Application of Project Management in Epidemic Prevention and Control: A Case Study of Shanghai

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Abstract. COVID-19 is one of the hot topics in current research. Most researchers have summarized the basic methods and overall processes to deal with COVID-19. However, there are optimal solutions for the most effective COVID-19 response processes. Therefore, this paper summarizes and analyzes the optimal solutions for COVID-19. The research topic of this paper is the prevention and treatment of COVID-19. The research methods of this paper are as follows: first, we will understand the detection and screening methods of COVID-19; second, we will analyze the main methods to stop the spread of the epidemic; finally, we will use the formula to evaluate the risk and analyze the most efficient treatment process. The analysis and improvement methods in this paper can help government departments and relevant organizations better control the epidemic, accurately implement containment, and play an important role in the deployment of medical resources and the identification and screening of COVID-19 patients.

Keywords: Project Management; Epidemic Prevention; Case Study; Shanghai.

1. Introduction

The COVID-19 pandemic has been a hot topic in recent years. There are different sides of the argument from different walks of life on this topic. The COVID-19 virus is highly contagious, so how to manage people who get sick, and how to manage areas where cases occur, has become a hot topic recently. The most effective way to treat people with mild symptoms is to stay at home, but because the disease is contagious, anyone who has contact with someone who has been diagnosed with the disease can also catch it. People living in the same place should also be home quarantined for medical observation. Therefore, how to carry out medical observation on isolated people and how to make use of medical resources has become a topic worth exploring. According to George Gao who is the head of the Chinese Center for Disease Control and Prevention (CDC), Stopping the spread of COVID-19 as quickly as possible and reaching zero cases as soon as possible can reduce the loss of life and impact socio-economic progress caused by it [1]. However, the latest outbreak in Shanghai began on March 1, 2022. The outbreak is characterized by asymptomatic infections accounting for almost 90% of the total number of infected persons based on news reports and related articles, and the infecting virus is an Omicron mutant strain that spreads quickly and is highly insidious, and to completely contain and eliminate it, project management becomes particularly important.

Due to the characteristics of multiple, widespread, and frequent outbreaks, making it the most severe test since the prevention and control of the epidemic in Shanghai. And the uncertain and insidious nature of the spread of new viruses, the deployment of resources from the health department plays a key role in preventing and managing outbreaks. To better allocate work and coordinate resources, project management techniques are a particularly suitable management method for one-off jobs with limited resources, complex relationships, tight deadlines, and high levels of responsibility. Applying project management in epidemic prevention and control covers nine main areas: scope management, time management, cost management, quality management, information management, human resource management, risk management, procurement management, and general management. Among them, in human resource management and cost and time management, project management

techniques can clearly show budget and resource allocation, helping managers to better align policies and reduce waste of resources.

This study around will be COVID-19 related topics, from the covid-19 relevant screening, isolation, and treatment of the three related specific link analysis summarized, combined with the new champions league since the start of a large number of statements summary analysis of the existing text data, and using the project management related theory as the foundation. Based on the knowledge of critical path, PERT diagram, and risk management in project management, we analyzed and summarized the COVID-19 epidemic situation in Shanghai, summarizes the universal in major cities, regions, etc., Novel COVID-19 containment best practices, minimizing overall damage and bringing the outbreak under control in the fastest and most reasonable manner.

2. Literature review

The concept of project management has been widely applied in disaster resilience. Sameer et al. applied project management concepts and frameworks to disaster resilience and studied how groups can improve community resilience [2]. According to Alta Karli's study about the COVID-19 outbreak in China, the researchers think that the virus has posed a significant threat to health security, as it can cause serious health effects and even affect international trade. And it has also received attention from global health organizations [3]. During the COVID-19 pandemic, the quality committees have done something to help with the epidemic prevention work, they increased the frequency of meeting from once a month to once a week, they also provided specific skills training to caregivers. During the meeting, they discussed operating procedures for renewing leadership, changing policies and setting new standards, as well as the changing environment. Within the structure of their work, protocols and documents are created for approval and review by the Quality Control Committee, which is ultimately distributed throughout the organization. Includes guidelines for patient transportation, airway management, and the management of drug shortages in personal protective equipment [4].

On how to use project management skills to effectively control the spread of COVID-19, Travers et al. studied the influence of empowered work environments on the psychological experiences of nursing assistants during COVID-19. They used Kanter's theory of structural empowerment and Spreitzer's theory of psychological empowerment in the workplace and determined the conceptual impact of organizational practice on the psychological experience of empowerment. In-depth interviews were conducted with convenience samples of NAs from nursing inpatients with COVID-19. Targeted content analysis was conducted to generate a data matrix that includes psychological experiences of meaning, capability, self-determination, and influence embedded within organizational structure components of information, resources, support, and opportunity [5].

