Management and Countermeasure Evaluation of Smart Community Health Information Sharing Platform Based on Medical Big Data

Zenan Gu[1,a,*], Wanyan Shi[2,b], Xiangchen Wu[1,c], Jingyun Qiu[1,d]

[1]Applied Engineering College, Zhejiang Business College, Hangzhou, Zhejiang, China
[2]Internal Medicine Department, Taishun TCM Hospital, Wenzhou, Zhejiang, China
[a]zenangu1023@163.com, [b]605952002@qq.com, [c]11543464@qq.com, [d]qjy870125@163.com
[*]Corresponding author

Abstract: With the accelerating pace of human work and life, as well as the trend of aging population, the construction of smart communities has received more and more attention. Internet technology has promoted the health care service model. Community health information sharing platform has become an indispensable part of smart communities. At present, the health management industry has developed rapidly, but there are many problems. Therefore, it is necessary to establish a smart community health information sharing platform with creativity, strong cooperation ability, solid theoretical construction and multi-level in-depth decision-making analysis. This study first examined the conceptual significance and current status of intelligent community health information sharing platforms, explored the role of blockchain in the health and medical big data platform, and then proposed management strategies in the context of medical big data. The application of an advanced computing intelligence system based on secure medical images and the improvement of the open data supply of the community health information sharing platform were the two angles from which the management policy of a smart community health information sharing platform based on big data was proposed. Relevant algorithms for the management of smart community health information sharing platform under medical big data were mentioned. Finally, community A was selected to implement the methods provided in this paper and compared with community B that did not implement the management methods in this paper. It was concluded that the management of community A was 7.52% higher than that of community B. The easy, intelligent, and secure community health service system could be constructed to better protect the health services of community members through the management and countermeasure analysis of the smart community health information sharing platform based on medical big data.

1. Introduction

At present, the health problem of residents is getting worse and worse, which has attracted

extensive attention from all walks of life. Practice has proved that the implementation of intelligent community health information sharing platform management is the key to improve residents' health quality and comprehensively control health costs, and community health management is an important way to achieve this key link. However, in the health management of the general population and patients with chronic diseases, there is still a lack of scientific support platform and an effective service model. This study suggested a management strategy and a threat analysis for the smart community health information platform based on large medical data.

The intelligent community health information sharing platform can realize the integration and all-round service of multiple lifestyle guidance. At present, the research on the health information sharing platform of smart communities has made some achievements: Liu L's research showed that the smart community health information sharing platform could achieve multi-level management under the effect of information networks [1]. Sharma Megha proposed a scheduling algorithm for intelligent community health information sharing based on particle swarm equilibrium clustering, which realized the access control of community health information data [2]. Zhang Xing applied the fuzzy C-means clustering technology to the clustering of health sharing data in smart communities, and optimized its zoning and scheduling [3]. He Minghua proposed an implementation scheme of Java based intelligent community health information sharing system [4]. In order to increase its level of intelligent management and implement adaptive management, Zhao Jin developed a smart platform for the sharing of health information among communities that was based on big data analysis and information fusion [5]. As far as the current research is concerned, there are few relevant researches on the intelligent community health information sharing platform, and there is no systematic and complete management system for the platform.

The utilization of medical big data can improve the management efficiency of the intelligent community health information sharing platform. At present, research on the application of medical big data to the intelligent community health information platform has made achievements: Estacio Emee Vida proposed a new method of medical big data mining using association rule mapping technology. This method constructed the correlation mapping relationship between medical data by introducing mining coefficients and correlation errors, and determined its attribution subspace according to the correlation between data, so as to divide it into attribute subspaces and realize the mining of medical big data [6]. Wang Ying proposed a medical big data mining algorithm based on Independent Component Correlation Algorithm (ICA) through research, which could improve the management efficiency of the intelligent community health information sharing platform [7]. Lee Brian proposed a medical data mining algorithm based on association subspace and Ma-pReduce. However, this algorithm could not analyze the type of data, which affected the efficiency of data mining [8]. Xu Boyi proposed to use health data collection, statistics and summarization to optimize the design of community health management, adaptive planning, and access algorithms and establish a community health information sharing database [9]. Gamache Roland proposed a new idea of community intelligent health management platform based on the Internet of Things, but it was not effectively verified [10]. In general, a platform for exchanging smart community health information based on large medical data would help an increasing number of individuals.

