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Optimization and Practice of the Emergency Response Mechanism of Primary Healthcare Institutions in Plague Prevention and Control

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Abstract: As a Class A infectious disease legally stipulated in China, plague is characterized by rapid transmission and high fatality rate, and its prevention and control effectiveness is directly related to public health security and social stability. As the "first line of defense" in the infectious disease prevention and control system, primary healthcare institutions play a key role in the early detection, timely reporting, and preliminary handling of plague outbreaks. This paper systematically analyzes the existing problems in the emergency response mechanism of primary healthcare institutions in the context of China's plague prevention and control efforts and proposes targeted optimization strategies. Through analysis, it aims to provide references for improving the emergency response system for plague prevention and control in primary healthcare institutions, comprehensively enhancing the emergency response capabilities of primary public health institutions, and strengthening the grassroots defense against plague.

Keywords: Plague prevention and control; Primary healthcare institutions; Emergency response mechanism; Optimization strategies; Public health

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1. Introduction

China is a country with a history of plague endemics, and currently, there are still natural plague foci in 19 provinces (autonomous regions), including Inner Mongolia, Qinghai, Tibet, and Gansu. The total area of these foci accounts for over 10% of the country's land area, making plague prevention and control a long-term and complex task [1]. In recent years, influenced by factors such as ecological environmental changes, increased population mobility, and more frequent field operations, the risk of plague transmission from endemic to non-endemic areas has continued to rise, posing a potential threat to public health security [2]. Primary healthcare institutions serve as the "last mile" connecting the public health system with residents, and their emergency response capabilities directly determine whether plague outbreaks can be detected, reported, isolated, and treated early. However, constrained by factors such as uneven allocation of primary public health resources, limited professional capabilities of medical personnel, and inadequate coordination mechanisms, some primary healthcare institutions face issues such as low response efficiency, difficulty in case identification, and weak handling capabilities in plague prevention and control emergency responses. Therefore, optimizing the emergency

response mechanism for plague prevention and control in primary-level medical institutions is not only a key measure to enhance the overall effectiveness of plague prevention and control but also an important practice to fulfill the requirement of "strengthening primary-level public health services" outlined in the "Healthy China 2030" Plan Outline. It holds significant importance for constructing a modern public health emergency response system.

2. Current status and issues of the emergency response mechanism for plague prevention and control in primary-level medical institutions

2.1. Inadequate organizational structure and insufficient implementation of responsibilities

Some primary-level medical institutions have not established dedicated emergency response teams for plague prevention and control, with routine prevention and control efforts often being handled on a part-time basis by the public health department. This results in a lack of targeted and systematic prevention and control measures. Even in primary-level medical institutions located in plague-endemic areas, emergency response teams are often formed on an ad-hoc basis, with members solely from the public health department, excluding key personnel from clinical departments, pharmacies, logistics, and other essential sectors. This leads to issues of poor coordination, overlapping responsibilities, or gaps in responsibilities among departments during emergency responses. Additionally, the "Emergency Plan for Plague Prevention and Control" in some primary-level medical institutions simply replicates content from higher-level documents without tailoring responsibilities to local conditions, such as the distribution of plague foci, population structure, and transportation conditions. Specific tasks, such as "who is responsible for reporting cases," "who is responsible for environmental disinfection," and "who is responsible for contacting higher-level authorities," are not clearly defined, resulting in buck-passing and a lack of leadership during emergency responses, severely impacting response efficiency.

2.2. Weak monitoring and early warning capabilities make early identification difficult

The professional capacity of medical personnel in primary-level medical institutions for plague prevention and control is generally inadequate. Due to the low incidence of plague, most medical personnel lack clinical practical experience and have a poor grasp of the typical symptoms, transmission routes, and identification criteria for high-risk groups of plague, making it difficult to accurately distinguish suspected plague cases from common infectious diseases. Some medical personnel in primary-level medical institutions located in non-endemic areas even have a complete lack of knowledge about plague prevention and control, rendering them unable to conduct effective preliminary screenings [3]. Furthermore, the monitoring methods employed by primary-level medical institutions are relatively limited. Most institutions do not have rapid plague detection equipment and can only conduct preliminary monitoring through symptom observation, without the ability to quickly confirm cases through laboratory testing. This results in difficulty distinguishing suspected plague cases from common cases, leading to potential issues of "false negatives" or "false positives." In addition, some primary-level medical institutions have not strictly implemented the reporting system for Category A infectious diseases. There have been irregularities such as seeking approval from the hospital director before reporting, using oral reports instead of systematic reports, and incomplete report content. These issues have led to delayed reporting or missing information, which in turn affects the timely assessment and response to the epidemic situation by higher-level departments.

