

## STATE OF THE REVIEW ON INTEGRATED EMERGENCY RESPONSE AND TELEHEALTH SYSTEMS FOR ENHANCED CRISIS MANAGEMENT

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**Purpose:** This study examines the purpose, methodology, findings, and originality value of implementing telemedicine in tertiary hospitals across different regions of China. The primary purpose is to address the significant imbalance in medical resources between urban and rural areas by leveraging telehealth systems, particularly focusing on the development and application of telemedicine.

**Methodology:** The research employs a mixed-methods approach, incorporating a literature review, surveys, and statistical analysis. Questionnaires, designed by telemedicine experts, were distributed to 185 tertiary hospitals, with a focus on telemedicine implementation, application, and key contributing factors. The survey design is optimized to represent the diversity of China's healthcare landscape.

**Findings:** The findings reveal a stark contrast in healthcare resources between the eastern, central, and western regions of China. Telemedicine platforms have been established in 22 provinces, covering 13,000 medical institutions. Tertiary hospitals, especially in the eastern region, play a pivotal role in providing telemedicine services. The study outlines the challenges, financial aspects, and factors influencing the success of telemedicine implementation in China.

**Originality Value:** This research provides original insights into the development of telemedicine in China, focusing on the telehealth system's impact on healthcare accessibility. It explores the educational background of telemedicine staff, funding sources, and the role of government support. The study also identifies key challenges and implications for practical telemedicine applications in addressing healthcare disparities, emphasizing the transformative potential of telemedicine in China's healthcare landscape.

**Keywords:** crisis management, emergencies, telehealth system.

**Category of the paper:** Review article.

## 1. Introduction

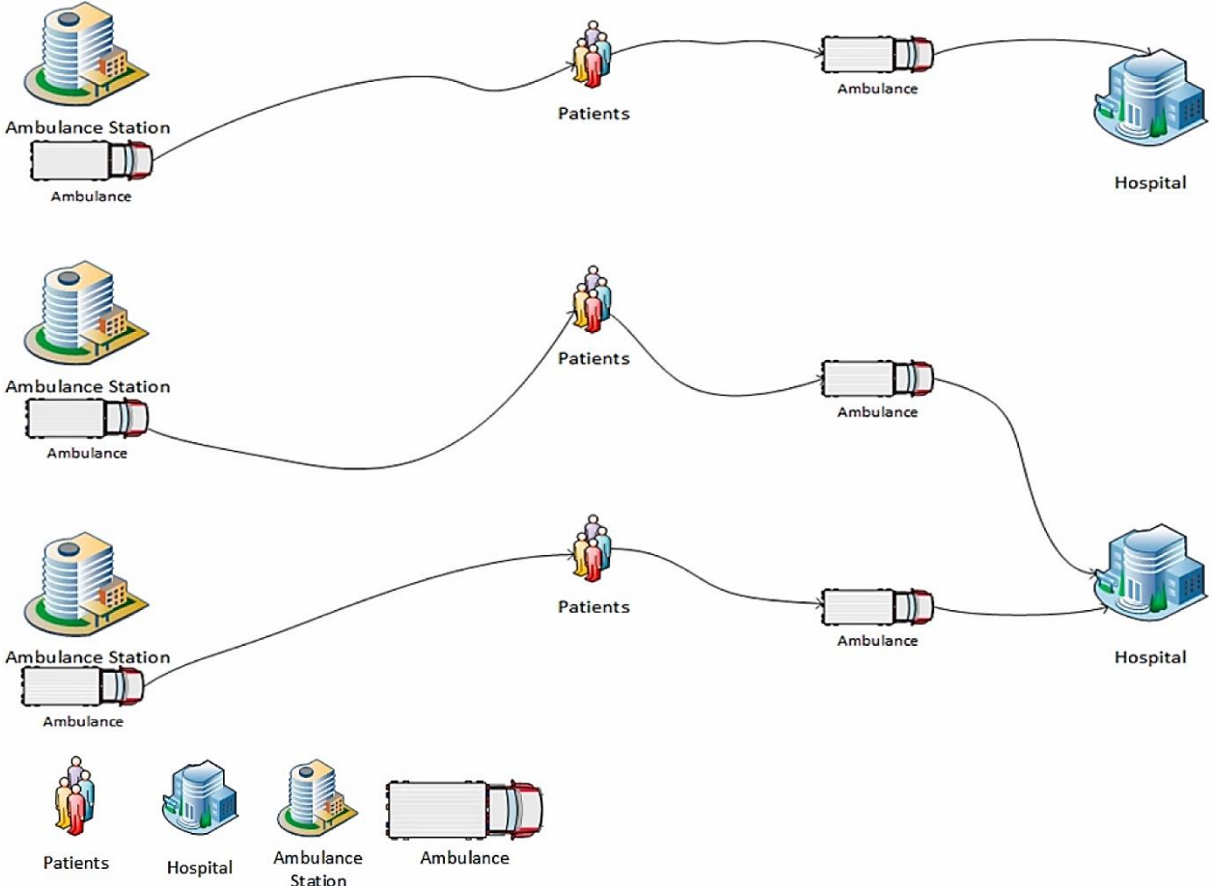
Today's world is a complex and rapidly evolving world. There are significant challenges faced by public safety due to crises and emergencies in which swift and coordinated responses in all sectors are important. Certain innovative approaches are integrated into the health sector to revolutionize crisis management. The integration of the emergency response system and innovation of these approaches within the transport sector along with the utilization of telehealth tools are important to manage the crisis in various sectors. This study shows the combination of integrating the emergency response system and the telehealth system along with the exploration; of how their convergence can lead to more effective and efficient responses to emergencies (Sutherland, Chakraborty, 2023, pp. 100256-100256). There is a interaction between emergency response systems operating within the transportation networks and the utilization of telehealth technologies in healthcare and this study aims to investigate the interaction between them. Integrating the emergency response system and the telehealth system are the two domains discussed in this study.

## 2. Emergency, Telehealth, transportation, medical transportation, cross-sectional (Medical & Telehealth)

Drones may be a very helpful means of transportation to help supply necessities, and they can be a vital tool to help vulnerable towns and populations get quick aid. Generally, the patient's arrival at the hospital was not delayed by the helicopters near landing and landing site position. In the future, helicopters could be able to view outdoors even in limited visibility thanks to technology. UAV helicopters can effectively carry water and emergency supplies to impacted locations, in place of road transportation or if there is no linked transportation network (Sutherland, Chakraborty, 2023, pp. 100256-100256).

