Design of Intelligent Pediatric Nursing Management Platform from the Perspective of Big Data

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Abstract: With the popularization of network technology, the management mode of pediatric nurses has also changed. Because the traditional pediatric nursing work is restricted by the traditional mode, it not only affects the service quality of children's outpatient departments and wards, but also has a negative impact on the psychological and physical health of patients. Therefore, the development of an intelligent pediatric nursing management platform is a prerequisite for the realization of the whole process management of children. Pediatric nursing management is a comprehensive service platform, which is fundamental and public welfare, and is of great significance to achieve high-quality nursing services. Based on relevant experience, this paper designed and implemented an intelligent pediatric nursing management platform, which has certain practical value and can provide decision-making basis for clinical work.

Keywords: big data; intelligent platform; pediatric nursing; management platform; system design

1. Introduction

With the rapid development of social economy, the demand of children's medical care market in China is growing rapidly, which puts forward higher requirements for pediatric nursing. Therefore, it is an important way to improve the quality of nursing work and reduce medical risks by scientifically and systematically building an intelligent pediatric nursing management platform to promote the whole process nursing management of children. This paper has developed an intelligent pediatric nursing management platform based on the relevant experience at home and abroad. Through the information exchange between the nurses and the patients and the intelligent data collection on the platform, the management of diagnosis and treatment information, medication and discharge information of children was realized. The behavior and quality of clinical nursing have been further standardized, the level and ability of pediatric nursing service have been improved, and the whole medical and health service system for children has been continuously optimized.

Nursing management refers to the process of monitoring, evaluating and analyzing the patients' condition, diet, sleep, life, mental state and other information to improve the quality of nursing and optimize nursing resources. Yanan Cao realized the modularization of pediatric nursing information system by applying prototype method and modular design ideas. Pediatric nursing work has been optimized, so that the efficiency of medical workers has been greatly improved, and the problems of medical record loss, error and management have been greatly improved [1]. Pan Li's experimental analysis shows that the application of teaching resource library in multimedia teaching of community nursing can effectively improve students' interest in learning and optimize the teaching effect [2]. Kirk D aims to develop and evaluate the classification of drug-related patient safety events related to HIT, and verify it with a set of events involving pediatric patients [3]. However, the application of big data in pediatric nursing management needs further promotion and research.

2. Research on the design of intelligent pediatric nursing management platform

2.1 Platform overview

Based on children's clinical characteristics and nursing needs, the pediatric nursing management platform mainly includes: data collection, information management, quality control, etc. The data acquisition system adopts the architecture of "hospital nursing unit ward" and three-level structure. The data is stored on the server and can be downloaded by each department in the maintenance center. The platform mainly includes two parts: data acquisition system and analysis management system [4-5].

2.2 Large capacity distributed storage technology

Large capacity distributed storage is a distributed database technology, which can store and access data, and interact with data during the access process. This technology uses data cache and partition storage in distributed database to realize the separation of

resources to ensure the stability of the system. This technology can achieve uninterrupted access to the database in data processing, adapt to massive storage space requirements, and support any number of server programs. Based on this technical feature and distributed database architecture, the application system can store and access large amounts of data and maintain its integrity [6-7]. The life cycle monitoring of children continuously accumulates and analyzes the data of each stage through real-time monitoring of their health status and clinical work. Through the systematic monitoring of children's changes in different nursing stages and health status, situations that are not conducive to children's treatment needs or have potential safety hazards will be timely found. The patient information system forms a nursing service evaluation system by integrating and analyzing various basic data of patients to determine whether there are unreasonable phenomena in medical institutions. With the help of technologies of Internet and Internet of Things, the nurse information system can realize patient identity verification, and provide support for patients in the follow-up work process such as status monitoring and treatment according to the data collected by the system, so as to ensure the legitimate rights and interests of patients [8-9].

