

## Retraction

# Retracted: Optimization of Clinical Nursing Management System Based on Data Mining

### Complexity

Received 23 January 2024; Accepted 23 January 2024; Published 24 January 2024

Copyright © 2024 Complexity. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### References

- [1] Y. Chen, "Optimization of Clinical Nursing Management System Based on Data Mining," *Complexity*, vol. 2021, Article ID 2110154, 11 pages, 2021.

## Research Article

# Optimization of Clinical Nursing Management System Based on Data Mining

**Yongxia Chen** 

Nursing Department, The First Affiliated Hospital of Bengbu Medical College, Bengbu, Anhui 233004, China

Correspondence should be addressed to Yongxia Chen; chenyongxia@bbmc.edu.cn

Received 28 April 2021; Accepted 28 May 2021; Published 9 June 2021

Academic Editor: Zhihan Lv

Copyright © 2021 Yongxia Chen. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

The clinical nursing work based on the establishment and improvement of the clinical nursing system breaks through the traditional nursing work model, which has achieved the advantages of full traceability, practical operation, comprehensive analysis, and individual error correction of nursing work, and greatly improves the nursing quality and work efficiency of nurses. With the advent of the era of big data, how to organically combine data mining technology with nursing information to optimize the nursing information system, apply big data to clinical nursing work through nursing information system, and provide patients with more efficient, high-quality, and safe nursing services is a problem that needs urgent consideration in today's era. Therefore, this research is based on the framework of the hospital's existing clinical care system, using data mining technology to improve the Bayesian algorithm and data preprocessing, optimizes the design of functional modules in the clinical nursing management system, and optimizes the patient information management, medical order management, medical order execution management, basic information and expense management, nursing execution process management, system and data management, barcode management, physical sign management, WAP information management, and other subsystems in the clinical nursing information management system. Experiments have proved that the use of a data mining-based clinical care management system can simplify user operations and improve users' application of software. The application system of nursing methods based on data mining technology more completely integrates nursing information management business, makes nursing information management initially "digital," and can improve the quality of hospital care to a large extent.

## 1. Introduction

The nursing information system relies on the continuous improvement and perfection of the hospital information management system, which has become a key link of the hospital information system. It has the advantages of being able to collect, process, and store data in a timely manner, form a modern nursing work and management model, guarantee clinical effective nursing hours, liberate nurses' human resources, and realize nursing work network office, which has played a positive role in promoting clinical nursing management [1]. Different from the traditional sampling, precision, and causality-based correlation analysis, the use of big data to collect and analyse massive data, conduct empirical correlation analysis on all data, and make clinical nursing decision-making and management gradually change from rule-based to effective data can be followed [2]. For a certain

problem, big data can quickly and efficiently analyse and integrate existing data and make judgments and predictions on existing problems [3]. Nursing managers or executors use a whole set of mechanisms of information storage, retrieval, acquisition, and utilization provided by the nursing management information system. Through data mining of massive information and real-time analysis, the overall control of the changes in nursing dynamics of the whole hospital can be made to make decisions [4].

The current information construction in our country lacks a unified standard for electronic medical records and clinical nursing practice records, and a unified nursing information standard system has not yet been formed, which limits the exchange and resource sharing of nursing information between hospitals and between our country and other countries [5]. Most of the domestic nursing information system is developed by the company itself, and the nurses put

forward the needs of the clinical nursing management system to the software developers according to the needs of clinical work, so as to carry out the research and development of the system [6]. This kind of hospital information system development model only adapts to the needs of a certain hospital, without forming a unified information system, which causes unevenness in the development of hospital information software, resulting in a waste of resources and restricting the clinical care management system. At the same time, in the era of big data, there are many medical data, including patient visit data, personal biological data, medical literature data, public health data, and management information data [7]. How to effectively interpret and apply patient big data to implement full-process, real-time, and personalized management of patients, how to integrate data from different levels, categories, and sources, how to extract valuable data to effectively guide nursing quality management, how to improve the difficulty of data collection, collection delay, and irregular transcription, how to organically combine data mining with nursing information to optimize the clinical nursing management system, so that big data can be applied to clinical nursing work through the nursing information system, and how to provide patients with more efficient, high-quality, and safe nursing services are issues that need urgent consideration in today's era. Data mining integrates and analyses massive amounts of data to obtain the "noncausal relationship" relevance, which is fed back to the clinical nursing management system. Nurses extract the feedback results of "big data" from the clinical nursing management system and then apply them to clinical nursing [8]. The clinical nursing management system based on the big data system should fully cover inpatient information management, medical order processing, medical order execution, drug management, clinical blood use, test specimen collection, electronic medical record management, performance management, real-time monitoring of adverse events, nursing quality evaluation, human resources management, medical records and material management, and so on, form an organic and unified whole, and realize the sublimation of data from quantitative change to qualitative change [9].

Therefore, this research is based on the case of a large domestic tertiary hospital, combining with the hospital's reform plan in clinical nursing management, using data mining technology as an auxiliary means, analyses, designs, and optimizes the patient information, doctor's order information, vital signs information and health education, and other business processes involved in the hospital's nursing information management system, and explains the whole process of nursing information management system from demand analysis, system design to final operation, and testing. The research results showed that the use of a clinical nursing system based on data mining technology can simplify user operations and improve users' application of software.

## 2. Optimal Design of Data Mining in Clinical Nursing Management System

Common data mining techniques (such as traditional subjective guidance system techniques, traditional statistical

analysis methods, neural network techniques, decision trees, evolutionary programming, case-based reasoning methods, and nonlinear regression methods) are used. After screening, evaluation, and verification, meaningful knowledge is imported into the knowledge base. A management model is established through reasoning to assist clinical nursing management decision-making [10]. The main algorithms of data mining include artificial neural networks, association rules, cluster analysis, decision trees, support vector machines, Bayesian methods, and integrated learning methods [11]. To apply the data of data mining technology to the clinical nursing management system, it is necessary to combine the existing clinical nursing system of the hospital to optimize the data mining.

