The Practice of Public Health Emergency Operations Center (EOC) The Operations of Chinese Center for Disease Control and Prevention (China CDC)'s EOC

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Case Study

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Abstract

Objectives To Share the construction status and operation management experience of the EOC of China CDC. It is also to promote the construction of global emergency operation management system.

Methods We searched the websites of WHO, USCDC and EU CDC for the EOC-related concepts. And through expert interviews and personal communication with experts, we collected relevant opinions and identify additional published literature, then described the current situation of construction of China CDC's EOC.

Results For EOC, different organizations / agencies have different definitions. In China, the EOC is a place where CDC organizes and conducts the related emergency response work. And it is also an important part of public health emergency system construction. The China CDC's EOC had developed a series of incident action plan (IAP) and the standardized forms for each incident. The event-specific data, context-specific data and event management data are usually obtained by different system and channel. The China CDC's EOC would improve the staff's abilities through an ongoing series of training and exercises. Comparing with before, the efficiency of incident response has been greatly increased after the establishment of EOC.

Conclusions The China CDC's EOC is still growing and groping phase. It is necessary to continue theoretical learning and practice to continuously improve the capacity of the construction and operations of the EOC system. We need continued close collaboration and partnership with international organizations to enable more to be accomplished through leveraging individual institutional strengths. The standardize approach to respond to public health emergencies meet global standards needs.

Background

The EOC of Chinese Center for disease Control and Prevention (China CDC) was officially established in 2016, as a branch of the Public Health Emergency Center (PHEC) of China CDC, which has become the core department for the public health emergencies and risk response. According to Administrative Measures for Health Emergency Operations (2016 Edition), China CDC's EOC fully plays a role in command and coordination, resource integration, risk communication and technical support in event response. We sorted out the EOC construction as a whole and analyzed the events responsed in recent years, and introduced and shared the experience of EOC construction and operation of China CDC.

A functional public health emergency operations centers(PHEOC)is an important component of meeting IHR requirements. In 2012, WHO established the Public Health Emergency Operations Centre Network (EOC-NET) in order to facilitate the establishment of global PHEOC[1–2]. From 2015 to 2016, the national health emergency working standards for disease prevention and control institutions (trial) and the 13th Five-year Plan for the Prevention and Treatment of Infectious Diseases issued by the National Health Commission of the People's Republic of China (NHCPRC) clearly put forward the requirements for the construction of EOC in China.

The EOC of Chinese Center for disease Control and Prevention (China CDC) was officially established in 2016, as a branch of the Public Health Emergency Center (PHEC) of China CDC, which has become the core department for the public health emergencies and risk response. EOC fully plays a role in command and coordination, resource integration, risk communication and technical support in event response, which is administrated by PHEC.

EOC is an emerging field of practice in China. It is necessary to effectively manage complex public health risk or threats by utilizing specific knowledge, technology and organizational principles found in incident management [3–4]. During recent years, the CDCs at all-levels across the country have been exploring the model of health emergency operation management, and the construction of EOC has been carried out to achieve the health emergency interconnection, resource integration and information sharing. Our paper summarizes the good practice of EOCs' construction in China, as well as the classic case statement of coping with threats. And it is hoped to better understand the public health response in China.

Emergency Operations Center (EOC) is usually been used by jurisdictions and organizations as one of the most important elements in their emergency management programs. It is the location where staff from multiple agencies typically come together to address imminent threats and hazards and to provide coordinated support to incident command, on-scene personnel, and/or other EOCs[1–2]. A growing number of countries agree that, EOC should be increasingly viewed as the necessary component of emergency preparedness and used for multiagency coordination and response to a variety of hazards, including natural disasters, chemical spills, radio nuclear incidents, humanitarian emergencies, and disease outbreaks[3–6].

