

Study on the Development of an Intelligent Regional Health Security Monitoring and Emergency Medical Response System in Less Developed Regions

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Abstract: Less developed regions face challenges such as uneven distribution of medical resources, lagging informatization, and insufficient regional synergistic capacity in response to public health emergencies and critical care treatment. Therefore, this study proposes an intelligent regional health and safety monitoring and emergency treatment system, which combines the Internet of Things, big data, cloud computing, and artificial intelligence technologies to realize cross-regional medical resource scheduling, ICU bed management, telemedicine consultation, intelligent first aid scheduling, and infectious disease early warning. This paper first provides a systematic literature review of the development of the global infectious disease early warning system (EWS) and regional collaborative treatment (RCT) model and analyzes the challenges in the construction of infectious disease prevention and control and emergency care systems in less developed regions. Subsequently, a framework for designing a regional collaborative healthcare and emergency management system adapted to the needs of less developed regions is designed for Ganzhou, Jiangxi, China, and key components and innovations are described. Finally, the feasibility of the system is analyzed from four dimensions: technology, economy, society, and policy, and a low-cost and intelligent regional medical collaboration solution is proposed. This study can provide theoretical support and practical reference for the construction of public health management and medical emergency response systems in less developed regions.

Keywords: Intelligent public health management; Regional healthcare collaboration; Digital divide; Feasibility analysis.

1. Background

With the acceleration of globalization and the increase in population mobility, there is a growing need to respond to various types of public health crises. The spread of infectious diseases is characterized by cross-regional and rapid spread, making prevention and control extremely challenging. At the same time, the demand for efficient treatment of emergencies is becoming more and more prominent, especially in epidemics, earthquakes, traffic accidents and other emergencies, where critically ill patients require rapid response, multidisciplinary collaboration, and high-level medical resource support.

However, the lack of medical resources, backward informationization level, and insufficient regional collaborative treatment capacity in less developed regions have led to lower efficiency in the treatment of critically ill patients and a relatively high mortality rate. WHO pointed out that there is a general lack of resources for emergency care and intensive care around the globe, especially in low-income and middle-income countries according to the report of the 76th World Health Assembly [1]. In contrast, developed regions, relying on perfect healthcare systems, advanced technologies, and sufficient resources, have established prevention and control networks with intelligent monitoring and systematic collaboration, forming a more mature collaborative treatment model.

In this context, the regional collaborative critical care model has become a key strategy to enhance the medical capacity of less developed regions. In recent years, under the framework of the "Healthy China 2030" strategy, China has actively promoted the collaborative development of regional

medical care, and improved the response capacity to public health emergencies by implementing the establishment of regional emergency centers, telemedicine systems, and cross-regional medical resource optimization mechanisms [2].

However, it is difficult for less developed regions to directly copy the high-cost treatment model of developed regions, and it is necessary to combine low-cost, intelligent, and sustainable operation programs to build a regional collaborative critical care system that suits the actual needs of the region. The system needs to be based on hierarchical diagnosis and treatment, intelligent technology, cloud computing and Internet of Things to optimize the scheduling of medical resources, improve the diagnostic and treatment capacity of primary care institutions, and realize the interconnection of medical resources between regions.

This study will design a regional health security monitoring and collaborative treatment system based on information technology, based on the differentiated experiences of less developed regions and developed regions in medical prevention and control and collaborative treatment of serious illnesses, combined with the medical resources of Ganzhou, Jiangxi Province. The system aims to realize the organic integration of low-cost technology and intelligent management, improve the rapid identification, rational triage and efficient treatment of infectious diseases in less developed regions through the integration of medical resources, real-time data collection and intelligent analysis, enhance the level of medical protection, and reduce the adverse impact of major public health events on the socio-economy.

2. Literature review

Early warning systems for epidemic infectious diseases and collaborative treatment of the region are the twin pillars of the management of public health emergencies [3][4]. Early warning systems permit decision-makers to adopt effective prevention and control measures for prevention of the outbreak of the epidemic by early detection and prediction of the outbreak of epidemic infectious disease. The collaborative treatment of the region increases the efficiency of the treatment of complex diseases by unifying the medical resources of the region, especially the underdeveloped areas with scarce medical resources. With the rise of the outbreak of global epidemic infectious disease cases over the recent years and the increasing problem of uneven allocation of medical resources, the study of the above-discussed areas has made significant progress concerning technological innovation and optimizing the systems. Technological advancements in early warning systems for infectious diseases are:

2.1. Technological evolution of early warning systems for infectious diseases

Early warning systems (EWS) for infectious diseases are crucial in detecting and responding to outbreaks escalating into pandemics. Over the past decade, the technological development of EWS has shown remarkable features from single data source to multi-source fusion and from traditional statistics to artificial intelligence-driven. At the data collection level, Nelson et al. (2010) pioneered using Internet and media data for event-driven surveillance, which provided important support for the early warning of the 2009 H1N1 influenza pandemic [5]. Lai et al. (2015) constructed a spatio-temporal model-based early warning model for the detection of the H1N1 influenza outbreak in Hong Kong using daily influenza cases and population data for analysis. The model accurately forecasts the spreading tendency of the disease using the analysis of daily influenza cases and population data [6]. The spatio-temporal prediction model presents a new model for surveilling infectious diseases in the urban area. At the analytical techniques level, O'Regan et al. (2015) examined the leading indicator of the elimination of mosquito-borne disease and suggested the likelihood of the prediction of the elimination of the disease by observing the efficiency of the control measure [7]. The study offered new perspectives for the prevention of and control of the prevention of the mosquito-borne infectious disease. Liao et al. (2018) proposed the Bayesian network model for the improvement of the precision of the prediction of the danger of death and serious disease of the HFMD using pathogen detection and environmental conditions [8]. Sims and Kasprzyk-Hordern (2020) suggested the WBE [9], representing the breakthrough of the new era of non-invasive detection technologies and presenting a new solution for the early detection of infectious diseases at the population level. According to relevant WHO reports, substantial progress has been made in disease surveillance across Africa over the past decade. In July 2023, Africa CDC and the World Health Organization (WHO) jointly launched a health security partnership aimed at strengthening capacity building in Africa in the areas of biosecurity, integrated disease surveillance, event surveillance, genomic surveillance, and epidemiological intelligence [10].

In contrast, developed regions focus on developing

intelligent management and systematic operations based on well-established healthcare systems, advanced technologies, and adequate resources. These regions have widely applied cutting-edge technologies such as the Internet of Things, artificial intelligence, and cloud computing to achieve real-time monitoring, rapid response, and precise intervention. For example, by integrating Artificial Intelligence (AI) and Internet of Things (IoT) technologies, the UK's National Health Service (NHS) has developed the "NHS Digital Health Hub" for real-time monitoring of the health data of patients with chronic diseases (e.g., diabetes, heart disease) and predicting the risk of deterioration by AI [11]. London's "DeepMind Health" project partnered with the NHS to analyze ophthalmic images using machine learning for early diagnosis of diabetic retinopathy [12]. In Australia, the "My Health Record" system (a national electronic health record) enables the sharing of patient data in the cloud and the use of AI to analyze epidemiological trends [13].

2.2. Model Innovation of Regional Collaborative Treatment

Research on regional collaborative treatment (RCT) focuses on resource optimization and service model innovation, forming a multilevel and multidimensional collaborative network. In terms of the service model, Rariy et al. (2021) designed a hybrid medical model, which effectively solved the accessibility problem of oncology patients in rural areas by means of employing the organic combination of telemedicine and face-to-face consultation [14]. The regional STEMI treatment network constructed by He et al. (2021) significantly improved the treatment efficiency of acute myocardial infarction patients through early optimization of hemodialysis reconstruction strategies [15]. At the management system level, Wang et al.'s (2021) study of the Korean cardiovascular disease control system showed that the integration of regional treatment centers with the national registry system significantly improved patient prognosis [16]. The Tuscany Rare Disease Network, described by Pieroni et al. (2023), demonstrated the role of a registration-based organization and management model in the treatment of rare diseases. Such regional networks can consolidate resources to improve the diagnosis and treatment of rare conditions [17]. Wiesner et al. (2024) state the necessity of improving clinical capability at the country, regional, and local levels to prepare for the occurrence of pandemics of future infectious diseases [18]. The collaborative model of such treatment can successfully increase the capability of the public health system to manage emergencies.