Examining the intersection of these domains aimed at developing novel solutions fostering the improvement in coordination among emergency services and transportation networks along with the healthcare providers. The goal of this review is the enhancement of the outcomes and well-being of the individuals who require urgent medical attention during a crisis. A comprehensive review and analysis of the integration of emergency response systems and telehealth tools are being done in this article to highlight the potential for the transformation of crisis management practices. The interconnectedness between the integration of emergency response systems and telehealth systems is being explored and this exploration it's helpful for the pavement of the way for innovative strategies that are helpful for the optimization of resource allocation, and response time along the delivery of critical medical care during

emergencies and crises (Langabeer, Gonzalez, Alqusairi, Champagne-Langabeer, Jackson, Mikhail, Persse, 2016, pp. 713-720). The technique of cross-sectoral lens is adopted and the framework is cohesive for the alignment of emergency response protocols with transportation networks and telehealth capabilities in the healthcare sectors. Due to this integration, there is a paradigm shift in crisis management that ensures a more agile, responsive, and coordinated approach to addressing emergencies and crises in various sectors. There was an extreme burden on the health system of every country due to the introduction of the COVID-19 pandemic in which all the countries highlighted the need to strengthen their technology infrastructure. The below image shows the telehealth and transportation response in the emergency.



**Figure 1.** The suggested system for ambulance dispatch and Telehealth role in emergency response management.

Source: Sutherland, Chakraborty, 2023.

Figure 1 explains the quick response in an emergency by implementing telehealth to support the transportation system. The telehealth installed in the ambulance helps the doctors to connect with the patients and help to get the first emergency report of the patient and can do the treatment on time by decreasing the response time delay. Figure 1 depicts a model consisting of ambulance stations and hospitals, respectively. The maximum time an ambulance can take is marked by. This then creates the static nodes. The model will use the road network represented by the Open Street Map. This is an open-source mapping organization that allows you to create probable routes that will be used to build the model's routing data. To verify that it is the most

efficient way, a quality assurance process will be implemented. Telehealth was the system that was introduced for the virtual health and care of patients outside of traditional clinical settings. The healthcare delivery was efficiently and effectively improved due to the integration of a telehealth system that includes the patient's triage, consultation, treatment, and clinical care along with the education of healthcare workers and patients. To successfully represent ambulance travels across a local region, time on scene and hospital wait times must be factored into the model. The fairness of each patient will also be considered to guarantee that all patients in the region are served by an ambulance enroute, on the scene, or transported to the hospital, and these time limits are represented in the ambulance routing paper. Figure 1 depicts the suggested patient routing model, in which the patient group represents the number of patients at a place, ambulances are routed between patient groups and the hospital, and ambulances are redeployed from the hospital to a new patient. To reduce the spear impacts of COVID-19 in developing countries and low and middle-class countries with limited resources and constrained economic situations, there was the introduction of a telehealth system and integration of a response system. The rural population of China was reported 38.57% of the total population of China. China made a lot of huge investments in healthcare and several major healthcare reforms in China. Despite this huge investment, the health outcomes continue to widen the rural-urban divide in the healthcare resources of China (Cui, He, Liu, Zheng, Wei, Yang, Zhou, 2021, pp. 103-115). During the COVID-19 pandemic, there was a disparity that posed an even larger threat because timely and high-quality healthcare services were important for vulnerable populations in rural areas. The telehealth system was based on technological infrastructure along with sufficient economic support.

Along with the economics board, there were well-trained workforces and target use populations with higher digital literacy. However, the countries having limited resources and no established infrastructures were unable to apply these implications. Thus, it becomes important to understand and share sustainable strategies for the implementation and adaptation of telehealth systems in developing countries. This search aims to understand and summarize the characteristics, challenges, and successful experiences in the implementation of telehealth services in various sectors. There is an in-depth exploration of the implementation of these strategies along with insights into the characteristics of telehealth implementation. In addition, there is the application of this implementation size to synthesize the findings and offerings of practical strategies in developing countries. Specific recommendations are provided to build telehealth systems that include guidance on infrastructure and mechanisms valuable for developing countries that are looking to develop their telehealth capabilities (Cui, He, Liu, Zheng, Wei, Yang, Zhou, 2021, pp. 103-115).

### **3. Benefits of telehealth system**

Team-based care and interrelated care objectives are being supported with the help of a telehealth system (Hasselfeld, 2020). The benefits of the telehealth system are organized into four categories.

- Improved provider experience.
- Improved client experience.
- Improved population health.
- Decrease costs.

### **4. Improved provider experience**

Telehealth methods are applied by the providers to improve the quality of care they provide to the patients. With the help of the telehealth system, there is increased flexibility in appointment scheduling (Greenway Health, n.d.). There are a lot of civilians including 40 to 60 percent who are treated in primary care offices rather than especially clear settings. The underserved and rural areas and the people belonging to these areas benefit from this telehealth system because it can access the client's home environment with the help of screen sharing, then formation regarding therapeutic intervention or diagnosis can be provided easily allowing doctors to see the videos and slideshows of the client. The patients and clients can call emergency on the response system with the instruction given by the telehealth system in case of emergencies that provide emergency dispatchers with the location of the client. There are a lot of factors that are burned out by the patient in the pervasive issue including the time pressures, fast-based environments, and family responsibilities used with the help of deadly health systems because they provide greater flexibility introduction in commute time to the clients (Gajarawala, Pelkowski, 2021, pp. 218-221).

### **5. Improved client experience**

In the telehealth system, clients are experiencing many benefits from it regarding their mental health and other problems. It made it easy for the clients to reach the providers and the doctors that are distant away from their locations. The transportation and travel costs were reduced due to the telehealth system and its providence to the clients which increased the livelihood of the clients and they were able to attend the regular and scheduled appointments

with the providers. The geography and technological barriers were reduced with the help of the telehealth system and provide the opportunity to individuals in remote locations to access what they need and the clients who were experiencing panic disorders were able to receive care treatment in a very safe environment of their location (Maxson, 2023). In addition, individuals who have physical visual or hearing problems and some clients are isolated due to mental disorders can easily assess with the telehealth providers stop the clients do not have to take significant leave for their checkups. The burden of finding childcare is also reduced with the help of a telehealth system that provides home-based care to clients. The care and treatment provided to the clients are team-based services and group-based interventions by which multiple providers can connect remotely at the same time with the client along with the promotion of provider collaboration and the exchange of health information among them.

## **6. Improved population health**

Telehealth systems and treatment are based on telehealth systems as a result of the improvement in health outcomes along with the improvement in quality of life and access to healthcare (Collins, Johnson, Tyson, 2023). There are a lot of people who are facing serious mental issues without having any treatment due to limited resources. With the death of the telehealth system people have the opportunity to bring improvement in their quality of life and their mental health as well due to the reduction in depressive symptoms and more confidence in managing depression because of the increase in satisfaction with mental health and coping skills stop in addition there were a lot of people who were taking the alcohol index but with the help of the treatment based on telehealth system, there was a lot of reduction in alcohol consumption by those clients along with the degrees in tobacco cessation.