To sum up, the construction and management of the smart community health information sharing platform is still in its infancy. The system is not complete, so it is urgent to rectify and manage the community's health information sharing platform. Based on the analysis of the concept, significance, and current situation of the smart community health information sharing platform, this article studies the role of blockchain in the health care big data platform from three aspects: participants, system functions, and data attributes, proposes management methods for the smart community health information sharing platform, and proposes management countermeasures and policies for the smart community health information sharing platform based on big data. A

convenient, intelligent, and secure community health service system could be built through the management and countermeasure analysis of the smart community health information sharing platform based on medical big data, which could improve the protection of the health services of community residents and would have some effect on their health in the future.

2. Conceptual Significance and Status Evaluation of Smart Community Health Information Sharing Platform

(1) Concept of smart community health information sharing platform

"Smart community" is a new concept of community governance and a new way of social governance [11]. The smart community health information sharing platform is a novel management technique built on medical big data and using the Internet of Things and new generation of information technology. It can provide a variety of modern and intelligent health care environment for community residents, thus forming a new management form of community based on information and intelligent community health information management and service [12]. The smart community health information sharing platform has made full use of the advantages of the Internet of Things and established a variety of functional modules to protect users' health information and privacy in a timely manner [13].

(2) The significance of building a smart community health information sharing platform

Health information management for residents is one of the important contents of the management of smart community health information sharing platform, and how to effectively obtain health information is also the most concerned thing of the public at present [14]. The establishment of a smart community health information sharing platform is conducive to improving the quality of medical and health services. First of all, through the community health information sharing platform, doctors can consult medical records, examination reports, electronic health records and other materials at any time to understand the patient's medical history and treatment history. This can provide patients with more accurate and efficient health tips, so as to reduce unnecessary examinations and the patients' medical expenses [15]. Secondly, the establishment of a unified community health information sharing platform can effectively reduce the operating costs of community medical institutions and ensure that community residents can enjoy high-quality health information services nearby through remote consultation, remote education and other means. Finally, this platform enables the health administrative department to fully utilize big data to support the government's scientific decision-making while improving the monitoring of community residents' health. The maintenance of residents' real-time safety and health monitoring and community health information sharing platform are important means to build a harmonious community and promote harmonious community management, so as to improve community functions and enhance community health information services [16]. The establishment and maintaining of a smart community health information sharing platform are crucial for raising residents' levels of health and defending their fundamental rights to health.

(3) Analysis of the health information sharing platform's current state in smart communities

The intelligent community health information sharing platform has a significant impact and significance on people's lives, but the current construction system of the platform is too simple.

3. The Role of Blockchain in the Healthcare Big Data Platform

(1) Participants

The big data medical platform is a big data platform built and managed by different types of organizations, capable of producing, analyzing, and using health data. Technical features such as collaborative management, smart contracts, and traceability of blockchain technology provide

important technical support for creating and operating a green medical big data platform.

(2) System Functions

The main goal of the health big data medical platform is to create a big data platform for collecting, analyzing, trading, applying, and managing medical data. Therefore, the system functions of the big data medical platform include core functions such as measurement and authentication services, service trade, and credit authentication. Blockchain technology provides important technical support for achieving the above system functions.

(3) Data Properties

The medical big data platform includes medical services, business registration, service trade, and traceability. After processing and analyzing basic data, it is necessary to store the data of the entire big data platform, including basic data such as information and knowledge, with a large capacity to store basic data. However, information and knowledge are often unstructured, and with the development of data processing technology, expressions and interpretations are constantly changing. The distributed data storage method in blockchain systems belongs to storage blocks, forming node groups, and storing, tracking, and verifying similar attributes of data through consensus mechanisms, thereby improving the reliability and storage balance of different types of data.

4. Management Method of Smart Community Health Information Sharing Platform

(1) Classification and management of residents' health information data

With the wide application of health care informatization, massive data sets have been generated in the process of medical service, health care and health management. For a community, thousands of residents gather, and the residents' health information data are numerous and disorderly. If residents need to query their own health data indicators on the platform, how the platform data administrator can query residents' information in massive data is an important issue. When the community classifies and manages the health information data of community residents, the search keywords can be a building, a unit, a building, a household, and a name in turn. In this form, the data classification is simple and clear, which can greatly improve the health information data management ability of community platform administrators and the speed of residents' search for personal health information.