Bednarz stated that the risk analysis carried out systematically as part of the implementation project contributed to a rapid and effective response during the COVID-19 pandemic. Their study was to identify and assess the impact of COVID-19 on project management practices in healthcare facilities, in particular risk analysis, project performance, work organization of project teams, and trends in project management development. In order to achieve the objective, there are 20 project managers from polish healthcare organizations were studied. The result from that is what they stated in previous sentences [6].

3. Discussion

3.1 Epidemic surveillance and screening

3.1.1 Conventional methods

The large data prediction model for the user's electricity consumption is implemented in the Clementine software. In terms of specific detection methods, there are currently five conventional methods for COVID-19 detection:

(1) Novel Coronavirus nucleic acid test: the nucleic acid test is performed on nasopharyngeal secretions dipped in cotton swabs. If positive, it indicates a novel coronavirus infection, which requires laboratory confirmation. If a negative test does not rule out virus infection, you need to check again at least 24 hours later.

(2) Novel Coronavirus antibody testing: Novel Coronavirus antibodies are divided into IgM and IgG. If IgM and IgG are positive, the COVID-19 vaccine can be confirmed after exclusion.

(3) Other specimens can also be taken for testing. For example, bronchoscopy may be required to take alveolar lavage fluid for nucleic acid testing in patients with suspected COVID-19, especially in patients with the severe disease during endotracheal intubation.

(4) Chest CT: Chest CT can find ground glass shadow.

(5) Blood routine examination: The total number of white blood cells was normal or low, accompanied by a decrease in lymphocyte ratio.

Novel coronavirus tests are prone to a false negative, requiring multiple nucleic acid monitoring in combination with a medical history and if necessary. At present, the most commonly used novel Coronavirus nucleic acid tests are throat swabs and nose swabs.

3.1.2 Detection object and scheme

The object include: people who go to primary medical and health institutions with respiratory symptoms, fever, and other symptoms within 5 days; quarantine observation personnel, including those in home quarantine observation, close contact and sub-close contact, entry quarantine observation, sealed area, and controlled area and community residents in need of antigen self-detection.

It is worth mentioning that, due to the large scale of the epidemic and the need to consider the economy, most regions in China will first carry out 10 or five mixed tests to quickly identify the scope of the virus, and then conduct separate tests on specific small areas.

To take a concrete example: there are three levels of screening. First, all single tests or 1:5 mixed tests will be carried out from key groups. Single tests will be carried out for people in close contact, sub-close contact, isolated places, residents of communities where confirmed cases and asymptomatic infected persons live, medical staff, patients and caregivers in municipal hospitals, and all samples of close contacts. Secondly, the residents of the residential building of the sub-close contact and the staff of all medical institutions were all mixed with 1:5 samples. In addition, the general population according to 1:10 mixed detection. In the case of the 1:5 mix-up, the RAPID nucleic acid testing lab collected samples, such as nasopharyngeal swabs, from five people. The lab takes a portion of each sample and mixes it to make a mixed sample. The rapid nucleic acid testers then performed one diagnostic test on the mixed sample, rather than on each of the five samples. If the rapid nucleic acid test results of the mixed samples are negative, it can be inferred that all patients are nucleic acid negative. If they are positive, they need to go back and conduct a single RAPID nucleic acid test on each of the five samples to find out which one (several) is positive. The biggest advantage of mixed detection is that more people can be detected with less manpower and material resources at the same time. Thanks to the mixed testing method, Wuhan completed rapid nucleic acid testing of 6.5 million people in just nine days. When conducting mass screening in a country with a large population, it is not feasible to continuously test everyone because there are simply not enough resources and time to do so. Human resources for rapid nucleic acid testing are one aspect, and reagents required for rapid nucleic acid testing are another.

But the hybrid test has one major drawback: the false-negative rate increases and the accuracy decreases. Therefore, to avoid cross contamination in the sampling process, it is necessary to implement one person disinfection; The mixing room shall be disinfected after each batch of sample dilution and mixing operation. The swab should be completely soaked in the virus storage solution and the sample should be oscillated thoroughly (oscillating on an oscillator for 30 seconds) before and after mixing. It is recommended to evaluate the detection sensitivity of rapid nucleic acid detection reagents for COVID-19 and to select rapid nucleic acid detection reagents with high sensitivity and accuracy.

3.1.3 Disposal of test results

Primary-level medical and health institutions shall immediately report to the CDC of their jurisdiction for the transport of COVID-19 related personnel, and the emergency centers shall transfer the antigen-positive personnel to medical institutions with fever clinics for nucleic acid testing by the guidelines for the transport of COVID-19 related personnel.

