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The Application of Intelligent Health Management Systems in Continuity of Care for Cardiovascular Patients

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Abstract. As a significant integrated product of information technology (IT) and medical care, intelligent health management systems demonstrate distinct advantages in the continuous care of cardiovascular patients. This study reviews the current application status and challenges associated with these systems. Such systems primarily facilitate therapeutic interventions through intelligent terminal monitoring, online guidance, and artificial intelligence (AI)-assisted support. They have yielded positive outcomes across multiple areas, which include enhancing medication adherence and self-management capabilities among hypertensive patients, which aid stroke patients in effective blood pressure control, and improves exercise tolerance and quality of life for those with chronic heart failure. Additionally, these systems perform well in arrhythmia screening and post-pacemaker implantation management. However, several critical issues persist: inconsistent long-term intervention efficacy, lack of unified technical standards, limited research sample sizes, and inadequate widespread acceptance. Future development requires multi-center, long-term follow-up studies, refinement of technical specifications and verification processes, and standardized implementation of intelligent management solutions. This study focuses on four major cardiovascular diseases (CVDs) including hypertension, stroke, heart failure, and arrhythmia, which systematically elaborates on the intervention models, application effects, and existing limitations of intelligent health management systems. The aim is to provide theoretical references for addressing individualized care needs and insights for system optimization and innovation.

Keywords: health management systems, cardiovascular, AI.

1. Introduction

With societal development, young adults face escalating work pressure, while population aging accelerates. Aging, irregular sleep patterns, and high-intensity work constitute key risk factors for hypertension and cardiovascular diseases, which makes these conditions a major health concern for China's elderly population. According to the World Health Organization, cardiovascular diseases triggered by hypertension have become one of the leading global causes of death [1]. Hypertension and its associated chronic cardiovascular conditions demand long-term pharmacotherapy and often result in loss of work capacity, which imposes substantial economic burdens on patients and society. In recent years, the integration of information technology and healthcare has advanced rapidly, with

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intelligent health management systems emerging as prominent representatives of digital healthcare. Built on the Internet of Things, big data, and AI models, these systems integrate health monitoring, rehabilitation planning, and targeted interventions to deliver continuous care for cardiovascular patients. Compared with conventional manual continuity of care, intelligent health management systems offer superior cost-effectiveness, broad applicability, and real-time data processing capabilities. Their ability to track and aggregate individual patient data further enables personalized care delivery. This study reviews the current application status and existing challenges of intelligent health management systems in monitoring cardiovascular patients, which aims to provide theoretical support for meeting individualized care needs and valuable insights for the optimization, upgrading, and innovative development of such systems [2].

2. Construction of a home-based elderly health monitoring and management system based on intelligent terminals

2.1. The intervention effect of intelligent health management systems on hypertensive patients

Cardiovascular diseases caused by hypertension have garnered global attention due to their high incidence, severe complications, and heavy treatment burdens. During long-term pharmacotherapy, patients often encounter multiple barriers to regular medication adherence. Consequently, researchers continuously explore innovative management strategies to enhance adherence and achieve better blood pressure control outcomes.

Owing to their convenience, which is characteristic of smart bracelets, there has been a significant potential in the management of hypertension. Zheng et al. have carried out a study on the effect of their clinical intervention using elderly hypertensive with the age over 60 years old creating a control group (120 cases) and observation group (120 cases). A team of intervention was constituted, intervention measures were drafted and a three-month intervention was conducted. The non-adherence to medication was evaluated with the determination of the Blood Pressure Treatment Compliance Scale (TASHP), and non-adherence to self-management behavior was measured using the Self-Management Behavior Assessment Scale to Hypertension Patients (HPSMBRS). The observation group had a greater rate of properly controlled blood pressure than the control group after the three months controlled experiment. On the basis of these results, scholars came to the conclusion that innovative management approaches led by smart bracelets help a large number of hypertensive patients to enhance medication compliance and self-management skills. Moreover, the strategies are effective in the promotion of the rate of sufficient blood pressure control, which is a beneficial hypertension intervention [1].