(2) Analysis and evaluation of community residents' health information data

Through the use of medical big data technology, the health data of community residents are deeply mined to find its inherent regularity, and two conclusions are drawn: health status assessment and health risk prediction. The assessment of health status divides the health status of residents into four categories: "health", "sub-health", "high risk" and "illness". Risk prediction refers to the risk prediction and early warning of potential diseases using scientific analysis methods through the vertical comparison of individual data and the horizontal comparison of group data, so as to discover risk factors and predict their development trends to automatically form a visual image. Community residents and community physicians can log in to the platform of the system at any time to understand their health status and risk level. The health information sharing platform can also send evaluation results to patients' smartphones when necessary (as shown in Figure 1).
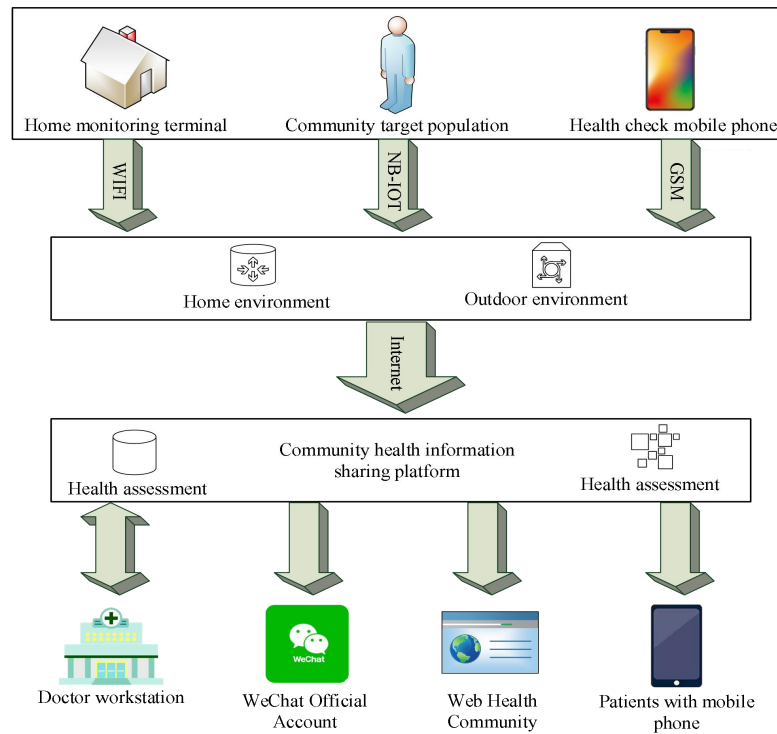
Figure 1. Smart community health information sharing platform management system

5. Evaluation of Countermeasures Related to Health Information Sharing Platform

(1) Using the advanced computing intelligence system of safe medical images to store data

Medical imaging is a processing technology that uses non-invasive technology to obtain human tissue images [17]. Medical image credits are two relatively independent disciplines: medical image system and image processing. The former refers to the process of image formation; the latter is to reprocess the acquired image to make the original unclear image clear. This emphasizes the special features in the image or classifies the image according to the pattern. The combination of medical image security and advanced computer intelligence technology has promoted the birth of AI medical images [18]. The concept of combining medical images with advanced computer intelligent systems began in the 1960s. The concept of logic and statistical pattern recognition was primarily used in the early stages of radiology diagnosis; after the 1980s, with the development of computer technology, the digitalization of medical images transformed from subjective perception to quantitative calculation, and computer-aided diagnosis came into existence. In addition to the development of the new generation algorithm of artificial intelligence, the powerful computer and storage technology, as well as other advancements contributed to the development of the new generation algorithm of AI. In the management of the intelligent community health information sharing platform, the advanced computing intelligence system of Artificial Intelligence (AI) medical images, namely safe medical images, is applied to the data storage of the community health information sharing platform, which would make the medical information sharing platform more convenient and efficient [19].