Primary medical and health institutions should give symptomatic treatment to those who are negative for antigen tests, and ask them to stay at home for observation. They should take an antigen test once a day for 5 consecutive days from the day they see a doctor, avoid social activities, wear masks correctly, wash hands and ventilate frequently. If the antigen results remain negative until the symptoms disappear, no other intervention measures shall be taken. Once the antigen test is positive, the positive person should immediately report to his/her community (town), and the community (town) should contact the emergency center to transport him/her to a medical institution with a fever clinic for nucleic acid testing by the guidelines for transport of COVID-19-related personnel. The sample swabs, sample tubes, and test cards of positive personnel shall be put into sealed bags and transferred to medical institutions for disposal as medical waste.

The rapid interruption of the spread of the epidemic and the identification of the source of the epidemic first requires the flow of information. Shanghai's health care informatics work started early in China and has now established a wide range of interconnected regional informatics systems.

3.2 Stopping the spread of the epidemic

The development of information technology in the construction of the prevention and prevention system of infectious diseases in Shanghai is divided into three stages. The first stage was the statutory infectious disease reporting system, which was built in the 1950s, during which people reported by handwriting at each level. The 1980s appeared with the establishment of an electronic reporting information system for statutory infectious diseases, and the 1990s appeared with the emergence of a data collection system, which was the second stage of development. The third phase began in 2003 with the construction of a national epidemic network case-by-case real-time reporting system. At this stage, there was a well-established information system for disease surveillance and management based on health records and electronic medical records, and data was shared between the various platforms, and standards are harmonized [7].

Shanghai uses three main methods to stop the spread of the disease: The first method is a fast and accurate approach to flow reconciliation. The relevant government departments require mobile reconciliation team members to arrive at the scene within 2 hours, complete the core mobile reconciliation information investigation within 4 hours, and check all the workplaces, places of residence, movement trajectories as well as family members and related persons of the case within 24 hours. The prevention department works with public security, communications, civil affairs, big data centers, and transport departments to improve the quality of mobile regulation through data capture and tracking, and staff needs to pinpoint people who have different levels of control due to different levels of exposure.

The second method is the precise isolation and detection of persons at risk. Firstly, those who test positive should be immediately sent to a hospital in the square cabin or a designated hospital for isolation and treatment, after which the hospital will disinfect the relevant items and the environment and transfer them back to their place of residence for health monitoring. For close contact with infected persons, 14 days of intensive isolation observation and 7 days of self-health management were implemented. Seven nucleic acid tests were performed during this period. For close contacts (sub-close contacts), 7 days of isolation observation and 7 days of self-health management accompanied by 5 nucleic acid tests are implemented. For those who have a permanent residence in Shanghai, home isolation is carried out, and for those who do not meet the residence requirements, centralized isolation and observation are carried out in hotels. The grid cell in which the positive infected person is reported and the adjacent grid cells are designated as closed control areas. The infected person's building is subject to 14-day closed management measures, while other areas within

the closed control area are subject to 7-day closed management and 7-day community health management measures.

The third method is the rigorous verification of health information and the timely evacuation of the crowd. The government requires property companies and relevant departments to carefully verify health information regarding the entry and exit of people and to report any abnormalities promptly. Individuals who have concealed special circumstances and evaded isolation are strictly held legally responsible for their actions and their breach of trust is included in the city's information platform [8].

3.3 Treatment of the epidemic

As the COVID-19 virus has evolved, its virulence has gradually decreased, but the ability to transmit infection has increased. So, there are different ways to treat people with COVID-19. Patients with mild symptoms, need to test themselves daily for COVID-19 using a PCR self-test kit. What they need to do is strict self-isolation, and a healthy diet, to build up their resistance. And patients can take more vitamin C, which is also conducive to physical recovery [9]. For patients with severe symptoms, volunteers are needed to assist medical staff in transporting patients from their locations to hospitals for treatment.

As COVID-19 has a significant impact on social health security, risk assessment of treatment methods and procedures is particularly important. Here is a risk assessment template that shows the risk that we considered, shown in Figure 1.

