Systemic Design For Emergencies In Healthcare Systems:

Enhancing Inclusive Information Sharing In Zhengzhou Amid Climate Change

Department of Architecture and Design
Master's degree program in Systemic Design
Academic Year 2023/2024

Politecnico
di Torino

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Looking ahead, We hope that one day, the knowledge and skills we have acquired here can make a small contribution to the world.

00.

ABSTRACT

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Climate change presents various challenges to global healthcare systems, making it urgently needed to come up with innovative approaches for healthcare transformation. The increasing frequency and intensity of natural disasters caused by climate change, along with their direct and indirect effects on public health, require a paradigm shift in the way healthcare systems operate and respond in the changing environment [1]. This thesis aims to critically explore how systemic design principles can be used to revolutionize healthcare systems, particularly in the context of climate change-induced challenges.

The foundational premise of this study is that the traditional linear communication models between various stakeholders within the healthcare system might be insufficient to ensure effective and timely information exchange in the context of the dynamic challenges posed by climate change [1].

Therefore, a systemic approach that emphasizes holistic, adaptable, and sustainable healthcare frameworks is regarded as a potential solution to enhance resilience, equity, and efficiency of healthcare systems [2]. The key point of this transformative approach focusses on the concept of inclusive information sharing which ensures the availability of necessary information to all stakeholders involved. It is a mechanism where all stakeholders in the healthcare ecosystem can collaboratively contribute to, and therefore, benefit from [3].

To achieve the goal, this thesis explores the intersection of healthcare services, systemic design principles, and climate-related emergencies to demonstrate innovative strategies that can bring a more adaptive and sustainable future to the whole healthcare industry. The effort is not only to address the current threats posed by climate change but also to build a healthcare system that is resilient in the face of future challenges, equitable in its service accessibility, and efficient in its operations.

By researching through case studies and practical evidences, this thesis aims to contribute to the development of healthcare innovation and empower the local healthcare industry, making they better equipped to meet the evolving needs of diverse local populations amid the uncertainties of climate change and also to build a healthcare ecosystem that is proactive to crises and continuously developing in a changing world.

01.

INTRODUCTION

THE KEY POINT OF THIS TRANSFORMATIVE APPROACH FOCUSSES ON THE CONCEPT OF *INCLUSIVE INFORMATION SHARING* WHICH ENSURES THE AVAILABILITY OF NECESSARY INFORMATION TO ALL STAKEHOLDERS INVOLVED.

1.1

RESEARCH BACKGROUND

Being the most populous country in the world and experiencing rapid economic growth, China is now one of the most climate-threatened countries. In fact, it is noticeable that in the past few decades, the climate patterns in China have widely changed, such as the rise of the average temperature, changes in precipitation amounts, and the occurrence of extreme weather events. The main cause of this situation is human factors, such as industrial activities generating greenhouse gases, illegal deforestation, high speed of urbanization, and huge amount of fossil fuel consumption.

Zhengzhou, which is the capital of Henan Province, exemplifies the effects of these human factors in a local context. Serving as a main industrial and transportation hub, Zhengzhou has faced accelerated urbanization and industrialization during the past decades, contributing significantly to the regional climate dynamics. Its experiences, especially during the summer months, when temperatures frequently soar above 40 degrees Celsius which pose a significant impact on people's health, temperatures frequently soar above 40 degrees Celsius which pose a significant impact on people's health, highlight the direct impact of rapid development and climate change on urban populations.

According to China's National Climate Center, average temperatures on the Chinese mainland have risen by about 0.5 to 0.8 degrees Celsius per decade since the 1950s, higher than the average global warming rate. This trend has led to more frequent and severe heat waves across the country, even posing a threat to human life and health [4]. For example, in recent years, highly industrialized cities like Zhengzhou have experienced record-breaking heatwaves, especially during summer times, when extreme temperatures frequently exceeding 40 degrees Celsius.

In addition, the precipitation pattern changes, which occur under the influence of widely affecting climate change, contributed to the frequent droughts and floods in different parts of China. In some areas, the long-term droughts even led to large areas of crop reduction or even collapse, thus

seriously threatening local agricultural production. For example, in 2020, according to the Ministry of Water Resources, more than 10 million hectares of farmland in Yunnan and Guizhou provinces had been affected in the most severe drought in recent years, therefore suffering huge economic losses. It is also reported that, on the other hand, floods brought by heavy rainfall events displace populations, destroy infrastructure, and cause water logging in urban areas. In particular, the flooding event on July 20, 2021, in Henan Province, which is one of the focus cases in this paper, results in more than 300 deaths and causes severe impacts on substantial buildings, transportations, and healthcare infrastructures in the urban area [5].

The impact of climate change on China's healthcare sector is multifaceted and far-reaching. Rising temperatures exacerbate heat-related illnesses, such as heatstroke and dehydration, causing additional strain on healthcare facilities and emergency services, especially during heatwaves [6]. According to the Chinese Center for Disease Control and Prevention, heatwaves have been associated with increased hospital admissions for heat-related illnesses, particularly among vulnerable populations such as the elderly and outdoor workers. Also, extreme weather events, such as typhoons and floods, can damage healthcare infrastructure and disrupt healthcare services leading to increased risks of injury, infectious diseases, and mental health issues among affected communities [7]. In response to these challenges, the Chinese government has taken steps to mitigate and adapt to the impacts of climate change. Initiatives such as the China's Policies and Actions on Climate Change [11], the "Thirteenth Five-Year" Greenhouse Gas Emission Control Work Plan [12] and the National Strategy for Adapting to Climate Change 2035 [13] aim to reduce emissions, enhance resilience, and promote sustainable development across various sectors, including healthcare industry [8].

However, addressing the complex interaction between climate change and public health requires comprehensive strategies that integrate environmental, social, economic and healthcare considerations [9].By investing in climate-resilient infrastructure, improving disease surveillance and early warning systems, promoting sustainable urban planning, and enhancing community resilience, China can strengthen its ability to protect public health and mitigate the impacts of climate change [10].

1.2

RESEARCH GOAL

The primary research objective of this paper is to mitigate information gaps within the healthcare system and facilitate effective information sharing to ensure equitable and timely access to essential information for all individuals. This objective is particularly critical in the context of increasing natural disasters caused by climate change, with the ultimate goal of enhancing the health, safety, and well-being of citizens.

The thesis aims to explore the application of systemic design for transforming Zhengzhou's healthcare industry. This research focuses on integrating a systemic framework with inclusive practices in information sharing, aiming to enhance the resilience and efficiency of the local healthcare system. The main goal is to equip healthcare systems with the ability to address the complex challenges caused by climate change. By integrating perspectives from various stakeholders and applying interdisciplinary approaches from fields such as environmental science, public health, sociology, this study intends to develop a strategic framework to strengthen the healthcare system's dynamic response to ongoing environmental challenges.

To achieve this, the research takes a detailed analysis of current communication and operational patterns within Zhengzhou's healthcare system, identifying key areas where systemic design principles can be most effectively applied. Meanwhile, special focus will be placed on the mechanisms of information flow among healthcare providers, patients, policymakers, and the local community. Furthermore, the research will evaluate the effects of external environmental pressures on the system, particularly focusing on populations that are more vulnerable to the impacts of climate change, including children, the elderly, individuals with chronic illnesses, and low-income groups. By searching case studies and practices from global contexts, the research will propose tailored strategies that address the unique socio-economic and environmental challenges faced by the city.

References :

1. World Health Organization. (2023, November 27). Global health community calls for urgent action on climate and health at COP28. WHO. https://www.who.int/news/item/27-11-2023-global-health-community-calls-for-urgent-action-on-climate-and-health-at-cop28

2. Barbero, S., & Pallaro, A. (2017). Systemic Design for Sustainable Healthcare. Design Journal, 20(sup1). https://doi.org/10.1080/14606925.2017.1352762

3. Hotez, E., Hudson, S., Bastani, A., Khorasani, L., Hohmeister, H. C. (2023). A call for inclusive public health communication to promote the health of neurodivergent communities during and post-COVID-19. Public Health in Practice, 5, 100388. https://doi.org/10.1016/j.puhip.2023.100388

4. Luo, Y., Qin, D., Zhang, R., Wang, S., & Zhang, D. (2016). Climatic and environmental changes in China. In Climatic and Environmental Changes in China (Vol. 10). https://doi.org/10.1007/978-3-662-48482-1_2

5. Wang, Y., Tan, D., Han, L., Li, D., Wang, X., Lu, G., & Lin, J. (2021). Review of climate change in the Yellow River Basin. Journal of Desert Research, 41(4), 235-246. http://www.desert.ac.cn/CN/10.7522/j.issn.1000-694X.2021.00086

6. World Economic Forum. (2024). Quantifying the impact of climate change on human health. Retrieved from https://www3.weforum.org/docs/WEF_Quantifying_the_Impact_of_Climate_Change_on_Human_Health_2024.pdf

7. Li, B., Ding, G., Gu, S., Bi, P., Su, B., Qin, D., Xu, G., & Liu, Q. (2014). The effects of summer temperature and heat waves on heat-related illness in a coastal city of China, 2011–2013. Environmental Research, 132, 212-219. https://doi.org/10.1016/j.envres.2014.04.002

8. Ministry of Ecology and Environment of the People's Republic of China. (2022). China's Policies and Actions for Addressing Climate Change. Retrieved from https://english.mee.gov.cn/Resources/Reports/reports/202211/P020221110605466439270.pdf

9. Walter, T.G., Bricknell, L.K., Preston, R.G. et al. Climate Change Adaptation Methods for Public Health Prevention in Australia: an Integrative Review. Curr Envir Health Rpt 11, 71–87 (2024). https://doi.org/10.1007/s40572-023-00422-7

10. Ji, J. S., Xia, Y., Liu, L., Zhou, W., Chen, R., Dong, G., Hu, Q., ... & Huang, C. (2023). China's public health initiatives for climate change adaptation. The Lancet Regional Health - Western Pacific, 40, 100965. https://doi.org/10.1016/j.lanwpc.2023.100965

11. The State Council of the People's Republic of China. (2021, October 27). 中国应对气候变化的政策与行动 [China's policies and actions on climate change]. Retrieved from https://www.gov.cn/zhengce/2021-10/27/content_5646697.htm

12. The State Council of the People's Republic of China. (2016, November 4). 关于印发"十三五"控制温室气体排放工作方案的通知 [Notice on the issuance of the "Thirteenth Five-Year" greenhouse gas emission control work plan]. Retrieved from https://www.gov.cn/zhengce/content/2016-11/04/content_5128619.htm

13. Ministry of Ecology and Environment of the People's Republic of China. (2022, June 13). 国家适应气候变化战略 2035 [National Strategy for Adapting to Climate Change 2035]. Retrieved from https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202206/W020220613636562919192.pdf

02.

METHODOLOGY

SYSTEMIC DESIGN FOSTERS A SHIFT FROM LINEAR, ISOLATED THINKING TO A MORE *COMPREHENSIVE, DYNAMIC APPROACH,* WHICH IS CRUCIAL FOR TACKLING THE MULTIFACETED CHALLENGES OF OUR TIME.

2.1

OVERVIEW OF SYSTEMIC DESIGN

In an era of increasing complexity and interconnectedness, addressing societal challenges requires holistic approaches that transcend traditional disciplinary boundaries. Systemic design appears as a potent method, emphasizing a holistic perspective to understand and improve relationships among different elements within systems rather than isolating individual components [1] (Figure 1). It fosters a shift from linear, isolated thinking to a more comprehensive, dynamic approach, which is crucial for tackling the multifaceted challenges of our time. This paradigm not only promotes sustainability but also encourages deeper consideration of the ethical, cultural, and practical impacts of design decisions within interconnected systems [2].

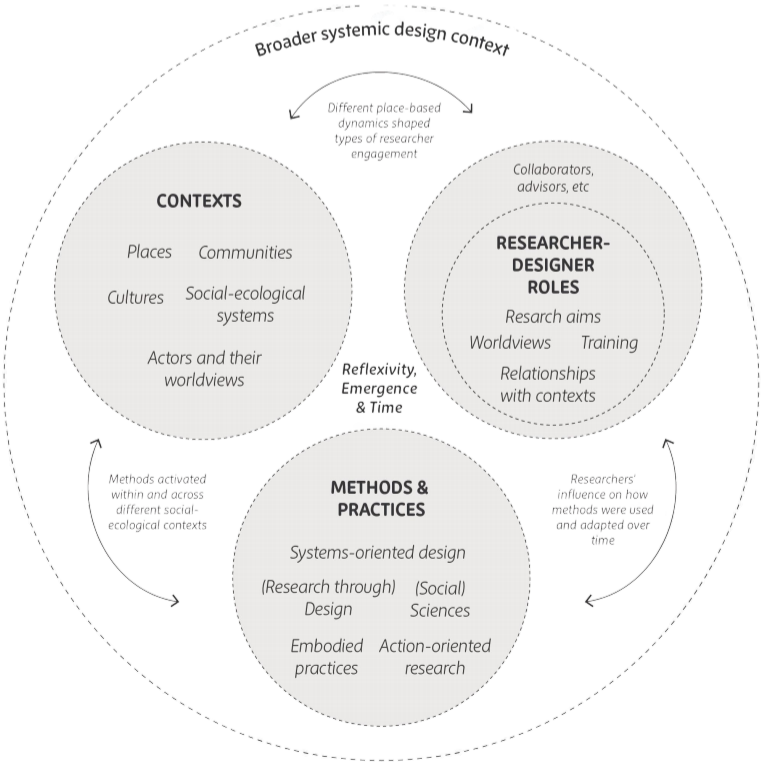


Figure 1.
Relationships between methods and practices, contexts, and researcher roles

Systemic design harnesses a holistic approach to problem solving, recognizing that the whole is greater than the sum of its parts. At its core are five foundational elements that guide its methodology and application. These elements form the cornerstone of systemic design, shaping its principles and practices. Each element contributes uniquely to the understanding and development of complex systems, facilitating a comprehensive approach to addressing societal challenges.

The five basic elements of systemic design are as follows [3]:

Output > input [4]

Following the principle that "the output of a system is the input of another one," coined by Bistagnino (the dean of the School of Industrial Design of the Faculty of Architecture at the Polytechnic University of Turin.), systemic design acknowledges the interconnectedness of processes. Outputs from one part of the system often serve as inputs for others, fostering continuous flows of matter, energy, and information.

Relations

In line with concept of "the whole is greater than the sum of its parts," relations between the elements within a system are fundamental, because they generate the system itself.

Autopoiesis

Autopoietic systems maintain and reproduce themselves by creating their own components and boundaries, emphasizing self-regulation and co-evolving dynamically with other systems.

Act locally

By prioritizing the local context, systemic design harnesses the unique material, social, cultural, and economic resources within a specific environment. This approach recognizes the importance of context-specific solutions and encourages tailored interventions that address local needs and challenges.

Humanity-centered design

Viewing wicked and interrelated problems through the lens of society and human beings, systemic design acknowledges humans as integral parts of larger ecosystems. This perspective underscores the importance of considering social, cultural, and ethical dimensions in designing solutions that benefit communities and promote collective well-being.

After we experienced what thinking in system means, we integrate this approach into our design process. Within the healthcare system's transformation in response to climate change challenges, systemic design offers a comprehensive method to enhance preparedness, responsiveness, and resilience. By considering the interrelationships among stakeholders, technological infrastructure, communication channels, and organizational processes, systemic design can develop robust, adaptable solutions that effectively address the complexity of emergencies.

2.2

PROJECT RESEARCH METHODOLOGY

This thesis explores the application of systemic design principles in the transformation of healthcare systems facing the challenges of climate change. Utilizing the systemic design approach, we analyze the multifaceted nature of healthcare system in addressing sudden natural disasters in the current environment, and propose a comprehensive solution that integrates technology, organizational processes, and stakeholder participation.

Our research is structured around four main steps based on the systemic design approach:

1. Understanding systems:

Recognizing how individual parts interconnect and influence each other within the whole system, and how external factors impact the system.

2. Tackling challenges

Identifying and analyzing existing problems the territory is facing with and the potential obstacles which may impede the successful implementation of our projects.

3. Designing the system

Developing strategies which can effectively deal with the challenges predefined, then conducting systemic projects, and building the new system.

4. Evaluating the system

Evaluating the effectiveness of a climate-adaptive healthcare transformation using qualitative and quantitative methods, and comparing it with the old system.

Understanding Systems

Following the five principles of systemic design, this project first conducted a holistic diagnosis (HD) of the territory and healthcare system structure of Zhengzhou city, analyzing all specific characteristics through field and desk research. HD is important to outline the context in which we have to work, focusing attention on the local healthcare system structure and climate change characteristics [5].

The first contribution of this research is the "complexity map," which provides a systematic and intuitive representation of all the major data collected, facilitating the analysis of connections between different blocks.

Understanding the territory

To facilitate the transformation of the healthcare system in response to climate change, it is necessary to have a comprehensive understanding of the territory where the system operates.

We carried out systemic desk research utilizing a variety of methodologies, including the collection of data from government websites and thorough reviews of scholarly literature. Our objective was to analyze data from a multidisciplinary perspective– geography, demography, climate, economy, education, and local healthcare system through systemic design principles [6]. This approach facilitated a comprehensive understanding of the interconnectedness and broader implications of these diverse factors within our study.

Additionally, this study utilized field research methods, which encompassed visits to local healthcare facilities and structured interviews with healthcare professionals and community residents. These activities were undertaken to provide firsthand, detailed insights, thereby facilitating a more profound comprehension of the entire system under investigation.

Identify the structure of healthcare system

We conducted a detailed analysis of the structure of the healthcare systems in China and Zhengzhou, as well as the response processes of healthcare institutions during sudden natural disasters. Our focus was on analyzing the flow of information and personnel, involving the network of healthcare facilities, including hospitals, clinics, emergency care centers, and other healthcare facilities, to understand their roles, capabilities, and interdependencies in emergency response. This holistic approach ensures that the new system integrates well into the broader socio-technical ecosystem and supports better coordination and collaboration among different stakeholders during emergencies.

Tackling Challenges

In this chapter, we delved into the complex challenges of healthcare system in Zhengzhou under the background of climate change. Through rigorous identification, analysis, and evaluation processes, we examined a range of factors that could impede the effectiveness of these systems, highlighting key issues that the system may encounter [7].

Tracking challenges

In the first stage, using the complexity map as a reference, we identified the challenges of the system through the insights gathered from stakeholders, existing literature, and case studies. This approach is not only able to solve specific issues but also maintaining their connection to the system, thereby promoting a comprehensive and detailed understanding.

Opportunity identification and evaluation

In the second stage, through in-depth research (drawing from good practice, case studies, and scientific literature), we identified opportunities associated with each challenge. By evaluating these opportunities based on predefined criteria (such as citizen involvement, time and financial cost, risk and security, etc.), we determined their feasibility and potential impact. This rigorous evaluation process enabled us to prioritize and select the most promising opportunities for further exploration and integrating it into our systemic design project.

Designing the System

Referring to various previous studies and by adopting a holistic perspective, interdisciplinary collaboration, and a human-centered design approach, we created innovative strategic scenarios to increase the local healthcare system's crisis response capacity and to improve the patient healthcare experience (especially during emergencies).

After clarifying the content of the strategies, we focus on creating a new system diagram that would apply the strategies to clarify how the new system would function in the face of a sudden natural disaster.

Systemic project

In this section, we conduct in-depth strategic planning and research regarding the identified opportunities. Through extensive desk research and analysis including case studies and literature reviews, we select the most suitable solutions for each opportunity and determine key strategic directions. These strategies include establishing an internal communication platform within the healthcare system, public education on climate change and emergency response, and healthcare information sharing among residents. We discuss the implementation methods and steps for each strategic approach, aiming to provide robust support for the transformation of the healthcare system.

Identify the new system

In this step, we consider the previously identified strategies as a whole, analyzing their interrelationships and impacts within the healthcare system. Employing a systemic approach, we study how these strategies work together and any problems that might come up, as well as their integration levels in healthcare services, emergency response, and information sharing. This ensures that the final system possesses resilience, adaptability, and responsiveness to evolving challenges.

Evaluating the System

The shift from linear to systemic modes has had a broad impact on the entire environment, involving value chains and the territory.

Overall, this chapter focuses on the comprehensive evaluation of the newly implemented system, understanding its outcomes and impacts and comparing it with the traditional system. It provides valuable insights into healthcare institution management, system resilience, and sustainable enhancement [8].

Study of the outcomes

This section conducts an in-depth investigation and evaluation of the implementation effectiveness of the new system. We will examine the system's effectiveness and impact on healthcare services, emergency response, information sharing, etc., through an analysis of the expected short-term, medium-term, and long-term effects of each strategy, as well as the qualitative and quantitative impacts generated.

Finally, we can outline the future vision of the system and envision its development in the long term.

Comparison of the old and new systems

This section conducts a comparative analysis of the new system and the traditional system, examining their similarities and differences in terms of functionality, efficiency, and applicability. The analysis highlights the strengths and improvements of the new system over the traditional one, while also identifying areas of deficiency. This provides a foundation for further optimization and improvement.

References

1. Haley Fitzpatrick. Methodological Pluralism in Practice: A systemic design approach for place-based sustainability transformations. Retrieved from https://systemic-design.org/contexts/vol2/methodological-pluralism/

2. Pereno, A., Barbero, S., Tamborrini, P. M. (2015). Design for Healthcare Sustainability: Ethical Implications of Eco-Design Research. 11th International European Academy of Design Conference, Paris, April 22-24th 2015. Retrieved from https://iris.polito.it/handle/11583/2603986

3. Fiore, E., Stabellini, B., & Tamborrini, P. (2020). A systemic design approach applied to rice and wine value chains. The case of the innovaecofood project in Piedmont (Italy). Sustainability, 12(21), 1-28. https://doi.org/10.3390/su12219272

4. Barbero, S., Tamborrini, P. M. (2015). Systemic Design Goes Between Disciplines for the Sustainability in Food Processes and Cultures. Proceedings of the AESOP Torino, 7-9 October 2015, pp 517-525. Retrieved from https://www.academia.edu/28348599/Systemic_Design_goes_between_disciplines_for_the_sustainability_in_food_processes_and_cultures

5. Battistoni, C., Giraldo Nohra, C., & Barbero, S. (2019). A systemic design method to approach future complex scenarios and research towards sustainability: A holistic diagnosis tool. Sustainability, 11(16), 4458. https://doi.org/10.3390/su11164458

6. Pereno, A., & Barbero, S. (2020). Systemic design for territorial enhancement: An overview on design tools supporting socio-technical system innovation. Strategic Design Research Journal, 12(2), 113-136. https://doi.org/10.4013/sdrj.2020.132.02

7. Pereno, A. (2017). Systemic design towards user-centered sustainability in medical treatments. Proceedings of the Relating Systems Thinking and Design (RSD6) 2017 Symposium (pp. 18-20). Oslo, Norway. Politecnico di Torino. Retrieved from https://hdl.handle.net/11583/2698966

8. Thomas, G., Lynch, M., & Spencer, L. (2020). A Systematic Review to Examine the Evidence in Developing Social Prescribing Interventions That Apply a Co-Productive, Co-Designed Approach to Improve Well-Being Outcomes in a Community Setting. International Journal of Environmental Research and Public Health, 18(8), 3896. https://doi.org/10.3390/ijerph18083896

03.

UNDERSTANDING THE TERRITORY

THE ENVIRONMENTAL CHALLENGES BROUGHT BY CLIMATE CHANGE HAVE PLACED *NEW DEMANDS* ON THE DEVELOPMENT AND INNOVATION OF URBAN HEALTHCARE SYSTEMS.

3.1

WHY ZHENGZHOU
- *THE CITY UNDER CLIMATE CHANGE*

Zhengzhou, situated in the central part of China as the capital city of Henan Province, has a population of over 13 million people, making it an important transportation hub and a critical regional economic center. The city is characterized by rapid industrial development and increasing population, with rapidly growing sectors such as electronics, automobiles, machinery and food processing. [1]

Figure 2.
Skyline of Zhengzhou City
(Font: finance. sina)

As the city continues to grow, different challenges come along. For example, a large number of people in the surrounding areas emigrate to Zhengzhou in search of better job opportunities, which puts enormous pressure on the local urban infrastructure, especially affecting the transportation, housing and medical systems, resulting in urgent improvement in the accessibility, resource allocation and service quality of public services [2].

At the same time, the environmental challenges brought by climate change have placed new demands on the development and innovation of urban healthcare systems. With the increasing frequency and severity of extreme climate events, urban health systems are under unprecedented pressure, and adaptive strategies are necessary to mitigate the impact on public health services [3]. The “7.20 flood” occurred in Zhengzhou on July 20, 2021 is a typical example of extreme weather events caused by climate change, characterized by heavy rainfall within the city exceeding the city’s annual average in just a few days. This intense precipitation caused severe urban flooding that exceeded the capacity of local drainage systems, disrupted traffic, and caused damage to healthcare facilities [4].

Figure 3.
Rescuers Assist Evacuation in Flooded Hospital (Font: eng. mod)

In order to tackle current and future environmental challenges through previous experiences, the Zhengzhou municipal government has made a top priority for green infrastructure investment as well as implemented actions to mitigate climate change impact. This includes the "14th Five-Year Plan" concerning ecological and environmental protection that was published in the year 2022 with the focus on raising environmental standards, promoting sustainable industrial development, controlling pollution emissions, protecting biodiversity, and adapting to climate change [5]. Additionally, strengthening the healthcare system is a priority to enhance its resilience and improve its capacity for emergency response and disease prevention.

3.2

HOLISTIC DIAGNOSIS

Geographic Factors

Zhengzhou is located on the eastern side of the North China Plain, which is an area surrounded by vast plains formed by the Yellow River's alluvial deposits. The Yellow River passes through the north of Zhengzhou, playing a crucial role in shaping the region's landscape as well as the local history [6]. While the river provides fertile soil and valuable water resources, making this region one of China's most productive agricultural areas, however, the river also poses significant flood risks to the nearby urban areas because of the rushing water[7][8].

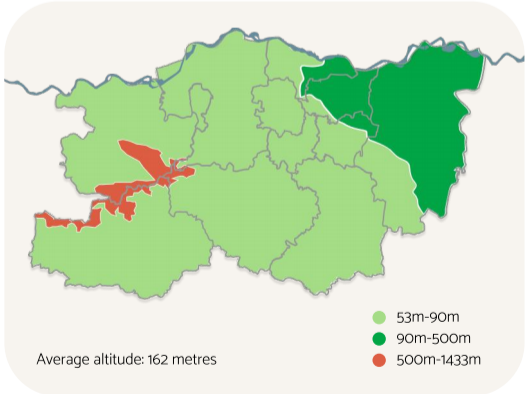


Figure 4.
Topographic map of Zhengzhou City

As the second-longest river in China, the Yellow River carries a significant amount of sediment, leading to frequent changes in its course and creating challenges for flood management. Climate change also increases the frequency and severity of these flood events by influencing rainfall patterns and increasing extreme weather events [8].

Moreover, because the central urban region of Zhengzhou is located in a relatively low-lying area, the large amounts of sediment have accumulated in some sections of the Yellow River which has caused parts of the riverbed to rise above ground level, forming "above-ground rivers" that pose a more severe challenge for the city's flood management [9].

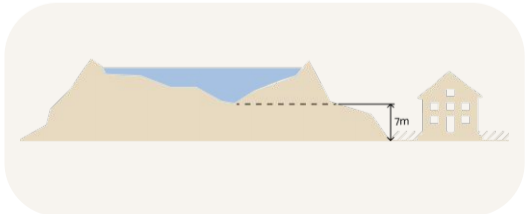


Figure 5.
Riverbed of "Above-Ground River"

Apart from the Yellow River, Zhengzhou is also affected by several smaller rivers that drain into the Yellow River. These include the Suoxu River, Jialu River, Wei River, and others, which together contribute to the local water system [10]. These smaller watercourses are susceptible to changes in precipitation patterns caused by climate change, potentially leading to more frequent and intense flooding events in the urban area.

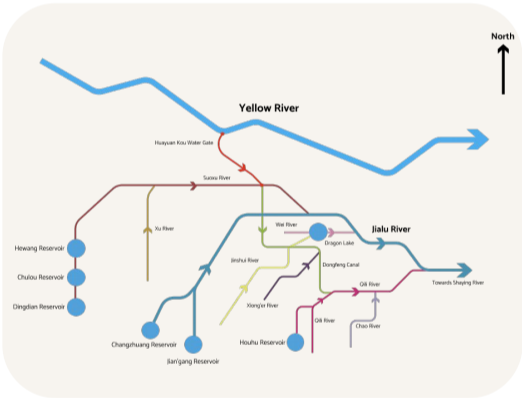


Figure 6.
System in Central Area of Zhengzhou City [10]

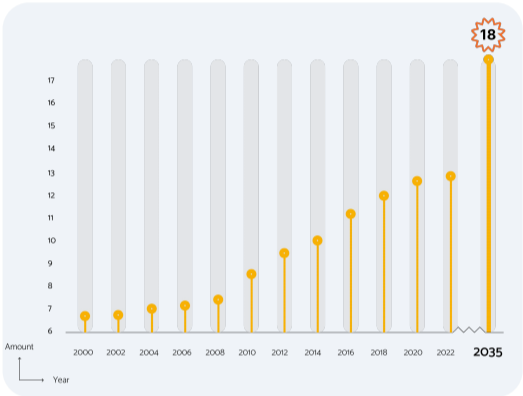
Therefore, to maintain the health and safety of the local river systems, it's essential for the government to implement comprehensive planning and strengthen infrastructure development which helps to effectively manage water resources and mitigate flood risks. Possible measures include constructing reservoirs, dams, and drainage systems to handle the rise in water levels and sediment buildup caused by heavy rainfall, ensuring the city's safety and sustainability [10].

Demographic Factors

As the capital city of Henan Province, like many other big cities in China, Zhengzhou City has seen significant demographic growth connected to its rapid economic and industrial developments. These demographic aspects have a profound influence on various aspects of city planning and management, especially in the context of healthcare and environmental challenges [10].

With over 13 million residents, Zhengzhou's population has grown significantly during the past and is still increasing at a slowing-down speed, driven by both natural increase and migration from rural areas seeking better opportunities in the city [11]. This rapid migration has resulted in high population density, particularly in urban centers, as in some areas reached around 7,000 people per kilometer square. The dentized urban population significantly exacerbated challenges related to healthcare, housing, and other public services, necessitating expanded infrastructure and more sustainable urban planning to meet the increased demand [12].

Figure 7.
Population Trend of Zhengzhou City (Unit: million)



From a demographic perspective, the city faces challenges due to increasing aging in the population and the specific needs of a large youth group. Elderly residents require customized healthcare services, including chronic disease management and specialized geriatric care, adding strain on the local healthcare system. Meanwhile, children need healthcare services tailored to their unique vulnerabilities, further challenging the scope and capacity of local healthcare systems [12]. Additionally, climate change exacerbates the vulnerabilities of both children and the elderly as the children are still developing their immune systems,

they are less adaptable to environmental changes and may lack the knowledge to protect themselves, especially in emergencies. Older adults may require additional attention and assistance due to pre-existing health conditions and mobility issues. Therefore, it is crucial for policymakers and communities to consider these specific needs when developing strategies to address the impacts of climate change [13].

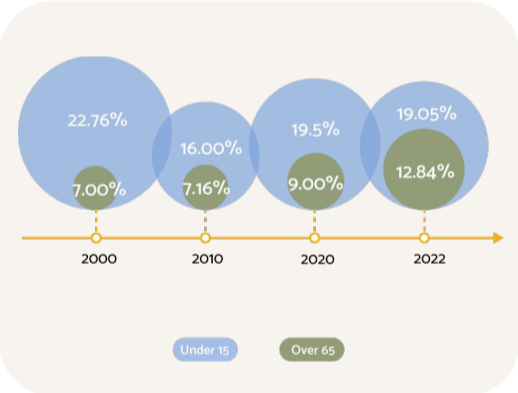


Figure 8.
Younger and Elderly Groups in Zhengzhou

Climate Factors

Zhengzhou is characterized by a continental monsoon climate, which brings with it marked seasonal variations. The city experiences cold, dry winters with temperatures occasionally dropping to as low as -5°C and light snowfall. Summers in Zhengzhou are notably hot and humid, with temperatures often exceeding above 35°C. July, which is not only the hottest month but also the peak of the monsoon season, with most of the city's annual rainfall, contributing significantly to the yearly average precipitation of approximately 640.8mm [14] [15].

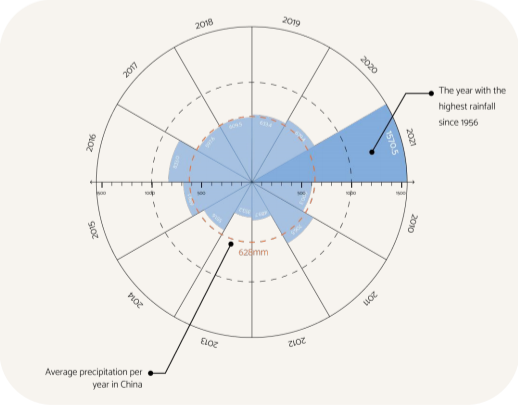


Figure 9.
Annual Precipitation of Zhengzhou City (Unit: mm)

Climate change has intensified the frequency and severity of extreme weather events in Zhengzhou. The "7.20 Flood" [16] serves as a typical example, highlighting the economic losses and casualties that ensued. These events underline the urgent need for better-prepared flood defenses and the improvement of the city's vulnerable infrastructure [17].

In addition to flooding, Zhengzhou has been facing increasingly severe heatwaves which is a direct effect of global warming. It is observable that, within the past two decades, the number of days experiencing extreme high temperatures exceeding 35 degrees Celsius has risen from 18 to 35 days, almost doubling. This trend has led to an increase in the number of drought days, which in turn has had a negative impact on local agricultural development by affecting agricultural productivity and water availability in the region, highting the need for efficient water management and conservation strategies in a sustainable way [17] [18].

they are less adaptable to environmental changes and may lack the knowledge to protect themselves, especially in emergencies. Older adults may require additional attention and assistance due to pre-existing health conditions and mobility issues. Therefore, it is crucial for policymakers and communities to consider these specific needs when developing strategies to address the impacts of climate change [13].

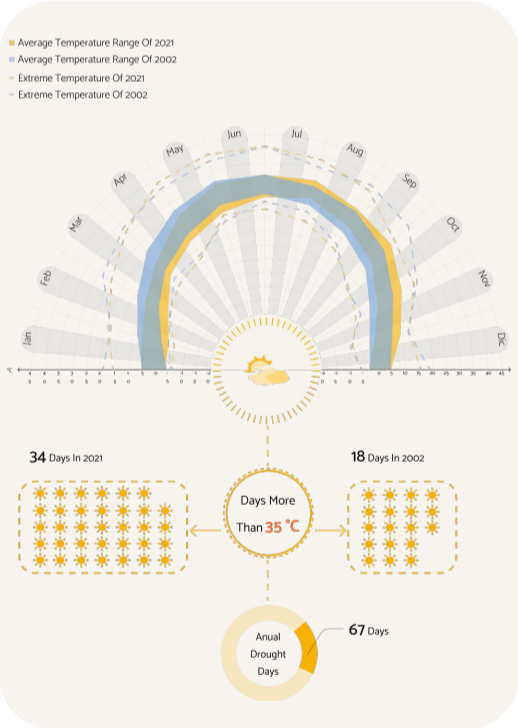
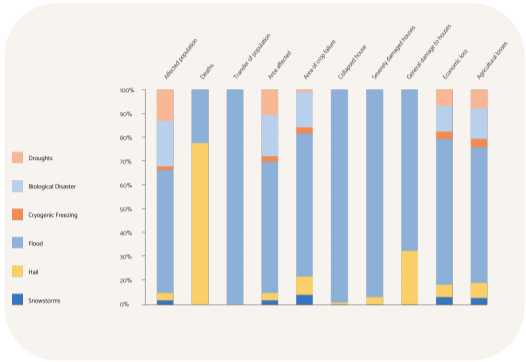


Figure 10.
Comparison of Average Temperatures in Zhengzhou City for 2021 and 2002

Figure 11.
Natural Disaster Frequency in Zhengzhou City （by type）



To mitigate these impacts, Zhengzhou need to implement comprehensive adaptation strategies. These might include improving flood defenses, expanding urban green spaces to reduce heatwaves, and guiding citizens to a more sustainable lifestyle [18][19]. Such measures are essential to safeguarding the infrastructure and population of Zhengzhou against the ongoing and future challenges posed by climate change.

Economic Factors

As the economic center in Henan Province, Zhengzhou has a dynamic economy that across the primary, secondary, and tertiary sectors. Each sector contributes to the city's overall economic system. In the past year of 2023, Zhengzhou's regional GDP exceeded 1.36 trillion yuan, with a year-on-year growth of 7.4%, ranking first among the nine national central cities and eighteen provincial capital cities [20].

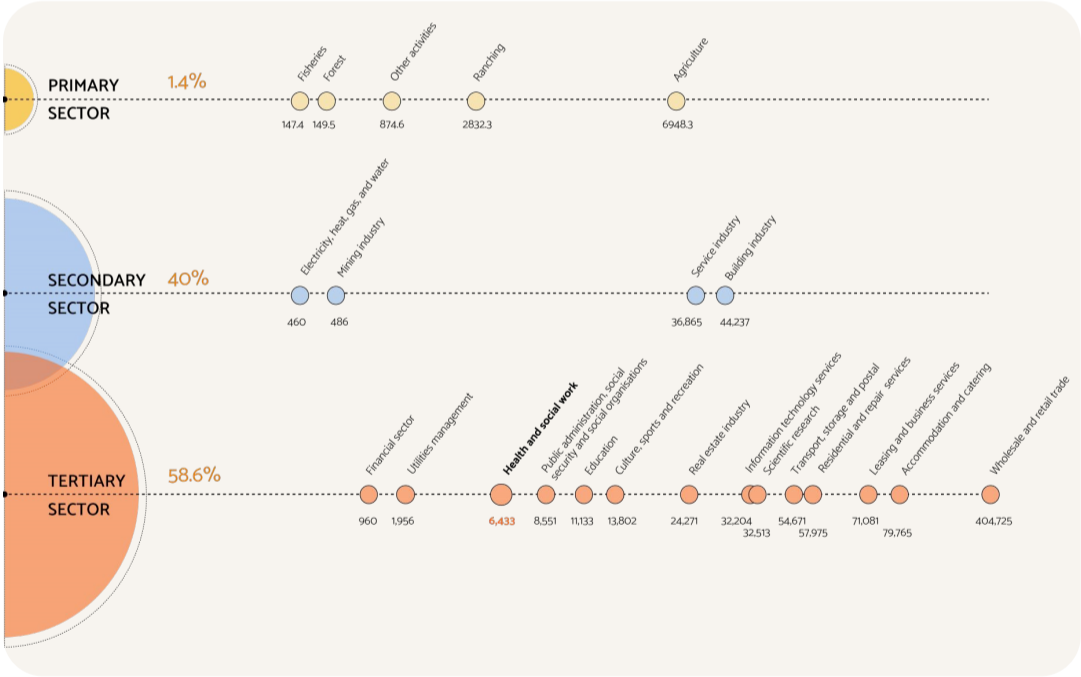


Figure 12. Economic Industry Composition of Zhengzhou City

Primary sector

Thanks to the fertile Yellow River Plain, agriculture remains an important part of Zhengzhou's economic structure. The region is a significant producer of wheat, which is a staple in the local diet. The city also produces corn, soybeans, and a variety of fruits and vegetables.

In terms of livestock, Zhengzhou engages in poultry and pig farming, contributing to its agricultural output. Recent investments in basic agricultural technology have enhanced both the productivity and efficiency of the primary production sector,

while the continuous development of precision farming techniques and sustainable agricultural practices has also supported the region's sustainable economic development [20].

Secondary Sector

The industrial sector in Zhengzhou is highly diversified, contributing approximately 40% to the local GDP with key industries including automobile manufacturing, equipment manufacturing, steel production, and electronics. The city is also home to main industrial parks such as the Zhengzhou Economic and Technological Development Zone, which hosts a variety of multinational corporations and domestic companies [20].

Tertiary Sector

The services sector in Zhengzhou is experiencing rapid growth, now accounting for more than 50% of the city's GDP. The financial services industry is a major component, with numerous banks and financial institutions headquartered in the city. Real estate has also seen considerable development, driven by urbanization and population growth. The city's educational and healthcare services are also expanding, with universities and hospitals catering to the growing population.

In terms of tourism, Zhengzhou attracted over 100 million visitors in recent years, drawn by historical sites such as the Shaolin Temple and the Museum of Henan, which significantly contribute to the local economy through cultural tourism [20].

3.3
COMPLEXITY MAP

The Complexity Map of Zhengzhou City provides a comprehensive overview of various factors impacting the city, integrating data across multiple sectors. This holistic visualization shows the intricate interplay between these factors and their impacts on the urban environment and public health.

By synthesizing this extensive data, the Complexity Map serves as an important tool for policymakers, urban planners, and researchers to understand the challenges faced by Zhengzhou. It also helps in developing targeted strategies to enhance the city's resilience, improve public health outcomes, and ensure sustainable development under the pressure of climate change. This comprehensive approach demonstrates the importance of systemic design approaches in addressing urban complexities and fostering a resilient future for Zhengzhou.

Map 1.
Complexity Map of the Territory

Complexity Map of the Territory

Che Kemeng S301537
Zhang Jianning S297771

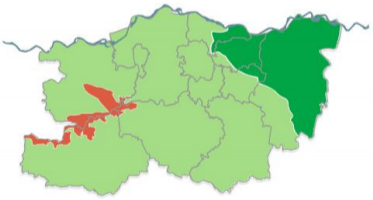
China

Henan province
Central Plains of China

Henan province

Zhengzhou city
Capital City of Henan Province

Topography



Average altitude: 162 metres

53m-90m 90m-500m 500m-1433m

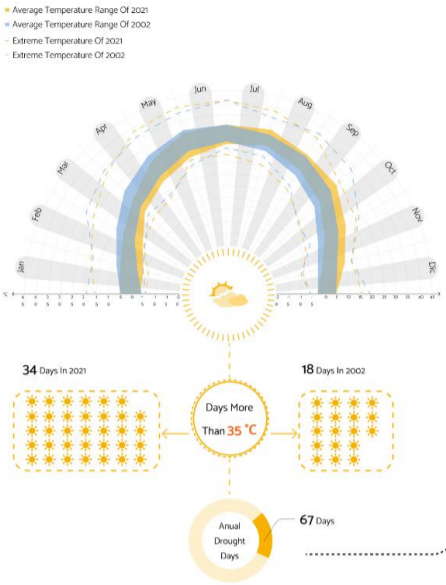
Runoff map

124 large and small rivers

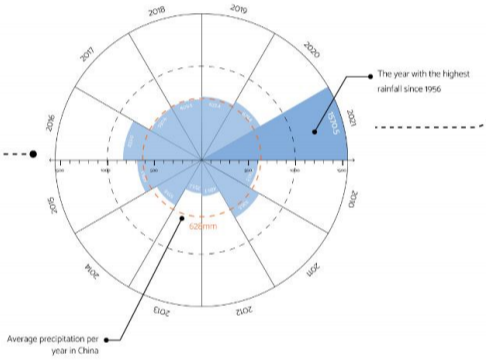
29 rivers with large watershed areas, belonging to the two major water systems of the **Yellow River** and the **Huaihe River**

CLIMATE

Temperature change

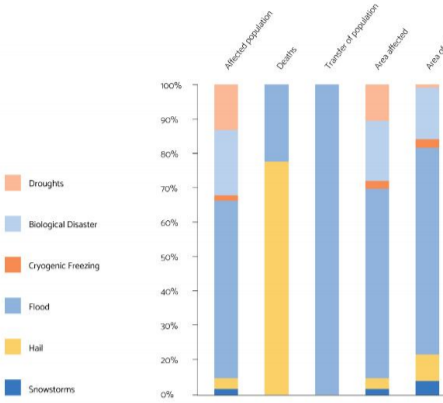


Precipitation

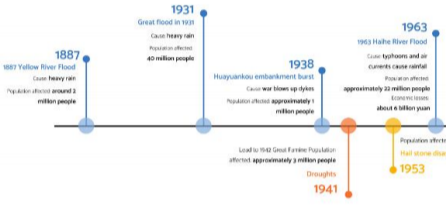


NATURAL DISASTER

Percentage of each disaster indicator by type of disaster in 202

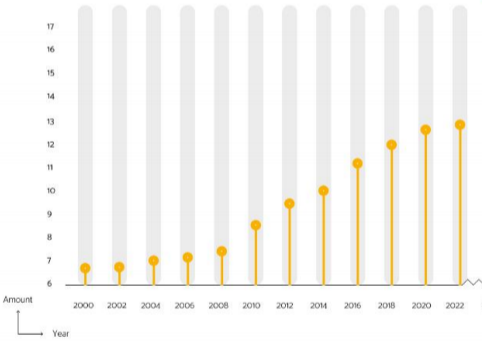


History of natural disasters



DEMOGRAPHY

Population trend (million)



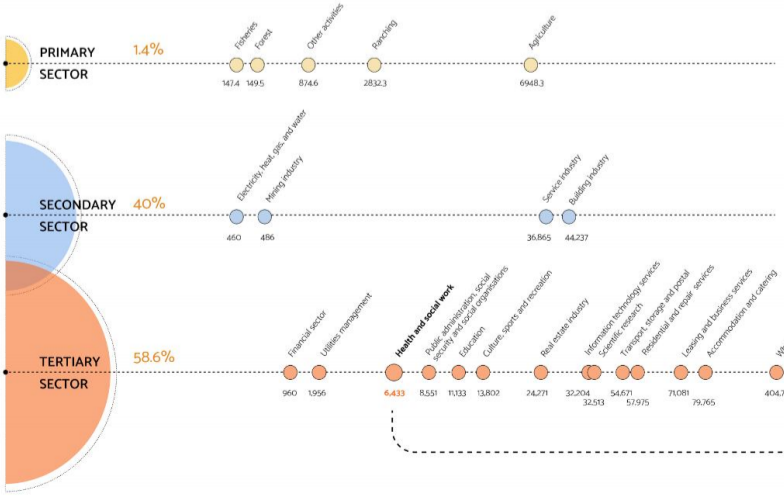
ECONOMY

1293.47 Billion yuan

INCOME **45,246**

EXPENDITURE **21,655.38**

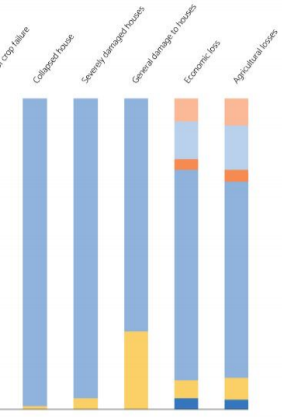
2,254.76 HEALTHCARE EXPENDITURE



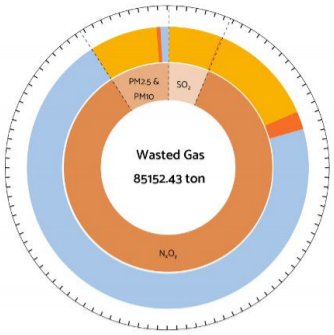
HEALTHC

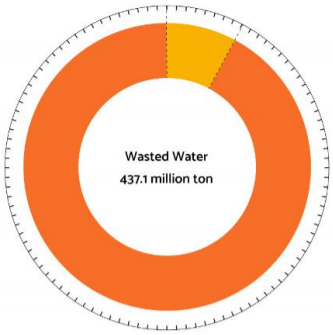
Nurses	533
Doctors	337
Stuffs	1199
Beds	952
Quantities	29

WASTES



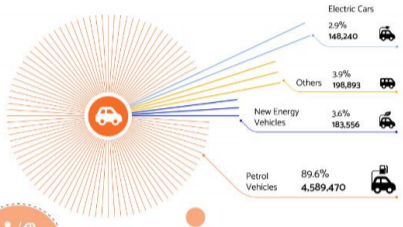
Industrial
Domestic
Motor Vehicles



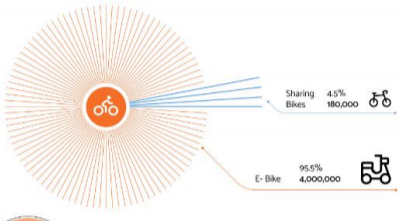


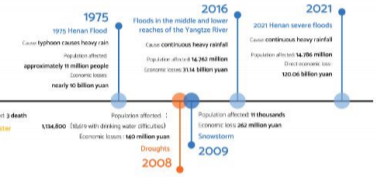
TRANSPORTATION

Motor Vehicles



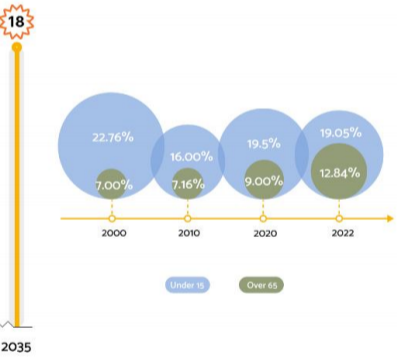
Non Motor Vehicles



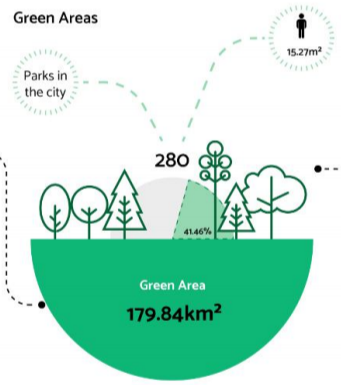


ECOLOGICAL RESOURCE

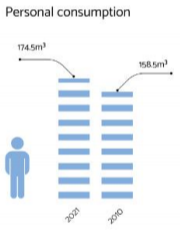
Age groups

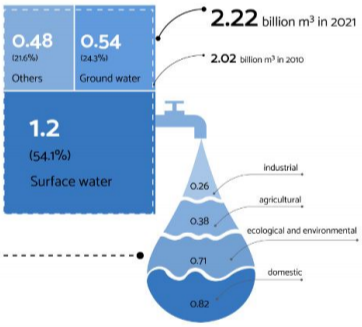


Green Areas

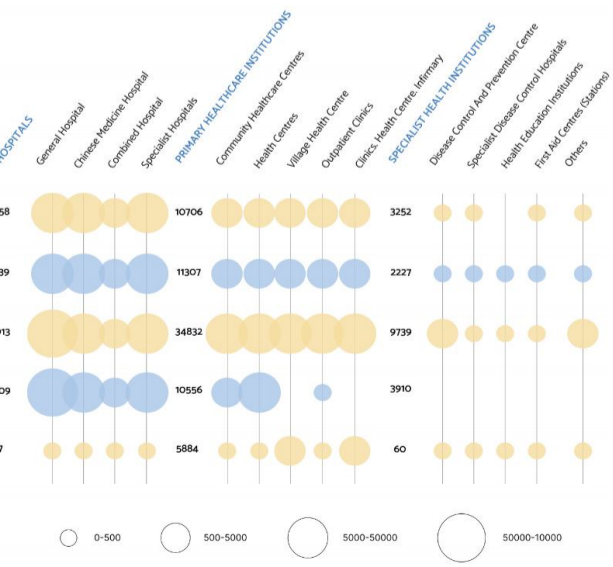


Water consumption (billion m³)



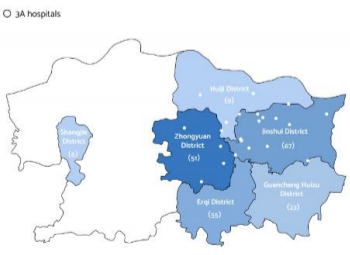


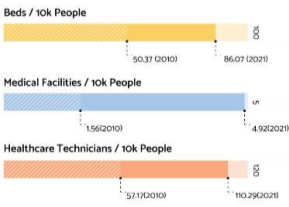
CARE RESOURCES



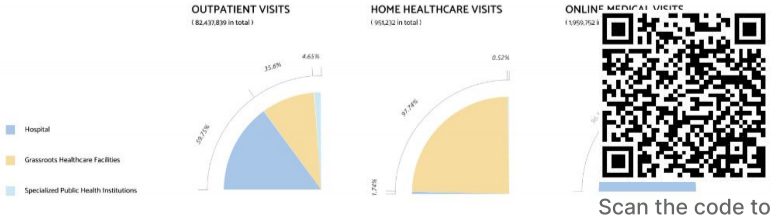
Healthcare resources distribution

Number of hospitals





Number of medical visits



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References :

1. Britannica, T. Editors of Encyclopaedia (2024, May 6). Zhengzhou. Encyclopedia Britannica. https://www.britannica.com/place/Zhengzhou

2. Li, G., Liu, J., & Shao, W. (2023). Urban flood risk assessment under rapid urbanization in Zhengzhou City, China. Regional Sustainability, 4(3), 332-348. https://doi.org/10.1016/j.regsus.2023.08.004

3. Cai, E., Bi, Q., Lu, J., & Hou, H. (2022). The spatiotemporal characteristics and rationality of emerging megacity urban expansion: A case study of Zhengzhou in Central China. Frontiers in Environmental Science. https://doi.org/10.3389/fenvs.2022.860814

4. Guo, X., Cheng, J., Yin, C., Li, Q., Chen, R., & Fang, J. (2023). The extraordinary Zhengzhou flood of 7/20, 2021: How extreme weather and human response compounding to the disaster. Cities, 134, 104168. https://doi.org/10.1016/j.cities.2022.104168

5. State Council of the People's Republic of China. (2021, March 13). 中华人民共和国国民经济和社会发展第十四个五年规划和2035年远景目标纲要 [The 14th five-year plan for economic and social development of the People's Republic of China and the long-range objectives through the year 2035]. Retrieved from https://www.gov.cn/xinwen/2021-03/13/content_5592681.htm

6. Li, J., Xia, H., Qin, Y., Fu, P., Guo, X., & Zhao, X. (2022). Web GIS for sustainable education: Towards natural disaster education for high school students. Sustainability, 14(5), 2694. https://doi.org/10.3390/su14052694

7. Dai, K., Shen, S., Cheng, C., & Song, Y. (2023). Integrated evaluation and attribution of urban flood risk mitigation capacity: A case of Zhengzhou, China. Journal of Hydrology: Regional Studies, 50, 101567. https://doi.org/10.1016/j.ejrh.2023.101567

8. Cheng, Q., Wang, W., Wang, H., & Zhao, Z. (2012). Investigation of the heavy metal contamination of the sediments from the Yellow River Wetland Nature Reserve of Zhengzhou, China. Iranian Journal of Public Health, 41(1), 26-35.