(2) Improving the open data supply of community health information sharing platform

The open supply of data on the smart community health information sharing platform determines the effectiveness of big data. From the four aspects of platform data, the open data supply of community health information sharing platform is improved. Firstly, the scope of data opening of

the smart community health information sharing platform can be set as limited or full opening based on individual residents' applications, which reduces the difficulty and cycle of residents' data acquisition; secondly, the openness level of health information sharing in smart communities is improved, and the information mobility is enhanced; thirdly, the results of community residents' health assessment data are refined. Generally, the open formats of community data are mostly statistical results or unstructured data and the means of information interaction are insufficient. The flexibility and availability of data are low and the benefits of data opening are limited. Finally, the type of open data is clarified. The community health information sharing platform is a platform serving the community residents. Therefore, the construction and management of the platform should meet the individual needs of community residents and take the residents' health management as the purpose of use.

6. Related Algorithms for Big Data-based Platform Management for Health Information Sharing

(1) Decision tree algorithm

The decision tree algorithm is now the technique that is utilized the most in the field of data mining. It can efficiently categorize and be used for illness categorization and diagnosis. The classification and diagnosis of diseases are studied in-depth using C4.5 and ID3 decision tree algorithms. In order to raise the management level of the intelligent community health information sharing platform, a medical big data decision tree model is built and data mining is done.

It is assumed that the attribute set M of the sampled data of the reduced medical big data has m sampled data; $D_i(i=1,2,3,\cdots,n)$ indicates the category number of the sampled data; m_i is the number of samples in category D_i. The information entropy corresponding to this data set M is as follows:

$$I(m_1,m_2,m_3,\cdots m_i) = -\sum_{i=1}^{n} Q_i \log_2(Q_i) \tag{1}$$

In this formula, $Q_i \approx m_i/m$ means that any sample in this set is a D_i category possibility. The medical big data attribute Y is set to b different values, and M is divided into b subsets $\{M_1,M_2,M_3,\cdots M_b\}$ according to attribute Y. Among them, M_j represents the sampling value y_j on Y; m_{ij} represents the number of samples in category D_i of M_j; the information entropy of attribute Y segmentation sampling is as follows:

$$X(Y) = \sum_{j=1}^{b} \frac{m_{1j} + \cdots + m_{ij}}{m} I(m_{1j},\cdots m_{nj}) \tag{2}$$

For a given subset M_j, Formula 3 can be used to calculate the required information $I(m_{1j},\cdots,m_{ij})$:

$$I(m_{1j},\cdots,m_{ij}) = \sum_{i=1}^{n} q_{ij} \log_2(q_{ij}) \tag{3}$$

Among them, $q_{ij} = m_{ij}/|m_j|$ represents the probability that the sample in M_j belongs to class D_i; the number of samples with y_j values on attribute Y is represented by $|m_j|$. According to the

calculated information entropy and expected information, the information gain obtained by dividing sample set M by attribute Y is as follows:

Based on the required information entropy and the required information, the information gain of Y segment sample group M is obtained:

$$Gain(Y) = I(m_{1j}, \cdots, m_{ij}) - X(Y) \tag{4}$$

It can be seen from Formula 4 that due to different attribute values, the information gain obtained would change with the change of attribute values. However, in practice, attribute values cannot directly affect the classification effect of ID3. The number of initial information obtained corresponding to attribute Y is as follows:

$$SplitInf_Y(M) = -\sum_{j=1}^{b} \frac{|M_j|}{M} \times \log_2(\frac{|M_j|}{M}) \tag{5}$$

On this basis, the sample set of medical big data attribute training is preprocessed to obtain the information gain ratio of each attribute. With the maximum information gain rate as the basic attribute, the attributes in the candidate attribute set are removed until the candidate attribute is empty, and their attributes are merged and reduced to form a medical big data feature decision tree mining model to achieve medical big data mining.

(2) Adaptive feature search algorithm

Big data mining technology is employed to adaptively plan and access health information in order to enhance the generalization capability of the algorithm. The following is the ideal objective function:

$$\left.\begin{array}{l} F_1(w,e) = \frac{\mu}{2} w^T w + \frac{1}{2} \gamma \sum_{i=1}^{L} e_i^2 \\ s.t. n_i = w^T \varphi(m_i) + b + e_i, \quad i = 1, \cdots, L \end{array}\right\} \tag{6}$$

Among them, w is CS combined weight vector; e_i is the interaction error of health information.

7. Experimental Investigation of Management and Countermeasures of Health Information Sharing Platform

The suggested technique is contrasted with the real-time performance and recall performance of the generic methods 1 and 2 in order to evaluate the adaptive scheduling and access efficiency of the adaptive feature search algorithm in this research in the realization of community health information sharing (as shown in Figures 2 and 3).

