Evaluation of Hospital Preparedness for Public Health Emergencies in Sichuan (China)

By

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KEYWORDS

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Instruments/tool/indicators
Factor analysis
ABSTRACT

Although public health services have been responding to emergencies for a long time, public health emergency preparedness is an evolving field. Improvements in public health preparedness often make little progress, as a result of a lack of a shared understanding of the topic and agreed criteria for emergency response and preparedness. It may be concluded from the existing literature that it is difficult to make such improvements because of a lack of a capacity to measure objectively public health emergency preparedness (PHEP) and that this is caused principally by a lack of consensus on the definition of public health emergency preparedness and its key elements.

Purpose

This research is directed towards the development of a means of measuring public health preparedness and to thus provide a method for driving improvement. To develop reliable and valid preparedness metrics, this research sought to identify and validate a comprehensive evaluation framework and to develop and test a standardized index to measure hospital PHEP.

Design and methods

A combination of qualitative and quantitative methods was used in this study. The qualitative study includes a comprehensive literature review, intensive interviews with key experts and transitions to an agreed framework through a modified Delphi
approach. The quantitative study involved a cross-sectional survey of hospitals in Sichuan province of China using the assessment tool (questionnaire) which was developed as a result of the qualitative studies.

The research was undertaken in three sub studies:

Study 1 sought to identify the concepts and findings about hospital public health emergency preparedness from the literature (Chapter 2), and this was complemented by intensive interviews with key expert informants. A meta-ethnographic approach was used to review and synthesize the findings of the literature. This led to an understanding of what hospital PHEP is and to the development of a conceptual model together with a set of elements.

Study 2 sought to further develop a framework for evaluating hospital PHEP. This was undertaken by using a modified Delphi approach supported by a panel of experts assembled from three areas (administering organizations, technological and academic institutions). It was further evaluated by analysis of qualitative data gathered by applying questionnaires to hospitals in the Sichuan province. Convergence of expert opinion was measured by using Kendall’s coefficient of convergence \( W \), mean value. Internal and external reliability of indicator system were assessed by Cronbach’s \( \alpha \) and test-retest. The content validity and construct validity were proved by Kendall’s \( W \) and the Spearman’s correlation respectively.

Study 3 aimed to estimate the level of preparedness for PHEP by applying the survey to hospitals in the rural areas of Sichuan province. There were 46 hospitals surveyed
and SPSS 19.0 were used for data analysis. Procedures and tests used in this study to analyse the quantitative data included descriptive statistics, *t*-test, and Factor Analysis.

**Findings**

A conceptual model for hospital PHEP with a set of initial elements was developed. The model proposed in this research includes five basic metrics which were identified as key components of maintaining a high level of PHEP, namely, “staff, stuff, service, space and system.” They were constructed around the stages of disaster management (pre-, during incident, and post-). The model ties together the core emergency preparedness competencies for hospitals, and the elements identified were intricately linked and describes PHEP activities for hospitals to prepare for, respond to, and recover from public health emergencies.

In the two-round Delphi study, Kendall’s coefficient of convergence W of the whole evaluation indicator system was 0.610, and mean value of all indicators were nearly 3.0, indicating the consensus was achieved after two rounds. The reliability and validity were verified by using Crohbach’s Alpha and Spearman’s correlation coefficient respectively, and have been demonstrated as ‘good’.

The final validated evaluation framework comprised of nine key elements: emergency plan, PHE detection and identification, laboratory diagnosis capacity, training and drills, communication and cooperation, medical treatment capacity, command system, and fully staffed workforce.

The survey of hospitals in rural Sichuan was then undertaken to test the framework
and examine the current status of hospital PHEP in rural areas of Sichuan province (China). Through using Factor Analysis method and establishing a statistical model (F=0.518F1+0.173F2+0.160F3+0.150F4), there were four major contributing factors identified which mainly affect hospital PHEP, namely, hospital service capacity factor, human resource factor, stockpiles and facilities factor, management, direction and coordination (MDC) factor.

The results of this study indicate that the majority of hospitals in the rural area of Sichuan province had a capacity to respond to public health emergencies, but still face some challenges and shortcomings. Additionally, comparison of hospital’s preparedness capacity using these four factors, revealed that tertiary-grade, teaching and general hospitals performed better than secondary-grade, non-teaching and non-general hospitals with statically significant.

**Discussion**

This research provides a comprehensive review and description of hospital PHEP, and confirms the key dimensions of hospital PHEP which could be used to develop new research surveys or improve the current tools. The proposed new and validated framework provides hospitals with a practical tool that facilitates the understanding of PHEP activities and decision-making for hospital PHEP investment with a view to building sustainability targets. It will also support critical developmental activities of hospitals: *pre-planning, coordination, quality improvement; health service improvement; effectiveness of training and drills; resources prioritization*. The
framework may also be helpful in constructing plans and strategies to enhance hospital preparedness and performance.

This study does have limitations. The sample size of 46 hospitals is relatively limited and selection bias also may have occurred. There may also be respondent reporting bias as a self-report method was used. Additionally, the research was conducted over almost 12 months, during which time there may be some changes in PHEP of the surveyed hospitals.

Further research is necessary to build on the findings of this study. The framework should be further validated across various provinces and in other jurisdictions outside of China. It should also be tested against more long term objective measures of hospital performance in public health emergencies. As the aim of research is to guide preparedness and response, focus should also be placed on practical guidelines and tools that may facilitate improvement.

In future, hospital PHEP research in China should make efforts to (1) establish a universally accepted standard of prepared PHEP which is accepted by policy makers and stakeholders, particularly those charged with evaluating the capacity of the public health and safety systems (Zhao Qi, 2009; Fan Liping, 2012;), (2) create a theoretical structure for further studies, and (3) integrate research of different disciplines. Therefore, researchers should give more attention to basic concepts, principles and methods, their application to public health incidents and disasters, and the key functional systems required to develop emergency resilience of hospitals.
LISTOF ABBREVIATIONS

PHE: public health emergency

PHEP: public health emergency preparedness

CDC: Centres for Disease Control

TCM: Traditional Chinese Medicine

ED: emergency department

CR: constitute ration

SD: standard deviation
STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institute. To the best of my knowledge and belief, the thesis contains no materials previously published or written by another person except where reference is made.

Signature:

Date: 6/1/2015

QUT Verified Signature
ACKNOWLEDGEMENT

To the people who support me along with my PhD journey, I want to dedicate this thesis to you all.

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CHAPTER 1 INTRODUCTION

1.1 Background

Public health emergencies directly affect people’s health, economic development and social stability. In the past decade, a succession of public health emergencies has challenged preparedness and response capacities of government agencies, hospitals and clinics, public health agencies and academic researchers around the world. Figure one displays a number of previous examples, and highlights the diversity and frequency of events that can be expected to occur in the foreseeable future.

![Figure 1: A timeline of major public health emergencies worldwide](image)

Each of these events has significantly challenged the public health systems and impacted on the health and wellbeing of affected people. For example, the epidemic of the severe acute respiratory syndrome (SARS) not only challenged the health systems capacity to respond but also directly affected health workers with consequential effects on the capacity of the health services to function. Similarly
H5N1 influenza (Bird Flu) while currently affecting a relatively small number of people has the potential to become human to human transmissible and with it high mortality rate could result in catastrophic rates of mortality and morbidity. In addition natural disasters such as the 2010 earthquakes in Haiti, China and Pakistan illustrate the potential diverse and complex forms that the threat to public health may take. Destruction of public health protections such as sewerage systems, clean water supplies and safe food can cause very significant mortality and morbidity.

Health systems need to be resilient which may be defined as the capacity of the system to prevent, mitigate, prepare for, respond to, and recover from the impacts of PHEPs. Maintaining emergency preparedness of hospitals is not a static effort, but is a dynamic process. Because emergencies happen suddenly and often unpredictably, preparedness for major emergencies is different from the routine functions of hospitals. However, measuring the capability of hospitals to respond to major disasters is undertaken under normal stress and not in the environment of non-routine stress.

It is difficult to predict the performance of hospitals under such major pressures; therefore any evaluation must be constructed around the stages of disaster management. A dynamic framework necessitates developing an organizational system and structure, reviewing resources, training staff, testing and improving service capability. In response to such threats to human health, many nations, led by the World Health Organization (WHO), have put in place systems and structures that seek to ensure the protection of the health and wellbeing of people. Further, there has been
a heightened interest in using surveys to assess preparedness for various disasters. The knowledge generated through well-designed, effectively executed research in anticipation of, in the midst of, and after an emergency, is critical to better achieve the overarching goals of preparedness, namely: preventing injury, illness, disability, and death, and supporting recovery (Lurie N, et al. 2013).

During and after incidents hospitals play the main role of providing health services to people, on time and without any interruption (Barbara I. Braun, et al. 2006). Additionally, hospitals are also crucial for those who are charged with planning how to prevent and treat large outbreaks of infectious disease and other mass casualty events (Niska, Shimizu. 2011). In response to this concern, China, the focus of the current study, has invested heavily in the state and local public health infrastructure, and has provided funds to survey hospitals about their preparedness of response to public health emergencies (Qi Zhao, 2009; LQ Liuet al., 2006).

However, the existing research has centred on areas which are relatively rich in human and material resources, or in the provincial and municipal health care institutions. According to the characteristics of emergency events in China, public health emergencies frequently occur in remote and rural areas. Therefore, the rural hospitals may be the first major response capability for public health emergency responses and management (Hu GQ 2006). Moreover, the rural areas have 60% of the nation’s population, but only 20% of its health resources (Qi Zhao, 2009). Thus, rural health care institutions may face some unprecedented challenges, such as proximity to
potential terror targets, and to international borders, as well as the availability of food and water supplies.

Since 2009, the Chinese government has invested more than 57 billion RMB in the renovation and expansion of county level hospitals (FL Lin, 2010). Despite the magnitude of this investment, it is difficult to measure, objectively, the progress that has been made, and the preparedness gaps that remain (Institute of Medicine 2008). Moreover, it is also difficult to measure hospital preparedness for some challenges arising from public health emergencies. For example:

(1) There are no national standards of “ideal preparedness”. Many experts posit that, to be realistic, jurisdictions of different sizes and characteristics may require different objectives. However, no consensus has been reached about the minimum functions that could be expected to see implemented at various levels (Pezzino et al. 2006).

(2) There are no standardized and validated instruments to assess and measure hospital preparedness for public health emergencies. Further, no consensus exists about any given tool, and no tool has been adopted broadly (Jenkins, et al 2013 ) .

The research attempts to fill the identified gaps. It also seeks to identify the key functions or activities for hospital preparedness, which would enable the reliable and valid assessment of the status of hospital preparedness.

1.2 Statement of Problem

China has made significant progress in their preparedness system in recent years. For
example, it has already established a standardized monitoring, early warning and reporting system for public health emergencies, using the principles of hierarchical management and graded response. Currently, the country’s public health emergency response system, at the national level, is based mainly on the CDC (Centers for Disease Control) and medical assistance units. At the township level the system tends to rely on the local county hospitals. Further, these hospitals play a leading role in the three-level medical network in rural areas.

However, evidence from the literature suggests that, within China, the rural health care infrastructure is ill-prepared for a large-scale public health emergency event when compared to the urban areas’ capabilities, mostly because of the limited capabilities and constrained health resources in the rural areas. Rural hospitals tend to have less capacity and resources than their urban and suburban counterparts (Zhao Qi, 2009; Ji Xing, 2011; Cheng Qinglin, 2010).

Sichuan, a mountainous province, located in the southwest of China, has high population mobility, a poor economy, and low health standards. Nevertheless, the public health emergency system has developed and improved over recent years; however, it still lacks appropriate resources for public health emergencies, particularly in the rural areas (YZ Chen, et al., 2009).

Definition of rural area: In China, agriculture area, has town and village, mainly depends on agriculture and husbandry, including different kinds of farms (raise livestock and aquafarm), tree farm, gardening etc. The region mainly lived agricultural population who engaged in agricultural production.
Thus, there is an urgent need to strengthen and improve rural hospital’s capability in order to effectively control or manage public health emergencies, and to improve people’s health and wellbeing.

1.3 Research Purpose and Objectives

The purpose of this research is to develop an evaluation framework including a set of key indicators related to public health emergency preparedness for hospitals, and to examine the current status of disaster preparedness in rural hospitals by using the framework in Sichuan province.

In order to achieve the research aim, there are four main research objectives:

1. To understand the concept of hospital public health emergency preparedness and identify its key elements

2. To design a framework for assessment of hospital public health emergency preparedness.

3. To utilize the framework to test its validity and utility.

4. To evaluate the current status of hospital preparedness in rural areas and identify the contributing factors which may derive possible improvements.

1.4 Research Questions

This research will address the following questions:

1. What is hospital public health emergency preparedness?

2. How could hospital preparedness be assessed?
3. What is the current status of hospital public health emergency preparedness in rural areas of China (Sichuan)?

1.5 Significance of Research

It is difficult to measure a hospital’s preparedness ability to respond to a bioterrorist attack, pandemic influenza, or any other large-scale public health emergency (Nelson C, Lurie N, Wasserman J., 2007). This situation has not developed because of a shortage of measures of preparedness, but because of uncertain goals, a lack of agreement about what the measures should aim at and how they should be interpreted, and a weak system of accountability for producing results (Lurie N, Wasserman J, 2006).

Currently, public health emergency preparedness is not well defined compared with more traditional public health activities, such as food safety inspections, outbreak investigations, community health assessments, immunization clinics, and environmental monitoring (Asch SM, Stoto M, Menders M, et al.,2005).

Given this situation, the concept of hospital public health emergency preparedness was proposed by reviewing a meta-analysis of the peer-reviewed literature, as published over the last ten years, and the elements for a high level of preparedness were identified. The results are expected to help provide a set of shared terms for discussion among various actors, especially in relation to what exactly is involved in enhanced hospital preparedness.

Secondly, through an intensive review of the literature and the conduct of a modified
Delphi study using key experts, a comprehensive assessment tool for hospitals was developed, based on agreed-upon elements. This tool may be used to help hospitals recognize how their daily work fits within emergency preparedness, as well as identify the gaps and areas for improvement.

Thirdly, the current state of county hospitals in Sichuan province was examined. By measuring preparedness, standard public health emergency preparedness is identified and, thus, there can be a reduction in the impact that the public health emergencies have on the health and well-being of the people.

This is one of the first studies in China to examine the preparedness of the Chinese hospital system in rural areas for public health emergencies. This research adds to the evidence available to guide improvement in preparedness and thus contributes to a reduction in risk.

1.6 Research Scope
As shown in Figure two, the research began with an extensive literature review to probe the depth and width of existing knowledge on public health emergency preparedness. For the purpose of the current research, the literature review was viewed as a preliminary step in understanding the concept of public health preparedness, and to validate the establishment of a theoretical framework.

The objective of developing an evaluation tool and identifying the relevant elements centered on the need for a quantitative method which could be used to provide action guidelines to the framework. A body of knowledge can be established and advanced with confidence only when appropriate methodologies and methods are applied with rigor (Fellow & Liu, 1997). In the light of that outlook, in the current study, intensive interviews, a Delphi study and a survey were chosen as the methods by which to collect the data. The qualitative and quantitative data was processed and analysed with computer-assisted tools to derive meaningful results.

1.7 Structure of the Thesis

The dissertation comprises eight chapters. A brief summary of each is outlined as follows:

Chapter One comprises the introduction section which outlines the direction of this investigation. It also states the research background, questions and objectives, and provides a brief discussion on research methodology and thesis organisation. The research scope and significance are also described.
Chapter Two summarizes the current state of knowledge via examining the relevant papers and publications. Areas include: the concept of public health preparedness; the current status of hospital preparedness in China, and the relevant problems of hospital preparedness. Accordingly, the research gap is identified from a wide range of literature which justifies the need for this research.