9. Li, Y., Ye, S., Wu, Q., Wu, Y., & Qian, S. (2023). Analysis and countermeasures of the "7.20" flood in Zhengzhou. Journal of Asian Architecture and Building Engineering, 22(6), 3782-3798. https://doi.org/10.1080/13467581.2023.2208195

10. Połomski, M., & Wiatkowski, M. (2023). Impounding reservoirs, benefits and risks: A review of environmental and technical aspects of construction and operation. Sustainability, 15(22), 16020. https://doi.org/10.3390/su152216020

11. Qiu, G., Bao, Y., Yang, X., Wang, C., Ye, T., Stein, A., & Jia, P. (2020). Local population mapping using a random forest model based on remote and social sensing data: A case study in Zhengzhou, China. Remote Sensing, 12(10), 1618. https://doi.org/10.3390/rs12101618

12. Chen, R., Dai, F., Yang, H., Zhang, X., Zhang, H., & Liu, M. (2020). Caring behaviours perceived by elderly residents and their associated factors in nursing homes in Zhengzhou City of China: A qualitative study. Health & Social Care in the Community. https://doi.org/10.1111/hsc.13252

13. UNICEF. (2023). Protecting children from heat stress: A technical note. Retrieved from https://www.unicef.org/media/139926/file/Protecting-children-from-heat-stress-A-technical-note-2023.pdf

14.Wang, W., & Yuan, X. (2024). Climate change and La Niña increase the likelihood of the '7·20' extraordinary typhoon-rainstorm in Zhengzhou, China. International Journal of Climatology. https://doi.org/10.1002/joc.8386

15. Li, H., Jombach, S., Tian, G., Li, Y., & Meng, H. (2022). Characterizing temporal dynamics of urban heat island in a rapidly expanding city: A 39 years study in Zhengzhou, China. Land, 11(10), 1838. https://doi.org/10.3390/land11101838

16. Tuo, W., Zhang, X., Song, C., & Hu, D. (2020). Annual precipitation analysis and forecasting – taking Zhengzhou as an example. Water Supply, 20(5), 1604-1616. https://doi.org/10.2166/ws.2020.067

17.Chen, Z., Kong, F., & Zhang, M. (2022). A case study of the "7-20" extreme rainfall and flooding event in Zhengzhou, Henan Province, China from the perspective of fragmentation. Water, 14(19), 2970. https://doi.org/10.3390/w14192970

18. Hao, H., Zhu, H., & Wang, F. (2022). Regional agricultural drought risk assessment based on attribute interval identification: A study from Zhengzhou, China. Water Supply, 22(5), 5309-5330. https://doi.org/10.2166/ws.2022.177

19. Dai, K., Shen, S., Cheng, C., & Song, Y. (2023). Integrated evaluation and attribution of urban flood risk mitigation capacity: A case of Zhengzhou, China. Journal of Hydrology: Regional Studies, 50, 101567. https://doi.org/10.1016/j.ejrh.2023.101567

20. Zhengzhou Statistics Bureau, & National Bureau of Statistics Zhengzhou Survey Team. (2024, April 7). 2023年郑州市国民经济和社会发展统计公报 [2023 Statistical Bulletin on National Economic and Social Development of Zhengzhou City]. Retrieved from https://tjj.zhengzhou.gov.cn/tjgb/8324080.jhtml

04.

STATE OF THE HEALTHCARE SYSTEM

THE HEALTHCARE SYSTEM IN CHINA IS CHARACTERIZED BY A COMPREHENSIVE AND ***TIERED STRUCTURE***, PROVIDING EFFECTIVE HEALTHCARE SERVICES TO THE LARGE LOCAL POPULATION

4.1

STRUCTURE OF CHINESE HEALTHCARE SYSTEM

The healthcare system in China is characterized by a comprehensive and tiered structure, providing effective healthcare services to the large local population [1]. The system is designed to achieve both broad coverage and a tiered service delivery mechanism that emphasizes preventive and primary care at the grassroots level, while also offering specialized and high-level healthcare services through advanced facilities [2].

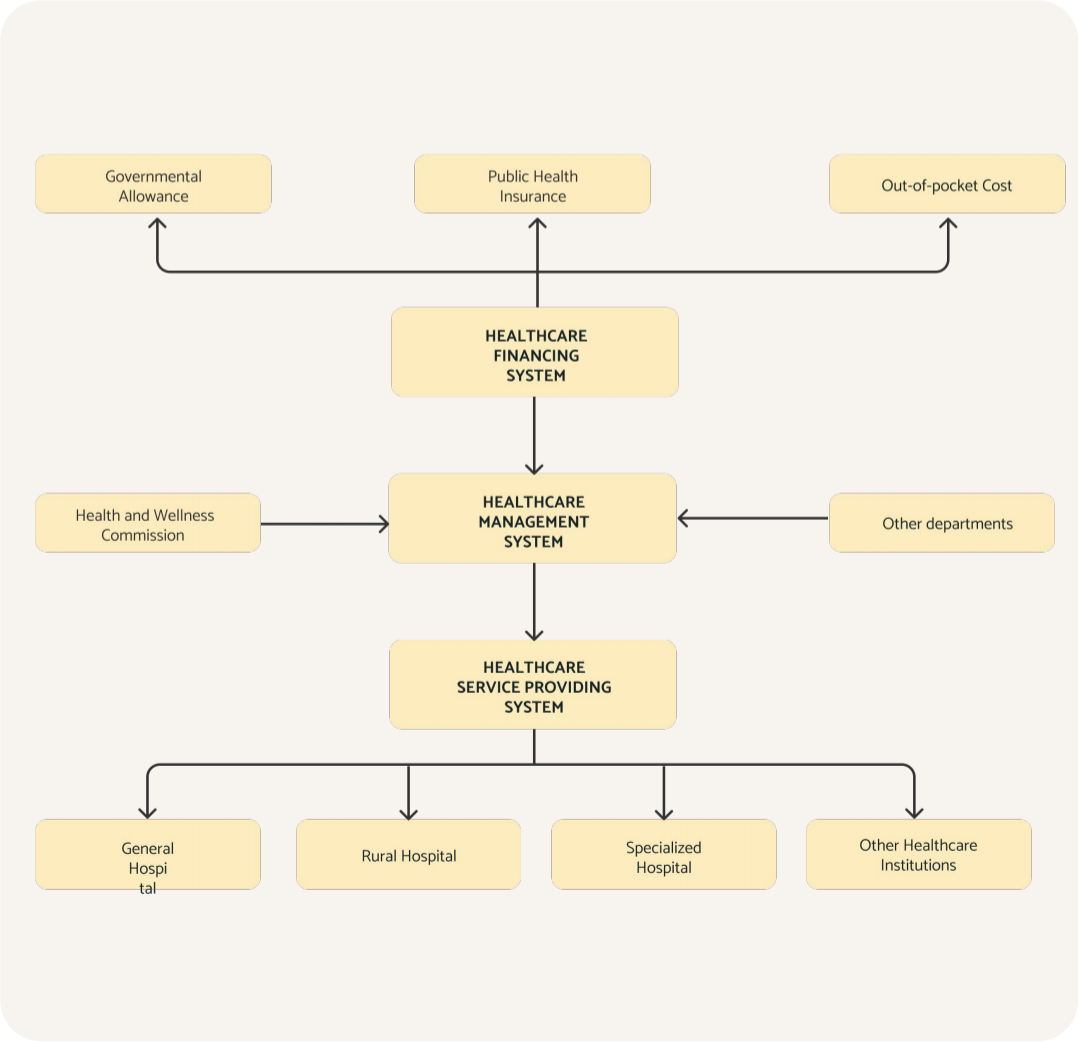

Figure 13. Chinese Healthcare System

This system is composed of three main subsystems: the Healthcare Financing System, the Healthcare Service Providing System, and the Healthcare Governance System. These subsystems function both independently and in an interconnected way, with various stakeholders engaging across different sections to ensure the effective operation of the entire system. [1].

Under the regulation of the Chinese health legal system, the National Health and Wellness Commission serves as the principal administrative entity for health management with other governmental departments including National Development and Reform Commission, Ministry of Civil Affairs, Ministry of Finance, and Ministry of Human Resources and Social Security etc. [3]. These institutions are important in the governance and supervision of healthcare practices with the responsibilities for planning, financing, and managing health insurance across the whole country [4].

Since the founding of the People's Republic of China in 1949, the Chinese healthcare services system has evolved through various phases of development.

This evolution has resulted in the establishment of the contemporary healthcare structure, which is essentially linked to broader systemic transformations in China's political, economic, and administrative fields [5].

The organizational structure of China's healthcare administrative system is tiered across four levels:

National Level: the National Health and Wellness Commission, which sets overall policies and guidelines.

Provincial Level: Health departments (or bureaus) within provinces, autonomous regions, and municipalities directly under the central government, which adapt national directives to regional contexts.

Municipal Level: Municipal health bureaus, which further tailored provincial policies to local needs.

County/District Level: County or district healthcare bureaus that are responsible for the on-the-ground implementation of health policies [6].

At each level, local governments are responsible to develop and carry out plans and decisions that align with national principles and strategic directions, ensuring that healthcare governance is both centralized and appropriately localized to meet diverse regional needs [6].

Healthcare Financing System

The healthcare financing system is primarily responsible for the financial aspects of healthcare, ensuring that resources are available to fund health services [7]. In China, this system can be broadly categorized into three main sources: governmental allowances, public insurance programs, and out-of-pocket costs. Each of these plays an important role in financing the healthcare services needed by the country's vast population [8].

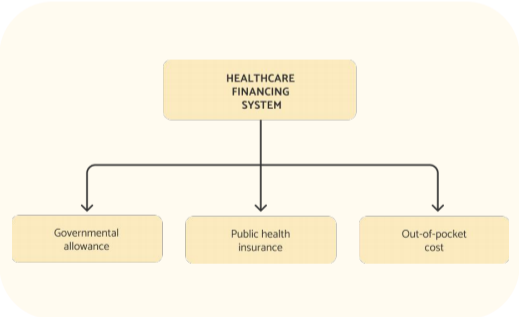

Figure 14. Chinese Healthcare Financing System

Governmental Allowances

These are funds allocated by various levels of government to support healthcare infrastructure, subsidize insurance premiums, and provide direct funding to public hospitals. This financial support is crucial for maintaining service delivery in less affluent regions especially for low-income population and for ensuring that public health priorities, such as infectious disease control, receive adequate funding [9].

Public Insurance Programs

Public Insurance Programs encompass a series of public health insurance plans that provide the majority of the population with access to healthcare services. These include the Urban Employee Basic Medical Insurance (UEBMI) for urban workers, and the Urban and Rural Residents Basic Medical Insurance (URRBMI) that covers non-employed urban residents and rural citizens [7]. These programs are designed to reduce individual financial burdens and improve access to healthcare services.

Out-of-Pocket Costs

Despite widespread insurance coverage, out-of-pocket expenses still constitute a significant part of healthcare funding in China. These costs are incurred by individuals when services are either not covered by insurance or only partially covered. High out-of-pocket costs can lead to financial strain for individuals,

particularly those facing chronic health issues or requiring specialized healthcare treatment not covered or not fully covered by insurance [10].

Healthcare Governance System

The governance of China's healthcare system is a complex and multi-layered framework designed to manage the whole country's healthcare infrastructures. It involves coordination between various government levels and departments to address the broad needs of over a billion people [13].

Map 2.
Chinese Healthcare Governance System

Chinese Healthcare Governance System

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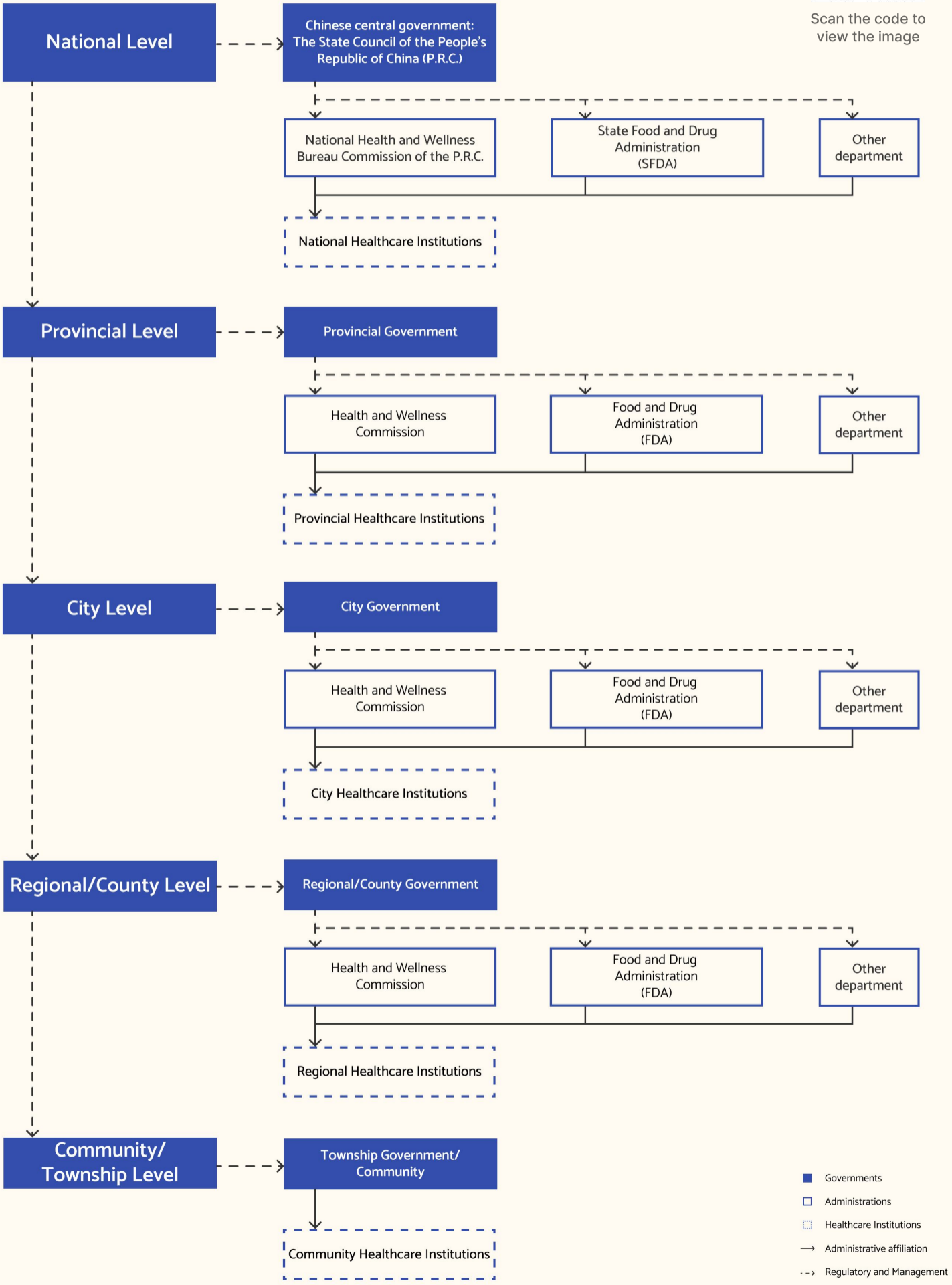

At the highest level of this system, the National Health and Wellness Commission of the People's Republic of China operates as the principal authority. It is responsible for the formulation of national health policies, guidelines, and regulations that govern the entire healthcare system [13]. These national directives are aimed at ensuring a uniform standard of care, promoting public health, and responding effectively to health emergencies across the country.

Once national policies are established, they are disseminated to provincial health departments, which play a critical role in adapting these guidelines to local contexts. In this case, provincial departments assess regional health disparities and challenges, adapting national policies to better align with the specific health needs and resources demands of their respective populations [13]. This adaptation process is crucial for addressing varied health issues that may be more prevalent in certain regions, especially economically disparate areas.

The process of decentralization extends further into the healthcare governance structure, reaching the city and regional / county levels. At these levels, municipal and county health bureaus are responsible for the implementation of the adopted policies [14]. These local bureaus have direct supervision of healthcare facilities within their jurisdiction, including hospitals, clinics, and community healthcare centers. They ensure that healthcare delivery is consistent with both provincial adaptations and national standards.

At the grassroots level, community and township health departments serve as the foundational authorities of the public health system. These departments are deeply integrated into their communities,

allowing them to respond swiftly and effectively to local health needs [15]. They manage primary healthcare facilities, implement preventive health programs, and promote health education campaigns. These local units are important in managing daily healthcare services, from vaccination programs to maternal and child health initiatives [16].

This layered structure allows for a high degree of specialization and responsiveness at each level of government, ensuring that health policies are not only universally applicable but also sufficiently flexible to meet local needs [17]. However, this system also requires effective communication and coordination between the different levels of health governance to prevent overlaps and ensure that resources are utilized efficiently. Therefore, to make sure the entire system works efficiently, it is necessary to improve data sharing, communication, policy alignment, and resource distribution among departments at various levels [18].

Healthcare Providing System

The healthcare providing system in China is an structured network designed to deliver healthcare services at multiple levels, ensuring accessibility and appropriate care across the nation. This system is hierarchically organized into primary, secondary, and tertiary facilities, proving healthcare services from basic preventive measures to complex, specialized treatments [19].

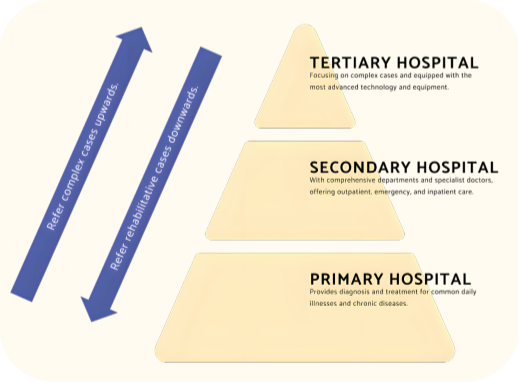

Figure 15.
Chinese Healthcare Providing System

At the base of the healthcare system, **primary care facilities**, such as community health centers and local clinics, serve as the fundamental point of contact designed for individuals seeking healthcare support [19]. These centers are critical in promoting public health by focusing on preventive care, health education, and the management of common diseases.

They are often affiliated with universities and serve as centers for medical sciences and research.

However, in China, it is also noticeable that when people encounter sudden health issues, they are more likely to choose tertiary hospitals for treatment due to their advanced facilities and specialized staff [23]. This preference often results in overcrowding and overburdening of these institutions, which can compromise the efficiency of healthcare service delivery. Therefore, to mitigate this situation, it is critical to enhance the capabilities of primary and community healthcare facilities [24]. By improving the quality of service, upgrading equipment, and increasing the availability of specialized personnel at grassroots hospitals, it is possible to increase public confidence in these facilities. This shift could help to balance the patient load more evenly across different levels of the healthcare system thus make full use of the local healthcare resources, reducing pressure on tertiary hospitals and ensuring quicker, more accessible healthcare services for the residents.

They play a crucial role in the early detection of health issues, which helps in mitigating the need for more complex treatments. In this case, primary care facilities are strategically located to ensure they are easy reaching for the community members they serve [20].

Secondary hospitals provide more specialized services than primary care facilities. They deal with health conditions that require more advanced diagnosis and treatment options that are beyond the ability of primary care [19]. These hospitals often serve bigger regions, offering both inpatient and outpatient services, and act as a bridge between primary care and highly specialized healthcare treatment provided by tertiary hospitals. Therefore, secondary hospitals are essential for handling moderately complex health issues that require specialized healthcare personnel and equipment [21].

Tertiary hospitals offer the most advanced level of healthcare available in China. These facilities are equipped with the most advanced technology and staffed by top-tier healthcare professionals specializing in various fields of healthcare [21]. Hospitals at this level are not only responsible for providing high-end, specialized treatments but also play a significant role in healthcare research and the training of future healthcare professionals. They are often affiliated with universities and serve as centers for medical sciences and research.

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4.2

HEALTHCARE SYSTEM OF ZHENGZHOU

The healthcare system in Zhengzhou is shaped by a complex interconnection of regional characteristics, government policies, and socio-economic factors. As a significant urban center, a large number of healthcare resources are concentrated within the urban area, including large hospitals, specialized clinics, and research institutions, making it a hub for regional healthcare services [25]. As regional referral centers, which means that when residents living in smaller cities around Zhengzhou cannot receive adequate treatment at local lower-tier hospitals, they often choose to transfer to tertiary hospitals in Zhengzhou for better care, as these hospitals are supposed to deal with the most complex and critical health conditions, providing services such as organ transplants, advanced cancer treatments, intricate surgical procedures and so on [22].

To address the pressure of the system under climate change, some government initiatives, such as the Healthy China 2030 plan [26], have influenced the development of healthcare services in Zhengzhou by promoting preventive healthcare measures, increasing healthcare funding, and seeking for health equity. These efforts especially contribute to improving healthcare accessibility in rural areas, enhancing the overall resilience and inclusiveness of the entire healthcare system [27].

Organizational Structure

Zhengzhou's healthcare system aligns with the structure of the general Chinese healthcare system which is a comprehensive multi-tiered framework designed to deliver healthcare services across various levels [19]. This model ensures that patients receive appropriate care at each level, optimizing resource utilization by allowing primary care centers to handle routine cases and reserving specialized, resource-intensive care for secondary and tertiary facilities [28]. This structure not only enhances the accessibility of healthcare services across different geographical regions but also facilitates better public health strategies by efficiently distributing expertise and resources where they are most needed.

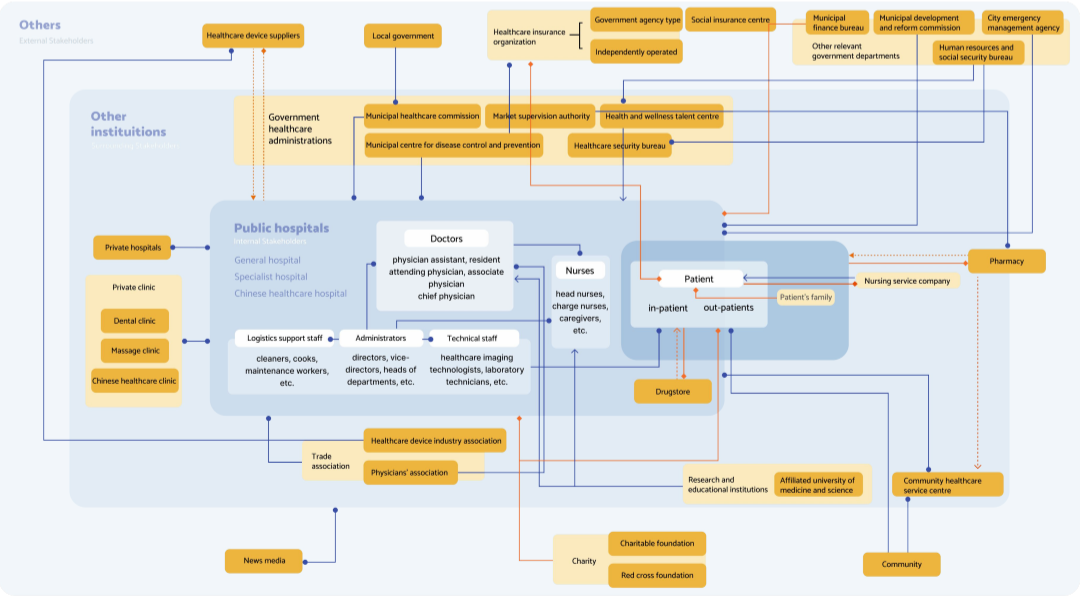
From an administrative perspective, Zhengzhou's healthcare system is managed by the Health and Wellness Commission of Zhengzhou City [29]. This organization ensures that local health services follow the national policies while also considering the unique health needs of the region. It collaborates with the Henan Provincial Health Department to guarantee cohesive operations throughout the healthcare system.

Under this organizational structure, Zhengzhou's healthcare system can be well-prepared to address the diverse health needs of the residents effectively and promptly while ensuring that the system has the necessary capacity and flexibility to respond quickly to the changing health concerns and emergencies. Additionally, this framework facilitates the seamless implementation of health policies released by the central government, guaranteeing that these directives can be carried out efficiently and consistently across the region. This alignment between central decision and local execution helps maintain a cohesive and unified healthcare operation, enhancing overall service delivery and ensuring that standards are consistently applied across all levels of healthcare.

Stakeholder Mapping

The healthcare system in Zhengzhou involves a complex network of stakeholders, each playing a crucial role in the delivery of health services and the implementation of health policies. Understanding the interconnection among these stakeholders is vital for assessing the system's efficiency, responsiveness, and overall effectiveness in addressing the health needs of the population.

These stakeholders can be categorized into three different groups based on their roles and the extent of their influence: internal stakeholders, surrounding stakeholders, and external stakeholders. Each group interacts with the healthcare system in unique ways, contributing to its overall functionality and effectiveness [31].



Map 3.
Healthcare System Stakeholders' Map

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INTERNAL STAKEHOLDERS:

Healthcare Providers: This group includes all categories of healthcare facilities, and the professionals who work within them, such as doctors, nurses, technicians, and administrative staff. They are directly involved in the delivery of health services and the daily management of healthcare operations.

Patient and Community Groups: These include patients, their families, and local community organizations that interact directly with the healthcare system. They demand healthcare services, provide feedback and participate in public health planning.

SURROUNDING STAKEHOLDERS:

Governmental Health Agencies: Entities like the Health and Wellness Commission of Zhengzhou City and relevant departments within it that supervise healthcare services at the municipal level are important stakeholders. They formulate health policies, ensure compliance with national standards, and manage public health programs.

Academic and Research Institutions: Local universities and research centers contribute to the healthcare system by conducting medical research, offering training and education to healthcare professionals, and promoting policy development through evidence-based findings.

Private Hospitals: These facilities enhance the healthcare system by providing alternatives to public services, often incorporating advanced technologies and specialized treatments. They play a crucial role in healthcare delivery, especially in areas where public resources might be limited or overcrowded.

EXTERNAL STAKEHOLDERS

Governmental Entities: This includes entities like the Municipal Finance Bureau, City Emergency Management Agency, and other governmental bodies that influence healthcare through regulatory oversight, strategic funding, and overarching health policies that affect the local healthcare system.

Healthcare Industry Suppliers: These external suppliers, including pharmaceutical companies, medical equipment manufacturers, and technology providers, are critical for providing the necessary healthcare products that sustain healthcare services.

Each stakeholder group brings unique perspectives, resources, and competencies to Zhengzhou's healthcare ecosystem, contributing to a dynamic and multifaceted healthcare system that strives to meet the diverse and changing health needs of the local population [32].

At the same time, by examining the diverse flows of resources among different stakeholders, it is possible to gain a deeper understanding of the interconnections and interdependencies that exist within the network of stakeholders involved in the healthcare system.

Information Flow:
Information in Zhengzhou's healthcare system circulates through electronic health records (EHRs) and communication between healthcare providers, government agencies, and citizens. Data related to patient care, epidemiological trends, and health outcomes are shared across various levels of the healthcare system [33]. This ensures that all stakeholders are informed and can make data-driven decisions. Furthermore, public health announcements and policy updates from governmental bodies are disseminated through official channels and media to reach healthcare providers and the public.

Material Flow:
Materials like healthcare supplies, medications, and equipment are strategically distributed across Zhengzhou's healthcare facilities based on needs assessments and demand forecasting. This involves analyzing historical data and current health trends to ensure facilities are well-stocked while coordinated logistics are important to ensure timely delivery of needed materials for responding to health emergencies and regular demand [34].

Financial Flow:
Funding for Zhengzhou's healthcare system comes from several sources, including government budgets, private insurance, out-of-pocket payments by patients, and contributions from non-governmental organizations. These funds are allocated to healthcare facilities and programs according to predefined budgets and spending guidelines. Financial flows within the healthcare system are managed by utilizing reimbursement systems for services provided, allocating grants for public health initiatives, and investing in healthcare infrastructure and technology [35].

Personnel Flow:
The movement and management of healthcare personnel involves recruitment, training, and deployment across various healthcare facilities. Personnel flow is strategically managed to meet the fluctuating demand in different parts of the system, with particular attention to addressing shortages in critical areas or specialties. Ongoing professional development and training programs ensure that healthcare workers remain competent in their fields and are updated on the latest healrhcare practices and technologies [36].

Healthcare Resources

Zhengzhou's healthcare resources are a significant asset to the city, reflecting the broader trend in urban China of consolidating high-quality medical facilities to serve dense populations.

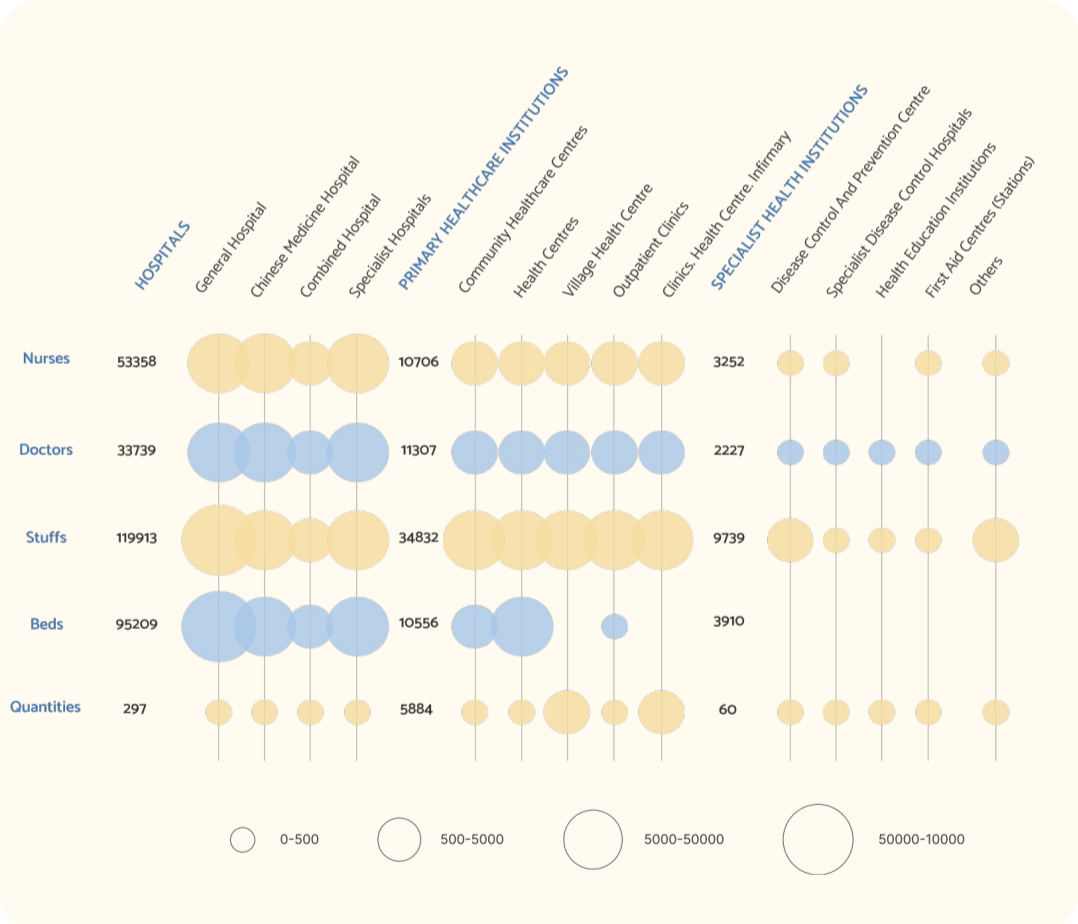


Figure 16.
Healthcare Resources of Zhengzhou City

According to a report released by the Zhengzhou Municipal Health and Wellness Commission, Zhengzhou is equipped with a robust network of healthcare facilities, including 298 public comprehensive hospitals that vary in levels of specialization and services. These hospitals are supplemented by 5,884 primary healthcare institutions, providing essential healthcare services and preventive care to the residents in their daily time.

The city also has a substantial workforce of healthcare professionals, with a total of 140,530 registered healthcare personnel. This workforce is essential for delivering healthcare services across the urban and suburban areas of Zhengzhou.

Furthermore, Zhengzhou's healthcare facilities are able to provide 95,209 fixed hospital beds, which are crucial for both urgent and long-term patient care. This infrastructure is intended to meet the diverse health needs of its population, from routine treatments to complex surgeries [37].

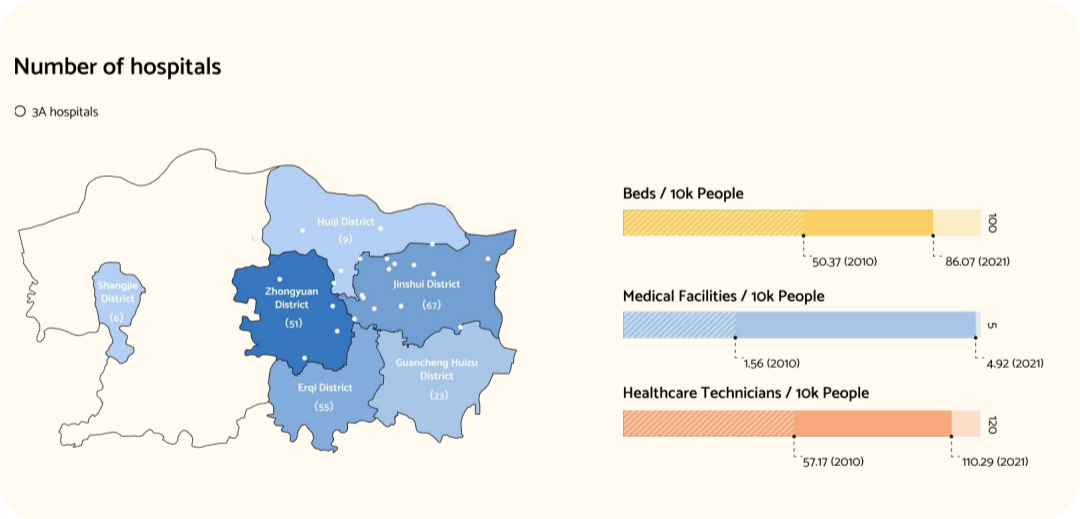


Figure 17.
Healthcare Resources Distribution of Zhengzhou City

From a per capita perspective, the city of Zhengzhou has 8.6 hospital beds per thousand people, compared to the national average of 6.92 beds per thousand people. Additionally, the doctor density in Zhengzhou is notably high at 110.29 per 10,000 people, significantly surpassing the national average of 23.9 per 10,000 people [37].

This higher density of healthcare professionals and facilities highlights Zhengzhou's commitment to enhancing healthcare accessibility and quality for its residents, aiming at support its growing population and urban development.

However, while the healthcare system in Zhengzhou is notably robust, the challenges and difficulties faced by the entire system still cannot be ignored:

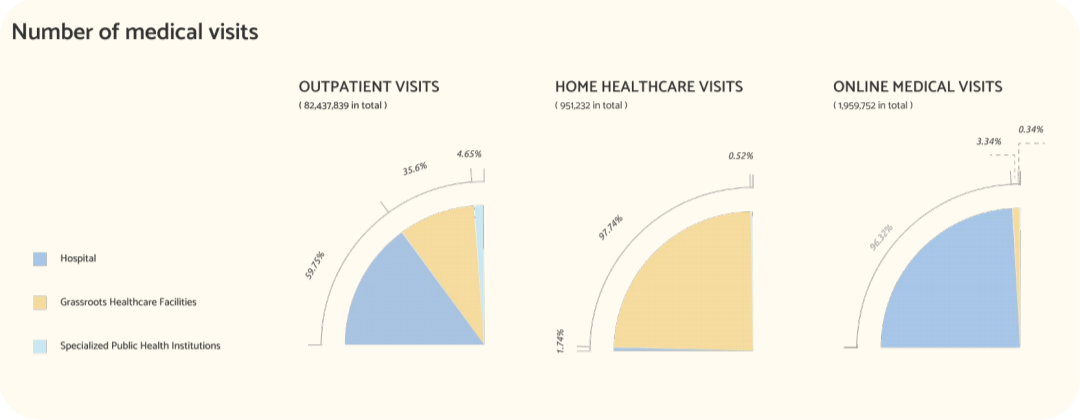


Figure 18.
Number of Healthcare Visits in Zhengzhou City

Resource Distribution: Even with a high amount of healthcare resources, there are also disparities in how these resources are distributed across the city. Urban centers typically have better healthcare facilities and more specialists, which can lead to unequal access for residents in peripheral or rural areas. This disparity might result in longer travel times for some patients and potentially overcrowded facilities in urban centers.

Workforce Pressure: A high number of registered healthcare professionals does not necessarily translate into perfect service delivery since the workload is unevenly distributed. The pressure on healthcare staff in high-demand areas can lead to overtired and reduced quality of care. Excessive workloads leading to physician fatigue are a significant concern in the healthcare.

This exhaustion may reduce doctors' empathetic capacities, potentially leading to conflicts with patients who may feel neglected or inadequately cared for. In this case, enhancing communication between doctors and patients becomes crucial, as it helps to reduce misunderstandings. Implementing such strategies can improve the effectiveness of the whole system, increase patient satisfaction, and reduce the incidence of conflicts within healthcare settings [37] [38].

Addressing such challenges requires a holistic approach that focuses not just on resource availability but also on enhancing efficiency, equity, and sustainability. This involves integrating advanced technology to ensure equitable access across different regions and adopt sustainable practices that promote long-term resilience in the healthcare system.

4.3

EMERGENCY RESPONSE SYSTEM

The enhanced "Henan Province Natural Disaster Relief Emergency Plan" offers a systemic framework for addressing the multifaceted challenges posed by natural disasters. This revision, carried out by the Provincial Emergency Management Department, not only updates the procedural aspects but also incorporates innovative organizational structures tailored to the evolving situation of natural disasters influenced by global climate changes and urbanization impacts.

The revised plan specified a comprehensive organization of the emergency management structure, centralizing command under the Provincial Disaster Reduction Committee. This body is tasked with overarching leadership and coordination responsibilities during major natural disasters. It collaborates with various governmental and non-governmental organizations to streamline efforts across different workgroups. These workgroups are tasked with disaster information management, life-saving assistance, logistics and material support, funds management, safety and public order, health and epidemic prevention, media relations, and reconstruction efforts. This structure is designed to foster a cohesive and coordinated response structure, optimizing resource allocation and response efficiency during crises.

A crucial aspect of the plan is the robust disaster information management system it proposes. This system requires that disaster and relief information be reported up the chain of command within two hours of an event's occurrence, ensuring that timely and accurate data are available for decision-making at all levels. To further refine the accuracy and reliability of the disaster reports, the plan introduces standardized protocols for data collection, assessment, and reporting. These protocols are aimed at ensuring that all reported data adhere to strict criteria of reliability and are comprehensive enough to guide the response efforts effectively.

The plan introduces a detailed, multi-tiered emergency response system that categorizes responses into four that categorizes responses into four levels based on the severity and impact

of the disaster. This stratification allows for a scalable and flexible response that can meet the specific needs of the situation. The activation of these levels is also governed by clearly defined criteria, ensuring that the response is proportionate to the emergency's demands. Each tier of response mobilizes different resources, expertise, and personnel, tailored to the unique challenges presented by the disaster's scale and property.

The healthcare system is crucial in this situation to ensure comprehensive preparedness to effectively manage the impacts of natural disasters, protecting the health and safety of both patients and healthcare personnel.

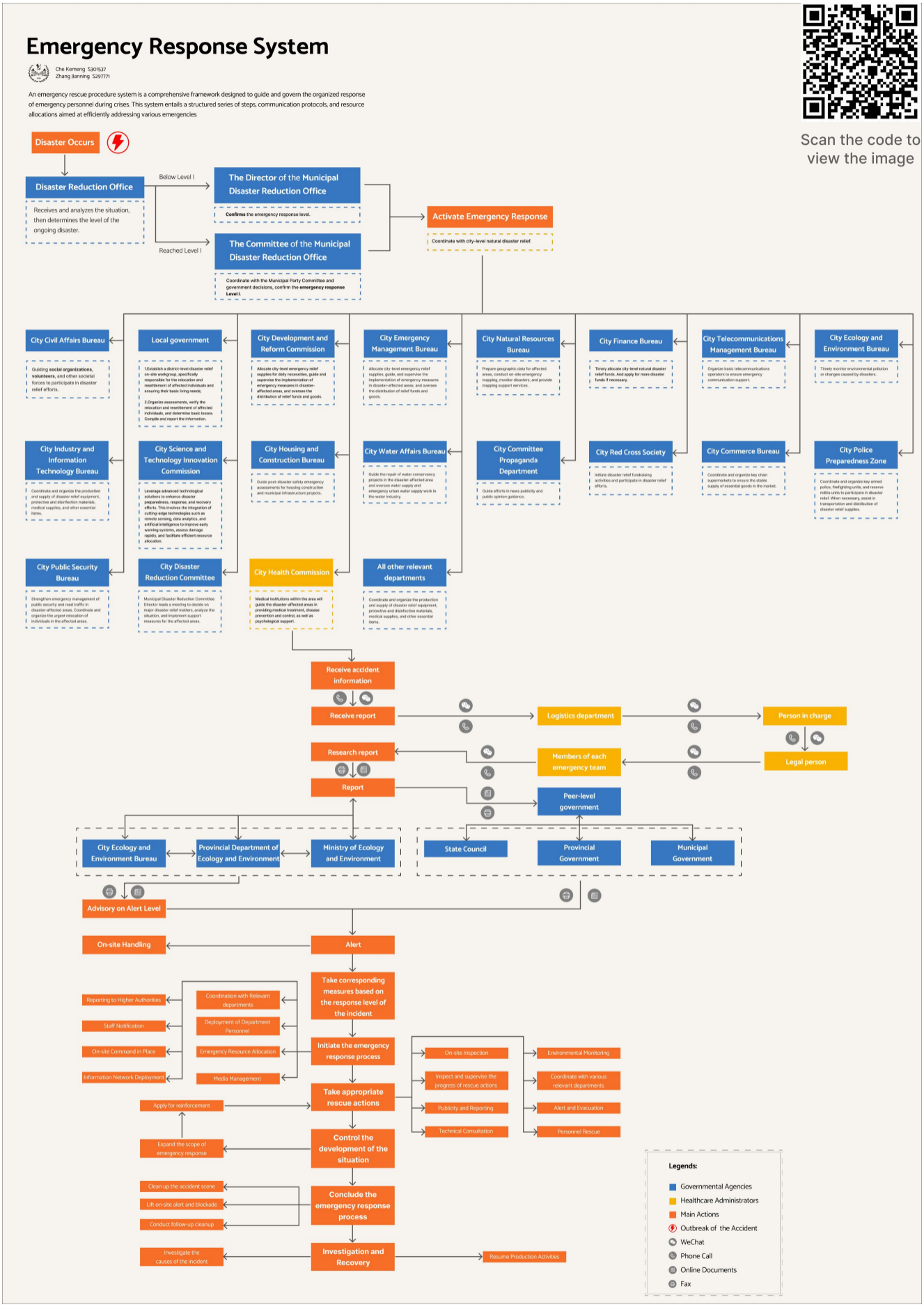
At its core, the plan starts with a thorough risk assessment where hospitals identify potential hazards that could impact their facilities, based on geographical vulnerabilities to disasters such as earthquakes, floods, or hurricanes. This risk assessment informs the development of mitigation strategies to enhance the structural resilience of healthcare buildings and to secure critical supplies and infrastructure.

Preparation extends into detailed emergency preparedness planning, which outlines specific actions to be taken before, during, and after a disaster. This includes establishing emergency command centers within the hospital, developing evacuation procedures, and creating shelter-in-place protocols to ensure that both patients and staff are safe during any disaster.

A crucial element of the plan is the development and maintenance of robust communication systems that remain operational during disruptions. These systems ensure ongoing communication within the hospital and with external entities like emergency services and other healthcare facilities. Integration with local and national emergency management systems is also important, ensuring that hospital response efforts are coordinated with broader disaster response strategies.

To guarantee effectiveness, regular training programs and simulation drills are implemented to ensure that all hospital personnel are familiar with emergency protocols and can execute them under pressure. These training sessions cover general emergency preparedness and specific disaster scenarios.

By integrating these elements into a cohesive emergency response plan, healthcare systems aim to maintain high standards of care and operational continuity, even under the most challenging conditions, thereby safeguarding the community's health and the whole system's functionality.



Map 4.
Emergency Response System Map

References :

1. Huang, X., Zuo, R., Xu, T., & Li, N. (2024). Can hierarchical healthcare system improve public health efficiency? Evidence from 27 eastern Chinese cities. Journal of Cleaner Production, 447, 141369. https://doi.org/10.1016/J.JCLEPRO.2024.141369

2. Yu, M., Zhou, W., & Jiang, B. (2022). Referral strategies and capacity decisions in a tiered hospital system with gatekeeping designs – Exemplified with Chinese healthcare system. Computers & Industrial Engineering, 171, 108447. https://doi.org/10.1016/J.CIE.2022.108447

3. Duan, W., & Qin, T. (2022). The Impact of China's Legal System on Public Health and Quality of Life during the COVID-19 Pandemic: An Empirical Study. International journal of environmental research and public health, 19(20), 13598. https://doi.org/10.3390/ijerph192013598

4. World Health Organization, & Asia Pacific Observatory on Health Systems and Policies. (2015). People's Republic of China health system review. Health Systems in Transition, 5(7). Retrieved from https://iris.who.int/bitstream/handle/10665/208229/9789290617280_eng.pdf

5. Chen, C., & Liu, M. (2023). Achievements and Challenges of the Healthcare System in China. Cureus, 15(5), e39030. https://doi.org/10.7759/cureus.39030

6. Liu, X. Z., & Wang, J. L. (1991). An introduction to China's health care system. Journal of public health policy, 12(1), 104–116.

7. Tikkanen, R., Osborn, R., Mossialos, E., Djordjevic, A., & Wharton, G. A. (n.d.). China. In International Health Care System Profiles. Commonwealth Fund. Retrieved from https://www.commonwealthfund.org/international-health-policy-center/countries/china

8. Wang, Y., Castelli, A., Cao, Q., & Liu, D. (2020). Assessing the design of China's complex health system - Concerns on equity and efficiency. Health policy OPEN, 1, 100021. https://doi.org/10.1016/j.hpopen.2020.100021

9. State Council Information Office of China. (2023, May 19). China significantly improves health insurance, services. Retrieved from http://english.scio.gov.cn/m/pressroom/2023-05/19/content_85403254.htm

10. You, X., & Kobayashi, Y. (2011). Determinants of out-of-pocket health expenditure in China: analysis using China Health and Nutrition Survey data. Applied health economics and health policy, 9(1), 39–49. https://doi.org/10.2165/11530730-000000000-00000

11. Jamal, M. H., Abdul Aziz, A. F., Aizuddin, A. N., & Aljunid, S. M. (2022). Successes and obstacles in implementing social health insurance in developing and middle-income countries: A scoping review of 5-year recent literatures. Frontiers in public health, 10, 918188. https://doi.org/10.3389/fpubh.2022.918188

12. Martinez-Lacoba, R., Pardo-Garcia, I., & Escribano-Sotos, F. (2021). Aging, Dependence, and Long-Term Care: A Systematic Review of Employment Creation. Inquiry : a journal of medical care organization, provision and financing, 58, 469580211062426. https://doi.org/10.1177/00469580211062426

13. Wang, Y., Castelli, A., Cao, Q., & Liu, D. (2020). Assessing the design of China's complex health system - Concerns on equity and efficiency. Health policy OPEN, 1, 100021. https://doi.org/10.1016/j.hpopen.2020.100021

14. Huang, Lulu & Liu, Jingshu & Guo, Zhaoyu & Lv, Shan & Zhang, Xiaoxi & Zhou, Xiaonong & Li, Shizhu. (2023). China's One Health Governance System: The Framework and Its Application. Science in One Health. 2. 100039. 10.1016/j.soh.2023.100039.

15. Tao, W., Chen, X., & Gan, S. (2022). How to promote grass roots medical treatment under China's graded diagnosis and treatment policy? - From the perspective of customer value theory. Frontiers in public health, 10, 994644. https://doi.org/10.3389/fpubh.2022.994644

16. Lassi ZS, Kumar R, Bhutta ZA. Community-Based Care to Improve Maternal, Newborn, and Child Health. In: Black RE, Laxminarayan R, Temmerman M, et al., editors. Reproductive, Maternal, Newborn, and Child Health: Disease Control Priorities, Third Edition (Volume 2). Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2016 Apr 5. Chapter 14. Available from: https://www.ncbi.nlm.nih.gov/books/NBK361898/ doi: 10.1596/978-1-4648-0348-2_ch14

17. Nofri, E. M. (2015, November 13). The Chinese healthcare system: How it works and future trends. Forchielli Alberto. Retrieved from https://www.albertoforchielli.com/the-chinese-healthcare-system-how-it-works-and-future-trends/

18. Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H., Roder-DeWan, S., Adeyi, O., Barker, P., Daelmans, B., Doubova, S. V., English, M., García-Elorrio, E., Guanais, F., Gureje, A., ... Pate, M. (2018). High-quality health systems in the Sustainable Development Goals era: time for a revolution. The Lancet. Global health, 6(11), e1196–e1252. https://doi.org/10.1016/S2214-109X(18)30386-3

19. World Health Organization, & Asia Pacific Observatory on Health Systems and Policies. (2015). 转型中的中国卫生体系 [China's Transforming Healthcare System]. Retrieved from https://apo.who.int/docs/librariesprovider15/publications/hits/china_health_systems_review_cn.pdf?sfvrsn=d2cffcda_5

20. National Academies of Sciences, Engineering, and Medicine; National Academy of Medicine; Committee on the Future of Nursing 2020–2030; Flaubert JL, Le Menestrel S, Williams DR, et al., editors. The Future of Nursing 2020-2030: Charting a Path to Achieve Health Equity. Washington (DC): National Academies Press (US); 2021 May 11. 4, The Role of Nurses in Improving Health Care Access and Quality. Available from: https://www.ncbi.nlm.nih.gov/books/NBK573910/

21. St. John, T. (2022, September 6). Primary, secondary, tertiary, and quaternary care. Verywell Health. Retrieved from https://www.verywellhealth.com/primary-secondary-tertiary-and-quaternary-care-2615354

22. National Health Commission of the People's Republic of China. (2022). 三级医院评审标准 (2022 年版) [Evaluation Criteria for Tertiary Hospitals (2022 Edition)]. Retrieved from http://www.nhc.gov.cn/yzygj/s3585/202212/cf89d8a82a68421cbb9953ec610fb861/files/9eb64d7dc64e43e2aad039a264da8919.pdf

23. Li, Y., Li, W., Wu, Z., Yuang, J., Wei, Y., Huang, C., & Huang, D. (2022). Findings About Patient Preferences for Medical Care Based on a Decision Tree Method Study Design for Influencing Factors. INQUIRY: The Journal of Health Care Organization, Provision, and Financing. https://doi.org/10.1177_00469580221092831

24. Lauriola, P., Martín-Olmedo, P., Leonardi, G. S., Bouland, C., Verheij, R., Dückers, M. L. A., van Tongeren, M., Laghi, F., van den Hazel, P., Gokdemir, O., Segredo, E., Etzel, R. A., Abelsohn, A., Bianchi, F., Romizi, R., Miserotti, G., Romizi, F., Bortolotti, P., Vinci, E., Giustetto, G., ... Zeka, A. (2021). On the importance of primary and community healthcare in relation to global health and environmental threats: lessons from the COVID-19 crisis. BMJ global health, 6(3), e004111. https://doi.org/10.1136/bmjgh-2020-004111

25. National Health Commission of the People's Republic of China. (2023, September). 2022 年我国卫生健康事业发展统计公报 [2022 Statistical Bulletin on the Development of Health and Wellness in China]. Retrieved from http://www.nhc.gov.cn/guihuaxxs/s3585u/202309/6707c48f2a2b420fbfb739c393fcca92/files/8a3994e41d944f589d914c589a702592.pdf

26. State Council of the People's Republic of China. (2016, October 25). "健康中国2030"规划纲要 [Healthy China 2030 Planning Outline]. Retrieved from https://www.gov.cn/zhengce/2016-10/25/content_5124174.htm

27. Shi, L., Makinen, M., Lee, D. C., Kidane, R., Blanchet, N., Liang, H., Li, J., Lindelow, M., Wang, H., Xie, S., & Wu, J. (2015). Integrated care delivery and health care seeking by chronically-ill patients - a case-control study of rural Henan province, China. International journal for equity in health, 14, 98. https://doi.org/10.1186/s12939-015-0221-8

28. Harris, C., Green, S., & Elshaug, A. G. (2017). Sustainability in Health care by Allocating Resources Effectively (SHARE) 10: operationalising disinvestment in a conceptual framework for resource allocation. BMC health services research, 17(1), 632. https://doi.org/10.1186/s12913-017-2506-7

29. National Health Commission of the People's Republic of China. (2023, March). 郑州市构建市域一体化医疗卫生服务体系实施意见 [Notice on the Implementation of the Construction of an Integrated Medical and Health Service System in Zhengzhou]. Retrieved from http://www.nhc.gov.cn/guihuaxxs/s7788/202303/1a6c05141f9547768ba1f7792c0313d0.shtml

30. Khan, G., Kagwanja, N., Whyle, E., Gilson, L., Molyneux, S., Schaay, N., Tsofa, B., Barasa, E., & Olivier, J. (2021). Health system responsiveness: a systematic evidence mapping review of the global literature. International journal for equity in health, 20(1), 112. https://doi.org/10.1186/s12939-021-01447-w

31. Saint Joseph's University. (n.d.). Health care reform: Duties and responsibilities of the stakeholders. Saint Joseph's University Center for International Business. Retrieved from https://www.sju.edu/centers/icb/blog/health-care-reform-duties-and-responsibilities-of-the-stakeholders

32. Hassan, D. (2005). Measuring performance in the healthcare field: A multiple stakeholders' perspective. Total Quality Management & Business Excellence, 16(8–9), 945–953. https://doi.org/10.1080/14783360500163086

33. Liang, J., Li, Y., Zhang, Z., Shen, D., Xu, J., Zheng, X., Wang, T., Tang, B., Lei, J., & Zhang, J. (2021). Adoption of Electronic Health Records (EHRs) in China During the Past 10 Years: Consecutive Survey Data Analysis and Comparison of Sino-American Challenges and Experiences. Journal of medical Internet research, 23(2), e24813. https://doi.org/10.2196/24813

34. Subramanian L. Effective Demand Forecasting in Health Supply Chains: Emerging Trend, Enablers, and Blockers. Logistics. 2021; 5(1):12. https://doi.org/10.3390/logistics5010012

35. Xu, J., & Yuan, B. (2021). Financing primary health care in China: Scoping report. The Lancet Global Health Commission on Financing Primary Health Care. Retrieved from https://www.lshtm.ac.uk/media/59781

36. Wang, Y., Li, Y., Qin, S. et al. The disequilibrium in the distribution of the primary health workforce among eight economic regions and between rural and urban areas in China. Int J Equity Health 19, 28 (2020). https://doi.org/10.1186/s12939-020-1139-3

37. Zhengzhou Statistics Bureau. (n.d.). Zhengzhou Statistical Yearbook. Retrieved from https://tjj.zhengzhou.gov.cn/ndsj/index.jhtml

38. Chen, C., & Liu, M. (2023). Achievements and Challenges of the Healthcare System in China. Cureus, 15(5), e39030. https://doi.org/10.7759/cureus.39030

05.