## **7. Research questions**

### **How can transportation infrastructure be optimized to facilitate faster and more efficient emergency medical responses by using Telehealth?**

Implementing advanced traffic management systems that leverage real-time data can help emergency vehicles navigate through traffic more efficiently. Smart traffic lights, dynamic lane control, and adaptive traffic signal timings can be employed to create green corridors for emergency vehicles (Jordan, 2023). Designating exclusive lanes for emergency vehicles can significantly reduce response times. These lanes can be strategically placed on major routes and highways, allowing ambulances and other emergency vehicles to bypass regular traffic.

During critical situations all over the world, emergency medical responses play a very pivotal role in saving the lives of thousands of people globally. But the emergency medical responses are only effective when the responses are provided on time and there is timely access to the health care facilities and resources for all people. To get swift and efficient medical assistance, there is a crucial component that plays its role which is transportation infrastructure. As we know telehealth technologies are being integrated into the healthcare system all over the world emerges a potential way to optimize the transportation infrastructure for the enhancement of speed and efficiency of emergency medical responses in various sectors (Kobeissi, Hickey, 2023).

Equip emergency vehicles with advanced communication and navigation systems. Integration with traffic management systems can provide real-time updates on optimal routes, traffic conditions, and potential obstacles, allowing emergency responders to make informed decisions. Enhancing public awareness about yielding to emergency vehicles and educating drivers on proper behavior when an emergency vehicle is approaching can further improve response times ([www.linkedin.com](http://www.linkedin.com)). Public campaigns and educational programs can contribute to creating a more responsive and cooperative traffic environment.

Using telecommunication technologies is the basic characteristic of a telehealth system that helps provide healthcare remotely. The traditional landscape of medical services is transformed with the help of telehealth systems and telecommunication technologies all over the world. The efficiency and timeliness of interventions are augmented with the help of this integration into emergency medical responses (Williams, Tremblay, 2019). By seeking the help of platforms related to telehealth systems it has become very easy and accessible for professionals and doctors to assess and diagnose patients and clients by providing them with immediate guidance in emergencies (Feng, Pan, 2021, pp. 1-10).

Pre-positioning ambulances and emergency medical resources in strategic locations, such as high-incident areas or near major events, can expedite response times. This involves predictive analysis and coordination between emergency services to anticipate potential demand (Utilities One, n.d., *The Impact...*). Implement and enforce legislation that supports the prioritization of emergency vehicles on the road. This may involve legal measures to penalize non-compliance with rules related to yielding the right of way to emergency vehicles.

Now patients can seek the healthcare facility and their treatment can be initiated even in their comfort zone without reaching the healthcare system. A lot of time was required at an early age to make critical medical decisions but now the telehealth system has made this process easy potentially saving precious moments that are crucial for patients in critical conditions (Sullivan, Hadi, Allen, 2016; Mohammadzadeh, Saeidnia, Lotfata, Hassanzadeh, Ghiasi, 2023). It has become very imperative to optimize transportation infrastructure to leverage the potential of telehealth in emergency medical responses. Several strategies can be employed to achieve the optimization of transportation infrastructure in the healthcare system. With the help of

telehealth systems, it has become very easy to enable real-time data sharing between emergency responders and healthcare professionals.

The integration of a telehealth system in the healthcare system makes sure that the responders have the accessibility to crucial patient information and medical guidance during transit. They also helped the patients with swift decision-making and appropriate pre-hospital care. The optimization can also be achieved with the help of the implementation of an advanced routing and navigation system that considers real-time traffic data and medical facility proximity. The integration of this system healthcare system can be optimized through the identification of the most efficient routes for emergency vehicles that are further helpful in the reduction of transit times to healthcare facilities.

Ensuring robust telecommunication networks and connectivity can also be helpful in the optimization of telehealth systems along transportation routes for the facilitation of uninterrupted communication between emergency responders and healthcare providers. For seamless telehealth operation during transit, high-speed Internet and reliable communication infrastructure can also optimize the telehealth system. According to Mathews et al., another important strategy that would be helpful in the optimization of the telehealth system is the emergency vehicle design and infrastructure because due to the design emergency vehicles that are equipped with telehealth technology are helpful in interfacing and medical equipment for supporting immediate interventions. In addition, if we established designated lanes and priority access on roads for emergency vehicles then it would be significantly helpful in the expedition of their transit (Amjad, Kordel, Fernandes, 2023, p. 6655).

Comprehensive training can also be provided for the optimization to achieve the best telehealth system for emergency responders for the utilization of telehealth technologies effectively if we familiarize them with the operation of medical equipment and telecommunication systems that are integrated into weaknesses then it would be a very effective strategy. There are multifaceted benefits to optimizing transportation infrastructure for telehealth integration and emergency medical responses (Little, 2021). The response time is reduced and the patient outcomes are enhanced with it along with the optimization of resource utilization although several challenges need to be addressed including the infrastructure costs, data security concerns, and the need for standardized protocols and regulations governing telehealth-enabled emergency responses.

### **What role can telehealth technologies play in providing initial medical support during transportation-related emergencies?**

There are a lot of significant challenges that are posed by transportation-related emergencies. As we know immediate medical transport and support are necessary to post certain challenges faced by patients in which transportation-related emergencies are significant. To deliver initial medical aid during critical situations of the patient's telehealth technologies have emerged as an indispensable tool (Haleem, Javaid, Singh, Suman, 2021).



There are multifaceted roles of telehealth technology to provide crucial medical support during transportation-related emergencies. With the help of telehealth technologies, there is a complete facilitation of real-time communication between the patient and the healthcare professionals.

Video conferencing and teleconsultations have been adopted in this system with the help of which paramedical and first responders can quickly connect with the medical experts. It enables them to seek timely guidance and decision-making regarding patient care. The quality of initial medical support is enhanced with the help of this instantaneous access to specialized advice matters even in remote or inaccessible locations (Managed Healthcare Executive, n.d.). It was difficult in earlier times for the professionals to reach the take care facilities of the patient before they were in the same location but now with the help of telehealth applications telehealth professionals have access to the patients remotely about their condition in emergencies. In addition, accurate decision-making is very important and prompt during transportation-related emergencies.

With the help of telehealth technologies healthcare professionals have access to medical protocols, diagnostic support, and specialized guidance with the help of which they can make critical decisions without reaching the exact location. Due to this support, it becomes easy for healthcare professionals to suggest appropriate medical interventions to the patients by advising them on stabilization techniques. They can also optimize the chances of positive patient outcomes during transit to healthcare facilities. There is another benefit of the telehealth technology which is the continuity of care and follow-up because they can contribute to maintaining continuity of care beyond the immediate emergency response. They can also monitor and follow up on the patient's ongoing monitoring and follow-up consultation with the help of post-equalization during transportation and telemedicine facilities provided to them. Due to this reason, they ensure a seamless transition and continued medical guidance until the patient reaches the medical facility (Bokolo, 2021).