Chapter Three describes the research methodology in detail including: the research design, data collection methods (namely intensive interviews, Delphi study, and survey); research process; selection of participants and research instrumentation; data analysis (quantitative and qualitative) and framework formulation.

Chapter Four describes the data analysis and presents the results of literature review and intensive interviews. The findings are tabulated to illustrate the concept of hospital public health emergency preparedness, and consistent elements for a high level of preparedness to further the development of a universal self-assessment tool. This chapter also discusses the outcomes of the Delphi study and presents the results of data analysis. The critical indicators for assessing hospital public health emergency preparedness are compiled.

Chapter Five assesses the current state of hospital preparedness in county and urban areas of Sichuan province, and identifies the relevant contributing factors.

Chapter Six discusses the key findings of the intensive interview, Delphi study, and the results of survey in the context of the literature.

Chapter Seven summarizes the key findings from the previous chapters, and discusses
the overall significance, strengths, limitations and implications of the present study. In addition, at the end of the chapter, recommendations for future research are proposed.
CHAPTER 2 LITERATURE REVIEW

The purpose of this review was to understand the concept of hospital public health emergency preparedness, and to examine the current research regarding preparedness and response, and to summarize the problems of public health emergency preparedness in China.

This chapter includes three parts. In the first part of the review, the definition and key elements of public health emergency preparedness (PHEP) are examined, and the instruments for assessing public health response system are presented and evaluated.

In the second section, a brief description of the public health emergency preparedness and response system in China is introduced, followed by an analysis of current hospital capacity of PHEP in China according to the previous studies, and identification of the deficiencies and relevant factors.

Finally, building upon the two previous sections, the review of literature narrowed to the subject of the measurement of public health preparedness program effectiveness, and how a supported measurement methodology was applied in China.

This literature includes both peer- and non-peer-reviewed sources to ensure wide coverage of less accessible materials such as government reports.
Part 1

2.1 Concept of Hospital Public Health Emergency Preparedness

2.1.1 Background

Public health threats are always present. Whether caused by natural, accidental, or intentional means, these threats can lead to the onset of public health incidents. During and after incidents hospitals play the main role of providing health services to the people, on time and without any interruption. Being prepared to prevent, respond to, and rapidly recover from, public health threats is critical for protecting and securing a nation’s public health; thus, the importance of hospital preparedness has been highlighted.

All hospitals should have emergency plans, have prepared beds, drugs, and equipment, and have educated and trained staff in advance to respond to any public health emergency (Loutfy MR, Wallington T, Mederski B, et al. 2004).

The research on hospital public health emergency preparedness in China is still at an early stage. For example, there are no uniformly accepted, standardised definitions and no conceptual framework to provide a structure for the research (XiaoPingGao 2010).

This part of the thesis first proposes a definition of hospital public health emergency preparedness, and identifies the common themes relating to the concept of hospital’s preparedness for public health emergencies. Consequently, it is the basis for the development of an agreed framework for evaluation.
2.1.2 Methods

Having explored the definitions of a hospital’s preparedness the literature review focuses on the following four research questions: (1) What is public health emergency preparedness? (2) What available, existing instruments are closely related to hospital preparedness? (3) What key components of commonality, with the identified instruments, can be used to evaluate hospital preparedness? And (4) What is an appropriate conceptual framework to synthesise these key components into the concept of hospital preparedness?

To address these questions, this section followed a meta-ethnographic approach to synthesise findings across included studies. This meta-analysis translates ideas, concepts, and metaphors across different studies and is increasingly seen as the well-developed approach for synthesising qualitative health research.

Further, this part comprises of four distinct phases: (1) a rigorous search of the literature to identify relevant articles; (2) a critical appraisal of the identified articles; (3) the development of a comprehensive definition of a hospital’s public health emergency preparedness, and (4) a subsequent meta-analysis to identify consensus elements for high levels of preparedness to further the development for a universal self-assessment tool.

The literature analysed in this section was identified through a comprehensive search strategy and analytical process. Figure three maps the process and outcomes of the review. Six electronic databases were used for the years 2002 to early 2014 (ProQuest,
EBSCO, Web of Science, Pubmed, Scopus, and Science Direct). The combined groups of terms were used during the search of the databases: disaster/emergencies, preparedness, hospital, assess/measure/evaluate, and instruments/tool/indications.

Additionally, snowballing strategies were used once specific key studies were retrieved. The related key references, citations, instrument names, and author names of the identified articles were inspected to ensure that all relevant articles were included. The focus identified peer reviewed journal articles close to the evaluation instrument of the hospital PHEP.

Studies were included that used qualitative methods focusing on instruments for measuring or evaluating the concept of hospital preparedness or the related concepts in the face of public emergencies. Papers were included that reported qualitative research only, as well as research using both qualitative and quantitative methods (mixed method) that reported the qualitative findings. The search was limited to journal articles published in English and Chinese. We used four inclusion and exclusion criteria to select articles. (1) We included studies that used qualitative methods focusing on instruments for measuring or evaluating the concept of hospital preparedness or the related concepts in the face of public emergencies. (2) We included papers that reported qualitative research only, as well as research using qualitative and quantitative methods (mixed method) that reported qualitative findings. (3) In order to obtain authoritative information, this review included only peer reviewed journal articles; books, reports and conference abstracts were excluded. (4) The study only focuses on community preparedness, staff preparedness, individual preparedness which could not be adapted to hospital preparedness were excluded.
2.1.3 Critical Appraisal of Articles

The research assessed the quality of individual studies using a checklist based on an existing appraisal scoring system for quantitative study quality assessment (Critical Appraisal Skills Programme). Evaluating a study’s quality involves the reviewer depicting the range of quality across the included studies (Munro et al., 2007). Thus, the strengths and weaknesses of the research articles were identified using this approach. The findings of studies can be weighted by the quality grade of the studies included. Therefore, the poorer-quality studies tended to contribute less to the cumulative meta-analyses, and the synthesis, therefore, became “weighted” towards the findings of the better quality studies (Munro et al. 2007; Campbell et al., 2011).

Study quality was assessed by two reviewers independently using a pretested form
No studies were excluded on the basis of quality.

Table 1 Methodological Quality of Included Studies (n=15) Adapted by author from Munro, 2007

<table>
<thead>
<tr>
<th>Quality Criterion</th>
<th>Agreed Assessment for Each Study</th>
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<tbody>
<tr>
<td></td>
<td>Yes</td>
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<tr>
<td><strong>Screening Questions</strong></td>
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<tr>
<td>1. Was there a clear statement of the aims of the research?</td>
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<tr>
<td>2. Is a qualitative methodology appropriate?</td>
<td>14</td>
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<tr>
<td><strong>Aims</strong></td>
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<td>3. Is there a clear statement of the aims of the research?</td>
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<td><strong>Appropriate research design</strong></td>
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<tr>
<td>4. Was the research design appropriate to address the aims of the research?</td>
<td>11</td>
</tr>
<tr>
<td><strong>Sampling</strong></td>
<td></td>
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<tr>
<td>5. Is the sampling method clearly described?</td>
<td>9</td>
</tr>
<tr>
<td>6. Is the sampling strategy appropriate for the research question?</td>
<td>12</td>
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<tr>
<td><strong>Data collection</strong></td>
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<tr>
<td>7. Is the method of data collection clearly described?</td>
<td>15</td>
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<tr>
<td>8. Is the data collection appropriate to the research question?</td>
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<tr>
<td><strong>Data analysis</strong></td>
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<tr>
<td>9. Was the data analysis sufficiently rigorous?</td>
<td>14</td>
</tr>
<tr>
<td><strong>Findings</strong></td>
<td></td>
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<tr>
<td>10. Is there a clear statement of findings</td>
<td>15</td>
</tr>
</tbody>
</table>

### 2.1.4 Results

**Related Concepts**

A number of related concepts are included within the results, namely: public health emergency, preparedness, public health emergency preparedness.

**Public health emergency**

The World Health Organisation defines a public health emergency as:

"an occurrence or imminent threat of an illness or health condition, caused by bio-terrorism, epidemic or pandemic disease, or (a) novel and highly fatal infectious
agent or biological toxin, that poses a substantial risk of a significant number of
human facilities or incidents or permanent or long-term disability (WHO/DCD,
2001).”

However, this definition is relatively restrictive, being limited to infective agents.

The real threats to public health may be more broadly considered to include anything
that has the potential to significantly and adversely impact on the health and
wellbeing of the community.

The National Disaster Medical System Federal Partners Memorandum of Agreement
defines a public health emergency as “an emergency need for health care (medical)
services to respond to a disaster, significant outbreak of an infectious disease,
bioterrorist attack or other significant or catastrophic event”(NDMS, 2005).

According to the Secretary of the Ministry of Health (MOH, China), public health
emergencies refer to events that occur unexpectedly and can cause, or potentially
cause, mass destructions to public health.

The Public Health Emergency Response Regulations define four categories of such
events: (1) serious epidemics; (2) mass diseases with unknown causes; (3) large scope
food poisoning; and (4) other events that can severely affect public health, for
example, the leaking of infectious bacteria from laboratories (State Department of the

The Health Emergency Response Handbook classifies PHEP into eight categories: (1)
serious epidemics and mass diseases with unknown causes; (2) large scope food and
professional poisoning; (3) events that leak infectious bacteria from laboratories; (4) hazards caused by natural disasters; (5) hazards caused by farm chemicals, ratsbane and other toxic chemicals; (6) preventive inoculation accidents; (7) hospital and laboratory infections; and (8) other events that can severely affect public health. (Liu Q, 2010)

Chen et al. (2006) divided public health emergencies into six categories according to the following characteristics: (1) natural disasters; (2) infectious disease events; (3) poisonings; (4) terrorist incidents; (5) nuclear and radioactive accidents; and (6) other mass disturbances that can severely affect public health.

**Preparedness**

Preparedness is commonly viewed as consisting of activities aimed at improving response activities and coping capabilities (Melinda Moore, 2012). Further, the term preparedness is typically understood as consisting of measures that enable different units of analysis—individuals, households, organizations, communities, and societies—to respond effectively and to recover more quickly when disasters strike (Sutton & Tierney, 2006).

The National Fire Protection Association (NFPA) defines preparedness as: activities, programs, and systems developed and implemented prior to a disaster/emergency that are used to support and enhance the mitigation of, the response to, and the recovery from disaster/emergencies.

The FEMA (the Federal Emergency Management Agency, USA, 2012) defines
preparedness as: the leadership, training, readiness and exercise support, and technical and financial assistance to strengthen citizens, communities, state, local, and tribal governments, and professional emergency workers as they prepare for disasters, mitigate the effects of disasters, respond to community needs after a disaster, and launch effective recovery efforts.

The National Research Council (NRC, USA, 2005) reported preparedness efforts as aiming to ensure that the resources, necessary for responding effectively in the event of a disaster, are in place, and that those faced with having to respond know how to use those resources. The activities that are commonly associated with disaster preparedness include planning processes to ensure readiness;formulating disaster plans;stocking resources necessary for effective response; and developing skills and competencies to ensure effective performance of disaster-related tasks.

Slepski defined emergency preparedness as being based on the term “emergency preparedness”, namely, “the comprehensive knowledge, skills, abilities and actions needed to prepare for and respond to threatened, actual or suspected chemical, biological, radiological, nuclear or explosive incidents, man-made incidents, natural disaster or other related events” (Slepski LA, 2005).

The concept of emergency preparedness also encompasses measures aimed at enhancing life safety when a disaster occurs, such as protective actions during an earthquake, hazardous materials spill, or terrorist attack. Further, it includes actions designed to enhance the ability to undertake emergency actions in order to protect
property and contain disaster damage and disruption, as well as the ability to engage in post-disaster restoration and early recovery activities. (Jeannette & Sutton, Kathleen Tierney, 2006)

Emergency preparedness activities differ according to which social unit (households, business, communications, and public or government entities) is involved. For local emergency management agencies, disaster preparedness focuses on establishing authorities and responsibilities for emergency actions and resources to support those actions (Haddow and Bullock, 2006).

There are different definitions for preparedness, and the activities and elements of preparedness often vary considerably across agencies, and shift dramatically from year to year. There are also consistent problems, confused and perplexed state and local health officials, businesses, non-profit organisations, and citizens. These problems include: What should preparedness aim at? (Jeannette & Sutton, Kathleen Tierney, 2008; Nelson C, 2007; Melinda Moore, 2012; Lurie N, Wasserman J, 2006); What constitutes preparedness? (Asch SM, Stoto M, Menders M, et al., 2005; Nelson C, 2007; Haddow and Bullock 2006); and who should be involved in preparedness? (Fraser M, 2007. Asch SM, Stoto M, Mendes M, et al., 2005; Jeannette & Sutton, Kathleen Tierney, 2008).

These questions are considered within the definition of hospital public health emergency preparedness.

*Public Health Emergency Preparedness (PHEP)*
Currently, public health emergency preparedness is not well defined. (Asch SM, Stoto M, Menders M, et al. 2005). To develop a definition, and identify the activities, three aspects must be considered, namely: “what public health emergency preparedness should aim at, what public health emergency preparedness activities include, and who is involved in it”.

“What should public health emergency preparedness aim at?”

Public health emergencies are defined by their health consequences, their causes and the precipitating events (Auf der Heide E.1989). A situation becomes emergent when its health consequences have the potential to overwhelm routine community capabilities.

Thus, the proposed definition will focus on situations “whose scale, timing, or unpredictability threatens to overwhelming routine capabilities” (Nelson C., et al., 2007). Additionally, the definition should be aligned with the all-hazards approach to preparedness instead of focusing on a “disaster du jour” (Keim M, Giannone P.2006), and should allow for the optimal development of capabilities across scenarios, and the better preparation of communities for the broad spectrum of potential risks (Lindell MK, Perry RW., 1993).

“What do public health emergency preparedness activities include?”

Preparedness intersects pre-disaster and post-disaster, serving as a temporal connector between the pre-impact and post-impact phases of a disaster event (Gordon, Paula. 2004). Emergency preparedness refers to four processes involved in ensuring an
institution: (1) complying with the preventive measures; (2) having a state of readiness to contain the effects of a forecasted disastrous event in order to minimize loss of life, injury, and damage to property; (3) providing rescue, relief, rehabilitation, and other services in the aftermath of the disaster; and (4) holding the capability and resources to continue to sustain its essential functions during a PHE (Thomas J. 2004).

Further, PHEP is a process as much as an outcome. It requires continuous improvement, including the frequent testing of plans through drills and exercises, and the formulation and execution of corrective action plans (Christopher Nelson, Nicole Lurie, 2007). It also includes the practice of developing plans and procedures, training staff, improving the health and resiliency of communities, and the acquisition of facilities, equipment, and materials needed to provide active protection during emergency response (Aledort J, Lurie N, Ricci K, Dausey D, Stern S, 2006). Thus, PHEP should include a full range of prevention and protection, response, and recovery activities, such as developing planning processes to ensure readiness; formulating disaster plans, and stockpiling resources necessary for effective response; and developing skills and competencies to ensure effective performance of disaster-related tasks.

“Who is involved in public health emergency preparedness?”

Preparedness is typically understood as consisting of measures that enable different units of analysis—individuals, households, organizations, communities, and
societies—to respond effectively and recover more quickly when disasters strike (Jeannette Sutton, Kathleen Tierney. 2006).

