of big data lies in the storage and analysis of massive data, while the strategic significance of big data lies in the specialization of data processing in which the purpose of value-added data is achieved by improving data-processing capability. Compared with traditional databases, big data have the following advantages: the capability of storing a massive amount of data information, rapid data exchange and sharing, diversified types of data, low-density value, etc.

1.2. Big data of nursing science

In 2011, nursing science, referring to an applied science with a multidisciplinary theory basis that studies nursing theory, knowledge, technology and the development patterns that maintain, promote, and restore human physical and mental health, was listed as a national First Level discipline (China). It is also a practical science and plays an important role in the medical field as an independent discipline. In the era of big data and massive information, people are increasingly concerned about how to apply information technology to work and life, and massive, unstructured data have also been widely used in hospitals, in which the most obvious changes are reflected in nursing services.

Big data of nursing refer to the vast amount of data related to care and health, including big data of hospital nursing, big data of regional health service platform, and big data based on nursing research or disease monitoring in large populations. Compared to other technologies, in terms of cost, speed, and optimization, the comprehensive cost of big data is optimal. Big data could play a huge role in gaining insight into the value of data, preventing the spread of disease, eliminating the waste of medical resources, and avoiding the high cost of medical care, and could become a "superpower" that makes medical care more efficient. Brennan and Bakken argued that nursing requires big data and vice versa. In traditional surveys in nursing, big data were understood based on electronic health records, claims data and public health data sheets, while large databases of nursing are about nursing diagnosis, nursing intervention and nursing outcome and are extracted from a large number of electronic medical records (EMRs) through a general nursing classification [4].

1.3. Nursing big data center

The term "big data center" refers to achieving the centralized processing, storage, transmission, exchange, and management of information within a physical space, in which computers, servers, and network and storage devices are generally considered the key equipment for the core of a data center.

A big data center of nursing is a data center that integrates nursing science, informatics and analysis to identify, define, manage and exchange data, information, knowledge and wisdom, along with a nursing research center that integrates business, learning and research. It is centered on big data mining and inference studies. The presence of a big data center is important because it guarantees an improved ability to interpret big data. For the same

data that are collected with the same method, different processing methods, different ideas, different decision-making methods, and different viewpoints can result in vastly different data processing outcomes [5]. Therefore, the development of the ability and perspective to systematically interpret data is the core of a large data center.

However, as a rising amount of data is collected, the demand for data analysis increases, definitely, the challenges we face are real. We must acquire a considerable number of valuable resources which have been standardized or normalized in order to stablish nursing big data centers and make use of analysis tools and model algorithm in order to obtain more research value from these impressive data.

2. Research status

2.1. Research status of big data at abroad

With the rapid development of Internet technology and computer technology, a global big data industry is gradually emerging. Many countries, including the United States (US), the United Kingdom, Japan and South Korea, have formulated national big data strategies. The US has even suggested that the strategic position of big data is comparable to oil in the industrial era. In the 1970s, the US and Japan developed information systems and successfully applied them to the health care industry. In the 1990s, the American Nurses Association (ANA) and the National Nursing Alliance placed the content of the published English journals on nursing science into the CINAHL database. In 2008, the journal "Nature" published an article about patents on big data, and researchers from various disciplines have since realized that huge amounts of data can bring opportunities and challenges to their fields [6]. Since the US Congress passed the *Act of Health Information Technology for Economic and Clinical Health* (HITECH) in 2009 [7], big data in the health sector have gradually increased their significance. In 2011, the journal "Science" published an article on challenges in data processing and indicated that we are faced with tremendous difficulties in processing a gigantic amount of data [8]. In 2011, the Korea Bioinformatics Center planned to develop a national DNA management system that integrates a large amount of DNA data and patient medical information to provide individualized diagnosis and treatment for the patient [9]. In 2013 and 2014, the University of Minnesota School of Nursing and its Center for Nursing Informatics hosted a conference on big data and transforming health care consensus, aiming at creating a national action plan for sharable and comparable nursing data. As of February 2014, the National Institutes of Health (NIH) has accumulated tens of billions of bytes of human genetic variation data at the Amazon Web Services Center, enabling researchers to access and analyze huge amounts of data [10]. In 2015, at the 3rd International Symposium on Systems Biomedicine, the "European Union Action Plan" on big data was launched by the Council of Europe to implement the strategy of prediction-treatment-care by investigating and analyzing data and to provide data strategy for big data of personalized medicine in Europe [11]. In April 2015, Joyce Sensmeier, the deputy director of the Information Department of the Healthcare Information and Management Systems Society (HIMSS) in Chicago, published an article on "Nursing Management" and presented her thoughts about how nurses should meet the challenges of big data era and rationally use their resources. Big data could accelerate the penetration of new Internet-based technologies into a wider range of areas and radiate to all walks of life, and nursing is no exception. In June 2015, at the Nursing Knowledge Conference in Minneapolis, it was announced that an expert group would work to represent informatics organizations, professional