2.3. Special Challenges for Healthcare in Less Developed Regions

Digital health systems are hindered by weaker infrastructures in underdeveloped regions. Less developed regions face the triple barriers of geography, resources, and knowledge, which are further exacerbated by the digital divide during the implementation of EWS (Early Warning System) and RCT (Randomized Controlled Trial). The theory of the Digital Divide explains the extensive disparity between the extent of the underdeveloped areas' access to, utilization of, and benefit from the utilization of information technology. This disparity leads to a lack of capacity in telemedicine, data sharing, and intelligent monitoring in less developed regions, further exacerbating the unbalanced distribution of healthcare resources. A number of pieces of research have suggested that

the digital divide affects the utilization of health information and the allocation of health resources but more deeply, the capability of the public health responses.

The first is the impact of the geographic obstacles and the digital divide. The influence of the geographical obstacles was noted by Gong et al. (2020), with the outcome that burn cases in distant parts of Australia are in critical health danger due to the unavailability of adequate resources for emergencies [19]. The digital divide creates varying degrees of response and accessibility of information for preventing and controlling infectious diseases. The developed world is able to track cases in real-time with the help of intelligent detection systems. In contrast, the underdeveloped world remains outdated in delivering information due to the unavailability of Internet infrastructure, which hinders epidemic prevention and control timeliness. Nakayama et al. (2023) noted that the underdeveloped areas are hindered by the weaker infrastructure that restricts the utilization of the health technologies that are digital in nature, making it challenging for the underdeveloped area patients to benefit from the distant diagnosis and treatment of the health conditions [20].

Secondly, the challenge of the scarcity of resources and knowledge up-dates presents itself. Bieliński and Jaśkiewicz's (2021) research revealed that the knowledge of lifeguards conducting first aid skills, such as the management of the airway and ventilation, lacked knowledge up-dates and lacked up-dates of the first aid knowledge and up-dates of resources, reflecting inadequate first aid training and knowledge updating in resource-poor areas [21]. Valentia's study revealed that the uneven distribution of digital health resources puts low-income people and those with less education at a disadvantage in accessing medical information [22]. Lastly, Han & Kumwenda (2024) revealed that the non-systematic updates of the training of the first responders in underdeveloped areas will impact the success of the implementation of the RCT [23].

Thirdly, health literacy and the utilization of technology are hindered by boundaries. With the utilization of digital health technology, the utilization of a microfluidic point of care (POC) device that offers a realistic solution for early diagnosis of underdeveloped areas was proposed by Yang et al. (2022) [24]. However, owing to the low rate of digital literacy, most inhabitants are incompetent in utilizing telemedicine and digital health tools effectively [25], and incorrect knowledge under emergency treatment conditions may lead to negative consequences. Misinformation and the unavailability of health literacy in underdeveloped areas are likely to escalate the challenge of providing first aid [26]. Wiesner et al.'s (2024) study indicated that the capability of underdeveloped areas to handle infectious diseases can be increased remarkably by health worker education and health area networking [27].

In summary, the study of EWS and RCTs has contributed extensively toward technological advancements and optimizing systems but remains confronted with the challenge of uneven allocation of resources, health inequalities, knowledge communication barriers, and the divide between the digital haves and the haves-nots. Multi-level interventions are required to enhance the accessibility of health care in underdeveloped areas. Firstly, more serious investments should be placed in developing infrastructure to enhance Internet coverage and extend telemedicine services to distant areas. Secondly, the education of health professionals should

be enhanced to improve the digital health literacy of the first responders and the population of the area to enhance the utilization of digital health resources. Meanwhile, the authorities should promote equitable digital health policies by providing Internet subsidies for the underprivileged population to make digital health resources accessible to everybody. Lastly, digital health solutions should be locally adapted by involving the population of the area and the multi-sectoral coordination to enhance the equitable allocation and efficient utilization of healthcare resources.

3. Prevention and control practices in less developed regions

The International Health Regulations (IHR 2005), which were revised by the World Health Organization (WHO) in 2005, are the legal basis for national infectious disease control and emergency response. Countries are expected by the IHR to be endowed with "core competencies" that they are capable of monitoring, reporting, responding to, and preventing cross-border health occurrences. Specifically, it insists that countries should be endowed with a complete mechanism of surveillance such that the World Health Organization (WHO) receives notice of the occurrence of emergencies of international health concern (PHEIC) within 24 hours and that the initial responses are triggered instantly [28]. This multilateral treaty not only creates binding legal obligations under international law but also facilitates the development of standardized cooperation frameworks through its provisions for regional coordination mechanisms and technical capacity-building initiatives. When building a regional synergistic infectious disease early warning and emergency management system in less developed areas, the IHR standards must be strictly adhered to to ensure the system's legitimacy and internationalization. Nevertheless, since less developed areas have limited resources, they still encounter numerous difficulties in the actual implementation process, such as poor medical infrastructure, low informatization, and inadequate public health management capacity. Hence, it is necessary to develop adaptable prevention and control measures based on local realities.