Responsibility for the preparedness of the nation’s community lies not only with governmental agencies, but also with active, engaged, and mobilized community residents, businesses, and nongovernmental organizations (Nelson C, et al., 2007). A large share of first aid, search-and-rescue, and other initial response activities are provided by on-site civilians prior to the arrival of response personnel (KerbyDM, Brand M, Johnson D, et al. 2007). This fact indicates that the individuals, households, organizations, communities, and societies are involved in the full range of activities. Accordingly, involving a broad range of actors in PHEP requires coordination.

To sum up, the thesis proposes a definition for hospital public health emergency preparedness including: the planning and actions that enable hospitals to prevent, protect against, quickly respond to, and recover from public health emergencies in a timely, coordinated and effective way. These activities may involve different units—individuals, households, organizations, communities, and societies.

**Measurements and Themes of Hospital PHEP**

**Meta-analysis**

Based on the meta-ethnography approach, this research followed a 7-step process (Noblit GW, Hare RD. 1988), using reciprocal translations, and analogous to constant comparisons in primary qualitative research, to compare the themes identified in each study. A “line-of-argument synthesis” was conducted, an approach similar to
grounded theory in primary research (Munro, et al. 2007), to determine an evaluation instrument for hospital public health emergency preparedness.

(1) Identifying themes and concepts

Concepts, themes, and subthemes were identified by reading and rereading the included studies. Initially, the author manually summarized the existing studies’ original findings by using original terms and key concepts from the articles. In this process, primary themes and sub-themes were found in the results section of an article, and secondary themes (translation) were extracted in the discussion and conclusion section of these studies, plus the definition of public health emergency preparedness (Nelson, Nicole, et al. 2007). Although the foci of these studies were different, and not all their components were directly comparable, a number of recurring themes and sub-themes were identified; they were then added to the initial themes.

(2) Determining how the studies are related

Thematic analysis was used to develop categories from the identified primary themes in the included studies. Thematic analysis was conducted in three main stages: (1) Identify themes or code findings; (2) Determine how studies are related; (3) Synthesise themes. Some primary themes were extracted from the stage 1 (Table 1). Stage 2 required that the relationships between the concepts (primary themes) arising from the different papers were considered. The author looked across the different papers for common concepts. These concepts represent related themes and concepts and, initially, included: prevent, protect and response ability; surveillance; training
and drills; stockpiles; emergency management; staff; on-site rescue and medical treatment; evaluation, and emergency funding. These categories were revised and merged through discussions with the research team. A similar process was followed for the sub-themes from the included studies. Stage 3 was conducted by following the steps:

(3) Reciprocal translation of studies

According to the meta-ethnographic method, categories were identified across each article, while the primary themes were translated from each study to determine the sub-themes. The translation involved a comparison of themes across papers and an attempt to “match” themes from one paper with themes from another, ensuring that a key theme captured similar themes from different papers (Britten et al., 2005; Munro et al., 2007).

(4) Synthesizing translation

To develop an overarching framework, the translated themes and subthemes were listed and juxtaposed with parameters derived from the articles (see Table 2). Then, after discussions with the research team, consideration was given to if and how the translations and the author’s interoperations were linked together. This method, the “line-of-argument” synthesis, is a method used to create a theoretical framework representing a further level of conceptual development incorporating all the included studies, rather than a description of the synthesized papers (Jenkins, Kelen, et al. 2009).
Measurements of preparedness

Preparedness has a variety of elements that are in turn supported by a number of activities. Elements of public health emergency preparedness consist of the various goals or end-states that public health emergency preparedness seeks to achieve. This research reviewed articles which used assessment tools that require jurisdictions and officials to complete written assessments of public health emergency preparedness activities. These assessments typically rate readiness on a list of key elements of preparedness. These articles are detailed in Table 2.
<table>
<thead>
<tr>
<th>Author</th>
<th>Disaster type</th>
<th>Purpose/Application</th>
<th>Scale</th>
<th>Scoring procedure</th>
<th>Key elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Healthcare Association of Hawaii 2001</td>
<td>Emergencies</td>
<td>Evaluate hospital readiness capacity at state and local level</td>
<td>N/A</td>
<td>N/A</td>
<td>12: (Number of key elements): Leadership and Authorities; Hazard Identification and Risk Assessment; Planning; Direction, Control and Coordination; Communications and Warning; Operations and Procedures; Resource Management; Logistics and Facilities; Training; Exercises; Performance improvement; Information</td>
</tr>
<tr>
<td>Michael I. Greenberg, et al. 2002</td>
<td>Bioterrorism and mass casualty</td>
<td>Evaluate the preparedness of hospital EDs to treat victims of a terrorist biological or chemical agent release</td>
<td>Yes/No/ don't know</td>
<td>N/A</td>
<td>6: Training; ability of Decontaminate; Cooperation; Evaluation and Treatment of Biological and Chemical Casualties; Exercises; Logistics, like antidotes.</td>
</tr>
<tr>
<td>Barbara I. Braun 2004</td>
<td>Bioterrorism</td>
<td>Assess linkages between hospitals and key community entities related to preparedness for bioterrorism</td>
<td>Yes/No and open-ended items</td>
<td>N/A</td>
<td>4: Hospital-specific emergency management plans; Hospital perception of community-wide emergency management plans; Hospital perception of community coordination; Hospital demographic information</td>
</tr>
<tr>
<td>Knudsen 2005</td>
<td>Chemical, biological, nuclear and explosive threats</td>
<td>Assess the level of preparedness of a community</td>
<td>Yes/No/ don't know</td>
<td>N/A</td>
<td>6: Risk assessment; Screening and identification; Prevention, Deterrence and Planning; Training, Awareness and Application; Leadership, Authority and Communication; Activation and Response</td>
</tr>
<tr>
<td>Hu GQ, et al. 2006</td>
<td>Public health emergencies</td>
<td>Assess the current preparedness capacity to public health emergencies in China</td>
<td>yes/ no/ partially</td>
<td>N/A</td>
<td>10: Laws and relevant regulations; Incident Command system; Risk Identification and Assessment; Emergency Plan; Expert Database; Emergency Response team; Medical treatment system for public health emergency; Recourse management; Emergency funding; Monitoring and Warning</td>
</tr>
<tr>
<td>Study</td>
<td>Area</td>
<td>Methodology</td>
<td>Score Method</td>
<td>Categories</td>
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<tr>
<td>Kaji, and Lewis 2006</td>
<td>All hazards</td>
<td>Measures of hospital disaster preparedness or hospital &quot;surge capacity&quot;</td>
<td>yes/no</td>
<td>Overall score was calculated by summing indicators. 6: Disaster Plan; Modes of intrahospital and interhospital communication; Decontamination capability and training; characteristics of Drills; Pharmaceutical stockpiles; Facility's surge capacity</td>
<td></td>
</tr>
<tr>
<td>Braun et al. 2006</td>
<td>All-hazards</td>
<td>Evaluate hospital-community services linkages that facilitated the response to local emergencies</td>
<td>yes/no</td>
<td>the accuracy of data entry was assessed by calculating agreement from duplicate entry of 12 randomly selected questionnaires. 4: Collaborative planning process; Community emergency operations plan; Established response capability; ongoing surveillance, reporting and laboratory identification</td>
<td></td>
</tr>
<tr>
<td>Zhang H, et al 2007</td>
<td>Infectious diseases</td>
<td>Measure the current status of hospitals preparedness for infectious disease in Beijing</td>
<td>yes/no</td>
<td>N/A 6: Emergency Plan; Laboratory Diagnosis Capacity; Medical Treatment Procedures; Specific Drug Stockpile; Personal Protective equipment stockpile; Staff Training</td>
<td></td>
</tr>
<tr>
<td>Xingming Li, et al. 2008</td>
<td>Public health emergencies</td>
<td>Assess the current status of hospital PHE preparedness in China</td>
<td>yes/ no/unknown</td>
<td>Each answered item was scored 1 for &quot;yes&quot; and 0 for &quot;no&quot; or &quot;unknown&quot;. Item scores were calculated by adding together &quot;yes&quot; answers. 8: Hospital's demographic data; Hospital PHE preparation; Response ability to a community PHE; Stockpiles of drugs and materials; PHE detection and identification; Procedures for medical treatment; Laboratory diagnosis and management; Staff training; Risk communication</td>
<td></td>
</tr>
<tr>
<td>Cliff B.J., et al 2009</td>
<td>Chemical, biological, nuclear and events</td>
<td>Quantify the levels of preparedness for rural hospitals</td>
<td>yes/no</td>
<td>Overall preparedness score was the mean score of categories 8: Administration and planning; Surge capacity; Education and training; Communication and notification; Supplies, Pharmaceuticals, and Laboratory support; Staffing and Support; Isolation and Decontamination; Surveillance</td>
<td></td>
</tr>
<tr>
<td>Authors</td>
<td>Title</td>
<td>Methodology</td>
<td>Scoring System</td>
<td>Topics</td>
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<tr>
<td>Zhu, et al. 2009</td>
<td>Public health emergencies</td>
<td>Evaluate the hospitals’ capacity in the public health emergency preparedness</td>
<td>yes/no</td>
<td>8: Emergency system; Emergency organization; Monitoring and Warning; Procedures for medical treatment; Logistics; Training and Exercises; Publicity and Education</td>
<td></td>
</tr>
<tr>
<td>Zhao Q. 2009</td>
<td>Public health emergencies</td>
<td>Evaluate rural medical institutions preparedness and response capacity for public health emergencies</td>
<td>yes/no/unknown</td>
<td>8: Planning; Monitoring and Warning; Laboratory diagnosis; Emergency response team and expert database; Communication, Coordination; Training and Exercises;</td>
<td></td>
</tr>
<tr>
<td>Kollek, and Cwinn 2011</td>
<td>Chemical, biological, nuclear events</td>
<td>Assess the readiness of emergency departments at the organizational and administrative levels</td>
<td>Yes/No/don’t know</td>
<td>5: Risk assessment; General Disaster Preparedness; Bio-preparedness; Decontamination; Availability of Equipment</td>
<td></td>
</tr>
<tr>
<td>Niska, and Shimizu 2011</td>
<td>Mass casualty and influenza</td>
<td>Evaluate hospital preparedness for emergency response</td>
<td>Yes/No</td>
<td>6: Emergency response plans; Components of hospital preparedness; Internal and External mass casualty drills, simulations, or exercises; Hospital preparedness funding</td>
<td></td>
</tr>
<tr>
<td>Davis, Christine, etc. 2014</td>
<td>Public health emergencies</td>
<td>Examine local health department preparedness capacities</td>
<td>N/A</td>
<td>8: Surveillance and investigation; Plans; Workforce; Communication and information dissemination; Incident command; Legal infrastructure and preparedness; Exercises.</td>
<td></td>
</tr>
<tr>
<td>Johnson LA, Rafael 2014</td>
<td>Infectious disease</td>
<td>Measure CDC’s capacity for infectious disease surveillance and preparedness</td>
<td>N/A</td>
<td>10: Planning; Research; Communications; Epidemiology; Laboratory; Surveillance; Containment; Intervention; Infection Control; Health Sector Response</td>
<td></td>
</tr>
</tbody>
</table>
15 studies published during 2002 between 2014 were included in this review. These studies were mainly conducted in US, UK, and China. All studies focused on evaluation instruments for hospital preparedness in different types of disasters. Most studies concerned with the preparedness or readiness of hospitals (including ED) to disasters (n=11). The other articles examined linkages between hospitals and key community entities related to preparedness during disasters (n=2). All reviewed instruments can likely contribute to the new instrument of evaluating hospital preparedness directly or indirectly. It is noteworthy that most of the studies are based on U.S. samples, post 9.11.

In 2002, the CDC (Centres for Disease Control, USA) created a voluntary self-assessment instrument “Public Health Preparedness and Response Capacity Inventory” (PHPRCI). The content was linked to the CDC’s 2002 Cooperative Agreement on Public Health Preparedness and Response for Bioterrorism. This is the main funding vehicle for the Federal government’s post-9/11 infusion of funds for public health preparedness. Items in the instrument seek information on a full range of preparedness structures, including planning, surveillance, laboratory capacity, communication, and training. Data from the assessment are intended to support both process improvement and accountability efforts. The reliability and validity of the instruments are context-specific, which need to be retested if with a different hospital sample or a different context, other than functional, are to be used.

To measure preparedness outcomes, the Montana Department of Public Health and Human Services established a partnership with Montana State University-Bozeman to
develop a tool to gauge baseline preparedness, as well as the progress made during the first two years of the Cooperative Agreement funding (Kuntz, Smilie, Wang, 2005). The tool, the Emergency Preparedness Scoring Matrix (EPSM), extrapolated a point-in-time measure (a single numerical score) and gave health departments a baseline/starting point preparedness score for 2002. The initial data were collected through the PHPRCI, with modifications specific for Montana. However, a challenge remains in identifying external parameters to test the construct validity.

Michael I. and Greenberg, in 2002, assessed the level of preparedness of hospital EDs (Emergency Departments) in a large metropolitan area to evaluate and treat victims of a terrorist biological or chemical agent release. The survey instrument, consisting of 38 questions, was mailed to the physician directors of each ED. The survey contained six key measures: training, cooperation, ability to decontaminate, evaluate and treat biological and chemical casualties, exercises, and logistics. The results of the research presented criteria for minimum preparedness for hospital EDs (Michael I., Greenberg 2002).

To assess the linkages between hospitals and key community entities related to preparedness for bioterrorism, Barbara I., et al. carried out a pilot study, before and after the terrorist events of September of 2001, in two independent samples of hospitals scheduled for the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) accreditation survey. Information was obtained using a self-administered questionnaire, with on-site verification of selected items, by JCAHO surveyors. The questionnaire contained 51 items, both open and close-ended,
in four sections: (1) hospital-specific emergency management plans; (2) hospital perception of community-wide emergency management plans; (3) hospital perception of community coordination; and (4) hospital demographic information. However, the questionnaire was not able to evaluate the completeness or accuracy of the linkages (Barbara I., et al. 2004).

To characterize disaster preparedness among a cohort of hospitals in Los Angeles County, US, Amy H. Kaji, et al., in 2006, carried out a cross-sectional survey study focusing on practice variation, plan characteristics, and surge capacity. Evaluations of hospital disaster plan structures, vendor agreements, modes of communication, medical and surgical supplies, involvement of law enforcements, mutual aid agreements with other facilities, drills and training, surge capacity (assessed by monthly emergency department diversion status, available beds, ventilators, and isolation rooms), decontamination capability, and pharmaceutical stockpiles were assessed by the survey. However, this instrument needs revision or substantial user training, as well as verification of the reliability in a particular setting before use.

Hu GQ., et al., in 2006, assessed the current preparedness capacity to public health emergencies in four Chinese provinces. The study was based on a capacity framework developed by the United Nations Development Program (UNDP). The instrument has 10 dimensions, including 204 indicators. The response categories were “yes, no, partially”, and the responses to measure were given values (yes=1; no=0; partially=0.5). These scores were used to calculate summary performance scores for each dimension. The UNDP framework assesses capacity from three levels:
the individual level, the level of the organization or entity, and the level of the system. However, this study evaluated PHEP capacity only, at the level of the system (Hu GQ, 2006).

In 2006, Braun I, et al. assessed community emergency preparedness linkages among hospitals, public health officials, and the first responders. A mailed questionnaire was used to assess the linkage issues related to training and drills, equipment, surveillance, laboratory testing, surge capacity, incident management, and communication. The internal consistency and validity of the instrument was tested. The responses categories were “yes, no, don’t know”; the accuracy of data entry was assessed by calculating the agreement from duplicate entries of 12 randomly selected questionnaires. The responses reflected the hospitals’ self-perception of the linkages. The quality of the linkages and the extent of the possible biases favouring positive responses were not assessed.

