

Analysis and Design of the Health Management System for Medical Staffs

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ABSTRACT

The concern about health of medical staffs is increasing recently with the outbreak of COVID-19. In this case, it is necessary to design a particular health management system for medical staff with the function to prevent and control both physical diseases and emotional issues. The system proposed in this paper is successful in combining the physical and psychological health of medical workers. It starts by evaluating the level of social support by big data mining and then calculates the possible stress felt by medical staff. Physiological indexes and stress sensing are recorded and then analysed through the knowledge base. Eventually, the medical advice generated by inference engine will be sent to the users if needed.

Keywords: *The health management system for medical staff; Mental health; Diseases prevention; Health intervention*

1. INTRODUCTION

With the fast-paced development of such novel technologies as big data, Internet of Things and artificial intelligence, there have been an increasing number of scholars interested in exploring how to build the health management system dedicated to health management and disease prevention[1]. Based on the big data technology, the health management system can store and analyse the data collected from different resources including public health, clinical treatment and medical research[2]. The intelligent operating analysis of these data is especially helpful in improving the performance in decision support-based public health, clinical treatment and medical research in the future, thus leading to a virtuous circle[3]. From the perspective of social development, the big data-based health management system contributes to the National Health Security Information Project[4]. The secure and effective cloud services of health management and disease prevention play a crucial role in optimizing regional medical resources, reducing medical expense, as well as improving the level of health management for hospitals and the decision-making ability of the government. In this sense, the system plays an essential role in promoting information people-benefit project and medical reform by improving the lifestyle of

residents at the civilian level, enhancing the quality of medical services at the industry level and adjusting the measure of healthcare at the social level[5].

In recent years, the study on health management of medical staff has drawn much attention due to the increase of disputes between medical organizations and patients as well as the occurrence of public health crisis, such as COVID-19. In addition, with the rapid development of social media, such as Wechat, Weibo and other self-media platforms, the social support provided to medical staff is also on the increase[6]. In addition to increasing the work pressure on medical staff, it may also cause psychological or mental problems[7]. However, most hospitals focus more on the diagnosis and treatment of specific diseases, which makes them less able to prevent daily chronic diseases, psychological and mental problems. Therefore, it is essential to study how a health management system can be constructed for medical staff based on big data to prevent chronic diseases, psychological and mental illness.

Therefore, a health management system focusing on the perception of medical staff about stress is proposed in this paper. It is capable to evaluate the work pressure placed on medical staff by calculating their work load and the degree of social support, which serves as a description and reflection of public opinion. On this basis, it provides

intelligent decision-making support for the development of personalised health intervention plans by recording the clinical history and physiological indicators of the subscribers and by comparing those similar cases included in the knowledge base, with the mental demand of medical staff as a significant objective of management. This system expands the scope of health management as compared to those traditional intelligent health management systems.

2. THE DEMAND OF MEDICAL STAFF

The construction standards adopted for the health management system of medical staff based on the big data technology is the Construction Guidelines in the Medical Big Data Platform for Medical Institutions as published by China Hospital Information Management Association(CHIMA)[8]. This system can perform all the functions required for basic-level medical health management service, with its core system integrating plenty of medical databases, such as the health management database, electronic medical records, physical examination records and so on[9]. In this paper, the mental state of medical staffs is also included in the scope of the health management system.

Due to the constant development of modern medical, the social need for medical services has been increasingly diversified[10]. It was demonstrated in a study that about 15 out of every 100 on-the-job clinicians in China are in sub-health state, while about 40 doctors are left in long-term job burnout state[11]. As for the health status of medical staff, it has been increasingly affected by a wide range of complex factors. In the meantime, medical staff

has also been turned into a byword for the "three-highs": high technology, high risk and high pressure[12]. The huge workload placed on medical staff and various inevitable trouble caused by COVID-19 have sparked widespread public concern recently. Apart from the doctor-patient relationship, medical staff are also put at the risk of psychological and physical hazards due to resultant nasty accidents[13,14]. According to the available research data, the quality of life of medical staff is also reduced by the relevant criminal cases where doctors came under attack by patients or their family members[15]. Therefore, the health management system intended for medical staff can offer help with "quantified selfers", where medical staffers could realise the body status, normal routine, behavioral characteristics, and receive message through the system. Moreover, the system could be relied on to quantify the social support provided to medical staff, thus evaluating their work stress and then offering targeted health advice.