3.1. Community-oriented grassroots prevention and control

Today, the pillars of prevention and control of infectious disease for less developed regions are the community health workers. With portable equipment and simplicity of training, these workers are assigned with early detection, health education, and monitoring cases at the grassroots level. For example, in sub-Saharan Africa, CHWs have achieved early detection and control of many infectious diseases through regular visits and health education. The Community Sentinel System in Nigeria sensitizes the local public health system by mobilizing community volunteers to monitor suspicious cases [29]. Additionally, primary health care providers work with local governments to establish emergency notification mechanisms to report community cases to the regional disease control centers rapidly. This bottom-up prevention and control model can significantly improve the detection rate of infectious diseases and reduce the risk of epidemic spread.

3.2. Promotion of low-cost technologies

Many less developed regions have adopted low-cost health monitoring and reporting technologies to compensate for the

shortage of medical resources. For instance, in India and Bangladesh, SMS platforms are widely used to report the number of cases and health surveillance is conducted with the help of simple sensors and mobile technologies. These technologies not only reduce the cost of prevention and control but also significantly improve the timeliness of infectious disease detection. India's eVaccine Intelligence System (eVIN) uses mobile applications and data analysis for efficient vaccine delivery and proper vaccine storage and utilization management [30]. Further, the rise of telemedicine and AI-supported diagnostic devices presents new solutions for rural populations. Several countries in Africa utilize AI-based automatic image analysis systems to diagnose conditions such as skin conditions and tuberculosis using mobile phones, increasing the diagnostic ability of primary physicians.

3.3. Support from International Assistance

Global health organizations and non-governmental agencies (NGOs) provide technical and financial support for underdeveloped regions. For example, the Global Alliance for Vaccines (GAVI) contributed toward improving immunization programs for more children to be reached by fundamental immunizations [31]. Global agencies, including the World Bank and the United Nations Development Programme (UNDP), accelerated the implementation of health infrastructures [32] and improved health conditions. The "Belt and Road" initiative provided financial and technical support for enhancing African and Asian medical systems. The China-Africa Friendship Hospital, built with the assistance of Chinese support, has installed modern medical equipment for most African countries and enhanced local medical professionals' ability to provide technical education [33].

Moreover, Internet of Things (IoT) technology has also been promoted in aid projects. For example, IoT-based telemedicine systems have been applied in some parts of Africa to achieve cross-regional interconnection of medical resources and improve the accessibility of healthcare for patients in remote areas. Such international cooperation has effectively made up for the shortage of resources in less developed regions and enhanced the response capacity of local public health systems.

4. Prevention and control practices in developed regions

4.1. Efficient data collection and sharing

Developed regions rely on national-level disease surveillance networks to realize multi-sector and multi-region data sharing. For example, the U.S. Centers for Disease Control and Prevention (CDC) launched the BioSense program in 2003, aiming to establish a national public health surveillance system. The system enhances the nation's ability to rapidly detect, quantify, and localize public health emergencies by collecting and analyzing pre-diagnostic health data [34]. In 2011, the CDC redesigned BioSense and launched BioSense 2.0, a cloud-based environment controlled by state and local health departments for managing integrated surveillance information [35]. It enables the receiving and processing of syndromic surveillance data within the safety of the state systems for the purpose of expanding the state systems' ability for surveillance.

In addition, between Member States of the EU, the

European Network for the Surveillance and Control of Infectious Diseases (ECDC) has been instituted to share disease information at the borders and formulate joint response strategies [36]. The coordination of ECDC has enabled tight cooperation between the member countries of the EU for the surveillance and control of infectious diseases, for sharing disease information at the borders, and for formulating joint response strategies. It establishes good foundations for the overall health security of the population within the EU.