nursing organizations, electronic medical record software developers, education and research institutes, the federal government, and medical care providers. In July 2015, the National Institute of Nursing Research (NINR) under the NIH held a conference on big data of nursing to promote the development of big data in the nursing field [12]. The US nursing databases include the NDNQI, and the NMMDS. Currently, the Elsevier database of Clinical Key for Nursing is the most used database, but unfortunately, there is no Chinese version.

2.2. Research status of big data in China

In May 2013, China joined the International Council of Nurses (ICN), and China's nursing development has since entered the international arena. The development of nursing care has also been met with new challenges in the development of nursing information. In June 2014, at the Symposium of Big Data and Translational Medicine of the International Council of Nurses, it was made clear that the future of nursing will be focused on transforming nursing practice, research and education in the context of big data, and developing and cultivating the ability to obtain and integrate data and information. In July 2015, China's State Council issued "Guidelines on actively promoting the 'Internet Plus action" and proposed that the reshaping of the healthcare service model requires nurses to seize opportunities and meet challenges, becoming designers and leaders in "Internet Plus" healthcare or the "Internet Plus" nursing field. On November 18, 2016, China's National Health and Family Planning Commission formulated and issued "The development plan for national nursing work (2016−2020)", which indicates that the rapid development of information technology has created favorable conditions for nursing development. On August 21−25, 2017, the 5th International Conference of Nursing Informatics was held in Hangzhou, China, with the theme of "Informatics promotes precision nursing: when information helps, nursing soars." On May 28, 2018, at the 19th General Assembly of Academicians of the Chinese Academy of Sciences (CAS), it was advocated that we should promote the deep integration of the Internet, big data and artificial intelligence with the real economy and develop a bigger and stronger digital economy.

In the field of big data research, the Big Data College was established in 2014 in China. Both the Big Data College and the Big Data International Forum were created by the WSS, an internationally renowned training institution. The China Education Big Data Research Institute was jointly established by the China Statistical Information Service Center and Qufu Normal University in 2015. Later, the China Big Data website (http://www.the bigdata. cn/) was launched. In 2014, the University of Electronic Science and Technology of China (Chengdu) established the Big Data Research Center http://www.bigdata-research.org/about/). The Zhongwei Institute of Nursing Information (http://www.zwini.org/nurseinfo-web/page/toIndex) was established in 2015. It is a non-profit research institute under the management of a board of directors and focuses on issues on the frontier of nursing and nursing management and the improvement of the effectiveness of nursing management by actively utilizing the power of digitalization and intelligentization to help the nursing industry solve practical problems in clinical services and management. In October 2016, China launched its first batch of national pilot projects for a medical big data center and industrial park; Fuzhou and Xiamen Cities of Fujian Province, and Nanjing and Changzhou Cities of Jiangsu Province were chosen as the first batch of pilot cities. In 2017, Guizhou Medical University launched a program in Medical Information Engineering, a new specialty that is dedicated to the analysis of health-related big data.