Due to their interaction, hypertension and sleep disorders tend to create a vicious cycle. Domestic surveys have shown that the rate of sleep disorders in older hypertensive patients in new rural areas ranges to 59 cases, and this fact predetermines the high priority of the process of sleep quality development among this patient group [2]. The bedside intelligent interaction system is an information technology-driven nursing model that aims at establishing personal medical care platforms. Using the above system, researchers investigated the nursing implications associated with the video-based education of relaxation and pressure-reducing exercises to hypertensive patients. Xie et al. randomly selected 124 hypertensive patients, including the control group who were provided with usual blood pressure control measures and the observation group who were provided with extra-video based education on relaxation and blood pressure- reducing exercises through the bedside intelligent interaction system, during the intervention period of 8 weeks. Experimental data were analyzed and showed that bedside and bedside intelligent intervention system can help

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decrease systolic and diastolic blood pressure, effectively enhance sleep quality and can be successfully used as the second line of intervention that is safe and efficient to cope with hypertension [3]. It is based on the above two sets of experiments that the intelligent health management systems play a positive intervention role in blood pressure and disease management of hypertensive patients. Still, the shortcomings of both studies are alike, such as the inability to test the adequate correlation between the technical interventions and the long-term results and the lack of the investigation of the system functionality.

2.2. The intervention effect of intelligent health management systems on stroke patients

Elevated blood pressure represents the most significant modifiable risk factor for both initial and recurrent strokes. To explore the positive impacts of telemedicine and mobile health technologies on blood pressure management in stroke patients, Liang et al. included 3803 participants, with systolic and diastolic blood pressure as primary outcome measures and medication adherence as a secondary outcome measure. For medication adherence (continuous data), the standardized mean difference (SMD) was used as the statistical indicator for synthesis. Blood pressure control was guided through three primary approaches: individual telephone interventions, telephone monitoring interventions, and telephone-based messaging interventions. Results showed that the experimental group achieved significantly lower systolic and diastolic blood pressure levels and higher medication adherence compared with the conventional care group. Although notable heterogeneity exists, which may affect result stability, the positive role of intelligent health management systems in stroke patient interventions remains undeniable [4].

3. Application of intelligent health management systems in the monitoring of heart failure patients

As population aging is quickening, the cardiac failure patients are growing at a high rate. Cardiac rehabilitation (CR) is an inclusive treatment modality of heart failure and it is combined with exercise therapy, nutrition consultation, medication education and education to the patient. Clinically however, the use of CR is very low and most patients are not exhibiting barriers to participate. As a result, home-based cardiac rehabilitation (HBCR) is an alternative model suggested by scholars. Patient education is incorporated in this program alongside guidance in exercises and nutritional counseling using information and communication technology (ICT). In order to compare the effectiveness and safety of an extensive HBCR regimen, scientists developed a single-centre, open-label, random trial of 30 heart failure patients, half of whom were in the control group and the other half in the HBCR group. HBCR group was provided annualized comprehensive rehabilitation interventions on ICT along with regular treatment measures with the 6-minute walking distance (6MWD) as the main outcome measure. The experiment showed that ICT-based HBCR interventions are very effective to improve 6MWD and make a tangible impact to ameliorate frailty status and nutrition results as well as provide specific advantages to heart failure patients [5]. Although the current study has the advantage of proper subject selection and excellent guiding significance, there are limitations (including short time of intervention before it can be clearly discovered how these are long term and the study cannot get rid of confounding factors).

Chronic heart failure patients are at a great risk of a cardiovascular event in 3 months after discharge. As a way of meeting the dynamic management requirement of this high-risk group, scholars have suggested a non-invasive telemedicine (TM) program that combines remote monitoring and interventions as a novel model to optimize the process of transitional care at this