4.2. Intelligent diagnosis and surveillance

In the developed world, extensive use of diagnostic and surveillance technologies including wearable devices, environmental sensors, and diagnostic systems with the assistance of artificial intelligence are evident. A good illustration of such use includes the implementation of wearable real-time for tracking the vital signs of COVID-19 patients by a hospital in the UK using a wearable chest patch and fingertip pulse oximeter worn at the fingertip. The system continuously estimated and transmitted vital sign signals of ambulatory subjects within the ward. The system minimizes the health worker's risk of infection while providing efficient continuous patient tracking [37]. The NHS of the UK also experimented with the use of an artificial intelligence device named Aire that determines the likelihood of heart disease and early death by analyzing the outcome of electrocardiogram test results. The device detects structural heart abnormalities likely unnoticed by physicians and flags such patients for enhanced monitoring, testing, and treatment. Early trials showed that Aire was 78% accurate at determining the likelihood of death within 10 years of the patient [38]. The intelligent system enhances the efficiency of the allocation of medical resources and presents correct decision support for the prevention and control of the population at the population health level.

4.3. Transnational Collaboration and Global Perspective

Many developed countries actively participate in global health collaborations, such as supporting the Global Influenza Surveillance and Response System (GISRS) of the World Health Organization. GISRS provides real-time surveillance of novel influenza viruses through a worldwide network of laboratories and ensures the rapid development and distribution of vaccines [39]. European and North American countries have strengthened cooperation through the Global Health Security Initiative (GHSI) to jointly develop prevention and control strategies [40].

Overall, prevention and control practices in developed regions are centered on technological innovation and global collaboration, with an emphasis on data-driven decision-making and intelligent management. In the era of globalization, these experiences are of great significance to less developed regions and can help them to improve their infectious disease surveillance capacity and public health system construction.

5. Construction of an intelligent regional health security monitoring and emergency treatment platform in Ganzhou

Ganzhou, Jiangxi is one of the larger prefecture-level cities

in China, with 18 counties and cities under its jurisdiction, most of which are rural or less developed regions with high population mobility and uneven distribution of medical resources. Although Ganzhou has a high level of medical care, the county hospitals and township health centers still suffer from a lack of medical resources, with low informatization and a lack of regional collaborative treatment capacity. Especially in sudden outbreaks of infectious diseases or public health events, county-level medical institutions are often unable to independently accomplish early identification, rapid response, accurate triage, and efficient treatment, resulting in overloading of primary hospitals, difficulty in timely transfer of critically ill patients, and mismatched medical resources. This study draws on the experience of regional collaborative treatment in developed and less developed regions at home and abroad and designs and builds a regional infectious disease early warning and emergency management system construction with Ganzhou as the research background.

5.1. Objectives and System Architecture

The core objectives of this system construction include four aspects: firstly, to improve the county-city regional collaborative treatment capacity and to realize cross-regional emergency dispatch, remote diagnosis, and resource sharing. Secondly, to optimize the dynamic deployment of emergency resources and to enhance the efficiency of ambulance dispatching, ICU bed allocation, and emergency medical transfer. Thirdly, to strengthen early warning and intelligent triage of infectious diseases and to enhance the ability of primary hospitals to respond to outbreaks. Fourthly, to promote low-cost digital health management programs to improve rural residents' health literacy and self-monitoring ability.

The system adopts a five-layer architecture design, including the data collection layer (county-city hospital linked information sharing, IoT health monitoring), the data transmission layer (5G+NB-IoT network supporting remote monitoring), the data analysis layer (AI-assisted diagnosis, intelligent first-aid scheduling), the decision-making support layer (regional medical emergency management and treatment linkage), and the application layer (integrated medical services and health management).

5.2. Innovations of the Regional Cooperative Emergency Medical System

The core innovation of this system is to establish a "city and county integrated regional cooperative treatment network," focusing on solving the problems of dispersed emergency resources, irrational scheduling, and weak cross-regional cooperative treatment capacity in less developed regions. It mainly involves three aspects of innovation and optimization.

(1) Optimization of regional emergency dispatching and ICU resources. On the one hand, there is the intelligent ambulance dispatching system. The Intelligent Ambulance Dispatch System will integrate the 120-emergency system, Beidou positioning, and real-time traffic monitoring to optimize cross-county ambulance dispatching and improve emergency response speed. The system predicts the peak demand for first aid through AI+big data analysis and optimizes the scheduling strategy to ensure the reasonable distribution of medical resources. The system has set up "Emergency Vehicle Transit Stations" in counties and