The operations of EOC is based on the concept of Incident Management System (IMS). IMS is a comprehensive and systematic incident management method, including event command and coordination, resource management and information management. Within the necessary framework, five basic functions are usually established: management, operations, planning, logistics, finance and administration, while maintaining flexibility to adapt to different events, institutions and jurisdictions [2]. The adoption of a common organizational model or framework for emergency management at all levels, from the country to the primary health services, is of great benefit. According to the IMS, the main functions of China CDC's EOC are as follows:

(1) During routine work, the emergency preparedness duty should be carried out to continuously event surveillance and risk assessment.

(2) When outbreaks, the EOC would be activated depending on the scale of the events. And the function of EOC contains recourse coordination, surveillance strengthening, coordinating resources, providing epidemiological technical services, etc.

(3) After the response completed, the EOC should conduct the evaluation of the event response process, summarize the problems in the event response process, and propose improvement plans. The purpose of improving emergency operation capability is to correct problems in future through training and exercise.

Materials And Methods

The EOC-related concepts, development status, core functions and other knowledge systems in this study are sorted out by searching the websites of WHO, USCDC and EU CDC. The online database PubMed, Elsevier Science Direct were used to identify studies and reviews published in English. Through expert interviews and personal communication with experts, we collected relevant opinions and identify additional published literature, then described the current situation of construction of China CDC's EOC. The advantages of EOC in coping with public health threats in China are further analyzed through the study of classic cases.

Results

Definition And Connotation Of EOC

For EOC, different organizations / agencies have different definitions. However, FEMA, USCDC and WHO all emphasize that EOC is a place to provide emergency response for professionals dealing with public health emergencies. It can command and coordinate relevant information and resources, and manage emergencies. We all believe that an effective EOC should be an organic combination of infrastructure and functionality.

In China, The EOC is a place where CDC organizes and conducts the related emergency response work. It is the place for emergency preparedness, daily operation and emergency response. It can be a dedicated place, or a space that is used in conjunction with other agency functions, or it can be a virtual place realized through information-based facilities. The China CDC's EOC could be used for daily emergency preparedness duty. During the emergency response, the working group personnel are centralized in different functional areas. EOC is an important part of the comprehensive planning and construction of emergency response management.

The Practice Of China CDC

In China, we focused on building the following core elements of the EOC, including sites/places and facilities, information and data, plans and procedures, training and exercises and logistics.

Sites/places And Facilities

The EOC is an important part of public health emergency system construction. According to the 13th Five-year Plan for the prevention of infectious diseases (2016–2020), China has clearly put forward the practice for the construction of EOCs. In the years leading up to 2010, China CDC initially established the EOC which contains a main hall and some function area for small meetings and discussions, and introduced the Remote Conference System to realize the remote consultation. In addition, the Teleconference System and LED information displaying system are also introduced to further the information display environment.

Plans And Procedures

Based on SARS, H7N9, and other infectious diseases outbreaks, as well as various natural disasters and man-made disasters, China CDC has its own model of incident detection, reporting and response processes. According to different events, we developed different technical, hazard-specific response and support plans, manuals and handbooks. In order to maintain consistency with WHO and other countries, China CDC compiled and issued a comprehensive plan at the end of 2016, called Administrative Measures for Health Emergency Operations (2016 Edition), which is like the combination of the emergency operation plan (EOP) and PHEOC plan. It contains the incident management and the standardized response procedures. The EOC can be activated in response to natural or manmade disasters, infectious disease outbreaks, and other public health emergencies. Besides watching level and alert level, there are three different levels of activation, depending on the scale of the event. In addition, the China CDC is also developing a series of incident action plan (IAP) and the standardized forms for each incident.

Data And Information

Information is the lifeblood of an EOC [3–7]. According to the activities and tasks, EOC has specific information needs and require various sets of data. EOC also need to collect and analysis data and information for operation. Three types of data ,including event-specific data, context-specific data and event management data, are usually obtained. Event-specific data can reflect information on what, how, where, who, and the current status of events. The sources of information may come from public health emergency management system, which focused on emergencies and health risk factors information, and the field investigation recourses. Context-specific data can reflect background information such as geographical information, demographic information, environmental information, health resources information, emergency shelter, the incidence of related diseases and health services. Event management data are organized for the functional domains (management, operations, planning, logistics, finance and administration) in the EOC. Such data may include human equipmental resources, the status of interventions, partner activities, resource deployments, expenditure progress on achievement of objectives, and so on. Besides, we also keep abreast of the current situation of staff information, expert database and logistics supplies.