For sure the patient has to reach the healthier center but some of the patients go into very critical condition if they are not consulted with the doctor at the right time. Due to this reason, telehealth systems and telemedicine are necessary for them to make them stable enough until they reach the medical facility. It is very helpful for the providers and the patients to reduce the risk of deterioration during the transit and is also helpful in the enhancement of the overall patient experience as well (Stoltzfus, Kaur, Chawla, Gupta, Anamika, Jain, 2023). If we talk about the rural areas then it becomes very difficult for the people living in the rural areas to have access to immediate medical care. When availing the opportunities of the telehealth technologies it has become easy for the people residing in rural areas to bridge the gap between the healthcare professional and the patient as the geographical gap is bridged between them.

Telehealth technologies the remote locations are connected with healthcare expertise and with the help of this connection they have facilitated timely interventions and mitigated the impact of transportation-related emergencies in the underserved areas. This aspect of the telehealth system is crucial because they are playing a role in improving healthcare equity and

access, especially in areas where medical infrastructure is limited. In short, the literature concludes that telehealth system and their technologies are playing an invaluable role in the augmentation of initial medical support during transportation-related emergencies. They have provided the ability to provide real-time communication and are also playing their role in the remote assessment and decision-making assistance along with the continuity of care and overcoming geographical barriers. With the help of this system, there is enhancement and efficiency along with effectiveness in the medical services of emergencies because they save the lives of people during transportation-related emergencies (Hayden, Davis, Clark, Joshi, Krupinski, Naik, Ward, Zachrison, Olsen, Chang, Burner, Yadav, Greenwald, Chandra, 2021).

### **How can data sharing in real-time communication between emergency responders and healthcare professionals be improved to enhance patient care?**

It is evident from the research that patient care can be enhanced and improved by seeking the help of data sharing in real-time communication between emergency responders and healthcare professionals. One of the most important key strategies that can significantly enhance collaboration is the interoperable system and standardization. By implementing this system, it will become easy for the emergency response and healthcare platforms to communicate seamlessly. Different data formats can be standardized with the help of this system along with the terminologies that can all also be standardized (Quinn, Forman, Harrod, Winter, Fowler, Krein, Gupta, Saint, Singh, Chopra, 2019, pp. 241-248).

With the help of this standardization of data formats, technologies, and protocols, there would be an efficient exchange of information without loss of critical details between emergency response and healthcare platforms. The development of different integrated communication platforms is necessary for real-time communication between emergency responders and healthcare professionals (Li, Wang, Wang, Zhang, 2023, p. 127017). Due to these integrated communication platforms, it becomes easy to share real-time data about the patient including the vital signs, medical history, allergies, and ongoing treatment plans of the patient with responders. This platform would be helpful for both healthcare professionals and patients because both benefit from this system. Secure messaging, video conferencing, and file-sharing functionalities are supported securely with the help of an integrated communication platform of a telehealth system.

Another important key strategy is mobile health technologies including wearable devices and mobile applications (Webisoft, 2023). Utilizing these technologies would be helpful in the facilitation of the continuous monitoring of patient's health status. With the help of these mobile health technologies, it has become easy for emergency responders and health care professionals to get access to the real-time data of the patient and use them timely in decision making and interventions as well. It is very important to use communication technologies for sharing data between healthcare professionals and emergency responders because they are responsible for providing comprehensive training to these responders. If we make sure that all personnel are

adept at using these tools then the process of data sharing and communication during emergencies can be streamlined. Due to this reason training and education of emergency responders in healthcare professionals are necessary to utilize the communication technologies in the telehealth system.

Certain patients have sensitive information about their disease so it is very important to implement robust privacy and security measures to safeguard the sensitive information of the patient when you are sharing data with emergency responders and healthcare professionals. The development of a clear and concise protocol along with the guidelines is also necessary for sharing information and communicating between emergency responders and the healthcare professionals who are playing their role in the establishment of a standardized framework for collaboration between them. The roles, responsibilities, and procedures for effective coordination and collaboration between healthcare professionals and emergency responders should be outlined in the guidelines that are provided to them. The creation of a feedback mechanism is necessary to gather input from both emergency responders and healthcare professionals for the essential and continuous improvement that needs to be made in the telehealth system.

If the evaluation is made for the effectiveness and efficiency of communication strategies and data-sharing protocols between the emergency responders and healthcare professionals then it will allow for adjustments and enhancements to be made based on real-world experiences and challenges (Jordan, 2023). The development of advanced communication systems can be done if we encourage public-private partnerships and investment in innovative technologies of telehealth systems because they play a crucial role in tailoring specifically for emergency response and healthcare settings. In conclusion, we can say that the enhancement of data sharing and real-time communication between emergency responders and healthcare professionals needs a multifaceted approach and method. These multifaceted approaches and methods include technological advancements, standardized protocols, training, security measures, and continuous refinement when we implement these strategies in the telehealth system then there would be a consequence of collaboration between these two critical sectors and the relationship between them can be strengthened ultimately leading to improved patient care during emergencies (Utilities One, n.d., Communicating...).

## 8. Methodology

### Case study of China

Telehealth system and telemedicine were one of the most crucial methods used by the government of China to address the inequality of medical resources between urban areas and rural areas. One of the most important issues that is relevant to the national economy and the livelihood of people in China is medical care. Patients and people living in rural and remote areas do not have easy access to high-quality medical services in China (Cui, Ma, He, Zhai, Zhao, Chen, Sun, Shi, Cao, Wang, 2020). According to the survey made in 2018 in the 11 provinces in the east of China, there were 1047 tertiary hospitals and 1216 tertiary hospitals in 21 provinces of the central and western regions of China. There were high-quality medical resources in the developed eastern regions of China and a serious lack of health resources in the central and western regions of China.

Shreds of evidence were taken from the health report of 2018 according to which 10.91 healthcare technicians per thousand people in China's urban areas and there were only 4.63 healthcare technicians per thousand people in the rural areas of China so there is a huge difference between the urban and rural areas of China that were getting the imbalance medical resources. The efficiency of treatment is reduced in rural areas and there is difficulty in accessing resources and medical treatment in the rural areas as compared to the urban areas in China. A solution was made for the assets of medical treatment for the people living in the rural areas that include the tediagnosis of patients by the healthcare professionals and providing them telemedicine that is helpful to shorten the spatial distance between the doctors and patients and it also enables the patient to be treated locally by off-site medical experts. The system of telemedicine was begun in the 1980s in China (Zhang, Lu, Shi, 2022).

According to research in 2019, 22 provinces in China established that telemedicine platform and cover 13,000 medical institutions in that coverage by providing them with teleconsultations tele diagnosis, and telemedicine along with remote medical education as well. In China, there is the application of telemedicine and the treatment of different diseases such as diabetes and burns with the help of a telehealth system (Ye, He, Beestrum, 2023, pp. 1-14). The hospitals of China have been divided into 3 levels including the tertiary hospitals, secondary hospitals, and the primary hospitals of China. Telemedicine services are mainly provided by tertiary hospitals. We can understand the development of telemedicine in China with the help of the implementation and application of telemedicine in the territory hospitals of this country.