**2.1. Bayesian Algorithm Improvement and Data Preprocessing in Data Mining.** Combining the advantages and disadvantages of each algorithm of data mining, this research chooses to analyse the improvement of the Bayesian algorithm [12]. Bayesian method considered that a certain event has some prior probability distribution before it happens. Bayes' theorem: let  $M_1, M_2, M_3, \dots, M_n$  be a division of  $\Omega$ , and for each  $i = 1, 2, 3, \dots, n$ ,  $p(M_i) > 0$ , if  $A$  is an event and  $p(A) > 0$ , then

$$P(M_i|A) = \frac{P(M_i) \times P(M_i|A)}{\sum_{i=1}^n P(M_i) \times P(M_i|A)}. \quad (1)$$

The best Bayesian classifier is to regard the Bayesian classifier as another space  $M'$ ; this space is different from the hypothesis space  $M$  [13]. The Bayesian equation is reused on  $M'$ , so  $M'$  contains a set of hypotheses.  $X_j$  represents the specific form of the corresponding coefficient in  $M$ . To get the best results, it needs to merge all the classification results, and the best way is to achieve the weighting of the posterior probability [14]. The specific method is as follows:

$$P(X_j|D) = \sum_{m \in M} P(X_j|m)P(D|m). \quad (2)$$

For example, its optimal classification is to maximize the value  $P(X_j|D)$  of  $X_j$ . The calculation equation is as follows:

$$\arg \sum_{m \in M} P(X_j|m)P(D|m). \quad (3)$$

In the standard Bayesian classification method, it is usually assumed that the value of the continuous attribute of the sample obeys the Gaussian distribution, and then the training sample set is used to estimate the distribution parameters of the population of each category, that is, the mean and standard deviation of the Gaussian distribution, so that equation can calculate the probability of the class condition 2.

$$P(x_j|\omega_i) = f(x_j, u_{ci}, \partial_{ci}) = \frac{1}{\sqrt{2\pi\partial_{ci}}} e^{-\left(\frac{(x_j - u_{ci})^2}{2\partial_{ci}^2}\right)}, \quad (4)$$

where  $f(x_j, u_{ci}, \partial_{ci})$  is the Gaussian density function of attribute  $x_j$  and  $u_{ci}, \partial_{ci}$  are the average and standard deviation of the attributes of the class  $\omega_i$  samples in the training set [15].

**2.2. Optimal Design of Data Warehouse and Database.** The fundamental purpose of the establishment of a data warehouse is to support data mining and fulfill the needs of the hospital. This study adopts a data warehouse approach to provide data sources for the clinical nursing management system. The ETL method is adopted to provide the data warehouse with sorted and cleaned data. Firstly, load the data from the data source to the data warehouse, where the structure of the data is kept as it is to ensure the efficiency of data collection, then it will be sent to the data warehouse for ETL, and the data will be sorted into the format required by the business model for storage [16]. Figure 1 is the architecture diagram of the data warehouse.

In Figure 1, the user first selects the functions in the system through the management system, and after selecting the required functions, the system automatically obtains the relevant data, then calculates the results, and displays them to the user.

**2.3. Optimal Design of Data Mining Model.** A copy of patient information is already stored in the hospital's clinical nursing system, and the patient information in the system can be borrowed. In addition to basic admission registration information, admission assessment also requires risk assessment for special patients, such as dragging risk assessment and bed falling risk assessment. These risk assessment forms are very similar, but there are many types and different contents. With the development of nursing technology, various assessment forms will increase day by day, and the system needs to consider the expandable functions of the assessment forms [17]. Through the method of data mining, it is necessary to provide a quantifiable classification for the hospital and then establish the classification of the departments with the help of clinicians and nurses' subjective understanding of each department [18]. Aiming at the optimized design of the data mining model in the clinical care management system, this research is implemented through the Entity-Relationship (E-R) diagram information model. The E-R diagram is a database designer describing and constraining the associated data from the user's perspective. E-R modeling is to embody a data model by analysing entities and their relationships. This usually requires a requirement analysis to determine the entity type, the relationship between the entities, and their attribute set codes and finally build the E-R model. Because each entity has many attributes, only the main related attributes are listed in each entity [19]. The E-R model of the data mining model constructed in this research is shown in Figure 2.

### 3. Optimization of Clinical Nursing Management System Based on Data Mining

The application of data based on data mining technology can help nurses and medical staff make correct judgments and provide patients with timely and accurate care, thereby improving the quality of medical services and ensuring patient safety. The system collects a series of data including basic patient information, medical records, diagnosis and

treatment history, nursing level, nursing diagnosis, nursing measures, and nursing essentials, providing correct reference data and decision-making plans for clinical nurses through data mining and summary analysis [20]. Due to the "complex" and "trivial" characteristics of each hospital's nursing business and the reasonable degree of matching of clinical nursing staff, the overall nursing business process is consistent and the clinical details are outstanding, which directly leads to the fact that the clinical care management system cannot be completely migrated from one project result to another directly online. Instead, individualized optimization adjustments need to be made according to the hospital's specific clinical conditions, hospital management procedures, and high-quality nursing requirements, so as to realize the clinical adaptation system and the system personality to meet the best clinical practice [21–23].

**3.1. System Function Requirement Analysis.** With the Ministry of Health's vigorous promotion of the "Quality Nursing Project" and the recognition of "three-point medical care and seven-point care" in the rehabilitation process of inpatients, hospitals are paying more and more attention to nursing work from top to bottom. The model of "led by the nursing department, participated in testing by clinical pilot departments, and conducted pilot application and promotion of various functional modules" is more conducive to the successful implementation of the project. Based on this, the system requirements of the clinical nursing management system based on data mining involve patient information management, medical order management, medical order execution management, basic information and expense management, nursing execution process management, system and data management, bar code management, physical sign management, WAP information management, and other subsystems. For example, the functional requirements of the "barcode management" subsystem can involve the printing of infusion and injection drug bottle labels for long-term and temporary medication orders and barcode management of blood bags. The system supports the function of reprinting sample labels after printing. The system provides one-time label printing of items. The system provides query and traceability management functions for label printing records.

**3.2. Overall Optimization Design of System Architecture.** The optimization of the organizational structure of the clinical care management system based on data mining technology in this study is shown in Figure 3. The system expands the coverage and service time of clinical nursing safety management by constructing a comprehensive risk management subsystem, promoting the sustainable development of the nursing safety management data mining system by incorporating economic evaluation in the research phase [24–26]. It is proposed that while advancing the digitalization of clinical nursing management, it is necessary to equationate a complete prevention and response plan to ensure patient privacy and information security.