2.3. Insufficient resource support and lack of emergency response support

In terms of material support, some primary-level medical institutions have not established a special reserve for plague prevention and control materials. They only make temporary purchases of a small quantity of materials before inspections by superior authorities. Moreover, the types of materials are incomplete, and the quantities are insufficient, lacking key materials such as N95 masks, protective suits, rapid detection reagents for plague, and emergency medicines. Even if some institutions have stockpiled materials, they have not established a dynamic management mechanism, leading to frequent occurrences of expired and damaged materials that cannot meet the needs of emergency response. In terms of

human resources, the number of public health personnel in primary-level medical institutions is generally insufficient. Most township health centers are only equipped with 1–2 public health personnel who are simultaneously responsible for multiple tasks, including chronic disease management, vaccination, infectious disease prevention and control, etc. The workload is heavy, making it difficult for them to focus on plague prevention and control. Additionally, the high turnover rate of medical staff at the grassroots level results in poor stability of the workforce, making it difficult to ensure the continuity of prevention and control work. Furthermore, plague prevention and control training in primary-level medical institutions is mostly conducted through short-term online training, with a focus on theoretical knowledge and a lack of practical drills. As a result, medical personnel have weak practical emergency response capabilities and are prone to panic and non-standard operations when facing sudden outbreaks. In terms of funding support, the plague prevention and control funds of primary-level medical institutions mainly rely on basic public health service funds. However, these funds need to be allocated for multiple public health tasks, and the proportion allocated to plague prevention and control is low, making it difficult to support the regular implementation of material reserves, training drills, health education, and other work. This results in a lack of resource support for prevention and control work.

2.4. Inefficient collaboration and barriers to information sharing

Some primary-level medical institutions have issues with an inadequate linkage mechanism with county-level CDCs. There is a lack of regular communication channels, and contact is only made temporarily after suspected cases emerge. This results in the county-level CDC being unable to promptly provide primary-level medical institutions with key information, such as monitoring data on epidemic sources and updates on prevention and control policies. Similarly, primary-level medical institutions cannot promptly provide feedback on suspected case leads and prevention and control difficulties within their jurisdictions. The delayed information transmission between both parties affects the coordination of prevention and control work. Meanwhile, primary-level medical institutions have not established a “green channel” with superior designated hospitals for plague treatment. When referring suspected cases, they need to arrange vehicles and go through cumbersome procedures on their own, and there is a lack of dedicated personnel for coordination. This results in delayed referrals and affects the efficiency of patient treatment [4]. Additionally, primary-level medical institutions have not fully collaborated with township governments, village (neighborhood) committees, grid staff, and other grassroots governance forces, failing to promptly obtain key information such as the “dynamics of outdoor workers,” “history of contact with wild animals,” and “situation of the floating population” within their jurisdictions. This leads to “blind spots” in the monitoring of high-risk populations and prevents the realization of “proactive detection and precise prevention and control” [5].

3. Optimization strategies for the emergency response mechanism of plague prevention and control in primary-level medical institutions

3.1. Optimizing organizational structure and responsibility system, clarifying division of responsibilities

3.1.1. Establishing a hierarchical organizational structure

Construct a three-tier emergency response organization system for plague prevention and control, involving “county-level health departments - primary-level medical institutions - village clinics.” The county-level health department should establish an emergency response command group for plague prevention and control, headed by the director, with the deputy director serving as the deputy head. The group members include the heads of departments such as disease control, medical administration, and primary healthcare, responsible for coordinating the emergency response work of primary-level medical institutions and conducting regular supervision and inspections. Primary-level medical institutions should establish an emergency response working group for plague prevention and control, headed by the hospital director, with the director of the public health department serving as the deputy head. The group members include clinical doctors, nurses, the heads of the pharmacy and logistics departments, ensuring that all key departments participate in the emergency

response. Village clinics should designate village doctors as the primary responsible persons for plague prevention and control and appoint a member of the village (neighborhood) committee to assist in the work, responsible for preliminary screening of suspected cases, information reporting, health education, and other basic tasks within their jurisdiction.