TRACKING CHALLENGES

EXAMINE THE PROPERTIES OF EACH COMPONENT AND THE DIFFERENT *INTERCONNECTIONS BETWEEN THEM* WITHIN THE LOCAL HEALTHCARE SYSTEM TO IDENTIFY POSSIBLE CHALLENGES AND ENHANCE OVERALL RESILIENCE.

5.1
INTERVIEWS

After the online research, we go to Zhengzhou to have a comprehensive understanding of the territory. After visiting several hospitals and their relevant departments, we conducted three key interviews to gain in-depth insights into the views and coping strategies of various stakeholders in the face of sudden natural disasters. The first interviewee was a doctor from Henan Children's Hospital, the second interviewee was a staff member of the street office, and finally, we interviewed an employee of the hospital's security department.

During our field research and through interviews with different stakeholders, we identified several key issues. First, the complexity of patient transfer is a significant challenge. In emergencies, especially when climate disasters occur, communication and coordination within the hospital and with the street office need to be more efficient and rapid to ensure that patients can be transferred and treated in a timely and safe manner.Second, we noticed that although some hospitals have been equipped with emergency power supplies, there may be insufficient or unstable power supply in actual operations, which poses a challenge to the normal operation of the hospital and continuous care in emergencies.
The third issue is about the mental health of children and other special groups. The psychological pressure and trauma that children may face after disasters need more professional and continuous attention and support to help them overcome post-disaster psychological barriers and adapt to difficulties. Finally, we also noted potential room for improvement in collaboration and information sharing between different sectors in emergency and disaster response. More effective cross-sector collaboration and information sharing can improve response speed and accuracy, thereby more effectively protecting and supporting communities and patients.

The findings from these issues provided deep insights for our research and guided the focus areas for further exploration and addressing in our project.

Doctor

30mins

Henan Provincial Children's Hospital

How did the flood affect your work?

The main task was to **clear the accumulated water**.

Did your hospital experience power outages during the flood?

Experience power outages, but has **emergency power supply.**

What kind of health threats can occur to people after the flood?

May have **infectious diseases** such as diarrhea, dysentery, and gastrointestinal infections but **not common in cities.**

What areas do you think the vulnerability of child patients is manifested in when facing a flood event?

Children's **psychological problems.**

Security section

10mins

The Fifth Affiliated Hospital of Zhengzhou University

Did your hospital do anything in advance to prepare for the flood?

We **checked all the drainage wells and sandbags**, we **added drills**, and our hospital also has **rubber boats.**

What's the process for communicating within the hospital during emergency?

We have an **emergency response team.** There are individuals responsible for **communication, power supply, and emergency response.**

Did any patients transfer to this hospital from other facilities?

There was a power outage and transfer procedures could not be completed, and **most patients could not be transferred**. Only critically ill patients will be evacuated by porters or rubber boats arranged by the hospital.

Sub-district office

12mins

Wulibao Street Office, Erqi District

Do you have emergency plans in your community for extreme weather events?

Use **Wechat and phone call** to transfer information level by level.

How did you communicate in your community when encountering similar emergencies like this?

Formed an emergency team, evaluate and solve the problem.

Are there any measures to deal with similar events in the future?

We **procured sandbags and barriers**, and also **conducted some related fire drills** from time to time.

5.2

CHALLENGES MAP

The study began with an in-depth territorial assessment of Zhengzhou City, focusing on the city's healthcare system within its geographical and urban context. We analyzed the system's integration with urban infrastructure and its interactions with the environment under the pressure of climate change, emphasizing information and resource exchanges between them.

Then we tried to highlight how urban planning, demographic shifts, and environmental factors are impacting the effectiveness of the healthcare system. As a result, we were able to examine the properties of each component and the different interconnections between them within the local healthcare system to identify possible challenges and enhance overall resilience.

Meanwhile, on the other hand, we conducted an in-depth analysis of the emergency rescue system to evaluate its effectiveness and underline the challenges it faces. A significant aspect of our study centered on the communication issues among the various components of the system.

These challenges can be divided into 5 groups: **Population Density, transportation, economic disparities, information sharing, and organizational synergy.** These challenges not only underline the interconnection between the local healthcare system and its external environment but also highlight the intricacies of its internal operational mechanisms, enhancing our comprehension of the system as a whole.

Map 5.
Complexity Map with Identified Challenges

Map 6.
Emergency Respond System Map with Identified Challenges

Complexity Map of the Territory

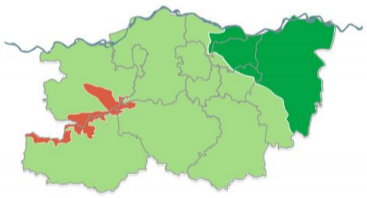
China

Henan province
Central Plains of China

Henan province

Zhengzhou city
Capital City of Henan Province

Topography



Average altitude: 162 metres

53m-90m · 90m-500m · 500m-1433m

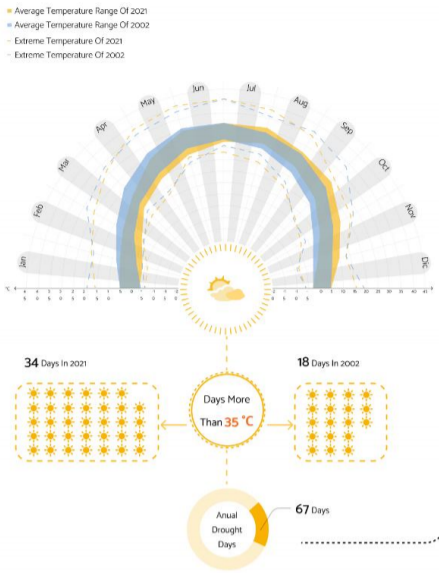
Runoff map

124 large and small rivers

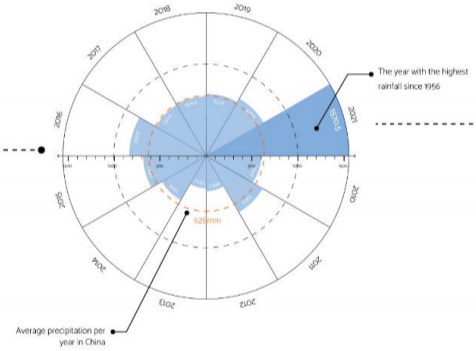
29 rivers with large watershed areas, belonging to the two major water systems of the **Yellow River** and the **Huaihe River**

CLIMATE

Temperature change

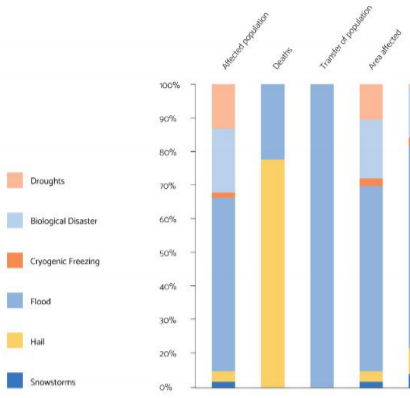


Precipitation

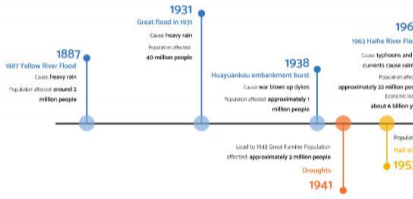


NATURAL DISASTER

Percentage of each disaster indicator by type of disaster in

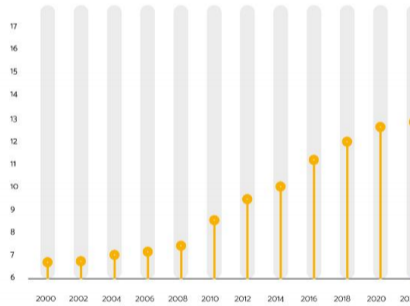


History of natural disasters

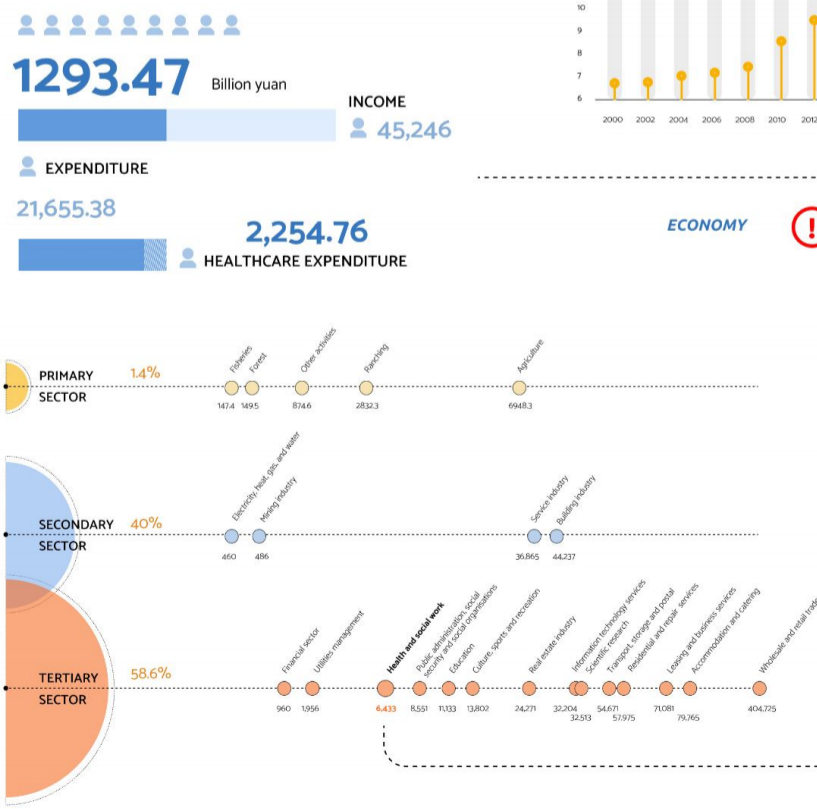


DEMOGRAPHY

Population trend (million)



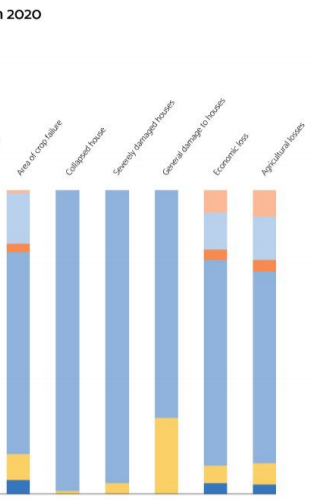
ECONOMY

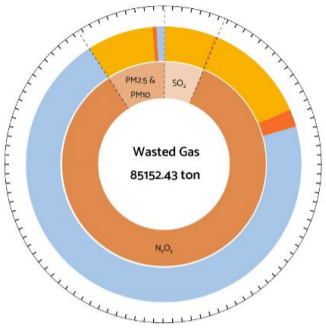


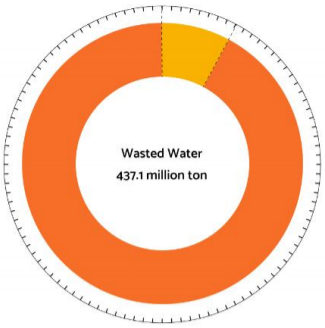
HEAL

Nurses
Doctors
Stuffs
Beds
Quantities

WASTES

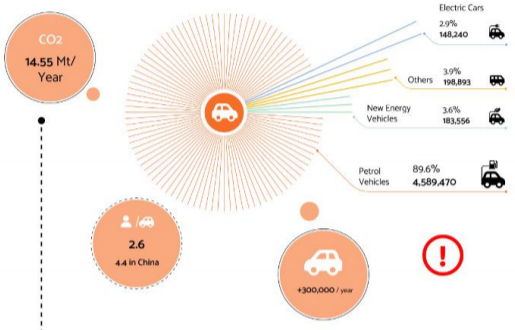




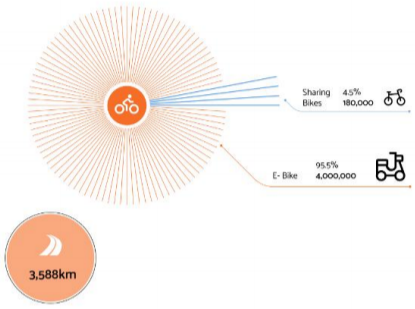


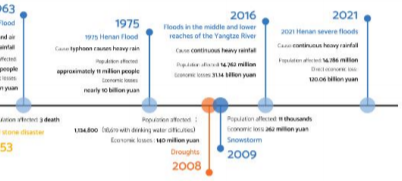
TRANSPORTATION

Motor Vehicles



Non Motor Vehicles

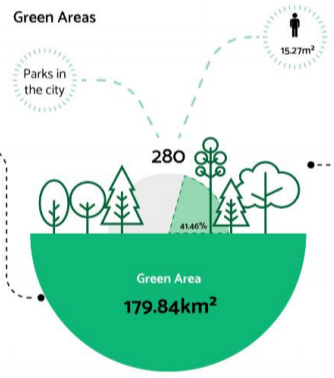




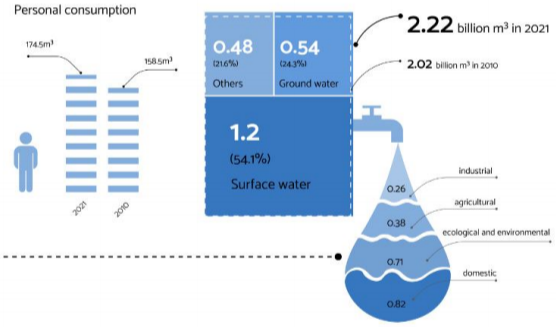
ECOLOGICAL RESOURCE

Age groups

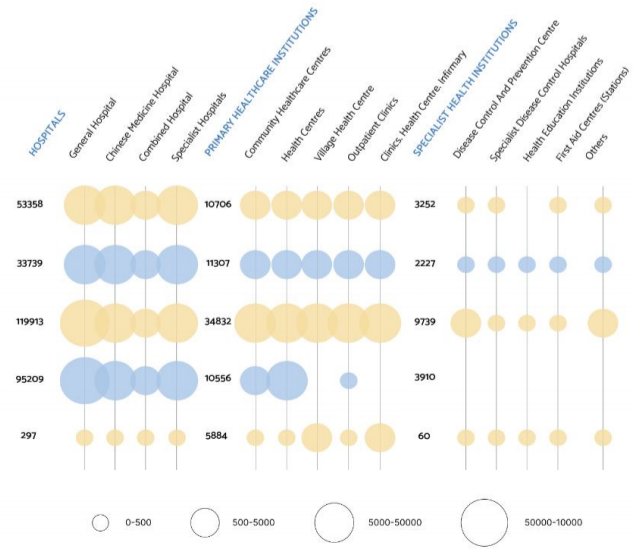
Green Areas



Water consumption (billion m³)

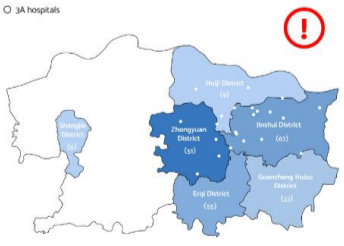


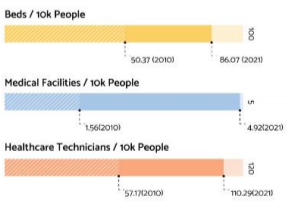
LTHCARE RESOURCES



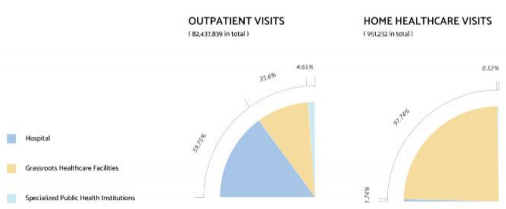
Healthcare resources distribution

Number of hospitals





Number of medical visits



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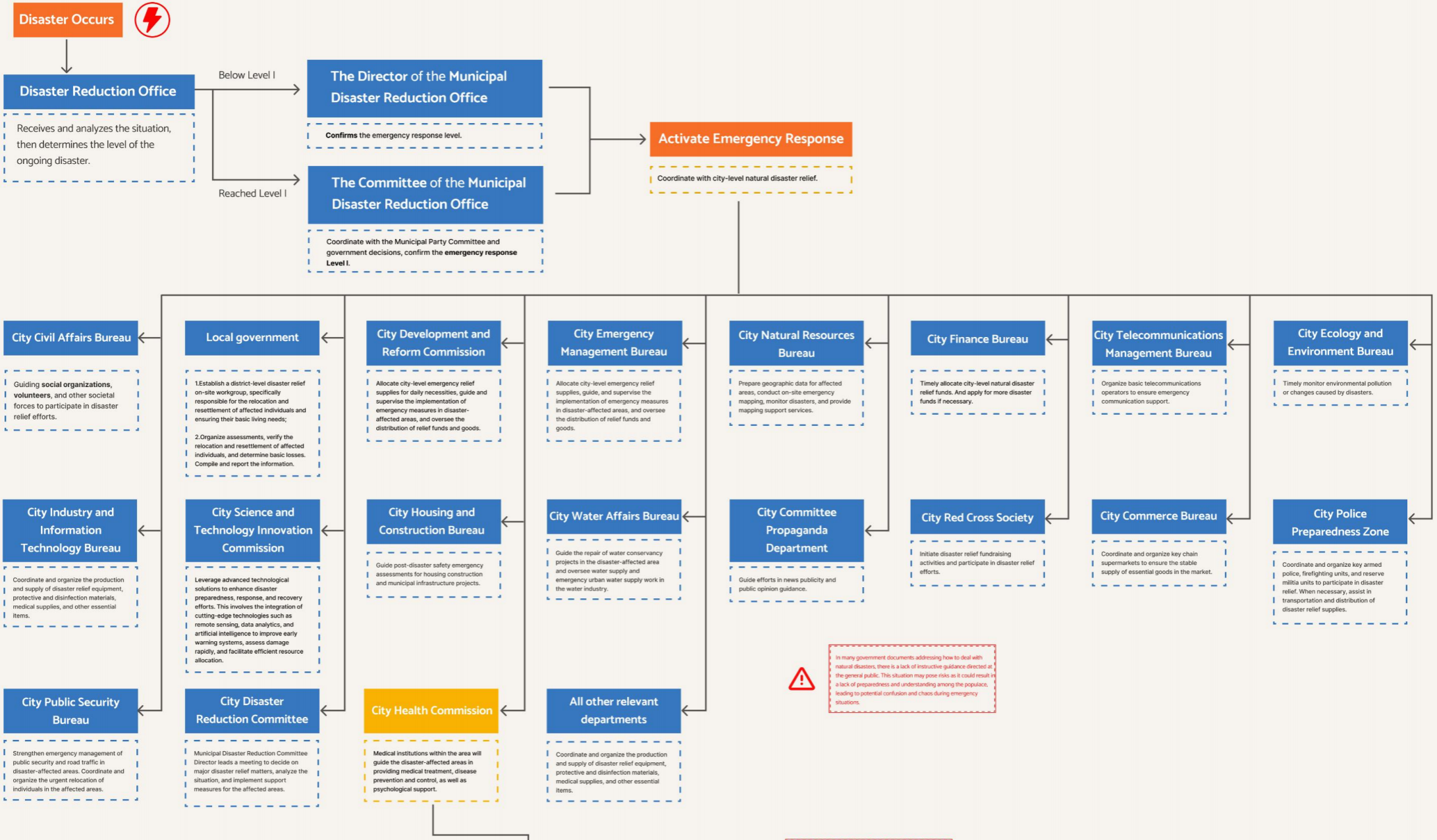
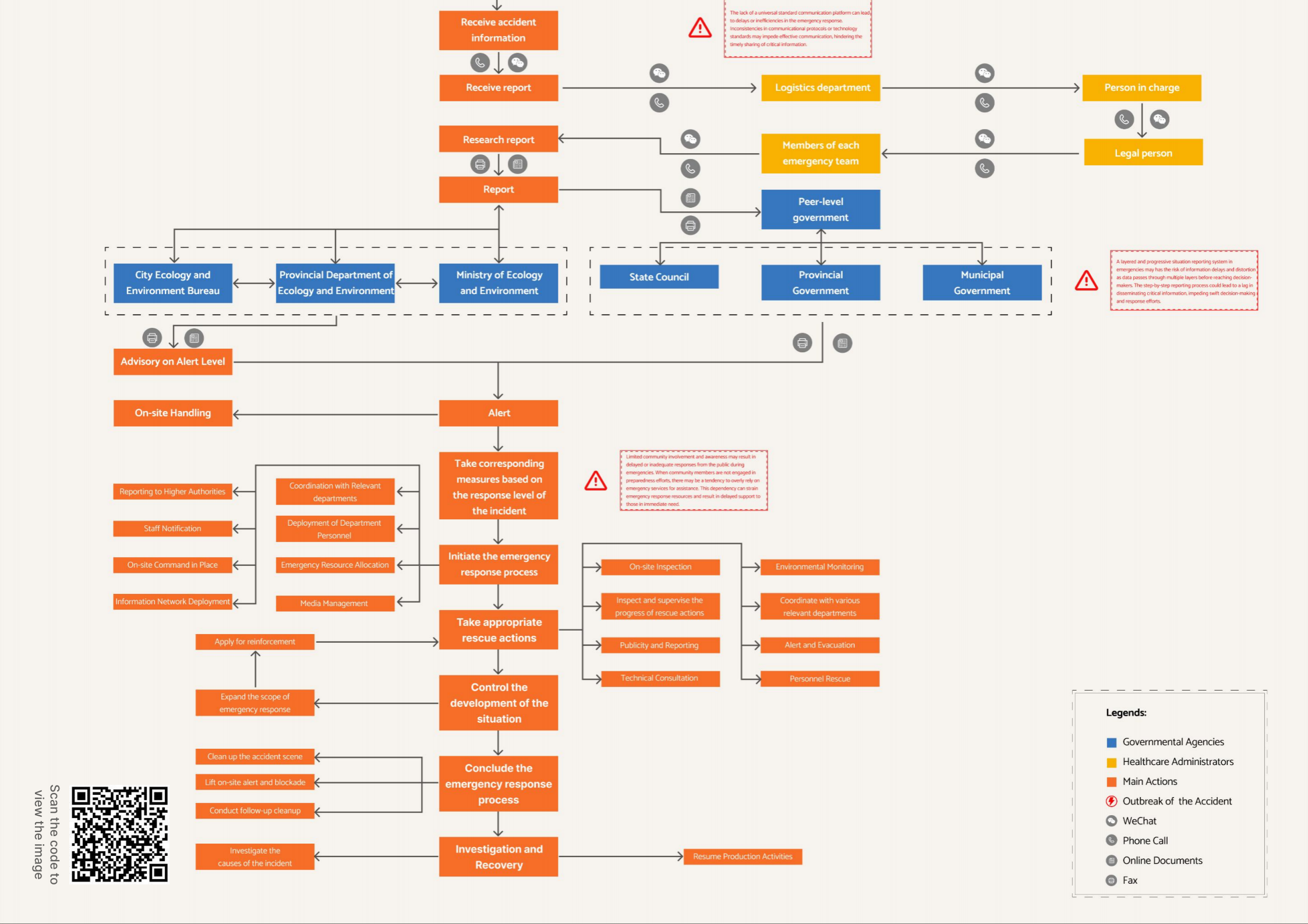
Emergency Response System

Che Kemeng S301537
Zhang Jianning S297771

An emergency rescue procedure system is a comprehensive framework designed to guide and govern the organized response of emergency personnel during crises. This system entails a structured series of steps, communication protocols, and resource allocations aimed at efficiently addressing various emergencies




Receive accident information
The lack of a universal standard communication platform can lead to delays or inefficiencies in the emergency response. Inconsistencies in communicational protocols or technology standards may impede effective communication, hindering the timely sharing of critical information.
Receive report
Logistics department
Person in charge
Legal person
Members of each emergency team
Research report
Report
Peer-level government
City Ecology and Environment Bureau
Provincial Department of Ecology and Environment
Ministry of Ecology and Environment
State Council
Provincial Government
Municipal Government
A layered and progressive situation reporting system in emergencies may has the risk of information delays and distortion as data passes through multiple layers before reaching decision-makers. The step-by-step reporting process could lead to a lag in disseminating critical information, impeding swift decision-making and response efforts.
Advisory on Alert Level
On-site Handling
Alert
Take corresponding measures based on the response level of the incident
Limited community involvement and awareness may result in delayed or inadequate responses from the public during emergencies. When community members are not engaged in preparedness efforts, there may be a tendency to overly rely on emergency services for assistance. This dependency can strain emergency response resources and result in delayed support to those in immediate need.
Reporting to Higher Authorities
Staff Notification
On-site Command in Place
Information Network Deployment
Coordination with Relevant departments
Deployment of Department Personnel
Emergency Resource Allocation
Media Management
Initiate the emergency response process
On-site Inspection
Inspect and supervise the progress of rescue actions
Publicity and Reporting
Technical Consultation
Environmental Monitoring
Coordinate with various relevant departments
Alert and Evacuation
Personnel Rescue
Take appropriate rescue actions
Apply for reinforcement
Expand the scope of emergency response
Control the development of the situation
Clean up the accident scene
Lift on-site alert and blockade
Conduct follow-up cleanup
Conclude the emergency response process
Investigate the causes of the incident
Investigation and Recovery
Resume Production Activities
Legends:
Governmental Agencies
Healthcare Administrators
Main Actions
Outbreak of the Accident
WeChat
Phone Call
Online Documents
Fax
Scan the code to view the image

5.3

IDENTIFICATION

Identifying challenges within the system involves a comprehensive approach that starts with detailed data gathering, including systematic observations and a mix of quantitative and qualitative analysis [1]. This process is important for discovering operational inefficiencies and areas needing improvement through direct monitoring and feedback collection from users and stakeholders which not only aids in identifying current issues but also facilitates the development of effective solutions and continuous system improvement.

Population Density

With a large population of 18 million in total and a density exceeding 6,800 people per square kilometer in its central urban areas [2], Zhengzhou faces significant urban challenges that not only strain the city's infrastructure and public services but also complicate traffic management, increase environmental pressures influencing the overall efficiency and resilience of the local healthcare system:

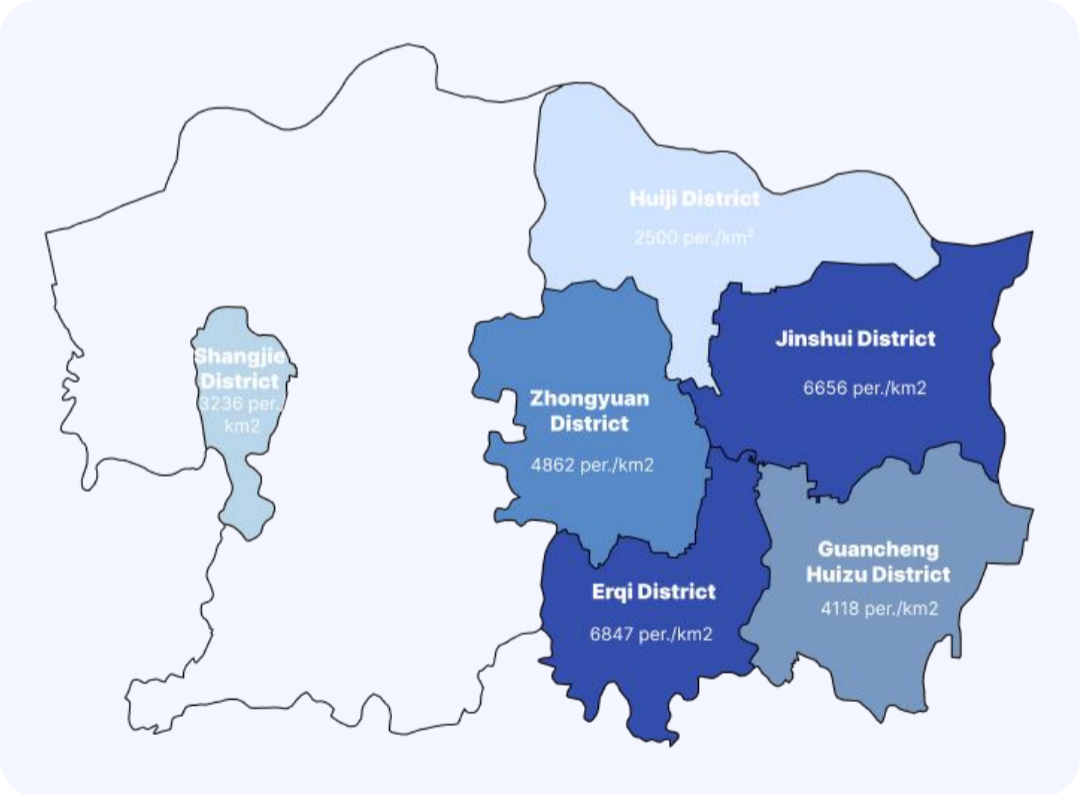


Figure 19.
Population Density of Zhengzhou City

Healthcare Resource Allocation: The high population density in Zhengzhou significantly makes it moer complicated for the allocation and management of healthcare resources. This issue becomes particularly urgent during emergencies such as floods, necessitating the swift and efficient distribution of healthcare personnel, medicines, and equipment to adequately meet the demands of the large population. Effective resource management strategies are essential to ensure that healthcare services remain functional and accessible during such critical times [3].

Emergency Healthcare Services: In densely populated urban regions, natural disasters can cause extensive damage, impacting a large part of the local population at the same time. This density exacerbates the challenge for the healthcare system, which must scale its response to address the extensive need for emergency healthcare services swiftly and effectively [4]. Planning for mass casualty incidents and enhancing emergency healthcare infrastructure are the essential components of disaster preparedness in such high-density areas.

Transportation and Evacuation Challenges: The logistics of evacuation and rescue in highly populated areas are significantly hindered by traffic congestion and crowded conditions. These factors can cause delays in the critical transportation of emergency vehicles, healthcare personnel, and essential supplies, making it more different for rapid response [6]. Therefore, developing clear and efficient evacuation routes and communication strategies is crucial to mitigating these risks.

Risk of Disease Spread: High-density settings also increase the risk of communicable diseases spreading, particularly in chaotic environments after natural disasters. The proximity of individuals can lead to rapid transmission of pandemics if isolation and personal protections are not promptly executed [7]. It is crucial for public health strategies to take measures for quick isolation and reliable healthcare response to prevent the outbreak of diseases in such environments.

Addressing these challenges requires a multi-faceted approach involving strategic planning, community engagement, and the integration of advanced technologies to enhance the responsiveness and resilience of healthcare and emergency services.

Transportation

As China's economy grows, car ownership in the whole country has notably increased, and in Zhengzhou, with one car for every 2.6 people, is much higher than the national average [7]. This rise in private vehicles has significantly improved personal mobility but also led to severe urban traffic congestion, highlighting the need for effective traffic management solutions. These challenges associated with transportation further impact various aspects of urban resilience and healthcare delivery, particularly during extreme weather conditions:

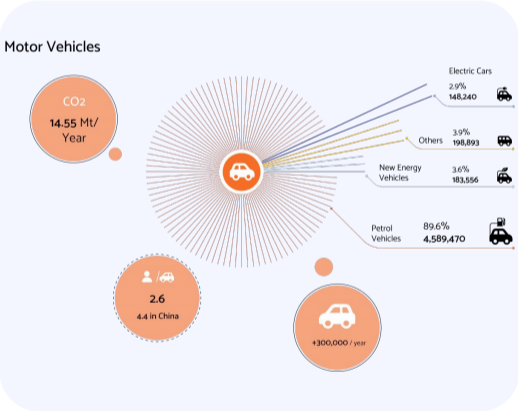


Figure 20.
Number of Motor Vehicles

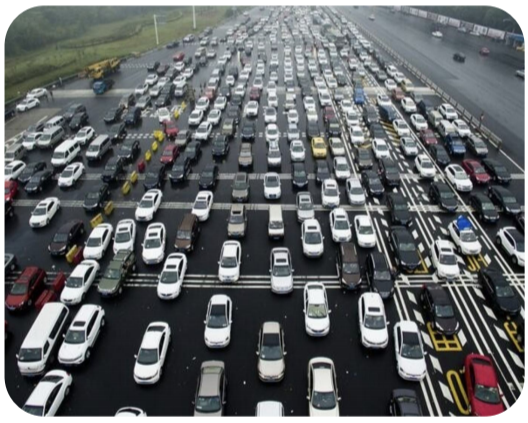


Figure 21.
Traffic Congestion in Zhengzhou City

Emergency Healthcare Response Time: The efficiency of Zhengzhou's transportation system is crucial during emergencies, as it directly influences the speed at which healthcare personnel and resources can be deployed. Delays in transportation can significantly hinder the effectiveness of emergency healthcare services, affecting crucial response times for patient survival during severe emergency events [8].

Evacuation Efficiency: Both private and public transportation modes are integral to the swift and orderly evacuation of residents from areas affected by disasters [9]. Efficient transportation logistics are essential to ensure the safety of the population during crises, requiring well-coordinated evacuation plans and clear communication channels.

Access to Healthcare Facilities: Reliable transportation infrastructure is vital for ensuring consistent access to healthcare facilities. This accessibility enables patients to arrive at hospitals and clinics in time, which is particularly critical for health emergencies [9].

Supply Chain Resilience: The transportation network is the foundation for the healthcare supply chain, facilitating the prompt delivery of healthcare equipment, medicines, and other essential supplies [10]. Maintaining these supply routes during extreme conditions is crucial to prevent disruptions in healthcare services.

Infrastructure Vulnerability: Zhengzhou's transportation infrastructure is susceptible to damage from extreme climate events like floods. Addressing these vulnerabilities is key to ensuring that critical transportation routes remain available during emergencies, allowing for the unimpeded movement of emergency vehicles and essential supplies [11].

These challenges highlight the need for strategic planning and investment in transportation infrastructure to enhance both daily functionality and disaster resilience [12].

Economic Disparities

Economic disparities manifest as significant variations in wealth and resource distribution across different urban and rural areas. These disparities affect various aspects of life, including access to healthcare, quality of education, and general living standards. The contrast between the developed, central areas of Zhengzhou and its less developed outskirts highlights the challenges in achieving balanced economic growth and equitable resource distribution. This uneven economic landscape poses significant challenges for city planners and policymakers aiming to foster inclusive growth and improve the quality of life for all residents [13].

Figure 22.
Comparison of GDP in Central Districts of Zhengzhou City

Resource Allocation: The economic variance among different districts within Zhengzhou leads to uneven distribution of resources, particularly in healthcare infrastructure and services [14]. Regions with lower economic status often struggle to have adequate healthcare resources, which becomes particularly problematic during extreme weather events when demand surges.

Healthcare Infrastructure Resilience: Economic disparities directly affect the resilience of healthcare infrastructure. Wealthier areas tend to invest in more robust healthcare facilities that are better equipped to withstand and recover from disasters, whereas economically disadvantaged areas may have less resilient infrastructure, making recovery slower and more challenging [15].

Emergency Response Capabilities: There is a noticeable divide in emergency response capabilities between affluent and less affluent areas. Wealthier districts are likely to have more investments in emergency infrastructure, personnel, and training, which enhances their preparedness and capacity to manage healthcare challenges during various crises [15].

Vulnerability of Communities: Economic differences also affect public health outcomes by influencing the level of health education and awareness across communities. Lower-income populations often have limited access to crucial information about healthcare practices, which exacerbates their vulnerability in times of natural disasters [13]. This lack of information can hinder effective personal and community-wide response measures during emergencies, increasing health risks [16].

Addressing these challenges requires a multifaceted approach that includes equalizing resource distribution, upgrading infrastructure in vulnerable areas, enhancing emergency preparedness universally, and improving health education across all the territory. By tackling these issues, Zhengzhou can improve its overall resilience and ensure a more equitable response to natural disasters.

Information Sharing

Effective information sharing is crucial for managing emergencies and maintaining public health [17]. Rapid dissemination of emergency alerts ensures public safety, while coordinated healthcare data sharing enables efficient care during crises. Proper management of resources through real-time data helps in effective allocation, particularly during disasters [18]. Additionally, sharing health surveillance information allows for timely responses to public health threats [19]. Streamlining these communication processes can significantly enhance Zhengzhou's disaster response and overall public health management, improving both emergency readiness and resilience.

Figure 23.
Different Ways for Information-sharing among Organizations

Emergency Communication: Rapid dissemination of information during emergencies, such as weather alerts and evacuation orders, is critical for protecting public safety [18]. Efficient information sharing ensures that both emergency responders and the public receive timely updates necessary for effective response and safety measures.

Healthcare Coordination: Sharing health-related data, including patient records and treatment histories, allows healthcare providers to deliver coordinated and effective care services [20]. This is especially crucial during crises when healthcare demands surge and resources must be managed efficiently.

Resource Management: Information sharing supports optimal resource allocation and supply chain management in healthcare [21]. Access to real-time data about healthcare supplies and equipment availability helps in planning and distributing these resources where they are needed most during emergencies.

Public Health Surveillance: The sharing of healthcare data between hospitals and public health authorities is crucial for monitoring disease outbreaks and coordinating public health strategies [22]. This data exchange is fundamental to launching timely interventions that can curb the spread of diseases during and after disaster situations.

Patient Transfer and Evacuation: Coordinating the transfer of patients between facilities during emergencies requires up-to-date information about patient conditions, treatment needs, and available healthcare resources. Effective information sharing among different facilities ensures that transfers are handled smoothly, and that patient care continues without interruption [23].

Enhancing these information sharing processes in Zhengzhou can significantly improve the city's ability to manage and respond to emergencies, safeguarding public health and improving disaster resilience of the whole city.

Organizational Synergy

Organizational synergy refers to the effective collaboration and coordination among various entities involved in emergency management and healthcare services [24]. Achieving organizational synergy involves aligning the efforts of local government agencies, healthcare facilities, emergency response teams, and public health authorities to ensure a cohesive and efficient approach to crisis management [25]. This unified response is crucial for optimizing resource use, streamlining communication, and enhancing the overall effectiveness of emergency operations. However, challenges can emerge in several key areas in this situation:

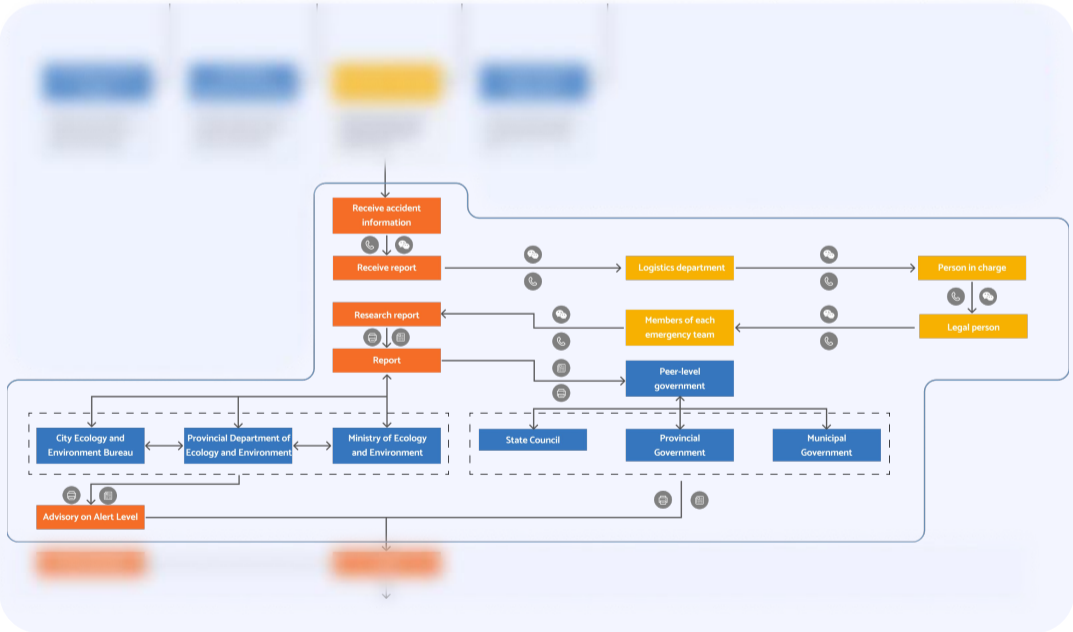


Figure 24.
Communication Process Among Different Departments

Information Flow Delays and Gaps: Effective emergency response depends on the rapid exchange of critical data among healthcare providers and governmental agencies.

healthcare facilities, emergency response teams, and public health authorities to ensure a cohesive and efficient approach to crisis management [25].

This unified response is crucial for optimizing resource use, streamlining communication, and enhancing the overall effectiveness of emergency operations. However, challenges can emerge in several key areas in this situation:

Information Flow Delays and Gaps: Effective emergency response depends on the rapid exchange of critical data among healthcare providers and governmental agencies. Delays or inaccuracies in communicating key details such as casualty numbers, locations, availability of healthcare resources, or operational status of healthcare facilities can significantly disrupt response efforts. To mitigate these issues, it's crucial to establish advanced real-time data-sharing mechanisms and protocols that ensure all parties have immediate access to necessary information [25].

Rigid Policy Framework: Governmental bodies often set stringent policies that healthcare providers must follow, during daily time and emergencies. These policies need to be communicated clearly and promptly to ensure compliance and adaptability [26]. Creating more dynamic policy frameworks that can be adjusted in real time and communicated through streamlined channels during crises will aid in maintaining flexibility and responsiveness.

Limited Access to Information: Healthcare professionals sometimes struggle to access essential, up-to-date information during emergencies, impacting their ability to make informed decisions quickly [25]. Establishing integrated information systems that consolidate data from various sources into a unified platform could greatly improve access to information and overall response efficiency.

Interoperability of Communication Systems: Different communication systems between healthcare providers and governmental agencies can lead to complications in interoperability. Ensuring that these systems are compatible is crucial for seamless communication [27]. Investing in universal or adaptable communication platforms will facilitate better coordination and faster response times.

Training and Drills: Regular training and simulated drills involving all stakeholders can improve synergy by familiarizing each group with the others' operational methods and communication styles. These exercises should focus on scenario-based planning that reflects possible risks on a local scale, ensuring all entities can operate cohesively and precisely under stress [28].

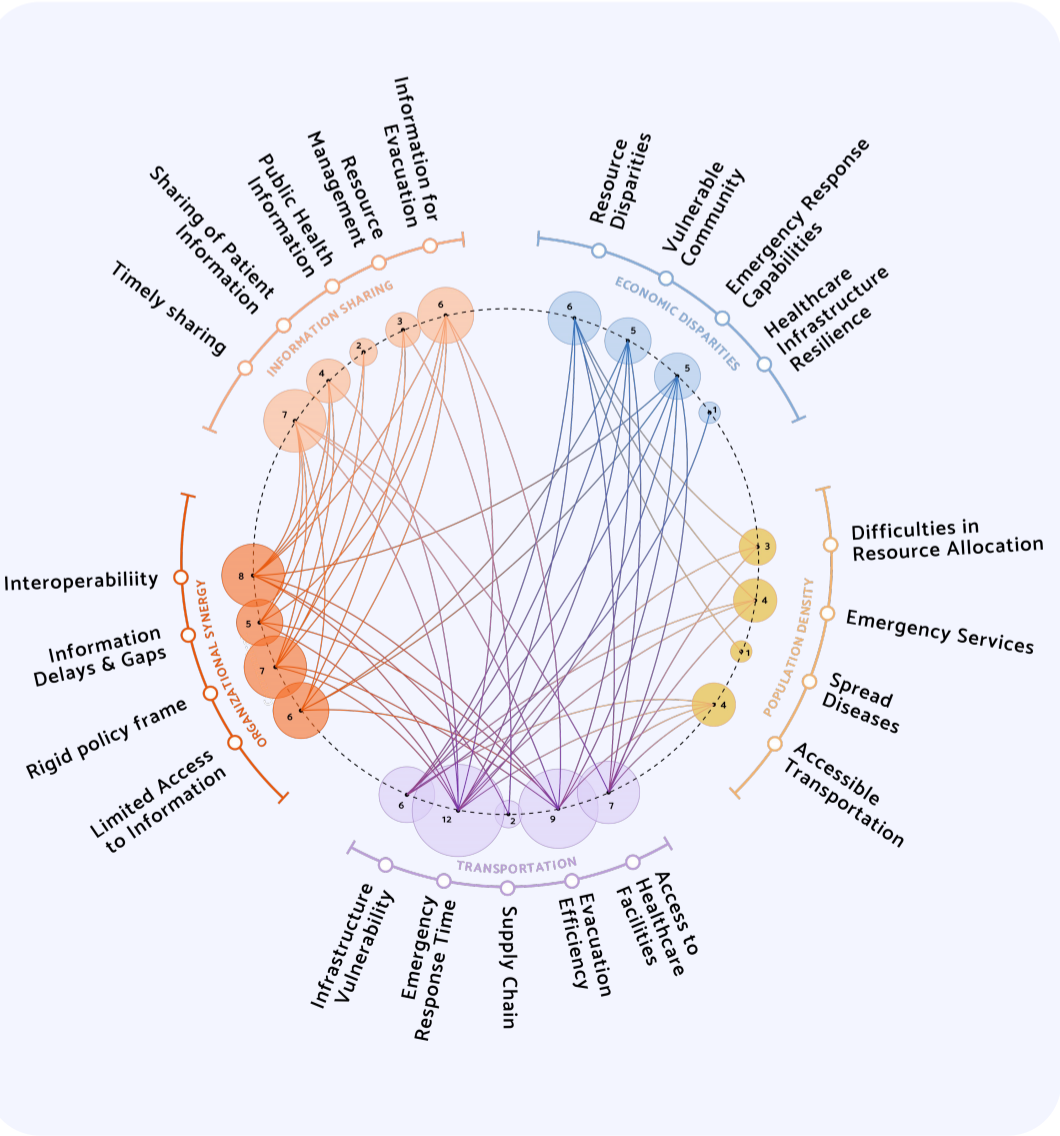
Feedback Mechanisms: Establishing robust feedback mechanisms to evaluate the effectiveness of communication and coordination is essential. These evaluations can provide insights into what adjustments are necessary to enhance interoperability and information flow for future responses [25][29].

Improving organizational synergy can enhance overall efficiency and effectiveness within organizations, enabling better resource management and quicker decision-making. This collaborative environment can streamline operations and lead to a more adaptable and resilient functional system.

5.4

RELATIONS

After identifying the existing challenges within the system, we conducted a detailed analysis of the interrelations among various challenges within the city's urban framework, focusing on the five specific dimensions mentioned before: population density, transportation, economic disparities, information sharing and organizational synergy.



Map 7.
Relation Map of Challenges

Each dimension was examined not only for its own complexities but also for its interactions with other dimensions, thus mapping out a comprehensive network of interdependencies among each challenge.

This analysis allowed us to understand how each challenge influences and is influenced by others, providing a clearer picture of the systemic intricacies. By understanding these relationships, we can identify critical areas where targeted interventions could effectively mitigate multiple challenges at the same time, thereby improving the overall resilience and functionality of the whole system.

