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A preliminary framework to measure public health emergency response capacity

Received: 3 August 2005 / Accepted: 19 October 2005 / Published online: 24 December 2005
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Abstract To provide a scientific guide for most countries in the world to build a complete public health emergency management system. Capacity assessment theory and emergency management theory were reviewed respectively and linked together to construct a preliminary, two-dimensional public health emergency response capacity framework. A preliminary framework for public health emergency response capacity was obtained, which consists of three levels: the systems level, the organizational level, and the individual level. A two-dimensional matrix or a set of two-dimensional matrixes that comprise capacity, dimension, and emergency function dimension formed the preliminary framework in three levels, respectively. This preliminary framework can act as a theoretical guide for a country or a region to set up their own public health emergency response systems.

Keywords Public health practice · Emergency preparedness · Framework

Introduction

Public health emergency has become an important threat to the development of the world with the occurrences of the 9/11 disaster, anthrax mail, mad cow disease, SARS, avian in-

fluenza, etc. In many countries, public health emergency has already been included in the long-term government development plan, and much money is being invested into preventing and responding to it. However, many countries are inexperienced at setting up emergency management systems, do not know how to build such a system, and do not know how to use it to deal with public health emergencies efficiently. Consequently, quite a little money is misused in an unreasonable way. For example, in China, the government has invested 11.4 billion RMB (central government, 5.7 billion; local government, 5.7 billion) to support 2,036 related projects in order to enhance public health emergency response capacity after SARS, but most of the money was used to build new working houses and new infectious diseases hospitals while some more important needs were not considered at all (National Development and Reform Commission (NDRC) 2005). For China, the lack of a scientific guide in building a public health emergency management system is the most urgent problem at present (Yu 2005).

After the 9/11 disaster, in order to respond to public health emergencies effectively, the United States government has started enforcing the public health system and has done some creative work on how to set up an efficient public health emergency response system. Public Health Preparedness and Response Capacity Inventory (Centers for Disease Control and Prevention (CDC) 2002) and State Capability Assessment for Readiness (CAR) (Federal Emergency Management Agency (FEMA) and National Emergency Management Association (NEMA) 2000) are two important research outcomes, and they are also the most important two instruments relating to public health emergency capacity assessment at present. The former was developed by the United States CDC to help state and local public health agencies to evaluate a state's ability to respond to bioterrorism, outbreaks of infectious diseases, and public health threats and emergencies. CAR was developed under the joint work of FEMA and NEMA to provide a nationally accepted assessment process whereby states, territories, or insular areas could judge their emergency management readiness and capabilities.

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These two instruments provide important references to construct public health emergency response systems for other countries. But they also have obvious limitations. Public Health Preparedness and Response Capacity Inventory is confined to public health agencies, and it cannot reflect the capacity of a public health emergency response system. The CAR emphasizes the whole emergency management system, but it does not offer a clear assignment of emergency management function in different organizations and individuals, which may lead to unexpected trouble when one function involves more than two organizations. In addition, these two instruments do not attach importance to the capacity dimension when constructing the assessment frameworks while they emphasize emergency management function dimension, so neither can give a clear description of capacity.

To provide a scientific guide for building an effective public health emergency response system, it is necessary to develop a theoretical framework that explicates the critical capacities of a complete public health emergency response system. This article attempts to propose such a model based on capacity assessment theory and emergency management theory.

Constructing a preliminary framework

Capacity assessment theory

The term capacity has many different meanings and interpretations. Much depends on who uses it and the context in which it is used. Bayou (2001), Kuban and MacKenzie-Carey (2001), the United Nations Development Programme (UNDP) (1995), Hopkins (1996), Handler et al. (2002), and Ebbesen et al. (2004) presented several different representative capacity definitions respectively. Of these definitions, the UNDP's is the most clear and comprehensive. It is defined as the ability of individuals and organizations or organizational units to perform functions effectively, efficiently, and sustainably. The capacity assessment model proposed by the UNDP shows obvious advantages compared with other capacity models.

To construct a preliminary framework to measure public health emergency response capacity, we selected the UNDP's capacity assessment model as an important reference. The following gives a brief introduction to this model.

According to this model, capacity assessment is defined as a structured and analytical process whereby the various dimensions of capacity are measured and evaluated within the broader environmental or systems context, as well as specific entities and individuals within the system. Three levels of capacities are expatiated in this model (Fig. 1).