2.3 Direct-Attached Storage (DAS) technology

DAS is a complex mathematical model, which requires the cooperation of algorithm experts and databases. The DAS system is used to mine data based on artificial intelligence algorithm technology, and then relevant data is processed [10]. DAS is widely used in the daily work of hospital clinical staff. Through model analysis, some key indicators can be combined with the clinical situation to obtain more comprehensive, detailed and meaningful clinical health information. In this paper, data analysis technology based on computer data processing ability is used to give strong support to the challenges faced by hospital medical staff in their daily work. The DAS technology was applied to the nursing management of child care patients, and the results of DAS analysis made the medical care process more standardized and effective. The DAS system based on data-driven algorithm can be used to analyze the general health indicators, clinical health and other factors of pediatric patients. For example, through DAS technology, body mass index and sleep quality can be observed; the correlation between hospitalization time and heart rate, respiratory rate, blood oxygen saturation and body mass index can be examined. It can also make a comparative assessment of the condition and severity of the disease [11-12]. For another example, through the comparison of DAS results, it can be found that the fatality rate of viral pneumonia was highly correlated with the increase of hospital stay and the severity of the disease. In addition, it can also be judged that nursing is not in place and the workload of nursing staff increases. Therefore, the problems existing in the daily care and medical care of child care can be found and solved through the platform.

3. Experimental design of intelligent pediatric nursing management platform

With the continuous improvement of the information system, the university hospital has built a clinical data center with complete functions and rich contents. Due to the large amount of data, wide distribution, partial disorganization, non-uniform specification, low quality and other problems, the data collection time is long, and the data security cannot be guaranteed. At the same time, there is an independent relationship between disciplines, which leads to the difficulty of data reuse. From the current situation, the current clinical data collection is still conducted in a traditional way, and has not formed an effective use (as is shown in Figure 1).

Spring Cloud provides configuration management for distributed systems. In a distributed environment, it implements remote call and business management of RESTFUL based on the microservice architecture. The platform mainly controls the registration, deployment, operation, audit and other key links of the service, and manages and monitors the monitoring service, log analysis platform ELK, configuration service, etc. of the enterprise platform. The access layer provides compatibility for PC and mobile device access. The Web layer uses VUE technology, and VUE is a set of user interfaces developed step by step. Among them, the special operation platform is the daily operation and maintenance of the platform, providing specialized disease management for specific diseases.

Assuming that the original database has TYM data volume and N data transactions, the time to obtain a candidate item set is: time of connection step+time of pruning step+time of calculating support level. Then, the time complexity of the conventional Apriori algorithm can be obtained:

$$P(TYM) + \sum_{r \geq 2} (P(C_r * C_r) + P(C_r * C_{r+1}) + P(N * C_{r+1})) \tag{1}$$

P_Apriori_BP algorithm assumes that there are m nodes, and then the time complexity of P_Apriori_BP algorithm is:

$$P(TYM) + \sum_{r \geq 2} (P(C_r * C_r) + P(C_r * C_{r+1}) + P(n * C_{r+1})) \Big/ m \tag{2}$$
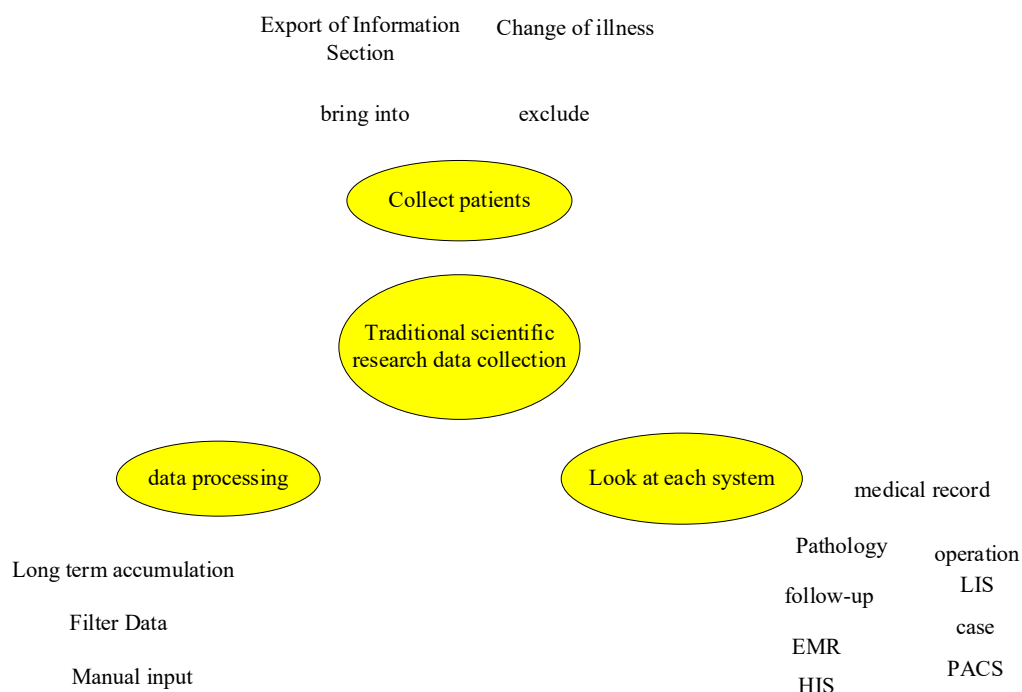
Figure 1. Traditional scientific research data collection