A patient simulation is used to generate a synthetic load in order to comprehend how the suggested model will function. This simulation model simulates the process of making an ambulance call and the operator's triage decision. The ambulance would then be dispatched by the dispatcher to the specified location, where it would arrive and take the patient to the hospital. The ambulances will have a certain amount of time to get all patients to the hospital.

The real-time deployment of ambulances within the designated area is another goal of this simulation model. It takes a long time for the ambulance to arrive at the site, treat the patient in preparation for transport, and then drive the patient to the hospital ([www.oecd-ilibrary.org](http://www.oecd-ilibrary.org)). The door-to-doctor meter is the second most significant measure for assessing overall hospital performance within the hospital. One crucial metric is LOS. Reduced door-to-doctor time and maybe lower LOS can be achieved by shortening the ambulance's arrival time at the hospital. A patient's boarding time on a ward may grow if they require repeated consultations with specialists from different specialty departments, contingent on their severity. Because the ED is a complex environment, reducing any part of the procedure can help lower the LOS measurement (Gupta, Dogar, Zhai, Singla, Shahid, Yildirim, Singh, 2019).

The state of the road the ambulance travels on has an impact on how long it takes to get to the hospital and to the site. The ambulance would have to take a different route, which could delay the response time. This can have an impact on short-term transportation while the road is being fixed, in addition to prolonging the urgent patient transfer. From this point on, the model would need to account for a repair period as well as temporary detours. In order to compute arrival times accurately, the model must also take into account the driving speed and satisfy the ambulance's average speed. The average speed increase when driving under lights and sirens can exceed the posted speed limit by up to 20%. The Polish ambulance speed case study also noted a similar issue, and both of these studies noted an elevated average speed that should be considered. The ambulance services in Australia vary by state; they all offer the same service but function separately (Hornyak, 2020). Every triage code in the wonderful state of Victoria has a maximum response time that must be fulfilled. The average response times will be recorded and compared within the model; this will then add to the scene's time (which will be standardized for simulation reasons), after which the patient has to be transported to the closest hospital. The best route and the condition of the roads are the only factors that affect patient transportation.

LGA stands for Local Government Area. The table shows the Average Arrival Time (in minutes) and the percentage of responses that occurred within 15 minutes for different quarters (20Q3, 20Q4, 21Q1, 21Q2) in the specified areas (Wodonga, Indigo, Wangaratta). The model's top priority in achieving the project's objectives is figuring out and implementing the most effective path for an ambulance to go to the emergency room. This will be modeled after how ambulances behave in Victoria's LGAs using call-out information for codes 1 through 5. Nevertheless, by restricting the routing simulation to just three Victorian LGAs—Wodonga, Wangaratta, and Indigo—the model's applicability is limited. The node graph sampled in Fig. The Australian Institute of Health and Welfare's annual reporting of hospital admissions from all Australian states and territory provides the data that the model is built on.

**Table 1.***Average Arrival Time in at least 15 minutes*

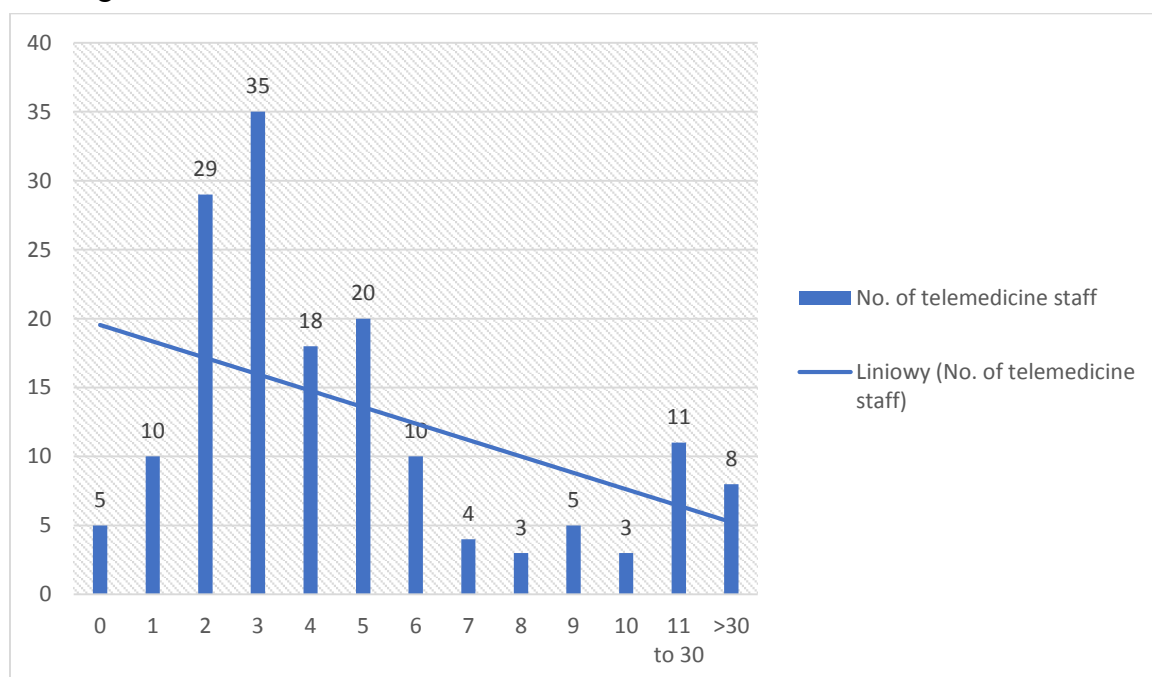
LGA	Average arrival time (min)				%Responses $\leq$ 15 min (%)			
	20Q3	20Q4	21Q1	21Q2	20Q3	20Q4	21Q1	21Q2
Empty Cell								
<b>Wodonga</b>	11:49	11:33	11:45	12:01	83.6	83.5	84.1	82.7
<b>Indigo</b>	21:28	23:12	22:39	21:51	28.3	21.5	27.6	26.3
<b>Wangaratta</b>	13:42	13:46	14:48	14:55	73.2	73.6	72.2	70.71

Last, but not least, think about the route selection to make sure the average time is satisfied. Because an ambulance should come within minutes after a Code 1 call, this is of the utmost importance. Because the exact location of demand is unknown, routing is a difficult option to make. The simulation used in this project is comparable to previous work in the field; for example, it relied solely on road transport, had a set number of stations, hospitals, and ambulances, assumed that all scene locations could accommodate patients, and followed predetermined paths.

After the investigation, it was found that the total number of tertiary hospitals in China was 185 according to the research. Almost 24 questionnaires were incomplete due to the missing data provided by 24 hospitals out of 185 hospitals. The number of valid questionnaires out of 185 was 161 and the effective rate of this validation was 87.0%. 59 hospitals were located in the eastern region, 54 hospitals were located in the central region and 48 hospitals were located in the western region. The accounting for these three hospitals was 36.7%, 33.5%, and 29.8% respectively. According to the research published, 161 hospitals were involved in the telemedicine and telehealth system. 137 treasury hospitals in these regions where their daughters were providing telemedicine services to the patients and 111 hospitals were seeking telemedicine services from the other hospitals to provide aid to the patients in emergencies. The results of some items were invalid and missing due to the incomplete information provided by multiple hospitals.