townships to reduce the idling rate of long-distance ambulances, improve ambulance turnover efficiency, and enable critically ill patients to arrive at hospitals with treatment capacity more quickly. At the same time, the ambulance is equipped with a remote medical support system, which can be connected to the experts of municipal hospitals through 5G video on the way of transfer, and remote consultation can be conducted in advance to gain time for the treatment of the patients after they arrive at the hospital. In addition, the system is linked with the intelligent ICU bed allocation system to inquire about bed occupancy in real-time, ensuring that emergency patients are sent to hospitals with available ICU resources and avoiding delays in treatment due to hospital saturation. On the other hand, there is a regional sharing platform for ICU beds. The system will establish an "Intelligent ICU bed allocation system" for the county and city, provide real-time monitoring of ICU bed occupancy in each hospital, and optimize inter-hospital patient transfer. The LSTM time series prediction model will predict the demand for beds in advance, reducing the risk of patients being stranded in primary hospitals. The transfer mechanism follows the principles of "hierarchical diagnosis and treatment, dynamic transfer" and "intelligent scheduling, accurate matching." Slightly ill patients stay in county ICUs, while seriously ill patients are prioritized to be transferred to municipal hospitals by intelligent scheduling, ensuring that high-end resources are focused on treating critically ill patients. The system uploads ICU bed occupancy rate, condition score, and other real-time data through EHR. It shares them with the ambulance system, emergency department, and call center to ensure accurate dispatching. At the same time, it adopts cloud computing and blockchain to store ICU data to ensure data security. It combines with GIS maps to visually display the use of beds in the city's hospitals to optimize patient triage and treatment paths.

(2) Remote medical treatment and AI-assisted diagnosis. This system will build a county-city telemedicine consultation platform, combined with AI intelligent assisted diagnosis, to improve the diagnostic capability of primary medical institutions, realize remote collaboration between primary doctors and city-level experts, and improve the efficiency of identifying and treating difficult diseases. Relying on 5G+ HD video diagnosis and treatment, the telemedicine system realizes real-time transmission and sharing of patients' cases, images, and testing data, and allows primary care doctors to remotely connect with experts from Ganzhou People's Hospital, Affiliated Medicine of Gannan Medical University, and Affiliated Medicine of Nanchang University Hospital for consultation and precise formulation of treatment plans, and improves primary care doctors' diagnosis and treatment level through remote training at once. Moreover, the system integrates AI intelligent assisted diagnosis, which automatically analyzes electronic medical records (EHR), imaging data, and laboratory test reports to provide identification of infectious diseases, risk assessment, and personalized treatment recommendations, reduce the rate of misdiagnosis at the grassroots level, and optimize the allocation of medical resources. Meanwhile, intelligent triage stations are set up in counties and townships, equipped with oximeters, remote PCR detectors, mobile ultrasound and other equipment for early screening of high-risk diseases. It supports WeChat applets to upload residents' body temperature, blood oxygen, heart rate and other data to build an intelligent health monitoring system for epidemic risk

warning and chronic disease management. The system will improve the efficiency of remote consultation, enhance the diagnostic capacity of grassroots, optimize the distribution of medical resources, effectively narrow the gap between medical resources in counties and townships, and build an intelligent medical service system.

(3) Implementing information sharing and emergency linkage. This system will set up the Ganzhou Regional Medical Dispatch Command Center, integrating the 120 emergency systems, city and county hospitals, and CDC to realize unified dispatching and efficient collaboration of medical resources. Relying on blockchain and federated learning technology, it ensures that patient medical records, examination reports, and ICU bed occupancy are securely shared among tertiary-level A hospitals in Ganzhou, as well as county hospitals in neighboring counties and cities, and optimizes inter-hospital transfer of critically ill patients. Combined with GIS visualization analysis, the command center can monitor the spreading trend of the epidemic and medical resources reserves in real-time and dynamically optimize the scheduling of 120 ambulances to ensure that patients are sent to the optimal treatment institutions. At the same time, the system will build a multi-departmental collaborative mechanism of "Health Commission + Hospital + Emergency Center + CDC". Relying on the CDC's epidemic monitoring, intelligent logistics scheduling, regional blood supply sharing, and other functions to improve epidemic prevention and control and medical supplies deployment capacity. At the same time, do a good job of health management of key populations through linking community health service centers and township health centers. By establishing a health management mechanism for patients with chronic diseases and the elderly, as well as optimizing vaccination and monitoring of high-risk groups, the accuracy and accessibility of public health services will be improved. The system will comprehensively improve the scheduling efficiency of medical resources, the emergency response capability of public health emergencies, and the collaborative operation capability of hospitals in Ganzhou, realizing the optimal allocation of medical resources and safeguarding the health and safety of the public.