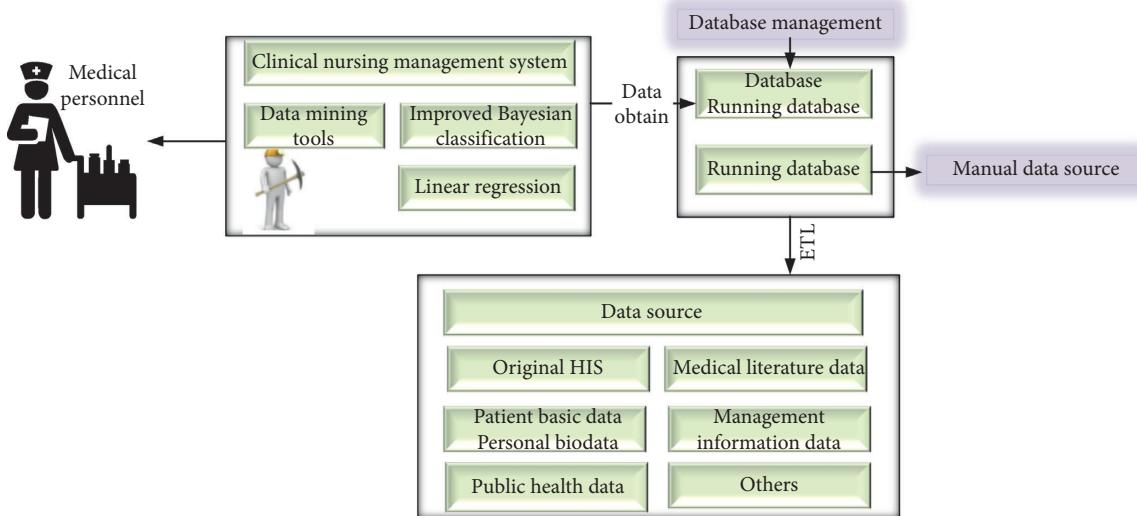


FIGURE 1: The optimization of the architecture diagram of the data warehouse in this study.

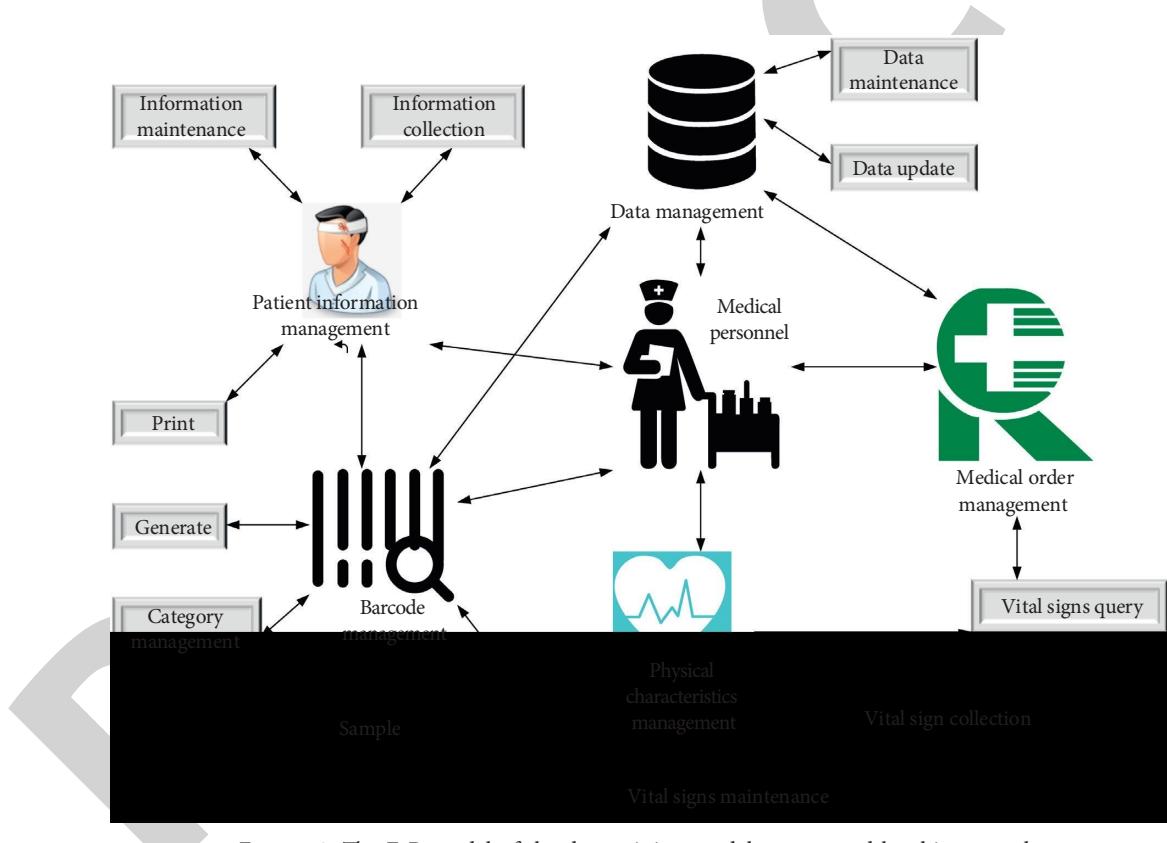


FIGURE 2: The E-R model of the data mining model constructed by this research.

According to the demand analysis, the system designer can divide the main functional modules of the clinical nursing management system based on data mining into nine main modules. They are patient information management, medical order management, medical order execution management, basic information and expense management, nursing execution process management, system and data management, bar code management, physical sign management, and WAP information management. In order to

ensure that the mobile terminal equipment can operate the system, the system expands the WAP information management function, which involves the user logging into the WAP system and the related operations of clinical care through the WAP system. In the system optimization design, the patient's physical signs are separated from the patient's information management and managed separately. At the same time, the management of medical order execution is separated from the management of medical orders. The

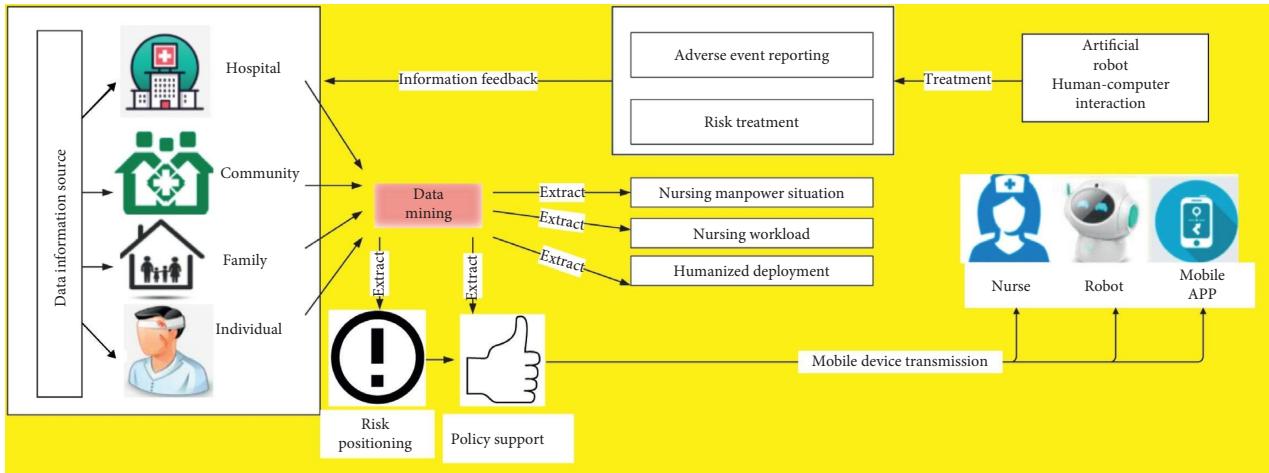


FIGURE 3: Optimization of the organizational structure of the clinical nursing management system based on data mining technology.