References :

1. Almalki, S. (2016). Integrating quantitative and qualitative data in mixed methods research–Challenges and benefits. Journal of Education and Learning, 5(3), 288. https://doi.org/10.5539/jel.v5n3p288

2. Zhengzhou Statistics Bureau. (n.d.). Zhengzhou Statistical Yearbook. Retrieved from https://tjj.zhengzhou.gov.cn/ndsj/index.jhtml

3. Chu, J., Li, X., & Yuan, Z. (2022). Emergency medical resource allocation among hospitals with non-regressive production technology: A DEA-based approach. Computers & industrial engineering, 171, 108491. https://doi.org/10.1016/j.cie.2022.108491

4. Chen, L., Chen, T., Lan, T., Chen, C., & Pan, J. (2023). The Contributions of Population Distribution, Healthcare Resourcing, and Transportation Infrastructure to Spatial Accessibility of Health Care. Inquiry : a journal of medical care organization, provision and financing, 60, 469580221146041. https://doi.org/10.1177/00469580221146041

5. Cochran, A.L., McDonald, N.C., Prunkl, L. et al. Transportation barriers to care among frequent health care users during the COVID pandemic. BMC Public Health 22, 1783 (2022). https://doi.org/10.1186/s12889-022-14149-x

6. Watson, J. T., Gayer, M., & Connolly, M. A. (2007). Epidemics after natural disasters. Emerging infectious diseases, 13(1), 1–5. https://doi.org/10.3201/eid1301.060779

7. People's Daily Online. (2021, October 28). 河南省高质量发展迈出新步伐 [Henan Province Takes New Steps Towards High-Quality Development]. Retrieved from http://henan.people.com.cn/n2/2021/1028/c351638-34977825.html

8. Jafari, M., Mahmoudian, P., Ebrahimipour, H., Vafaee-Nezhad, R., Vafaee-Najar, A., Hosseini, S. E., & Haghighi, H. (2021). Response Time and Causes of Delay in Prehospital Emergency Missions in Mashhad, 2015. Medical journal of the Islamic Republic of Iran, 35, 142. https://doi.org/10.47176/mjiri.35.142

9. Yazdani, M., & Haghani, M. (2023). Logistics of patient evacuation in response to disease outbreaks: Critical considerations for transportation planning. Transportation Research Interdisciplinary Perspectives, 22, 100975. https://doi.org/10.1016/j.trip.2023.100975

10. Bishop, E., Bowen, B., Karim, S., Protopappa-Sieke, M., & Weinstein, W. (2023, July 11). Bolstering health system supply chain resilience to reduce risk. McKinsey & Company. Retrieved from https://www.mckinsey.com/industries/healthcare/our-insights/bolstering-health-system-supply-chain-resilience-to-reduce-risk

11. Zhao, X., Li, H., Cai, Q., Pan, Y., & Qi, Y. (2023). Managing extreme rainfall and flooding events: A case study of the 20 July 2021 Zhengzhou flood in China. Climate, 11(11), 228. https://doi.org/10.3390/cli11110228

12. Yazdani, M., & Haghani, M. (2023). Logistics of patient evacuation in response to disease outbreaks: Critical considerations for transportation planning. Transportation Research Interdisciplinary Perspectives, 22, 100975. https://doi.org/10.1016/j.trip.2023.100975

13. Zhao, Y., Oldenburg, B., Mahal, A., Lin, Y., Tang, S., & Liu, X. (2019). Trends and socio-economic disparities in catastrophic health expenditure and health impoverishment in China: 2010 to 2016. Tropical Medicine & International Health. https://doi.org/10.1111/tmi.13344

14. Yu, X., Zhang, W., & Liang, J. (2021). Physician distribution across China's cities: regional variations. International journal for equity in health, 20(1), 162. https://doi.org/10.1186/s12939-021-01503-5

15. Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., & et al. (2020). From poverty to disaster and back: A review of the literature. Economics of Disasters and Climate Change, 4, 223–247. https://doi.org/10.1007/s41885-020-00060-5

16. Bhandari, N., Shi, Y., & Jung, K. (2014). Seeking health information online: does limited healthcare access matter?. Journal of the American Medical Informatics Association : JAMIA, 21(6), 1113–1117. https://doi.org/10.1136/amiajnl-2013-002350

17. World Health Organization. (2023, November 13). Knowledge management is key to public health planning, new study shows. Retrieved from https://www.who.int/europe/news/item/13-11-2023-knowledge-management-is-key-to-public-health-planning--new-study-shows

18. Yu, M., Yang, C., & Li, Y. (2018). Big data in natural disaster management: A review. Geosciences, 8(5), 165. https://doi.org/10.3390/geosciences8050165

19. Edelstein, M., Lee, L. M., Herten-Crabb, A., Heymann, D. L., & Harper, D. R. (2018). Strengthening Global Public Health Surveillance through Data and Benefit Sharing. Emerging Infectious Diseases, 24(7), 1324–1330. https://doi.org/10.3201/eid2407.151830

20. Adane, K., Gizachew, M., & Kendie, S. (2019). The role of medical data in efficient patient care delivery: a review. Risk management and healthcare policy, 12, 67–73. https://doi.org/10.2147/RMHP.S179259

21. Esmaeilzadeh P. (2023). Evolution of Health Information Sharing Between Health Care Organizations: Potential of Nonfungible Tokens. Interactive journal of medical research, 12, e42685. https://doi.org/10.2196/42685

22. Nsubuga, P., White, M. E., Thacker, S. B., et al. (2006). Public health surveillance: A tool for targeting and monitoring interventions. In D. T. Jamison, J. G. Breman, A. R. Measham, et al. (Eds.), Disease control priorities in developing countries (2nd ed., pp. 997-1016). Washington, DC: The International Bank for Reconstruction and Development / The World Bank. https://www.ncbi.nlm.nih.gov/books/NBK11770/

23. Hempel, S., Ganz, D., Saluja, S., Bolshakova, M., Kim, T., Turvey, C., Cordasco, K., Basu, A., Page, T., Mahmood, R., Motala, A., Barnard, J., Wong, M., Fu, N., & Miake-Lye, I. M. (2023). Care coordination across healthcare systems: development of a research agenda, implications for practice, and recommendations for policy based on a modified Delphi panel. BMJ open, 13(5), e060232. https://doi.org/10.1136/bmjopen-2021-060232

24. Organizational Synergy. (n.d.). The concept of organizational synergy: What exactly it is. Retrieved from https://organizational-synergy.com/the-concept-of-organizational-synergy-what-exactly-it-is/

25. Raviglione, M. C., & Rieder, H. L. (2021). Synergy between government and non-governmental organizations in health: WHO and the Union collaboration in tuberculosis control. Journal of Clinical Tuberculosis and Other Mycobacterial Diseases, 24, 100251. https://doi.org/10.1016/j.jctube.2021.100251

06.

OPPORTUNITIES

THROUGH VARIOUS ANALYTICAL METHODS THE STUDY PINPOINTED AND ASSESSED DIFFERENT ***EFFECTIVE PRACTICES*** THAT COULD BE ADOPTED TO ENHANCE THE SYSTEM'S RESILIENCE.

6.1

IDENTIFICATION OF THE OPPORTUNITIES

Following the identification of various challenges, we created another analysis seeking for multiple opportunities and potential solutions aimed at enhancing the resilience of the local healthcare systems against the impacts of climate change. Utilizing a range of analytical tools, including literature reviews, desk research, and interviews, we systematically evaluated and selected the most effective practices that could be implemented to our system. This multidimensional analysis enabled us to figure out the applicability of these practices within the healthcare system of Zhengzhou, offering insights into potential improvements and adaptations.

In the following section, we examined the potential opportunities associated with each identified challenge.

Challenges of Population Density

Challenges
Opportunities

Difficulties in Healthcare Resource Allocation

Traceability of healthcare resources [1][4][6][7]:

Using blockchain technology to create a healthcare resource database to track the allocation of medical resources such as medicines and equipment.

Collaboration for resources and healthcare personnel distribution [1][4]:

Establishment of cross-institutional and inter-regional collaboration in healthcare systems to facilitate resource sharing.

Establishment of a stockpile of emergency healthcare supplies [7]:

Establishment of stockpiles of healthcare supplies in vulnerable areas with regular maintenance and real-time information updates.

Emergency Healthcare Services in High-Density Areas

Telehealth and remote consultations [9]:

Introduce tele-health services and remote consultations to enhance the reach of healthcare services and bridge the gap during emergencies.

Establishment of a stockpile of emergency medical supplies [7]:

Establishment of stockpiles of healthcare supplies in vulnerable areas with regular maintenance and real-time updates.

Transportation and Evacuation Challenges

Establishment of healthcare emergency transport corridors [10]:

These corridors can be reserved roads or temporary corridors that can be activated quickly in case of emergency.

Telehealth and remote consultations [9]:

Introduce tele-health services and remote consultations to enhance the reach of healthcare services and bridge the gap during emergencies.

Strengthening co-operation between hospitals and traffic management [1]:

Ensure that traffic calming support is available in the event of an emergency. Share the hospital's emergency plan so that traffic management authorities can better understand the hospital's needs.

Public education [11]:

Establishment of stockpiles of healthcare supplies in vulnerable areas with regular maintenance and real-time information updates.

Risk of Community Spread of Diseases

Public education [11]:

Enhance community awareness of the risks of disease transmission in natural disasters and how to deal with them through education and publicity.

Establishment of community stockpiles of healthcare supplies [7]:

Establishment of healthcare stockpiles in the community and regular maintenance and real-time updating of them.

Strengthening cooperation between hospitals and the community [2][8]:

Establishing close cooperation with designated hospitals to ensure that they can be supported by specialized hospital personnel and equipment in case of emergency.

Challenges of Transportation

Emergency Healthcare Response Time

Establish information sharing platform [2][3][4][5][8]:

Leverage digital platforms, including secure messaging systems, data-sharing platforms, and telecommunication tools, to facilitate instant communication and information sharing.

Establishment of healthcare emergency transport corridors [10]:

Ensure that emergency vehicles and healthcare supplies can reach hospitals quickly.

Establishment of a stockpile of emergency healthcare supplies [7]:

Ensure that traffic calming support is available in the event of any emergency. Share the hospital's emergency plan so that traffic management authorities can better understand the hospital's needs.

Evacuation Efficiency

Public education [11]:

Improve citizens' knowledge about how to evacuate during emergencies.

Establish evacuation assembly points:

Ensure that emergency vehicles and healthcare supplies can reach hospitals quickly.

Establishment of an emergency communications system [2][4]:

Deploy mass notification systems that can reach large populations quickly.

Access to Healthcare Facilities

Provide accessible transportation:

Providing accessible transportation options for community members to reach healthcare facilities or disaster shelters.

Supply Chain

Traceability of healthcare resources [1][4][6][7]:

Using blockchain technology to create a healthcare resource database to track the allocation of healthcare resources such as medicines and equipment.

Establishment of healthcare emergency transport corridors:

Ensure that emergency vehicles and healthcare supplies can reach hospitals quickly.

Strengthening cooperation between hospitals and traffic management [1][2]:

Ensure that traffic calming support is available in case of any emergency. Share the hospital's emergency plan so that traffic management authorities can better understand the hospital's needs.

Infrastructure Vulnerability

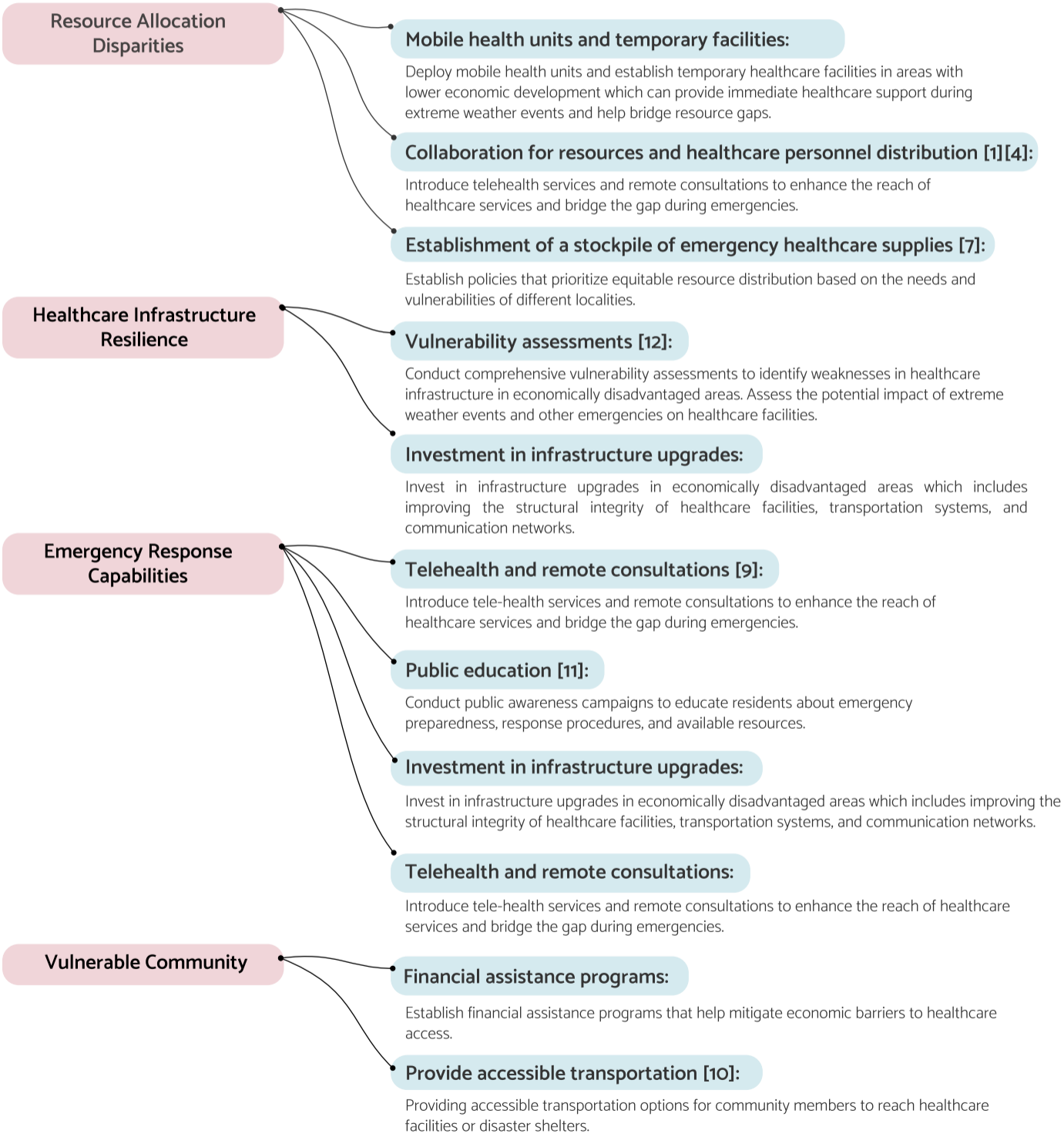
Building climate resilience in healthcare facilities:

Ensure that critical healthcare facilities, such as hospitals, are equipped with infrastructure to respond to natural disasters, such as back-up generators, water supply systems, etc.

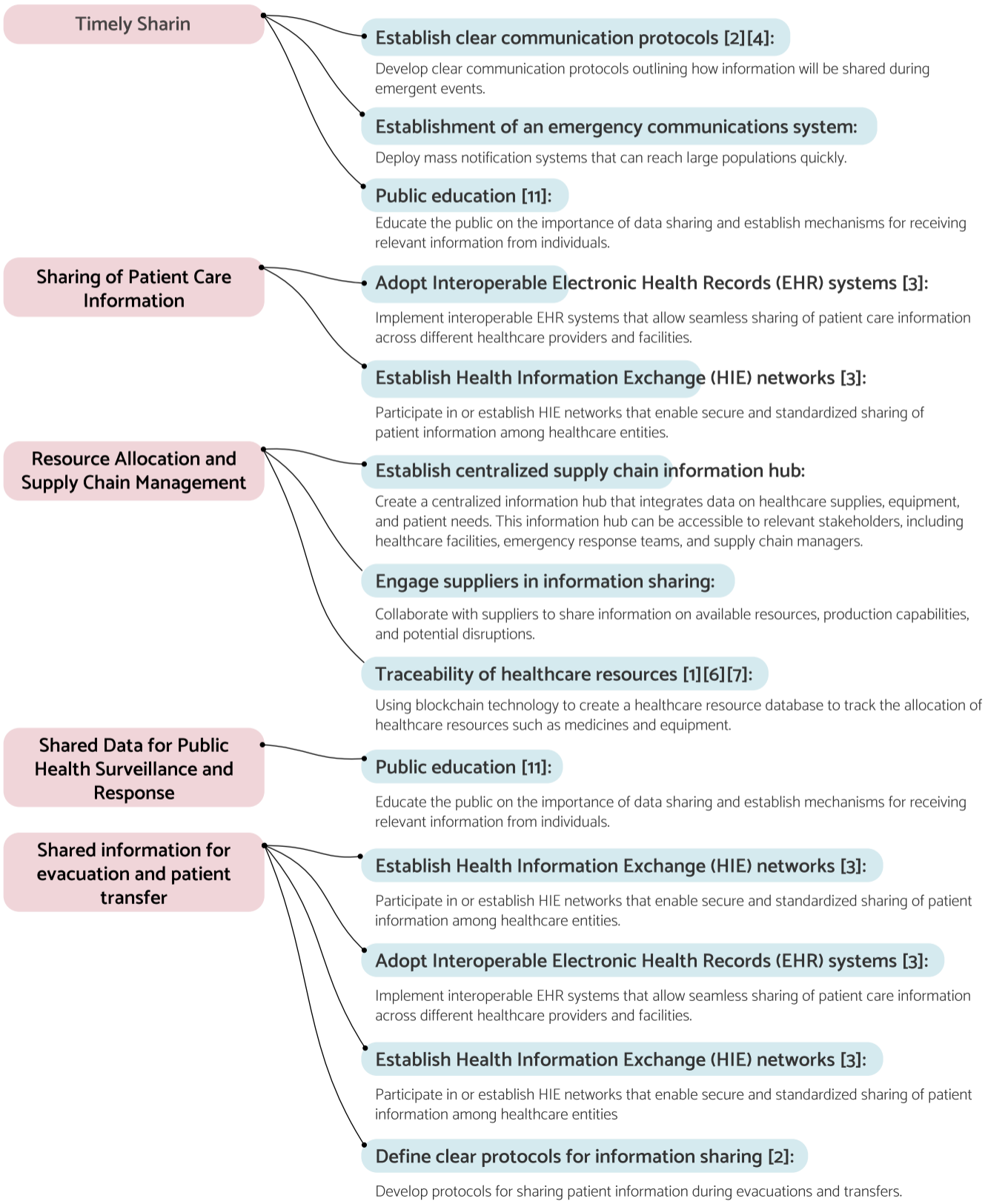
Investment in infrastructure upgrades:

Invest in infrastructure upgrades in economically disadvantaged areas which includes improving the structural integrity of healthcare facilities, transportation systems, and communication networks.

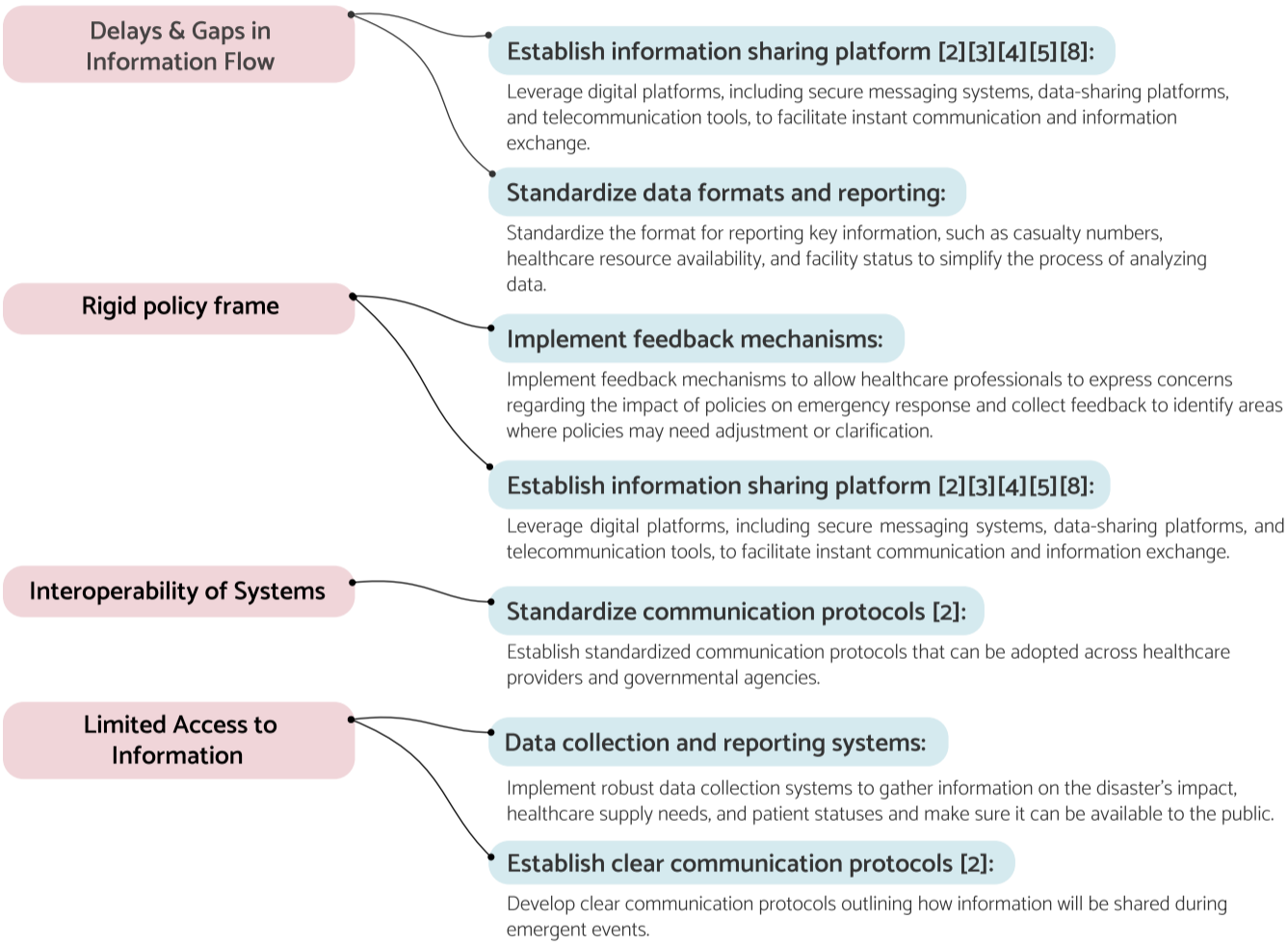
Challenges of Economic Disparities



Challenges of Information Sharing



Challenges of Organizational Synergy



Relations

The Challenges and Opportunities Map provides a comprehensive overview of the intersection between various challenges and potential opportunities within the healthcare system of Zhengzhou.

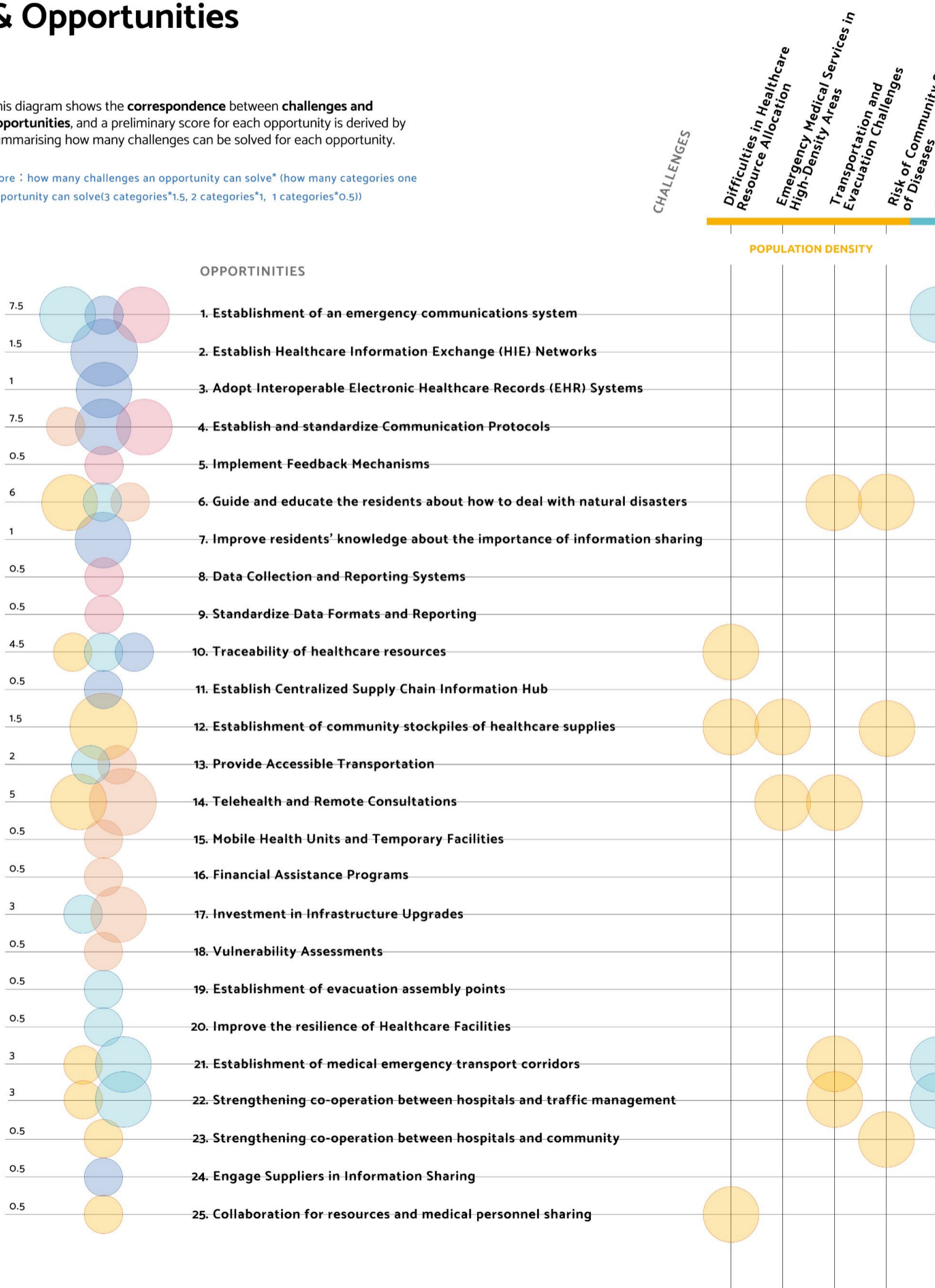
The map effectively visualizes how each identified opportunity can solve multiple challenges, providing a strategic framework for prioritizing interventions. By focusing on high-impact opportunities, stakeholders can maximize resource utilization and achieve significant improvements in the healthcare system's resilience and efficiency.

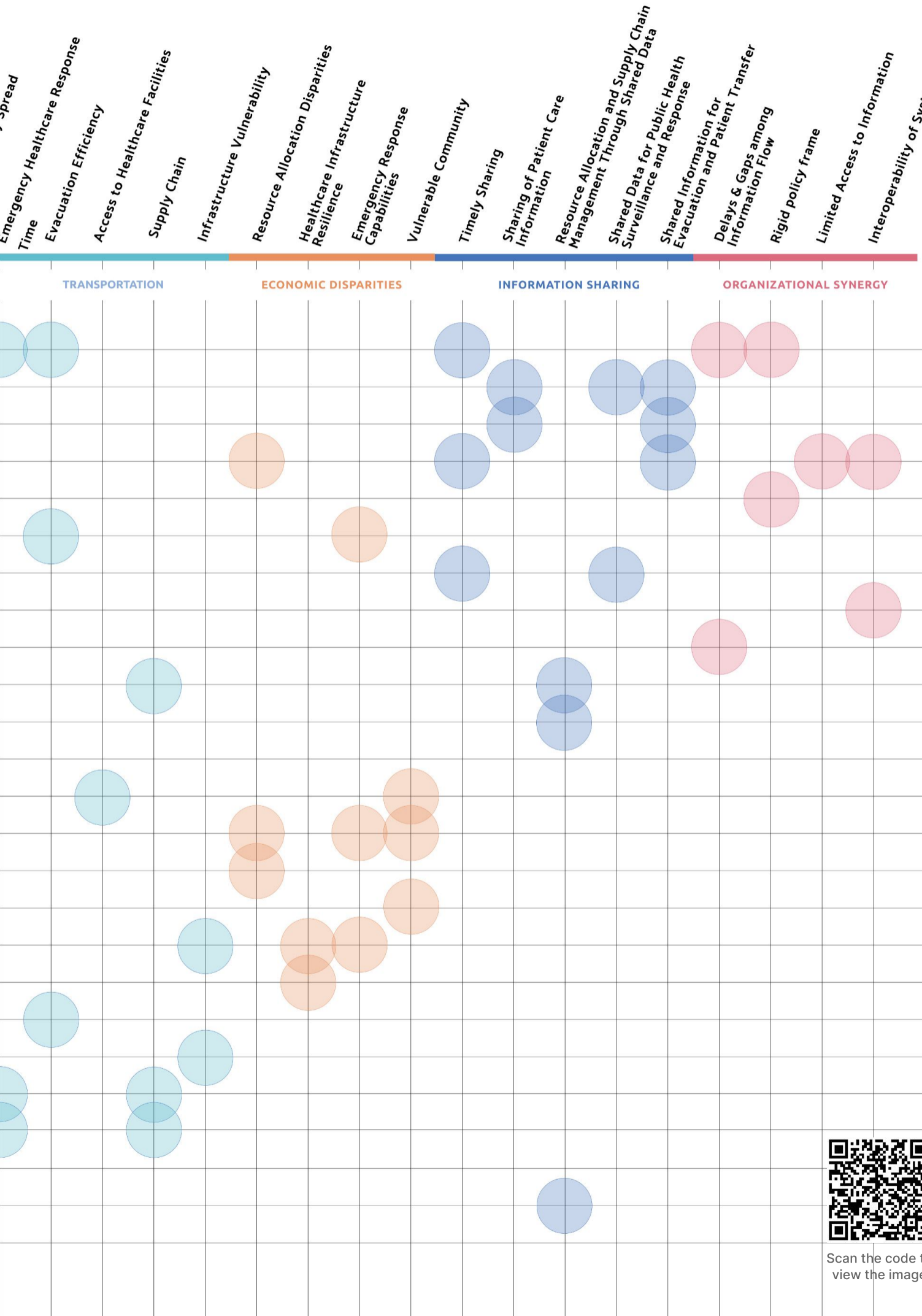
Map 8.
Challenges and Opportunities

Challenges & Opportunities

This diagram shows the **correspondence** between **challenges and opportunities**, and a preliminary score for each opportunity is derived by summarising how many challenges can be solved for each opportunity.

score：how many challenges an opportunity can solve* (how many categories one opportunity can solve(3 categories*1.5, 2 categories*1, 1 categories*0.5))





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6.2

EVALUATION AND SELECTION

Classification of Opportunities

After identifying the challenges and opportunities, we classified the key opportunity points to explore the interactions and connections between strategies. The categories include Information net, Standardize, Public education, Data Management, Resource Traceability and Distribution, Accessibility, Financial Support, Emergency Preparedness, and Co-operation.

The aim of these opportunities is to strengthen the resilience and responsiveness of systems, particularly in the healthcare and emergency response sectors, by fostering comprehensive, interconnected strategies. This holistic approach seeks to improve resource management, collaboration, and communication to ensure sustainable solutions to pressing societal issues.

Information net
This category of information net opportunities focuses on establishing robust communication and information sharing systems to improve coordination and patient care. The initiatives include creating emergency communication systems, HIE networks, and interoperable EHR systems. These efforts enhance data sharing across healthcare providers, ensuring comprehensive information sharing and improving patient outcomes by making medical data readily available. This category reduces response time, ensures timely assistance, and facilitates continuity of care.

Standardize

Standardize emphasizes uniformity and consistency across communication and feedback mechanisms to improve system efficiency. Standard protocols and feedback mechanisms simplify communication between entities, reducing misunderstandings and streamlining decision-making. This ensures better service quality and enhances overall system performance through continuous improvement.

Public education
This category focuses on educating residents to handle natural disasters and emphasizes the importance of information sharing, leading to a more informed and prepared community. Educational initiatives guide residents in handling emergencies, reducing panic and ensuring safe responses. Additionally, they improve residents' understanding of the importance of healthcare information sharing, which enhances cooperation, ensuring resources and assistance reach those in need.

Data management
This category of data management underscores the need for systematic data collection and reporting to inform decision-making and improve efficiency. Data collection and reporting systems ensure accurate and timely data gathering, aiding effective decision-making and allowing for targeted interventions. Standardizing data formats simplifies exchange and interpretation, reducing errors and streamlining the process, fostering consistency across entities.

Resource traceability and Distribution
Resource Traceability and Distribution could improve overall system responsiveness. Initiatives such as centralized hubs and local stockpiles optimize distribution, reducing shortages of healthcare resources and ensuring timely access to them. Resource traceability systems ensure proper allocation and utilization, minimizing waste and enhancing efficiency.

Accessibility
This category makes healthcare more accessible, focusing on transportation, telehealth, and temporary facilities. Accessible transportation ensures patients can reach facilities promptly, reducing treatment delays. Telehealth and remote consultations provide access to healthcare remotely, particularly for those in underserved areas. Mobile health units and temporary facilities offer services directly to communities, enhancing access in underserved regions and reducing pressure on established facilities.

Financial support
Financial Support initiatives assist individuals and invest in infrastructure upgrades to strengthen system resilience. Assistance programs support residents and businesses affected by emergencies, helping them recover and sustain their livelihoods. Investments in infrastructure improve healthcare facilities and other key areas, enhancing overall system resilience and capacity to handle emergencies.

Emergency preparedness
This part builds resilience through preparedness initiatives and improving response. Vulnerability assessments identify weak points, allowing for targeted improvements, reducing risks, and improving preparedness. Establishing evacuation assembly points ensures safe and orderly evacuations, while enhancing healthcare facilities' robustness increases their ability to withstand emergencies, ensuring continuity of care. Medical emergency corridors enable rapid movement of patients and supplies, reducing response time and improving outcomes.

Information net
Co-operation
This category aims to strengthen partnerships between various entities to enhance system performance. Collaborations between hospitals and traffic management ensure smooth patient transportation, reducing treatment delays. Strengthening ties with local communities fosters support and resource sharing, improving overall system performance. Engaging suppliers in information sharing improves supply chain efficiency, reducing shortages. Sharing resources and medical personnel enhances the system's overall resilience and response capabilities, ensuring timely assistance during emergencies.

Systemic Matrix

In this section, we examine the application of a systemic assessment framework to guide the selection of strategic opportunities, ensuring that the chosen strategies are feasible, impactful, and suit the local characteristics.

We categorized the integration of these potential opportunities into our system into three distinct phases: the preparedness process, the implementation process and the impact following implementation. Then each opportunity is assessed based on the characteristics inherent to each phase.

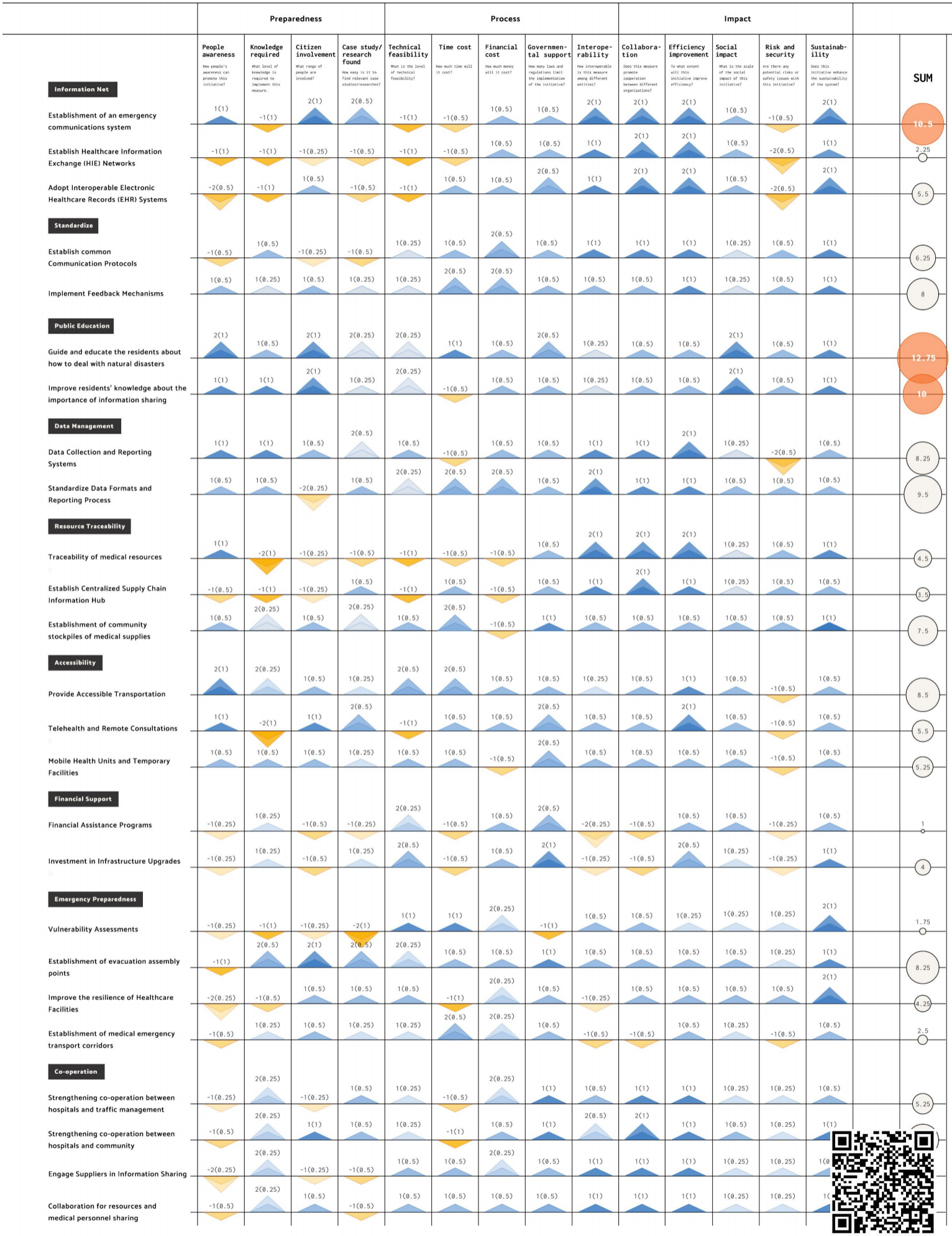
In evaluating preparedness, we analyzed community awareness about the initiative and the depth of knowledge essential for its successful execution. It is also critical to assess the extent of citizen involvement and the availability of related case studies or research that can help and guide the initiative.

The evaluation of the implementation process investigates the technical feasibility of the opportunities, considering the necessary time and financial needs. This assessment is accompanied by an examination of government support and the potential for interoperability among various entities within the healthcare ecosystem.

Finally, the impact analysis is helpful in evaluating the initiative's efficiency improvements and its wider societal effects. This analysis includes a thorough examination of potential risks or security concerns, alongside an assessment of the opportunity's contributions to sustainability. A crucial element of this assessment involves understanding how the initiative promotes collaboration, as partnerships across organizations are the foundation of the robust and resilient healthcare system.

Based on the specified scoring criteria, we quantified the contribution of each opportunity using a dual-dimension evaluation approach: The first dimension assesses the relevance of each evaluation criterion to the opportunity, applying coefficients of 0.25, 0.5, and 1. For instance, the level of resident participation may not significantly impact the hospital's decision to establish Health Information Exchange (HIE), hence it is assigned a coefficient of 0.25 (which means low relevance). The second dimension involves scoring each opportunity according to these evaluation criteria, with potential scores of -2, -1, 1, and 2, where negative values indicate that the opportunity performs poorly under the given standard.

Map 9.
Evaluation Matrix



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6.3
CONCLUSION

In conclusion, this assessment of the various opportunities has ended up with the identification of three high-priority initiatives, each achieving a score of 10 and above. These initiatives include: the establishment of a robust emergency communication system, the development of educational programs to train residents on their roles and responses during natural disasters, and the encouragement of proactive healthcare information sharing among the community.

Each selected opportunity demonstrates a strong alignment with our strategic goals, emphasizing not only community resilience but also the enhancement of collective preparedness and response capabilities.

The implementation of these initiatives can bring critical improvements in the systemic effectiveness of disaster management within our system. Furthermore, these priorities were chosen based on their feasibility, potential impact, and the critical role they play in strengthening community engagement and response mechanisms in emergencies. As we move forward, these specific areas will be integrated into our targeted actions, ensuring that our interventions are effective in addressing the challenges faced by our system during crises.

References :

1. Alexander, D. E. (2015). Disaster and emergency planning for preparedness, response, and recovery. In Oxford Research Encyclopedia of Natural Hazard Science (pp. 1-20). Oxford University Press. https://doi.org/10.1093/acrefore/9780199389407.013.12

2. Kapucu, N. (2012). Disaster and emergency management systems in urban areas. Cities, 29(Supplement 1), S41-S49. https://doi.org/10.1016/j.cities.2011.11.009

3. Alhadhrami, Z., Alghfeli, S., Alghfeli, M., Abedlla, J. A., & Shuaib, K. (2017). Introducing blockchains for healthcare. In 2017 International Conference on Electrical and Computing Technologies and Applications (ICECTA 2017) (pp. 1-4). https://doi.org/10.1109/ICECTA.2017.8252043

4. Alharazi, A., & Al Thobaity, A. (2023). From planning to execution: Delving into the crucial role and challenges of HEPPUs in hospital emergency management. International Journal of Disaster Risk Science, 14(858-867). https://doi.org/10.1007/s13753-023-00522-w

5. Song, G. (2023). Application analysis of electronic information technology in hospital management. Digital Communication World, (12), 126-128. Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=SZTJ202312040&uniplatform=OVERSEA&v=ZeeusaSBUmhbNVndLhkWpdQGEXeKX-qC-xeN5cXbkeMHhddggHchbcO1h9e6QoDx

6. Guo, S., Li, W., Wu, F., & Zheng, G. (2021). Emergency logistics informatization construction based on natural disasters: A case study of the heavy rainstorm in Zhengzhou. Office Automation, 22, 6-9. Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2021&filename=BGDH202122004&uniplatform=OVERSEA&v=OICb7LjB9fMvCkwSMkf7wf0AOx3Id9mx1mXKFRHXw2U9Zm4DvKs6jyRYV5hbLAHH

7. Zhang, Y., Chen, Z., & Gao, X. (2023). Blockchain-driven mechanism for rebalancing and ensuring the coordinated supply of medical resources during the COVID-19 pandemic. Journal of Safety Science and Technology, 19(12). Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=LDBK202312028&uniplatform=OVERSEA&v=wAb4ZKGrFouo1dCV8WZMZuo80KCMy7gBzdO8FYxihoWAvhX_VgUR1XF2JlD3sql3

8. Gao, X. (2023). Current status and strategies for the informatization construction of regional medical alliances. China Industrial Economy, 24(24), 56-58. Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=KJHU202324013&uniplatform=OVERSEA&v=tHr5TFMiBgofT498DzMLnPFIIW7aqexhd03vjWenbvYPcbfe2gDB-4zc3WTB47mQ

9. Ward, K., Vagholkar, S., Lane, J., Raghuraman, S., & Lau, A. Y. S. (2023). Are chronic condition management visits translatable to telehealth? Analysis of in-person consultations in primary care. International Journal of Medical Informatics, 178, 105197. https://doi.org/10.1016/j.ijmedinf.2023.105197

10. Taghizadeh, M., Mahsuli, M., & Poorzahedy, H. (2023). Probabilistic framework for evaluating the seismic resilience of transportation systems during emergency medical response. Reliability Engineering & System Safety, 236, 109255. https://doi.org/10.1016/j.ress.2023.109255

11. Li, H. (2021). Public participation in disaster prevention and mitigation in natural disasters: A phased path model. Chinese Public Administration, 2021(6), 128-135. https://oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2021&filename=ZXGL202106017&uniplatform=OVERSEA&v=gTq0uPlnVDo3rVC4UZcSpwba_1WYSNd6A3HR_ryOuBLO2tmyF0OKDvx3lYpYheLY

12. U.S. Climate Resilience Toolkit. (n.d.). Climate risks and community vulnerabilities assessment. Retrieved from https://toolkit.climate.gov/topics/human-health/building-health-care-sector-resilience/element-1-climate-risks-and-community

07.

NEW HEALTHCARE SYSTEM DESIGN

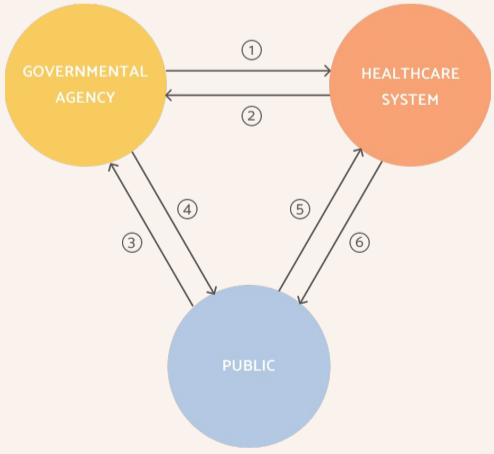
TO ADDRESS THE CHALLENGES CAUSED BY CLIMATE CHANGE , WE RECOGNIZED THE *INTERCONNECTED ROLES* OF HEALTHCARE PROVIDERS, COMMUNITY MEMBERS, AND GOVERNMENTAL AGENCIES.

7.1

IDENTIFY STRATEGIES

Understanding the Dynamics of Collaboration

In our systemic approach to addressing the challenges caused by climate change within the healthcare system, we recognize the interconnected roles of healthcare providers, community members, and government agencies. Healthcare providers serve as the frontline responders, delivering critical care and services during emergencies. Community members play a vital role in promoting resilience and preparedness by adopting preventive measures and actively participating in educational initiatives [1]. Government agencies provide essential support through policy development, resource allocation, and coordination efforts [2]. Effective communication among these actors is very important, facilitated through various channels such as a real-time emergency communication platform, educational materials, and community engagement events. By fostering collaboration and information sharing among healthcare providers, community members, and government agencies, we aim to strengthen the healthcare system's capacity to respond to climate-related challenges and safeguard public health.

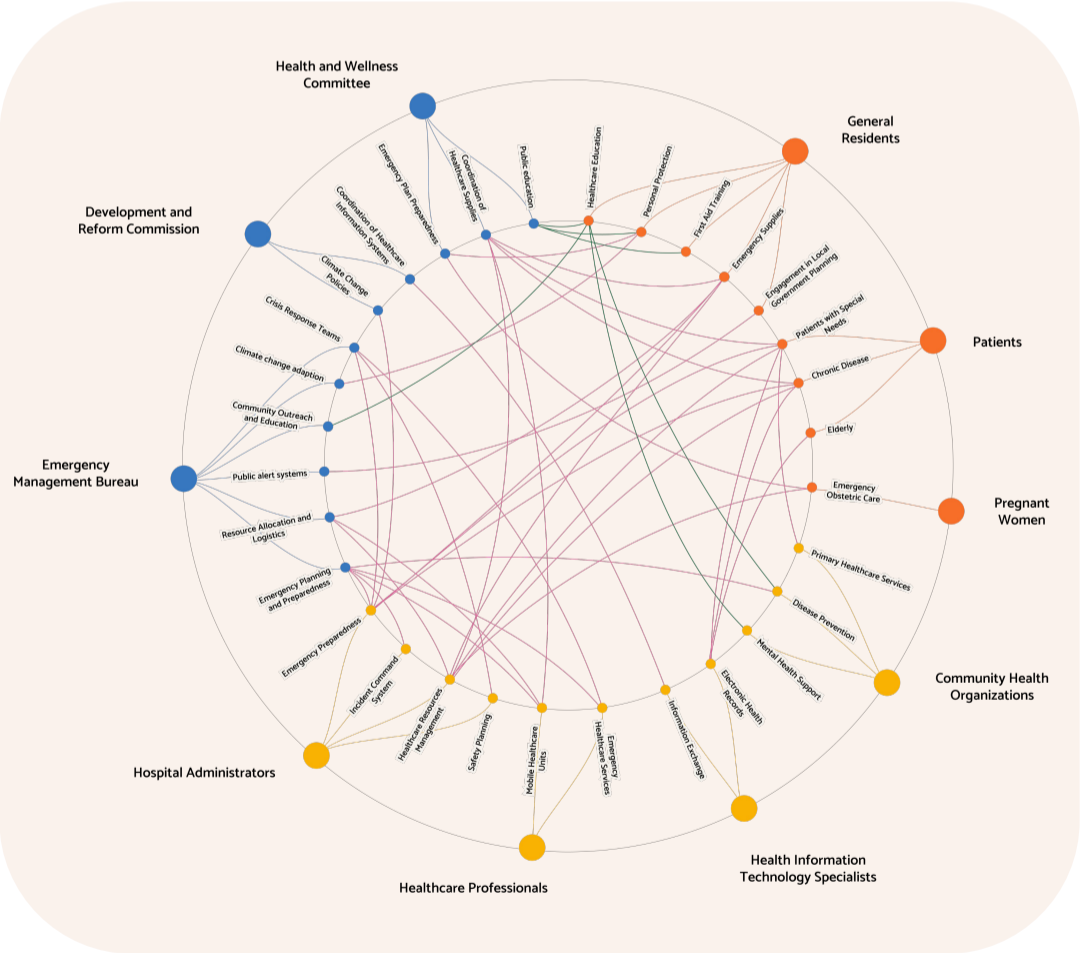


1. **GOVERNMENT TO HEALTHCARE SYSTEM:** emergency alerts, policy updates, resource availability.
2. **HEALTHCARE SYSTEM TO GOVERNMENT:** resource needs, patients situation
3. **PUBLIC TO GOVERNMENT:** reporting & request for assistance
4. **GOVERNMENT TO PUBLIC:** notifications, alerts, emergent assistance
5. **PUBLIC TO HEALTHCARE SYSTEM:** health status reporting/consultation, resource needs
6. **HEALTHCARE SYSTEM TO PUBLIC:** diagnostic information, health guidelines, resource availability

Figure 25.
Communication Pattern between Main Stakeholders

In conclusion, this assessment of the various opportunities has ended up with the identification of three high-priority initiatives, each achieving a score of 10 and above. These initiatives include: the establishment of a robust emergency communication system, the development of educational programs to train residents on their roles and responses during natural disasters, and the encouragement of proactive healthcare information sharing among the community.

Each selected opportunity demonstrates a strong alignment with our strategic goals, emphasizing not only community resilience but also the enhancement of collective preparedness and response capabilities.



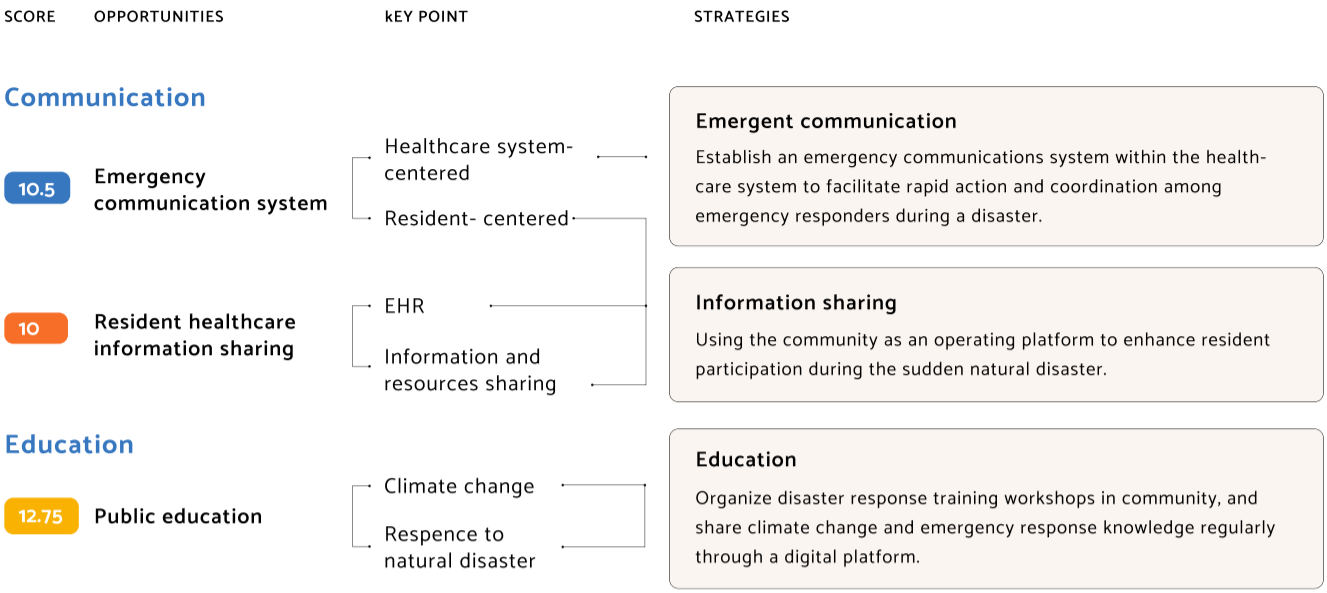
Map 10.
Ecosystem Affinity Map

Strategies

After mapping out the interactions and connections among system elements, we aim to develop holistic solutions that address the problem systematically. This approach ensures that solutions are interconnected and examined collectively, paving the way for the building of a new, sustainable healthcare system.
Based on the assessment of opportunities in the previous section, we looked at three opportunities with scores greater than 10, reflecting two strategic priorities: first, improving the healthcare system's emergency communication capabilities by streamlining coordination among responders and engaging residents through effective information sharing. Second, creating a robust educational framework, organizing disaster response workshops, and promoting a deeper understanding of emergency preparedness and climate change through accessible digital platforms. These key areas are further refined into specific approaches such as electronic health records, information exchange, and climate change response education.

By combining these specific approaches and looking for connections between them to maximize the goal of healthcare transformation through integrated strategies, three strategies in different directions were finally identified: enhancing emergency communications, facilitating healthcare information sharing, and providing comprehensive public education.

This approach encourages partnerships between healthcare organizations, emergency responders, and the community to create a system that not only mitigate the impacts of disasters, but also enhances the value of the healthcare system through increased collaboration and resource sharing practices.