In China CDC, branch for logistics takes the responsibility to the information supply and update for EOC. With the support of the logistic department, EOC can coordinate the relevant personnel and other resources timely and efficiently in the emergencies. Moreover, the Emergency Operations Management Information System (EOMIS) of China CDC is about to be online. In the future, it will be more conveniently and efficiently to manage the emergency resources.

Training And Exercises

The function and staffing of the EOC should be assessed through an ongoing series of training and exercises [2–5]. Well-trained professionals are the key to the operations of EOC. Trained experts who

know what to do are critical to building a functioning EOC [7–10]. Training should be purposefully conducted according to the capabilities required by the EOC. In China CDC's EOC, how to use the incident management system, special post training for working group of EOC, and professional technology, skills and practical training are the most three important training content. In addition, all personnel should have the information and communication technology (ICT) skills required to work in the EOC. The training targets of EOC mainly include all kinds of personnel who may participate in emergency response. The training can be carried out according to different professions, positions and levels. Training methods can be used in a variety of styles including face-to-face or online teaching, internships, etc. The training frequency is determined by the needs. Before and after the training, the trainees should be assessed to confirm whether the training objectives are achieved and whether their abilities meet the needs of participating in emergency operations. According to the evaluation results, the training program can also be improved.

Exercises are a primary training tool. The abilities of professionals should be consolidated and improved. The two types of exercises - discussion-based exercises and operations-based exercises are usually used in the daily activity in the EOC[11–14]. In practice, the various exercise types may be modified or combined in order to meet specific objectives, especially when resources are limited.

Initiatives In Public Health Emergency Management

Through the adjustment of health emergency practice and EOP in 2016, China CDC's EOC established the new IMS response procedure. In 2017, the China CDC's EOC had been launched three times for emergencies. The activations illustrating improvements in time to activation are as follows:

Table. The practice of China CDC's EOC in 2016–2017

Date	Outbreak/Disaster	Type	Location	Response level *	Comments/action taken
2017 Jan-Jun	H7N9	Infectious disease outbreak	Many provinces, China	□	Coordinated departments to develop the epidemiological and lab test strategy.
2017 Aug-Oct	Earthquake	Nature disaster	Sichuan and Xinjiang, China	□	Deployed team to the field for the public health prevention and control
2017 Nov-2018 Jan	Plague	Infectious disease outbreak	Madagascar	□	Deployed team to the field for the public health prevention and control
2018 Jul-Sep	Flood	Nature disaster	Several provinces, China	□	Deployed team to the field for the public health prevention and control
2018 Jul-Oct	Vaccine	Infectious disease outbreak	Several provinces, China	□	Assess the risk of problematic vaccine and develop reseeding strategies
2018 Jul-Oct	Polio virus	Infectious disease outbreak	Xinjiang provinces, China	□	Strengthen sampling and case monitoring, formulate vaccination strategies
* There are three different levels of China CDC's response depending on the scale of the event.					

Level □ is the lowest level of response. Only one or two subject matter department lead to the response with their staff. However, EOC would not be activated.

Level □ involves more than two departments staff, or the relevant area and resources from the China CDC. Time-sensitive tasks and needs may extend beyond core business hours. EOC staff may lead or assist with the response

Level □ is the highest level, requiring all agency-wide effort.