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vulnerable period. Researchers developed the HERMeS trial to evaluate the effectiveness and safety of this telemedicine program, which consisted of the everyday use of mobile health-based biometric data and symptom monitoring and nurse-led structured video conference (VC) follow-ups. The study was carried out in 10 members of the research facilities in Spain, with 508 patients who had previously been hospitalized due to decompensated heart failure (within 30 days) randomly distributed to the control condition (UC group) and the telemedicine category (TM group). The TM group was informed of the interventions via PIRENe platform, whereas the UC group was provided with commonplace, face-to-face follow-up and routine management of heart failure to be conducted at every center. The main objective of measurement was a composite endpoint of heart failure (first and recurrent) events (cardiovascular (CV) death or non-fatal) within six months. The experiment revealed that this telemedicine solution, in its interaction with multi-channel data integration and proactive intervention mechanisms makes it possible to monitor the signs of deterioration of the disease in due time and to correctly revise the approach to the treatment process [6]. Nonetheless, there are still limitations, such as the 6-month follow-up that is not long enough to verify long-term intervention impacts, a failure to control confounding variables such as differences in the technical acceptance and family support of patients, and the absence of subgroup analysis made in patients with various ejection fraction subtypes.

At another experiment, a home based remote management and intelligent platform which was based on patient needs and a combination of several modular functions also registered positive therapeutic benefits and high demand among patients. The features of the platform are surveillance of vital signs (blood pressure, heart rate, weight, etc.); medication reminders and treatment plan requests; dietary and exercise planning personalized; health education provision; professional-patient communication; and follow-up care. It customizes its platform to meet the usage patterns of patients of various ages and education level and offers a standardized and intelligent system of continuity of care in chronic heart failure patients [7]. The emission of smart information technology has created many new forms of management to enhance the heart failure patient care systems. Two single-site controlled studies were performed in order to provide information about the relevance of intelligent management systems and multidisciplinary-based care on heart failure. The participants in a study on outpatient management of chronic heart failure (CHF) between 2020 and 2022 were chosen randomly consisting of 284 patients with the cardiac function classes II to IV in the hospital of Fuyang (People of Anhui Province) chosen randomly as an experimental group (144 cases received the use of the IMS-NHM system in addition to routine interventions) and a control group (140 cases received routine interventions only). The eventual results were that the experiment group achieved much higher scores on the Morisky Medication Adherence Scale, each of the dimensions of self-management ability, and 6MWD than the control group after six months of intervention. Also, the experimental group had a higher rate of outpatient visits, lower rate of hospitalization, and much lower score as per Minnesota Living with Heart Failure Questionnaire [8].

In a retrospective controlled study on acute heart failure care conducted between 2019 and 2022, 164 patients were selected from Zhoukou Central Hospital. The observation group (85 cases) received full-cycle care via an intelligent informatization multidisciplinary platform, while the conventional group (79 cases) received traditional care. After three months of intervention, the observation group demonstrated a significant increase in left ventricular ejection fraction, significant decreases in left ventricular end-diastolic volume and end-systolic volume, shortened hospitalization duration, higher SF-36 quality of life scores, reduced anxiety and depression scores, improved nursing satisfaction, and a lower complication rate [9]. Despite shared limitations, such as the inability to confirm long-term effects, intelligent health management systems have demonstrated

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robust development potential and clinical application value in heart failure patient rehabilitation, daily data monitoring, and disease management.

4. Application of intelligent health management systems in the monitoring of arrhythmia patients

Arrhythmia, a common type of cardiovascular disease, requires precise screening, diagnosis, and long-term post-surgical management to significantly reduce disease burden. Traditional diagnostic and management models face numerous limitations, which includes low follow-up adherence after pacemaker implantation and high missed diagnosis rates for atrial fibrillation, which fail to meet clinical needs. In recent years, the rapid advancement of intelligent technologies has provided innovative approaches to overcome these bottlenecks. Innovative management models based on artificial intelligence (AI) and big data analytics have been proposed and implemented in clinical trials.