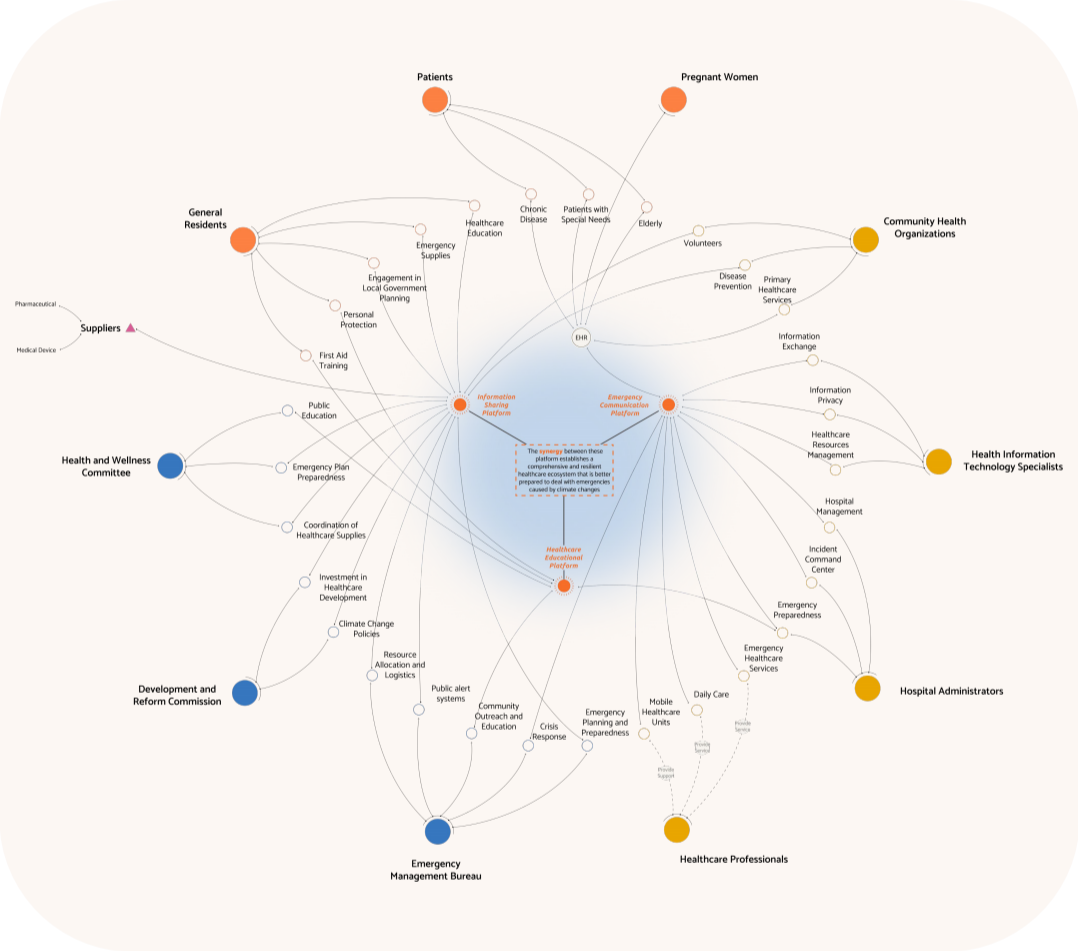
Firstly, the establishment of an emergency communication system serves as the foundation for effective response during crises. This system enables timely dissemination of critical information to healthcare facilities, emergency responders, and the public, facilitating swift action and coordination during disasters [3].

Secondly, encouraging residents to share important information enhances awareness and facilitates decision-making by real-time data during crises. By integrating this strategy, healthcare systems can make full use of technology platforms, social media channels, and community networks to gather information on emerging threats, resource availability, and community needs. This data can help resource allocation, logistical planning, and response strategies, enabling healthcare providers to adapt quickly to evolving circumstances and allocate resources effectively.

Finally, by educating residents on natural disaster response, individuals and communities can be equipped with necessary knowledge to take measures that reduce risks and protect themselves during emergencies. This method fosters a culture of preparedness and resilience within the community. By integrating this strategy into the broader healthcare system, healthcare providers can collaborate with local authorities and community organizations to develop educational campaigns, training programs, and other initiatives to achieve a more resilient community [4].

Each of the three strategies complete and reinforce one another in building resilience on the territory. Emergency communication systems are an important pillar in responding to sudden natural disasters to ensure the health of the population and the stability of the healthcare system.

Meanwhile, educational activities empower residents to utilize communication channels effectively and engage in information sharing, while shared information enhances the effectiveness of disaster response efforts. This interconnection fosters a cycle of preparedness, response, and recovery, strengthening the overall resilience of the healthcare system.



Map 11.
New Ecosystem Affinity Map

In summary, integrating the establishment of these strategies creates a comprehensive approach to resilience-building in the face of climate change. By fostering collaboration, communication, and community engagement, these strategies enhance the preparedness, response capabilities, and adaptive capacity of healthcare systems, ultimately improving outcomes for both healthcare providers and the communities they serve.

7.2

EMERGENCY COMMUNICATION SYSTEM

Introduction

The first strategy includes the establishment of a real-time emergency communication system specifically tailored to healthcare organizations. The system is designed to facilitate seamless communication and coordination during crises and to ensure a rapid and effective response to emergencies. Aimed at healthcare stakeholders, including healthcare staff, administrators and emergency responders, the system is designed to provide them with intuitive tools and real-time updates to improve their ability to effectively manage and respond to emergencies.

At the core of the system is the rapid dissemination of critical alerts and notifications, ensuring that healthcare staff and emergency responders receive timely information about upcoming or ongoing emergencies. In addition, the platform facilitates a feedback loop, allowing all the staff to provide real-time feedback on their work progress, identify emerging issues, and communicate new needs as they arise. With role-based messaging capabilities, the system ensures that relevant information is delivered to the appropriate person based on their role or responsibility in the healthcare organization. In addition, the platform provides real-time traceability, enabling healthcare managers to track the availability and distribution of critical resources, such as healthcare supplies, beds, and personnel, in the event of any emergency.

Case Studies

As we initiate our first strategy, implementing a real-time emergency communication platform for the healthcare system, it's important to collect insights from relevant case studies to guide our design. The case studies allowed us to understand the support of existing technologies and ensure the feasibility of the strategy. At the same time, by analyzing the platform's structure and functionality, we can learn from the best practices and optimize our solution.

Ascom Healthcare Platform

Keywords:

Interoperability | Asset Tracking | Workflow Efficiency | Healthcare Connectivity | Communication Standards

Relevance:

★★★★☆

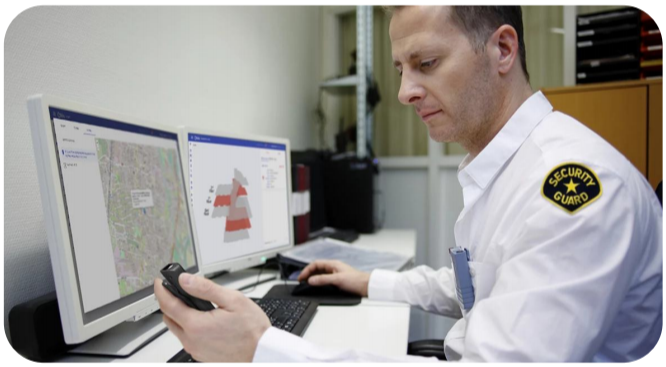
Navigating the Future of Healthcare Technology.

Swiss

https://www.ascom.com/asia

Ascom is a global provider of healthcare communication solutions, including the Ascom Healthcare Platform. The Ascom Healthcare Platform is designed to enhance communication and collaboration within healthcare organizations, improving overall efficiency, patient care, and staff coordination.

It addresses the unique challenges faced by healthcare professionals and organizations, emphasizing the importance of reliable communication systems in delivering high-quality and timely care, especially during emergency situations.



Features:

Alarm Management:
Alarm management is an integral part of the Ascom Healthcare Platform. The system helps prioritize and manage alarms effectively, ensuring that critical alerts are promptly addressed.

Real-time Locating System (RTLS):
Some implementations of the Ascom Healthcare Platform include RTLS technology, allowing healthcare organizations to track the real-time location of assets, equipment, and even personnel.

Secure Messaging:
Ascom offers secure messaging capabilities within its platform, enabling healthcare professionals to communicate efficiently and securely.

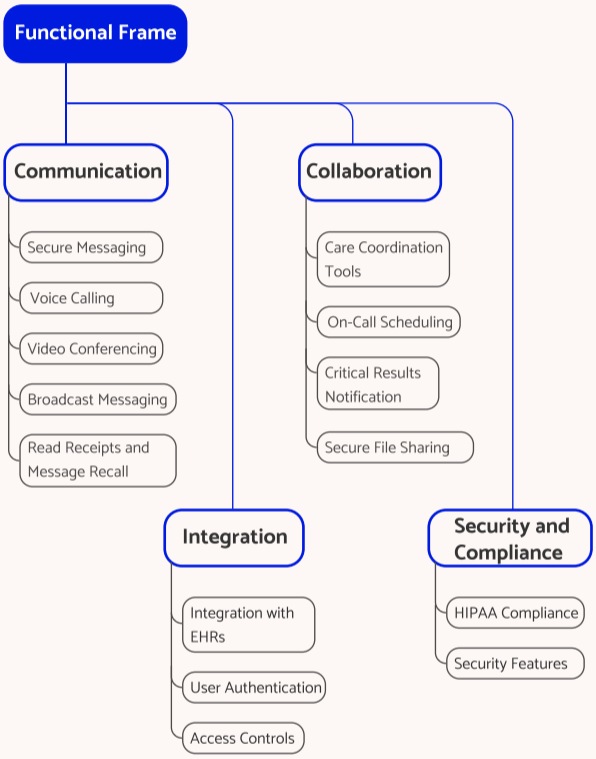
Tiger Connect

Optimize Workflows. Maximize Productivity.

California, the U.S.
https://tigerconnect.com/

TigerConnect aims to address the unique communication challenges within healthcare settings, ensuring that healthcare professionals can securely and efficiently communicate with each other to provide better patient care especially during emergent situations.

The platform is designed to be compliant with healthcare regulations, including the Health Insurance Portability and Accountability Act (HIPAA), to ensure the protection of patient information.



Features:

Secure Messaging:
Enables healthcare professionals to send and receive secure, encrypted text messages, ensuring the confidentiality of patient information.

Voice Calling:
Allows users to make voice calls securely within the platform, facilitating real-time communication between healthcare team members.

Video Conferencing:
Supports secure video conferencing for virtual consultations, multidisciplinary team meetings, and other collaborative discussions.

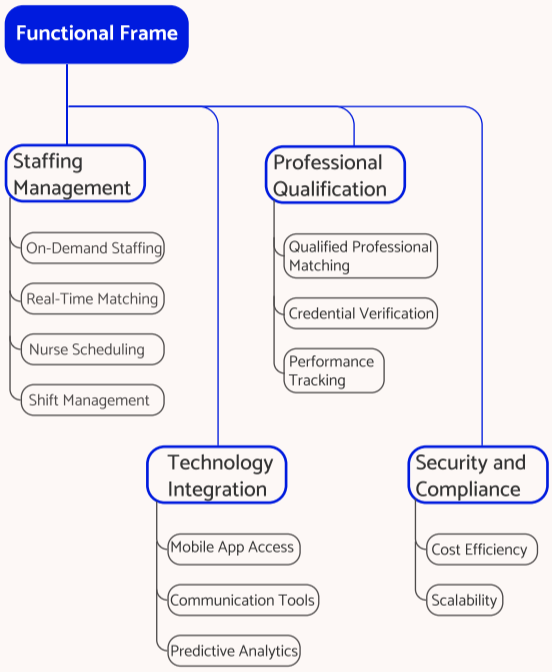
Keywords:

Secure Messaging | Voice Calling | Video Conferencing | Healthcare Connectivity | Broadcast Messaging

Relevance:

★★★★★

IntelyCare



Keywords:

On-Demand Staffing | Real-Time Matching | Flexibility | Nurse Scheduling

Relevance:

★★★★☆

Quality care starts with a quality career: Discover a new world of nursing.

Massachusetts, the U.S.
https://www.intelycare.com/

IntelyCare is a company that focuses on healthcare staffing solutions, particularly in the field of nursing. IntelyCare's platform aims to connect healthcare facilities with qualified nurses and other healthcare professionals to address staffing needs.

The platform utilizes technology to match healthcare facilities with available and qualified nursing staff in real-time, allowing for more efficient and flexible staffing solutions. This can be particularly valuable for healthcare facilities dealing with fluctuations in patient numbers, seasonal variations, during emergencies.

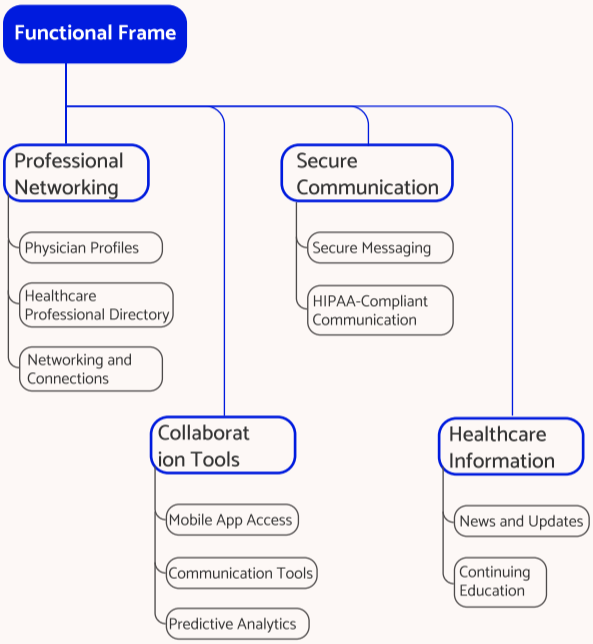
Features:

On-Demand Staffing:
IntelyCare's platform provides on-demand access to qualified nursing professionals, allowing healthcare facilities to fill staffing gaps quickly.

Real-Time Matching:
The platform uses technology to match available nursing professionals with the specific needs and requirements of healthcare facilities in real-time.

Flexibility for Facilities:
Healthcare facilities can use the platform to request staffing support for various shifts, enabling flexibility in managing their workforce based on demand.

Doximity



Keywords:

Healthcare Networking | Collaboration | Resource Manegement

Relevance:

★★★★☆

Medicine Made Mobile
Bringing tech to healthcare

the U.S
https://www.doximity.com/

Doximity is a social networking platform tailored for healthcare professionals, providing a secure environment for physicians, nurses, and other medical practitioners to connect and collaborate. Offering features such as a comprehensive physician directory, secure messaging, and collaboration tools, Doximity aims to facilitate communication within the healthcare community.

It serves as a hub for professionals to share medical insights, access current research and news, and explore career opportunities. The platform prioritizes secure communication, making it HIPAA-compliant for confidential interactions among healthcare professionals.

Features:

Professional Networking:
Doximity serves as a social networking platform for healthcare professionals, allowing them to create profiles, connect with colleagues, and expand their professional network within the medical community.

Secure Communication:
The platform provides a secure messaging system that enables healthcare professionals to communicate with each other in a HIPAA-compliant manner. This feature facilitates secure and efficient communication among medical practitioners.

Medical News and Updates:
Users can access medical news, research updates, and other relevant information, keeping them informed about developments in their respective fields.

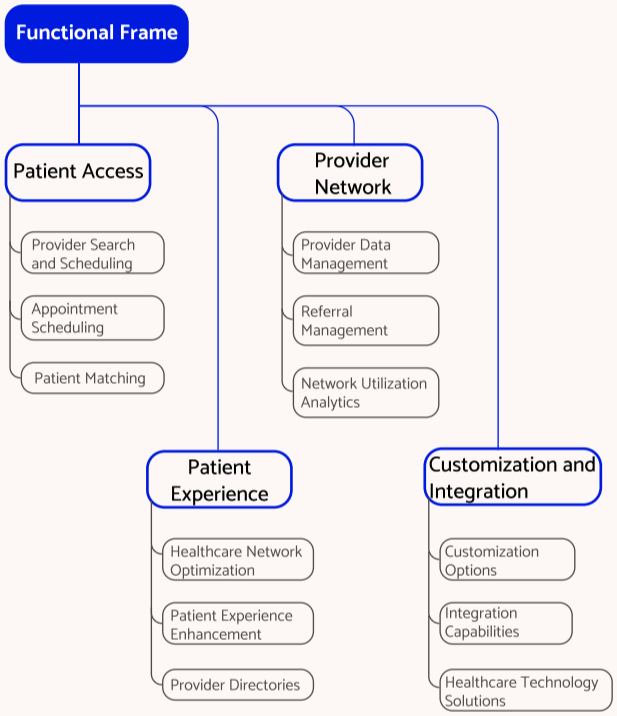
Kyruus Health

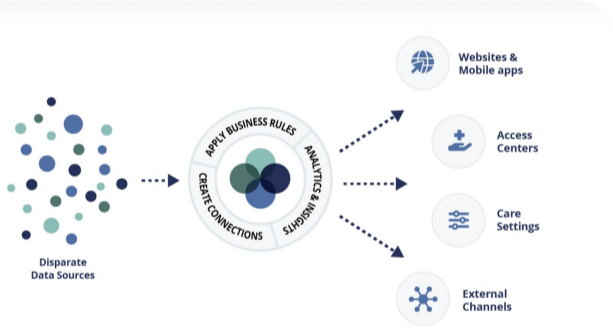
Creating connections that power better care experiences

the U.S.
https://kyruushealth.com/

Kyruus is a healthcare technology company that specializes in patient access solutions and provider data management. The company is known for its innovative platforms that aim to improve the way patients find and connect with healthcare providers, and how healthcare organizations manage their provider networks. Key offerings from Kyruus include tools for provider search and scheduling, patient access optimization, and efficient provider data management.

By leveraging analytics and insights, Kyruus helps healthcare organizations enhance network utilization, streamline referral management, and ultimately improve the overall patient experience.





Features:

Provider Search and Scheduling:
The platform allows patients to easily search for healthcare providers based on various criteria such as location, specialties, and availability. It often includes features for online appointment scheduling to enhance the patient booking experience.

Patient Access Optimization:
Kyruus provides tools to optimize patient access to healthcare services by improving the efficiency of the provider-patient matching process. This ensures that patients are connected with the right providers based on their specific needs.

Provider Data Management:
The platform assists healthcare organizations in managing comprehensive and up-to-date information about their provider networks. This includes details about specialties, locations, credentials, and availability.

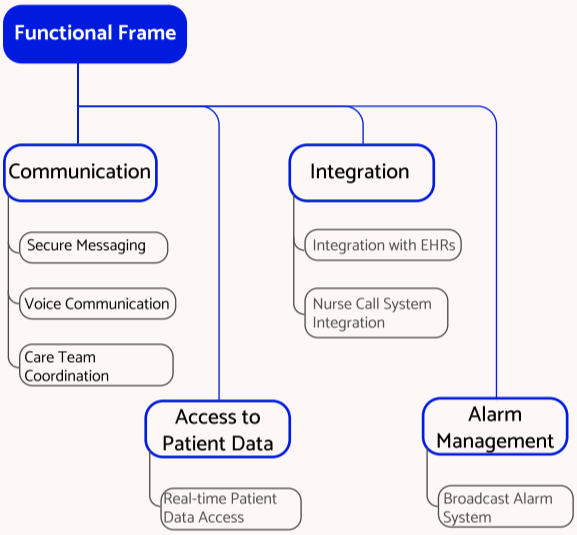
Keywords:

Patient Access Solutions | Network Utilization | Scheduling | Provider Data Management

Relevance:

★★★★☆

Mobile Heartbeat



Keywords:

EHRs | Real-time Patient Data Access | Mobile Healthcare Solutions | Care Team Coordination

Relevance:

★ ★ ★ ★ ★

Mobilize Your Care Team

the U.S

https://www.mobileheartbeat.com/

Mobile Heartbeat is a healthcare technology company dedicated to advancing clinical communication and collaboration within healthcare organizations. At the core of their offerings is the MH-CURE platform, designed to streamline communication workflows among healthcare professionals.

The platform integrates secure messaging and voice communication, facilitating real-time and hands-free interaction within care teams. Emphasizing care team coordination, Mobile Heartbeat's solution supports the seamless exchange of critical information, integrates with existing healthcare technologies, and provides access to patient data.

Features:

Alarm Management:
MH-CURE may include features for managing and responding to clinical alarms. This ensures that critical alerts are promptly communicated to the appropriate members of the care team, helping improve response times to urgent situations.

Clinical Workflows Alignment:
Mobile Heartbeat's solution is designed to align with clinical workflows, making communication an integral part of the daily routines of healthcare professionals. This alignment enhances operational efficiency and ensures that communication supports rather than disrupts existing processes.

Policy Support

The establishment of a communication platform within the healthcare system requires strong policy support from all levels of government to ensure its effectiveness and sustainability. Policies governing healthcare infrastructure and emergency response protocols form the basis for the operation of the communication platform. By aligning with the National Disaster Management Strategy and the Health Information Exchange Policy, we try to integrate our communication platform into existing frameworks, ensuring interoperability and data security.

In doing so, we can promote information sharing among healthcare organizations and streamlining coordination among healthcare providers to work together more efficiently. In addition, policies advocating for the adoption of standardized communications protocols and the allocation of resources for technology infrastructure upgrades are critical to support the implementation and maintenance of the platform.

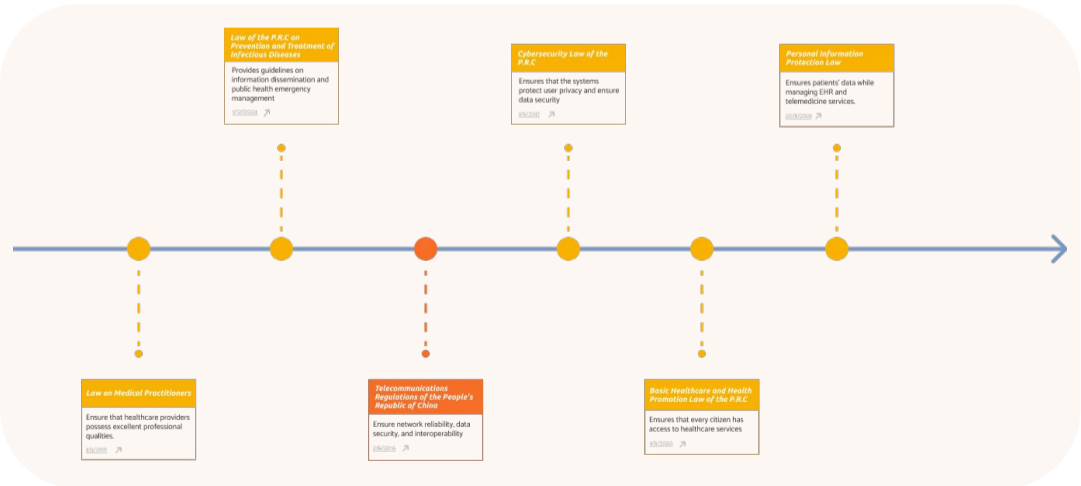


Figure 26.
Legal Framework for Emergency Communication System

Implementation Process

The diagram illustrates a detailed, multi-phased approach for implementing the emergency communication system within healthcare settings, aimed at enhancing crisis responsiveness and preparedness.

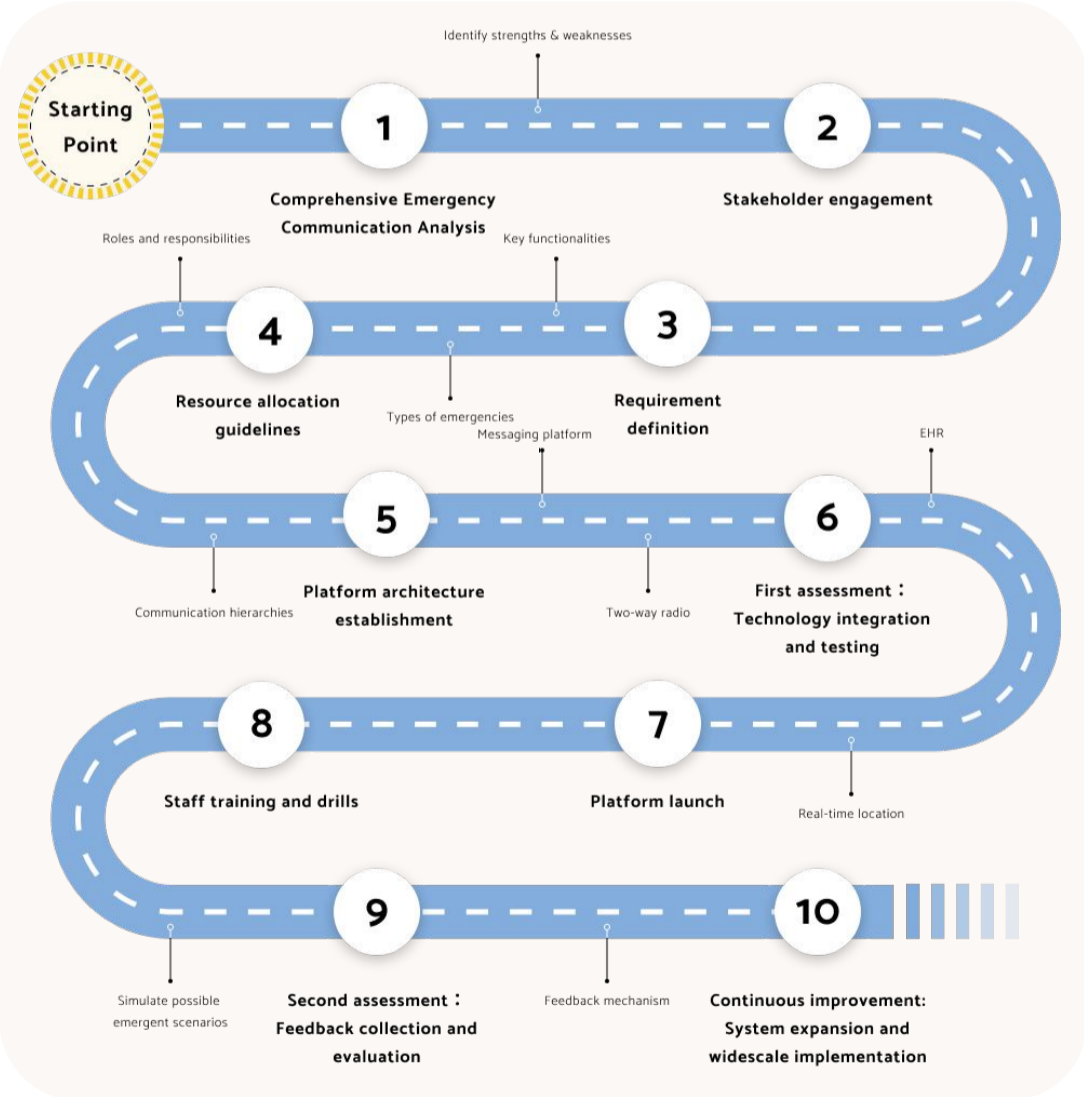


Figure 27. Implementation Process of Emergency Communication System

1

Comprehensive Emergency Communication Analysis

This foundational phase involves a thorough evaluation of existing communication systems to figure out strengths, weaknesses, and gaps. At the meantime, it is necessary to make sure responsibilities, and the essential functionalities that the new system must support are clearly defined.

2

Stakeholder Engagement

At this stage, it is crucial to gather diverse perspectives and ensure that the system addresses the needs of all potential users includeing discussions with healthcare providers, administrative staff, IT personnel, and emergency responders.

3

Requirement Definition

Detailed technical and operational requirements are defined in this phase. These include the types of emergencies the system will need to handle, the specific technological solutions (such as messaging platforms, integration with existing health IT systems), and any necessary compliance with regulations.

4

Resource Allocation Guidelines

This phase ensures that there is a clear understanding of resource distribution, prioritization of service delivery, and management of supplies and personnel during crises through establishing guidelines for how resources should be allocated during any emergency.

5

Platform Architecture Establishment

Develop the architecture of the communication platform while detailing the technological infrastructure, communication channels, and hierarchies. This phase involves selecting appropriate technologies and designing the network to ensure reliable communication during emergencies.

6

Technology Integration and Testing

Technologies selected in the previous phase are integrated into the existing infrastructure to improve its functionality. This phase includes testing of the new systems

to ensure compatibility and functionality which may involve simulations of various emergency situations to evaluate system performance under stress.

7

Platform Launch

The fully tested communication platform is officially launched and becomes operational. This phase may be carried out to manage transition challenges and to ensure all users are ready to adopt the new system.

8

Staff Training and Drills

Comprehensive training sessions and regular drills are conducted to ensure that all healthcare personnel are familiar with the operations of the new emergency communication system. This kind of training is designed to simulate emergency scenarios to improve response effectiveness.

9

Second Assessment: Feedback Collection and Evaluation

Following the implementation, a second assessment is conducted to gather user feedback and evaluate the overall effectiveness of the communication system. This feedback is critical for identifying any issues and making necessary adjustments to improve system performance.

10

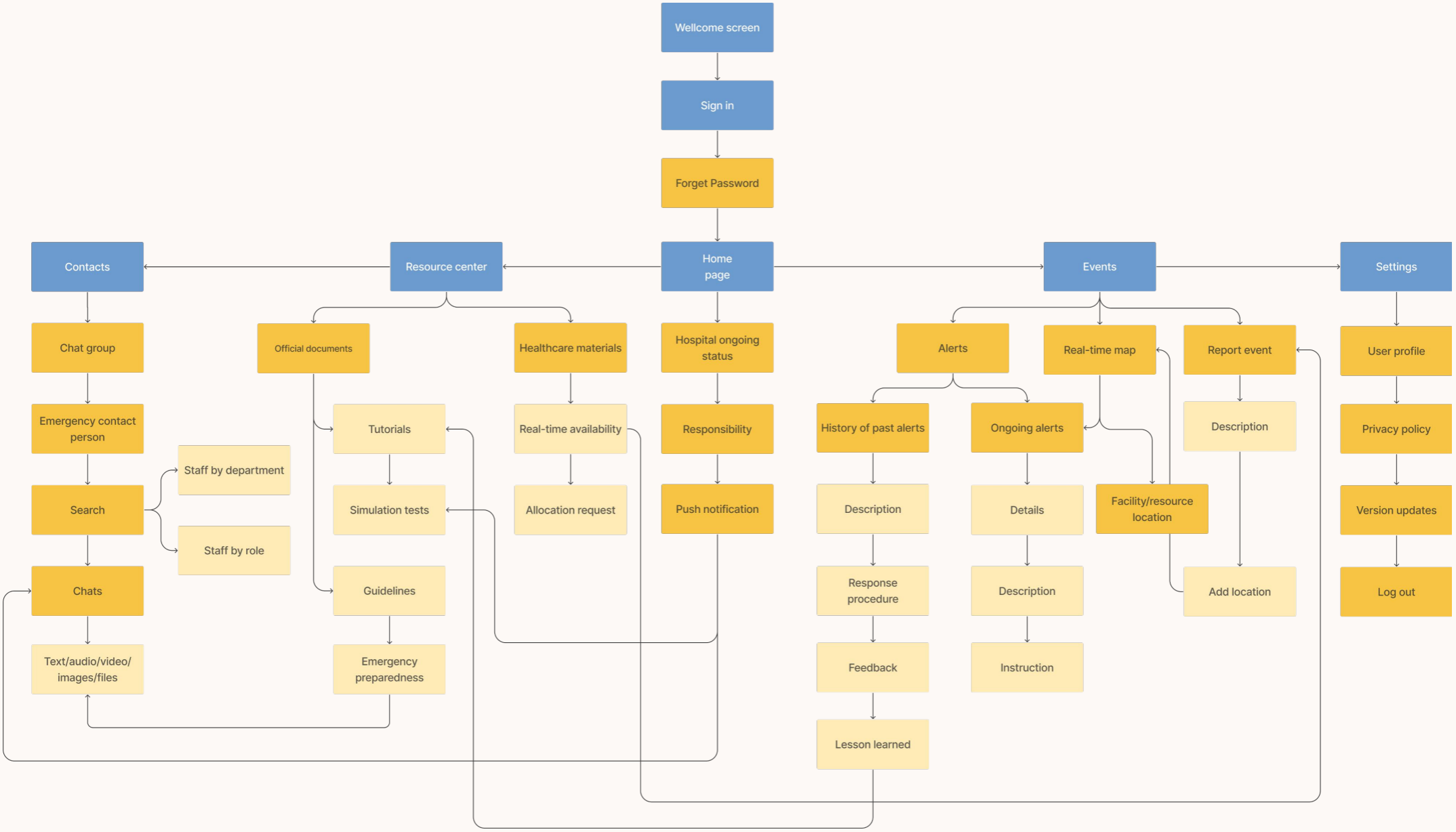
Continuous Improvement: System Expansion and Widescale Implementation

Continuous improvement would be carried out based on the feedback from the second assessment. Plans for expansion and wider implementation are developed, aiming to extend the benefits of the system to other institutions and possibly across different regions.

This comprehensive approach ensures that the emergency communication system is not only well-designed and functional but also adaptable and scalable, meeting the current and future needs of healthcare institutions in managing emergencies.

To define the functions and details of the communication platform, we created a sitemap to clarify its functionalities and complexities. This structure enables seamless emergency response, providing healthcare staff with real-time and updated information enabling them to handle critical situations more efficiently.

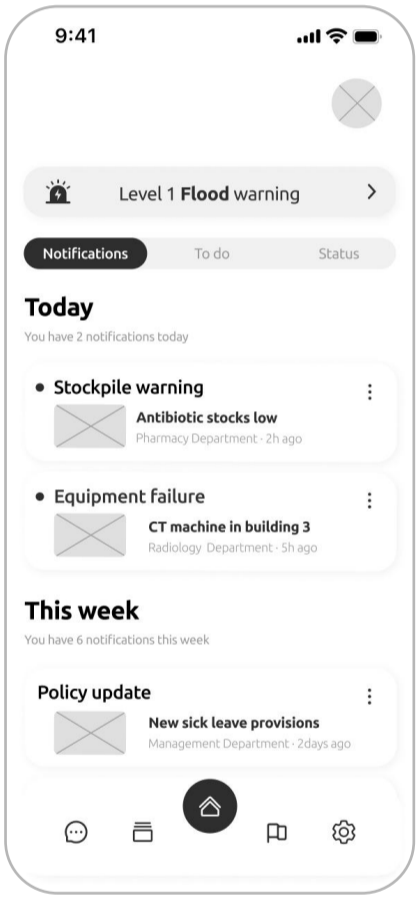
Map 12.
Sitemap of Emergency Communication System


Wellcome screen
Sign in
Forget Password
Contacts
Resource center
Home page
Events
Settings
Chat group
Official documents
Healthcare materials
Hospital ongoing status
Alerts
Real-time map
Report event
User profile
Emergency contact person
Tutorials
Real-time availability
Responsibility
History of past alerts
Ongoing alerts
Description
Privacy policy
Staff by department
Search
Simulation tests
Allocation request
Push notification
Description
Details
Facility/resource location
Version updates
Staff by role
Chats
Guidelines
Response procedure
Description
Add location
Log out
Text/audio/video/ images/files
Emergency preparedness
Feedback
Instruction
Lesson learned

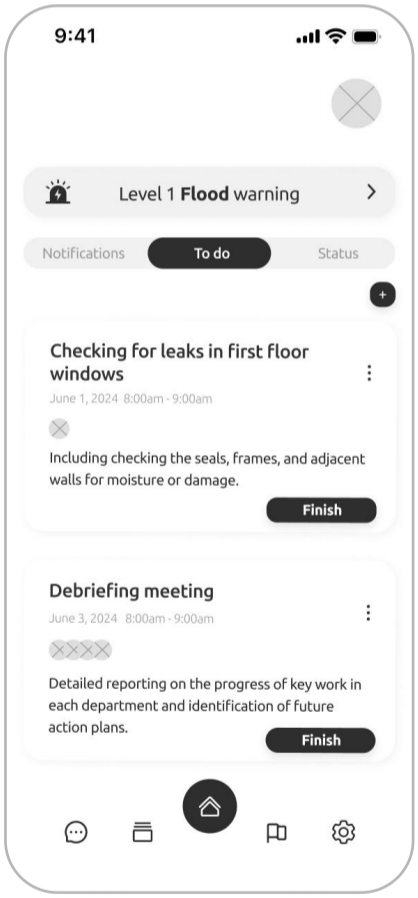
Interface

Home Page

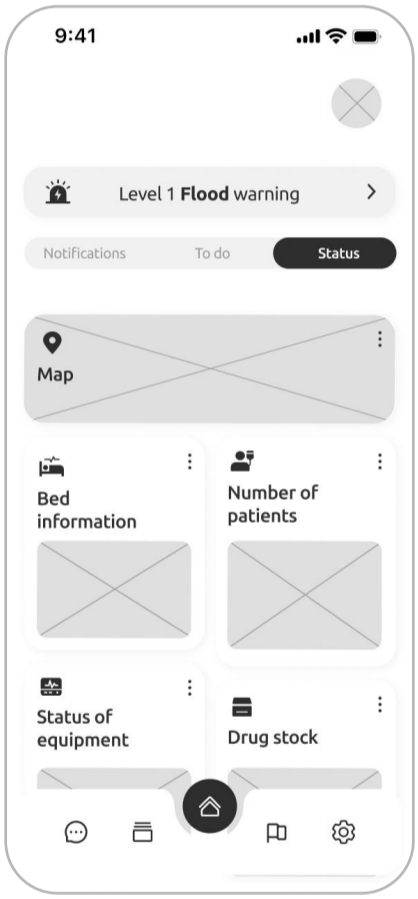
The Home Page design is constructed for efficient communication and task management, including real-time notifications, to-do lists, and critical status monitoring, to ensure that healthcare staff can respond quickly to emergencies and effectively manage daily responsibilities.



Notification interface provides real-time updates and emergency alerts for healthcare personnel.



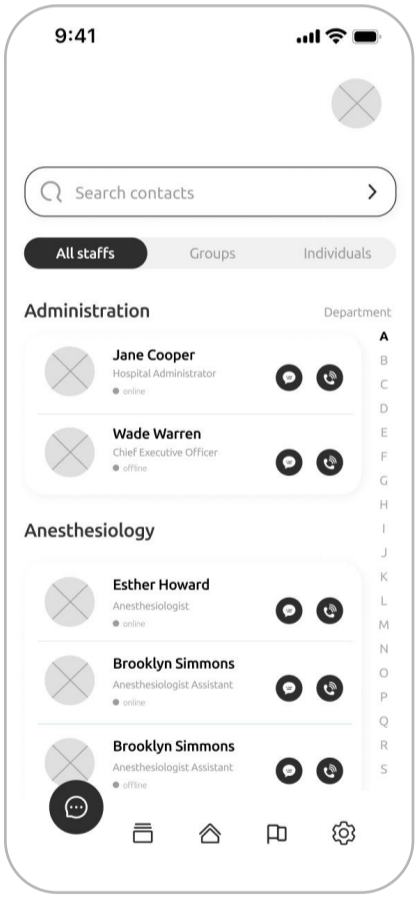
The to-do list interface clearly displays daily tasks and includes timely reminders and clear assignment of responsibilities.



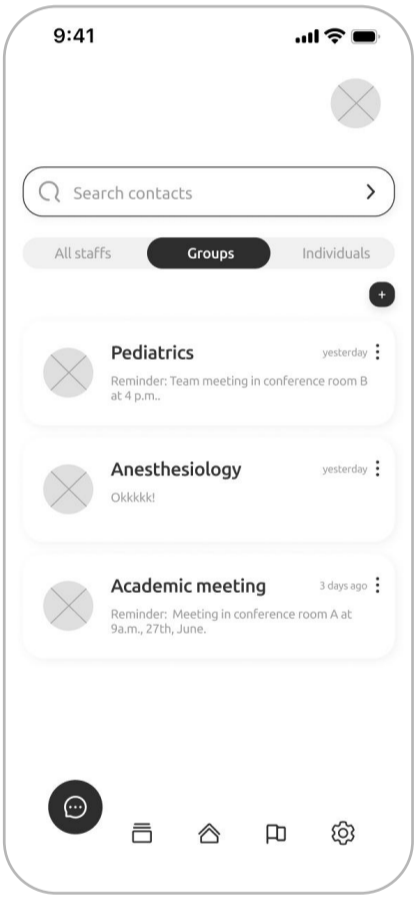
The status interface displays the operational status of key healthcare resources and systems in real time through dynamic charts and indicators.

Contact

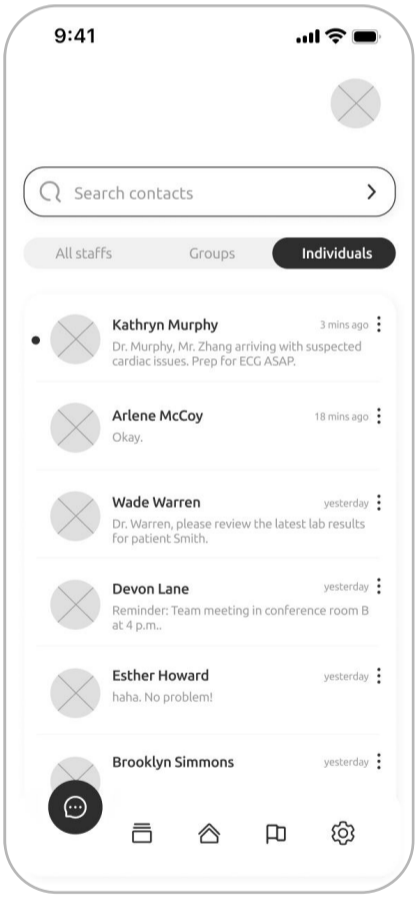
The Contact functionality module provides a comprehensive communications platform that enables healthcare staff to easily find and contact colleagues by category (all staff, groups, individuals).



This screen is the “All Staffs” option of the Contacts function, which provides users with a clear catalog of employees, categorized by department.



This screen is the “Groups” communication section, which displays chats and notifications from various specialty groups within the hospital.

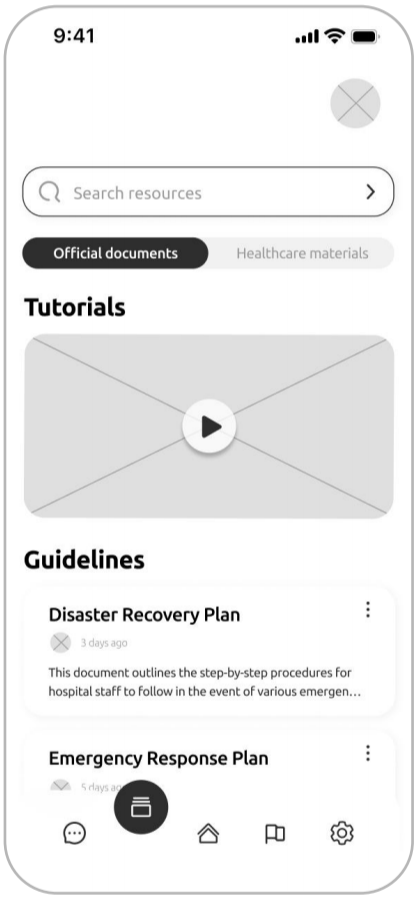


This interface is the ”Individual” communications section, which provides a platform for users to view and manage direct messages with individual individuals.

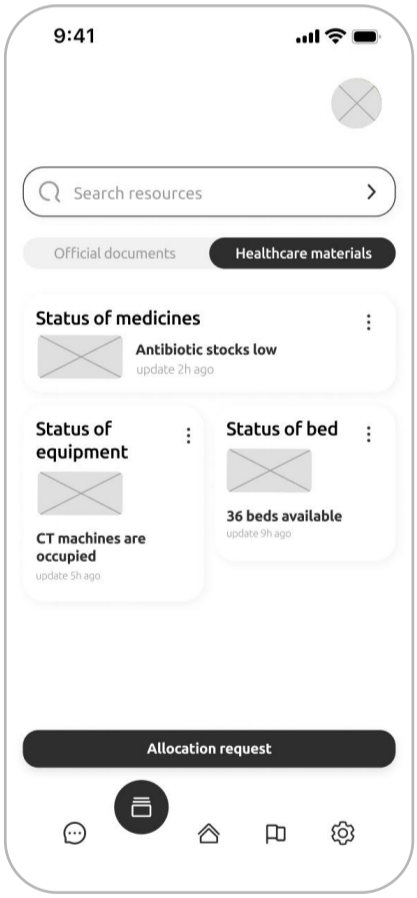
Interface

Resources

The Resource module provides key information for healthcare professionals, including two categories of official documents and medical materials, ensuring quick access to necessary information and references.



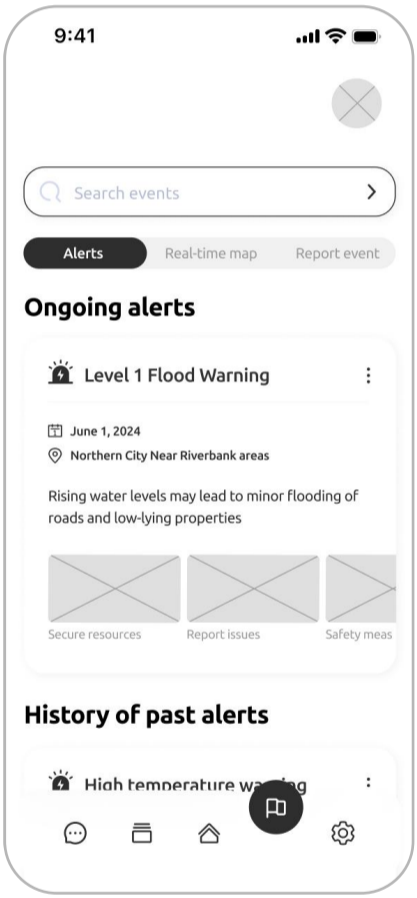
This “Official Documents” interface provides key tutorials and guidance documents for healthcare professionals.



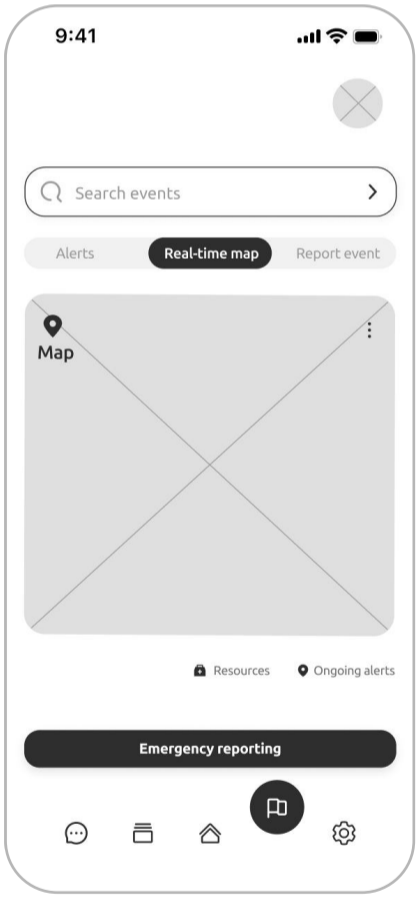
This “Healthcare Materials” interface provides hospital staff with real-time status updates on critical healthcare resources.

Events

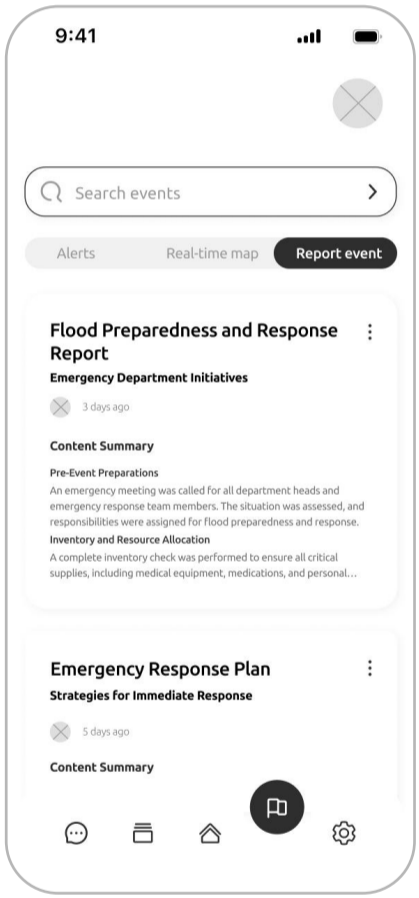
The Events module integrates three key functions - alerts, real-time mapping and reportings - to provide healthcare professionals with the tools to monitor and respond to a wide range of emergencies in real time. Through this module, users can receive instant alerts, view the geographic location of events, and easily report new or ongoing events, as well as view event-related report files.



This screen is the “Alerts” section provides healthcare staff with immediate and ongoing alerts, such as flood or heat warnings, as well as showing a history of past alerts.



Real-time Map page provides the user with a map view of the distribution of the hospital’s resources and the geographic location of the alarm in progress.

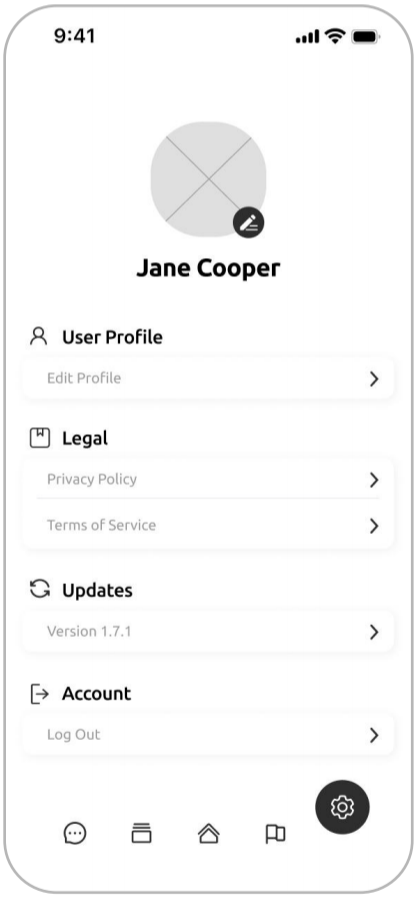


Report event page provides a platform for users view detailed reports on emergency situations such as flood preparedness and response.

Interface

Setting

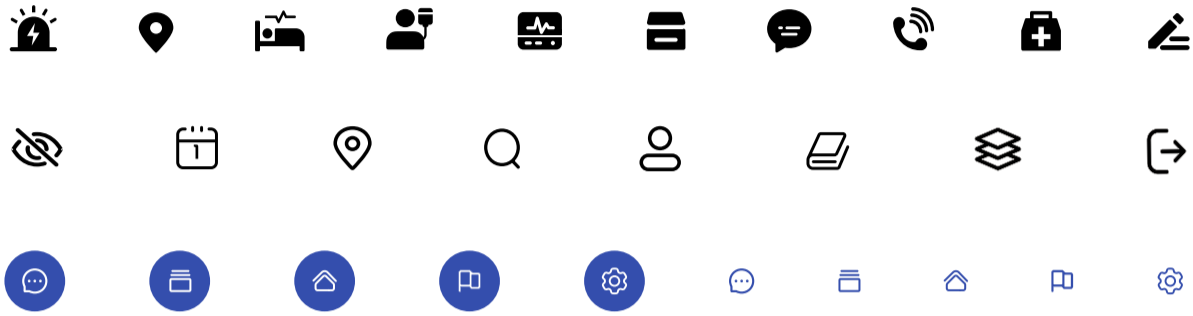
This settings interface provides a clean and intuitive platform for users to easily manage their personal data, view legal information, check for updates and log out of their accounts.