Xingming Li, Jianshi Huang and Hui Zhang (2008) surveyed four hundred hospitals in four cities and provinces of China using a standardized questionnaire to assess the current hospital PHEP. The data were collected and analysed as they related to: the hospital demographic data; PHE preparation; response to PHE in the community; the stockpiles of drugs and materials; the detection and identification of PHE; the procedures for medical treatment; laboratory diagnosis and management; staff training and risk communication. The questionnaire consisted of 17 sections and 192 items. Each answered item was scored 1 for “yes” and 0 for “no” or “unknown”. The item scores were calculated by adding together the “yes” answers. The higher the total
item score, the better the hospital PHE preparedness capacity. However, the instrument may underestimate the evaluation of the reliability and validity by only using the Cronbach’s $\alpha$ coefficient without any other correlation analysis (Xingming Li, et al. 2008).

Cliff BJ, et al. (2009) examined disaster preparedness, risk perception and association in rural hospitals in the United States. The study described the perceived risk of disaster events and the status of disaster preparedness in rural hospitals. It was based on a regionally stratified, random sample of rural hospitals, consisting of a mailed questionnaire and a follow-up telephone interview. The study examined seven elements of preparedness: administration and planning; surge capacity; education and training; communication and notification; supplies, pharmaceuticals and laboratory support; staffing and support. There were 37 indicators within the seven subcategories of preparedness. Each indicator had nominal variable with a yes/no scale based on the self-reported responses. Each “no” response was coded as a “0” and each “yes” response was coded as a “1”. The responses to each indicator were added to establish a total sub-score for each subcategory. However, the validity and reliability was not tested.

Zhao Qi, et al. (2009) evaluated rural medical institutions’ preparedness and response capacity for PHE in China. The survey was carried out in six provinces. The content contained eight elements of preparedness: planning; surveillance; laboratory diagnosis; emergency response team and expert database; communication and coordination; training and exercises. Both the validity and reliability were tested, while the
correlation was also evaluated. Each answered item was scored 1 for “yes” and 0 for “no” or “unknown”. The item scores were calculated by adding together the “yes” answers. Few studies about disaster preparedness concentrated on rural areas; this research was the first to put county CDC and hospitals together as an entity to response PHE, and developed an assessment framework and instrument based on UNDP theory. However, the six provinces did not fully represent all rural medical institutions of China.

Dexiang Zhu and some researchers evaluated the PHEP capacity of hospitals in Guangzhou by using a questionnaire. The instrument had seven indicators and twenty-one sub-indicators, and tested the correlation by the Analytical Hierarchy Process. The content validity of the questionnaire was evaluated. Each indicator was a nominal variable with a yes/no scale based on the self-reported responses. Each “no” response was coded as a “0” and each “yes” response was coded as a “1”. The questionnaire used, in the main, categorical variables, like “yes/ no”, which may cause a loss of some information compared with the measurement data.

Kollek D. and Cwinn, in 2011, assessed the readiness of emergency departments at the organizational and administrative levels. The questionnaire was emailed to hospitals. The questionnaire consisted of multiple-choice questions divided into sections by demographics of the department, risk assessment, general disaster readiness, readiness for bio-events, ability to decontaminate, radiation readiness, and the availability of antidotes. The response was defined to “yes, no, don’t know, null”.

The limitation of this study is the low response rate caused loss of information.
Besides, it wasn’t impossible to provide a before and after comparison of specific centres that responded in the first study to those that responded in the second study, because the results in each study were pooled to maintain the confidentiality of data from individual institutions (Kollek D., Cwinn, 2011).

**Themes of Hospital PHEP**

Despite different instruments having different assessing objectives, and because there are many differences in the preparedness elements, a number of common themes appear both in the research on preparedness and in the guidance documents. Further, almost every instrument covered the functional requirements of disaster management at all stages of a crisis (pre-incident, incident, post-incident). Ten primary themes and 23 subthemes were identified from the synthesis of the related studies. The following table (Table 3) outlines these three categories and the relevant elements.

**Table 3 Themes and sub-themes emerging from the included studies**

<table>
<thead>
<tr>
<th>Themes</th>
<th>Sub-themes</th>
</tr>
</thead>
</table>
| Emergency Plan       | • Type of emergency plan: e.g. bioterrorism and chemical events; communicable disease, etc.  
                        | • The accessible of plan: whether is accessible to all medical staff; promote the emergency plan  
                        | • Details of the plan: e.g.: a protocol to initiate the emergency plan, a classification of the role in community wide planning.  
                        | • The period of evaluating and revising the plan  |
| Surveillance         | • Disease surveillance: e.g. surveillance policy and system; surveillance systems for different types of diseases, etc. |
| Training and drills  | • Type of training/ drills: e.g. bioterrorism and chemical events; communicable disease  
                        | • Evaluation for effectives of training/drills: whether assess effectives of training/drills at fixed period.  
                        | • Drills cooperation with multiple agencies |
| Stockpiles                                                                 | • Emergency supplies: e.g. drugs, food, water, protection facilities, emergency beds,  
|                                                                          | • Emergency stockpiles management: e.g. whether establish system and plan of stockpiles,  
|                                                                          | whether have a person responsible for stockpiles management  
| Emergency command system                                                | • Emergency command centre  
|                                                                          | • Emergency relevant system: e.g. whether establish emergency report system, medical  
|                                                                          | treatment system, emergency watch system, etc.  
|                                                                          | • Emergency committee or group  
| Fully staffed workforce                                                  | • The staff structure of critical department  
|                                                                          | • Capacity of critical staff  
| On-site rescue and medical treatment                                     | • On-site rescue: e.g. capacity of emergency rescue, equipment for on-site rescue (for  
|                                                                          | example, ambulance, communication equipment.)  
|                                                                          | • Medical treatment: e.g. expert group for emergency medical treatment; treatment  
|                                                                          | strategies for different diseases; equipment for medical treatment, etc.  
| Crisis communication and cooperation                                    | • Communication and cooperation with hospitals: e.g. within department within hospitals;  
|                                                                          | within key staff within hospitals  
|                                                                          | • Communication and cooperation with other facilities: e.g. with other health facilities;  
|                                                                          | with government offices for emergency; with media and public  
| Evaluation and adaption                                                  | • Experience learning: e.g. lessons learned; experience summary  
|                                                                          | • Evaluation of hospital capacity: e.g. hospital vulnerability analysis  
|                                                                          | • Adaption of hospital: e.g. adaption of the emergency plans, etc.  
| Emergency funding                                                       | • Emergency funding collection: e.g. the means of collecting funding;  
|                                                                          | • Emergency funding management: e.g. emergency funding planning; management system,  
|                                                                          | etc.  

The emergency plan element consists of activities related to developing, evaluating, 
and revising emergency plans and other agreements; such plans can be either informal 
or formal, with different plans for different types of emergencies. For example, 
organizations, multi-organizational response networks, and preparedness activities 
centre on the development and the adoption of the formal disaster plans (Jeannette 
Sutton, Kathleen Tierney. 2006). Additionally, the emergency plans should be 
accessible to all hospital staff. These plans are outlined below.

The element of surveillance involves the ability to maintain and improve the systems 
and network to monitor, detect and investigate the potential hazard. And laboratory
functions are mainly identify, test, and isolate variety of etiology.

Training and Exercises is focus on developing and maintaining a public health and health care workforce through training, exercises and drills and real events or other educational activities.

The stockpiles are related to activities for building infrastructure, such as original critical facilities to meet the building codes for high risks, e.g. floods and earthquakes. Included in the concept of stockpiles are emergency supplies, e.g. water and food, and a certain number of ambulances, beds, as well as protection for inventories and drugs.

The activities of a command system include the identification of responsibility in all sectors, the specification of how resources will be managed, how preparedness networks are to be formed, and the management procedures adopted. The goal of the command system is to develop, test, and improve decision-making, as well as the response capability using an integrated incident command system in the hospital.

The element of communication and cooperation involves activities to provide accurate and credible messages to, and cooperate with, the public, organizations and community institutions. The types of information focus on health and safety, the continuity of operations and government, the critical facilities and infrastructure, the delivery of services, the environment, and economic and financial conditions.

The elements of on-site rescue and medical treatment involve the ability to implement public health functions, including capabilities to detect, investigate, and identify health hazards, as well as to rapidly provide medical services to the public and
casualties during crisis.

The element of evaluation and adaption contains the use of hazard and hospital vulnerability analyses to determine what should be done in the future, and to ensure that mitigation issues are addressed during the adaption process. The emergency plan needs to be revised or a new plan developed, based on the evaluation results, as well as the experiences summary.

The final element, funding management, involves the means for the collection and analysis of funding for emergency responses, the tracking of resources, and ensuring adequate and timely reimbursement.

Therefore, part 2 proposes what hospital PHE preparedness is, reviews the measurements for public health emergency preparedness, and describes the current capability of a hospital's public health emergency preparedness in China, as well as the factors which affect preparedness capacity.
Part 2

2.2 The Public Health Emergency Preparedness and Response System in China

2.2.1 Introduction

Public health emergency preparedness and response (PHEPR) involves activities directed at preventing possible emergencies and planning to ensure an adequate response and recovery if an emergency occurs. The purpose of the PHEPR is to provide a process to quickly identify, notify, assemble and deploy public health personnel, partners from the private health sector and private hospitals, and appropriate medical equipment and supplies (Debra Revere, Kailey Nelson, et al. 2011).

Since the outbreak of SARS in 2003, the Chinese government has paid more attention to the development of the public health emergency preparedness and response. At present, China has developed the standardized public health emergency preparedness and response system. (Figure four)
According to *National Public Health Emergency Preparedness*, Figure four depicts the public health emergency preparedness and response model. Public health emergencies (PHE) in China are divided into 4 levels, namely Special major PHE, Major PHE, Large PHE and General PHE. For example, if the public health emergency is confined within a certain region of a province, the provincial emergency plan will be appropriate. If the public health emergency is diffused across provinces and endangers the national public health, the national plan will be needed.

In China, the PHEPR system consists of PHE headquarters, administrative Department of Public Health, CDC (Centres for Disease Control), and medical treatment institutions. The relevant departments and organizations are divided into two categorical types: the technical institutions, including medical institutions, CDC,
health monitoring institutions, and entry and exit inspection and quarantine bureau; as well as relevant departments and organizations, including government branches and non-governmental organizations (NGO).

### 2.2.2 Methods

This section utilised a standard comprehensive literature search method. Electronic data bases, including PubMed, Web of Science, CNKI, and Wang Fang Med Online, were searched. The algorithm and terms in PubMed and Web of Science were [China AND hospital management AND (emergency OR crisis OR disaster)] OR [China AND hospital AND (emergency response OR emergency preparedness)]. The terms in the Wang Fang Med Online searches and the CNKI were [hospital management AND (emergency OR incident OR crisis OR disaster)] OR [hospital AND (emergency response OR emergency preparedness)]. The time period was limited between 2001 through to 2014. In addition, the reference lists of most recent relevant articles were examined (known as the snowball technique) to identify any missing articles.

The articles were reviewed by the principal researcher, with the duplicate articles being excluded. The list was narrowed by reviewing the titles and abstracts, while the list was further narrowed by a reading of the texts. A total of 135 full-text articles were reviewed for the detailed analysis.

### 2.2.3 Results

**Progress in the PHEPR system in China**

By 2010, 27 provinces, autonomous regions, and municipalities in China had set up
offices of PHE. The national and some provincial CDCs established Departments of Emergency Response, along with the development of an emergency plan (FL Lin, 2010). In January, 2004, the national PHE information system was launched and 31 provinces began network reporting (GQ Hu, 2006; Hui Zhang, 2006). The MOH, National Development and Reform Committee developed a Construction Plan for CDC in China, and invested 114 billion RMB in the medical rescue system. Ten national disaster relief and disease prevention leading groups were organized for directing and supporting local government to deal with PHE (Hong Chen, 2010); Multiagency coordination system has been formed, such as the National Development and Reform Committee which developed emergency material production and reserve system; civil aviation, railways department, traffic department and others established epidemic monitoring reporting systems. (Liu XH 2008).

**Previous studies on preparedness and readiness in China**

Up until 2007, there is no national data on China’s hospital preparedness or readiness capacity (Zhang Hui, Huang Jian-Shi, et al. 2007). Therefore, to understand the current capacity of hospitals in China, a summary was made of the research surveying hospitals in China, as well as those related to medical institutions’ PHEP. Eighty-nine (89) articles were related to medical institutions’ PHEP capacity in China from 2001-2014 (Table 4).

**Table 4 Summary of topics in articles included in the review**

<table>
<thead>
<tr>
<th>Topics</th>
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44
Table 4 shows the topics included in the reviewed articles. These topics were quite broad, and covered almost all aspects of medical institutions’ PHEP capacity. The current research lists the current status of PHEP in China, from the frequent and major topics in the articles, namely, emergency plan, command and direction system, communication and cooperation system, surveillance, logistics (stockpiles), funding, medical treatment, training and drills (exercises), and evaluation.

*PHE Plan*

During a sudden, large-scale infectious disease outbreak, hospitals need to quickly convert their current care capacity to surge capacity (XD Tan 2003). An emergency preparedness system is primarily composed of emergency plans and organizational structures which lay the foundation for dealing with PHE.

Therefore, the infectious disease emergency plan is needed before, during, and immediately after the infectious disease outbreak. Most studies showed that most hospitals had emergency plans and these plans focused on infectious diseases control, but less attention were paid to preparedness for biological, nuclear radiation and other

Some researchers recommended that emergency response plans should focus on particular types of incidents to which a hospital might have to respond (JX Fu, et al. 2005). They further suggested that hospitals establish a database of incidents: analysing the factors that have an influence on incidents in China (JX Fu, et al. 2005) and develop guidelines for classification of those incidents (J Wen, et al. 2006).

In addition, reviewing and updating the emergency plan is important to enhance response capability. For example, Zhang (2006) showed that little more than half of the 152 hospitals surveyed reviewed and updated their emergency response plan at least once; while less than half had participated in a disaster exercise for a large-scale infectious disease outbreak within the past 12 months. In 2011, Chen investigated 80 hospitals in seven big cities (Beijing, Shenyang, Jinan, Lanzhou, Chengdu, Nanjing and Guangzhou), and found that 12.3% updated their plans once a year.

**Surveillance**

The objective of real-time surveillance is to replace the periodic manual reporting with online reporting to meet the requirement of emergency alert and response (Huigang Liang, Yajiong Xue, 2004). In order to facilitate public health surveillance, hospitals at the city and county levels are required to develop infectious disease databases of public health risks. H. Chen in 2011 showed that all responding hospitals had professional staff for routine monitoring, nearly 100% of hospitals had a surveillance plan, and most hospitals established comprehensive monitoring and
surveillance networks. More than half of hospitals provided training and exercises to monitoring staff (H. Chen 2011).

Hospital laboratories play an important role in detection of the PHE (Gu CHY, Chang GWJ, et al. 2004; Xu JG 2005). Xingming Li, et al selected 15 kinds of infectious diseases on which to assess laboratory diagnosis. The results showed that the majority of responding hospitals could isolate and identify class A infectious diseases (according to the Law on Communicable Disease Prevention and Control of China). However less than 10% of surveyed hospitals reported that they could isolate and identify infectious diseases caused by pathogens that can potentially be used as a bioterrorist weapon. Most hospitals had strict laboratory operational regulations and personnel specially assigned to laboratory management (Xingming Li, et al. 2008).

**Stockpile**

So far, China has not enacted quantifiable standards for various emergency materials stockpile. The hospitals store up emergency materials according to their own assessment and financial capacity (FL. Lin, et al., 2010). Most hospitals have different levels for ambulances, beds, protective equipment, and drugs. They have stored up emergency drugs for treating infectious diarrheal, influenza, and botulism toxin.