H7N9 Avian Influenza Epidemic

The reported H7N9 case number has been significantly higher since December 2016 than the same period in the past in China. As of January 8, 2017, 169 confirmed cases and 44 deaths have been reported. The epidemic has spread to 10 provinces. The confirmed cases have increased by 6.34 times compared with the same period in last two years, as well as the number of deaths has increased by 5.29 times. Given the current situation, it is expected that China CDC will continue to carry out intensive surveillance, situation analysis, field investigation, laboratory testing and technical support services for

human infection with H7N9 avian flu. After risk assessment, China CDC's EOC has been activated with a level response for the H7N9 influenza outbreak. The PHEC of China CDC subject matter experts to lead the response with their program staff. And EOC staff participated the response. According to the event scale, we set up Plan and Coordination (P&C), Epidemiology, and Laboratory detection functional team. It is deployed to enable the early detection of human cases, respond rapidly to interrupt human transmission, and oversee case management. The Chinese Field Epidemiology Program(CFETP) fellow served as the liaison between the EOC and field provinces. The PHEC coordinated seamless communication between the CDCs' laboratory and the China CDC's EOC. When the EOC was deactivated in June 2017, none of the human contacts had tested positive. Through our 6-month epidemiological action, the epidemic had been controlled.

Jiu Zhaigou And Jing He Earthquake

On Aug 2017, a 7.0 and a 6.6 magnitude earthquake hit JiuZhaigou county(belongs to Sichuan province) and Jing He county(belongs to Xinjiang province) separately. The two natural disasters caused hundreds of people died and injured.

The day after the earthquake, China CDC take the level response and dispatched the Post-disaster Rapid Response Team (PRRT) to the earthquake site immediately. Since then, the EOC organized three workgroups (including P&C, Situation awareness, Technology& Logistics) to do the surveillance, field investigation and risk assessments. And did preparation for the several different threats of post disaster, including infectious disease, concerns about the importation of foodborne and waterborne disease. The EOC also conducted and coordinated several training sessions and exercise for CFETP fellows and Public Health Emergency team to take part in the response. Some comprehensive operational handbook was developed according to this response process. Besides, EOC also provides other related hardware services and integrated coordination. For example, the video conference system and teleconference system had been provided for this disaster risk assessment. GIS map had been described for the situation and risk display. EOC also coordinated logistics branch of PHEC to provide emergency supplies and equipment for field teams.

The whole response process only last one month. After the disaster, EOC leaded the after action review (AAR) on what worked well, what could be improved, and prepares after action reports and improvement plans. And developed the reports on how well the response operations met objectives, recommendations for correcting gaps or weaknesses, and plans for improving response operations.

Plague Outbreak In Madagascar

Since August 2017, Madagascar had experienced a human plague outbreak which spread to a wide area of the country including the capital. As of October 30, 1,801 confirmed and suspected cases of plague had been reported, of which 62 percent cases reported as pneumonic plague. Obstacles to efficient containment of outbreaks include reporting lags from the field, delays in information sharing of outbreak data through the public health system, inefficient coordination of outbreaks, and slow response at the

central level. Notification came via NHCPRC, public health partner briefings and worldwide declaration of a Public Health Emergency of International Concern. According to the situation, on October 28, China CDC decided to activate level response and the EOC set up four functional workgroups(including P&C, Situation awareness and JIC, Experts, and Logistics). Besides, we sent a six-expert team to Madagascar to assist in the prevention and control and provide health services for the Chinese living in Madagascar. The EOC provides the technical support to the field team to develop the integrated disease surveillance strategies and reporting mechanisms for Madagascar MOH and helped them redefine new case definition and the standard for the case identification. In addition, the field team and the medical team assisted a Chinese tourist suffered from suspected pneumonic plague infection in Madagascar. The EOC supplied the teleconference system to support the remote video meeting on the discussion of the treatment plan of patients. When the EOC was deactivated in January 2018, the trend of case increasing has been shut down.

Discussion

Developing EOCs to facilitate appropriate coordination, response, and management of public health events is essential for building countries' emergency response capacity. Experience gained from practice of China CDC's EOC demonstrated the following as a recommended sustainable path for EOC development.