It can be seen from Figure 2 that in the real-time comparison chart, the proposed method is more real-time; as shown in Figure 3, the recall rate of the proposed method in the recall comparison chart is far higher than that of the other two general methods. As a result, the management capability of the intelligent community health information sharing platform is significantly improved by the adaptive scheduling and access efficiency of the suggested technique, which is significantly greater than other general adaptive scheduling and access efficiency.

In order to verify the advantages of the intelligent community health information sharing platform management and countermeasures in this paper, community A is selected to implement the methods provided in this paper and compared with community B that does not implement the methods in this paper (as shown in Figure 4):
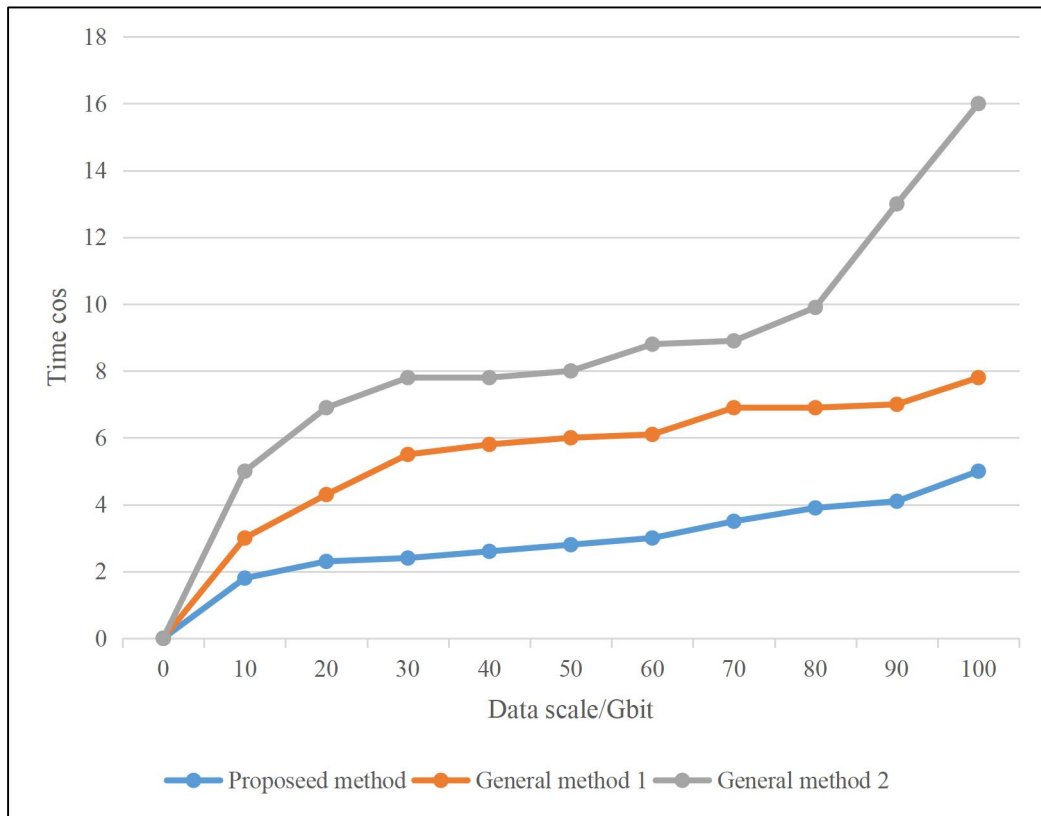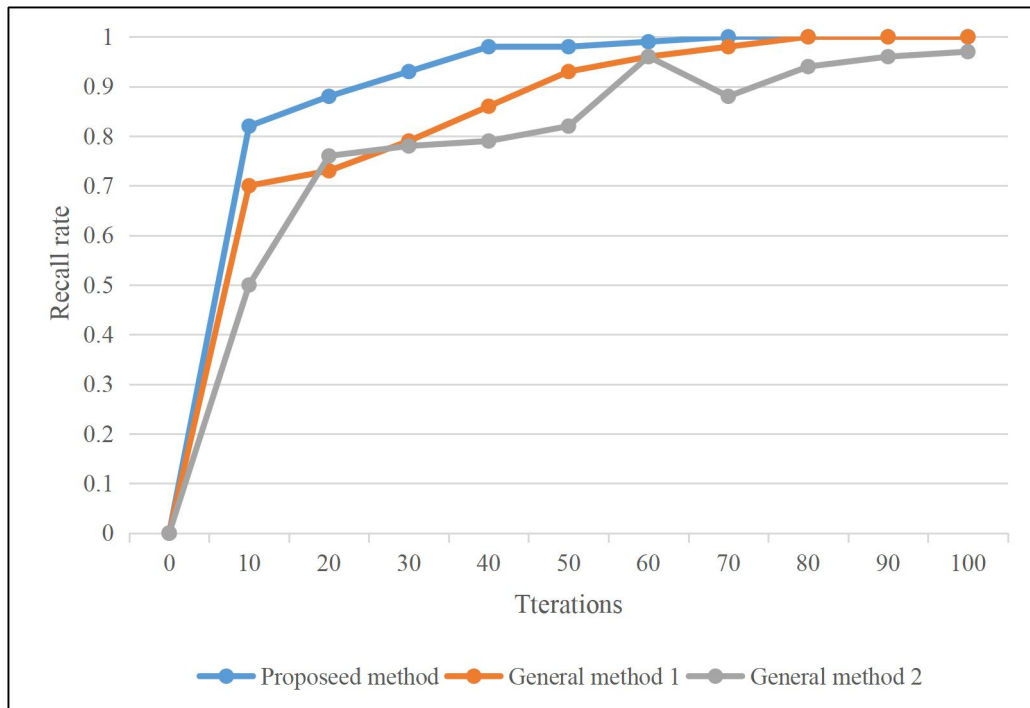
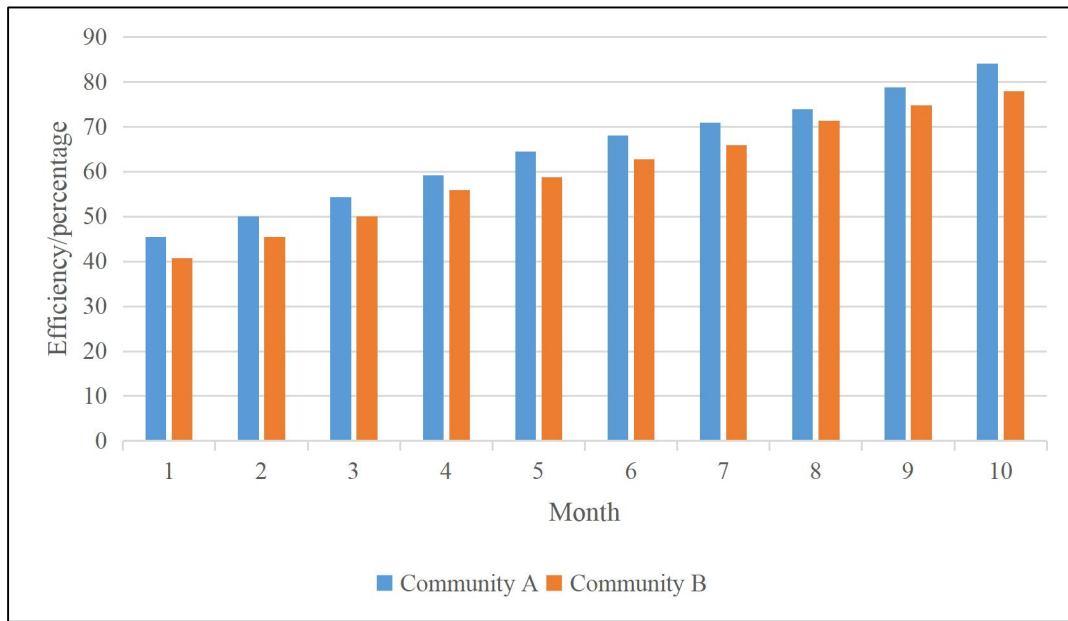Figure 2. Real time comparison

Figure 3. Recallability comparison

Figure 4. Comparison of management efficiency

It can be seen from Figure 4 that within 10 months of the smart community health information sharing platform, community A's management ability improves 7.52% compared with community B. As a result, the management strategy of the big data-based smart community health information sharing platform examined in this research has some favorable implications for community and health management.