reason is that the main work of nurses is arranged through medical orders, and most of the work of nurses is the execution of medical orders, including infusion check, drug placement, drug dispensing, skin test, oral medication, treatment, physical sign collection, and nursing records; all need to be included in the three checks and seven pairs performed by the nurse. Figure 4 shows the modular structure of the optimized clinical care management system in this study.

Taking “bar code management” as an example, this optimization system manages all labels with QR codes in a unified manner. The label number, label type, related information, printer, printing time, label execution time, and so on are recorded in the printing record table (Table 1). For different types of labels, the content of the associated information is different: for the wristband, the label content contains the medical record number and the number of hospital admissions; for bottle labels, the medical order number must also be included; for the bedside card, it also contains information such as medical record number and bed number. Each record in the print record table is updated twice, namely, when it is created and when it is executed.

**3.3. Example Analysis in Detailed System Design.** Taking the optimized design of “nursing execution process management” as an example, the optimized design of the clinical nursing management system under this data mining technology is explained in detail. In the nursing management system of the hospital in the past, the nurses passed the inspection of the doctor’s order, but they still need to print the doctor’s order to perform the drug placement check and the dispensing check in the treatment room. At the same time, the nurse also needs to manually copy the contents of the medical order onto the bottle label and sign the user name and execution time on the bottle label. This method cannot effectively supervise the work of nurses, such that the execution time of the signature cannot be checked, the bottle label cannot be kept for a long time and cannot be traced, the workload cannot be counted, and the electronic identification cannot be performed. In this study, the clinical

nursing management system based on data mining technology used handheld devices to complete three checks and seven pairs in the process of drug placement check, dispensing check, doctor order execution, and execution check. This eliminates the need for nurses to copy doctor orders, the basis for checking is not clear, automatically verify the relationship with the patient during execution, and check the status of doctor orders in real time (especially in pediatrics, where doctor order status changes frequently); it is convenient for electronic check, electronic patrol, postevent statistics, execution supervision, and so on. The schematic diagram of nursing execution process management is shown in Figure 5.

#### 4. Implementation and Testing of Main Functional Modules of Clinical Nursing Management System Based on Data Mining

**4.1. System and Tools for System Development.** The environment required for system development hardware is as follows. The CPU is a Pentium D or higher processor. The computer memory is above 1 G (current desktop configuration can meet it). The monitor is a VGA compatible display system (1024\*768). Hard disk capacity is above 20 G and 7200 rpm hard disk, and optical drive requires DVD with burning function. The environment of the system development software is as follows. The operating system is MS Windows XP or Windows 10. The database management system needs to be able to adapt to Microsoft SQLSERVER and Oracle. The development system selected is Microsoft Visual Studio 2019.

**4.2. Implementation of System User Login.** In this paper, we use a data set from our own owned data set. We split the data into a training data set test data set by finding a ratio of 8 : 2. After randomly assigning the data into training set and test set, we first use the model to learn and simulate the data in the training set, and after the training model is completed, we compare the data results of the test set of the model to

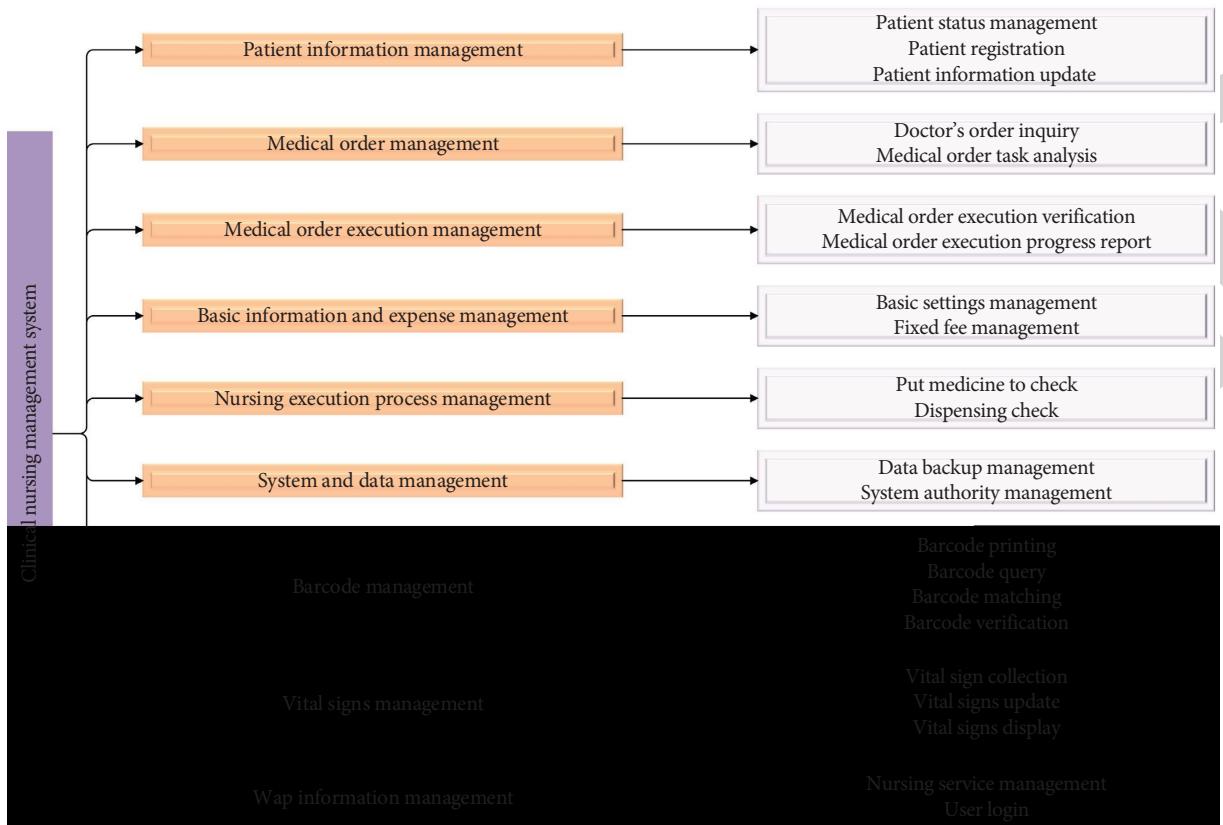


FIGURE 4: Optimized clinical care management system module structure.