Risk Type	Area of risk exposure	Description of Hazard and risk exposure	Primary Consequence	Persons at risk	Likelihood	Consequence	Risk Assessment	Mitigation Action	Action Holder	Residual Risk
H&S	Self Isolation	People in a community can be infected because they live close to each other	number of people who get covid increase	People nearby	3	5	15	Tell people in the community to stay away	staff	No residual risk
H&S	The process of getting a patient to a hospital	Staff escorting patients can become infected	Staff get covid	Staff	2	3	6	Provide more protection for staff	staff	No residual risk
project risk	project	Residents do not want to isolate themselves	COVID-19 spreads faster	all of the people in coumminity	1	5	5	Publicize the epidemic prevention law	community	People resist the staff
H&S	people	The whole city is short of food	people feel hungry. Detrimental to the patient's recovery	all of the people in Shanghai	3	5	15	The government buys food from other cities	government	The government's budget is not enough
H&S	PCR test	The result of PCR test is not correct	people do not know they get covid	all of the people	1	3	3	use new PCR test to replace the old one	staff	No residual risk

Figure 1. Risk assessment template structure

This template includes the type of risks, description of the risk, primary consequence, the person at risk, likelihood, and consequence and risk assessment, mitigation action, action holder, and residual risk. That information supports the analysis of risks in the Treatment of Covid-19. There are two risk types in this template, which are H&S and project risk. H&S indicates the risk to people's health and safety. Because we are discussing the treatment of Covid-19, there are many H&S types of risk analysis. Project risk in this template is the risk to the management and operation of Treatment of Covid-19. The risk assessment shown in this template score is gotten from a formula:

Risk = Probability (P) x Consequence (C) [10].

The probability in this formula is the same as the Likelihood in the template. The risk assessment result is gotten from both likelihood value and consequence value, both values are scores from 1 to 5, and if any one of them increases the score of risk assessment will increase. Mitigation action talks about the ways to prevent the risk. The residual risk means the risk after the prevention has token.

The risk shown in the first row is about self-isolation, as mentioned before, patients with mild symptoms need to take self-isolation. That means a huge number of people in shanghai are taking self-isolation, if there is some problem there, it will lead to a serious result. People who live nearby may get covid because they contacted Covid-19 patients. Because the virus is so contagious, the number of people with COVID-19 in this region is likely to skyrocket. One way to prevent this terrible

situation is to notify people who live nearby when someone is diagnosed with COVID-19 and ask them to stay away from the sick person as much as possible, thereby reducing the risk of infection. The second risk that we considered is that staff who sent the patients to the hospital may also be infected. This risk is less likely because health care workers must have been vaccinated and take appropriate precautions. The prevention of this risk can be to enhance the protective equipment of staff, such as masks, protective clothing, gloves, etc. There is a project risk in the template which is the people's attitude toward self-isolation. If people are not willing to self-isolate, then it becomes very difficult to manage the community and manage the treatment for COVID-19. The probability of this happening is very low, but the consequences can be very serious. To prevent this, epidemic prevention laws can be publicized in the community and people can be informed of the consequences of not following the rules or laws. Of course, too much publicity can also lead to resistance from employees and the government, and even reluctance to seek treatment. Because many places in Shanghai have been locked down due to COVID-19 cases, the food industry chain is in a very bad situation. There is a high probability that there will be a shortage of food. This is a serious problem because food shortages can lead to resistance to COVID-19 treatment, and hunger is not conducive to recovery. To prevent this, the government can buy food from neighboring cities and provide it to Shanghai residents. The last risk we discussed is related to the PCR test. PCR test is the test for COVID-19 which let people know whether they get the disease. There may be defects in the PCR test, which may result in an inaccurate test result. The solution to this problem is as simple as replacing the defective PCR test with a new one.

4. Conclusions

With increasing internationalization and urbanization, the development of transport modes, and increasingly widespread mass population movements, the risk of cross-territorial transmission of major public health emergencies has expanded, and their control and prevention have become extremely complex. As a large city with a large population and active international contacts, Shanghai's high-density airline network and the frequent international movement of people have led to outbreaks that are difficult to control. As centers of international exchange, international megacities have increasingly become metropolises that lead the world's political, economic, and cultural development. In the process of promoting globalization and cooperation, mega-cities are the main vehicle for promoting open collaboration between regions and driving world economic growth. However, when the epidemic broke out in Shanghai, the Shanghai government imposed a city-wide lockdown and a ban on the movement of people, which caused huge economic losses and still did not contain the outbreak.

The project management methods mentioned in this paper can be applied to help government departments establish emergency management systems in the early stages of an outbreak, helping them to quickly identify patients at all levels of government and to establish precise containment zones. Project management methods such as the critical path method and WBS can also play an important role in the deployment of medical supplies in hospitals and the processes associated with the identification and isolation of patients.

The application of project management can be an effective and rational solution to the problems of dealing with sudden disasters and major issues such as epidemic outbreaks, which often have complex processes and difficulties in the rational allocation of resources. Hope that in the future we will see the project management approach being widely studied and used by more decision makers to deal with urgent matters efficiently.

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