When the hospital levels were compared with each other, the tertiary hospitals generally had a higher score than the secondary ones. Further, most hospitals had protective equipment stockpiles, biohazard protective suits, safety glasses and ventilators (LP Fan, et al. 2012; XH Liu, 2008; Xingming Li, et al 2008).
Training and drills

Almost all the investigated hospitals had a staff training program, with varied contents that include awareness of emergency plan, medical treatment procedures, infectious disease prevention and control, routes of transmission of infectious diseases, disinfection and sterilization, and principles of quarantine and isolation (H. Chen, 2009; LM Sun, et al. 2006; LM Yu, et al. 2005; XH Liu 2008).

Emergency command system

More and more hospitals have emergency command institution arrangements and most CDCs above county level had PHE office (DX Zhu, 2009; QL Chen 2009; DP WU, et al. 2009). While, only some hospitals had specific emergency command mechanism and division of functions for different types of emergencies. And most hospitals above second-class had experts database from various fields, e.g., epidemiology, clinical medicine, and public health, etc. to provide technical support in the event of a PHE.

Crisis Communication and cooperation

Crisis communication is an important part of a PHE response and the key to ensuring complete, transparent and prompt information exchange, to help hospitals make timely responses and reduce the serious consequences (Zheng L. 2003). No hospital or medical system can manage a public health emergency alone. Therefore, hospitals need to communicate and cooperate with other local health agencies, functioning as a networked public health service. (H. Zhang, et al. 2005).
One study indicated that medical staff in 12.1% of the hospitals underwent training for evaluation of PHE-related stress and only one-third of respondents had specific programs and spokespersons for communicating critical messages and information to the media, public, governments and stakeholders (XM Li, et al. 2008).

The lack of emergency communication, the absence of central direction, and insufficient exchange information, led to a failure of comprehensive and accurate statistical data in the SARS epidemic situation (Jingqiang Shen, et al. 2007).

**On-site rescue and medical treatment**

One survey (i.e. Q. Zhao 2009) showed that large a proportion of hospitals in Jiangxi, Jiangsu, Fujian, Yunnan, Gansu, and Ningxia had specific drugs and medical treatment procedures for SARS and influenza, with 22.4% of the respondents having medical treatment procedures for 8 selected kinds of infectious diseases. More than half the hospitals had special medical treatment procedures for treating class A infectious diseases.

Another study revealed that physicians in 80.2% of the responding institutions reported being familiar with the latest treatment protocol for a PHE; nearly 95% could transfer PHE victims to corresponding medical agencies for appropriate treatment; and 100% could provide training on the protocol system. However, more than half the hospitals had specific procedures for patient transfers in a PHE. Furthermore, the tertiary grade hospitals and the teaching hospitals had a greater capacity than secondary grade B and non-teaching institutions, respectively.
**Funding**

The approach of collecting emergency funding is singular: most hospitals get emergency financial support from nation and local government. (FL. Lin, et al. 2010). One study revealed that only 44.6% of hospitals had a funding allocation system for emergencies and only 23.1% of hospitals established special emergency fund management departments (Q. Zhao, et al 2009).

**Evaluation**

Hui Zhang and Chuanmei You’s survey respectively reported that most hospitals re-evaluated the effectiveness of staff training, and analysed vulnerability of hospital after crisis, and summarized the experiences which will be for amending emergency plan and staff training (Chuanmei You, et al. 2009; Hui Zhang, et al. 2008 ).

**Recent studies on preparedness in other countries**

Recent studies (e.g. Fockler, 2010; Kollek, 2011; Klitzman, Freudenburg, 2003) reported that public health infrastructure was “structurally weak in nearly every area”. They expressed concern that the hospitals were not adequately prepared. To understand the extent to which hospitals were prepared for PHE in developed countries, this part of the research examined a number of studies about emergency preparedness, and summarized the deficiencies in hospital preparedness in other countries. This information served as important data for hospital preparedness development in China.

Canadian hospital emergency preparedness was assessed using a survey that analysed
deficiencies in readiness—most notably in the availability of the appropriate equipment, medical treatment, and the disinfection and decontamination capacity (Kollek, Cwinn, 2011). There were also deficiencies in hospital capability to respond to major biological, chemical or nuclear events. such findings were consistent with studies performed in other countries (Davis, Bevc, et al., 2014; Anathallee M, Curphey A, et al, 2007; Johnson L, et al. 2014;).

In subsequent years, the focus on hospital preparedness shifted from bioterrorism attacks to natural disasters and major infectious disease. The published literature demonstrated that U.S. hospitals had response plans for chemical releases, natural disasters, epidemics, and biological incidents; they had staged drills, mass vaccinations or medication distributions (Niska, Shimizu, 2011), as well as improved surge capacity (Cliff, Morlock, et al. 2009). However, as recently as 2012, local health department preparedness capacities were identified, with reduction in surveillance, investigations, plans, communication, and incident command over three years (from 2010 to 2012) (Davis, Bevc, et al., 2014). Such activities are critical for preparedness responsibilities, as well as for the basic functions of a public health organization. Decreases in the preparedness capacities in the U.S. may be caused by multiple years of funding cuts and job losses (Bhandari MW, Scutchfield FD, 2010).

The preparedness of emergency departments (EDs) in the United Kingdom (UK) was assessed in 2006 for the management of potential biological incidents (Anathallee, et al. 2008). It was found that the UK was not prepared well for emerging biological
events and bioterrorism. The majority of EDs did not have isolation facilities available for the management of patients with potential infectious diseases.

Between 2011 and 2013 the level of preparedness of health facilities in the European Region were assessed. The participating countries (Balkans, the UK, Caucas and Ukraine) were generally prepared for major infectious disease outbreaks; however, the level of preparedness needed improvement. For example, there was a need to strengthen national preparedness plans, the initial response, the plans for securing vaccine supplies, and improving communications. Similarly, in Italy, hospitals’ preparedness capacity was not high enough to cope with surge demands, particularly in terms of medical and allied health personnel, and adequate supplies (Djalali, et al. 2014; Giacomet V, et al. 2007; Fusco FM, et al. 2012).

**Summary of deficiencies of medical institution preparedness capacity**

According to the findings from the literature review there are no national standards for disaster preparedness, and no validated tool to assess overall hospital disaster preparedness. The most frequent identified problems or factors in the articles and the relevant suggestions by the researchers were summarized for the current study (Table 5). Importantly, they could be considered in the development of an evaluation tool for hospital preparedness; they are evidence or standards for future hospital response capability improvement.

**Table 5 Problems faced by hospitals preparedness and suggestions for improvement**

| Problems |  
|---|---|
Emergency response plan were not integrated, appropriate or able to be implemented

There were insufficient communication and coordination among hospitals, between hospitals and local health agencies

Information systems were unable to provide sufficient data to enable appropriate decision-making

Physicians, nurses, and equipment were inadequate, and storage of emergency drugs needed to be sure sufficient and various

Budgets were insufficient for maintenance of facilities and equipment and storage of supplies

Medical staff were inexperienced and unprepared

There was inadequate experience and capability for nuclear, biological and chemical incidents

**Suggestions**<sup>5,7-10</sup>

Developing, implementing and maintaining response plans on the basis of vulnerability analysis

Strengthening communication and coordination between hospitals and community agencies

Establishing mechanisms for coordinating the response of different hospitals to disasters

Establishing or improving mechanism for information collection, issuing of early warning, resource support, managing response, coordination, training and research

Establishing an emergency-drug-supply system for most of the infectious diseases

Strengthening different hospitals capacity to provide different numbers of extra beds

The form of training and exercise should be diversified, activities should include case analysis, role plays and testing of skills

1. The main problems and their reasons of emergency public health incident response. J Kong, 2009
3. Problems and countermeasures of hospital infection control in public health incident response. Ding Y, 2005
5. Establishment of Chinese public health incident command system. Duan YR, 2004
7. Rethink the Chinese emergency incident medical rescue system after Wenchuan earthquake. Huang XK, 2009
8. The general scheme design of public health emergency medical treatment. Wu XK, 2004
10. Research on the hospital function of response to public health emergency. LX Luo, 2004

Most studies showed that medical institutions had emergency plans (XH Liu 2009; JX Fu, et al. 2005; J Wen, et al. 2006). However, not all hospitals with emergency plans reported that they had evaluated and revised their public health emergency systems (J
Besides, all kinds of medical institutions need to communicate and cooperate with other local health agencies, functioning as a networked public health provider. Problems such as lack of communication and coordination between hospital departments and inter-agency networks hinder the availability of resources in a community and limit timely forecasting, public communication and effective regulation of a PHE (Wu WB, 2011; Deng Y, 2004; LX Luo, 2004). These studies show that if a PHE occurred, most of hospitals reported that they could take responsibility for PHE rescue service, transport the medical staff in a timely manner, and provide priority health services to vulnerable populations. Yet, not every hospital attended regulation and revision workshops for emergency plans for infectious epidemic control held by local agencies. This lack of cross-institutional interaction indicated that the ability of hospitals to coordinate with community agencies in preparation for, or response to a PHE was generally poor. Communication and coordination between hospitals and community agencies should be strengthened, and mechanisms established for coordinating the responses of different hospitals to disasters.

Characteristics of a PHE include suddenness and unpredictability (Tan XD 2003). For most hospitals, medicine supplies maybe in great demand when faced with a sudden increase in patients. Therefore, hospitals must have programs to ensure appropriate levels of emergency supplies including drugs, medical equipment, electricity, water and oxygen, disinfectant, etc.
Most hospitals possessed emergency resource reserves, but few had corresponding drug distribution programs (Meng J, 2009; Duan YR, 2004). In addition, hospital capacity was affected by economic level and classification of the hospital, suggesting that the importance of local economic development strengthens hospital ability to provide PHE (Huang XK, 2009).

Sufficient emergency response personnel and equipment are necessary to respond effectively to a large-scale infectious disease incident. Some studies indicate that, during the SARS epidemic, hospitals were short of infectious disease physicians, nurses, and equipment in some cities (Cao J, 2006). Loutfy et al reported that different hospitals could provide different numbers of extra beds (Loutfy MR, Wallington T., et al. 2004). All the articles we reviewed indicated that most hospitals admitted that their extra beds were not enough to meet the demands (LP Fan, et al. 2012; XH Liu, 2008).

Currently most hospitals had transfer and treating procedures for infectious diseases, including SARS, influenza, and infectious diarrheal, and their physicians were aware of current PHE protocols, but less held these procedures for biochemical incidents, leakage of nuclear and terrorist attacks. Therefore there are two issues with respect to training and exercises were mainly discussed, namely, the content, and the methods of training and exercises (Dong Q, 2006; J Kong, 2009).

Storage of emergency drugs, equipment and facilities largely depended on emergency funding. Thus, funds are the one of key factors affecting PHE. In China, the way of collecting funding is relatively singular and lacks regulation and supervision for fund
Part 3

2.3 Gaps in Knowledge and Research Questions

This review of the literature and context demonstrates that there is no agreed framework for understanding the components either of health system resilience or for its measurement.

Attempts to date have focused on urban areas, but less attention has been given to rural areas. For instance, Xu feng, et al. in 2010 developed a capacity assessment framework for community hospitals and; Shen jinyu (2011) developed a ‘capability index’ for CDCs based on expert consultation and literature review. Shen jinqiang (2011) produced an assessment for urban PHE preparedness capacity. Other researches has focused on military hospitals and analysed the current status of special hospital preparedness capacity (Qiu XY 2007; Lv HY 2005; Lin YF 2007; Yang XY 2008; Wang ZH 2008).

This is partly related to the perception that more concentrated areas have an increased risk of disastrous events (Barbara J. 2010).

Public health emergencies frequently occur in rural areas, and county hospitals are the most important units for initial response to PHE (Hu GQ 2006). Therefore, it is necessary to investigate and assess the preparedness and responsiveness of county level in high risk areas of rural China. It is also necessary to develop and evaluate measures for health system resilience. Most Assessment instruments were developed by scholars themselves, were not comprehensive and rigorous, and the validity and
reliability of some questionnaires were not tested (Zhu, et al. 2006).

Although Zhao Qi, et al. assessed the county-level public health emergency response system in 6 provinces of China (2009), and identified some organizational factors which influence the organizational response to PHE, he still suggested that a system of assessment indicators need further improvement. Particularly, the data was collected during 2005-2006 when the construction of PHE system was at an elementary stage. Therefore, it is necessary to know the current status of preparedness.

In order to rectify these problems, this research aims to evaluate hospital PHE preparedness capacity in rural areas of Sichuan Province using an assessment instrument that is derived from those previously used and further improved by experts’ opinion. The research will analyse the level of preparedness and identify the factors and impediments that appear most relevant to their level of preparedness.
CHAPTER 3 STUDY DESIGN AND METHODS

3.1 Introduction

This chapter details the study design and methods used in this PhD research program; it includes the study design and sampling, the data collection, and management and analysis. The materials and methods used are detailed and specified in each corresponding results chapter. Some overlaps between this chapter and the other three results chapters were inevitable; even though efforts have been made to minimize such repetition.

3.2 Study design and sampling

3.2.1 Study design

As the nature of the current study was exploratory, a combination of qualitative and quantitative methods was used to address the research questions. According to Fellow and Liu (2008), explanatory research answers a particular question/s or explains a specific issue/s or phenomenon/a. In contrast, exploratory research investigates a phenomenon, identifies the variables, and generates hypotheses for further study. The present research explores the evaluation framework and identifies the key indicators; it also explains the contributing factors necessary for hospital preparedness.

Qualitative research is able to uncover and help us understand what lies behind any phenomenon about which little is known, as well as identifying the intricate details (Strauss & Corbin, 1998). The quantitative paradigm tends to provide more generalised findings, with more demonstrable rigor of larger sample sizes from broader sets of
subjects (Clark, 2009). In contrast, quantitative research is “[tests] a theory composed of variables, [is] measured with numbers, and [is] analysed with statistical procedures in order to determine whether the predictive generalisations of the theory hold true” (Creswell, 1994).

The benefits of combining qualitative and quantitative techniques within a research method help to develop or extend theory and test its application. Additionally, it enhances between-method triangulation through augmenting the quantitative output with rich qualitative data (Strauss & Corbin, 1998). Triangulation can capture a more complete, holistic and contextual portrayal of the study because the weakness in each single method is compensated by the counter-balancing strengths of another (Jick, 1983).

Pragmatically, concerns about combining and balancing qualitative and quantitative methods in health services research depend on the aims of the study (J.P. Clark, 2000). The purpose of this research is to define public health emergency preparedness and develop an appropriate assessment framework to evaluate hospital public health emergency preparedness by using both qualitative and quantities research approaches. The marriage of these two methods in this research was based on the model provided by Morgan (1998) for multi-method research designs. The model is summarized as: QUAL→QUAN (Morgan, 1998).

It involves a quantitative follow-up study to help evaluate or interpret results from a qualitative study. Qualitative data can generate hypotheses or develop content for a
survey. Quantitative data collection may help to generalize results to different samples or to test emergent theories. Quantitative research is used to quantify the problem by way of generating numerical data or data that can be transformed into useable statistics. It allows researchers assume sample is representative of the population, and use statistics to generalize results from a sample to a wider or entire population. Quantitative research usually builds on and/or test hypotheses which are based on prior research and theories on the topic. By collecting and analysing quantitative data, findings of research can be reported in terms of statements, data, tables and graphs to address each research questions or hypothesis.