TABLE 1: Field description of the label printing record table.

Name	Description	Types
Label_Code	Label number	VARCHAR2
Label_Type	Label type	VARCHAR2
Print_ID	Print person ID	VARCHAR2
Print_Time	Print event	DATE
Carried_out_Time	Execution time	DATE
Related_Message	Related information	VARCHAR2

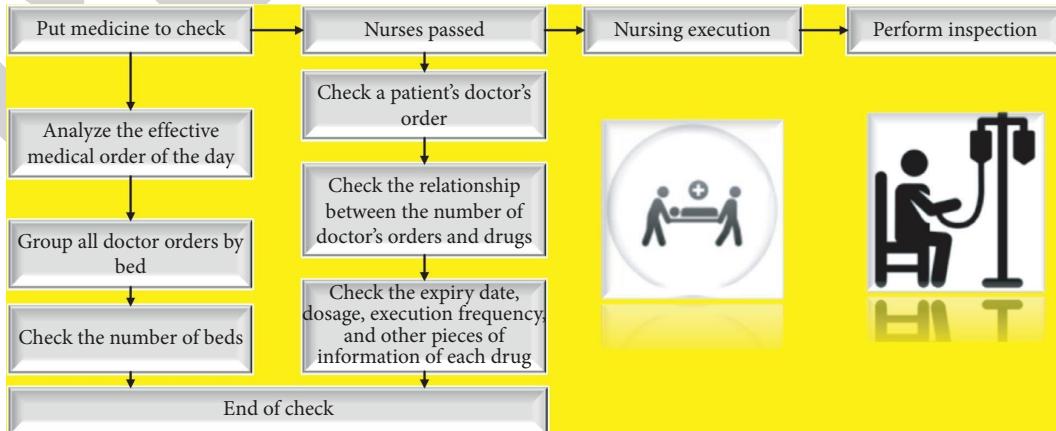


FIGURE 5: The process of nursing execution process management.

obtain its accuracy. The user can enter the login interface every time he clicks on the “Clinical Nursing Management System” running program on any mobile terminal. Enter the “user name” and “password” recorded in the system in advance to log in to the application interface and select the corresponding subsystem interface. If the account number and password are correct (the user account is not case sensitive; the password is case sensitive), the user can enter the nursing management system; otherwise, the system will prompt the user to input an error. And regardless of the user name or password which does not match, the system will prompt “user name or password error,” and the user will not be able to enter the system. The specific login interface is shown in Figure 6.

Among them, the key codes for system login are as follows:

```
public static user database Operation
{
    #region User login method
    //Operation method for encrypting the password
    when the user logs in
    public string string strTextPassword
    {
        //Store the string to be encrypted in the byte
        array
        byte[] bytIn = Get Bytes (str TextPassword);
        //Establish the key and offset of the encrypted
        object for system login
        //Allows the login user to enter the English text
        when entering the password
    };
    //Define the offset
    //Define the key
    //Create an instance of DES encryption class and
    assign values to related attributes
    DESCryptoProvider mobjService = new DES
    Crypto Service Provider ();
    m objCryptoService.mode = CipherMode.CBC;
    ICryptoTransform
    encrypto = mobj.CreateEncryptor();
    return System. Convert.ToBase64String (ms. To
    Array ());
}
```

**4.3. Realization of Basic Patient Management Function.** Select the nursing form in the system interface, reach the patient list, select the patient information, and click “Enter” to enter the “Basic Patient Management” function selection interface. Before starting patient handover, first click on the patient’s wristband scanning application box, and use the camera to scan the terminal. If it cannot be recognized, enter the digital code of the patient’s wristband barcode. After the patient’s wristband barcode is correct, the follow-up process can be entered. The details are shown in Figure 7.

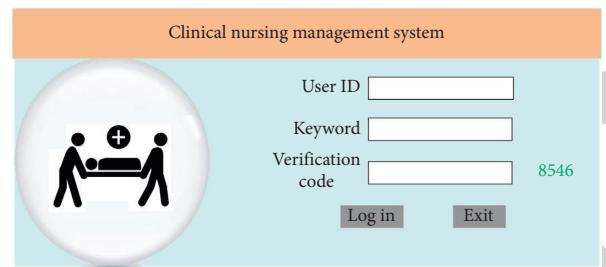


FIGURE 6: System login interface diagram.

**4.4. Realization of Medical Order Execution Management.** The infusion doctor’s order is the largest amount of medicines, and its process is more complicated than other doctor’s orders. The complete infusion doctor’s order process includes placing the medicine, dispensing the infusion bottle, and receiving the bottle. After the infusion bottle label is barcoded and the patient wears a barcode wristband, the infusion process can be electronically checked three times and eight pairs [27, 28]. During the drug placement and dispensing process, the nursing staff needs to scan the bottle label through the terminal to confirm the operation. To facilitate the nurse’s execution of medical orders, different default processing interfaces are provided for each type of label (wristband or bedside card, bottle label, oral medicine, and specimen collection label). When the scanned barcode can be recognized by the current interface, the current interface processes the relevant barcode content by itself. Otherwise, it sends the barcode information to the main window of the PDA interface. The main window specifies the default barcode processing interface for each recognizable barcode. By searching the registration interface, the corresponding processing interface can be loaded, and the barcode information can be transferred to the relevant processing interface. The system processing procedure is shown in Figure 8.

**4.5. System Testing and Analysis.** The purpose of system software testing is to find potential defects in the program as much as possible. This kind of defect not only is manifested in the functional errors of the software but also may be the software’s low performance, poor fault tolerance, and poor ease of use. The goal of software testing is to use the most appropriate method to find as many errors as possible and correct them at different stages at the least cost. Software testing usually needs to be completed in stages. During the redevelopment phase, the programmer’s own team performs the testing to perform white box testing on each module in the system. Various methods such as statement coverage, judgment coverage, combination coverage, and path coverage are used to detect whether there is a problem with the code in the program, whether the logic is faulty, and whether the value in the judgment condition meets the requirements. This part of the content takes the “Doctor’s Order Information Management” module as an example to describe the system test, as shown in Table 2.