In the field of post-pacemaker implantation management, patients with moderate to severe atrioventricular block (AVB) often exhibit a tendency to prioritize surgery while neglecting follow-up care. The conventional outpatient model of follow up is limited by time and transportation, and only 55 65% of patients have undergone follow-up which is standardized. This raises the chances of poor complication resolution and medication compliance. In this case, scholars have come up with a multi-dimensional telemedicine management system that incorporates ambulatory wearable electrocardiogram monitoring, online video consultation with hospitals and software programs downloaded in cell phones. One single-center randomized controlled trial on 205 AVB patients demonstrated that, 12 months follow-up reporting significantly indicated a higher health knowledge, and quality of life utility values, and medication compliance in the remote management group than in the traditional outpatient follow-up group. Also, this model offered the opportunity to minimize the loss to follow up rate and minimise average time of consultation and did not prove significant differences on pacemaker parameters and complication occurrence among the two groups. These results support the fact that the remote management model does not only provide the quality of management but also promotes a great level of efficiency and patient compliance [10].In the field of atrial fibrillation screening and diagnosis, atrial fibrillation—the most common type of arrhythmia—exhibits occult and paroxysmal characteristics. The weighted prevalence rate among Chinese adults aged ≥45 years is 1.8%, yet only a small proportion (6.0%) of high-risk patients receive standardized anticoagulant therapy. Traditional screening methods relying on single electrocardiograms and pulse palpation struggle to capture transient atrial fibrillation episodes, featuring high error and misdiagnosis rates, limited coverage, and inadequate cost-effectiveness. To address this challenge, intelligent screening solutions based on AI algorithms and wearable devices have emerged. Relevant studies include multi-center cohorts and retrospective analyses, which forms three core application frameworks: a deep learning-based ECG atrial fibrillation diagnosis model, a real-time monitoring scheme integrated with wearable devices, and a new-onset atrial fibrillation prediction model based on sinus rhythm ECG. Findings of the research have shown that deep learning models that use ECG data can diagnose atrial fibrillation with an accuracy of 97.72-99.2 and sensitivity and specificity of up to 99% in the case of best results. The sensitivity of wrist-worn devices in screening atrial fibrillation ranges between 85.0 and 100% and their specificity is between 93.5 and 99.0%. The model predicting the occurrence of new-onset atrial fibrillation has the highest AUC rate of up to 0.93 making it possible to accurately identify high-risk persons. Moreover, cost-benefit evaluations reveal this smart screening strategy to be cost-effective to the population of age ≥65 and repeated screening will improve but not diminish health outcomes [11]. Despite the limitations of the existing

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studies that include the single-center sample size, the lack of the stratified analysis and inconsistent technical standards, the telemedicine management, and AI-based screening technologies have offered efficient and accurate innovative solutions to the post-pacemaker management and the atrial fibrillation diagnosis. Such technologies are successful in enhancing patient experiences, solving the weaknesses of the conventional methods, and have a high research and development potential.

Further multi-center and long-term follow up research is required in the future to narrow technical requirements, verification procedures, which can facilitate the use of intelligent technologies in arrhythmia management on a large scale.

5. Conclusion

This is a review article that systematically explores the use of intelligent applications in health management systems as continuity of providing care to chronic cardiovascular disease conditions such as high blood pressure, stroke, cardiovascular failure as well as arrhythmia, which is a synthesis of the successes attained in solving the constraints in the conventional models of care. The systems can be applied in hypertension management to both improve self-management and adherence to medication using wearable devices and interactive platforms and to strengthen the ability to control blood pressure and sleep quality. Telemedicine and mobile health technologies are shown to have positive effects in blood pressure management and drug adherence optimization in stroke patients. ICT-based remote monitoring schemes and home-based cardiac rehabilitation interventions play important roles in the heart failure monitoring by improving exercise tolerance, nutritional conditions and reducing readmission rates. In the case of arrhythmia, AI paired with wearable devices can offer effective atrial fibrillation monitoring and standardized remote follow-up related to post-pacemaker patients, an effective solution to the problems with conventional diagnosis and treatment in terms of coverage and continuity. In future, the technologies in this domain will move further to a more intelligent integration and eco-cooperation. Multi-modal information and predictive learning will be included in AI models and help them to stratify risks more accurately and provide more precise interventions. The adoption of Internet of Things (IoT) will steer the home monitoring devices towards the direction of increased integration and non-invasiveness. 5G and blockchain technologies will guarantee real-time data delivery and safe sharing, which promotes the creation of an integrated, full-cycle management system both at the hospital and community levels. With time, intelligent health management systems will see beyond being discrete tools and provide fundamental assistance on creating a closed-loop preventive, diagnostic, treatment and management model of cardiovascular diseases, and so, help to further deliver the patient-centered, proactive health management paradigm.

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