The answers that were unqualified in the analysis of corresponding content were considered as missing values or missing data that the hospitals did not provide accurately in the questionnaire. Mean values were used for describing the quantitative data in the questionnaire and the qualitative values were described with the help of count and percentages. The implementation and application of telemedicine were represented on the questionnaire with the help of Excel software and column charts, bar charts, pie charts, and radar charts so stop methods of cheesecake test, two-sided test, variance analysis, and non-parametric tests were used to apply the study methods. The development of telemedicine in different regions was compared by using these techniques in the questionnaires. The dependence of telemedicine services effect on the other factors in the multivariate analysis was calculated and adopted with the help of the model of dependence the software SPSS 23.0 was used to get the significance of the test level.

75.8% of the tertiary hospitals in China ranged from one to six in the following figure. There were 6.8% of the average number of telemedicine staff in each hospital in China. 7.4% of the telemedicine staff were in the tertiary hospitals of the eastern region, 6.7% of the telemedicine staff were in the central region of the tertiary hospitals of China and 6.2% of the telemedicine staff were present in the tertiary hospitals of the western region of China respectively. The telemedicine staff was mainly composed of those staff who have master's and bachelor's degrees. 49.58% of the telemedicine staff have a bachelor's degree and 38.85% of the staff have a master's degree along with 11.56% percentage of the telemedicine staff having decreased below the master's and bachelor's degrees. The majority of the telemedicine staff were connected with the fields of medicine, computer science, and communication along with the management field as well.



**Figure 2.** Distribution of the telemedicine staff and telehealth technology to improve the emergency response time collaborating with the transportation system in China.

Data source: Journal from National Library of Medicine.

Figure 2 shows that emergency response time can be decreased by using the well-trained staff and telehealth system in the transports for the emergency management. Telehealth is an advanced technology-based solution that is also helpful for the doctors to see more patients at a time. Figure 2 shows the results of the survey that was taken in the journal. As per the survey findings, telemedicine was introduced by 83.2% (134/161) of the tertiary hospitals through self-fundraising. In contrast, just 8.1% (13/161) of the hospitals were able to secure financing for their research. When it came to capital investment, 64.6% (104/161) of tertiary hospitals had made an investment of less than 500,000 RMB, or roughly US \$71,218. About 19.3% (31/161) of the hospitals made an investment in telemedicine deployment of more than 1 million RMB (about \$142,500 USD).

Government financial support, versatile fundraising, research funding, and corporate sponsorship are the main sources that are funding for telemedicine implementation in the tertiary hospitals of China. 83.2% of the implementation of telemedicine in tertiary hospitals in China is done with the help of self-fundraising. 8.1% of the financial support was received by the research funding for the implementation of study medicine in China (News-Medical, 2020; www.linkedin.com, n.d., U.S. to China...; Wang, Gu, 2009, pp. 23-27).

**Table 1.**

*Educational background of the telemedicine staff in the tertiary hospitals of different regions in China (person per hospital)*

<b>Educational background</b>	<b>Total (n)</b>	<b>Eastern Region</b>	<b>Central Region</b>	<b>Western Region</b>
Computer science and communication	1.8	1.4	1.6	2.5
Medicine	2.7	4.1	1.9	1.7
Management	1.3	1.3	0.9	1.6

Table 2 shows data analysis on the telehealth used in the emergency response system by the transportation/ambulances in China. Teleconsultation is the core service of telemedicine in the telehealth system. We need to explore teleconsultations in depth. The teleconsultants in the tertiary hospitals of China are considered as the deputy chief physicians of the hospital. According to a deep and thorough analysis of teleconsultations in tertiary hospitals in China, 72.1% of the tertiary hospitals apply the teleconsultation process through the platform of telemedicine. The telemedicine platform is the most important way of application of teleconsultations in telehealth systems. 74.5% of the hospitals in China provide consultation services within 24-hour intervals. They provide teleconsultations in different hospitals during the time interval of 10 to 40 minutes. 20 to 30-minute time intervals is the highest duration of time interval in 43.8% hospitals of in China. 51.4% of the effect of teleconsultations was considered good and 31.5% is considered an excellent effect of table consultation in the hospitals of China whereas 17.1% of the hospitals provided poor consultation services to the patients. Another core business of telemedicine in the telehealth system is remote education. However, the overall participation in the frequency of remote education in the tertiary hospitals of China is relatively low compared to other countries (Zhou, Huang, Llp, 2022).

## **9. Research limitations and implications**

Certain key factors are affecting the development of telemedicine in tertiary hospitals in China. These key factors include process optimization, patient cognition, funds, medical staff cognition, market demand, construction plan, laws and regulations, degree of emphasis on telemedicine, unified standards, advanced software, advanced hardware, and many other factors



as well (He, Cui, Lyu, Sun, Zhang, Shi, Zhang, Jiang, Zhao, 2024, pp. e45020-e45020). The most crucial factor which is prominent as 68.3% of the treasury hospitals is the standard formulation. The promotion of telemedicine in international hospitals in China is mainly hindered by the lack of uniform standards. It explores the key factors that are affecting telemedicine in China by considering the court telemedicine services in China. By applying these examples of unordinary logistic regression for the analysis of the relationship between the effect of telemedicine and the aforementioned factors above. The effect and impact of teleconsultation study is to know how useful tele-consultation purpose in the treatment and health of patients. The effect of teleconsultations is divided into 3 categories poor good and excellent (Bangert, 2004).

## **10.Limitations**

As we took out findings having a deeper insight into the development of telemedicine and telehealth systems in China several limitations are hindering the way of research as well (Ma, Sun, Tan, Li, He, Zhai, Wang, Cui, Li, Gao, Wang, Zhao, 2022, p. 104856). This research sample covers most of the area after tertiary hospitals in China but the sample size is still insufficient as some areas having tertiary hospitals do not provide complete information about the hospital because their questionnaires have blank spaces and were incomplete due to incomplete data.

## **11.Practical implications**

Certain practical implications pose the impact of telemedicine and telehealth systems in China. As we know the significant disparity in the medical resources between urban and rural areas in China has been highlighted in this review. With the help of telemedicine and telehealth systems, the gap between remote access to high-quality medical services can be bridged. This underscores the significance of such technological intervention in addressing healthcare disparities worldwide. With the help of initiatives taken by telemedicine and telehealth systems, patients in rural and remote areas can receive timely medical consultation and treatment from healthcare professionals who are located away from their location.