Infrastructure

EOC is more than just a physical place. The conference room is not an EOC, the command center is not an EOC, and the dispatch of emergency personnel is not an EOC either[3–4]. The EOC should be an organic combination of sites and emergency management functions. EOC can be a fixed place, a temporary facility, or a virtual architecture. Employees can participate remotely. The larger the area of the site is not the better. The EOC should be positioned as a focal point for coordinating resources, information and communications for data reception, integration, analysis and interpretation, and coordination, with less focus on physical infrastructure. Therefore, the lack of a dedicated physical location has not hindered EOC's operations. The construction of EOC should be demand-oriented.

Management

Collecting, processing and sharing information in time is the core function of EOC[15–17]. Information can be presented in a variety of ways. Information should be collected according to local conditions. In particular, EOCs monitor epidemiologic data and field reports from a variety of sources using data technologies and informal networks of public health professionals during activation [2–3]. Ideally, information collection should be based on standardized terminology and general data structure, and should be able to exchange horizontally and vertically. However, it may not necessarily to have an emergency operations management system for information management. The content and process of information system construction should comply with the requirements of information management. In

practice, which kind of methods is more suitable for information management, still needs to be further assessed.

Compared with information management, plans and procedures may be more important[1, 2, 3, 18]. Proper plans and procedures are one of the necessary conditions for the operation of the EOC. They are the contents of EOC mechanism construction. Regardless of the public health emergency or event for which the activation has occurred, the EOC operates according to principles of the IMS. Organizing all emergency responses according to principles of IMS clarifies roles, responsibilities, chain of command, and accountability [3]. IMS is a flexibility and standard guide. In China CDC's EOC construction process, we derived the event response plans and procedures which meets our response needs according to IMS.

Well-trained staff is one of the necessary conditions for EOC operation. Training should be continuously strengthened for staff in future. EOC is where information and resources are coordinated when activated and should be staffed with a team of subject matter experts, analysts, logistics staff, and support staff [11].

EOC should function during non-outbreak periods, and surveillance data should routinely be interpreted by an epidemiologic workforce. Like USCDC's EOC, their slogan is seven days, twenty-four hours. Such an "always on" EOC facilitates the rapid transition to response model during outbreaks and improves the cost-effectiveness of the infrastructure investment. But This is the most fully functional EOC and China CDC is on the way to this direction. Routine use of EOCs during outbreaks and non-outbreak periods helps ensure sustained technical capacity for data analyses, interpretation, and visualization tools and equipment, as well as the knowledge to analyze and interpret incoming health information[2–4]. This EOC model would meet the global public health response need.

The EOC construction experience of China CDC is also limited, nevertheless, we continue to summarize and sort out the traditional response process with combining the IMS concept to explore the event response system suitable for China's national conditions. With the One Belt And One Road initiative, China's public health services should also go abroad to help other international partner in need. We need to continuously improve our strategy for the functional construction of EOC. Efforts to strengthen EOC capacity must build on existing emergency response structures. Any augmentation of technology and infrastructure also should improve nonemergency capability to be sustainable and effective.

Conclusions

This study was conducted during the understanding of EOC construction by China. And the introduction of China CDC's emergencies response experience and strategies in the process of EOC construction. However, the construction of EOC, especially it's the experience in dealing with international public health events, is limited. It is necessary to continue theoretical learning and practice to continuously improve the capacity of the construction and operations of the EOC system. We need continued close collaboration and partnership with international organizations to enable more to be accomplished through leveraging individual institutional strengths. The standardize approach to respond to public health emergencies

meet global standards needs. With this effort, we aims to reach the goal of saving lives and protecting people while making the world a safer place from disease outbreaks and other public health threats.

Abbreviations

EOC: Emergency Operations Center

Declarations

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Author's contributions

Fan Ding & Lianmei Jin conceived and designed the study, and they analyzed the data and drafted the manuscript. Qun Li revised and approved the manuscript.

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Availability of data and materials

All data supporting the findings of this study are included in the article.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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