The health management system intended for medical staff performs the following functions. Firstly, it constructs an interconnected information service system for the medical staff working in the industry. Secondly, it promotes the integration of different health information resources related to medical staff. Thirdly, it builds a system capable to collect and analyse information using big data technology, and offers support in cross-sectoral cooperation, social services and artificial intelligence decision-making in the future. Fourthly, this system contributes to the development of personalised health plans, as well as health management and disease prevention.

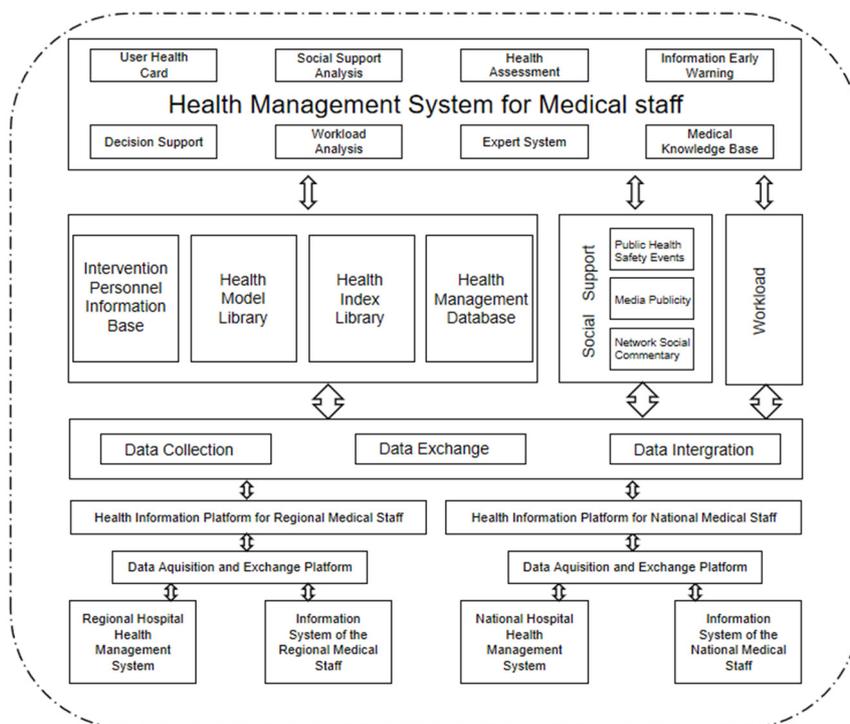


Figure 1. Structure Chart for Functions of the System.

3. THE DESIGN OF HEALTH MANAGEMENT SYSTEM FOR MEDICAL STAFF

3.1. Monolithic Construction

In this paper, the technology of big data mining and health services intelligent push is applied to design a health management system, the core module of which is a computer program, as shown in Fig1. With the support of virtual medical professionals, this system can help

address the problems with health management of medical staff. With a large number of expert-level knowledge and experience collected from the field of health management in the expert database, it relies on machine learning to simulate the knowledge and capability of experts to deal with the health management problems for medical staff, in addition to offering expert-level health advice to them. Fig 2 shows the overall structure of this health management system, the core part of which is the expert system based on human-computer interface, knowledge base, multiple inference mechanisms and control strategies. It consists of the input and output modules.