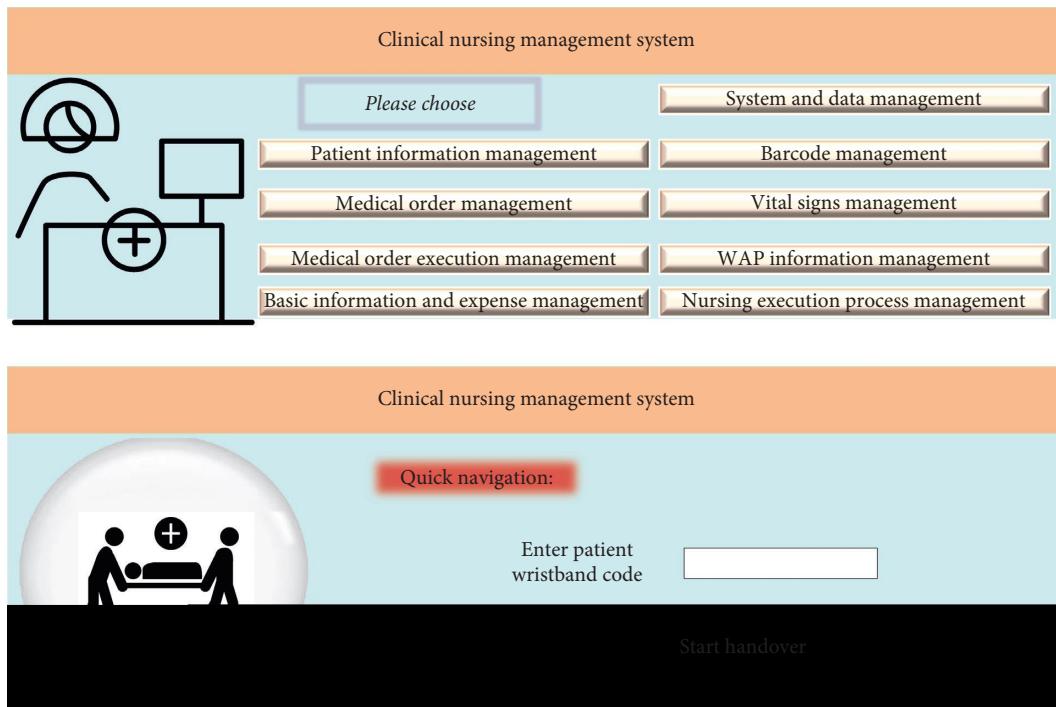


FIGURE 7: Implementation interface of basic patient management functions.

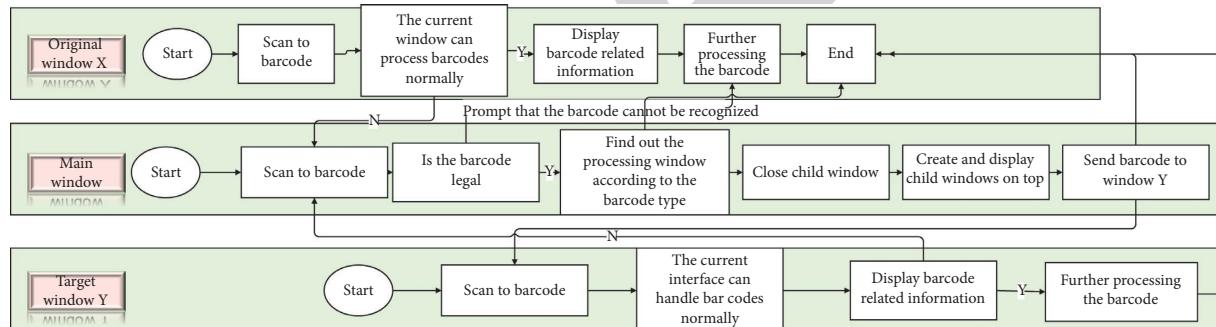


FIGURE 8: Implementation process of medical order execution management execution.

TABLE 2: Medical order information management test table and test results.

Subjects	Number	Operation during testing	Expected results		Actual operation result	Test results
			Test	Test		
	1	Click the button to get the basic information of the patient to display the doctor's order	Enter patient information and corresponding medical order management page		Successfully enter the patient information and medical order search page	Pass
	2	Enter the medical order information corresponding to the patient and write the code to succeed	Enter the medical order information corresponding to the patient to search and write code		Enter the medical order information corresponding to the patient and write the code	Pass
	3	Click save and generate patient order execution form button to successfully save and generate	Successfully save and generate a list of the patient's medical order execution sheet		List of patient order execution services	Pass
	4	Modify the patient's medical order information code and save it	Successfully save the patient's doctor's order information and display the basic information list of the selected patient's doctor's order		Successfully save the patient's doctor's order information and display the doctor's order service list	Pass

## 5. Prediction of the Probability of Adverse Events in the Nursing Process of ICU Patients in the Nursing System

The main research of this part is to verify the application of the optimized Bayesian decision-making method in the data mining technology in the clinical ICU data set. This study uses an improved standard Bayesian algorithm to predict the occurrence of adverse events in ICU patients during the nursing process, thereby assessing their mortality risk and assisting medical staff in making medical decisions. Combined with the previous content, when using an improved standard Bayesian method to predict the probability of adverse events in ICU patients, each ICU patient is represented by an  $n$ -dimensional attribute vector  $M_j = \{M_1, M_2, M_3, \dots, M_n\}$ , ( $j = 1, 2, 3, \dots, N$ ). The dimension  $n$  of the vector  $M_j$  (that is, the number of attribute

components) is determined by the number of characteristic variables that are closely related to the probability of the patient's adverse events obtained through the final screening. Each attribute component corresponds to a selected characteristic variable (also known as attribute variable). We set the results of good events and adverse events in ICU patients to correspond to two categories (or groups)  $C_1$  and  $C_2$ , respectively. Therefore, for each patient  $M_j$ , the standard Bayesian classifier predicts the probability of adverse events in the patient (i.e., the probability that  $M_j$  belongs to category  $C_2$ ), assesses the patient's risk of death, and determines whether the patient can be transferred out of the ICU smoothly in the future. Based on the improved standard Bayesian method of attribute weighting, according to equations (1) and (4), the prediction equation for the probability of occurrence of adverse events of patient  $M_j$  is

$$(C_2|M_j) = \frac{P(C_2|M_j) \times P(C_2)}{P(C_1|M_j) \times P(C_1) + P(C_2|M_j) \times P(C_2)} = P(C_2) \frac{\prod_{f=1}^n P(C_2|M_f)^{W_f}}{P(C_1) \prod_{f=1}^n P(C_1|M_f)^{W_f} + P(C_2) \prod_{f=1}^n P(C_2|M_f)^{W_f}}. \quad (5)$$