China did not engage in information technology construction until the 1990s, and big data in the field of nursing and health developed late compared to other countries, thus lagging behind. In traditional medical research, enumeration data and measurement data are the most common data forms; as numerical structured data, they can be processed using the general data analysis techniques or tools. However, in the context of big data, unstructured data, e.g., text, images, videos, e-mails, and questionnaires with open-end questions, are increasingly emerge, and the primary content and inevitable trend of big data research relate to understanding and investigating these large-scale, multi-channel, and diverse data to obtain valuable information. Hospitals at the county level and above in China have essentially established their hospital information systems, and in 20% of the hospitals at the county level and above, the patient-centered and EMRs-based integrated management system of registration, billing, prescription, and treatment have been established. In 12 provinces including Beijing, Shanghai and Anhui, electronic health archives have also been established. The data resources for medical "big data" include electronic health records (EHRs) data from medical services, billing and expense data from hospitals and healthcare, academic, social and government data for medical research, data involving medicines, medical equipment, and the clinical trials of medical manufacturers, behavior and health management data related to residents, the government's population and public health data, and the data generated by networks in China's public social and economic life. All of these types of data constitute the initial data resources for big data in China's health sector [13].

In summary, the research and application of big data in the field of nursing are still relatively lagging, and the involvement of nurses in big data science is mostly limited to entering the data into HER [5].

The real applications of big data in clinical nursing still need to be improved. Many countries and governments have already attached great importance to the application and development of big data. Therefore, it is necessary for nursing researchers to participate in the construction of a big data information platform and to incorporate nursing elements into a multi-level, cross-organizational information platform.

3. Current issues

Although viewed as beneficial and satisfying, inspiring both innovation and new thinking, big data can also mean big danger. The credibility of big data can be jeopardized by data incompleteness and dubious standards and processes for storing, acquiring, analyzing, and presenting big data [14]. Furthermore, although the application value of big data has been fully reflected in numerous industries, big data still have their own limitations and development limitations.

3.1. Big data do not indicate causality but relationship

Big data can reveal "what is it?" but not "why is it?", show large trends and patterns but not revolutionary innovations, and offer appropriate services but not satisfy new demands, all of which are core issues to be addressed in our research and development on and improvement of big data.

3.2. Big data do not represent the whole and tend to show selective bias

Although colossal in quantity, big data are only sampled data of a time section; they may infinitely approximate the whole but cannot represent the whole [15]. When the amount of data is too large, interference information may emerge or too much noise may

be present, making cluster analysis very difficult. Many data are not relevant to what we want to investigate, and it is necessary to delete a large quantity of irrelevant data using statistical methods. Therefore, the most important step in data mining technology is cleaning data and the padding missing data, and sometimes it is necessary to calculate the statistically significant statistic of each of the characteristics so that filtering and filling can be performed based on quantile, mean, variance, covariance and correlation coefficient.

3.3. Resource data sharing is poor and data security needs improvement

Large hospitals have essentially implemented informatization construction, but the corresponding data resources are still scattered in different data pools that are not connected and thus information islands form, with the result that nursing data cannot be shared between hospitals, and relevant data from health systems throughout society cannot be effectively integrated, which in turn affects the formation of nursing resource data. The issue of how to extract the big data of nursing from the immense amount of medical care information resources and make them play an independent role is one of the difficulties in building a big data information platform. In addition, while promoting data transmission and sharing, big data also creates a risk that personal privacy will be breached. In the era of big data, it is necessary to engage in data sharing, which is largely limited by strict data protection; only when the sharing and protection of big data are guaranteed can the potential value of medical big data be maximally realized [16].