In this research, qualitative research involves literature review, intensive interview, Modified Delphi method. The quantitative approach, in the main, includes a survey questionnaire of hospital capability to test the reliability of the instrument and its utility. The study was undertaken in three sub studies, as outlined below:

**Study 1**

Propose a definition for hospital PHEP and its elements based on the literature, and further informed by intensive interview with experts.

**Study 2**

A modified Delphi Method was used to develop and validate an evaluation framework and identify key indicators for evaluation.

**Study 3**
An instrument (questionnaire) for assessment was designed based on the validated framework. The instrument was tested and revised via pilot study prior to administration to a stratified sample of hospitals in Sichuan province.

The detailed process and method are illustrated in Figure five.

![Figure 5 Overall research process and methods](image)

3.2.2 Sample

Intensive Interview

Choosing the appropriate sample is an important step in qualitative research as the most suitable answers are embedded in the samples. Morse (1991) suggested that Morse (1991) suggested that four types of samples are commonly used for qualitative research: the
purposive sample, the nominated sample, the volunteer sample, and the sample that consists of the total population. For the interview method in the current research, purposive sampling and the snowball technique were used to contact key informants and participants.

Purposive sampling is when a researcher chooses specific people within the population to use for a particular study or research project. Unlike random studies, which deliberately include a diverse cross section of ages, backgrounds and cultures, the idea behind purposive sampling is to concentrate on people with particular characteristics who will better be able to provide data that are detailed and relevant to the research question (Morse, J. M. 1991).

The purposive sampling technique was used to identify the experts to review the dimensions for hospital PHEP assessment. These constituted a Reference Group for the research. The purposive sampling technique is an appropriate sampling strategy for the purpose of selecting participants who can provide broadly based feedback on the content of PHEP.

The sample size is important for a research design. When determining sample size for qualitative studies, “What sample size will reach saturation or redundancy?” “How large a sample is needed to represent the variation within target population?” should be considered. As there is no exact way of determining sample size in qualitative research (Mark Mason, 2010), Strauss and Corbin (1998) provided guideline for actual sample size: “The number of participants and key informants in such research
may be as few as 10 people or as many as 40 people.” This may help researchers estimate sample size when conduct interview. In this range, the sample should be large enough to leave researcher with “nothing left to learn” or beyond this range, the concepts, themes, etc. begin to be redundant.

If a potential participant was unable to participate, then the researcher approached the next available participant. Additional (candidate) experts were identified through “snowballing” technique in which participants identified additional experts for possible involvement. A snowball sampling technique is well-suited to study of social networks, subcultures, or dispersed groups who share certain practices or attributes (Lindlof, Taylor, 2001). It is recognized that expert’s self-selection may potentially bias the sample as those who choose to participate may be more interested or experienced in the study area than the non-participants. However, in this field, such interest implied genuine knowledge and expertise and, thus, an ability to contribute to the objectives of the research.

Participation in the Reference Group was guided by four “expertise” requirements: (1) knowledge and experience with the issues under investigation; (2) capacity and willingness to participate; (3) sufficient time to participate in the following Delphi survey; (4) effective communication skills.

The next important step is to choose the way the researcher gets access to the targeted respondents. Before the real action of research, targeted individuals were contacted by an email or phone call. In principle, researchers and their study participants must
agree on the expectations during the study process, particularly the expectations each party has of the other (Miles & Huberman, 1994). The participants were informed that the participation is voluntary, and that they can withdraw at any point during the process. In order to develop a trustful relationship between the participants and researcher, a full explanation about the confidentiality and anonymity was provided. A covering letter which includes all these key points was sent to potential participants to gain their agreement to participate in this study. The consent form for the interviews stated that every interviewee has read the purpose of the study and accepted the requirements and agreed to participate in the interview process.

**Modified Delphi Method**

Contrary to a traditional survey, which would use a random sample to estimate the views held by separate individuals in a target population, the Delphi method uses interactions by a panel with relevant expertise to arrive at a consensus. A general population, or even a narrow subset of a general population, might not be sufficiently knowledgeable to answer the questions accurately (Okoli & Pawlowski, 2004).

Unlike a typical user survey, the validity of a Delphi study depends not on the number of participants polled, but rather on the expertise of the panel members who participate (Armstrong, 1985). The Delphi group size does not depend on statistical power, but rather on group dynamics for arriving at consensus among experts (Okoli & Pawlowski, 2004). The number of experts is determined by the criteria: “the number is required to constitute a representative pooling of judgements and the
information processing capability of the research team” (Ludwig, 1994). Generally, the approximate size of a Delphi panel is under 50 (Witkin & Altschuld, 1995). According to Delbecq, Van de Ven and Gustafson (1975), ten to fifteen could be a sufficient number if these participants are homogeneous. Ludwig (1997) pointed out that “the majority of Delphi studies have used between 15 and 20 respondents”.

In this study, the same reference group used for interviews was used in the Modified Delphi. The survey also requested some personnel information on the experts for the purpose of assessment of the final results. It included highest qualification, working department, working position, working role, experience in this area, and key personnel evaluation criteria.

Survey

Sichuan province located in the southwest of China, has 17 prefecture-level cities, 3 autonomous prefecture, and 183 counties. Excluding traditional Chinese medical hospitals, and military hospitals, there are 122 hospitals above the secondary level in county-level cities of Sichuan province.

According to "the hospital classification system" of the Ministry of Health of People's Republic of China, all hospitals in China are classified into primary, secondary, and tertiary hospitals based on their functions in providing medical care, medical education, and conducting medical research. A secondary hospital is defined as a regional hospital that provides comprehensive medical care, medical education, and medical research for the region. A tertiary hospital is defined as cross-regional,
providing comprehensive and specialized medical care with a high level of medical education and research functions. Secondary and tertiary hospitals are further classified into subgroups: Grade A, Grade B, and Grade C according to their service levels, size, medical technology, medical equipment, and management and medical quality.

In this research, hospitals above the secondary level were selected for investigation for the following reasons: (1) the human resources, facilities and instruments for public health emergencies are mainly in the secondary and tertiary hospitals, and they play a main role in response to incidents; and (2) hospitals above the secondary level are usually designated to be responsible for public health emergency tasks (Zhan hui, 2005).

Generally, if the population size is less than 1000, for simple random sampling, the sample ratio must not be lower than 30% to ensure high accuracy. In the current research, the sample of surveyed hospitals was estimated, preliminarily at around 80, the ratio reached 50% and, thus, the sample size was considered appropriate for this research.

Next, the Finite Population Correction (FPC) factor was calculated to adjust the sample size when the sample rate was more than 20% (Xiangxue Cui, 2009). The FPC factor was a modulating factor which optimizes the sample size to ensure the credibility or accuracy of the investigation. It is calculated using the following formulation (XJ Xu, 2009):
FPC = $\sqrt{\frac{N-n}{N-1}}$ \[N: \text{population}; n: \text{sample}, \]

And adjusted sample = $n^* \sqrt{\frac{N-n}{N-1}}$

**Eq.1 Formulation of calculating FPC**

Using this calculation, the final number of the surveyed hospitals equalled $80^* \sqrt{\frac{122-80}{122-1}} = 47$.

The principle of the research design was based on the limited existing resources. It used a relatively small sample size within the allowed sample error range ($\leq 5\%$) to achieve a high rigorous result (Xiangxue Cui, 2009).

In this research, the average sample error was calculated by the formulation $\sqrt{\frac{p(1-p)}{n} \left(\frac{N-n}{N-1}\right)}=1.5\%$ (P: 95\%) (Xiangxue Cui, 2009), the result indicated that the sample size of 47 hospitals was appropriate for the research.

### 3.3 Data Collection

**Intensive interview**

The interviewees were contacted by phone or email; they all signed the consent information sheet. Due to the constraints of time and financial resources, face-to-face interviews were conducted when the participants were in Chengdu city; the other interviews were conducted by phone or webcam.

Each interview lasted from 45 minutes to 1 hour, depending on the specific situation, and was tape-recorded with the permission of the interviewees. The digital voices were captured by a combination of note taking, and recording; the transcripts were
converted into a word document. The accuracy of the transcription was checked by reading the transcription whilst listening to the audio record. If the interviews were recorded in Chinese, the researcher transcribed those results into English. The transcription from each interview was read and re-read.

A number of common themes emerged from the categorization process. The data is broken down, conceptualized and categorized, and similar incidences, claims and discursive practices are grouped together (Strauss & Corbin, 1998). The information derived from these interviews was used in the next stage, namely, the Delphi study.

**Modified Delphi study**

Delphi process begins with a well-structured questionnaire which is based upon an extensive review of literature and intensive interviews outcomes. Using a structured questionnaire is an acceptable and common modification of the Delphi process format, if basic information concerning the target issue is available and usable (Kerlinger, 1973).

These questionnaires were distributed by email to participants, with an advanced introduction to the research. All the participants were asked to rate each potential item of the framework to establish the preliminary priority of the items. The results of the first-round questionnaires were reviewed by the researcher for the design of the second questionnaire, and to summarize the items based on the investigation.

In Round 2, each Delphi panel member received the second questionnaire with summarised items. In this round, consensus begins forming and the actual outcomes
were presented among the participants’ response, as shifts in rating items is allowed. Basically, consensus on a topic can be decided if there is a two-thirds majority (Behrens et al., 2006) to 83% agreement (Armon et al., 2001).

Pilot study

A survey questionnaire was designed based on the results of Delphi study. Then the questionnaires were emailed to the hospital’s Emergency Department Director. When completed, they were returned by email. Follow up phone calls were made to seek to improve response rates.

The data from the returned questionnaire was then transferred into a database for analysis using SPSS 19.0. The reliability was tested using Cronbach’s $\alpha$ and test-retest method. The face validity and content validity of the questionnaire was assessed and was approved by the experts during the intensive interviews, that is, the Modified Delphi Method. The importance and consistency of the indicators was evaluated by Spearman’s correlation coefficient.

Survey

The self-administered survey was emailed to the targeted hospitals. It was accompanied by an official letter stating the importance of the survey. Each hospital was required to designate a department director who would be responsible for coordinating the completion of the questionnaire. The questionnaire took approximately 30 – 60 minutes; each section needed to be filled out by different key staff members who were familiar with the various hospital data. Each returned
questionnaire was carefully reviewed for its completeness and consistency.

As with the pilot study, the data from the returned questionnaire were checked, cleaned, and transferred into a database for analysis by using SPSS 19.0

3.4 Data Analysis

Meta-ethnographic approach

A meta-ethnographic approach was used to synthesize the findings from literature review.

Meta-ethnography is a qualitative research methodology developed by Noblit and Hare (1988) to provide a similar function to meta-analysis. It is a method for combining data from qualitative evaluation and research.

The meta-analysis translates ideas, concepts, and metaphors across different studies and is increasingly seen as the most well-developed approach for synthesising qualitative health research, and one that clearly has origins in the interpretive paradigm from which most methods of primary qualitative research evolved, it was the method selected (Britten, Campbell, et al. 2002) (Also see the chapter of literature review).

Mean value and Kendall’s coefficient

The mean value is the arithmetic average of a set of values which points to the central location of the data. In this study, mean value was chosen to present the rating factors to the panel members (Delphi study). The larger the mean value is, the more
important the indicator is.

Accordingly, Kendall’s coefficient of concordance (W) was applied to measure the agreement in the ratings. A strong consensus exists for $W \geq 0.7$; a moderate consensus exists for $W=0.5$; and a weak consensus exists for $W<0.3$ (Schmidt, 1997). The consensus then demonstrates the trend towards group consensus (Chapter of Results in detail).

**Factor analysis**

For the survey results, each answered qualitative question was scored 1 for “yes” and 0 for “no” or “unknown”. Item scores were calculated by adding together “yes” answers; each item of quantitative questions was calculated using Quartiles: 25% (P25), 50% or mean (P50), 75% (P75) to describe the properties of a group scores or data.

After all the data were transferred into a database, a Factor Analysis was applied to identify the main factors which affect the overall hospital preparedness capacity. Factor Analysis is a statistical approach that can be used to analyse inter relationships among a large number of observed variables and to explain these variables in terms of their common underlying dimensions (factors). (See the Chapter of Results).
CHAPTER 4 RESULTS: QUALITATIVE STUDIES

The second objective of this research was to design and validate a framework for assessment of hospital public health emergency preparedness. This was undertaken by critical analysis of the concepts identified in the literature and the development of a draft framework based on those concepts. This draft framework was then further developed and validated by intensive interview with key experts in the field and by a modified Delphi approach using those experts to achieve agreement on the framework.

This chapter is therefore divided into two parts which report the outcomes of those two steps in the validation process. Study one describes the outcomes of key expert interviews and study two the process and outcome of the Delphi study.

4.1 Developing a theoretical framework for hospital preparedness

The increase in frequency, scale and severity of impact of contemporary crises in their many forms—from terrorist threat to climate change, earthquakes to rail crashes—has resulted in an increased focus on prevention and preparedness rather than just response to events after they happen. This shift in thinking has been marked by a shift from ad hoc response arrangements, towards being better prepared and this is best illustrated by the concept of resilience.

Resilience is defined the quality of being able to resume its original shape, or the ability to recover quickly (Norris et al. 2008). Disaster resilience is the capacity to prevent, mitigate, prepare for, respond to, and recover from the impacts of disasters.
Preparedness and resilience are critical features of modern risk and crisis management, and understanding the risk in detail is vital to ensuring appropriate measures are in place. Preparedness is based less on responding to an emergency and more about a strategy of “building resilience”. The strategy of building resilience is contributing to a sustainable reduction in vulnerability through increased absorptive, adaptive and transformative of an organization; improve ability to identify, address and reduce risks. A comprehensive approach to disaster management (PPRR disaster management cycle) ensures an emphasis on the reduction of risks and the building and enhancement of resilience (Council of Australian Governments, 2009).

Human vulnerability to disasters has two sides: the degree of exposure to dangerous hazards (susceptibility) and the capacity to cope with or recover from the consequences of disasters (resilience). Vulnerability reduction programs reduce susceptibility and increase resilience. Susceptibility to the impact of disasters decreases through activities that seek to prevent the risk, or through preparedness measures that limit the impact on the population. Thus, preparedness activities enhance resilience.

When emergency events occur, hospitals will be on the front line, playing an active part in reducing human vulnerability to disasters. However it is unclear exactly what hospitals can do to improve their resilience and how this could be measured so as to foster improvements. In this research, we aimed to develop a comprehensive
evaluation framework for hospital preparedness. Such a framework would serve to reveal and improve the preparedness of hospitals and thus contribute to a more resilient health system.

The relationship between preparedness and resilience could be demonstrated in the following Figure six.

![Figure 6 Components of Emergency Management. (Adapted from Ministry of Community Safety and Correctional Services, 2012, Emergency Management Ontario)](image)

While there have been around the world considerable investments in improving public health preparedness, a general conceptual framework would be an important step toward understand the nature of PHEP to enhance the development of evidence and to inform policy and practice.

The purpose of Study 1 is to develop a framework for hospital resilience which is derived from the literature but modified as a result of the input from key experts. It
also seeks to identify consistent elements for a high level of preparedness and to further the development of a universal self-assessment tool that hospitals can use to guide their emergency preparedness efforts.

4.1.1 Methods

In Study 1, key elements of hospital preparedness which had previously been identified by a comprehensive literature review and reported in Chapter 2 were used to develop a draft framework which was the basis for structured interviews with key experts. Intensive interviews were conducted to complement and validate the potential elements of hospital preparedness identified in the literature review.

Sample of Interview respondents

A purposive sampling technique was used to identify the experts to review the dimensions for hospital public health emergency preparedness assessment (Chapter 3 of Methods in detail).