In the above equation,  $P(C_1)$  and  $P(C_2)$  can be easily obtained directly from the training set, and  $W_f = ((1/\text{Wald}_f) \times n) / \sum_{f=1}^n \text{Wald}_f$  can be calculated from the results of Logistic regression analysis. Therefore, the current problem is how to obtain  $\prod_{f=1}^n P(C_1|M_f)^{W_f}$  and  $\prod_{f=1}^n P(C_2|M_f)^{W_f}$ .  $P(C_i|M_f)$  can be obtained from the training set  $M_f$  by fitting the probability density function of feature attribute component  $C_i$  in each group (i.e., the class conditional probability density of  $M_f$ ). The estimation method of the class conditional probability density varies according to the value type of the attribute variable  $W_f$ :

(1) When the value of  $M_f$  is discrete, then

$$P(C_i|M_f) = \frac{N_{if}}{N_i}, \quad (6)$$

where  $N_{if}$  represents the number of samples in group  $C_i$  that contains the attribute component of the  $M_f$  value and  $N_i$  represents the total number of samples in group  $C_i$ .

(2) When the value of  $M_f$  is continuous, according to the improved Bayesian method described above, the kernel density estimation method is used to fit the conditional probability density function of  $M_f$ . According to equation (4), the calculation of  $P(C_i|M_f)$  is as follows:

$$P(C_i|M_f) = \frac{1}{nh} \lim_{n \rightarrow \infty} \sum_{t=1}^n \frac{K(M_f - M_t)}{h(M_f + M_t)}. \quad (7)$$

In the equation,  $K(x)$  is called the kernel function, and  $h$  is called the window width of the kernel

function. The larger  $h$ , the smoother the estimated probability density function, but the deviation may be larger.

Since we are using machine learning data mining techniques, the optimality of the system should be the best system available. We compared the existing system with the designed system and found that our designed system is more efficient and its accuracy is higher, with an overall performance improvement of nearly 10.5%.

In this study, the standard Bayesian method before and after the improvement and the Logistic regression method were used to establish a model to predict the probability of adverse events during ICU patients in the hospital. The resolution performance of the three on the validation data set is shown in Figure 9. The area under the ROC curve of the Logistic regression model is  $AUC = 0.754 \pm 0.018$ , the standard Bayesian model is  $AUC = 0.812 \pm 0.004$ , and the improved standard Bayesian model is  $AUC = 0.858 \pm 0.007$ ; the difference is statistically significant ( $p < 0.001$ ). This shows that the improved standard Bayesian model can better distinguish patients with adverse events. The above results show the superiority of the improved Bayesian inference method obtained under the data mining technology. Compared with the Logistic regression model, the improved standard Bayesian model has a significant improvement in resolution. This shows that the improved Bayesian model has stronger predictive ability in distinguishing whether ICU patients will have adverse events during the nursing process. Nursing staff can use this probability prediction to carry out targeted nursing work for ICU patients with a high probability of predicting adverse events, which has feasibility and application value.

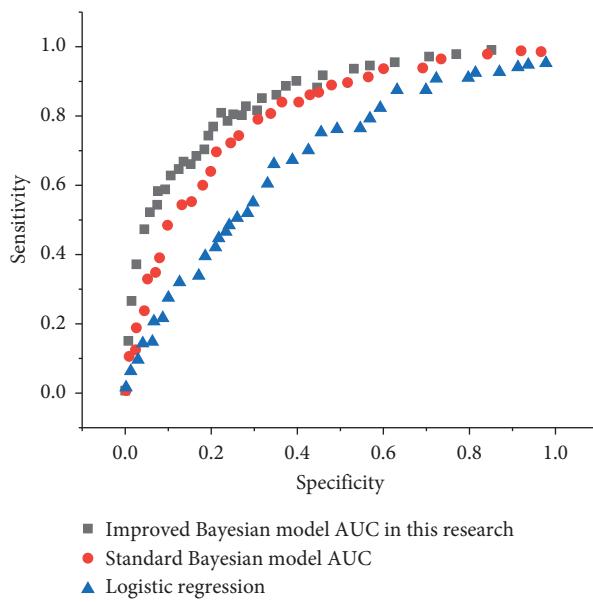


FIGURE 9: The resolution performance results of the standard Bayesian method, logistic regression method, and improved Bayesian method on the validation data set.

## 6. Conclusion

At present, nursing information technology has penetrated into various aspects of nursing clinical, management, education, and research. The integration of nursing management and informatization is also in line with the “three closes” requirements of high-quality nursing services. It optimizes the nursing workflow and improves the efficiency of nursing work and the quality of nursing service. In the “efficient, convenient, economical, and safe” nursing environment, the patient’s medical experience has been improved, and patient satisfaction has been improved. Therefore, the gorgeous appearance of data mining technology has brought medical information technology into a critical opportunity for rapid development. This brings new development areas to nursing disciplines and also poses new challenges to nursing quality management. Nursing management will move towards dataization, informationization, and refinement. In this study, Bayesian algorithm improvement and data preprocessing with the help of data mining technology were used to optimize the design of functional modules in the clinical nursing management system and optimize the patient information management, medical order management, medical order execution management, basic information and expense management, nursing execution process management, system and data management, barcode management, physical sign management, WAP information management, and other modules in the clinical nursing information management system. Combining the development of Internet hospitals, cloud hospitals, and smart hospitals, patient-centered medical and health management services covering the entire life cycle have become a new development trend. The construction of the hospital’s big data system is important for improving medical services, advancing precision medicine, assisting

clinical diagnosis and decision-making, promoting hospitals’ fine management, chronic disease management, drug development and side-effect monitoring, infectious disease prediction, and scientific research management which are becoming more and more significant.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that they have no known conflicts of interest or personal relationships that could have appeared to influence the work reported in this paper.