1. The systems level: It contains:

- a. *Policy*: systems have a purpose; they exist to meet certain needs of society or a group of entities. Also included are value systems, which govern the entities within the system

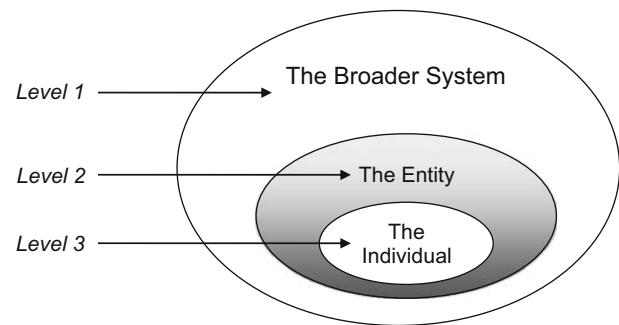


Fig. 1 Levels of capacity within a system context:

- b. *Legal/regulatory*: includes the rules, laws, norms, or standards that govern the system and within which a capacity initiative is to function
 - c. *Management or accountability*: defines who manages the system and what entities or stakeholders function within the system. From a capacity development perspective, this would identify who is responsible for potential design, management and implementation, coordination, monitoring and evaluation, and all other related capacities at the systems level
 - d. *Resources*: (human, financial, information) that may be available within the system to develop and implement the program and/or the capacities
 - e. *Process*: the interrelationships, interdependencies, and interactions among the entities, including the fact that these may comprise subsystems within the overall system.
- 2. The entity or organization level:** It consists of:
- a. *Mission and strategy*: include the role, mandate, and definition of products/services; clients/customers served; interactions within the broader system and "stakeholders;" the measures of performance and success; and the presence of core strategic management capacities
 - b. *Culture/structure and competencies*: organizational and management values, management style, and standards, organizational structures and designs, core competencies
 - c. *Processes*: supporting such functions as planning, client management, relationships with other entities, research/policy development, monitoring and evaluation, performance/quality management, financial and human resources management, etc.
 - d. *Human resources*: the most valuable of the entity's resources and upon which change, capacity, and development primarily depend
 - e. *Financial resources*: both operating and capital, required for the efficient and effective functioning of the entity
 - f. *Information resources*: of increasing importance, and how these resources (all media, electronic and paper) are managed to support the mission and strategies of the entity

- g. *Infrastructure*: physical assets (property, buildings, and movable assets), computer systems and telecommunications infrastructures, productive work environments.

3. The individual level: Individual capacity assessment is designed according to the following nine aspects:

- a. Job requirements
- b. Training/retraining
- c. Career progression
- d. Access to information
- e. Performance/conduct incentives/security
- f. Values and attitudes
- g. Interrelationships and teamwork interdependencies
- h. Work redeployment
- i. Professional integrity

Emergency management theory

According to the capacity assessment theory advocated by the UNDP, determining a complete set of emergency management functions is the precondition to make a scientific capacity assessment for public health emergency response. In this step, our purpose is to determine such a complete public health emergency function list.

In the past 50 years, emergency management theory research has made great advances in some fields, such as military affairs, business, economic activities, and has already formed a complete system. Some famous emergency/crisis management models have been put forward, including the prevention, preparation, response, recovery (PPRR) model (Xue et al. 2003), the mitigation, preparation, response, recovery (MPRR) model (McLoughlin 1985), the reduction, readiness, response, recovery

(RRRR) Model (Health 2001), Fink model (prodromal breakout/acute chronic resolution) (Belardo and Pazer 1995), five-phase model (signal detection, preparation/prevention, containment/damage limitation, recovery, learning) (Pearson and Mitroff 1993), three-phase model (precrisis, crisis, postcrisis) (Xue et al. 2003). These models have a common feature in that each model penetrates the whole process of an emergency or crisis, containing precrisis, crises, and postcrisis, and each can give a acceptable explanation to emergency management, but these descriptions are simple. None of these models can give a detailed emergency management function list.

In addition, FEMA and NEMA proposed a 13-function model (FEMA and NEMA 2000), Pearson and Mitroff provided a more detailed framework consisting of four major crisis management variables (types, systems, phases, & stakeholders) (Pearson and Mitroff 1993). FEMA and NEMA's 13-function model provides more information compared with the above emergency management models, but it has two obvious defects when we try to use it to guide the building of public health emergency response system in other countries. On the one hand, it was designed according to American political system and laws; it will bring some unexpected difficulties when generalized in other countries. On the other hand, such a 13-function model neglects the capacity dimension; maybe it can give a complete description to emergency management, but it cannot give the same clear description to capacity dimension. Pearson and Mitroff's four major crisis variables model is merely aimed at constructing a common tool to describe any crisis management process; it does not present a complete emergency management function list or pay attention to capacity dimension.

Table 1 A detailed public health emergency function model

Phase	Function description
Prevention	1. Laws & authorities 2. Establishment of public health emergency management system 3. Hazard identification, risk assessment, & vulnerability analysis 4. Hazard mitigation
Preparation	5. Planning 6. Storage and management of emergency materials and resources 7. Surveillance, notification, and early warning 8. Public education and emergency staff training 9. Exercises and corrections
Response	10. Direction, control, & coordination 11. Situation assessment and need assessment 12. Epidemiological investigation, tracking, decontamination, isolation, quarantine, vaccination, and safe disposal of wastes 13. On-site medical aid and off-site medical treatment 14. Laboratory test 15. Information communication, dissemination and declaration 16. Mass casualty and emergence materials transportation 17. Safety protection of emergency worker and public
Recovery	18. Assessing damage and summarizing experiences and lessons 19. Supplying victims and emergency workers with stress counseling 20. Restoration of public infrastructure damaged by the emergency