From this formula, it can be seen that the transaction database is partitioned using the idea of segmentation, and the algorithm is improved by combining it with the MapReduce model, so as to achieve the comparison of multiple instances, accelerate the pruning of data sets. At the same time, the design idea of parallel processing is adopted to achieve the parallel operation between multiple nodes, so as to overcome the bottleneck problem of the application program. Therefore, P_ Apriori_ BP algorithm has obvious advantages.

4. Analysis of intelligent pediatric nursing management platform

The platform has the ability to acquire, model, calculate and store clinical data. With the combination of these data and knowledge, the clinical trial was finally supported.

The construction of data specification starts from the data integrity and specification requirements, establishes standardized and complete data, and ensures the accuracy, integrity and consistency of data quality. Structuring of medical records is as follows. Outpatient and resident doctor workstations have been transformed to realize the structure of medical records. Traditional medical records have been organized into hundreds of data units. Scientific research projects have been structured through standardized options. Structuring of reports is as follows. RIS, LIS, endoscopy, ultrasound, pathology system and other systems have been updated to input structured information when submitting reports, and a standardized organization template has been established to ensure the standardization and integrity of the data collection process.

When the data center is faced with a large number of consolidated data, the efficiency of finding and locating research data is low if the traditional associated database search method is used. Therefore, the new data center uses Elastic search, the most popular distributed search technology at present, to solve the problem of slow query speed of key data. Elasticsearch can realize and integrate many different searches, such as structured, unstructured, geographic location, and measurement. It can be used for full-text search, structured search, and real-time analysis. It is currently the most popular enterprise search engine. The research platform is based on Elastic search, which is used to conduct structural modeling of clinical data, including patient's basic information, outpatient medical information, inpatient medical information, test report, etc.

ETL is a data acquisition tool. A large amount of patient data, outpatient diagnosis and treatment information and other data from HIS/EMR/integrated platform are converted, cleaned and stored in MySQL database (Figure 2).
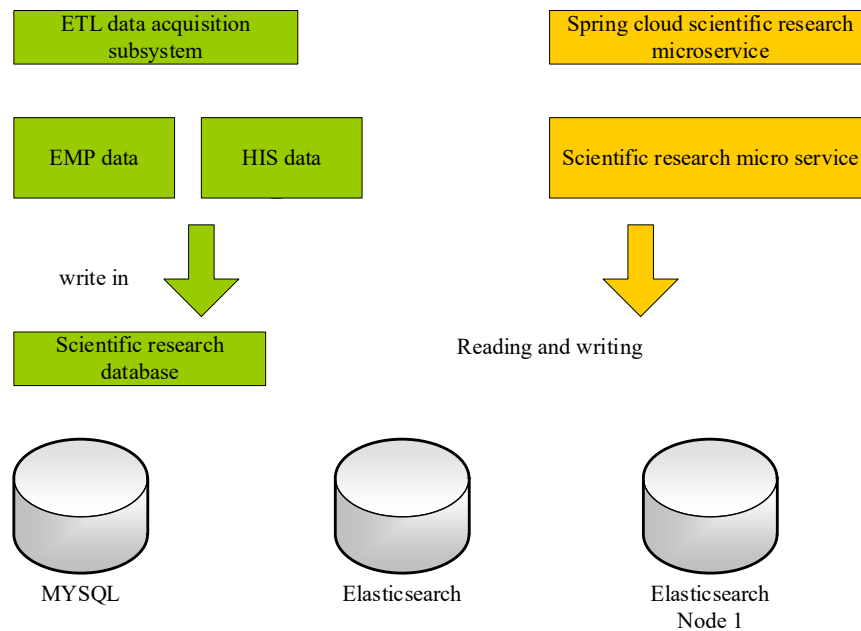
Figure 3. Data acquisition and processing flow