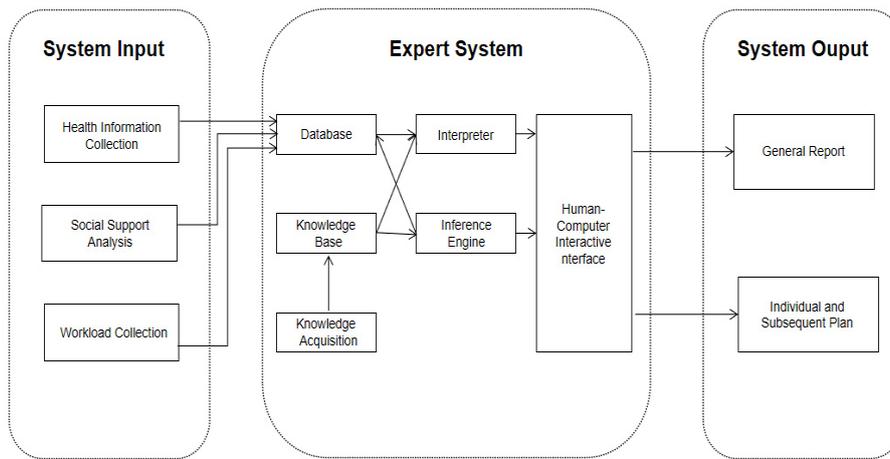


Figure 2 The Overall Structure of the Health Management Expert System for medical staff.

3.2. Design of system input

Below is a figure showing the process of how the file is created. Firstly, the catalogue of medical staffs' health records involves the following six aspects. The first one is personal details. The second one is physical examination files. The third one is medical records. The fourth one is drug history files. The fifth one is work department and work responsibility record form. The sixth and last one is doctor's health information files. Besides, the input system is equipped with a transmission interface of a wearable intelligent device. Secondly, the social support data collected by the health management system will be presented in the user interface, including the analysis of social media public opinion and comments. In the system, the result of social support analysis is classified into five grades: very good, good, general, bad and very bad. Lastly, the workload record obtained from the organizations where users work will be added into the

data analysis through machine learning, including working hours and the number of seeing patients. Besides, the work hours information is divided into four situations: outpatient, admission office, operating room and further education. In this health management system intended for medical staffs, the working hours will be used to record the workload. For the further research about workload quantization, it will be discussed in the future.

Form filling: different types of healthcare users fill in different forms. Therefore, the establishment of health records is supposed to start by determining the user type, while the form type that the user needs to fill in is supposed to be determined according to the specific situation. Then, the required form is filled in by the object in line with the inquiry classification. After the file is established, the personal user health file information card is issued to the medical staff. In the meantime, the user health file is archived.

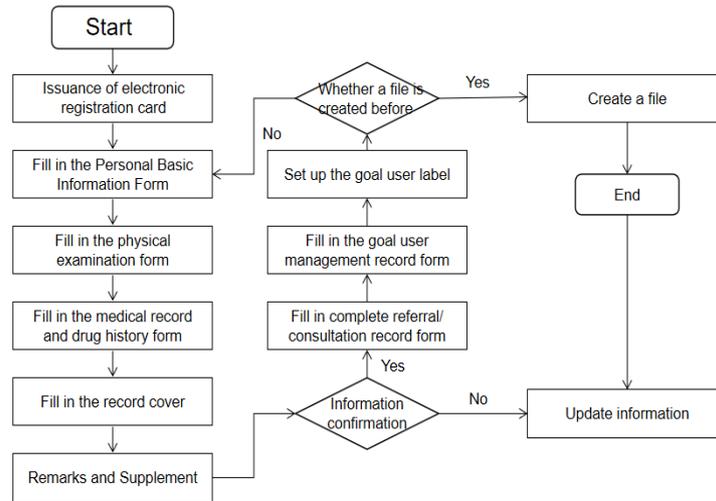


Figure 3 Architecture of the System Functions.

3.3. The design of Expert system

Figure 3 illustrates how the expert system functions. Users enter their own health data into the input module of the system before its transmission to the expert system. Then, the system will collect these data for storage in the database of health management field. Meanwhile, the database acquires relevant knowledge from the knowledge acquisition mechanism before storing it in the knowledge base [16].

To ensure the integrity and dependability of the knowledge base, it is necessary for knowledge engineers to update the knowledge on a continued basis during the operation of the expert system [17]. Through the input module of the system, inference engine performs intelligent reasoning and decision-making. The existing knowledge and experience in the knowledge base are used to generate all-sided reports and develop personalised future plans. Finally, the reasoning results are presented to the users through the man-machine interaction interface. The staff of health management system are expected to have knowledge and experience in the related fields.