Table 2 A common two-dimensional public health emergency capacity framework mode

Emergency function dimensions	The systems/organization/individual level capacity dimensions					
	Dimension 1	Dimension 2	·	·	·	Dimension <i>n</i>
Function 1	—	—	·	·	·	—
Function 2	—	—	·	·	·	—
·	—	—	·	·	·	—
·	—	—	·	·	·	—
·	—	—	·	·	·	—
Function <i>m</i>	—	—	·	·	·	—

m number of the emergency functions, *n* number of the capacity dimensions, “·” and “—” ellipsis mark

Considering the above, we chose the PPRR model as the basic framework, enriched it through using existed public health statutes (State Department of P.R. of China 2003; Anonymous 2003; Anonymous 2002), and evaluation tools (CDC 2002; FEMA and NEMA 2000; National Public Health Performance Standards Program (NPHPSP) 2003) for references, and finally formed a detailed 20-function public health emergency response model (Table 1).

Creating the preliminary public health emergency capacity framework

Combining UNDP’s capacity assessment framework with the public health emergency function model (Table 1), it seems to obtain a two-dimensional public health emergency capacity assessment framework for the public health emergency response system. However, the job is not so easy. The UNDP’s capacity assessment model includes three levels (the systems level, the entity or organization level, and the individual level) and the 20-function public health emergency response model mentioned in Table 1 is merely applicable to a whole system. It is not appropriate to simply combine them.

To set up a detailed two-dimensional public health emergency capacity assessment framework, to determine the complete public health emergency response system, it is necessary to identify all organizations and individuals in this system and the corresponding function of each organization or individual. It is impossible to put forward a common public health emergency response system for all countries in the world due to great political and cultural differences. The 20-function public health emergency response model can be used as a general requirement of public health emergency response system in a country; however, much work needs to be done to determine respective functions of different organizations and individuals in this system according to the political system and laws in each country. Thus, this article only presents a preliminary two-dimensional public health emergency capacity assessment framework.

According to UNDP’s capacity assessment model, public health emergency capacity framework also includes three-level subframeworks, each corresponding to a matrix. For each matrix, a row denotes an emergency management function and a column denotes capacity dimensions. Among the three-level subframeworks, the systems level is the simplest; it can be described using a simple matrix. All

the intersections of rows and columns in the matrix formed the systems level capacities. Table 2 shows a common abbreviatory capacity framework mode for three levels. For the organizational and individual levels, either requires a set of matrixes because public health emergency response system in any country always consists of many organizations and individuals. Once the public health emergency function of an organization or individual is determined, it is easy to construct its capacity model by changing the contents of the first rows (in Table 2) and filling in the corresponding capacity dimensions of an organization/individual according to the UNDP’s capacity model.

Discussion

How to use such a preliminary framework

The most important characteristic of such a two-dimensional public health emergency capacity framework is that it emphasizes the capacity dimension while attaching importance to emergency management dimension. This preliminary framework can help a country build its public health emergency response system at two points. Firstly, it presents a relatively comprehensive public health emergency function list based on emergency management theory analysis and literature review, which can act as a reference for most countries in the world. Secondly, it adds capacity dimension into public health emergency response system building by adopting the UNDP’s capacity model and puts forward a detailed capacity requirements at three levels (systems/organization/individual). It will act as a detailed guide to build a country’s public health emergency response system once the function allocation of organizations and individuals in this system is completed. If a detailed two-dimensional public health emergency capacity framework is determined in a country base on the preliminary framework, this country can use the systems-level capacity assessment to make a preliminary SWOT analysis and provide the government with important macro evidences. For an entity or organization, the organizational level capacity framework can be used as a development goal, especially for those key stakeholders in the system, such as public health agencies and medical organizations. In addition, it also acts as the foundation of capacity indicators development.

However, this preliminary framework is not an operable model but merely a theoretical framework for a country

although it has the above-mentioned advantages. In fact, there is a lot of work to do to establish a detailed and operable framework in a country or a region. Unless two steps are finished, this preliminary framework cannot do anything to the practice in a country. The first step is to determine a complete public health emergency response system using stakeholder analysis. Stakeholder analysis aims to evaluate and understand stakeholders from the perspective of an organization or to determine their relevance to a project or policy (Brugha and Varvasovszky 2000). The second step is to accurately assign emergency functions and responsibilities to different organizations and individuals in the system.

Future study of this preliminary framework

There are at least two critical things to do for this preliminary framework. One is to set up a standard public health emergency response system by making a stakeholder analysis. The other is to enrich the emergency functions and combine them with the capacity dimensions at the three levels, respectively. The 20-function list in this article is merely a basic requirement for a public health emergency response system. It will be expanded and enriched when we attempt to build a concrete public health emergency response system. In particular, it is urgent to identify key organizations' and individuals' capacities and develop corresponding indicators to guide and promote the development of public health emergency response capacity building.

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