As mentioned in Chapter 3, the number of participants and key informants in structured interviews can be from 10 to 40. In this study, the number of participants was 15 in total from three different categories; academic institutions, administering organizations and technical institutions (Figure seven).
A list of possible participants was provided by key academics at Sichuan University (the selection process see as Figure eight).

**Figure 8 The Selection Process of Panel Members (Okoli&Powlowski, 2004)**

The purpose of step 1 was to help categorise the experts before identifying them. In this research, there were three major categories – namely, academic institutions, administering organizations and technical institutions – that are familiar with issues concerning disaster management. After the step 1 was completed, the actual names of
potential experts were placed into the appropriate categories. In the next step, the researcher contacted all the potential experts and asked them to recommend additional experts. At step 4, the qualifications of those experts in each category were compared and ranked in priority for invitation. Based on the rankings, the panel list was created at the final stage.

4.1.2 Results

The comprehensive review of the literature described in Chapter two, identified ten primary themes and twenty three subthemes (Table 3) and these themes are structured throughout the cycle of pre-incident preparedness, incident management and post incident recovery or adaptation. These themes and subthemes formed the basis of a draft framework which was validated through a process of intensive interviews with experts in disaster management.

The respondents to this element of the research comprised a balance of expertise. The fifteen experts selected as above comprised four professors in the area of disaster management at universities (including the Queensland University of Technology, Sichuan University, and Chengdu University of Traditional Chinese Medicine), two consultants from the Health Bureau of Sichuan, directors or managers from CDC (3) and hospitals (6). They all occupied significant positions in their own organizations and had more than 5 years of experience in their professional area (Figure nine and ten).
The interview was conducted in Sichuan province of China, interviewees were contacted by phone or email and they all signed the consent information sheet. Face-to-face interviews were conducted when participants were in Sichuan; other interviews were conducted by phone or webcam.

After interview, the records were manually transcribed and arranged into key themes and issues. Within this process, the data was broken down, conceptualized and
categorized, and similar incidences, claims and discursive practices are grouped together.

There were two main questions for the intensive interview:

(1) What are the ingredients or constituents or elements of hospital public health emergency response preparedness?

(2) What were the expert’s opinions about challenges of major hospitals in rural areas of China regarding to the hospital preparedness for public health emergency? (e.g., hospital culture and social beliefs, policy and plans for disaster management, management mechanism, management procedures, costs of preparation, governance frameworks, socio-economic frameworks)

Examples of responses and the themes extracted from the interviewees’ responses are presented in the following table (Table 6).

**Table 6 Examples of interviewees’ response**

<table>
<thead>
<tr>
<th>Interviewees’ Responses</th>
<th>Exacts (elements for PHEP)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Q 1: What are the ingredients or constituents or elements of hospital public health emergency response preparedness?</strong></td>
<td><em>Emergency plan (guide, document), rescue, on-site rescue and medical treatment, training and drill, supportability (stockpiles of drugs, facilities, structure of staff), early detection and disease surveillance, emergency command system, evaluation and adaption.</em></td>
</tr>
<tr>
<td>Examples of statements:</td>
<td></td>
</tr>
<tr>
<td>• To respond to PHE events effectively, hospital should be prepared from three aspects, namely preparedness before incident, response during incident, and evaluation and adaption after incident. <strong>Emergency plan</strong> is important, which defines the responsibilities of different departments and their interactions, and it also makes different specific procedures for different types of PHE.</td>
<td></td>
</tr>
</tbody>
</table>
- I think, in order to assess an organization’s preparedness capacity of PHE, we should focus on its rescue and independent response ability in 24 and 72 hours.

- Hospitals should have plans, guide for rescue, and documents for disease diagnostic criteria.

- Plus, I think hospital should provide training and drills for emergency plan to raise staff’s awareness and understanding for emergency plan.

- Hospitals should have a certain amount of stockpiles to ensure hospital respond to PHE.

- The selection of evaluation indicators should be considered from hospital’s capacity of supportability, such as management of drugs and medical facilities, structure of staff, etc., early detection and warning, emergency disposal (on-site rescue and treatment, emergency command system), and evaluation. Supportability is foundation for hospital preparedness capability, disease surveillance and emergency disposal is core function, and evaluation can promote hospital preparedness capacity development and progress.

<table>
<thead>
<tr>
<th>Please give us your opinions about challenges of major hospitals in rural areas of China regarding to the hospital preparedness for public health emergency?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples of statements:</td>
</tr>
<tr>
<td>- I think the limited resources in rural areas is a common problem for health organizations, therefore, in the future, rural hospital should strengthened allocation and complement of emergency resources (not only material but also human resources) among different level of hospitals.</td>
</tr>
<tr>
<td>- Only we know what we have could know what lack for, so it is necessary to evaluate hospital preparedness capacity regularly.</td>
</tr>
</tbody>
</table>

| Emergency resources, evaluation, emergency funding, disease reporting system, information communication, cooperation. |
● Rural hospitals in China may well be the first and important response organization when emergency occurs, however, they are not competent to respond to PHE, so there is a need for technical and financial support (such as emergency funding) from local government and higher authorities.

● The main responsibility of hospital is to provide medical care and medical treatment, and for rural hospital in China, they also play an important role in early detection and warning. However, the disease reporting system hasn’t been set up in some areas, and among hospitals and other health organizations, information communication and cooperation should be strengthened.

The transcription of the interviews was imported and analysed by SPSS 19.0 software.

To analyse the relative importance of issues identified in the structured interviews, we used a statistical method known as the Saliency index. Saliency index is defined: The average percentile rank of an item across all lists is the item’s gross mean percentile rank—its salience index. This measure takes into account the open-ended nature of free listing, and it incorporates both how often and how early items occur in informants’ lists. What this method does is to take into account the open-ended nature of free listing, and it incorporates both how often and how early items occur in informants’ lists, and quantify the importance of an item in relation to the number of uses mentioned by informants (Cotton, 1996). The preference ranking index estimates the preference or importance of a plant in relation to a particular criterion. Indexes of agreement compare the level of agreement between informants with respect to the components and/or structure of a domain.
The Saliency index of each code was calculated for assessing its importance for hospital preparedness. The larger the Saliency index, the more important the proposed element. The Saliency Index is calculated by the following Equation 2,

$$S_j = \frac{n - r_j}{n - 1}$$

Eq. 2 Formulation of calculating Saliency index

“$S_j$” indicates the Saliency index of element $j$; “$r_j$” indicates the mean position of element $j$ in code list. “$n$” indicates the total number of elements. Frequency (times mentioned by experts during interview) and Saliency index of each item was calculated as shown as Table 7.

Table 7 Proposed potential elements of hospital public health emergency preparedness

<table>
<thead>
<tr>
<th>No.</th>
<th>Proposed Elements</th>
<th>Frequency</th>
<th>Saliency Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emergency plan</td>
<td>15</td>
<td>0.696</td>
</tr>
<tr>
<td>2</td>
<td>Hospital incident command system</td>
<td>13</td>
<td>0.644</td>
</tr>
<tr>
<td>3</td>
<td>Disease surveillance</td>
<td>15</td>
<td>0.409</td>
</tr>
<tr>
<td>4</td>
<td>Laboratory diagnosis capacity</td>
<td>14</td>
<td>0.361</td>
</tr>
<tr>
<td>5</td>
<td>Training and drills</td>
<td>11</td>
<td>0.327</td>
</tr>
<tr>
<td>6</td>
<td>Stockpiles</td>
<td>14</td>
<td>0.350</td>
</tr>
<tr>
<td>7</td>
<td>On-site rescue and medical treatment</td>
<td>15</td>
<td>0.609</td>
</tr>
<tr>
<td>8</td>
<td>Communication cooperation with other facilities</td>
<td>11</td>
<td>0.171</td>
</tr>
<tr>
<td>9</td>
<td>Expansion of workforce surge capacity</td>
<td>10</td>
<td>0.117</td>
</tr>
<tr>
<td>10</td>
<td>The staff structure of critical department</td>
<td>12</td>
<td>0.224</td>
</tr>
<tr>
<td>11</td>
<td>Emergency Funding</td>
<td>7</td>
<td>0.095</td>
</tr>
<tr>
<td>12</td>
<td>Evaluation and adaption</td>
<td>5</td>
<td>0.090</td>
</tr>
</tbody>
</table>

The indicators which were mentioned by experts less than 2 times were excluded: for example “income of hospital emergency department staff”, “Hospital management pattern”, “public education”, “media report”.

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Therefore, a preliminary evaluation framework for hospital preparedness was developed from those extracted from literature but which demonstrate high saliency index following analysis of the outcomes of the interviews.

This preliminary framework included the elements of emergency plan; surveillance; training and drills; stockpiles; emergency command system; on-site rescue and medical treatment; crisis communication and cooperation with other facilities; fully staffed workforce; evaluation and adaption. These “first level indicators” where able to be further explained and detailed through the second and third level indicators detailed in Table 8.

**Table 8 Initial three-level indicator system**

<table>
<thead>
<tr>
<th>First level indicator</th>
<th>Second level indicator</th>
<th>Third level indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Emergency Plan</td>
<td>A1 Type of emergency plan</td>
<td>B1 Monitoring system</td>
</tr>
<tr>
<td></td>
<td>A2 The accessible of plan to all staff</td>
<td>B12 Type of surveillance event</td>
</tr>
<tr>
<td></td>
<td>A3 Details of the plan</td>
<td>B13 Analysis and management of information</td>
</tr>
<tr>
<td></td>
<td>A4 The period of evaluating revising plan</td>
<td>B21 Working procedure and policy of laboratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B22 Varieties of etiology can be isolated and identified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B23 The structure of laboratory staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B24 Equipment</td>
</tr>
<tr>
<td>B Surveillance</td>
<td>B1 PHE detection and identification</td>
<td>B2 Laboratory diagnosis capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B21 Working procedure and policy of laboratory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B22 Varieties of etiology can be isolated and identified</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B23 The structure of laboratory staff</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B24 Equipment</td>
</tr>
<tr>
<td>C Training and Drills</td>
<td>C1 Emergency training</td>
<td>C1 Emergency training</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C12 Evaluation of the effectiveness of training</td>
</tr>
<tr>
<td></td>
<td>C2 Drills</td>
<td>C21 Type of drills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C22 Back-up files of drills</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C23 Evaluation of the effectiveness of drills</td>
</tr>
<tr>
<td>D Stockpiles</td>
<td>D1 Emergency funds</td>
<td>D1 Emergency funds budget</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D12 Emergency funds management</td>
</tr>
<tr>
<td></td>
<td>D2 Emergency materials</td>
<td>D21 Stockpiles of emergency materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D22 Management of emergency materials</td>
</tr>
<tr>
<td>E Emergency command system</td>
<td>E1 Emergency command center/office</td>
<td>E1 Emergency command center/office</td>
</tr>
<tr>
<td></td>
<td>E2 Emergency relevant system</td>
<td>E2 Emergency relevant system</td>
</tr>
</tbody>
</table>

84
<table>
<thead>
<tr>
<th>E22 Medical treatment system</th>
<th>E3 Emergency committee or group</th>
<th>E31 Type of emergency committee or group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F On-site rescue and medical treatment</strong></td>
<td><strong>G Crisis communication and cooperation</strong></td>
<td><strong>H Fully staffed workforce</strong></td>
</tr>
<tr>
<td><strong>F1 On-site rescue</strong></td>
<td><strong>G1 Communication and cooperation with inside/outside of hospitals</strong></td>
<td><strong>H1 The staff structure</strong></td>
</tr>
<tr>
<td><strong>F2 Medical treatment</strong></td>
<td><strong>G11 Communication and cooperation system</strong></td>
<td><strong>H2 Capacity of critical staff</strong></td>
</tr>
<tr>
<td></td>
<td><strong>G12 Means of communication and cooperation</strong></td>
<td><strong>H3 Expansion of workforce surge capacity</strong></td>
</tr>
<tr>
<td></td>
<td><strong>F11 Capacity of emergency rescue</strong></td>
<td><strong>H31 Plan for continuity of health care workforce</strong></td>
</tr>
<tr>
<td></td>
<td><strong>F12 Equipments for on-site rescue</strong></td>
<td><strong>I Evaluation and adaption</strong></td>
</tr>
<tr>
<td></td>
<td><strong>F13 System of transferring patients</strong></td>
<td><strong>I1 Evaluation of hospitals capacity</strong></td>
</tr>
<tr>
<td></td>
<td><strong>F21 Treatment strategies for different disease</strong></td>
<td><strong>I2 Experience learning and adaption of hospital</strong></td>
</tr>
<tr>
<td></td>
<td><strong>F22 Treatment plans for different emergencies</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>F23 Equipments for medical treatment</strong></td>
<td></td>
</tr>
</tbody>
</table>

For example, the first level indicator (element) of ‘surveillance’, includes the capacity for detection and identification of public health emergencies which in turn rely on the presence of monitoring systems, capacity to identify types of events and the ability to analyse and manage the information resulting.

**Developing the Framework for Hospital Preparedness**

The indicators identified and evaluated through this analytical process form the elements of hospital resilience; organised on the basis of the logical association between first, second and third tier indicators. However to present these elements into a format that may be useable for hospital managers we have taken the further step of constructing a model which aligns these, to components identified in previous research and described in detail in Chapter 2.

In addition, we also need to convert these elements into ‘measures’ in order for them to form a means of measuring resilience. The evaluation framework must be based on
valid criteria that are measureable, reliable, and enable conclusions to be drawn. Generally assessments measure performance against known standards for a list of critical elements. Measurement data can be generated using a variety of formats, including filling out written instruments (Sutton, et al. 2006; Nelson et al. 2007; Thomas Fockler, 2009). The logical process of assessment is described as Figure 11.

Fig.11 The process of assessment (Adapted by the author, from Nelson et al., 2007)

According to the process, critical elements or dimensions are needed to be proposed first, then organised into a meaningful association.

Previous research has largely adopted a simple framework for the components of health system resilience as comprising staff, stuff, space, service and systems. These have been adopted and modified for the purposes of this research into the following diagram (Figure 12).
For the purposes of this research the following descriptions apply to these components.

“Staff”------ governs the human resources, and policies of recruiting, training, and development to produce talent workforce and leadership.

“System”------ refers to a series of activities for command, control, communications, coordination, continuity of operations, stress management.

“Stuff”------ typically denotes supplies and equipment, and contains a very wide range of items, including beds, ventilators, and other medical apparatus; pharmaceuticals; and a range of other essential resources.
“Service”------or “operations”, refers to roles and responsibilities of hospitals, including epidemiology functions, laboratory functions, and capability of providing mass health care services. Health systems are only as effective as the service they provide (WHO, 2010).

“Space”------or “structure” refers to both physical structure and facilities, such as laboratory, pharmacy, radiology, occupational health, medical supply, and so on.

In addition, the literature also recognises the need to consider the resilience of organisations throughout the lifecycle of disaster management. Disaster risk management lifecycle includes pre-impact incident risk reduction—prevention and preparedness as well as response during incident, and recovery post-incident management activities (Keim, Giannone, 2006; Settle AK. 2011). Many major disaster assessment frameworks, such as the Common Ground Preparedness Framework (CGPF), the National Security Strategy (NHSS), Emergency Support Function8 (ESF#8) of National Response Framework (NRF) were developed based on the disaster management cycle (P. Joseph Gibson et al., 2012; US Dept of Health and Human Services, 2009; US Dept of Homeland Security, 2010), including pre-impact incident risk reduction—prevention and preparedness as well as response during incident, and recovery post-incident management activities (Settle AK 2011; Gibson et al., 2012; Keim 2006).