This interface provides users with a clean and simple personal configuration center

Visualization

Icons



Colors

Main colors

#344EAD

#6C9BCF

Texts

#32302D

#9C9C9C

Other colors

#D40202

#F66E27

Texts

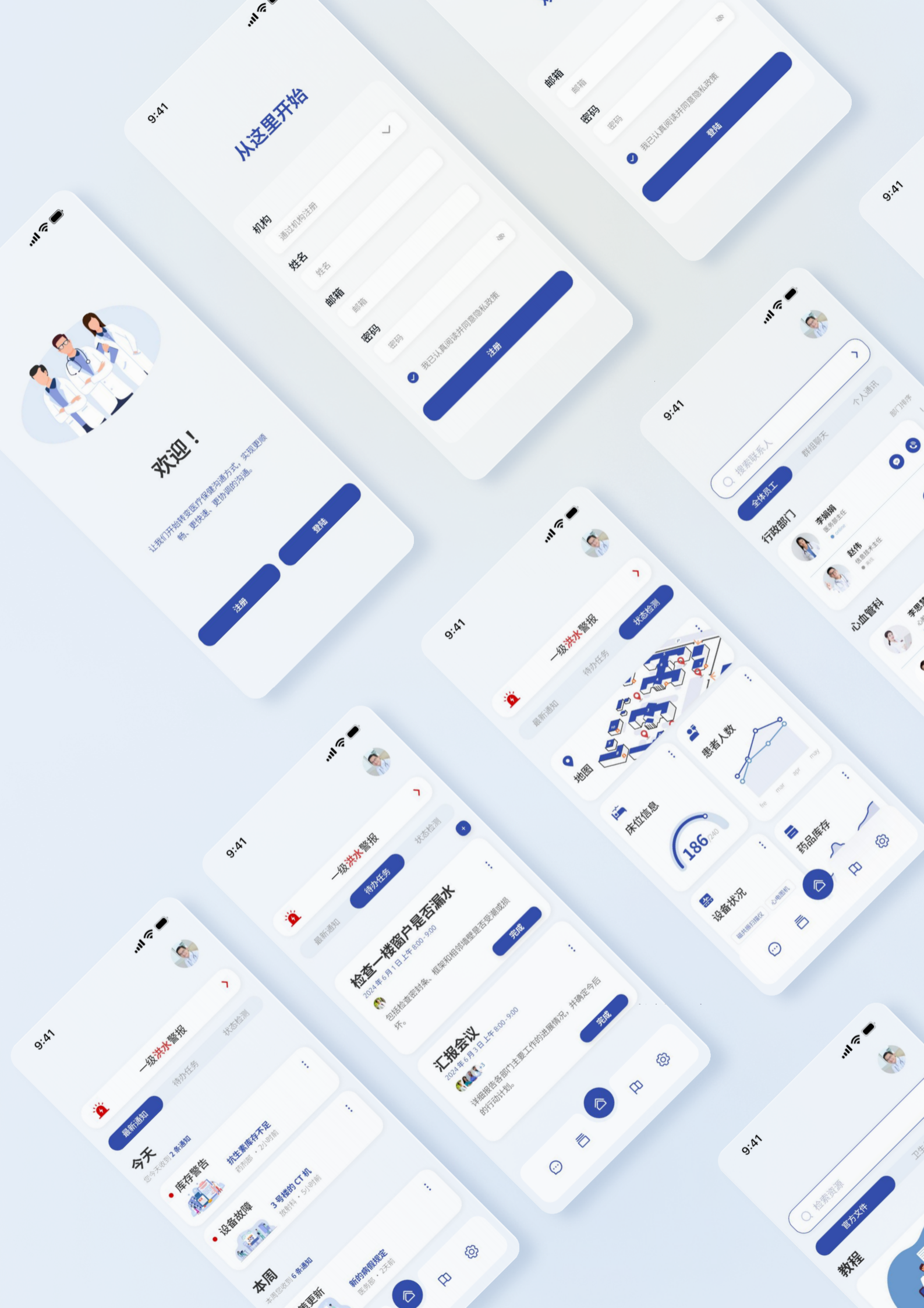
MiSans

24px Semibold

18px Semibold

14px Normal

12px Normal


9:41
从这里开始
机构
通过机构注册
姓名
姓名
邮箱
邮箱
密码
密码
我已认真阅读并同意隐私政策
注册
欢迎！
让我们开始转变医疗保健沟通方式，实现更顺畅、更快速、更协调的沟通。
登陆
注册
邮箱
密码
我已认真阅读并同意隐私政策
登陆
9:41
提索联系人
个人通讯
群组聊天
部门排序
全体员工
行政部门
李娟娟
医务部主任
赵伟
信息技术主任
心血管科
9:41
一级洪水警报
状态检测
待办任务
最新通知
地图
患者人数
床位信息
186/240
药品库存
设备状况
9:41
一级洪水警报
状态检测
待办任务
最新通知
检查一楼窗户是否漏水
2024 年 6 月 1 日 上午 8:00 - 9:00
包括检查密封条、框架和相邻墙壁是否受潮或损坏。
完成
汇报会议
2024 年 6 月 3 日 上午 8:00 - 9:00
详细报告各部门主要工作的进展情况，并确定今后的行动计划。
完成
9:41
一级洪水警报
状态检测
待办任务
最新通知
今天
您今天收到 2 条通知
库存警告
抗生素库存不足
药剂部 · 2小时前
设备故障
3 号楼的 CT 机
放射科 · 5小时前
本周
本周您收到 6 条通知
新的病房规定
医务部 · 2天前
9:41
检索资源
官方文件
教程


搜索联系人
群组聊天
全体员工
个人通讯
应急小组
心血管科
学术会议
张宏强（心脏病专家）
李思慧（心脏科医生）
王明华（心脏科医生）
李娟娟（医务部主任）
赵伟（信息技术主任）
王静怡（心脏功能技师）
9:41
搜索事件
事件报告
实时地图
警报状态
洪水准备和应对报告
应急部门临议
内容摘要
地图
当前警报
一级洪水警报
2024 年 6 月 1 日
北部城市河滩附近地区
水位上升可能导致道路和低洼地带发生轻微水灾，给周围的居民和交通带来不便。
安全指南
问题报告
设备资源安全
历史警报
高温预警
紧急情况汇报
当前警报
资源信息
搜索资源
卫生保健材料
官方文件
药物状况
抗生素库存不足
2小时前更新
床位状况
可提供 36 张床位
设备状况
CT 机被占用
5小时前更新
资源分配要求
程永清医生

By organizing the functional structure to facilitate rapid access to critical information, the platform ensures that healthcare professionals can swiftly react to crisis situations. The hierarchy of information simplify the process of locating essential resources such as emergency contacts, real-time alerts, and healthcare materials, reducing the time healthcare providers spend searching for necessary information, thereby reducing response time which is crucial in emergency management.

Additionally, the platform integrates communication tools and an alert system that enables coordinated communication among different healthcare teams. This ensures timely updates on changing conditions and supports a unified approach to emergency management. These features are crucial for ensuring a cohesive response strategy among healthcare staff and guarantee that all team members are well-informed.

Through these strategic elements, the Emergency Communication Platform can contribute to improving the operational capabilities of healthcare institutions in managing various crises efficiently. By integrating these technological and organizational resources into a single, easy-to-use platform, healthcare facilities can be better prepared to handle emergency situations. In this way, the Emergency Communication Platform can act as a critical tool in improving the resilience and capability of healthcare systems.

Storyboard

This storyboard shows the operational flow of the emergency communication system within a healthcare setting during a flood scenario, illustrating the system's role in coordinating a rapid and efficient response.

Figure 28.
Storyboard of Emergency Communication System

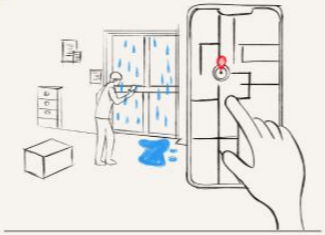
1

When the flood is arriving, healthcare staff received early warning notifications on their phones, understanding the potential risks.

2

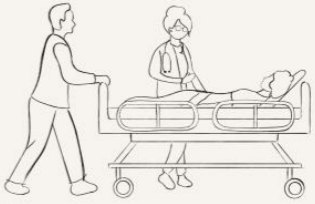
The emergency command center activated the emergency plan and assigned tasks to relevant personnel through the emergency communication system.

3



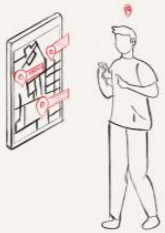
The patrol team discovered places within the premises where leaks were occurring, recorded them by taking photos, and marked them on the real-time map.

The logistics team transported flood prevention materials to the designated locations based on information from the real-time map.



Through electronic health records, healthcare staff transferred patients who were inconvenient to move within the affected area to safe areas.

4

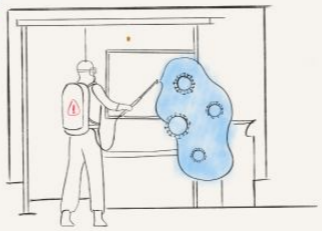


Employees provide feedback on their work progress or any related issues encountered through the platform.

5

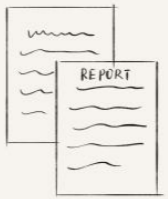
The emergency command center evaluates overall response measures and makes necessary adjustments based on real-time feedback data from various departments.

6



After the flood, a thorough disinfection of the hospital environment is conducted according to regulations.

7



Review the entire response process within the hospital, summarize experiences and lessons to form an official report, and use it as material for future learning.

In this story, as the flood approaches, healthcare staffs receive early warning notifications on their phones, which include details on the upcoming risks, enabling them to prepare and respond promptly. The emergency command center activates the emergency plan and assigns specific tasks to relevant personnel through the system, ensuring a structured and prompt response. Then, under tailored instruction, a patrol team navigates the facility to identify and document areas affected by leaks or flooding, capturing images and marking these locations on a real-time map to manage the crisis effectively.

At the meantime, employees can use the communication system to provide real-time feedback on their tasks and report any issues encountered, facilitating ongoing adjustments and immediate problem-solving. The emergency command center monitors the feedback and evaluates the overall response efficiency. It is supposed to make necessary adjustments based on real-time data from various departments to optimize the response strategy. Then following the flood, there is a thorough disinfection of the hospital environment to prevent any health hazards, ensuring the facility is safe for patients and staff. Finally, after the emergency, the response process is reviewed comprehensively to create a report summarizing experiences and lessons learned during the situation, which can be served as a valuable resource for improving future emergency response strategies.

With this storyboard, we highlight the capabilities of such an emergency communication system in enhancing response coordination, facilitating real-time communication, and ensuring a thorough post-event recovery and learning process.

7.3

HEALTHCARE GUIDANCE AND EDUCATION

Introduction

As we investigate healthcare guidance and education, our focus turns to providing communities with the necessary knowledge and resources to help them understand the complexities of climate change and its impact on public health. This strategy includes a multifaceted approach: by launching a public education platform based on WeChat, residents will have access to structured educational content about health and climate change at any time. The platform serves as a comprehensive resource center offering articles, research papers, and educational videos covering various health and climate topics. In addition, workshops will be organized to provide practical learning experiences and skill-building opportunities in person.

These workshops aim to raise residents' awareness of climate change, enhance personal protection abilities, and teach essential first-aid skills. By incorporating climate-related healthcare guidance into broader public health initiatives and using technology to spread information, we aim to cultivate a more resilient and informed populace that can adapt to the health challenges posed by climate change.

Case Studies

As we move deeper into the implementation of our second strategy centered on healthcare guidance and education, the exploration of relevant case studies becomes necessary. The selection of case studies covers a variety of educational approaches, such as paper-based documents, online platforms, and workshops. By examining the experiences of other organizations in implementing healthcare education programs, we can gain valuable insights into effective pedagogical approaches, engagement strategies, and impact assessment techniques.

Education in Emergencies & Climate Crisis

Keywords:

Young people | Online community | Knowledge sharing

Relevance:

★★★☆☆

An educational toolkit for 10-16-year-olds

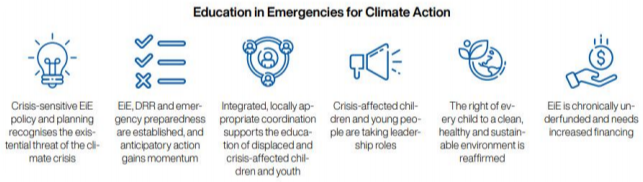
UK

https://www.redcross.org.uk/get-involved/teaching-resources/weather-together-resources

Extreme weather in the UK is happening more frequently. Despite the increasing knowledge of a climate crisis, many of us wouldn't know what to do in the next heatwave or how to prepare when flood warnings are issued. The lack of environmental education around extreme weather in the UK has increased eco-anxiety among young people.

The Red Cross designed this toolkit for learning about weather and climate change impact, to equip learners with the skills and knowledge they need to prepare for and cope with extreme weather. The toolkit includes three topics:

- flood education
- heatwaves
- eco-anxiety



Featured Activities:

Mainstream Disaster Risk Reduction (DRR) and environmental education in school curricula
Include DDR knowledge in curricula and put into action disaster preparedness and mitigation programmes in schools. Curricula should also improve learning and skills on biodiversity, environmental protection, climate change and sustainable development.

Support children and young people's participation in climate policy decision-making processes
Recognizing children and young people as equal stakeholders in addressing the climate emergency, and with education as a platform, climate policy should involve young people in all local, national, regional and international climate negotiations and decisions.

Disaster Education in Japan

Keywords:

Children education | Parent-Child | Training courses | Survival skill

Relevance:

★★★★☆

Japan Children's Network: Preparing for Natural Disasters to Protect Children's Lives

Japan

https://web-japan.org/kidsweb/cool/20/202011_disaster-prevention-education_en.html

Every year, Tsurukawa Second Elementary School in Machida City, Tokyo, the capital of Japan, holds a disaster prevention morning assembly for students to learn how to protect their lives in the event of a disaster. Students deepen their awareness of disaster prevention by learning about evacuation points, what to do in case of a rainstorm, and dangerous locations such as nearby rivers and cliffs.

Featured Activities:

Parent-Child Disaster Prevention Experience
This program is designed to allow you to use familiar items and gain experience while having fun. You can play the "Disaster Prevention Card" game and learn about disaster prevention while having fun.

Hands-on training courses
The "Tokyo Direct Earthquake 72-Hour Tour" simulates an earthquake that strikes Tokyo directly outside the capital. You take a quiz on your tablet and experience a virtual trip to an evacuation center.

Disaster Resilience Early Education Tool Kit

A disaster resilience curriculum planning tool kit for early childhood educators and families

UK

https://www.redcross.org.uk/get-involved/teaching-resources/weather-together-resources

Extreme weather in the UK is happening more frequently. Despite the increasing knowledge of a climate crisis, many of us wouldn't know what to do in the next heatwave or how to prepare when flood warnings are issued. The lack of environmental education around extreme weather in the UK has increased eco-anxiety among young people.

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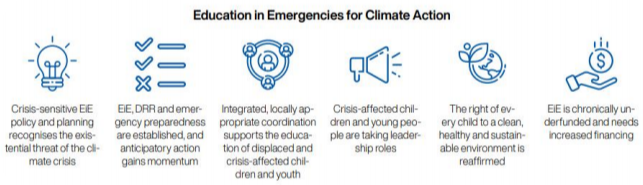

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Support children and young people's participation in climate policy decision-making processes
Recognizing children and young people as equal stakeholders in addressing the climate emergency, and with education as a platform, climate policy should involve young people in all local, national, regional and international climate negotiations and decisions.

Keywords:

Young people | Online community | Knowledge sharing

Relevance:

★★★☆☆

Disaster Education in Japan

Keywords:

Kids education | Mental healthcare | Play-based | Skills for resilience

Relevance:

★★★★☆

Japan Children's Network: Preparing for Natural Disasters to Protect Children's Lives

Australia

https://www.abc.net.au/abckids/early-education/helping-hands-disaster-resilience-tool-kit/responsive-early-education-after-a-disaster-or-emergency-/103168504

Follow-up teaching and learning to expand children's understandings about floods and other hazard risks through play-based experiences, can help them develop skills such as being prepared and staying safe during an emergency.2 When planning an inquiry or project about natural hazards, educators can focus on these 'big ideas' for conceptual understandings:

1.How can I stay safe from hazards and disasters?

2.How can I help protect my home/school/community from hazards and disasters?

3.Who are the 'Everyday Helpers' who keep us safe?

4.How can I help to reduce the risk of a disaster in my community?

Featured Activities:

'Re-enactment soothing play'
Responsive early childhood education is paramount during both the response and recovery phases in the wake of a disaster.
Also focus on children's mental healthcare
Educators can help children feel safe, secure and supported by providing opportunities to build their knowledge about weather patterns, hazard impacts on the surrounding natural environment, and disaster risk.

Policy Support

Policies on public health education and disaster preparedness provide the foundation for our education strategy. By aligning with these policies, we ensure that our initiatives can be integrated into broader national strategies to promote public health and resilience to climate-related risks. Understanding different regional and local strategies and government support is critical for setting education programs to the specific needs and contexts of different communities.

This includes policies that support community-based education programs, fostering partnerships between communities and health care providers, and providing necessary resources for education.

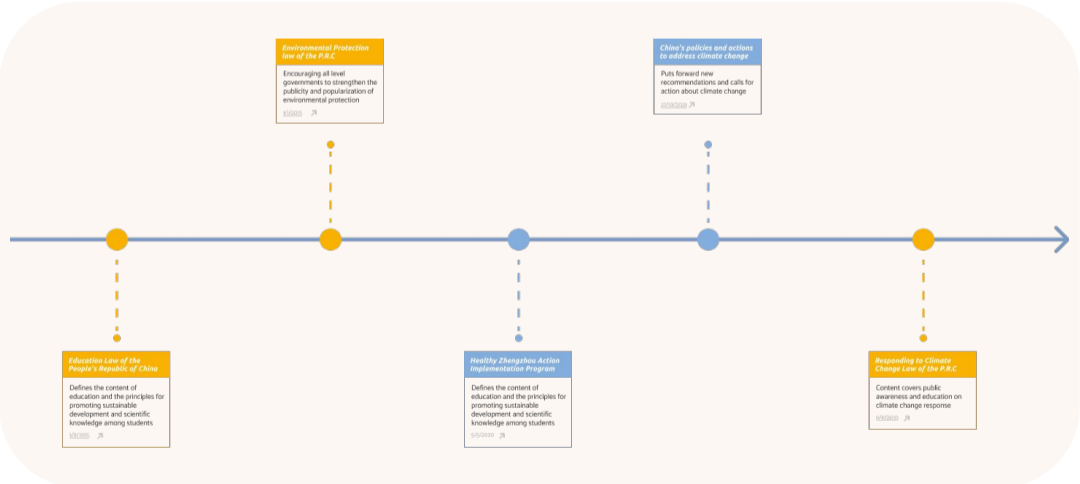


Figure 29.
Legal Framework of Healthcare Guidance and Education

Implementation Process

The diagram presents a strategic framework for providing healthcare guidance and education to residents on managing health risks associated with climate change. It outlines a multi-step process designed to develop and implement educational initiatives that inform and equip communities to effectively respond to environmental challenges. The process is adaptive, allowing for continuous evaluation, feedback, and scaling to ensure that the approach is effective, responsive, and capable of evolving with changing health and environmental conditions.

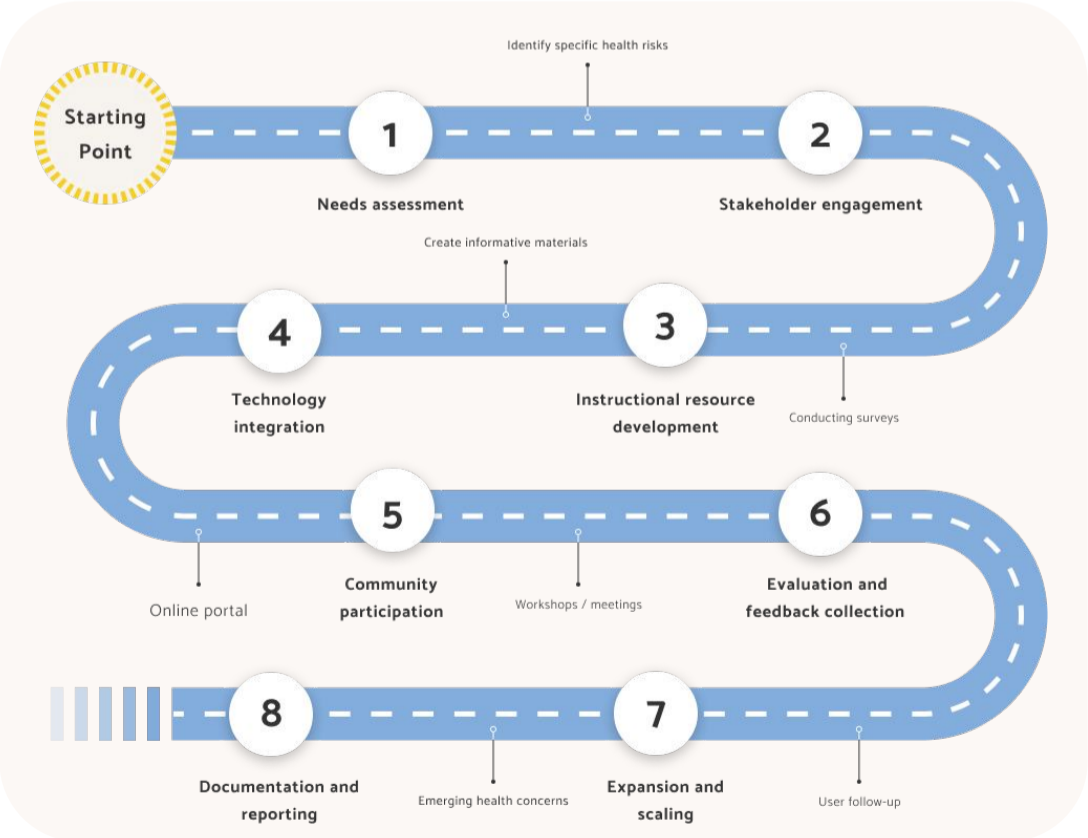


Figure 30. Implementation Process of Healthcare Guidance and Education

1

Needs Assessment

This initial phase involves a thorough assessment of community-specific health risks related to climate change. The approach is data-driven, utilizing both existing health data and targeted surveys to identify and prioritize local health risks, ensuring that the subsequent educational materials are tailored and relevant.

2

Stakeholder Engagement

Key stakeholders, including local health officials, community leaders, and resident representatives, are engaged early in the process. This phase aims to foster collaborative relationships and ensure that all perspectives and needs of diverse community members are carefully considered in the educational strategy.

3

Instructional Resource Development

Based on the insights gathered from the needs assessment and input from stakeholders, targeted instructional resources can be created which are important to educate the community about identified health risks and appropriate preventive and adaptive strategies.

4

Technology Integration

This phase integrates appropriate technologies to enhance information dissemination and engagement. An online portal may be established, providing accessible, up-to-date information and resources. Mobile applications and social media strategies might also be employed to reach a broader audience.

5

Community Participation

To encourage community participation, workshops, informational sessions, and public meetings are organized which are crucial for educating residents, gathering further input, and adapting resources based on direct community feedback.

6

Evaluation and Feedback Collection

Following the implementation of educational activities, this phase evaluates the effectiveness of the information dissemination and educational activities. Collecting feedback from participants and stakeholders is also necessary to assess impact and identify areas for further improvement.

7

Expansion and Scaling

Successful strategies and programs can then be scaled up to reach a wider audience. This phase involves additional resource allocation, the demand for more technological tools, and possibly extending the program to neighboring regions or populations with similar needs.

8

Documentation and Reporting

Continuous documentation and reporting are critical for tracking progress, outcomes, and emerging health concerns that may require attention. This documentation supports ongoing program refinement and can serve as a valuable historical resource for future public health initiatives.

This structured approach not only provides a blueprint for addressing immediate health risks related to climate change but also contributes to the resilience and long-term health security of the community while emphasizing the importance of education, community involvement, and the flexible integration of technology in public health strategy.

Storyboard

This storyboard presents the approach to healthcare guidance and education, utilizing both digital and traditional methods to enhance user engagement and knowledge.

Figure 31.
Storyboard of Healthcare Guidance and Education

The process begins with users receiving paper surveys that include simple questions to attract their attention. These surveys also contain a QR code linking to the educational platform. After completing the survey, users can scan the QR code which directs them to a digital dashboard. This dashboard is customized with content tailored to the users' indicated interests, ensuring that the information provided is relevant and engaging. Users are then guided to a calendar within the platform, where they can find information about upcoming offline lectures and events.

This feature allows users to plan their participation in educational activities that further strengthen their understanding of healthcare topics. The final step involves offline lectures where participants can communicate directly with healthcare experts. These activities are designed to deepen the users' knowledge through face-to-face discussions and provide the opportunity for addressing individual questions and concerns.

7.4

HEALTHCARE INFORMATION SHARING

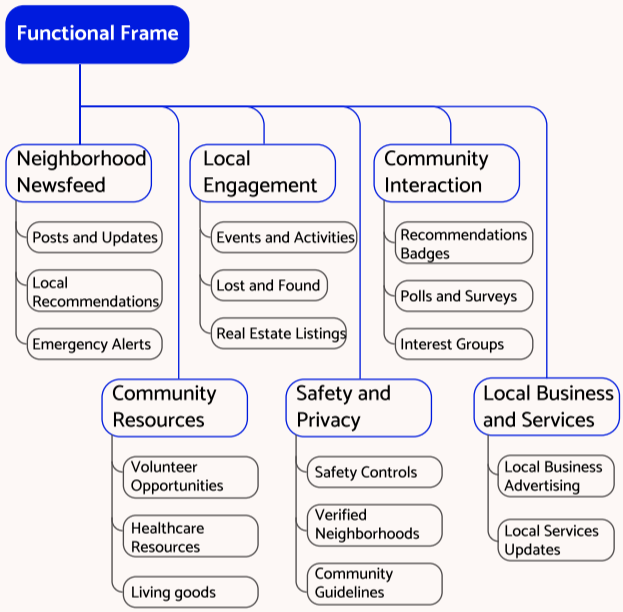
Introduction

When we focus on enhancing community resilience in the face of climate-related challenges, the sharing of healthcare information becomes an important aspect of our strategic vision. At the heart of this initiative lies a community-driven effort to establish a platform for residents to exchange important healthcare information, particularly in times of emergencies. Through this platform, residents can have access to critical resources and information, guidance on health management during a crisis, and opportunities to obtain support within the community. This approach aims to create effective channels of communication so that residents can be guided by healthcare professionals to increase resilience and ensure the health and safety of individuals during difficult times.

Case Studies

Case studies related to this strategy demonstrate the importance of interoperable systems, data security protocols, and stakeholder engagement strategies in facilitating seamless information sharing. In addition, they emphasize the role of technology, regulatory frameworks, and partnerships in facilitating effective information sharing. Through a comprehensive analysis of these case studies, we aim to discover key lessons, identify best practices, and inform the development of healthcare information sharing strategies.

Nextdoor



Keywords:

Community Engagement | Safety Alerts | Neighborly Communication | Volunteer Opportunities

Relevance:

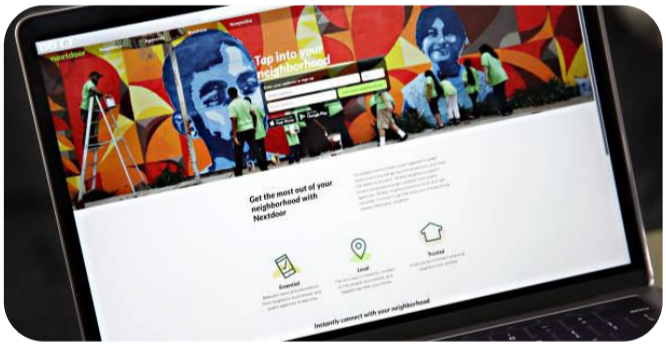
★ ★ ★ ★ ★

We believe in the possibilities nearby

Massachusetts, the U.S.
https://about.nextdoor.com/

Launched in 2011, Nextdoor serves as a private online space for neighbors to communicate, share information, and build a sense of community. The platform's primary focus is on facilitating local interactions, allowing users to discuss various topics such as local events, recommendations, safety concerns, and community news. Each Nextdoor community is defined by a geographic area, ensuring that the platform remains hyper-local and relevant to the residents within that particular neighborhood.

Nextdoor has gained popularity as a tool for fostering community engagement, supporting neighborly communication, and enhancing the overall sense of belonging in local neighborhoods.



Features:

Neighborhood Newsfeed:
The core feature of Nextdoor is a neighborhood-specific newsfeed where residents can post updates, share information, and discuss various topics relevant to their local community.

Safety and Alerts:
Nextdoor provides a platform for residents to share safety tips, report suspicious activities, and receive or distribute alerts within their neighborhood. This helps enhance local safety and security especially during emergencies.

Local Government and Services Updates:
Nextdoor partners with local government agencies and services to provide residents with official updates, announcements, and information related to local governance, public services, and community initiatives.

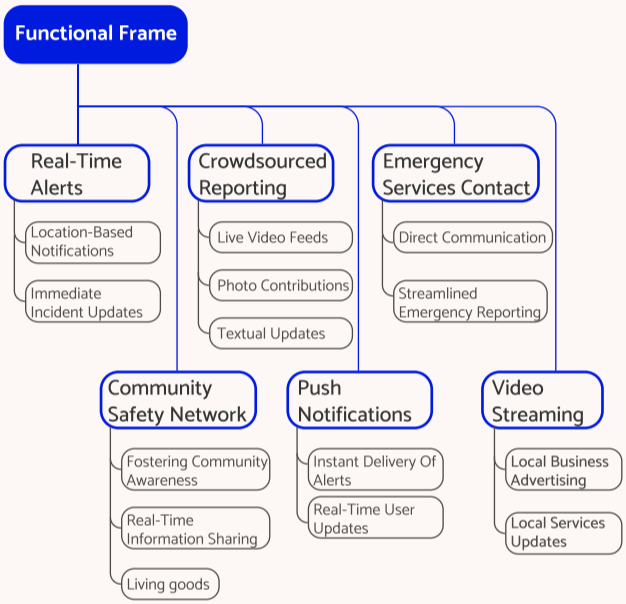
Citizen

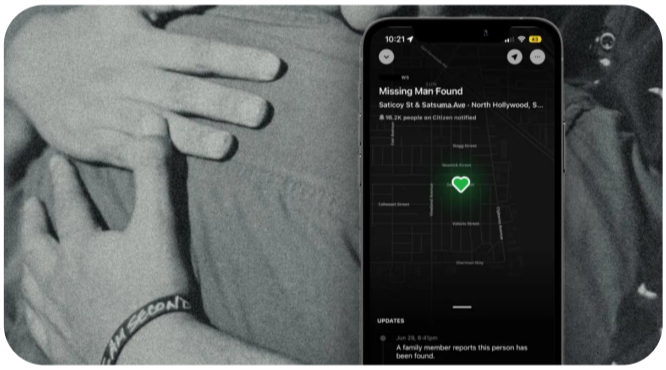
Where people protect each other.

the U.S
https://citizen.com/

The platform aims to enhance community awareness and safety by delivering location-based alerts and updates on emergencies, crimes, and other incidents reported by both users and local authorities.

Citizen employs a crowdsourced approach, allowing users to share live video feeds, photos, and textual updates about what is happening around them. The app utilizes geolocation and real-time data to notify users of potential risks or incidents in their immediate area, empowering them to make informed decisions about their safety.





Features:

Real-Time Incident Alerts:
Citizen provides users with real-time alerts about incidents, emergencies, and crimes occurring in their immediate vicinity. These alerts are location-based and aim to keep users informed about their safety.

Emergency Services Contact:
Citizen may include a feature that allows users to contact emergency services directly through the app, streamlining the process of reporting emergencies or requesting assistance.

Crowdsourced Reporting:
The platform allows users to contribute to incident reporting by sharing live video feeds, photos, and textual updates. This crowdsourced information enhances the real-time awareness of incidents within a community.

Keywords:

Healthcare Networking
Collaboration
Resource Manegement

Relevance:

★★★★☆

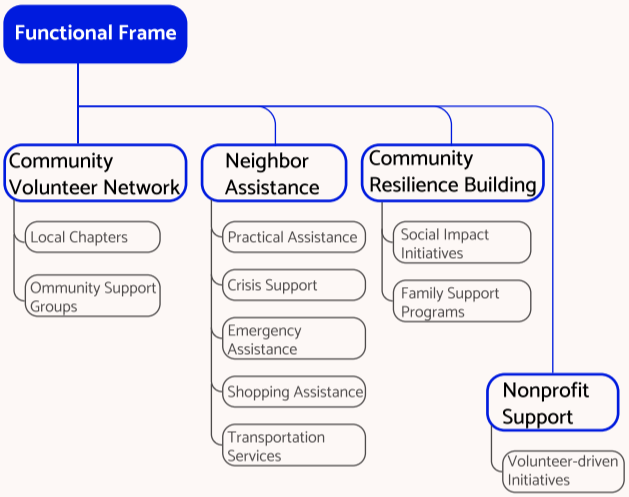
Neighbor Brigade

Help is next door.

Massachusetts, the U.S.
https://www.neighborbrigade.org/

Neighbor Brigade is a nonprofit organization that operates as a community-based volunteer network, aiming to provide assistance and support to individuals and families facing crises or challenging situations which operates on the principle of neighbors helping neighbors, fostering a strong sense of community and solidarity.

The organization emphasizes the power of small acts of kindness and community connections in creating a supportive and resilient environment.



Features:

Volunteer Coordination:
Neighbor Brigade efficiently coordinates a network of local volunteers who are willing to offer their time and assistance to neighbors in need. This coordination involves organizing tasks, schedules, and responses to specific situations.

Crisis Response:
The organization excels in providing swift responses to crises, whether they are sudden emergencies, illnesses, or life-altering events. Neighbor Brigade mobilizes its volunteer network quickly to address the immediate needs of individuals or families facing challenges.

Transportation Support:
Neighbor Brigade offers transportation services, helping individuals get to medical appointments or other essential engagements when they may be unable to drive themselves.

Keywords:

Neighbor Assistance | Crisis Support | Community Care | Emergency Response | Social Welfare

Relevance:

★★★★☆

WeChat

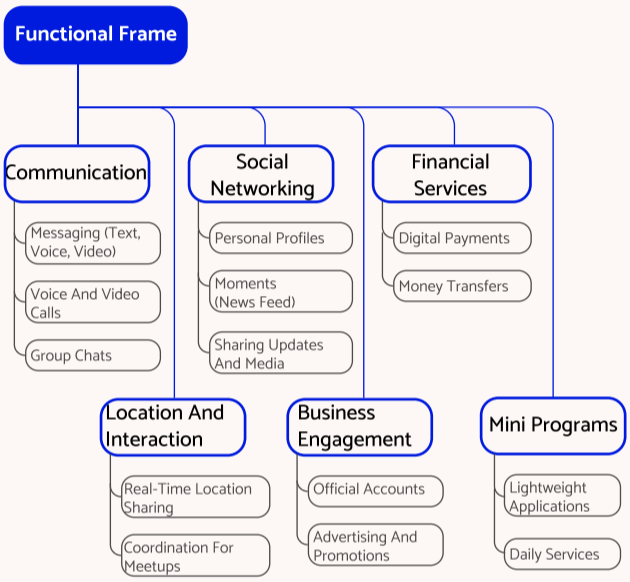
Connecting a billion people with calls, chats and more.

China
https://www.wechat.com/en/

WeChat, developed by Tencent, is a comprehensive and versatile messaging and social media platform that has evolved into an integral part of daily life for millions of users worldwide.

It seamlessly integrates messaging, social networking, and financial services into a single application. Users can communicate through text, voice, and video, share updates and media on personal profiles, and engage with businesses and celebrities through official accounts.

Its diverse capabilities have positioned WeChat as a central tool for both personal and professional interactions, defining the way people connect, share, and engage in the digital era.



Keywords:

Official Partners | Group Chats | Location-Based Services | In-app Services | Digital Payments

Relevance:

★★★★☆

Features:

Messaging and Calls:
Users can send text, voice, and video messages, as well as make voice and video calls to individuals or groups.

Mini Programs:
Lightweight applications that run within the WeChat app, offering diverse functionalities such as healthcare consultation and scheduling, utility services, gaming and more.

Group Chats:
Users can create and participate in group chats for communication, file sharing, and event organization.

Official Accounts:
Businesses, organizations, and celebrities can create official accounts to connect with users, offering a channel for updates, education, and citizen engagement.

Policy Support

The successful implementation of this strategy relies on strong policy support at various levels of the government to ensure the effectiveness and sustainability of our healthcare information sharing platform, particularly concerning the security of residents' healthcare information.

To support resource and information exchange within the community, policies should not only encourage the establishment of secure communication channels but also require strict compliance to data security protocols. Robust policy support for data security is essential to build trust among residents and ensure their confidence in sharing healthcare information on the platform. By prioritizing data protection and privacy regulations, policymakers can contribute to the successful implementation of our project's objectives, fostering a secure and reliable information sharing environment for residents during emergencies.

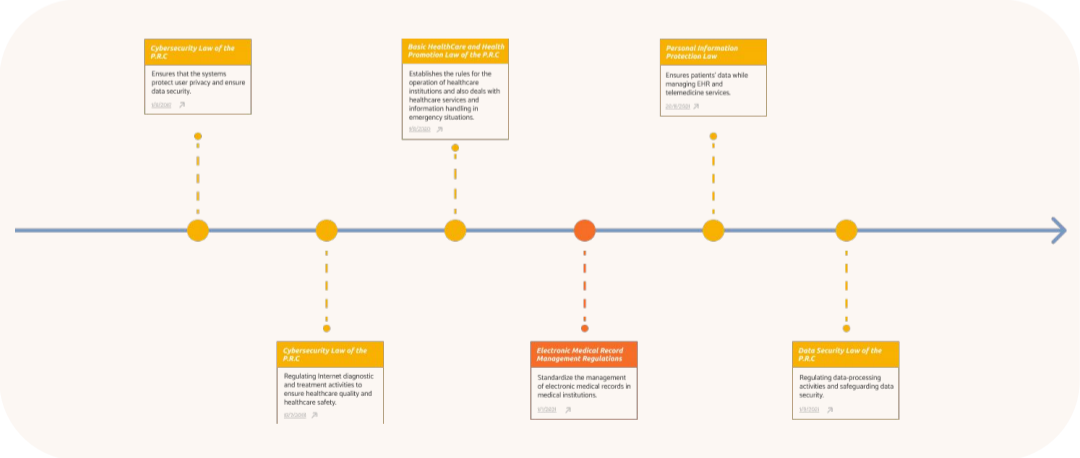


Figure 32.
Legal Framework of Healthcare Information Sharing

Implementation Process

The diagram offers a detailed framework for the community-led initiative designed to create a robust platform for sharing healthcare information, both in emergency situations and during daily periods. This approach aims to facilitate efficient communication and resource distribution across various stages, under expert supervision.

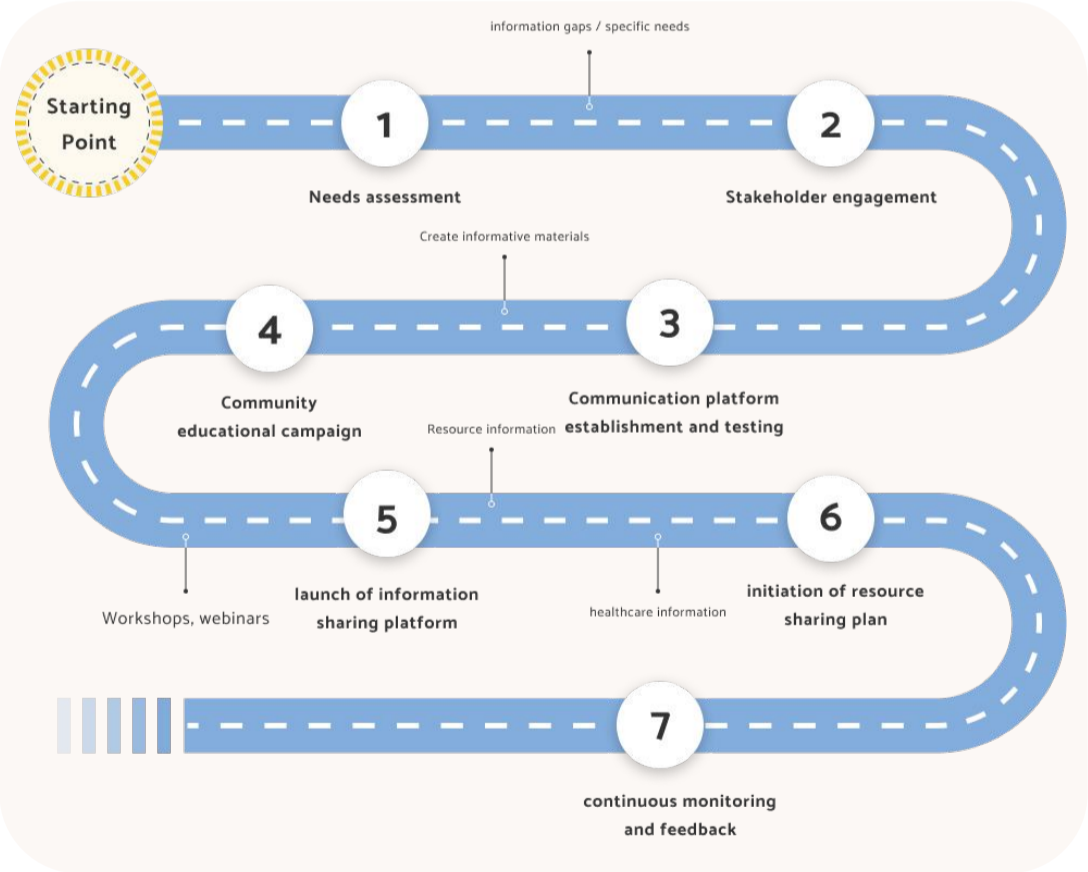


Figure 33. Implementation Process of Information-Sharing Platform

1

Needs Assessment

This process starts with the identification of healthcare information requirements and existing information gaps within the community. It includes an analysis of potential emergency scenarios and the associated informational needs that emerge during these events.

2

Stakeholder Engagement

This phase involves engaging various stakeholders, including healthcare providers, local authorities, and community leaders, to gain insights and support for the initiative which are crucial for gathering diverse perspectives and ensuring the effectiveness of the communication strategy.

3

Communication Platform Establishment and Testing

In this phase, the communication platforms are going to be established and tested. These platforms are intended to facilitate the efficient sharing of healthcare information and resources among community members.

4

Community Educational Campaign

The main objective of this phase is to enhance awareness among individuals regarding the importance of healthcare information sharing, particularly in the context of public emergencies aiming to provide them with our healthcare information sharing platform, guiding them in the fundamental usage and the regulations that must be followed. The campaign involves workshops, webinars, and other educational tools to enhance community knowledge and preparedness.

5

Launch of Information Sharing Platform

Following the educational activities, this phase involves the initiation of the healthcare information sharing platform which functions as the central hub for efficiently accessing and disseminating critical healthcare information and resources.

6

Initiation of Resource Sharing Plan

Along with the launch of the information sharing platform,

this phase initiates a structured plan for sharing basic healthcare resources, such as medications and healthcare consumables, ensuring that these are distributed safely and efficiently.

7

Continuous Monitoring and Feedback
The final phase involves continuous monitoring of the platform and the overall information sharing process. Feedback can be collected and used to refine and improve the system, ensuring it remains responsive to the community's needs.

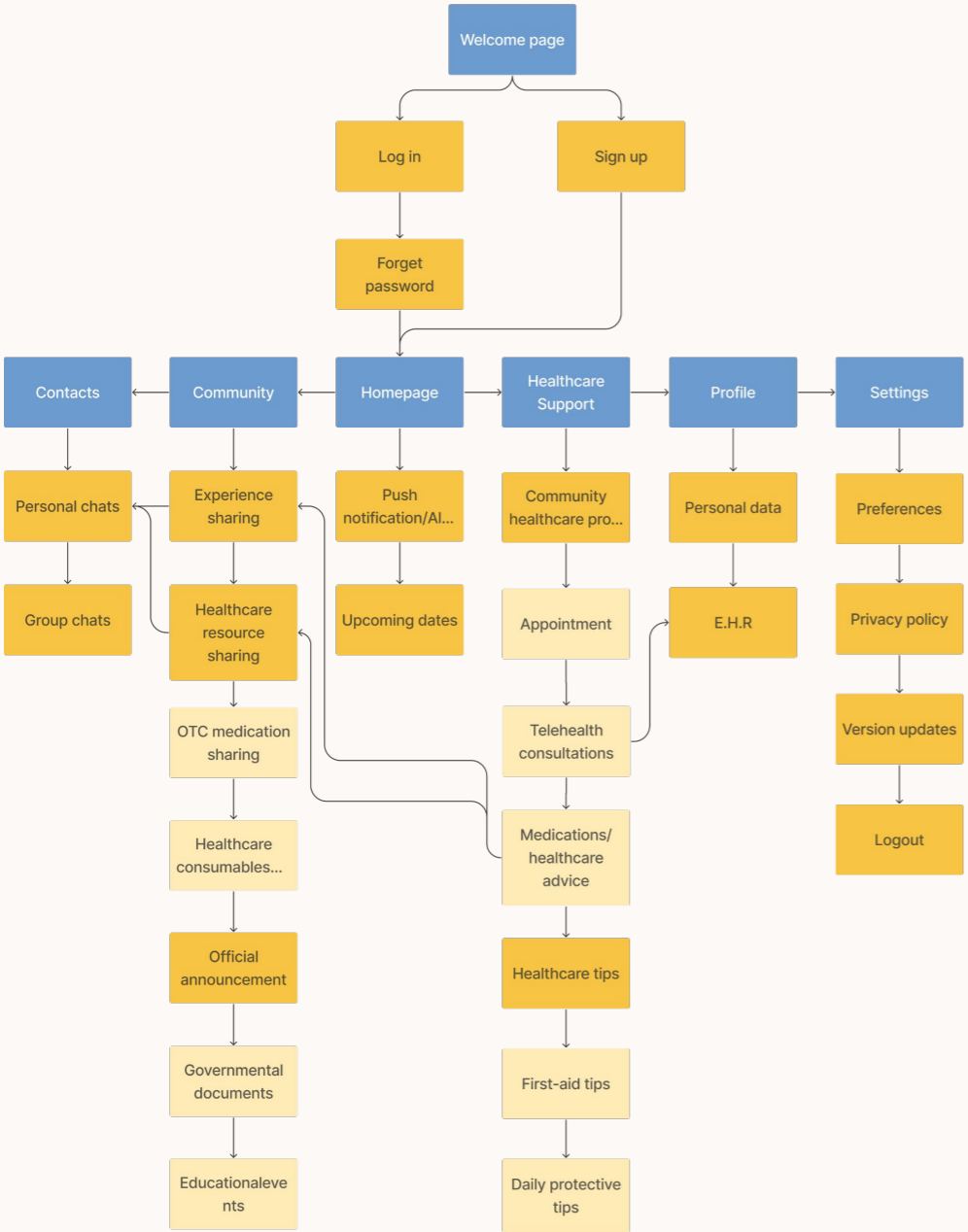
This approach not only facilitates timely access to critical healthcare information during emergencies but also enhances overall community resilience and collective responsibility in healthcare management.

Sitemap

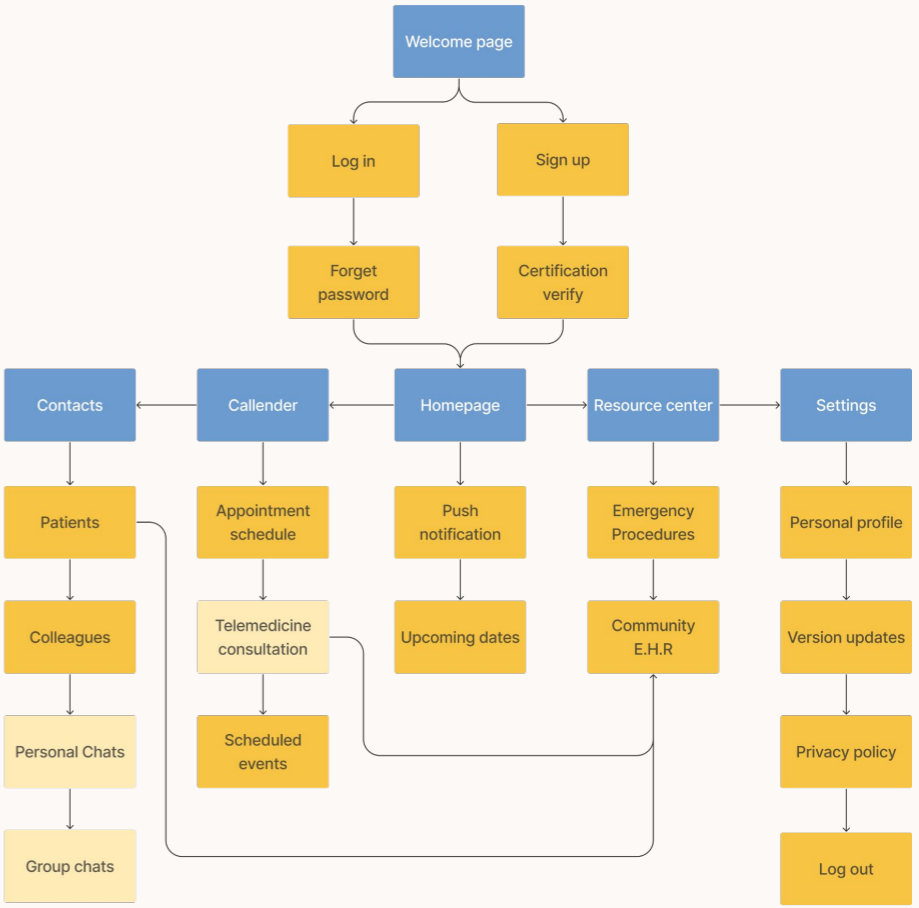
This sitemap provides a visual representation of the structure and navigational schema for the Healthcare Information Sharing Platform, specifically designed for two distinct user groups: residents and community healthcare professionals. It organizes the platform's features into a hierarchical layout that facilitates user understanding of the site's architecture and potential navigation paths.

Map 13.
Sitemap of Healthcare Information-Sharing Platform

(For residents)



(For community healthcare professionals)



For residents, the platform offers features for community interaction, healthcare resource sharing, and personal healthcare information management. It includes tools for users to connect with each other through chats, manage healthcare appointments, engage in telehealth services, and access health education materials. These features empower residents to exchange experiences, make informed decisions, and manage their health information effectively within the platform.

For healthcare professionals, the platform includes scheduling tools, resource management capabilities for accessing important documents and community EHRs, and robust communication options through personal and group chats and telemedicine consultations. These features streamline coordination and improve operational efficiency, supporting effective management within the healthcare community.

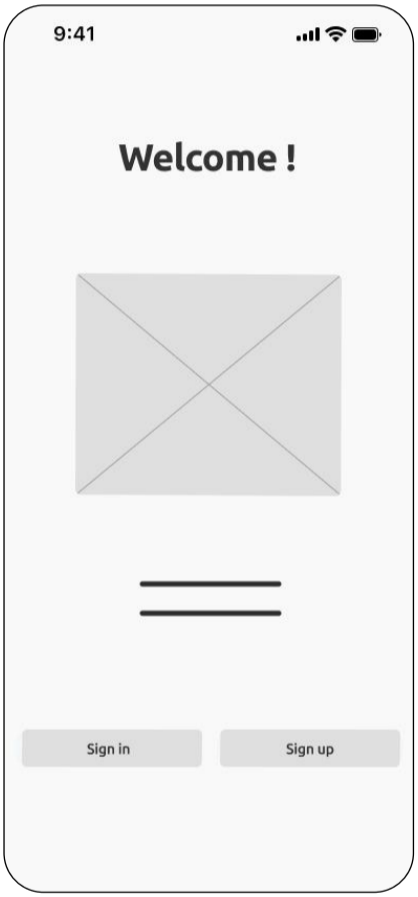
The dual-interface approach emphasizes functionalities to support a seamless and integrated mode to community-based healthcare, facilitating better coordination, management, and access to information.
This platform ensures that both residents and professionals have easy access to critical healthcare information when they need it.

Wireframe 1

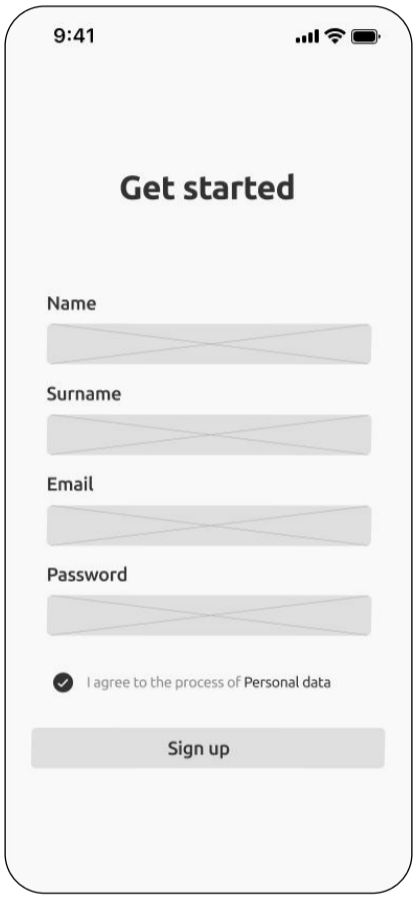
Since our healthcare information sharing platform primarily targets two different user groups, including residents and healthcare professionals, we have designed two different architectural versions to meet the specific needs of these groups when using the platform. This section introduces the version designed for the public, thus the **“ public version ”**.

Welcome Page

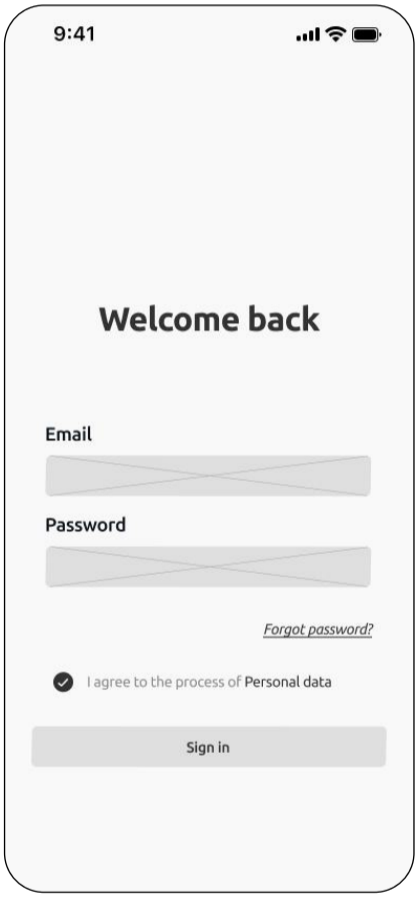
These pages display three screens designed for user authentication and account management, enhancing user experience with clear, easy-to-navigate interfaces.



The first screen, the Welcome Screen, serves as the entry point where users can opt to either sign in or sign up, featuring a simple design with two buttons.



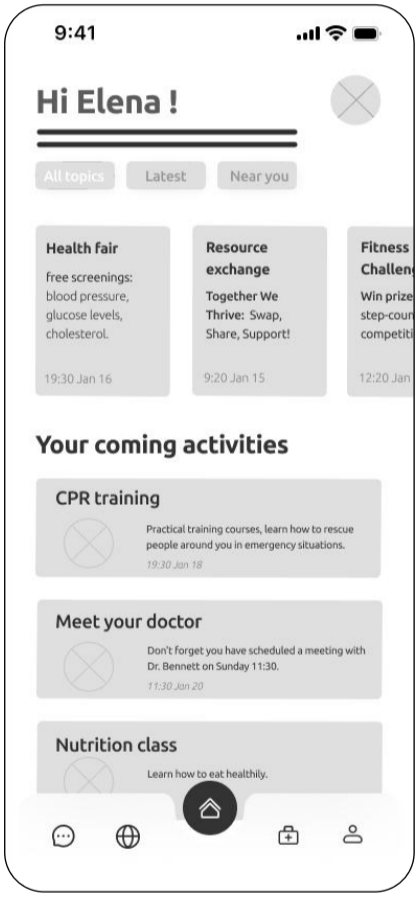
The Sign Up Screen caters to new users, allowing them to create an account by inputting their name, surname, email, and password, and includes a checkbox for agreeing to the processing of personal data to comply with data protection regulations.