3.4. Standardized nursing terminology still lacks

Applications of big data are based on resource sharing, and the standardization of terminology is the basis for realizing resource sharing and exhorting the benefits and effects of big data. Standardized nursing terminology, a generalized data model and the information structure of EMRs are the basis for integrating nursing data into clinical databases for big data and big data science uses. Sensmeier [17]suggested the use of the Systematized Nomenclature of Medicine-Clinical Terms recommended by the ANA. In the era of big data, we certainly need to adopt international standards to maintain compatibility with the standard terminologies of international institutions. More importantly, however, we need to establish a unified standardized nursing terminology with Chinese characteristics; this has become a necessity for promoting the development of nursing science in China.

3.5. Unified software development deficiencies

Most of China's nursing information systems have been independently developed by companies. The requirements for Nursing Information Systems (NIS) were created for software developers by nurses based on their clinical needs, and those developers engage in systematic research, development and improvement. This kind of hospital information system development model can only meet the needs of a certain hospital but is unsuitable for schools, research institutes, databases, etc., since it has neither a unified standard nor a unified information system, and thus the levels of nursing information software development are uneven and the R & Ds are often redundant, wasting resources while impeding the introduction of NIS. At the same time, the information systems between hospitals are not unified, which makes it impossible for hospitals to share information resources and is not conducive to the development of information systems. Furthermore, this situation restricts the promotion of big data.

3.6. The shortage of talents in nursing informatics

In other countries such as the US, nursing informatics was recognized in the 1990s and became an independent discipline in the 2000s with its own teaching and research faculty and qualification credentials. In this regard, the gap between China and other countries is large, and basic education on nursing informatics remains inadequate in China. In most nursing schools, there are no graduate programs in nursing informatics, while in most hospitals, there are no full-time nursing informatics posts; this situation is bound to hinder the development of nursing informatics. Therefore, in terms of national policy, nursing informatician qualification and examination should be set up to train the talents of nursing informatics so that the developmental needs of the big data of nursing can be met.

4. The significance of setting up centers for the big data of nursing

Under normal circumstances, owning big data itself is meaningless, and big data's real significance is reflected in the specialized processing of data with a large amount of information [18]. However, to effectively process specialized data on a large scale and within a certain time frame, special technical supports such as large-scale data mining technology are needed. In mining big data, we cannot always rely on outside teams; instead, we should have an in-house task team and core technology. The establishment of centers for the big data of nursing enables the reasonable and effective use of big data, which will play a vital role in the development of big data centers in industry, academia and education. It can also provide supports to the clinical decisions of accurate nursing, public health and satisfactory service.

4.1. For forecasting

The core meaning of big data is prediction [19]. First, it can predict hot trends in which literature with different data features is quantitatively or qualitatively analyzed to reveal patterns, trends and hot issues in the specialty. Second, it can make predictions about diseases; for example, after data mining the search terms frequently used by Americans, Google established a mathematical model with a set of 45 search terms that can accurately predict the flu, and the prediction result had a correlation of 97% to the official data. In addition, for genetic data, since some diseases are hereditary, when we have some information about genes, we can predict and prevent certain diseases.

4.2. For evaluation

Research papers are the main forms used to present research achievements and activities, and the quantity and quality of such papers are important indicators for evaluating the level of the scientific research of and results of research institutes and personnel [20]. Therefore, the evaluation referenced here is mainly performed based on the "literature", aiming to provide services to "scientists", as reflected in the assessment of comprehensive nursing capability, teaching on nursing, scientific journals, nursing talents, etc.

(1) Evaluation of comprehensive nursing capability: Comprehensive nursing capability refers to the ability of nurses to find, analyze, and solve a problem, analyzing. The evaluation of the comprehensive nursing strength of a hospital involves and evaluation of the ability of nurses in the mastery and application of knowledge, which reflects the overall level of scientific research of the nursing personnel and department.

(2) Evaluation of nursing teaching: During "China's 13th Five-Year Plan" period, the Ministry of Education will build a networked, digitalized, personalized, and lifelong educational system. Using big data and starting by setting nursing teaching objectives, this system can make value judgments and research evaluations of the effect and process of teaching based on the goals of nursing teaching, thus exploring an innovative development route that promotes the fusion of information technology and education.