1) Knowledge base design: Knowledge acquisition and knowledge representation is crucial for realizing expert system.

A) Knowledge acquisition: Currently, manual acquisition, semi-automatic acquisition and automatic acquisition represent the three mainstream solutions to acquiring knowledge. By identifying a large number of the expert knowledge and experience in the field of health management, the expert system acquires knowledge in a semi-automatic way. The system can obtain the case-control studies automatically. Then, the documents are arranged and edited by system management engineers.

B) Knowledge representation: The data structure of knowledge is organised and expounded through

knowledge representation. The commonly used approaches to knowledge representation include predicate logic representation, production knowledge representation and frame theory representation. With the most of the knowledge in the health management field belonging to causality, the production knowledge representation method is applied in the expert system for knowledge representation. The basic form is shown below.

(1)

If M then N.

In (1), m represents the prerequisite for the result produced by n. In the expert system of the health management system designed in this paper for medical staff, the diagnostic rule about whether the working pressure reaches the standard is expressed as follows:

(2)

If SS= 'bad' || 'very bad' WL>=8h
Then Workload Alarm triggered.

In (2), SS refers to the social support which is classified into the following 5 levels: very bad, bad, fair, good, very good, while WL stands for workload.

3.4. The design of Inference Engine

The inference engine represents the most significant component of this expert system for performing the function of intelligent decide-making. Since the choice of inference method is directly influenced by the knowledge representation method of the knowledge base, the rule-based inference method is adopted in this system. Take the follow-up plan as an example. A personalised follow-up plan is developed through the comparison with the knowledge base and the subsequent operation of the inference engine. Firstly, it is necessary to determine the on-site follow-up time depending on the exact user type. Then, the management object must be determined. As shown in Fig.2, the inference will not proceed if the

management object is not the user. Once the management object is determined, the Inference Engine will generate an on-site follow-up plan in line with the existing rules.

Take Table 1 as an example. If the user is identified as in need for medical advice, then the date of telephone follow-up will be finalised.

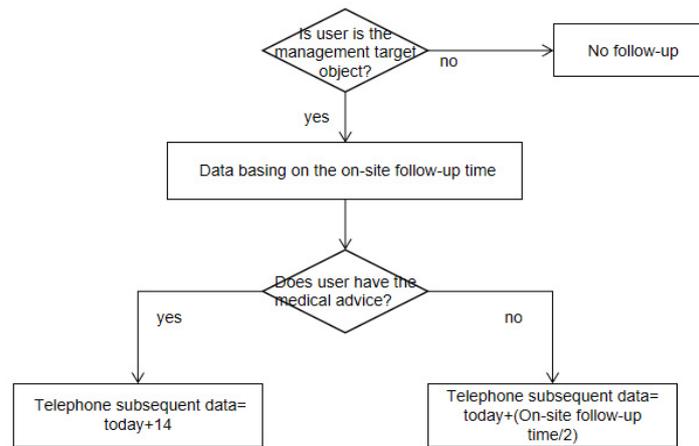


Figure 4 Inference Process of Subsequent Date.

3.5. The system output

There are two parts included in the system output module. One is the general report of users, while the other part is the individual and subsequent plan. The general report is intended to assist users in realizing their health status and develop personalised plans of health intervention for them. The individual and subsequent plan supports the staff of the health management system in mastering the health status and the effect of health intervention of users at any time.

4. CONCLUSION

The concern about health of medical staffs is increasing recently due to the outbreak of massive public health events and some vicious crimes over doctor-patient disputes. It is thus significant to design a health management system for medical staffs. In this paper, the work stress of the particular profession is first taken seriously in comparison with traditional researches. The system is effective in combining psychological and mental health through the big data mining carried out under a basic framework of the expert system, which provides a better guarantee for medical staffs through the provision of more accurate and efficient health service.

Table 1. User on-the-spot subsequent Time

User Type	Social Support	Workload	Chronic Diseases (hypertension, diabetes, etc.)	Others
On-the-spot subsequent time	One month	One week	Three months	Six months

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