By seeking the help of teleconsultations all over the world the patient has access to specialists and medical care professionals without traveling. Sometimes the patients are in critical condition but they are away from the location of the specialists and healthcare professionals. But now they can leverage the help of teleconsultations and healthcare

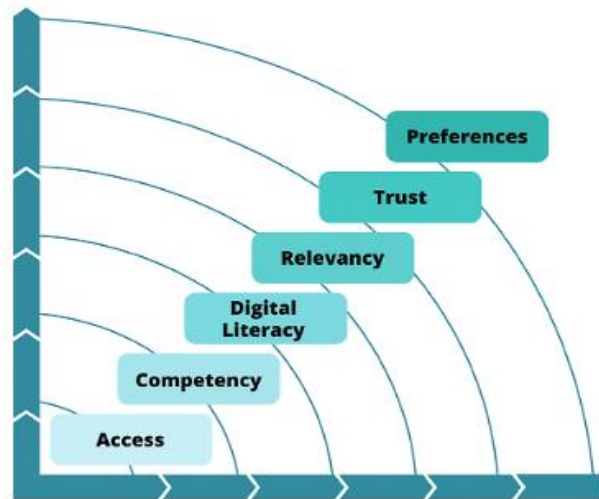
professional with the help of telemedicine and telehealth systems at their location without traveling long distances. It is also helpful in the improvement of healthcare sensibility and reduction of burden on the physical infrastructure as well. This research is also based on the economic and societal implications of the implementation of telemedicine and telehealthcare systems. Telemedicine and telehealthcare systems have reduced the necessity for physical travel to urban centers for medical care and treatment as the patients can seek consultancy at their homes with healthcare professionals through video conferencing and many other ways integrated into the telehealth system (Yang, Hu, Jiang, Li, 2023). The healthcare costs of patients are also lowered with the help of telehealth systems because they have improved the overall efficacy and efficiency of healthcare delivery, especially in remote areas and rural areas.

Certain challenges are affecting the successful implementation of telemedicine and telehealth systems in China that are revealed in this research. These challenges and issues are related to the funding sources because fundraising was less. In addition, another issue that was promoted and highlighted in the research is the standardization, technological infrastructure, and staff qualifications as well. It is very important and crucial to address these challenges for sustainable growth and the widespread adoption of telemedicine practices in China. Telemedicine plays a very crucial and pivotal role in providing telemedicine services to patients. Tertiary hospitals also serve as a hub for teleconsultations and remote medical education.

The comprehension of this hierarchical structure within the healthcare system serves as an aid in the development of targeted strategies for the optimization of the implementation of telehealth services. The research was conducted based on research methodologies and questionnaire-based surveys were included and statistical analysis was taken that provide a valuable and deep insight into the current state of telemedicine implementation in the tertiary hospitals of China. Certain limitations exist in the questionnaire-based surveys and statistical analysis including incomplete data and missing information provided by certain hospitals that impact the comprehensiveness of the findings. This research also underscores the importance of standardized protocols and regulations in the telemedicine and telehealth system to make sure that there is uniformity, equality, quality, and interoperability in all different healthcare institutions in China.

Clear-cut guidelines and instructions were established that were helpful to overcome the obstacles that are relevant to varying standards and enhancement of the effectiveness of telemedicine services in the telehealth sectors. Adequate training and education in telemedicine practices for healthcare professionals is also necessary and the importance of this study is highlighted in this research because the main focus is on education and skill development in telehealth technologies among the medical staff. This development and further training of the medical staff are helpful in the enhancement of the quality and reach of telemedicine services in the telehealth sectors of China. The telemedicine implementation cannot be overstated without the help of government sectors and government support because they were the only ones to provide support funding and research grants and facilitate telemedicine implementation in China (Anthony, 2020, pp. 1-9).

The role of government support was prominent in the encouragement of more extensive financial backing and policy support for the acceleration of adaptation and evolution of the telehealth system. The findings and research suggest future research and improvements made in the tertiary hospitals of China emphasize the need for comprehensive studies that delve deeper into the impact, efficacy, and longer-term outcomes of telemedicine implementation in China's healthcare landscape. In short, we can say that this research highlights and signifies the importance of the transformative potential of telemedicine imitating healthcare disparities in China.



**Figure 3.** Telehealth engagement drivers and emergency response management system integrating with transportation crisis management.

Source: Sakumoto, Krug, 2023.

Figure 3 indicates (Sakumoto, Krug, 2023) access is to ensure widespread availability of telehealth services, considering factors like internet access and device availability. Competence refers to the healthcare professionals' proficiency in using digital tools for remote patient care, requiring continuous training and education. Both providers and patients need to be adept at using digital devices and online platforms for effective telehealth engagement leads to digital literacy. Customizing telehealth to align with cultural, linguistic, and individual preferences for improved effectiveness and acceptance. Trust and Preferences are for building confidence in the security of telehealth services and acknowledging diverse preferences, crucial for widespread adoption.

## 12.Social implications

The implementation and growth of telemedicine and telehealth systems in China pose significant social implications on society because various aspects of society, public attitudes, corporate social responsibility, environmental issues or policymaking, and the overall quality of life are influenced by it.

### **13. Impact on society**

Telemedicine and telehealth system in China has a great influence and impact on society as it bridges the gap in healthcare access between the urban areas and rural areas of China. It was difficult for the people residing in rural areas to reach the healthcare systems immediately when they were in emergency and critical situations but having the help of the telemedicine telehealth system it became very easy for them to assess the healthcare professionals and providers in a short time (Hong, Li, N., Li, D., Li, J., Li, B., Xiong, Li, W.-M. Zhou, 2020). Now the telemedicine and telehealth system has facilitated the system by providing easy access to medical expertise for individuals who are residing in remote regions and do not have easy access to healthcare centers for the improvement of healthcare equity across the country. Medical services are enhanced with the help of telemedicine and telehealth systems because this system provides teleconsultations and remote health care to individuals who are residing in rural areas. As a result, individuals in underserved areas receive improved medical services timely by having timely consultations without the need for extensive travel (Huang, Xu, Sian Hsiang-Te Tsuei, Fu, Yip, 2023). The efficiency of medical services is also enhanced with the help of the integration of telemedicine technologies in the telehealth system. It also enables remote diagnosis and treatments with the reduction of the burden on healthcare facilities and the increasing of effectiveness as well.

### **14. Influence on public attitudes**

Public attitudes are positively influenced after the successful implementation of telemedicine in the telehealth system. It also fostered trust and reliance on technology-enabled healthcare solutions the integration of telemedicine and the telehealth system is helpful in the encouragement of people to seek medical assistance more promptly and easily (Getzzg, 2023). The expectations are also Increased after the public awareness of telemedicine in the telehealth system. People are expecting more and more from the system because they can get treatment and guidance residing in rural and remote areas. It has become easy for them to assess the healthcare professionals and providers dealing with their emergency and critical situations. This public awareness is leading towards the increment in the expectation for accessible healthcare services which is in turn helpful in the promotion of demands for similar advancement in the healthcare systems (Haimi, 2023, p. 95).