(3) Evaluation of scientific journals: The level of scientific journals must be examined through evaluation. In other words, the evaluation criteria determine the direction and goals of future development of a journal. The application of big data will also provide new technical means and methods of journal evaluation. The research and development of intelligent review assistance systems to assess each of the criteria of the journal, such as impact, innovative ideas, and application value, will greatly enhance the accuracy and comprehensiveness of the evaluation criteria for scientific periodicals.

(4) Evaluation of nursing talents: Nursing is a highly specialized discipline that investigates human health, and nursing talents should be the "scientist-type"; however, nursing is also a highly articulate specialty, and nursing talents should also be the "artist-type". Undoubtedly, whether an evaluation examines Nobel Laureates, Nightingale Awards winners, or academics at the American Academy of Sciences, bibliometric analyses are indispensable.

4.3. For research

In traditional nursing research, investigators test their hypotheses using samples with a small size, which greatly reduces the credibility of the research results, at least to some extent. Against the current background of big data, data acquisition is no longer a problem, so nursing research is no longer limited by the sample size, single data type, insufficient funds, etc., and researchers can spend more time designing research plans or conducting in-depth analysis on the data analysis results, improving research efficiency while saving time, manpower and financial resources. Nursing research is mainly non-experimental, and descriptive research, case-control research and cohort research are the most commonly selected research types; the large-scale, multi-form and multi-source features of big data resources can well satisfy the data needs for such studies. Taking case-control studies as an example, large sample size has become the development trend in which nursing investigators can obtain a large number of cases through data platforms, performing retrospective studies using the retrospective data stored in systems such as EHR to examine the effect of a particular nursing intervention or medicine on the nursing outcome. In addition, big data-oriented cohort studies present a good opportunity for nursing research [21]. The large-scale cohort study has the characteristics of a large sample size; a prospective outlook; a multidisciplinary, multi-pathological, multi-factor, integrative, and sharing approach; etc. The "10V" features of big data can well satisfy the needs of large-scale cohort studies, and the investigators can screen the target population using the database, conducting patient information tracking and follow-up in the medical information platform for prospective research. They can survey the literature through the big data platform of nursing to obtain data with a high degree of matching, which provides a good opportunity for nursing research. Transforming big data resources into research results and promoting them clinically are the most basic applications of big data in nursing research.

4.4. For education

Big data are important to both educators and learners because big data revolutionize the education policy, research and practice of nursing science. Since the datasets of big data are huge and complex, it is impractical to manage them with traditional software tools, whose technology is more than a decade old. If big data are a noun and the analytics is a verb, the issue of how to extract, validate, transform, and use big data has become a new trend. Analytics can provide numerous methods for nursing education, including improving operations and making economic decisions, to help achieve specific learning goals and to predict behaviors and events by revealing the relationships and patterns between big datasets.

The types of data used in nursing education include data on teaching, learning, and evaluation. Students generate data through e-learning archives, EMRs, and social media. In addition, administrators and school staff generate data through academic reports, class attendance sheets, scholarships, research, and so on. Related personnel, including students, teachers, administrators, doctors, and scholars, can make decisions through the collection, analysis, and use of data. They can collect the data on education and assessment from different systems from the curriculum list of the first year to the clinical skills record of the final year [18].