3.1.2. Refining the responsibility list

Primary-level medical institutions should develop a "Responsibility List for Emergency Response to Plague Prevention and Control" based on local conditions, clarifying the specific responsibilities and workflows of each position [6]. Outpatient doctors are responsible for admitting patients with fever, immediately implementing isolation measures for patients who meet the criteria for suspected cases, filling out the "Suspected Plague Case Registration Form," and notifying the Public Health Department. Upon receiving the notification, personnel from the Public Health Department must complete the reporting of suspected cases through the "China Disease Prevention and Control Information System" within 10 minutes, while simultaneously reporting by phone to the County-level CDC. They also assist in identifying and registering close contacts and establish a "Close Contact Ledger." The person in charge of the pharmacy is responsible for the daily management and allocation of plague prevention and control supplies, ensuring rapid availability of emergency supplies. Upon receiving the isolation notification, the person in charge of logistics must conduct initial disinfection of the patient contact area within 30 minutes, using chlorine-containing disinfectants to wipe surfaces and ventilate the area to ensure environmental safety.

3.2. Strengthen monitoring and early warning capacity building to enhance early identification efficiency

3.2.1. Conduct differentiated training to enhance the professional capabilities of medical personnel

Develop differentiated training programs for primary healthcare institutions in plague-endemic and non-endemic areas. In plague-endemic areas, conduct specialized training once every quarter, while in non-endemic areas, conduct training once every six months. The training content covers plague epidemiology, symptom identification, case management, personal protection, and reporting standards. Additionally, incorporate domestic typical cases into the teaching and organize practical drills on "identifying and managing suspected cases," simulating scenarios such as "admitting patients with fever and swollen lymph nodes" and practicing the entire process of "isolation-reporting-disinfection-referral." County-level CDCs regularly send experts to provide on-site guidance at primary healthcare institutions, answering questions to enhance training effectiveness [7].

3.2.2. Improve the monitoring network and diversify monitoring methods

Establish a three-dimensional monitoring network consisting of "symptom monitoring + high-risk population monitoring + plague-endemic area information monitoring" [8]. Symptom monitoring is conducted through outpatient consultations, village doctor visits, and family doctor services, with a focus on patients with fever accompanied by swollen lymph nodes or respiratory symptoms. High-risk population monitoring targets farmers, herders, and field workers, conducting monthly follow-ups to record contact history and health status. Plague-endemic area information monitoring involves real-time collaboration with county-level CDCs to obtain data on rodent density and flea indices. At the same time, equip key institutions in both plague foci and non-plague foci with rapid plague detection reagents to enable on-site preliminary screening of suspected cases and shorten confirmation time.

3.2.3. Standardize reporting procedures to ensure timely and accurate information

Clarify that the first-attending physician is the primary responsible person for reporting. Upon discovering suspected cases, they can first report through the information system and then notify the hospital dean, streamlining the process to avoid delays. County-level health departments should open a green channel for reporting, and county-level CDCs should respond and provide guidance within one hour of receiving reports. Additionally, establish a supervision mechanism where county-

level health departments inspect the timeliness, completeness, and accuracy of reports every month, publicly criticize institutions and individuals for delays, omissions, or misreports, and incorporate reporting performance into grassroots performance evaluations to strengthen accountability.

3.3. Strengthen resource support to lay a solid foundation for emergency response

3.3.1. Establish a standardized material reserve system

Develop the "Standards for Material Reserves for Plague Prevention and Control in Grassroots Medical Institutions," specifying the types, quantities, and expiration dates of material reserves for township health centers and village clinics in both plague foci and non-plague foci. For example, township health centers in plague foci are required to have 500 N95 masks and 30 sets of protective suits, while village clinics should have 50 N95 masks and 5 sets of protective suits. Establish a dynamic material management mechanism where designated personnel at the grassroots level conduct monthly inventories to promptly replenish shortages and replace expired materials; county-level health departments should conduct regular inspections and order rectifications for institutions that fail to meet standards [9].

3.3.2. Strengthen human resource development

Implement policies such as targeted recruitment, on-the-job training, and preferential professional title assessments to bolster staffing, ensuring that each township health center has at least two full-time public health professionals responsible for plague prevention and control. Incorporate plague prevention and control knowledge into the continuing education of medical personnel, and regularly conduct online theoretical training and offline practical drills. Establish a "county-township collaboration" support mechanism, where county-level hospitals and Centers for Disease Control and Prevention (CDC) dispatch experts to provide on-site guidance, enhancing the quality of the grassroots workforce.