5.3. Feasibility Analysis

The construction of this system requires comprehensive consideration of the current situation of medical resources, information technology infrastructure, and policy environment in Ganzhou, and the following feasibility analysis is conducted in terms of technical, economic, social, legal, and policy aspects.

(1) Technical feasibility

In recent years, Ganzhou has been vigorously developing 5G infrastructure under the impetus of the "Digital Ganzhou" construction plan. Many counties and cities such as Zhanggong District, Nankang District, Ruijin City, Xinfeng County, and other counties and cities have already built 5G base stations and preliminarily deployed low-power networks such as NB-IoT/LoRa, which provide a sound technical foundation for telemedicine and intelligent first aid systems.

In addition, some medical institutions in the city have introduced smart wearable devices, blood oxygen meters, and mobile PCR detectors. This plays a positive role in epidemic prevention and control, as well as chronic disease management, and can provide experience for promoting this system.

At present, municipal hospitals such as the First Affiliated Hospital of Gannan Medical University and the Second Affiliated Hospital of Gannan Medical University have introduced AI-assisted screening in imaging diagnosis (including AI image recognition and analysis system for pulmonary artery, aorta, heart, lower limb blood vessels, and prostate). Some county hospitals have started to apply it on a pilot basis, improving grassroots doctors' diagnostic precision and reducing the risk of misdiagnosis. Meanwhile, some county-level hospitals in Ganzhou have established telemedicine cooperation with the Affiliated Hospital of Nanchang University, Jiangxi Provincial People's Hospital, Ganzhou People's Hospital, and the Affiliated Hospital of Gannan Medical University, realizing teleconsultation, medical record sharing, and teleimaging diagnosis, and possessing the technological foundation for further promotion.

In terms of medical data sharing, the traditional problem of medical data silos can be ensured by blockchain technology to ensure safe data sharing and improve cross-hospital data interoperability. Ganzhou is promoting smart healthcare, and municipal hospitals have initially realized the interconnection of electronic medical records (EHR). Combined with federated learning technology, it will further enhance regional medical data synergy and support intelligent ICU bed management and cross-hospital emergency scheduling.

(2) Economic feasibility

With the rapid development of intelligent medical equipment, the cost of telemedicine equipment such as intelligent diagnosis and treatment terminals, 5G teleconsultation equipment, and mobile PCR detectors has dropped significantly and has been applied in most municipal hospitals as well as some county hospitals, and has the feasibility of large-scale promotion. Meanwhile, implementing the government's medical informatization subsidy policy will further promote the infrastructure upgrade of county and rural hospitals and reduce the burden of informatization construction of primary medical institutions. The system will be based on 120 emergency systems, municipal hospitals, county hospitals, and township health centers in Ganzhou. It will improve the efficiency of medical resource utilization by optimizing resource dispatching instead of building additional large-scale medical institutions. Therefore, the overall investment is low. Meanwhile, the intelligent emergency dispatching + regional ICU bed-sharing model will effectively reduce the phenomenon of idle beds and empty ambulances, reduce the waste of medical resources, and improve the efficiency of medical services.

In terms of medical insurance and government support, Ganzhou has implemented the "hierarchical diagnosis and treatment system," the government guides patients to seek reasonable medical treatment through medical insurance policies. The implementation of this system will further optimize the flow of medical resources in counties and cities and improve the efficiency of using health insurance funds. In addition, the Jiangxi Provincial Government has increased its investment in "Internet + Healthcare" in recent years. Ganzhou can apply for special funds for national medical informatization, grassroots health capacity enhancement projects, and other policy support to ensure the long-term sustainability of the system construction.

(3) Social feasibility

Ganzhou Municipal Government attaches great importance to regional medical synergy. At present, Ganzhou has been actively promoting the construction of provincial and

municipal "regional medical centers" and has set up telemedicine centers in municipal hospitals such as the First Affiliated Hospital of Gannan Medical University and the People's Hospital of Ganzhou, which provides strong policy support for the construction of smart healthcare. Furthermore, the "Healthy China 2030" strategy promotes the development of medical digitalization and the construction of intelligent emergency dispatching and telemedicine systems to meet the needs of the national public health management, which has the value of nationwide promotion. Moreover, the improvement of residents' health awareness also provides a good social foundation for the promotion of this system.