## **15. Influence on corporate social responsibility and environmental issues**

One of the main influences on corporate social responsibility is the strengthening of their profiles. The corporations that are supporting telemedicine and taking the initiatives of telemedicine in the telehealth industry are strengthening their CSR profiles due to their contribution to healthcare assessment they are also contributing to aligning their goals and societal well-being ([www.china-briefing.com](http://www.china-briefing.com)). The environmental effect due to the telemedicine integration in the telehealth system is the reduction of pollution. As we know with the integration of telemedicine people are not forced to move and cover the travel distances from their location to the Healthcare Center for treatment, which introduces pollution in the way that it minimizes the carbon emission from the vehicles on which they are going to travel to reach the healthcare centers (Telemedicine Development...). In this way, the integration of telemedicine in the telehealth sector helps contribute to positive environmental sustainability by lowering the carbon footprint associated with frequent patient travel for medical consultations.

## **16. Influence on policy development**

Policy development is also influenced by the help of telemedicine and telehealth systems because the research findings could inform policymakers about the critical factors affecting the development of telemedicine and telehealthcare systems. With the help of this system, there is an encouragement in the formulation of policies that promote standardized practices, and funding these policies is also helpful in the promotion of infrastructure development for supporting telehealth services across different regions. The regulatory bodies are prompted with the help of insights into the limitations and implications for the establishment of unified standards and regulations for telemedicine practices in different regions of China that also make sure that the quality and ethical delivery of services are provided to the patients.

## **17. Impact on quality of life**

The quality of life is also impacted and influenced by the integration of telemedicine in the telehealth center (European Commission, 2018). The enhanced accessibility to telemedicine is positively impacting the quality of life by providing timely medical intervention there is also a reduction in the severity of the illness with the help of the improved healthcare system of

telemedicine in the health system. With the help of telemedicine, healthcare professionals are potentially saving lives in remote areas and rural areas of different countries. The need for extensive travel is also minimized with the help of telemedicine in the telehealth system for medical consultations (Omboni, McManus, Bosworth, Chappell, Green, Kario, Logan, Magid, Mckinstry, Margolis, Parati, Wakefield, 2020, pp. 1368-1383). With the help of telemedicine, the financial burden on the patients is reduced and lowered because they are seeking health care at their location which is positively influencing their quality of life as well.

## **18.Originality and value**

The comprehensive examination of the implementation and impact of telemedicine and telehealth systems in Chinese tertiary hospitals Highlights the originality and value of this research (CGTN). There are certainly significant issues between health care inequality in rural areas and urban areas in China. These issues and challenges are addressed in this research along with the scarcity of high-quality medical resources in rural regions compared to the well-resourced urban areas. In this research, we came to know about the unequal distribution of medical resources between the eastern regions that are developed in China and the under-resourced regions of China including the central and western regions of China (Earley, Newman, 2021, pp. 109-127). This research highlights the disparity in the number of healthcare technicians per thousand people. This disparity is significantly higher in the urban areas of China and much lower in the rural and remote areas of China which are affecting the efficiency and accessibility of healthcare services for the people who are residing in the rural and remote areas of China. They were completely unable to get access to the healthcare providers and professionals in their emergency and critical situations but with the help of telemedicine in the telehealth system it becomes easy and efficient for them to assess the healthcare professionals in time of emergency (Chen, Wu, Zhang, Jing, Cheng, Tian, Jin, 2023).

The research based on the treasury hospitals of China further delves into the development and application of the telemedicine and telehealth system as a solution to fill the gap between the urban areas and rural areas of China by providing them the healthcare services very easily. Moreover, we get further insight and thorough comprehension of the establishment of tally medicine platforms across multiple provinces of China. This surge covered thousands of medical institutions in China and the aim of this research is the facilitation of teleconsultations, Tele diagnosis, and remote medical education to the people who are living in the rural and remote regions of China.

Certain factors are affecting the implementation of telemedicine in the hospitals of China. These factors include the financial sports sources, staff qualification, and standard formulation (Allen, 2022). It further emphasizes the importance and necessity for uniform standards in China that are helpful in the exploration of various factors that are hindering telemedicine's full potential.

## **19. Conclusion**

In conclusion, it is a pivotal opportunity for the revolutionizing of crisis management across various sectors through the help of the integration of emergency response systems and telehealth technologies in the healthcare system. This research is the investigation, and innovation of the strategies that are leveraging this system and the aim of this research is for the enhancement of crisis management globally. After a complete and thorough examination of the intersection of emergency response and telehealth systems, this research has identified the practical frameworks, tools, and protocols that foster seamless coordination, collaboration, and healthcare delivery during crises and emergencies. The convergence of these systems underscores the optimization of resources and refinement of response time. With the help of multiple case studies along with simulations and prototypes, this result is the evaluation of technological advancements along with the regulatory challenges and logistical considerations that offer valuable insight to integrate telehealth into emergency response frameworks across a diverse range of sectors including public safety, healthcare, disaster management, and community services as well. The critical leads of collaboration and communication among the stakeholders including government agencies, healthcare providers, technology developers, and emergency responders are critically addressed and studied in this research (Huawei; External).

Different approaches are being tailored to various crisis scenarios in this research to emphasize the adaptable strategies and guidelines through the cross-sectoral partnerships and interdisciplinary cooperation between them. The government frameworks regarding telemedicine and telehealth systems were modified and accounts tweeted after the COVID-19 pandemic because, after the COVID-19 pandemic, there was an adoption of telemedicine telehealth systems along with the integration of emergency response systems for the promotion of telehealth services worldwide. There were certain challenges and concerns faced by telemedicine and telehealth systems during this time.

These challenges and concerns include healthcare infrastructure, high-speed Internet access, and healthcare information systems. In short, we can say that telemedicine and telehealth system was a key strategy during the COVID-19 pandemic, especially in the areas that were rural and remote, and it was hard to reach the improvement of sensibility and healthcare delivery

to people living in these areas. To emphasize the necessity and importance of our robust telehealth infrastructure and adequate resources in developing countries some disparities persisted in this way. This research also integrates the benefits of the telehealth system and telemedicine to improve the system of management for telehealth in rural and remote areas. The certain benefits of telehealth systems are the categorization of improved provider and client experience, enhancement of population health, and reduced cost as well. Certain facilities were promoted with the help of telehealth including remote care, improved accessibility, and a positive impact on mental health and chronic condition management.

Addressing the research questions of this research, this article is the exploration of optimization of transportation infrastructure, employing telehealth technologies for initial medical support during emergencies, and enhancement of real-time data sharing between the emergency responders and healthcare professionals. With the help of strategies used in this research, there is encompassment in the interoperability integration of communication platforms, mobile health technologies, comprehensive training, robust privacy measures, critical and clear protocols along with the feedback mechanism. Public-private partnerships are very important and crucial for the improvement of patient care during emergencies through their collaboration and investment in innovative telehealth technologies.

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