3.3.3. Ensure dedicated funding

County-level finance should allocate special funds for plague prevention and control, clarifying their sources and uses. These funds should be exclusively used for material reserves, training drills, and other purposes, and not be mixed with other funds. A dynamic adjustment mechanism for funding should be established, with annual adjustments based on changes in plague foci, price levels, and other factors. County-level health departments should strengthen supervision and conduct regular audits to ensure that funds are used for their designated purposes.

3.4. Improve the collaborative and linkage mechanism, break down barriers to information sharing

3.4.1. Strengthen linkage with county-level CDCs

Establish a regular communication mechanism between "primary healthcare institutions and county-level CDCs," with weekly online meetings. Primary healthcare institutions provide feedback on surveillance situations, suspected case leads, and prevention and control challenges, while CDCs share data on plague foci, policy updates, and technical guidelines, enabling real-time information sharing. The CDC should establish a technical guidance team to visit primary healthcare institutions monthly to guide the improvement of contingency plans, standardize procedures, and enhance capabilities. Additionally, a 24-hour emergency response mechanism should be established to ensure that primary healthcare institutions receive professional support promptly in case of emergencies.

3.4.2. Improve coordination with higher-level designated hospitals

Both parties should establish a green channel for the referral of suspected cases, signing agreements that clearly outline the process, division of responsibilities, and contact information, with designated personnel for coordination. Primary healthcare institutions can directly call a dedicated phone number upon discovering suspected cases, and the hospital should arrange an ambulance and medical staff within one hour, making necessary preparations for admission to achieve "seamless connection." Simultaneously, an information-sharing mechanism should be established, with primary healthcare

institutions providing preliminary diagnoses and contact histories of patients, and hospitals providing feedback on confirmed results and treatment progress to inform prevention and control efforts.

3.4.3. Strengthen linkage with grassroots governance forces

Primary healthcare institutions should establish a collaborative prevention and control mechanism with township governments, village (neighborhood) committees, and grid staff, integrating plague prevention and control into grassroots governance and clarifying the responsibilities of all parties. Village (neighborhood) committees and grid staff should assist in conducting screenings of high-risk populations, health education, and environmental disinfection, providing information on the dynamics of outdoor workers, wildlife contact histories, and floating population data to eliminate surveillance blind spots. Additionally, an information-sharing platform should be established to facilitate information exchange and coordinated actions among all parties, thereby forming a joint force for prevention and control.

3.5. Improve plan management and drills to enhance emergency response capabilities

Primary-level medical institutions should regularly revise their "Emergency Response Plan for Plague Prevention and Control" based on local conditions. Each year, the plan should be optimized and updated based on factors such as changes in epidemic foci, policy adjustments, and resource availability to ensure its scientificity, relevance, and operability [10]. At the same time, a regular drill mechanism should be established. Primary-level medical institutions should conduct quarterly emergency drills for plague prevention and control, covering the entire process from identifying, isolating, reporting, and transferring suspected cases to environmental disinfection and close contact tracing. Drills should take various forms, including tabletop exercises and live-action drills, and should be conducted with on-site guidance from experts from county-level health departments, CDCs, and designated hospitals. After drills, problems should be promptly summarized, and processes optimized to continuously improve the practicality of the emergency plan and emergency response capabilities. Additionally, primary-level medical institutions should establish an emergency response evaluation mechanism. After each emergency response or drill, evaluations should be conducted from dimensions such as "response speed, handling standards, coordination efficiency, and resource support," and evaluation reports should be formed. Based on identified issues, corrective measures should be developed to continuously optimize the emergency response mechanism and ensure a steady improvement in emergency response capabilities.

4. Conclusion

As the "first line of defense" in plague prevention and control, the completeness of the emergency response mechanism of primary-level medical institutions directly determines the effectiveness of plague prevention and control efforts. In the future, with the continuous advancement of China's public health system construction, the emergency response mechanism for plague prevention and control in primary-level medical institutions needs to further develop towards "intelligence, precision, and regularity." By introducing technologies such as big data and artificial intelligence, an intelligent monitoring and early warning system can be constructed to achieve automatic identification of suspected cases, precise location of at-risk populations, and intelligent allocation of prevention and control resources. Through deepening the integration of medical treatment and prevention reforms, primary-level medical institutions and public health institutions can be promoted to collaborate deeply, transforming prevention and control efforts from "passive response" to "active prevention." By strengthening regional coordination and international cooperation, the overall effectiveness of plague prevention and control can be enhanced, providing solid support for safeguarding the health of the people and public health security.

Disclosure statement

The author declares no conflict of interest.

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