Lastly, the Welcome Back Screen is tailored for returning users to log in with their email and password, and a password recovery option promoting a quick and hassle-free login process.

Home Page

This interface displays the homepage of the application, where users are directly led after completing the login process.



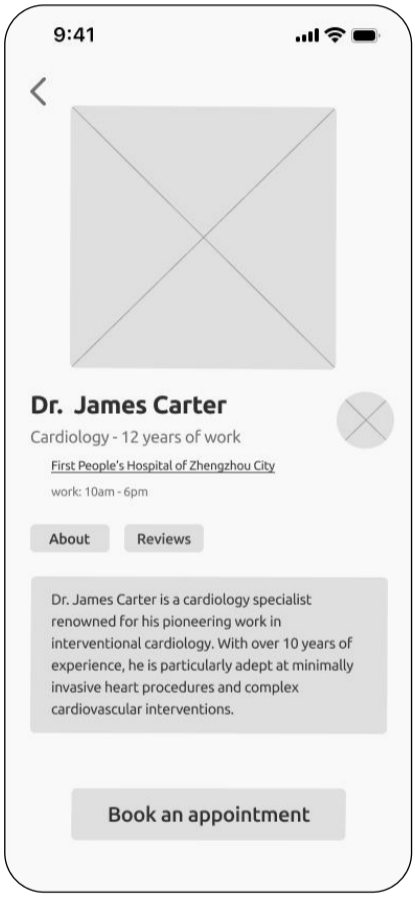
The upper part of the interface displays some activities currently underway in the community, as well as newly released news within the community. Users can filter the messages they are interested in by publication time and location.

The lower part shows the "Upcoming activities" that users have booked or agreed to participate in, arranged in chronological order, making it convenient for users to manage and attend on time.

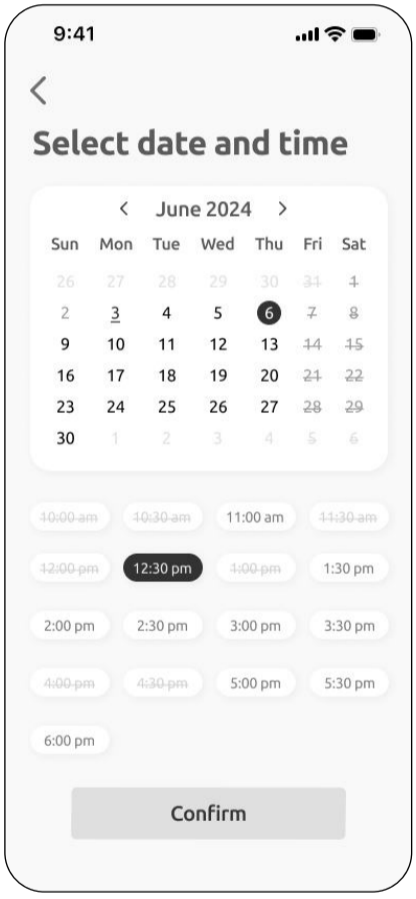
Healthcare Resources Page

This section integrates various types of health resources, including general healthcare knowledge and first aid information, among others. It also allows users to seek professional help from doctors through this platform.

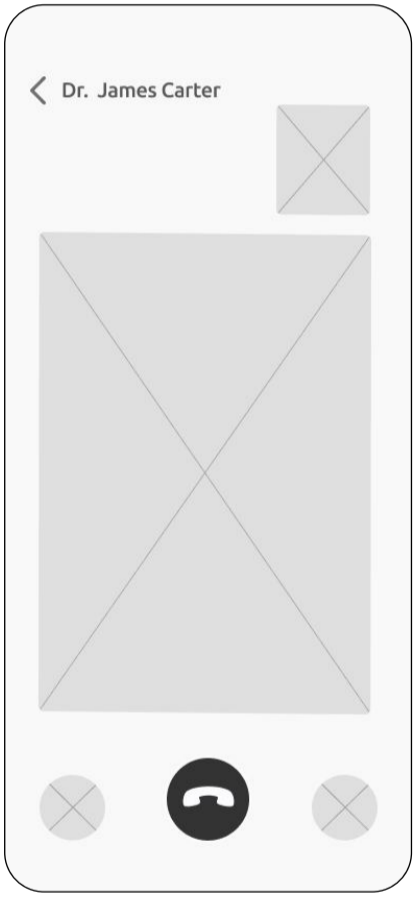
The first screen offers a menu of health categories such as Digestion, Sleep, Sports, Vaccination, Nutrition, and Teeth, enabling users to easily access information or services related to these topics. It also includes a section for users who might need professional help, listing different doctors available for consultation.



The second screen provides a detailed profile of a specific healthcare professional. It includes his work hours, a brief biography highlighting his expertise, and an option for users to book an online appointment directly.



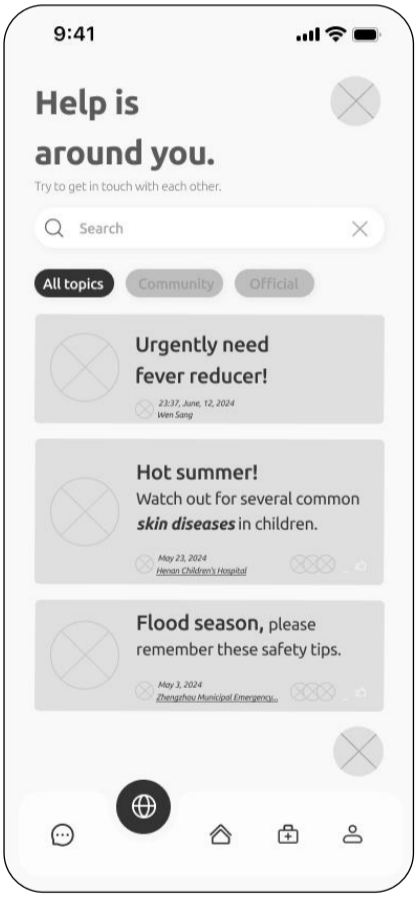
The third screen is dedicated to scheduling, allowing users to select a date and time for an appointment.



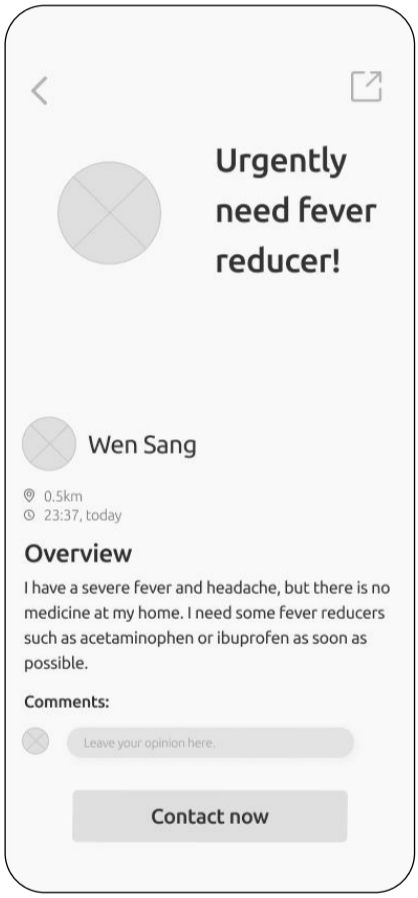
The last interface displays a virtual consultation room, allowing users to communicate face-to-face with healthcare experts directly, enhancing the accessibility of healthcare consultations, especially when they are not available in physical settings.

Community

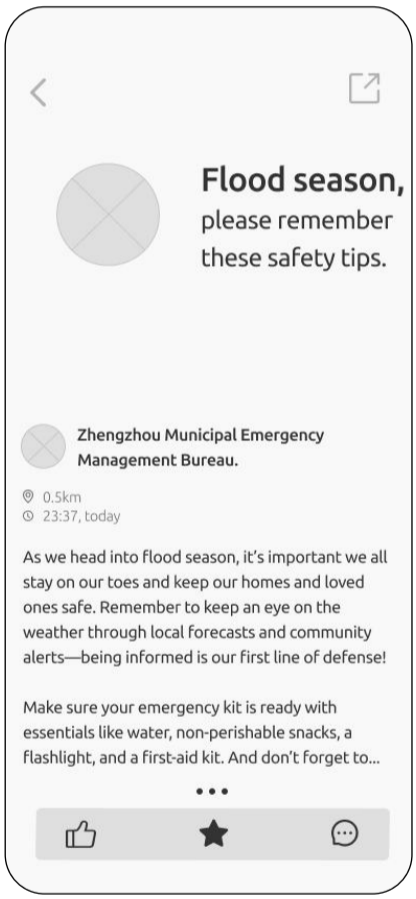
In the community section, users have the ability to browse through a variety of messages published by both other community members and official organizations. This feature enables users to stay informed about local events, emergency alerts, and helpful tips. Additionally, users can actively participate by posting their own content, whether they're seeking assistance, sharing resources, or providing updates, thus fostering a dynamic and interactive community environment.



The first screen, titled "Help is around you," serves as a hub where users can find and offer help within the community. It features posts from users like "Urgently need fever reducer!" and important alerts such as "Flood season, please remember these safety tips," categorized under tabs like 'All topics', 'Community', and 'Official'.



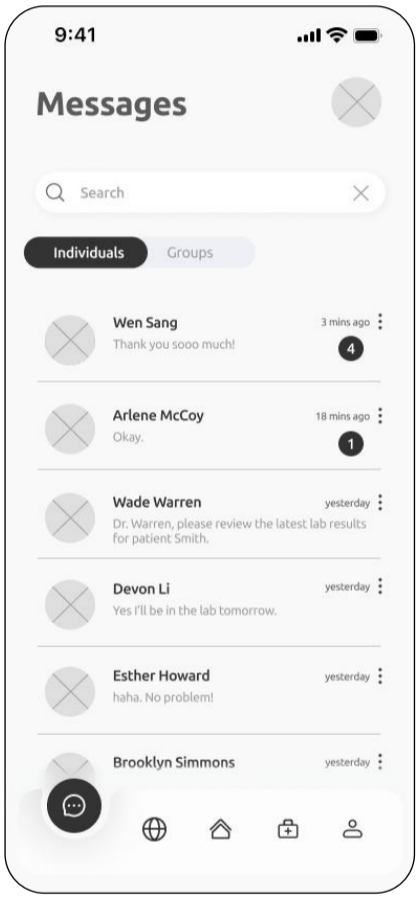
The second screen provides a detailed view of a specific request by a user, who urgently needs fever reducers. This page includes the user's proximity, time of the request, and a detailed description of their need, along with a "Contact now" button to facilitate immediate communication.



The third screen displays an official message from the Zhengzhou Municipal Emergency Management Bureau, offering safety tips for the flood season. This includes general advice on staying informed and prepared, underlining the app's role in disseminating crucial information to ensure community safety.

Messages

This section is designed to facilitate communication between users within the app's ecosystem.

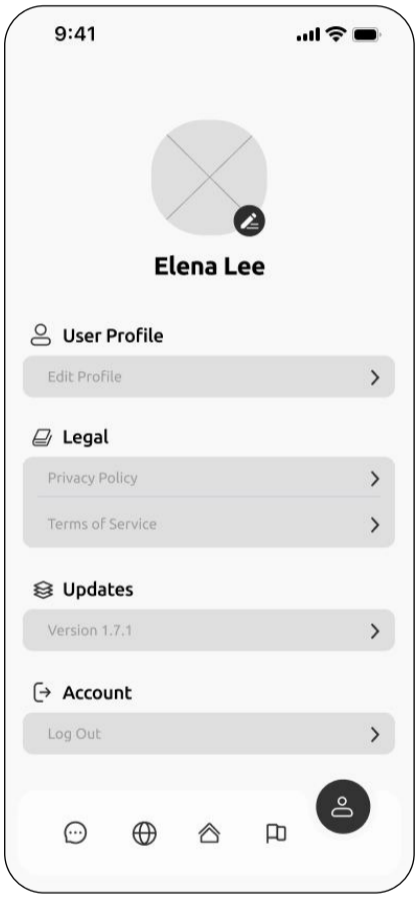


This screen features a clean and intuitive interface, with a search bar at the top for quickly locating specific conversations or contacts. Below this, the interface is divided into two tabs: "Individuals" and "Groups," allowing users to easily navigate between personal messages and group discussions.

This layout helps users manage their communications efficiently, ensuring they can keep track of multiple conversations and respond promptly.

Settings Page

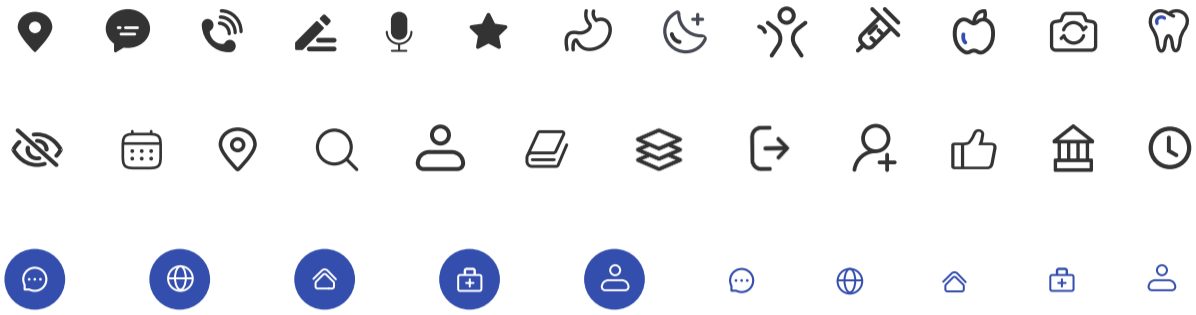
This user profile screen emphasizes ease of use, security, and accessibility, allowing users to maintain control over their personal information and app settings with minimal effort.



The screen is designed for efficient management of personal and account settings. This structure ensures that users can easily navigate through their settings, update personal information, manage legal agreements, check for new updates, and securely manage their account access, all from one convenient location.

Visualization

Icons



Colors

Main colors

#344EAD
#B4C0E0
#4DE29A
#FCCCE0

Texts

#32302D
#9C9C9C

Other colors

#EA484A
#99ACF2
#F9B202

Texts

MiSans

24px Semibold

18px Semibold

14px Normal

12px Normal

9:41
欢迎！
将健康掌握在您手中!
公众版
注册
登录
从这里开始
名字
请输入
姓氏
电子邮件
密码
我已认真阅读并同意隐私政策
欢迎回来
忘记密码?
你在寻找什么?
搜索
全部
活动
睡眠
牙齿
消化
营养
疫苗
需要帮助？
张医生
心脏科
4.9
李医生
儿科
5.0
张宏强医生
心脏科 - 12 年工作经验
郑州市第一人民医院
简介
评价
你好思华!
所有主题
最新
附近
健康博览会
资源共享
健身挑战
您即将参加的活动
心肺复苏培训
与您的医生会面
营养课


9:41
李思华
个人资料
编辑资料
法律信息
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账号
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张宏强医生
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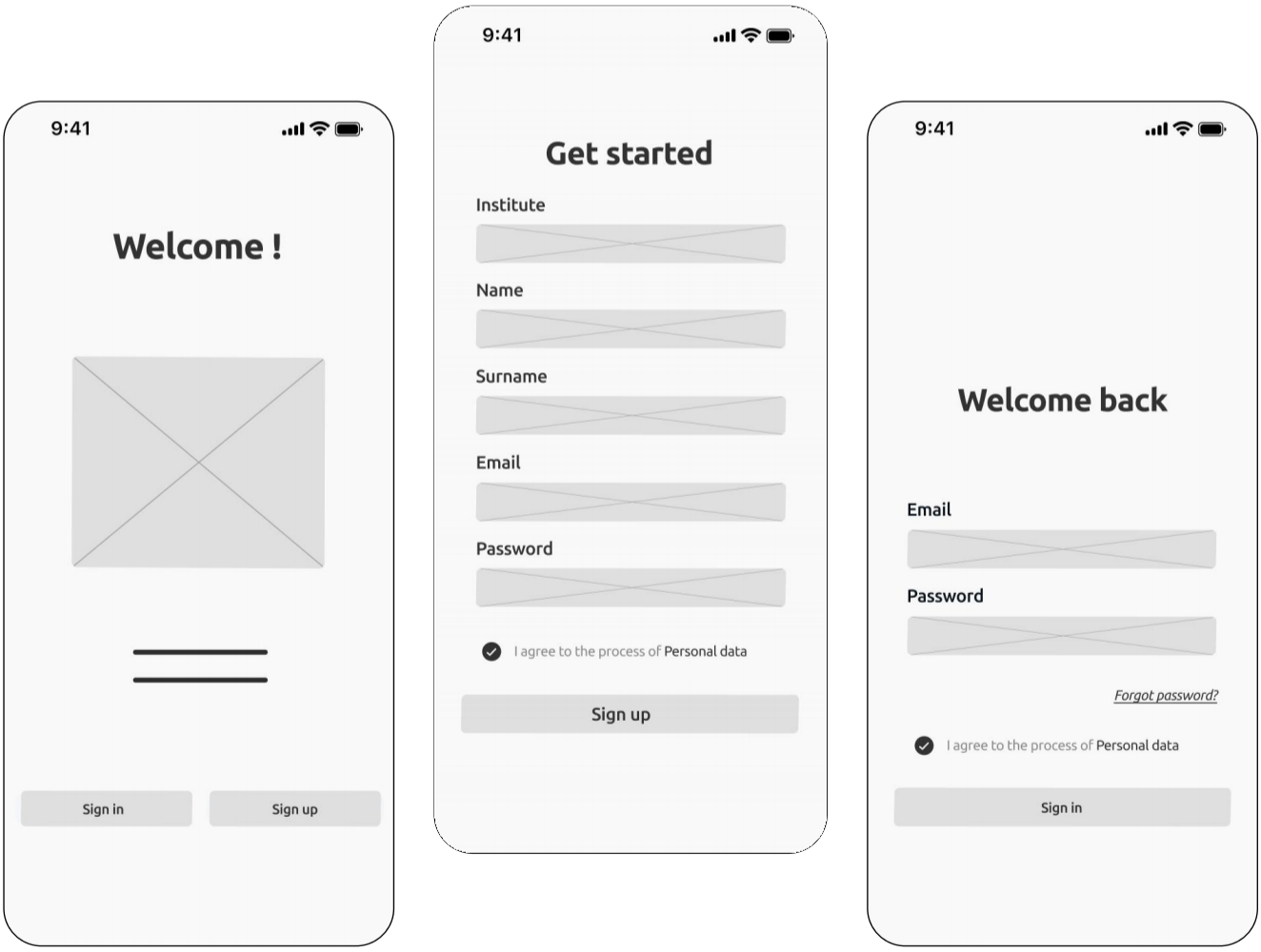
六月 2024
确认
预约
汛期来临，
请记住这些安全
提示!
郑州市应急管理局
5.5km
五月三号, 2024
随着汛季的到来，确保我们的家庭和亲人安全是至
关重要的。请记得通过当地天气预报和社区警报随
时关注天气情况——掌握信息是我们的第一道防
线！确保您的应急包中备有必需品，如水、耐储存
的零食、手电筒和急救包。别忘了把重要文件放在
防水容器里！
在可能需要疏散的情况下，提前规划好逃生路线，
并确保全家人都知道这些计划。如果有邻居或亲友
信息
搜索联系人
群组
个人
桑文
程永清医生
纪风
曾凡光
蔡乐飞
陈能强
紧急需要
退烧药!
在线
桑文
0.5km
23:37今天
概述
我现在发高烧，头痛得厉害，但家里没有药。我需
要一些退烧药，比如对乙酰氨基酚或布洛芬。能不
能请尽快帮帮我？谢谢！
留言:
在这里留下你的评论
现在联系
帮助近在咫尺!
所有主题
社区
官方
紧急需要退烧药！
盛夏时节!
注意这些预防儿童皮肤病
来临,
安全提示

Wireframe 2

Here, another version of the healthcare information sharing platform is specifically designed for healthcare professionals, thus we called **"Pro+ Version"**. Its main feature is the integration of Electronic Health Record (EHR) information management, which allows for seamless access and manipulation of patient data.

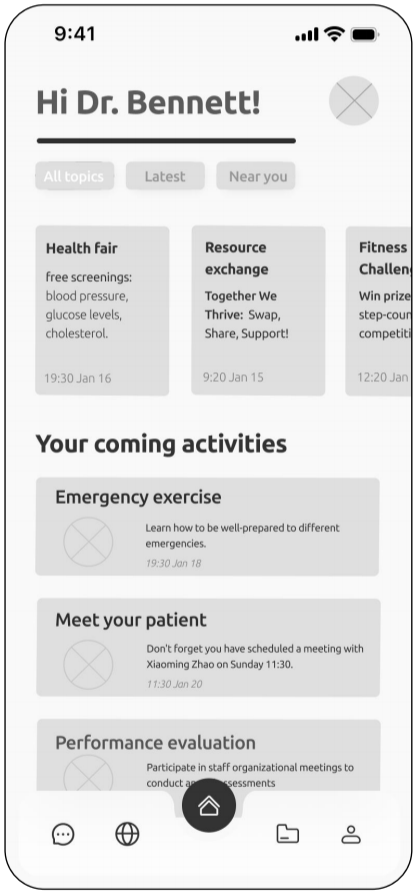
Login

In these pages, the key difference from the public version lies in the second page–the registration page. Here, healthcare professionals are required to log in through their respective healthcare institutions to verify their identities. This additional step ensures that access is granted only to verified medical personnel, enhancing the security and integrity of the platform.



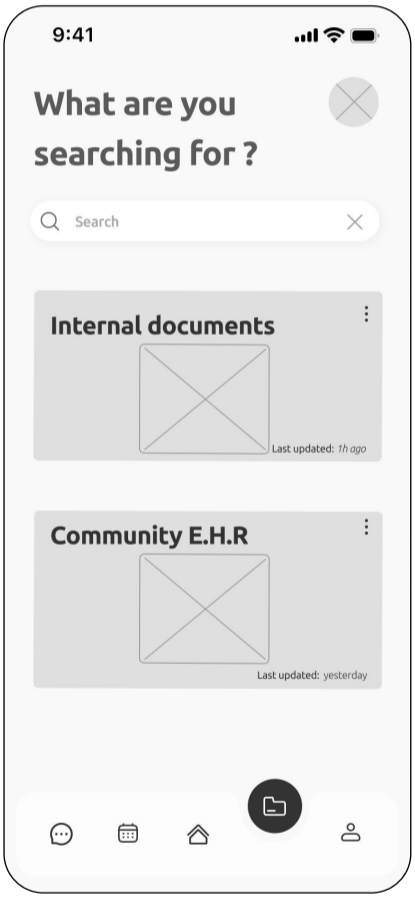
Home Page

The structure and functionality of the homepage are essentially consistent with the public version. However, the content displayed on this homepage is tailored to meet the specific needs and preferences of individual users.

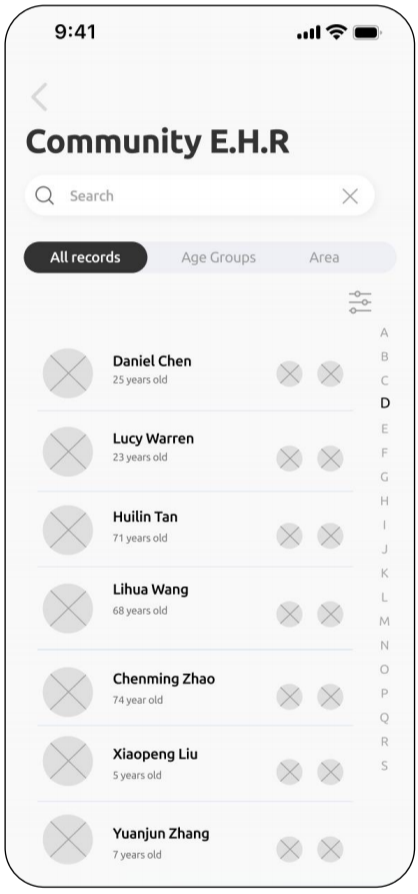


Resources

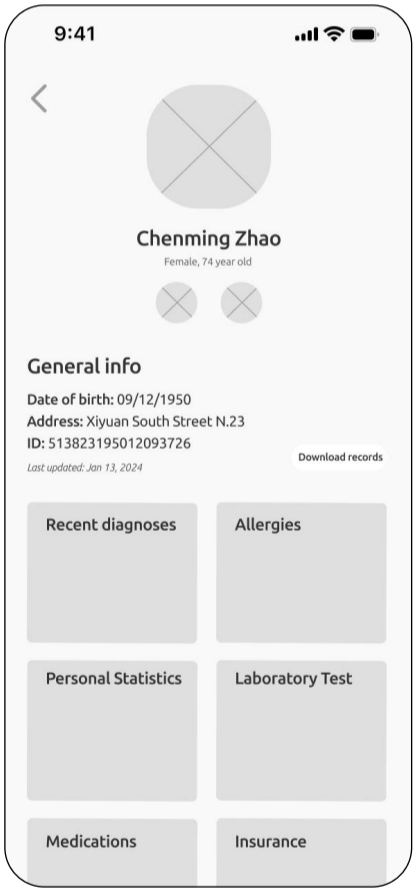
This section integrates internal materials from the healthcare system as well as the electronic health records (EHR) of community residents.This integration facilitates efficient data management and quick access to essential records, helping healthcare staff to streamline their workflows and improve patient care.



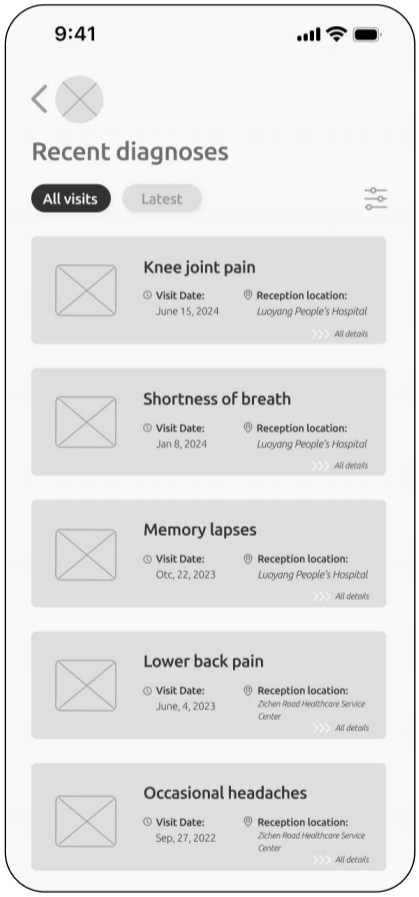
The first screen provides a field for users to input queries and displays categories like 'Internal Documents' and 'Community E.H.R,' enabling quick navigation to desired sections or documents within the app.



The second screen showcases the Community E.H.R section where individual patient records are listed by first name, alongside filters such as "All records" and "Age Groups". This allows healthcare professionals to efficiently locate and manage patient records.



The third screen shows detailed information for a specific patient including general information such as date of birth and address, as well as more specific healthcare details like recent diagnoses, allergies, personal statistics, laboratory test results, medications, and insurance data.

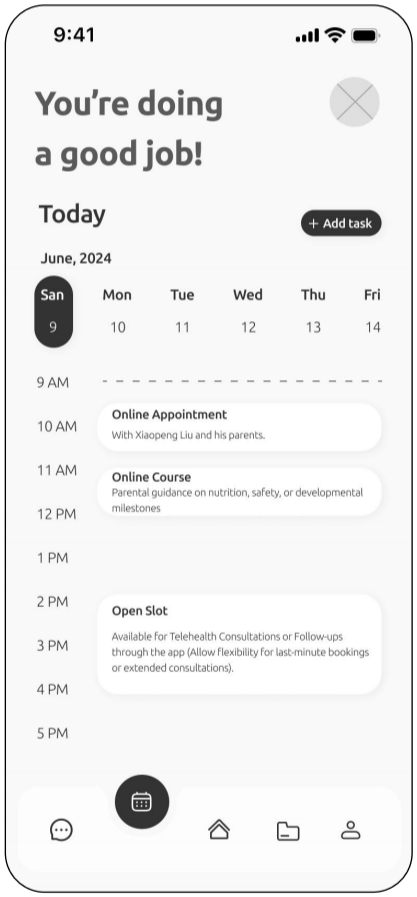


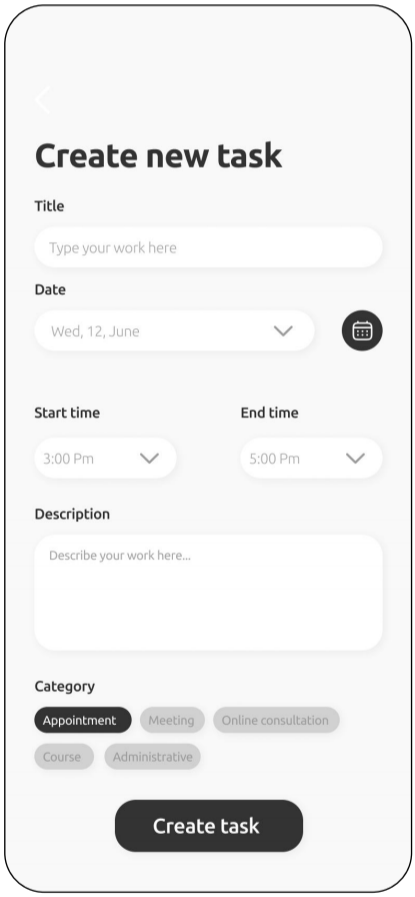
This fourth screen is designed to provide healthcare staffs with a convenient overview of patients' healthcare history. It shows a structured list of various healthcare conditions diagnosed over time, including details like the date of the visit and the location of the healthcare facility where each diagnosis was made.

This layout helps the healthcare professionals quickly navigate through patients' past health issues, review specific details, and access further information if needed to help the doctors understand better about patients' condition.

Calendar Page

In this calendar section, users' schedules are displayed along a timeline, providing a clear and structured overview of daily activities. It allows users to effectively create and manage their own schedule information. This functionality includes options for adding new tasks, setting reminders, and categorizing activities to enhance organization ensuring that users can keep track of their commitments efficiently.



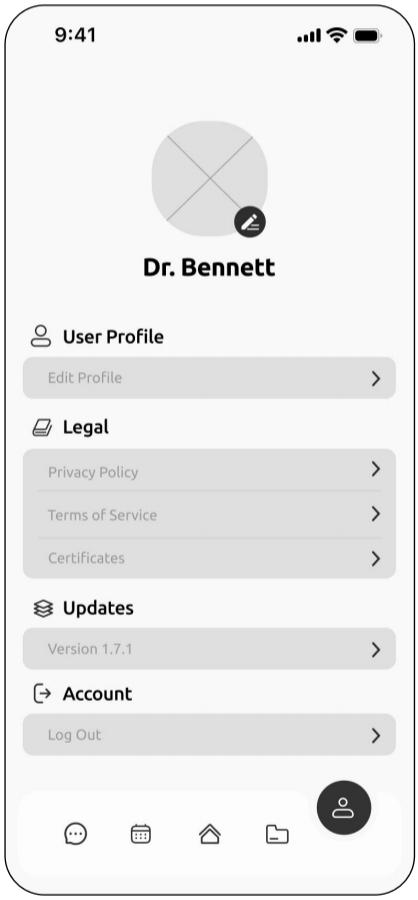


The first screen displays a detailed schedule for the day. Users can view their tasks listed by hour. This screen also offers a visual calendar for the week, allowing for easy navigation between days, and there is an "Add task" button to quickly incorporate new activities into the schedule.

The second screen shows how to create new tasks. It allows users to input details such as the title, date, start and end time, and a description of the task. Users can categorize the task under labels such as "Appointment", "Meeting", or 'Course', and at the bottom there is a "Create task" button to finalize the creation of new tasks.

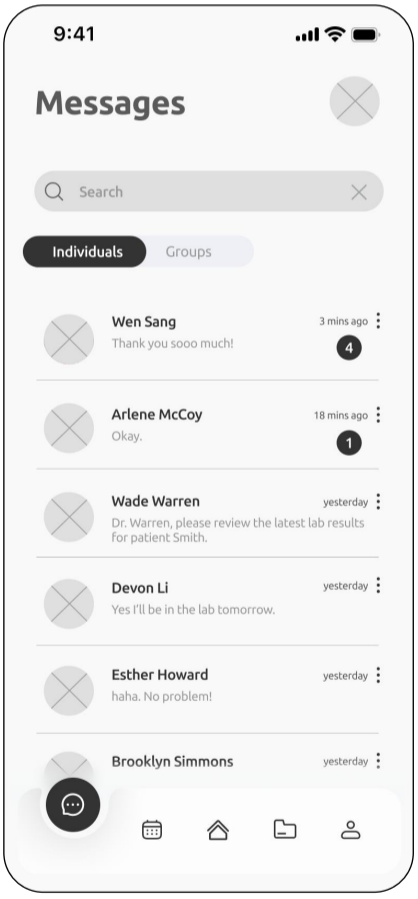
Settings Page

This section is almost the same in content and functionality to the public version, the only difference is that the professional version adds a “Certificates” section to the “Legal” part, allowing employees to view and manage their own relevant certification materials.



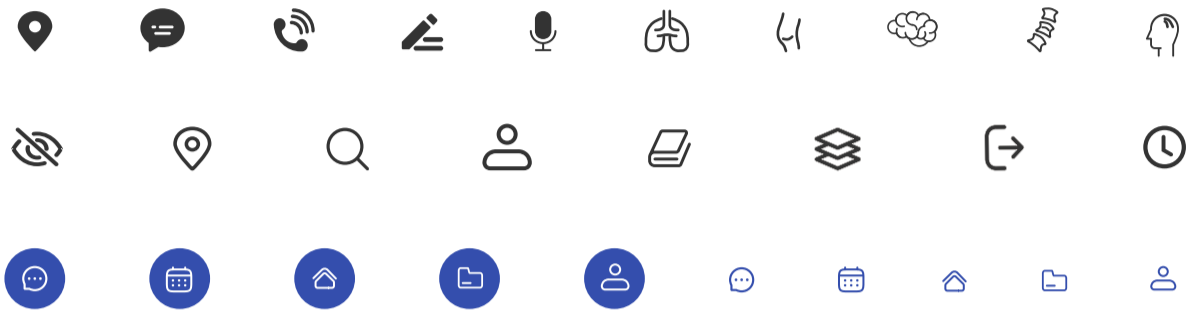
Message Page

The same to the public version.



Visualization

Icons



Colors

Main colors

#344EAD

#4DE29A

#C4D5F6

Texts

#32302D

#9C9C9C

Other colors

#EA484A

#99ACF2

#F9B202

Texts

MiSans

24px Semibold

18px Semibold

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12px Normal


9:41
欢迎！
将健康掌握在您手中!
专业版
注册
登录
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从这里开始
机构
通过机构注册
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请输入
姓氏
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电子邮件
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年龄阶段
区域
陈强
王玉
田会林
王丽华
赵陈明
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你在寻找什么?
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内部资料
上次更新: 10小时前
社区电子健康记录
上次更新: 昨天
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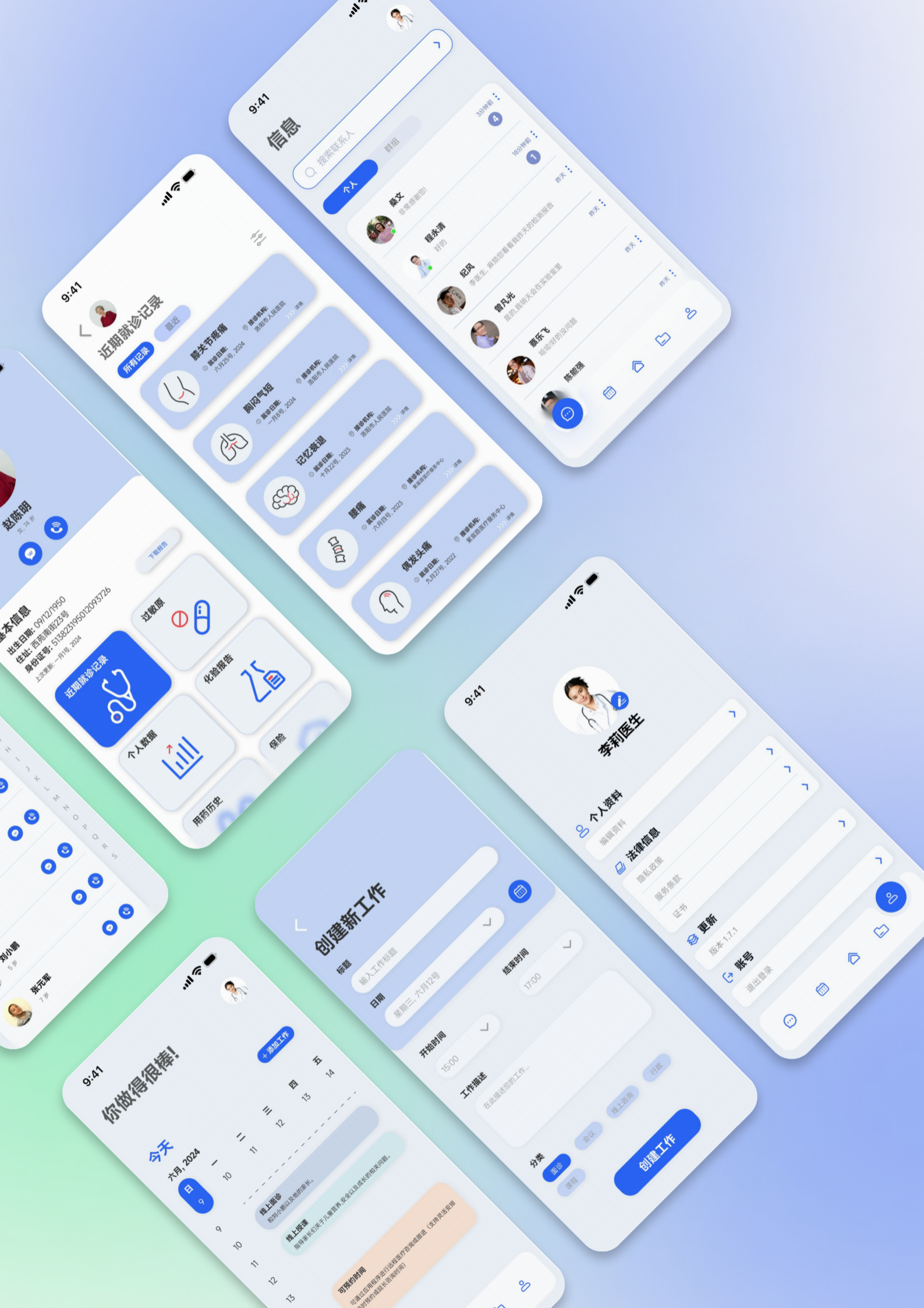
李医生你好!
这是您社区内的最新动态。
所有主题
最新
附近
健康博览会
资源共享
健身挑战
您即将参加的活动
应急演练
学习如何为各种紧急情况做好准备。
与您的病人会面


9:41
信息
搜索联系人
个人
群组
蔡文
非常感谢您!
程永清
好的
纪风
李医生，麻烦您看看我的天的检测报告
曾凡光
是的,我明天会在实验室里
黎乐飞
陈能强
9:41
近期就诊记录
所有记录
最近
膝关节疼痛
就诊日期: 六月25号, 2024
就诊机构: 洛阳市人民医院
胸闷气短
就诊日期: 一月8号, 2024
就诊机构: 洛阳市人民医院
记忆衰退
就诊日期: 十月22号, 2023
就诊机构: 洛阳市人民医院
腰痛
就诊日期: 六月8号, 2023
偶发头痛
就诊日期: 九月27号, 2022
赵陈明
基本信息
出生日期: 09/12/1950
住址: 西苑南街25号
身份证号: 513823195012093726
上次更新: 一月1号, 2024
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你做得很棒!
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线上面诊
和张小鹏以及他的家长。
线上授课
指导家长们关于儿童营养,安全以及成长的相关问题。
可预约时间
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结束时间
17:00
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在此描述您的工作...
分类
面诊
课程
会议
线上咨询
行政
创建工作

Storyboard

To explain the functionality and operational dynamics of this healthcare information sharing platform, we have developed two different storyboards to illustrate the platform's performance across two different scenarios: one during emergency conditions and the other in regular daily contexts. This approach allows us to demonstrate the functionalities of the platform in managing information flow efficiently under both stress and normalized conditions, highlighting its critical role in facilitating timely communication and enhancing inclusive information sharing in varied settings.

This storyboard describes a scenario where both community support and technological innovations play crucial roles in providing healthcare solutions during a flood crisis.

Figure 34.
Storyboard of Information-Sharing Platform (During emergencies)

1

When the floods arrived, it was impossible for the citizens to go out.

2

A resident suddenly experienced a headache and fever at home, but was unable to go out to seek medical attention due to the heavy rain.

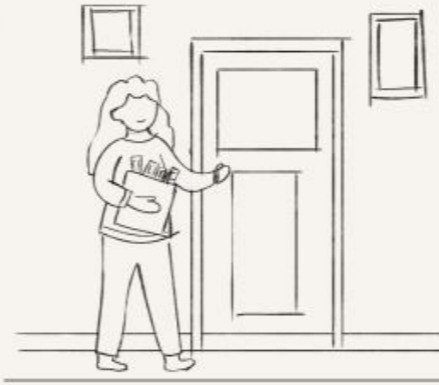
3

Through telemedicine, the doctor provided him with advice on medication and other precautions.

4

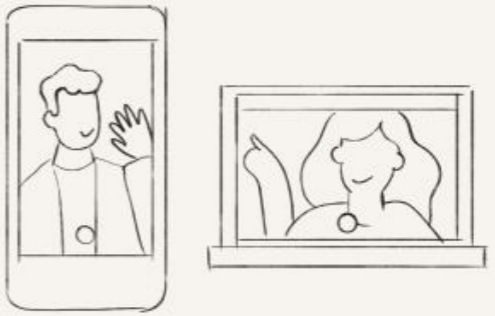
He sought help from other community members because he did not have any medication at home.

5



The kind-hearted neighbor gave him the spare medications from her home.

6



He felt much better after taking the medicine and thanked his neighbours who had helped him via video.

The narrative begins with a resident trapped in his home due to severe flooding, making him unable to access any external facilities. When he gets symptoms like a headache and fever, the resident consults a doctor via his phone, receiving healthcare advice and prescription guidance remotely. But unfortunately, he is unable to find necessary medications at home, so he reaches out through the community digital network for help. A neighbor responds by supplying the medication needed for him, and then the story concludes with the resident feeling better and thanking his neighbor.

This storyboard not only illustrates the challenges posed by natural events but also underscores the innovative strategies that can mitigate their impact on health.

The second storyboard illustrates how the healthcare information sharing platform contributes to enhancing community preparedness and response effectiveness for emergency situations within the context of daily life.

Figure 35.
Storyboard of Information-Sharing Platform (During daily time)

1

The community is preparing to carry out regular drills for emergency response.

2

The staff issued notifications to local residents through the platform, informing them of the objectives and detailed information of the drill.

3

Healthcare personnel locate the elderly population and other vulnerable groups within their jurisdiction (those who cannot be reached through the platform) via EHR (Electronic Health Records).

4

Staff members go to their home to inform them of the specific details of the drill and create response plans tailored to their situations.

5

The drill was held as scheduled, with residents being evacuated and individuals with mobility issues being relocated with the assistance of community personnel.

It begins with the community planning regular emergency response drills, followed by staff using the platform to send detailed information to residents. The notifications include goals and detailed information about the drill, ensuring that all community members are well-informed and can participate effectively. Besides, the staff may personally visit the residents, especially those with specific needs such as facing chronic diseases and reduced mobility identified by the E.H.R., to provide customized drill details and create tailored response plans for them. Then the sequence concludes with the successful execution of the drill, demonstrating community evacuation and assistance for individuals with mobility issues, facilitated by community personnel.

This storyboard illustrates the critical role of the healthcare information sharing platform in enhancing emergency preparedness through community collaboration, targeted outreach, and the effective use of digital tools to manage and execute emergency drills. This approach not only increases the readiness of the community but also ensures that the specific needs of vulnerable populations are addressed efficiently.

The two storyboards describe the dual functionality of the information sharing platform, showcasing its critical role both in emergency situations and everyday life to enhance community preparedness as well as fostering a well-equipped community to handle crises through continuous engagement and inclusive communication strategies.

7.5

THE NEW SYSTEM

New System Map

The new system map, which we built based on the existing emergency response flowchart to demonstrate how our three strategies coordinate the efforts of government agencies, healthcare system, and the citizens in the event of any unexpected natural disaster.

And, in emergency situations, the healthcare system can rapidly establish communication through our unified emergency communication system which facilitates immediate connections between healthcare providers, emergency responders, and administrative staff, ensuring that crucial information is disseminated without delay. The platform supports real-time updates and detailed reports on the progress of internal situations, including patient statuses, resource availability, and logistical challenges. By providing a centralized hub for communication, it enhances the coordination of efforts, minimizes response times, and reduces the potential for misunderstanding.

Additionally, residents can access accurate and reliable information provided by governmental bodies or healthcare authorities through the information sharing platform, which is tailored to disseminate critical information swiftly, aiding residents in making informed decisions, enhancing their ability to protect themselves, and improving their overall response to emergencies. The integration of these platforms not only streamlines communication within the healthcare system but also bridges the gap between public health authorities and the community, fostering a more resilient and well-prepared populace.

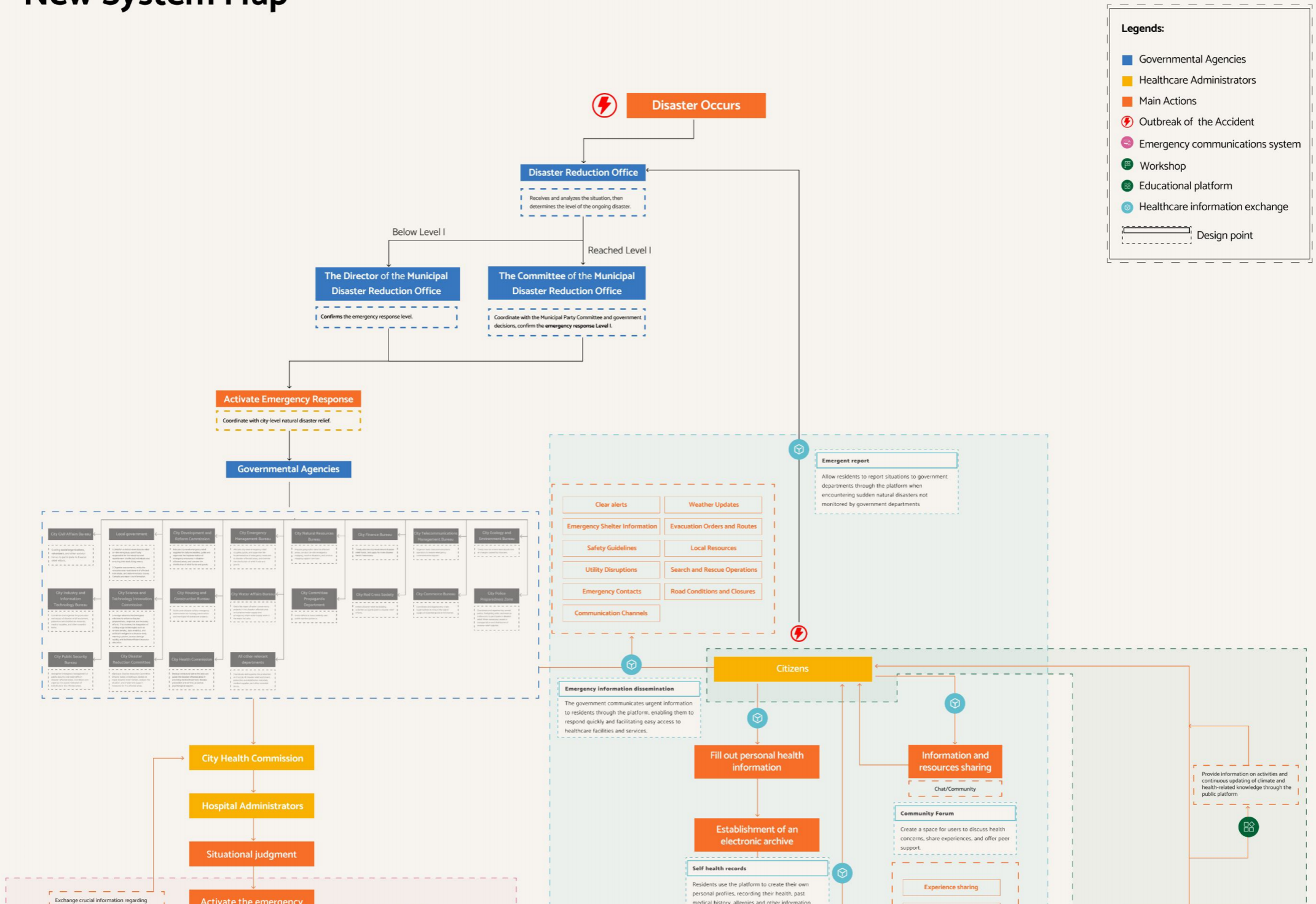
Following the end of the crisis, the experiences and lessons learned are analyzed and transformed into educational resources to enhance citizen preparedness for future emergencies. These materials are integrated into training programs and public awareness campaigns, fostering a culture of continuous learning.

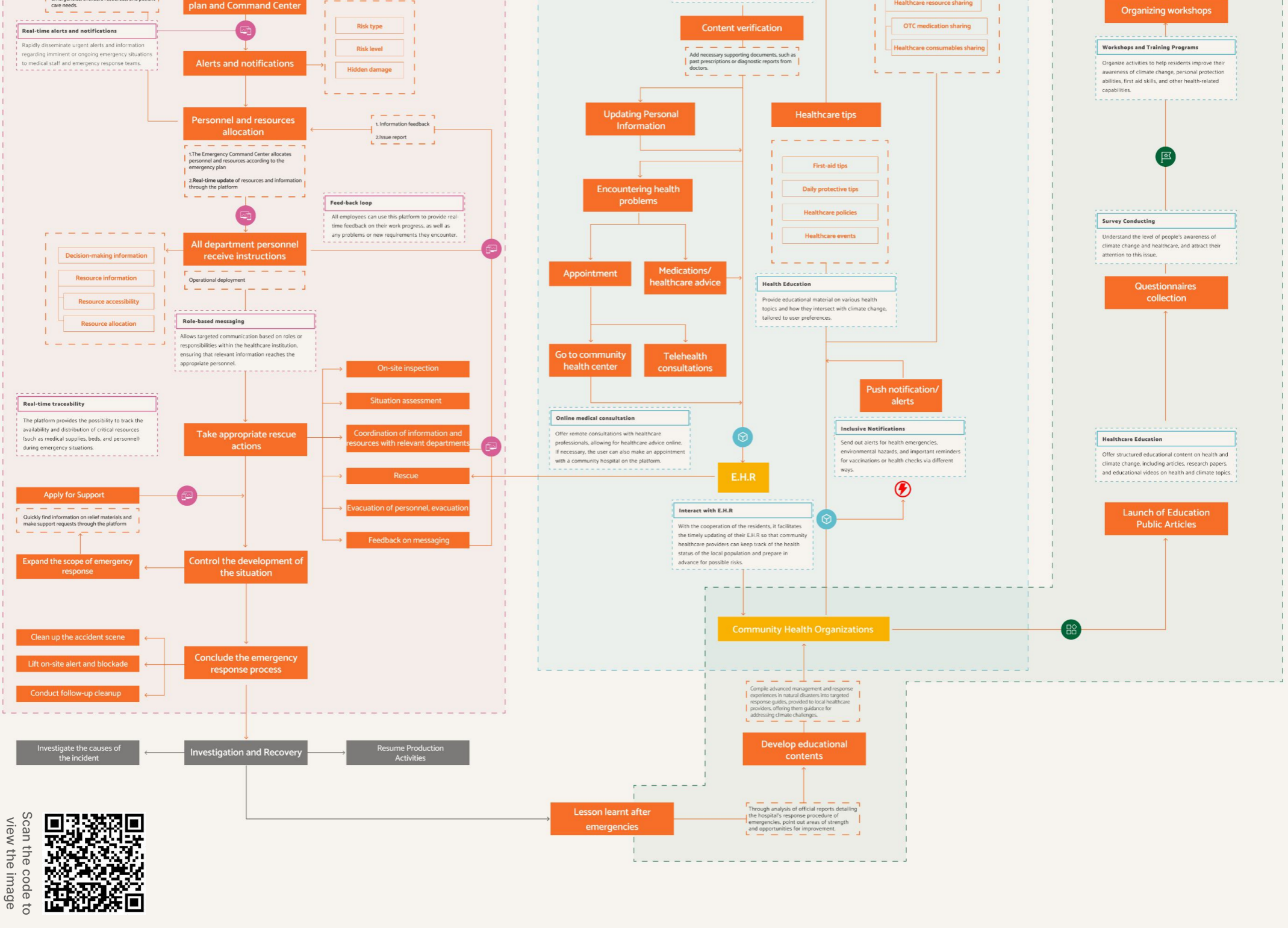
This process establishes a self-updating cycle of information within the system, continuously refining community response mechanisms based on real-world experiences and evidence-based practices, thus enhancing overall crisis management efficiency and effectiveness of the whole system.