## References

- [1] S. Mills, “Electronic health records and use of clinical decision support,” *Critical Care Nursing Clinics of North America*, vol. 31, no. 2, pp. 125–131, 2019.
- [2] S. M. Evans, J. Berry, B. J. Smith et al., “Attitudes and barriers to incident reporting: a collaborative hospital study,” *Quality and Safety in Health Care*, vol. 15, no. 1, pp. 39–43, 2006.
- [3] Z. Zhang, “Big data and clinical research: perspective from a clinician,” *Journal of Thoracic Disease*, vol. 6, no. 12, pp. 1659–1664, 2014.
- [4] Z. Wu, P. Cong, L. Yang, and W. Jian, “Investigation and analysis of the current situation of hospital nursing information system from the perspective of nurses,” *Chinese Journal of Modern Nursing*, vol. 25, no. 1, pp. 11–15, 2014.
- [5] H. A. J. M. De Wit, C. Mestres Gonzalvo, J. Cardenas et al., “Evaluation of clinical rules in a standalone pharmacy based clinical decision support system for hospitalized and nursing home patients,” *International Journal of Medical Informatics*, vol. 84, no. 6, pp. 396–405, 2015.
- [6] H. Noguchi, M. Miyahara, S. I. Kang et al., “Bayesian statistic model for nurse call data considering time-series, individual patient variabilities and massive zero-count call data,” in *Proceedings of the 2020 42nd Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, pp. 5598–5601, IEEE, Montréal, Canada, July 2020.
- [7] P. F. Brennan and S. Bakken, “Nursing needs big data and big data needs nursing,” *Journal of Nursing Scholarship*, vol. 47, no. 5, pp. 477–484, 2015.
- [8] H. Kim, I. Kim, and Y. Chae, “Design of a nursing clinical decision support system applying nursing diagnosis and nursing evaluation model based data mining,” *Studies in Health Technology and Informatics*, vol. 122, pp. 784–785, 2006.
- [9] J. Yang, Y. Zhao, J. Liu et al., “No reference quality assessment for screen content images using stacked autoencoders in pictorial and textual regions,” *IEEE Transactions on Cybernetics*, 2020.
- [10] G. M. Keenan, K. D. LopezV. E. C. Sousa et al., A shovel-ready solution to fill the nursing data gap in the interdisciplinary clinical picture,” *International Journal of Nursing Knowledge*, vol. 29, no. 1, pp. 49–58, 2018.
- [11] C. Hou, J. Zhang, and J. Wang, “Medical wireless IoT system and nursing intervention of chronic bronchitis based on clinical data,” *Microprocessors and Microsystems*, vol. 82, no. 18, p. 878, 2021.

- [12] K. Häyrinen, J. Lammintakanen, J. Lammintakanen, and K. Saranto, "Evaluation of electronic nursing documentation-Nursing process model and standardized terminologies as keys to visible and transparent nursing," *International Journal of Medical Informatics*, vol. 79, no. 8, pp. 554–564, 2010.
- [13] B. S. Rosenstein, J. CapalaJ. A. Efstatheou et al., How will big data improve clinical and basic research in radiation therapy?" *International Journal of Radiation Oncology\*Biology\*Physics*, vol. 95, no. 3, pp. 895–904, 2016.
- [14] J. Jones, K. Schilling, and D. Pesut, "Barriers and benefits associated with nurses information seeking related to patient education needs on clinical nursing units," *The Open Nursing Journal*, vol. 5, no. 1, pp. 24–30, 2011.
- [15] Y. Guo, J. Chen, J. Song, X. Xue, L. Wang, and X. Li, "Clinical observation on the construction of hospital quality nursing service," *International Journal of Nursing*, vol. 37, no. 14, pp. 1977–1981, 2018.
- [16] C. Bravetti, A. Cocchieri, F. D'Agostino, R. Alvaro, and M. Zega, "The assessment of the complexity of care through the clinical nursing information system in clinical practice: a study protocol," *Annali Di Igiene : Medicina Preventiva e Di Comunità*, vol. 29, no. 4, pp. 273–280, 2017.
- [17] J. H. Larrabee, S. Boldrighini, K. Elder-Sorrells et al., "Evaluation of documentation before and after implementation of a nursing information system in an acute care hospital," *Computers in Nursing*, vol. 19, no. 2, pp. 56–58, 2001.
- [18] W. Ruan, "The discussion of major points of nursing work and its implementation strategy in health management department," *Chinese Journal of Medical Education Research*, vol. 16, no. 4, pp. 429–432, 2017.
- [19] J. B. Seaman, A. C. Evans, A. M. Sciulli, A. E. Barnato, S. M. Sereika, and M. B. Happ, "Abstracting ICU nursing care quality data from the electronic health record," *Western Journal of Nursing Research*, vol. 39, no. 9, pp. 1271–1288, 2017.
- [20] J.-I. Hwang, J. J. Cimino, and S. Bakken, "Integrating nursing diagnostic concepts into the medical entities dictionary using the ISO Reference Terminology Model for Nursing Diagnosis," *Journal of the American Medical Informatics Association*, vol. 10, no. 4, pp. 382–388, 2003.
- [21] Z. T. Korach, J. YangS. C. Rossetti et al., Mining clinical phrases from nursing notes to discover risk factors of patient deterioration," *International Journal of Medical Informatics*, vol. 135, Article ID 104053, 2020.
- [22] Q. Xiao, J. Wang, Y. Wang, and Y. Wu, Data mining in nursing: a bibliometric analysis (1990-2017)," *Studies in Health Technology and Informatics*, vol. 264, pp. 1616-1617, 2019.
- [23] H. M. Krumholz, "Big data and new knowledge in medicine: the thinking, training, and tools needed for a learning health system," *Health Affairs*, vol. 33, no. 7, pp. 1163–1170, 2014.
- [24] L. Chen and X. Xu, "Effect evaluation of the long-term care insurance (LTCI) system on the health care of the elderly: a review," *Journal of Multidisciplinary Healthcare*, vol. 13, pp. 863–875, 2020.
- [25] C. Zhao and J. Li, "Equilibrium selection under the Bayes-based strategy updating rules," *Symmetry*, vol. 12, no. 5, p. 739, 2020.
- [26] W. Sun, J. Wang, N. Zhang, and S. Yang, "Scalable implementation of hippocampal network on digital neuromorphic system towards brain-inspired intelligence," *Applied Sciences*, vol. 10, no. 8, p. 2857, 2020.
- [27] F. Orujov, R. Maskeliūnas, R. Damaševičius, and W. Wei, "Fuzzy based image edge detection algorithm for blood vessel detection in retinal images," *Applied Soft Computing*, vol. 94, Article ID 106452, 2020.
- [28] J. Chen, W. Wang, Y. Zhou, S. H. Ahmed, and W. Wei, "Exploiting 5G and blockchain for medical applications of drones," *IEEE Network*, vol. 35, no. 1, pp. 30–36, 2021.