5. Conclusions

In the information age, data has become an important factor determining the development of hospitals. With the continuous updating and development of modern nursing concepts and management models, it has become an inevitable choice for nursing management departments to apply big data to clinical nurse assisted decision-making. Therefore, this paper establishes a clinical data center, applies the distributed search and analysis engine technology of Elastic search, and further improves the data indicators according to the professional knowledge of clinicians, so as to lay a foundation for clinical research project management. At present, the analysis and application of the platform for single disease data need to be further improved, such as: post processing of historical data, intelligent data mining and analysis, efficiency of data collection, and improvement of data collection quality. In the future, the platform will be continuously improved to make the scientific management platform more intelligent.

References

[1] Yanan Cao, Hui Zhu:Research on Digital Information System Construction and Intelligent Management of Clinical Pediatric Nursing in Hospital. J. Medical Imaging Health Informatics 10(4): 898-905 (2020).

[2] Pan Li, Chunyan Li:Construction of Multimedia Teaching Platform for Community Nursing Based on Teaching Resource Library Technology. Int. J. Emerg. Technol. Learn. 12(7): 68-78 (2017).

[3] Kirk D. Wyatt, Tyler J. Benning, Timothy I. Morgenthaler, Grace M. Arteaga:Development of a Taxonomy for Medication-Related Patient Safety Events Related to Health Information Technology in Pediatrics. Appl. Clin. Inform. 11(05): 714-724 (2020).

[4] Konstantinos V. Katsikopoulos, Marc C. Canellas:Decoding Human Behavior with Big Data? Critical, Constructive Input from the Decision Sciences. AI Mag. 43(1): 126-138 (2022).

[5] Marion Maisonobe:The future of urban models in the Big Data and AI era: a bibliometric analysis (2000-2019). AI Soc. 37(1): 177-194 (2022).

[6] Clarisse Dhaenens, Laetitia Jourdan:Metaheuristics for data mining: survey and opportunities for big data. Ann. Oper. Res. 314(1): 117-140 (2022).

[7] Yi-Kuei Lin, Hoang Pham:Preface: reliability modeling with applications based on big data. Ann. Oper. Res. 311(1): 1-2 (2022).

[8] Narayan Prasad Nagendra, Gopalakrishnan Narayanamurthy, Roger Moser:Satellite big data analytics for ethical decision making in farmer's insurance claim settlement: minimization of type-I and type-II errors. Ann. Oper. Res. 315(2): 1061-1082 (2022).

[9] Joe Zhu:DEA under big data: data enabled analytics and network data envelopment analysis. Ann. Oper. Res. 309(2): 761-783 (2022).

[10] Hudhaifa Mohammed Abdulwahab, S. Ajitha, Mufeed Ahmed Naji Saif:Feature selection techniques in the context of big data: taxonomy and analysis. Appl. Intell. 52(12): 13568-13613 (2022).

[11] Abbas Mardani, Edmundas Kazimieras Zavadskas, Hamido Fujita, Mario Köppen:Big data-driven large-scale group decision-making under uncertainty (BiGDM-U). Appl. Intell. 52(12): 13341-13344 (2022).

[12] Hari Mohan Rai, Kalyan Chatterjee:Hybrid CNN-LSTM deep learning model and ensemble technique for automatic detection of myocardial infarction using big ECG data. Appl. Intell. 52(5): 5366-5384 (2022).