8. Conclusions

Medical big data is a cutting-edge technology, but it has not been widely used in the field of smart community health. In the contemporary medical and health industry, an intelligent platform for community health information exchange is significant. This article proposes a management strategy for a smart community health information sharing platform based on blockchain medical big data, and further emphasizes the application, feedback, and interaction of information to achieve real-time health promotion. This was done in light of the rapid development of medical big data and security images. Due to the heavy demands of school and job, children from many families currently have little time to visit the old at home, and it is inconvenient for the elderly to leave. The multi-level demands of community members for health services can be satisfied through the use of medical big data and Internet home health monitoring. The intelligent management capability of the community health information sharing platform, which can precisely achieve the adaptive scheduling of community health information, is made possible by the smart community health information sharing platform based on medical big data. The recall rate of the information is strong, and more and more locals would gain from the future smart community health information sharing platform.

Acknowledgement

References

[1] Liu L, Pei Z. Analysis of the implementation status of hierarchical diagnosis and treatment under the mode of medical consortia from the perspective of community. Intelligent Health, 25.4 (2018): 17-18.

[2] Sharma Megha. Zika virus pandemic—analysis of Facebook as a social media health information platform. American journal of infection control, 45.3 (2017): 301-302.

[3] Zhang Xing. Health information privacy concerns, antecedents, and information disclosure intention in online health communities. Information & Management, 55.4 (2018): 482-493.

[4] He Minghua. Understanding residents' continued usage intention of community sharing platforms in smart communities in a post-COVID era: evidence from China. International Journal of Networking and Virtual Organisations, 26.4 (2022): 268-290.

[5] Zhao Jin, Chong Zhihong. Research and Implementation of Regional Health Information System for Smart Healthcare. Journal of Clinical and Experimental Medicine, 2.2 (2018): 1-6.

[6] Estacio Emee Vida, Rebecca Whittle, Joanne Protheroe. The digital divide: examining socio-demographic factors associated with health literacy, access and use of internet to seek health information. Journal of health psychology, 24.12 (2019): 1668-1675.

[7] Wang Ying. Intelligent community medical service based on internet of things. Journal of Interdisciplinary Mathematics, 21.5 (2018): 1121-1126.

[8] Lee Brian. Modernizing centers for disease control and prevention informatics using surveillance data platform shared services. Public Health Reports, 133.2 (2018): 130-135.

[9] Xu Boyi. Healthcare data analysis system for regional medical union in smart city. Journal of Management Analytics, 5.4 (2018): 334-349.

[10] Gamache Roland, Hadi Kharrazi, Jonathan P Weiner. Public and population health informatics: the bridging of big data to benefit communities. Yearbook of medical informatics, 27.01 (2018): 199-206.

[11] Dong Xiaojuan, Zhang Yuan. Application and implementation of intelligent community system based on the internet of things technology. Agro Food Industry Hi-Tech, 28.1 (2017): 1558-1562.

[12] Monnard Kristin. Co-creation of knowledge: A community-based approach to multilevel dissemination of health information. Health promotion practice, 22.2 (2021): 215-223.

[13] Chen Fulong. An infrastructure framework for privacy protection of community medical internet of things. World Wide Web, 21.1 (2018): 33-57.

[14] Zhang Xingtin. How the public uses social media wechat to obtain health information in china: a survey study. BMC medical informatics and decision making, 17.2 (2017): 71-79.

[15] Gardner Rebekah L. Physician stress and burnout: the impact of health information technology. Journal of the American Medical Informatics Association, 26.2 (2019): 106-114.

[16] Alabdulatif Abdulatif. Real-time secure health surveillance for smarter health communities. IEEE Communications Magazine, 57.1 (2018): 122-129.

[17] Currie Geoff. Machine learning and deep learning in medical imaging: intelligent imaging. Journal of medical imaging and radiation sciences, 50.4 (2019): 477-487.

[18] Xiao Yi, Liu Shiyuan. Collaborations of Industry, Academia, Research and Application Improve the Healthy Development of Medical Imaging Artificial Intelligence Industry in China. Chinese Medical Sciences Journal, 34.2 (2019): 84-88.

[19] Augustine C A, & Keikhosrokiani P. A Hospital Information Management System With Habit-Change Features and Medial Analytical Support for Decision Making. International Journal of Information Technologies and Systems Approach, 15.2 (2022): 1-24.