4.5. For clinical practice

Big data can reflect the scale and impact of data-related issues in the medical and nursing fields. The application of big data to clinics is mainly reflected in the health guidance of patients through the collection of clinical data. Big data enable every bit of data uploaded to the network in the nursing process to be automatically recorded. Over a nurse's lifetime career, the number of patients to whom he or she provides care is limited, but the big data database has a wide variety of data related to the patient records, and once a patient is received, information about that patient can be immediately compared with that in the database; then, based on the existing data, nurses can provide real-time health interventions on the patient's condition and provide health guidance on diet, exercise, etc., potentially improving the work efficiency of nurses while achieving the real individualization of health care and promoting the rehabilitation of the patient [22]. However, big data enable the health monitoring of specific groups by collecting data on collective signs. In this way, many traditional methods of information collection will be overturned, all kinds of information will be monitored and collected at any time, and patient care can be expanded to before disease onset and after patient discharge, even to the relatives and friends of the patient, making it possible to achieve individual-centered whole-process health care and resource sharing [23]. Through the use of personal digital assistants (PDAs), sensors, wearable medical devices, etc., nurses can perform real-time, continuous monitoring and evaluation of the health of the patient, detect the health problems or risks of a specific patient, and adopt targeted preventive measures accordingly, causing care services to expand to the later ecological service circle. For example, in Europe, elders are asked to wear a watch capable of monitoring life signs and in the event of health problems, the watch will send an automatic alarm, making it possible to save elderly people's lives.

4.6. For decision making

Big data can be used as datasets for medicine, operational logistics, cases, and decision-making systems. On the one hand, based on data applications under big data, the nursing decision support system can improve clinicians' rational decision-making related to

patient care. It can help nurses and medical staff make correct judgments, obtain correct information at the right time to support the best clinical decision-making, and provide timely and accurate care for patients, which can significantly affect the evidence-based practice of nurses, improve the quality of patient clinical care and patient outcome, lower medical costs, and ensure patient safety. On the other hand, big data can make decisions for care managers. Empirical correlation analysis can be conducted on the entire dataset by utilizing the ability of big data to collect, analyze and extract massive amounts of data, enabling the subversion of the traditional top-down elite decision-making management model and causing nursing managers and practitioners to make decisions that cease to rely on experience and brainstorming but on the analysis of the entire data, gradually transforming from following the rules to following the data.

4.7. For the market

According to incomplete statistics, as of the end of October 2016, 184 enterprises in China's big data industry have obtained financing. The big data industry has become the new favorite of the capital market, and data sources have become the core competitive feature of big data companies. On November 17, 2016, at the 3rd World Internet Conference "Internet Plus Smart Healthcare" Forum hosted by the National Health and Family Planning Commission, the innovative applications of big data, cloud computing, Internet of Things, and information and communication technologies in the field of health care were discussed to promote collaborative innovation in production, education and research. Obviously, based on the sharing and application of massive data, big data centers can be used for the transformation of pharmaceutical research and development of the results of collaboration among production, education and research entities. On November 23, 2016, at the Pharmaceutical Industry and Commerce Strategic Cooperation Forum, it was made clear that with the "Health 2030" proposal, we should "gather the momentum, integrate, and achieve the win-win result", develop a big health market using the ideas of big data and the Internet, implement the concept of big health, and accurately both tap the needs of users and meet their demands. Therefore, big data centers can be used to analyze the behavior characteristics of users and meet the specific demands of users.

According to the industry direction of "big data, small sensors, huge storage, cloud applications", in addition to directly providing users with the data they need, big data centers can provide targeted information by analyzing data according to different enterprises and their needs. Furthermore, they can provide learning platforms, training services, consulting services and so on.

5. Conclusion

In short, when the amount of data accumulated is large enough, the information system will transform from one providing a simple data-exchange and information transfer to one providing a massive data-based integration analysis. Big data enable the information system to change from "a tool for people" to "self-thinking". Standards are the cornerstone, data are the core, and applications are the key. Through the integrative analysis of massive data, big data can reveal the "non-causal relationship"; reasonable analysis and utilization of these big data will change nursing practice, nursing research and nursing education, promoting the advancement of the nursing discipline. The establishment of big data centers to apply the big data of nursing to various aspects such as nursing management, precision care, and patient safety will serve as the connection and center of the government, enterprises, universities, research institutes, capital and entrepreneurial businesses to build

a large-scale innovation platform for nursing in China in the five major fields of the discipline, academics, technology, industry, and manufacturing, forming the "laboratory of nursing science" of the big data industry. Huge "nursing databases" are both inexhaustible assets and an insurmountable barrier for competitors.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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Appendix A. Supplementary data

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