In recent years, residents of Ganzhou have significantly increased their acceptance of telemedicine and intelligent health management. They are willing to obtain medical services through online consultation and intelligent monitoring to reduce the pressure of hospital visits. In the meantime, since medical resources are more limited in rural areas of Ganzhou, implementing this system can provide better quality medical resources to remote areas through intelligent triage stations and telemedicine, improve the fairness of medical services, and enhance the satisfaction of residents.

(4) Legal and Policy Support

This system is construction aligns with the policy direction of the national and local governments on medical informatization. The "Healthy China 2030" planning outline explicitly proposes accelerating medical digitization, encouraging telemedicine, AI diagnosis, and regional medical resource integration [41], which provides policy support for the construction of this system. Meanwhile, the Guiding Opinions on Promoting and Regulating the Development of Healthcare Big Data Applications stipulates the requirements related to medical data management, sharing, and privacy protection [42]. This system guarantees data security and compliance through blockchain and federated learning technology to ensure medical data management complies with national regulations.

Additionally, this system is constructed by the framework requirements of WHO's International Health Regulations (2005) to ensure data management legitimacy and cross-border collaboration capabilities. Local governments are also actively promoting smart healthcare reform. The Ganzhou Municipal Government has proposed in the "14th Five-Year Plan for Healthcare Development in Ganzhou" to accelerate the promotion of "Internet + Healthcare" services, regional medical informatization, and the construction of emergency response capacity for public health emergencies, which is a good opportunity for this system [43]. Besides, the Jiangxi Provincial Health Commission has launched the pilot project of "smart healthcare + county medical community," and the construction of this system fits the direction of this policy. It can obtain financial and policy support to ensure a stable long-term operation.

This study proposes the construction of an intelligent regional health security monitoring and emergency treatment system based on intelligent first aid dispatch, telemedicine, and intelligent monitoring in an integrated manner, taking into account the distribution of medical resources, the level of information technology development, and the policy environment of Ganzhou. The construction of this system will effectively enhance the county-city integrated emergency care network, optimize cross-regional medical resource dispatching, improve the ability of grassroots hospitals to

identify and treat infectious diseases and utilize technologies such as IoT, blockchain, and AI to achieve intelligent epidemic early warning and improve the ability of emergency response to public health emergencies.

6. Conclusion

This study proposes a conceptual framework for an intelligent regional health security monitoring and emergency treatment platform. Aiming at the problems of shortage of medical resources, lagging informatization, and insufficient regional synergy in underdeveloped regions, it discusses how to utilize the Internet of Things, big data, cloud computing, and artificial intelligence to achieve efficient and synergistic management of infectious disease early warning, health monitoring, medical resource scheduling, and emergency rescue and treatment. The framework designed in this study aims to enhance disease identification and achieve early intervention through telemedicine and AI-assisted diagnosis, as well as optimize ICU bed scheduling and emergency resource allocation to improve the efficiency of treatment for critically ill patients, and improve the collaborative treatment capability among medical institutions and reduce resource mismatch through the county-city medical linkage mechanism. Moreover, the application of cloud computing and telemedicine systems can reduce the cost of infrastructure construction and make the system more sustainable. In the healthcare context of Ganzhou, the solution proposed in this study will combine the functions of regional medical collaboration, intelligent health monitoring at the primary level, and intelligent ICU bed scheduling to optimize the allocation of medical resources in a low-cost and high-efficiency model and improve the response capacity to public health emergencies. As Ganzhou has a good foundation in 5G network coverage, intelligent medical equipment pilot, telemedicine promotion, etc., and the government's support for the "Healthy China 2030" strategy and the development of regional healthcare collaboration provides a favorable policy environment for the construction of the system, the platform has a high degree of technical, economic, social and policy feasibility. However, the study still faces challenges such as medical data sharing, privacy protection, technical adaptability of primary healthcare institutions, and policy and financial support. However, the study still faces challenges such as medical data sharing, privacy protection, technical adaptability of primary care organizations, and policy and financial support. Future research should further optimize the AI multi-source data fusion early warning system, build a cross-regional collaborative treatment network, and explore more economically adaptable and low-cost medical informatics solutions. Furthermore, strengthening government support and inter-provincial cooperation will help promote the long-term sustainable development of the system.

In conclusion, the intelligent regional health security monitoring and emergency treatment platform framework proposed in this study can provide less developed regions with feasible ideas for optimizing the allocation of medical resources, enhancing the ability to prevent and control infectious diseases, and strengthening the management of public health emergencies, as well as providing a model that can be used in other similar regions.

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