Therefore, this synchronization across all parties involved not only boosts the efficiency of emergency responses but also strengthens community resilience. By utilizing these integrated systems, stakeholders can better anticipate crisis situations, allocate resources more effectively, and implement coordinated actions that safeguard public health and safety.

Map 14.
New System Map

New System Map





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Roadmap

This roadmap outlines a strategic framework for implementing and scaling innovative solutions to climate challenges. It provides a structured timeline and clear milestones that guide actions and research, emphasizing the importance of continuous monitoring and iterative adaptations which are essential for sustainable healthcare. However, it should be noted that although we have divided the entire timeline by different months, the actual implementation time may not completely coincide with our planning. Considering that the approval cycle of the projects cannot be fully determined, therefore, what is reflected in this roadmap is a relative order of our three strategic implementation processes.

Firstly, the implementation of the emergency communication system is prioritized as it is essential for enabling seamless and efficient communication among healthcare staff during crises. This system ensures that all relevant personnel within the healthcare system can quickly establish contact, share critical information, and coordinate their actions in real time.

Establishing this communication framework first is crucial, as it provides the necessary operational foundation for managing emergency situations effectively within the system.

Secondly, the phase of guiding and educating the citizens follows. With a robust communication system already in place for healthcare staff, the next step focuses on guiding the public on how to effectively cooperate with healthcare personnel during emergencies, including guidance on preventive measures, emergency contacts, and protocols. This education activity is important to ensure that the community is well-prepared and can react appropriately in times of crisis, thereby reducing panic and enabling more organized public participation.

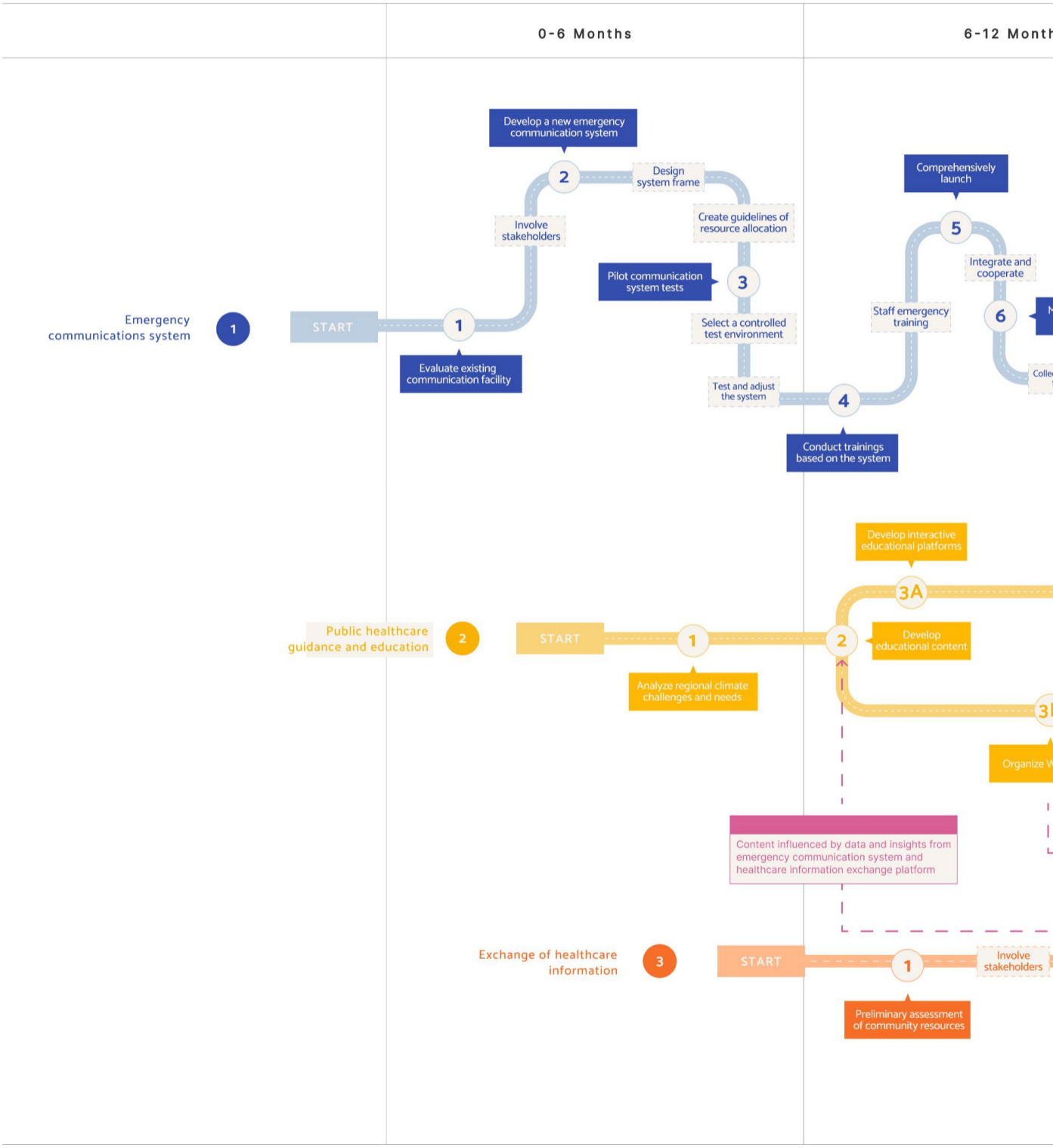
Finally, the implementation of the healthcare information sharing platform is designed to build upon the communication strengths of the healthcare system and the educated public. This platform aims to facilitate broader and more accessible information sharing between healthcare providers,

governmental agencies and the public, ensuring that everyone has access to timely, accurate, and relevant information. It also serves as a tool for ongoing public engagement, feedback collection, and continuous improvement in crisis management strategies.

By arranging these strategies in this order, the roadmap ensures that each phase supports the effectiveness of the next, creating a comprehensive and resilient emergency management system that is well-equipped to handle crises with maximum efficiency.

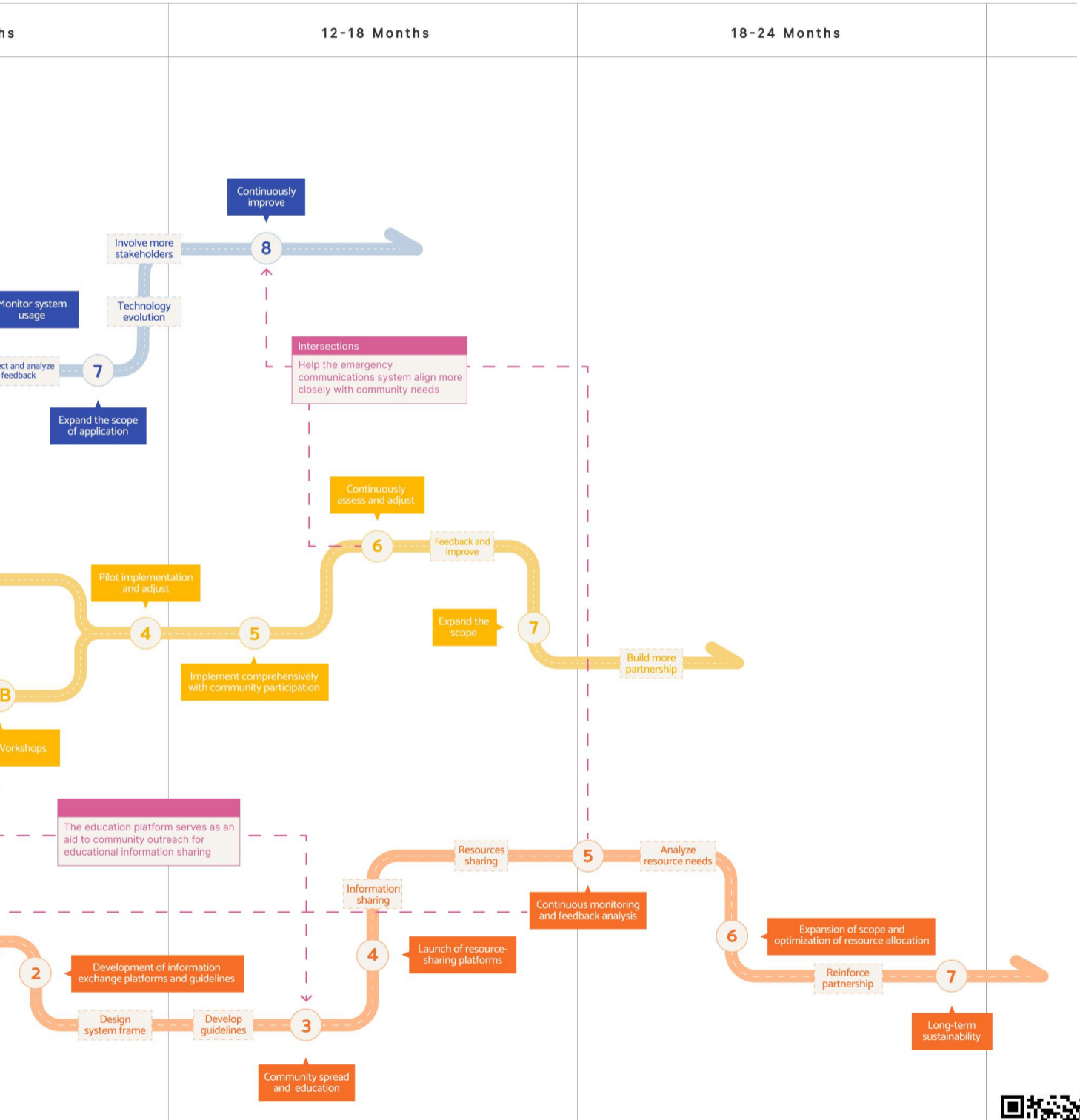
Map 15.
Roadmap of the New System

ROADMAP



Main Step

Secondary Step



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Conclusion

In conclusion, the new system map and accompanying roadmap provide a robust framework that strengthens the local healthcare system's resilience to climate change. This approach enhances strategic coordination among government agencies, healthcare providers, and citizens, fostering improved information sharing. By aligning stakeholders towards common goals, the system promotes a unified response to climate-related emergencies and supports the development of long-term adaptive strategies, ensuring the healthcare system evolves to meet emerging challenges effectively.

References :

1. Li, X., Huang, Q., & Yin, L. (2024). Community-based disaster risk management theory in the context of climate change. Journal of Catastrophology. Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CAPJ&dbname=CAPJLAST&filename=ZHXU202404110O1&uniplatform=OVERSEA&v=uH06tGCpsapourC-d50n6tP0MW62NsMIQeeGWSGkPkeARALD760Zvgib13g6T6Yr

2. Qin, J., & Wu, X. (2024). Local government emergency management of natural disasters: Issues, international comparisons, and optimization paths—A case study of the rainstorm disaster in Zhuozhou, Hebei. Future and Development, 2024(3), 1-9. https://doi.org/CNKI:SUN:WLYF.0.2024-03-001

3. Fan, J., Meng, Y., Mao, A., & Qiu, W. (2024). Current status, problems, and countermeasures of information sharing in public health emergency response agencies in China. Journal of Medical Informatics, 2024(3), 30-34+76. https://doi.org/CNKI:SUN:YXQB.0.2024-03-003

4. O'Neill, P. (2004). Developing a risk communication model to encourage community safety from natural hazards. New South Wales: State Emergency Services. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=9ba065b8e2cf8b70c7a5ae59ba207565a010cbe0

5. Ahad, A., Tahir, M., & Yau, K.-L. A. (2019). 5G-based smart healthcare network: Architecture, taxonomy, challenges and future research directions. IEEE Access, 7, 100747-100762. https://doi.org/10.1109/ACCESS.2019.2930628

6. Chamola, V., Hassija, V., Gupta, V., & Guizani, M. (2020). A comprehensive review of the COVID-19 pandemic and the role of IoT, drones, AI, blockchain, and 5G in managing its impact. IEEE Access, 8, 90225-90265. https://doi.org/10.1109/ACCESS.2020.2992341

7. Tanwar, S., Parekh, K., & Evans, R. (2020). Blockchain-based electronic healthcare record system for healthcare 4.0 applications. Journal of Information Security and Applications, 50, 102407. https://doi.org/10.1016/j.jisa.2019.102407

8. Wijesooriya, N. R., Mishra, V., Brand, P. L., & Rubin, B. K. (2020). COVID-19 and telehealth, education, and research adaptations. Paediatric Respiratory Reviews, 35, 38-42. https://doi.org/10.1016/j.prrv.2020.06.009

9. Vora, J., Tanwar, S., Tyagi, S., Kumar, N., Obaidat, M. S., & Rodrigues, J. J. P. C. (2018). Ensuring privacy and security in E-health records. In 2018 International Conference on Computer, Information and Telecommunication Systems (CITS) (pp. 1-5). Alsace, Colmar, France. https://doi.org/10.1109/CITS.2018.8440164

10. China Meteorological Administration. (2023, February 17). 气候变化教育的全球发展趋势. 中国教师报. Retrieved from https://www.cma.gov.cn/2011xwzx/2011xmtjj/202302/t20230220_5316166.html

11. Ju, W., Zhang, S., Sang, J., & Zhao, G. (2023). Analysis of the confirmation and authorization of personal health and medical data in internet healthcare. Chinese Journal of Health Informatics and Management, 20(6). Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=WSGL202306008&uniplatform=OVERSEA&v=RqCTPp0kUE8gUpgt9FyZa7Wo-ZpLvS8Ivy185R7WGWJ2dq2mD1hLIDvEDS0P3A4q

12. Qiu, Y., Huang, Z., Liu, S., Chen, Y., Xu, Y., & Xu, F. (2023). Construction of a medical data security system based on domestic cloud-native technology. Modern Hospitals, 23(12), 1889-1993. Retrieved from https://oversea.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=XDYU202312022&uniplatform=OVERSEA&v=VHrvo7vMJrz11Wqs2ZUxVM175dvydMhpkSeHJJ0tkfcQ6qla_LaBdE-rosumBs23

13. Qu, J. (2023). The dilemmas and countermeasures in the construction of a health data governance system. Medicine and Society, 36(12). Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=YXSH202312002&uniplatform=OVERSEA&v=JsIszx74Cq_EIRXdDSCAp174YW6-3bo1U6mQGBRMPwMiZ_nvIzv37KJgjUSraUQP

14. Qiu, J., Huang, W., Fu, Y., & Tong, Z. (2023). Factors influencing WeChat users' ability to discern health information: A case study of medical health WeChat public accounts. Journal of Modern Information. Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CAPJ&dbname=CAPJLAST&filename=XDQB20231220005&uniplatform=OVERSEA&v=uZX20wZuO6KkxP6f4wVK2ffBOiEK1KVnH7g-KV9yI2QZZq-1sz8Po_UNugGFiEyo

15. Jiang, Y. (2024). Legal issues and countermeasures in the information disclosure of medical and health institutions in China. Medicine and Society, 371), 118-123. Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=YXSH202401018&uniplatform=OVERSEA&v=XjOTCF4IFBudqAqGwHy8m6tag__X00jmtHRJgLDnj0avfQzaREhk4ZfnBIvwAitJ

16. Han, C. (2024). Dilemmas and solutions in the protection of personal health data in the field of medical artificial intelligence. Science, Technology and Law (Bilingual), 19(1), 54-60. Retrieved from https://www.cnki.net/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2024&filename=KJFL202401006&uniplatform=OVERSEA&v=vExNdQUVuWXxqWdyyFq6SIv0-api5-ILjW83asD_RPrc0JfOoknr_eFVQYNHvxYB

17. Yin, H. (2023). Legal guide to personal medical and health information. Seeking Truth, 2023(5), 116-126. https://doi.org/10.16059/j.cnki.cn43-1008/c.2023.05.014

18. Zhang, R., Lu, Y., Zhu, R., & Zhou, L. (2024). Preliminary exploration of ethical governance paths for internet healthcare from the perspective of medical equity. Chinese Medical Ethics, 2024(1), 54-60. https://doi.org/CNKI:SUN:XNLX.0.2024-01-007

08.

EVALUATE THE NEW SYSTEM

BY EMPLOYING BOTH QUANTITATIVE AND QUALITATIVE METHODOLOGIES, IT HELPS TO PROVIDE A *HOLISTIC VIEW OF THE EFFECTS* ACCOMPANIED WITH THE DIFFERENT STRATEGIES.

8.1

OUTCOMES AND IMPACTS

Methodology

By fostering collaboration and communication among various stakeholders associated with the healthcare system, and establishing a systemic information sharing model, we were able to facilitate the transformation of the current healthcare system into a more resilient one which can address the persistent challenges posed by climate change. This transformation not only mitigates the current challenges faced by the local healthcare system but also promotes long-term, sustainable benefits across the entire territory.

In the subsequent phase of our research, we took a comprehensive analysis of both the qualitative and quantitative impacts that our initiatives have brought to the healthcare system as well as the resources needed at each stage. This section of the analysis will employ both quantitative and qualitative methodologies, providing a holistic view of the effects induced by our strategies. Additionally, these impacts will be evaluated over time, offering insights into the short-term, mid-term and long-term as well as prospective benefits these projects empower upon the healthcare system and the broader territorial context.

At the same time, these outcomes and impacts can be classified according to their respective scope of influence:

- **Micro:** The scope of influence is the local healthcare system.
- **Meso:** The whole territory of Zhengzhou City.
- **Macro:** The national level.

Through this systematic approach, we can enhance our comprehension of the potential developmental path of the new system as designed. This deeper insight facilitates more informed decision-making and allows for the proactive adaptation of strategies to align with evolving demands and challenges. Such foresight is crucial in ensuring that the system remains effective and sustainable within a dynamic context.

So in our case, we evaluated the outcomes and impacts of each initiative across the five different dimensions below:

- **Environmental Impacts**
- **Social Impacts**
- **Economic Impacts**
- **Cultural Impacts**
- **Process Impacts**

In terms of outcomes, these typically refer to predefined objectives that can be measured using quantitative metrics. Impacts, however, can be qualitative and subjective, and based on people's feelings or experiences, making it harder to quantify as a result.

Map 16.
Future Envisioning

Future Envisioning

Strategies

Short-term

Emergency communications system

Adapt real-time alerts and notifications

S: Hospital administrators and staffs
T: Cooperate with external information-technology company
F: Governmental funds

Reduce the time required from the receive of an alert to the activation of the corresponding emergency procedures.

Enhance employees' sense of preparedness and situational awareness in the face of emergencies.

Role-based messaging

S: Hospital administrators and staffs
T: Cooperate with external information-technology company
F: Governmental funds

Reduce the time it takes for messages to be delivered and increase the response rate of healthcare professionals receiving messages.

Enhancement of targeted communication and clarity of roles in emergencies, leading to more efficient problem solving.

Organize staff trainings

S: All the staffs, emergency professionals, patients
T: -
F: Governmental funds

Reduce incident response time and error rate.

Increasing the operational proficiency of healthcare workers in order to improve their emergency response capacity, as well as their confidence in crisis management.

Public healthcare guidance and education

Create official accounts for public education

S: Expert Contributors, Community Managers
T: Based on WeChat
F: Governmental funds, social funds

Prevent illness and injury through education thus conserve healthcare resources.

Empowers individuals with the knowledge needed to protect themselves and others.

Exchange of healthcare information

Create self health records

S: Healthcare professionals, legal experts, residents
T: Cooperate with external information-technology company
F: Governmental funds, Research Grants, Corporate Sponsorship

Reduce emergency healthcare diagnosis times, reduce the use of disposable healthcare supplies and reduce wastes.

Lower the risk of healthcare accidents and enhance the continuity of healthcare services.

Build community Forum

S: Community Managers, residents, healthcare professionals
T: Cooperate with external information-technology company
F: Governmental funds, Corporate Sponsorship

Decrease unnecessary hospital visits and decrease carbon emissions.

Cultivates a culture of knowledge sharing and mutual aid, mitigate the feeling of isolation and anxiety.

Disseminate emergency information

S: Government Agencies, healthcare staffs, residents, software developers
T: Cooperate with external information-technology company
F: Governmental funds, Corporate Sponsorship

Timely and accurate emergency information can save lives, reduce injuries, mitigate disaster-related costs.

Minimize panic among the public.

Legends:

- **S** Stakeholder
- **T** Technologies
- **F** Funds
- Quantitative impacts
- Qualitative impacts
- Environmental impacts
- Social impacts
- Economic impacts
- Cultural impacts
- Process impacts

Mid-term

Long-term

Micro

Meso

Macro

Create feedback loop

S: Hospital administrators and staffs
T: Cooperate with external information-technology company
F: Governmental funds

Accurate and fast feedback reduces problem solving time and increases problem resolution rates.

Streamline the feedback process and improve the efficiency and clarity of internal communications.

Real-time traceability

S: Hospital administrators, logistics department, healthcare resource suppliers
T: Cooperate with external information-technology company
F: Governmental funds

Increased resource utilization and reduced response time to resource requests.

Optimize resource management decisions to maximize the benefits of resource allocation and enhance the adaptability of resource distribution in emergency situations.

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Organize different workshops

S: Professionals in healthcare and climate change fields, Partnership Organizations, residents
T: Digital Platform Supporting, Audio-Visual Equipments
F: Governmental funds, social funds,Corporate Sponsorships.

Educate residents on proper waste disposal, minimizing environmental damage; well-prepared communities are better to take preventive measures, which can minimize property damage.

Foster community cohesion and build a sense of solidarity among residents.

Adapt inclusive notifications

S: Government Agencies, healthcare staffs, residents, software developers
T: Cooperate with external information-technology company
F: Governmental funds, Corporate Sponsorship

Minimize damage to property and infrastructure, reduce injuries.

Ensure that no segment of the population is left uninformed or unprepared, promote inclusivity among the community.

Provide online healthcare consultation

S: Government Agencies, healthcare staffs, residents, software developers
T: Community healthcare professionals,
F: -

Reduce the need for travel which can lower carbon emissions.

Ensure continuity of care when physical access to healthcare facilities is obstructed, promotes a broader acceptance and integration of technology in healthcare.

Interact with E.H.R

S: Government Agencies, healthcare staffs, residents, software developers
T: Community healthcare professionals, software experts
F: Governmental funds

Reduce reliance on paper records and thus lowering carbon emissions, reduce unnecessary tests or treatments.

Enhances accessibility to healthcare information, optimize resource allocation, foster transparency in healthcare.

Post-event report

S: Hospital administrators, all the staffs
T: -
F: -

Providing strong support for subsequent emergency decision-making.

Public healthcare education

S: Government Agencies, healthcare staffs, residents, software developers
T: -
F: Governmental funds, Corporate Sponsorship,

Lower healthcare costs associated with treating injuries and illnesses.

Reduce panic and improve self-sufficiency, raise people's awareness about prioritizing health, safety, and preparedness.

By systematically analyzing the outcomes and impacts of these projects, we can better understand their attribution to the system as well as areas for improvement, facilitating the refinement of future initiatives. At the same time, we also analyzed the resources required for implementing each project. This encompassed an examination of the associated stakeholders, the necessary technological inputs, and the financial investments involved. Such an approach allows for a comprehensive understanding of the operational needs of each initiative, facilitating more effective planning and resource allocation. This systematic evaluation is crucial for ensuring the successful execution and sustainability of the projects.

Emergency Communication System

Adapt real-time alerts and notifications

Reducing Response Times: By streamlining the process from receiving an alert to activating corresponding emergency procedures, the system ensures rapid responsiveness. This reduction in time is crucial for mitigating the impact of emergencies, allowing for immediate action that can reduce potential damage.

Enhancing Employee Preparedness and Awareness: The new system also focuses on improving the employees' sense of preparedness during emergencies. This is achieved through continuous training and updates facilitated by real-time alerts, which keep the workforce informed and ready to respond effectively. Enhanced awareness contributes to a more resilient organizational environment, where employees are always prepared for potential threats and to handle them efficiently.

Organize staff training

Reducing Incident Response Time and Error Rate: Targeted training programs are designed to improve the response skills of healthcare workers, enabling them to act swiftly and accurately in emergency situations. By reducing the time, the training helps mitigate the impacts of emergencies and enhances patient outcomes.

Increasing Operational Proficiency: The training modules aim to improve the technical and operational skills of healthcare workers, directly enhancing their ability to handle emergency scenarios. This increase in proficiency not only improves the effectiveness of healthcare delivery in crisis situations but also ensures that responses are conducted with a higher standard of care.

Boosting Confidence in Crisis Management: By providing continuous and comprehensive training, the system creates greater confidence among healthcare workers when managing crises. This confidence is crucial for maintaining calm and making informed decisions under pressure, which are important attributes in emergency response.

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Boosting Confidence in Crisis Management: By providing continuous and comprehensive training, the system creates greater confidence among healthcare workers when managing crises. This confidence is crucial for maintaining calm and making informed decisions under pressure, which are important attributes in emergency response.

Role-based messaging

Accelerating Message Delivery and Response Rates: Role-based messaging is designed to streamline communication channels, ensuring that messages reach the appropriate healthcare professionals swiftly. By reducing the time it takes, the system allows for quicker reactions to emergencies, thus increasing the overall efficiency of response efforts.

Enhancing Targeted Communication and Role Clarity: This system enhances the clarity of communication during emergencies by ensuring that each message is specifically tailored to the roles of its recipients. By clearly defining what is expected of each role during an emergency, the system eliminates misunderstanding and reinforces the responsibilities of each team member.

Facilitating More Efficient Problem Solving: With enhanced communication clarity and role-specific messaging, healthcare teams can engage in more effective and coordinated efforts. This organization allows for quicker assessments of situations and more structured approaches to emergency management, leading to faster resolution of issues without overlapping efforts or confusion among team members.

Create feedback loop

Reducing Problem-Solving Time and Increasing Resolution Rates: By implementing a feedback loop, the system provides accurate and swift responses to inquiries and issues raised by staff. This approach significantly reduces the time spent on diagnosing and resolving problems, directly increasing the rates at which these problems are addressed and resolved.

Streamlining the Feedback Process: The design of the feedback loop aims to simplify the procedures involved in obtaining and providing feedback. By making the process more straightforward and less cumbersome, staff are more likely to engage with the system and utilize it for continuous improvement.

Improving Efficiency and Clarity of Internal Communications: The feedback loop facilitates clearer and more efficient internal communications. It allows for the quick dissemination of information and insights across different levels and departments, ensuring that all team members are aligned and informed.

Real-time traceability	Post-event report
Increased Resource Utilization and Reduced Response Time to Resource Requests: Real-time traceability allows for the continuous monitoring of resources, ensuring that asset utilization is maximized, and wastage is minimized. This system capability ensures that resources are allocated where they are most needed in a timely manner, significantly reducing the lag between resource requests and their fulfillment. **Optimization of Resource Management Decisions:** With real-time data at their easy reach, managers and decision-makers can make more informed choices regarding resource allocation. This data-driven approach allows for the assessment of current resource status and usage patterns, enabling strategic adjustments that maximize the benefits derived from available resources. **Enhanced Adaptability of Resource Distribution in Emergency Situations:** The real-time traceability ensures that the system can adapt to changing circumstances, particularly in emergency scenarios. By having a clear overview of resource availability and deployment in real time, the system can quickly redirect resources to where they are most required, thus enhancing the organization's capacity to respond to emergencies effectively.	**Support for Subsequent Emergency Decision-Making:** Post-event reports generate detailed and structured feedback on the handling of each emergency, including what strategies were effective and which areas require improvement. This source of data is valuable for refining emergency protocols and training programs, thus improving the organization's future response efforts. **Enhanced Learning and Continuous Improvement:** By systematically analyzing post-event reports, the organization can identify patterns and trends that may not be apparent during the situation. This ongoing learning process is critical for evolving institutional knowledge and continuously improving response strategies. **Accountability and Transparency:** Post-event reports also help to increase transparency and accountability within the organization. They provide a clear, documented account of actions taken during emergencies, which can be critical for internal reviews as well as for compliance with external regulatory requirements. **Evidence-Based Resource Allocation:** The insights gained from post-event reports can guide more strategic resource allocation.

Understanding the dynamics of past events allows for better planning and provisioning of resources, ensuring that they are directed toward high-impact areas.

Healthcare Guidance and Education

Create official accounts for public education

Create official accounts for public education Prevention of Illness and Injury: By disseminating accurate and timely information on health, safety, and emergency preparedness, these official accounts play a critical role in educating the public on how to prevent illnesses and injuries. This not only helps save healthcare resources by reducing the demand on healthcare facilities but also lessens the overall burden on the healthcare system.

Empowerment of Individuals: Providing accessible and reliable information empowers individuals with the knowledge they need to protect themselves and others in various situations. This empowerment enhances community resilience, as informed citizens are better equipped to handle health-related challenges effectively and safely.

Encouragement of Proactive Health Behaviors: Through continuous education and engagement, these accounts encourage proactive health behaviors among the population. By promoting habits such as regular vaccinations, healthy lifestyle choices, and effective emergency preparedness, the system helps cultivate a community that is more aware of health.

Organize different workshops

Education on Environmental Practices: Workshops aimed at educating residents on proper waste disposal play a crucial role in minimizing environmental impact. By communicating individuals about sustainable practices and the consequences of improper waste handling, these workshops help reduce pollution and promote a healthier community environment.

Enhanced Community Preparedness: The workshops also help communities to take effective preventive measures against potential hazards. Educating residents on how to safeguard their properties and react during emergencies significantly minimizes potential property damage and enhances overall safety.

Building Community Cohesion: By bringing residents together to learn and engage with these important issues, workshops foster a greater sense of community cohesion. This unity is crucial in times of crisis, as a cohesive community is more effective at responding to and recovering from emergencies.

Support for Long-Term Resilience: The knowledge taught through these workshops equips residents with the skills necessary to adapt to and mitigate risks associated with environmental and other challenges. This long-term resilience is crucial for sustaining the well-being of the community.

Create self-health records

Reduction in Emergency Healthcare Diagnosis Times: Self-health records enable quicker access to patient histories, allowing healthcare providers to make faster and more accurate diagnoses during emergencies. This simplifies treatment initiation, potentially improving patient outcomes and reducing the time spent in emergency care.

Reduction in the Use of Disposable Healthcare Supplies: By providing accurate and readily available patient information, self-health records help minimize unnecessary tests and procedures. This not only conserves healthcare resources but also significantly reduces the generation of waste.

Lowering the Risk of Healthcare Accidents: The detailed and up-to-date information contained in self-health records reduces the likelihood of medical errors and adverse events, such as allergic reactions or incorrect medication dosages. Healthcare providers can make informed decisions based on comprehensive patient data, thus enhancing patient safety.

Enhancing the Continuity of Healthcare Services: Self-health records ensure that patient information is consistent and accessible across different healthcare settings. This continuity is crucial for managing chronic conditions and providing coordinated care, which is particularly important in a multi-level healthcare system.

Build Community Forum

Decrease in Unnecessary Hospital Visits: The community forum provides a platform for individuals to seek advice and share experiences related to health concerns, which can prevent unnecessary hospital visits. By addressing minor health issues or questions through community support, residents can avoid trips to the hospital unless medically necessary, thereby reducing the pressure on healthcare facilities.

Reduction in Carbon Emissions: Fewer unnecessary hospital visits translate into reduced vehicular traffic, which directly lowers carbon emissions associated with healthcare transportation. This contribution is critical in promoting environmental sustainability and aligns with broader goals to reduce the carbon footprint of the healthcare sector.

Cultivation of a Knowledge-Sharing Culture: The forum encourages residents to exchange health-related knowledge and advice, fostering a culture of learning and mutual aid. This culture not only enhances individual and community health literacy but also strengthens the overall resilience of the community.

Mitigation of Isolation and Anxiety: By connecting individuals with their peers who may be experiencing similar health issues, the community forum helps mitigate feelings of isolation and anxiety. This support network is especially beneficial for individuals dealing with chronic conditions or those in remote areas, providing them with a sense of belonging and emotional support.

Disseminate emergency information

Lifesaving and Injury Reduction: Providing timely and accurate emergency information is essential for saving lives and reducing injuries. By ensuring that critical alerts and safety instructions reach the public quickly, individuals can take appropriate actions sooner, significantly mitigating the risks associated with emergencies.

Cost Mitigation Related to Disasters: Effective communication of emergency information helps in reducing the economic impact of disasters. Well-informed communities can better prepare and respond to emergencies, which in turn decreases the need for extensive post-disaster recovery efforts.

Minimization of Public Panic: Clear, consistent, and factual emergency communications play an important role in reducing fear and panic among the public. By providing reliable information and practical guidance during crises, the system helps maintain public order and prevents the spread of misinformation that can lead to unnecessary distress and chaotic responses.

Adapt inclusive notifications

Minimization of Property and Infrastructure Damage: By ensuring that timely and relevant notifications reach all the population, the system helps residents take appropriate preventative measures. This widespread dissemination of information can significantly reduce the extent of damage to property and infrastructure during emergencies.

Reduction of Injuries: Inclusive notifications also play a crucial role in injury prevention. By informing all community members about potential hazards and emergency procedures, individuals can be better prepared to protect themselves and others, leading to a noticeable decrease in injuries during disaster events.

Enhancement of Community Inclusivity: By adapting the notification system to meet diverse community needs, including language preferences and accessibility for people with disabilities, the system promotes inclusivity. This ensures that vulnerable populations, such as those with hearing or visual impairments, the elderly, and non-native speakers, receive and understand emergency information.

Provide online healthcare consultation

Reduction in Travel Needs: Online consultations significantly reduce the need for patients to travel to healthcare facilities for non-emergency consultations. This not only saves patients' time and resources but also contributes to lowering carbon emissions by decreasing the number of vehicles on the road.

Ensuring Continuity of Care: The availability of online consultations is particularly crucial when physical access to healthcare facilities is hindered, such as during natural disasters, pandemics, or even personal mobility constraints. This system ensures that patients continue to receive the care they need without interruptions, maintaining treatment effectiveness and patient well-being.

Promotion of Technological Acceptance in Healthcare: By providing a reliable and efficient online consultation service, the system promotes a broader acceptance and integration of technology within the healthcare industry. Patients and healthcare providers can become more accustomed to and supportive of using digital tools for health management, paving the way for further innovations in healthcare delivery.

Improvement in Healthcare Accessibility: Online consultations make healthcare more accessible to various populations, including those in remote or underserved areas, the elderly, or individuals with mobility issues. This expansion of access helps to ensure that more people can receive timely healthcare attention regardless of their physical location.

Interact with E.H.R

Reduction in Paper Record Reliance: By shifting from paper to electronic records, the system reduces the use of paper, which not only saves resources but also lowers carbon emissions associated with paper production, storage, and disposal. This transition supports environmental sustainability efforts within the healthcare industry.

Reduction in Unnecessary Procedures: E.H.R. systems provide comprehensive and accessible patient histories, which help healthcare providers avoid redundant or unnecessary tests and treatments. This not only reduces the cost and time involved in patient care but also minimizes the risk of over-treatment and potential side effects for patients.

Enhanced Accessibility to Healthcare Information: EHRs allow for quick and easy access to patient records by authorized personnel across different healthcare settings. This accessibility improves the coordination of care, especially for patients with complex or ongoing health issues, ensuring that all health professionals involved in a patient's care have up-to-date information.

Optimization of Resource Allocation: With better tracking of health interventions and outcomes through EHRs, healthcare facilities can more effectively allocate their resources. This optimization can lead to more targeted and efficient use of healthcare supplies, personnel, and financial resources.

Fostering Transparency in Healthcare: EHRs contribute to greater transparency within the healthcare system. They provide a clear trail of all interactions and treatments, which can be crucial for legal, medical, or administrative reviews. This transparency helps build trust and accountability between patients and healthcare providers.

Public healthcare education

Reduction in Healthcare Costs: By educating the public on preventive healthcare practices and safety measures, the system helps reduce the incidence and severity of injuries and illnesses. This preventive approach lessens the demand for healthcare services, therefore leading to lower healthcare costs associated with treatments.

Reduction in Public Panic: Effective healthcare education equips individuals with the knowledge and skills needed to respond calmly and effectively in emergencies. By improving self-sufficiency and preparedness, the system helps minimize panic during crisis situations, leading to more orderly and efficient emergency responses.

Increased Health and Safety Awareness: The educational initiatives raise public awareness about the importance of health, safety, and preparedness. By prioritizing these aspects, individuals are more likely to adopt healthier lifestyles, adhere to safety regulations, and prepare adequately for potential emergencies, enhancing both individual and community well-being.

8.2

EVALUATION OF THE NEW SYSTEM

In our study, we conducted a comprehensive evaluation of the overall resilience of both the old and new systems using a systemic approach. This analysis was designed to assess the robustness and adaptability of each system in response to various stress and challenges, providing a detailed comparison that highlights the strengths and potential areas for improvement.

The resilience of each system was measured by 12 key indicators, which provided a structured framework to evaluate how well each system could maintain functionality and recover from disruptions caused by emergencies. These indicators encompassed various dimensions such as physical robustness, operational flexibility, and the ability to quickly restore fundamental services.

We also considered the capacity of each system to adapt to changing conditions over time, which is essential for long-term resilience. This adaptive capacity includes the system's ability to learn from past disturbances, implement changes based on these learnings, and prepare for future risks. Additionally, we examined the interconnection of each system with its external environment, which affects its ability to utilize external resources and support when addressing and recovering from disruptions.

This comprehensive evaluation approach ensures a holistic assessment of system resilience, highlighting strengths and identifying areas for enhancement to better withstand future challenges.

Figure 36.
System Evaluation

Indicators	Description	Score (1 — 5)
1. Response Speed	The speed at which relevant departments take action after receiving notification of an emergency.	
2. Speed of information transmission	The speed of information transmission and communication between components within the system.	
3. Resource Allocation and Management	The flexibility and effectiveness of the system in reallocating resources as the emergency situation evolves.	
4. Staff Preparedness	Whether the early training provided to employees has improved their ability to respond to emergencies.	
5. Interoperability	Whether interoperable communication systems with the same standards are used.	
6. legally support	Whether the government has introduced support policies for some key nodes within the system.	
7. Post-Emergency Evaluation and Feedback	The effectiveness and accuracy of post-emergency evaluations, and the effectiveness of incorporating feedback and lessons learned into ongoing improvement efforts.	
8. Public involvement	The clarity, accuracy, and timeliness of the mechanisms for disseminating information to the public before, during, and after an emergency.	
9. Scalability and Flexibility	The system's ability to scale up or down its response based on the development of the emergency.	
10. Acceptance of information	Whether information about the occurrence of an emergency can be received and promptly addressed by government departments with higher authority.	
11. Equity and Accessibility	Whether the system ensures that all community members have equal access to emergency resources and support.	
12. Accuracy and Quality of Information	The accuracy and quality of the information transmitted at different stages.	

New system

Previous system

Based on the evaluation chart, it's evident that the new system represents a considerable improvement over the previous system across several critical indicators for emergency management. And overall, these enhancements suggest that the new system is more robust, responsive, and equipped to manage emergencies effectively. It not only enhances the operational capabilities but also ensures that timely information sharing, and system adaptability are prioritized, which are critical for maintaining public trust and ensuring all community members have equitable access to necessary support.

09.

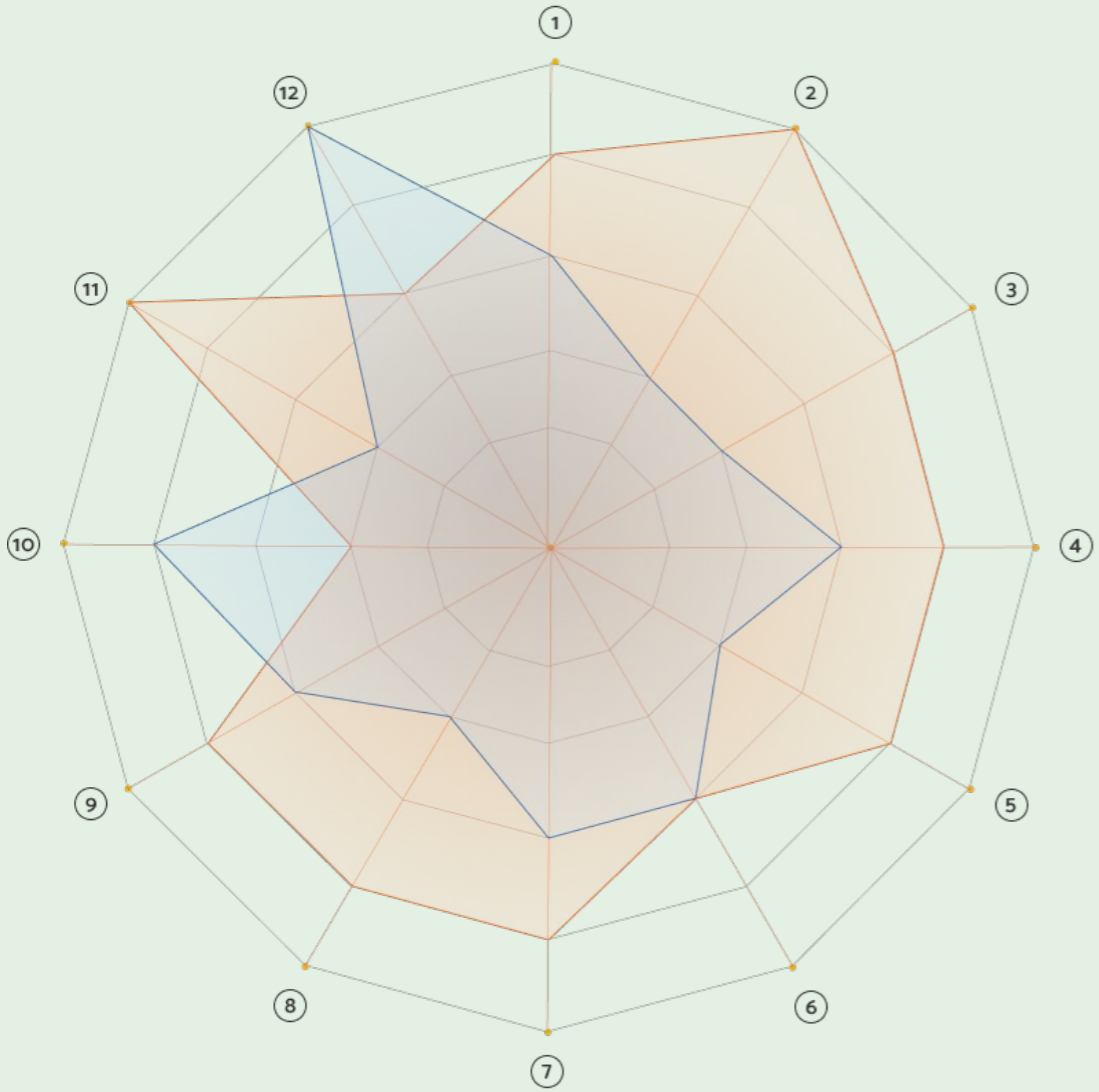
CONCLUSION

BY ASSESSING MULTIPLE AXES, WE COULD HIGHLIGHT AREAS WHERE SIGNIFICANT *IMPROVEMENTS* HAVE BEEN MADE AND WHERE FURTHER ENHANCEMENTS MIGHT STILL BE NEEDED.

9.1
IMPROVEMENTS ANALYSIS

Next, we conducted a comparison of both the old and new emergency response systems by visualizing their composite scores through a radar chart. This visualization technique allowed us to clearly describe their performances across different dimensions. The chart provides a comprehensive view of each system's strengths and weaknesses which facilitates an intuitive understanding of how the new system has improved over the old one. By assessing multiple axes, we could effectively highlight areas where significant improvements have been made and where further enhancements might still be needed. This method of representation not only enhances the analysis but also aids in transparently communicating the comparative efficacy of the emergency response systems to stakeholders.

Figure 37.
Performance Comparison between Previous System and New System



Overall Score:

Before: 34

After: 46

35% *Improved*

Previous System

New System

1. Response Time.
2. Speed of information transmission
3. Resource Allocation and Management
4. Staff Preparedness
5. Interoperability
6. legally support
7. Post-Emergency Evaluation and Feedback
8. Public involvement
9. Scalability and Flexibility
10. Acceptance of information
11. Equity and Accessibility
12. Accuracy and Quality of Information

To sum up with, the redesigned system showed a 35% improvement in overall resilience compared to the baseline established by the old system. However, while the new system generally performed better across most dimensions, it did score slightly lower in two specific areas: the eleventh indicator - acceptance of information, and the twelfth - accuracy and quality of information. These areas represent opportunities for further refinement to enhance the system's effectiveness.

This disparity can be attributed to the structural differences in the feedback mechanisms between the two systems. In the old system, the information feedback loop was mainly established among governmental departments, creating a streamlined flow where reports from subordinate departments were routinely processed and incorporated within standard procedural frameworks [1]. This method ensured that information, once submitted, was consistently adopted and handled in a structured manner, reinforcing the reliability of the data.

Conversely, the new system implements a more broad feedback mechanism designed to engage a wider range of stakeholders. While this approach broadens the scope of input and enhances the diversity of perspectives, it also introduces challenges related to the timely processing and potential prioritization of information. The broader scale of this new feedback loop can sometimes lead to delays or the neglect of certain pieces of information as it passes through more complex channels.

Moreover, the previous system's linear and layered communication structure had the advantage of reinforcing the accuracy of information through successive verifications at each level of the hierarchy. This process of confirmation helped ensure that decision-makers received thoroughly examined and precise information, enabling accurate perceptions of ongoing situations.

In conclusion, while the new system shows marked improvements in most areas, it also highlights areas needing refinement, particularly in optimizing information flow and ensuring the accuracy and timeliness of feedback. These insights point to the need for continuous adjustments and policy implementation to balance the feedback mechanism's inclusivity with the operational efficiency and reliability of information processing.

9.2

LIMITATION OF THE RESEARCH

This study, aimed at building a more resilient healthcare system in Zhengzhou City with an emphasis on enhanced information sharing among different stakeholders under the pressures of climate change, has provided practical insights from a systemic way and proposed innovative solutions to pressing challenges not only in the healthcare system but also in the whole territory. However, it is essential to recognize the limitations that influenced the research scope, methodology, and ultimately the conclusions drawn. Acknowledging these limitations is crucial for accurately interpreting the study's findings.

1. Scope Limitations: The scope of our study was necessarily focused on specific aspects of the healthcare and emergency response systems within Zhengzhou, driven by the urgent need to address the impacts of climate change. This focus meant that some potentially influential factors, such as broader socio-political dynamics or deeper analyses the intricate relationships among government departments, the healthcare system, and citizens within the framework of legal and regulatory guidelines, were not detailly covered. Also, the study's concentration on Zhengzhou might limit the applicability of its findings to other regions without similar geographic, demographic, and climatic conditions.

2. Data Constraints: Our research generally relied on publicly available data, which included historical data, current policies, and previous studies on Zhengzhou's healthcare system and its response to emergencies. While extensive, the data could be subject to inaccuracies inherent in retrospective analyses and may not fully capture real-time dynamics or predict future trends accurately. The availability and reliability of data, especially concerning climate change impacts, were significant constraints that could affect the depth and breadth of our findings.

3. Methodological Limitations: The methodology applied in our study, while comprehensive, involved certain choices and assumptions that could influence the outcomes.

For instance, the decision to use specific frameworks and models for system redesign and evaluation could introduce biases or overlook alternative effective approaches. Our methodological tools were selected to best fit the available data and the specific context of Zhengzhou, which might not be as effective in other contexts or with different sets of data.

4. Generalizability and Transferability: The findings and recommendations of this study are specifically tailored to Zhengzhou's unique conditions as a city experiencing rapid change due to both urbanization and climate impacts. Therefore, the generalizability of these findings to other cities, even within China, may be limited. The transferability of our proposed solutions to cities with different healthcare infrastructures, economic backgrounds, or climate challenges requires careful adaptation and may need significant modification.

5. Future Changes and Uncertainties: Our study's conclusion and proposed system designs are based on current and historical trends, which are subject to changes and uncertainties. The pace of technological advancement shifts in policy, and unforeseen socio-economic changes can all dramatically influence the effectiveness and relevance of the proposed designs. Furthermore, the continuously evolving climate change may introduce new challenges that were not anticipated at the time of this study, requiring ongoing adaptation and flexibility in the healthcare system.

In conclusion, while this study provides a foundational step towards enhancing Zhengzhou's healthcare system in response to climate-induced challenges, the outlined limitations highlight the need for ongoing research, monitoring, and adaptation. Future studies should aim to expand the data sources, incorporate broader geographic and systemic analysis, and continuously update the methodologies to keep pace with the rapid changes in technology, policy, and climate science. This will ensure that Zhengzhou's healthcare system remains robust, responsive, and resilient in the face of future challenges.

9.3

POSSIBLE DEVELOPMENTS

As Zhengzhou continues to evolve under the pressures of urbanization, climate change, and demographic shifts, the relationships between government bodies, the healthcare system, and citizens are likely to experience significant transformations. This chapter explores the possible developments in these relationships, focusing on the legal and regulatory frameworks that will shape future interactions and the overall efficacy of the healthcare system.

1. Enhancement of Healthcare Legislation: Future developments may include the establishment of a more human-centered and comprehensive legal framework for healthcare. Such reforms would aim to promote equity in healthcare services from a legal standpoint, ensuring that all individuals have access to necessary healthcare services in any situation [2]. This initiative emphasizes the commitment to integrating principles of fairness and accessibility into the healthcare legal system.

2. Expansion of Healthcare Services: It is necessary to enhance the development and refinement of digital healthcare services, with a particular focus on improving accessibility and compliance during emergency scenarios. At the same time, efforts should be directed towards increasing the prevalence of community doctors and improving their professional capabilities and qualifications. Such enhancements will enable community doctors to build stronger trust relationships with residents, thereby effectively reducing the operational load on large public hospitals.

3. Advancements in Health Technology:
Legal and regulatory adjustments may pave the way for advanced technological integration in the healthcare system. This could include the use of big data and AI [3] to improve healthcare delivery and policy making, with strong legal safeguards to protect patient privacy and data security. The government's role in regulating and facilitating technological adoption in healthcare will be crucial in maximizing benefits and minimizing risks [4].

4. Strengthening of Legal Frameworks for Emergency Response [5]:
Considering the distinct geographical and climatic characteristics of the region, it is important to conduct a detailed analysis of the potential risks posed by climate change while establish comprehensive emergency response strategies and operational procedures. Furthermore, it is crucial to establish clear legal mandates clarifying the specific responsibilities and collaborative frameworks for all relevant organizations to ensure that, in the event of any emergency, each entity can efficiently fulfill its designated role and collaborate effectively, thereby guaranteeing the execution of emergency operations.

5. Innovative Insurance Models:
Promote the development of insurance products that specifically address the risks associated with climate change. These could include parametric insurance policies that pay out quickly based on the occurrence of specific environmental triggers, helping to stabilize economies and rebuild communities post-disaster more quickly.

6. Establish comprehensive volunteer service framework [6]: In the community, mobilize proactive residents to create structured volunteer teams. Implement essential training programs and define clear channels of communication along with specific roles and responsibilities among team members. This preparation enables the community to initiate effective self-rescue operations under the guidance of trained volunteers, particularly when government support is delayed during emergency situations.

In conclusion, these developments will not only improve the healthcare system's efficiency and compliance but also foster a more resilient, inclusive, and adaptive community. By prioritizing these strategic initiatives, Zhengzhou can ensure that its healthcare system is well-equipped to handle future challenges, ultimately benefiting all stakeholders involved.

References :

1.Li, H., Zhang, X., Tang, W., Bao, J., Ye, X., & Wang, L. (2014). Discussion on the medical emergency decision-making mechanism from a collaborative perspective. Chinese Journal of Public Health Management, 2024(1), 91-94. https://doi.org/10.19568/j.cnki.23-1318.2014.01.043

2. Qiu, Y., Huang, Z., Liu, S., Chen, Y., Xu, Y., & Xu, F. (2023). Construction of a medical data security system based on domestic cloud-native technology. Modern Hospital, 2023(12), 1889-1893. https://doi.org/CNKI:SUN:XDYU.0.2023-12-022

3. Janjua, M. B., Duranay, A. E., & Arslan, H. (2020). Role of wireless communication in healthcare system to cater disaster situations under 6G vision. Frontiers in Communications and Networks, 1, 610879. https://doi.org/10.3389/frcmn.2020.610879

4. Li, S. (2023). The internal mechanism and optimization path of emergency management operation rules empowered by digital technology. Administrative Forum, 2023(5), 122-129. https://doi.org/10.16637/j.cnki.23-1360/d.2023.05.002

5. Dai, H. (2023). The generation logic, core essentials, and practical unfolding of the rule of law in emergency management in the new era. Journal of the Party School of the Central Committee of the CPC (National Academy of Governance), 2023(4), 139-149. https://doi.org/10.14119/j.cnki.zgxb.2023.04.012

6. Tian, W., Zhao, Y., & Wei, H. (2023). Volunteer collaboration in natural disaster response: A case study based on Zhuoming Disaster Information Service Center. Chinese Public Administration, 2023(1), 130-138. https://doi.org/10.19735/j.issn.1006-0863.2023.01.15

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