In this review, public health emergency preparedness involves activities of prevention,
protection, response, and recovery from health emergencies. Thus, the process of hospital preparedness has three phases, each of these phases fall within one of three time periods: pre-incident, incident, and post-incident (Figure 13).

Fig.13  Disaster management cycle. Adapted by author, from (O’Brien et al. 2010; Copolla 2007; Twigg 2004).

The framework and model we developed needs to provide performance criteria, and to influence the approach towards a higher-order interpretation. Therefore, a comprehensive model for hospital preparedness (resilience) links the elements identified and evaluated in this research to the life cycle of disaster management and to the domains of activity.

The following diagram seeks to represent those associations (Figure 14).
According to this model, hospital preparedness must occur through the continuum of the disaster management life cycle (pre-event, during the event and post-event) and in each of the domains of staff, stuff, space, service and systems. Finally there are key elements that must also be addressed and these elements contribute both individually and collective to the domains and continuum of activities.

Table 9 further represents these associations and links them to possible means of measuring preparedness and resilience.

**Table 9 Metrics of hospital preparedness**

<table>
<thead>
<tr>
<th>Key components</th>
<th>Prevention and Protection</th>
<th>Response</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td>Develop operation-ready medical and nonmedical workers’ surge capability to training of volunteers and</td>
<td>Medical and nonmedical volunteer recruiting; On-site medical and nonmedical</td>
<td></td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workers and Volunteers</td>
<td>Through training and drills; Staff disaster management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff</td>
<td>Respond to emergencies; Feasibility of volunteer register</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Workers : Staff capacity enhancement; The rapidity for adaptation of staff by training course;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stuff</td>
<td>Critical infrastructure, equipment, medications and other supplies: e.g. beds, ventilators, and other medical apparatus.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surge capacity of equipment, medications and other supplies within hospital;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of equipment to return to pre-event functional levels in the first day; The adaptation of infrastructures and equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>Provision of a package of clinical and public health interventions; Daily medical care; Daily surge capacity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-site rescue (out-of-hospital care); Distribute vaccine or medication; Ancillary services: e.g. food, water, transport.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provide mental &amp; behavioural health care to workers and volunteers and patients; Medical treatment; Develop, test and improve the capability of mass health services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space</td>
<td>Hospital facilities and medical assets: e.g. laboratory, pharmacy, radiology, occupational health, medical supply;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surge capacity infrastructure: e.g. efficiently the use of nonmedical spaces such as unstaffed beds, corridors and restaurants as treatments spaces; Creating treatment areas beyond the hospital. Non-health assets: communication infrastructure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment and identification of feasible modification to medical facilities to increase surge capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Disaster plans; Warning and surveillance system; Incident command system; Information and communication.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency plans; cooperation with other health and non-health facilities; communication mechanism and protocols; specific procedures for vulnerable population; treatment strategies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimizing recovery strategies; The rapidity for adaptation of plans and policies; Adaptation of communications;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 4.1.3 Discussion

This study built upon the draft framework for hospital disaster preparedness derived from the rigorous literature search strategies, critical appraisal, and meta-ethnography described in Chapter 2. The elements of resilience identified by the process of structured interview with experts where incorporated into the domains identified in
the literature to form a new model of hospital preparedness.

Maintaining emergency preparedness of hospitals is not a static effort, but is a dynamic process. Because emergencies happen suddenly and often unpredictably, preparedness for major emergencies is different from the routine functions of hospitals. However, measuring the capability of hospitals to respond to major disasters is undertaken under normal stress and not in the environment of non-routine stress. It is difficult to predict the performance of hospitals under such major pressures; therefore any evaluation must be constructed around the stages of disaster management. A dynamic framework necessitates developing an organizational system and structure, reviewing resources, training staff, testing and improving service capability.

By breaking down the domains (staff, system, space, stuff, service) in the model of a sustainable (resilient) organization and putting them into context of hospitals, we built an evaluation framework for hospital preparedness. This evaluation framework comprehensively describes hospital preparedness activities by identifying and conceptualizing the essential components of hospital preparedness during the disaster lifecycle (and their interactions).

The difficulty of translating the complex interdependencies inherent in the concept of hospital preparedness has meant that measures and metrics have tended to concentrate on one single component or didn’t assess components by putting them into each phase of disaster management. For example, some empirical studies focused on the
emergency plan in the response process (Hong Chen, 2011; WL He, 2004; Xiaomei Jiang, et al., 2005; DC Liu, et al., 2010) when the emergency occurs, however, an effective plan involves all the activities, practices, interactions, and relationships that are aimed at improving the ability of the system during pre-incident, incident and post-incident.

Nevertheless, the basic components of a surge system are laid out in this Chapter. However further research was necessary to validate this conceptual framework of hospital preparedness and the indicators of performance within each of the themes and to identify explicit or minimum criteria for being a resilient hospital.

4.2 Study 2 Finalized the Framework and Develop an Evaluation Tool

Hospitals play a dominant role in managing health aspects of major emergency scenarios and are considered as safe havens where affected individuals go for shelter, food, water, and psychosocial assistance. Therefore, hospitals must maintain a high level of emergency preparedness. To address this continuous threat of disasters, a standardized and unified approach is required based on consistent benchmarks to assess hospital public health emergency preparedness (Markenson D, et al. 2005). Consensual benchmarks may improve capacity for an effective disaster response and provide a unified, comprehensive response framework (Cherry, Trainer, 2008).

Study 1 explored a series of elements for developing an evaluation framework. Based on this, the research advanced in to the Delphi study to further identify and refine the
most critical indicators which are relevant to the study and which should be included in the instrument for evaluating hospital PHEP. This process enabled the distillation of the views of experts using a modified Delphi method, with the outcome of an agreed instrument for evaluation.

Not only did the Delphi study supplement information to the preliminary findings from literature review and intensive interviews, but also it verified the preliminary findings in order to refine the initial framework. Compared to traditional questionnaire survey, the Delphi technique can provide more profound and reliable findings because of the following reasons: (1) the existing literature implied that there is limited consensus on benchmarks on the assessment of framework for public health emergency preparedness due to the breadth and complexity of its activities, so there is a driver for seeking agreement on this complicated matter, and Delphi study fits perfectly for this purpose rather than traditional questionnaire; (2) the merit of “trying to achieve consensus” embedded in Delphi technique inherently validate the data which will be converted into the strategic actions on a decision-support framework, as “two heads works better than one” through group opinions’ exchange the course of Delphi study involves consistent revision of participants’ responses.

4.2.1 Methods

The study methods comprised the following: (1) a modified Delphi method used to identify key indicators for measurement; and (2) Crohbach’s Alpha and Spearman’s correlation coefficient were used to verify the validity and reliability of the framework.
The Delphi process allows researchers to involve experts in a systematic method of consensus development and prioritization involving multiple rounds or review and synthesis (Dalkey, Helmer, 1963). This process is designed to ensure the representation of various experiences and areas of expertise; highlights points of convergence and divergence in the expert opinions; narrows the scope of agreed upon information; and refines or modifies the information to achieve consensus (Brennan, et al., 2006). A modified Delphi technique can be implemented using an initial event list rather than a blank piece of paper, while the panellists may be provided with a context within which to consider their response. Also the number of rounds in the modified technique may be decreased to as few as two if the panellists have been provided with an event list, and if early group consensus is achieved (Martino, 1993).

A questionnaire for the Delphi survey emerged from the literature review and intensive interviews. In the questionnaire, each potential item was assessed by experts in the study area; they used a five-point scale to evaluate the importance to the research topic. Then an evaluation framework was developed with the identified key indicators.

The questionnaire was emailed to experts, along with an introduction to the research, in advance. The experts gave importance weighting to each potential item of the framework, and provided comments for every level item. Also, the experts were invited to identify the illogical parts of the indicator system. They were asked to return the questionnaire within three weeks.
Some personal information on the experts (e.g. highest qualification, working department, working position, working role, and experience in this area) was requested during the survey, mainly for the purpose of assessment of the final results.

Theoretically, the Delphi process can be continuously iterated until consensus is determined to have been achieved. In most cases, two to three rounds in the modified Delphi method are often sufficient to collect the needed information and to reach a consensus (Cyphert & Gant, 1971; Brooks, 1979; Ludwig, 1997).

4.2.2 Data Analysis and Management

The survey data was managed and analysed using SPSS 19.0.

First, the authority of experts was assessed. The basic information of the experts was identified, and the authority of experts was evaluated, which was expressed by the authoritative coefficient Ca. Generally, when Ca is higher than 0.7 the result will be acceptable (Yanping Li, 2013).

Two impact factors were used; one was the evaluation criteria for the indicator (expressed by Cd), and the other factor was the experience of the expert in this area (represented by Ce).

Ce was divided into five levels, with each level given a score, namely “unfamiliar=0, less familiar=1, familiar=2, more familiar=3, very familiar=4”.

Cd was decided against the evaluation criteria used by the experts. Each answer was given a score “never=0, little=1, somewhat=2, much=3, a great deal=4” (Table 10).
Table 10 The evaluation criteria of experts and corresponding score (Cd)

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>To what extent do you rely on these criteria to give your evaluations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>Experience (C₁)</td>
<td>0</td>
</tr>
<tr>
<td>Theory (C₂)</td>
<td>0</td>
</tr>
<tr>
<td>Literature (C₃)</td>
<td>0</td>
</tr>
<tr>
<td>Instinct (C₄)</td>
<td>4</td>
</tr>
</tbody>
</table>

Thus, the authority of experts was calculated by the following equations (Eq.3):

\[
Cd = \frac{(C₁+C₂+C₃+C₄)}{4},
\]

\[
Ca = \frac{(Cd+Ce)}{2}
\]

Eq.3 Formulation of calculating authority of experts

Secondly, the mean value (“Mj”) of each indicator was calculated to assess the ‘intensity of importance’ weight for each item. In the questionnaire, each potential item was assessed by experts in the study area, using a five-point scale regarding their importance to the research topic. A score according to the magnitude of importance was given as follows: Very important = 4; Important = 3; Moderately important= 2; Of little importance= 1; Of no importance= 0. The larger the mean value, the greater indicator is.

Thirdly, Kendall’s coefficient of concordance (W) was applied to measure the experts’ agreement on the indicators. It is a measure of the agreement among several quantitative or semi-quantitative variables that are assessing a set of \( n \) objects of interest (Dawson B., 2014). Kendall’s W ranges from 0 (no agreement) to 1 (complete agreement). Intermediate values of W indicate a greater or less degree of unanimity.
Reliability and Validity of Indicator System

Through the literature review, intensive interviews and modified Delphi, an evaluation framework with indicators were finalized. The framework includes nine themes, and 24 sub-themes.

(1) Reliability

Internal reliability and external reliability were tested by Cronbach’s $\alpha$ and test-retest method, respectively. This involved testing the same participant twice, over a period of time, using the same test. Similar scores suggest a test has external reliability. Generally, Cronbach’s $\alpha \geq 0.6$ indicates that the internal consistency is acceptable; if the test-retest reliability is 0.7 or higher, then it has good external reliability (Joseph A., et al. 2003).

(2) Validity

In this study, content validity and construct validity were tested. Content validity required each question of the survey or test to be given to a panel of experts, who then rated it. The experts gave their opinion about whether the question was essential, useful or irrelevant. It was tested by Kendall’s W. Construct validity which defines how well a test or piece of experiment measures up to its claims. The evaluation of construct validity required the correlations of the measure to be examined in regard to the variables that are known to be related to its construct. This was demonstrated by Spearman’s correlation coefficient ($\rho$), which was calculated by the strength and
direction of the relationship between the two continuous variables, where both variables were at least ordinal scales (Dawson B., 2014).

4.2.3 Results

Profiles and Expertise of the Panel Experts

In this study, with reference to the selection process of panel members described in the study 1, 15 experts were invited to participate in the Modified Delphi study. The choosing of qualified experts for the purpose of high-performing group consensus achievement is a most important factor determining the Delphi study’s effectiveness. In contrast to traditional surveys, a Delphi study does not require a statistical sample that attempts to represent a population; instead it aims to approach high profile experts who have a profound understanding of the specific topic (Okoli C., et al., 2004).

Table 11 Profile of the panel experts

<table>
<thead>
<tr>
<th></th>
<th>Number of panel experts</th>
<th>CR*(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>Female</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td><strong>Working experience(years)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 10</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>11-15</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>15-20</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td>&gt;20</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td><strong>Position</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>Executive/Associate Director</td>
<td>7</td>
<td>46.7</td>
</tr>
<tr>
<td>Consultant</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td><strong>Organization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>University</td>
<td>4</td>
<td>26.7</td>
</tr>
</tbody>
</table>
They all occupied significant positions in their own organizations and had at least more than 5 years of experience in their professional area. The following table shows the familiarity of panel experts in public health emergency.

**Table 12 Familiarity of experts in public health emergency**

<table>
<thead>
<tr>
<th>Familiarity</th>
<th>Numbers of experts</th>
<th>CR(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very familiar</td>
<td>6</td>
<td>40.0</td>
</tr>
<tr>
<td>More familiar</td>
<td>7</td>
<td>46.7</td>
</tr>
<tr>
<td>Familiar</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Less familiar</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

The evaluation framework was finalized by identifying key evaluation indicators during the Delphi study. The validity of a Delphi study depends on the expertise of the panel members who participate (Armstrong J.S., 1985). Therefore, the authority of experts (Ca) was assessed. Among the reference group, there were six experts who were very familiar with public health emergency preparedness, and nine experts who were familiar in this area. The Ca of experts was 0.825, it is therefore concluded participants have good expertise.

**Finalized the evaluation framework**

To achieve a statistically rigorous consensus, this research looked at the degree of consensus. Accordingly, Kendall’s coefficient of concordance (W) was applied to
measure the agreement in the ratings. A strong consensus exists for \( W \geq 0.7 \); a moderate consensus for \( W = 0.5 \); and a weak consensus for \( W < 0.3 \) (Schmidt, 1997).

Kendall’s \( W \) was computed by SPSS software to illustrate the degree of consensus for the indicators (Table 13).

In the first round, Kendall’s \( W \) for the first-level indicator ranged from 0.352 to 0.492, \( P < 0.05 \), and Kendall’s \( W \) for the whole indicator system was calculated to be 0.434. The results indicated a fairly close to moderate consensus level. This finding can be explained. The panellists had multiple professional backgrounds and dealt with disaster/emergency work at different levels (including project management, policy consultation, and technical support); all the indicators were broad and covered various aspects of hospital management, such as planning, a fully staffed workforce, stockpile management, etc. This result may reflect that people who work in different organizations have different knowledge, skill sets, and interests about hospital preparedness capacity. As such there were difficulties in achieving a relatively low degree of consensus.

After the revision of the Delphi questionnaire, in the second round, Kendall’s \( W \) for the first-level indicator ranged from 0.522 to 0.685; \( P < 0.05 \) concluded that the level of agreement was higher than in the first round. Kendall’s \( W \) of the whole indicator system was 0.610, showing that there was a very strong consensus level.

After two rounds Delphi, Kendall’s \( W \) of entire framework had great degree of unanimity among reference group.
Table 13 Kendall’s W for each indicator in two rounds of Delphi

<table>
<thead>
<tr>
<th>First-level Indicator</th>
<th>First Round</th>
<th></th>
<th>Second Round</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mj*</td>
<td>Kendall’s W</td>
<td>P Value</td>
<td>Mj</td>
</tr>
<tr>
<td>Emergency plan</td>
<td>3.486</td>
<td>0.442</td>
<td>0.015</td>
<td>3.667</td>
</tr>
<tr>
<td>Surveillance</td>
<td>3.000</td>
<td>0.416</td>
<td>0.107</td>
<td>3.173</td>
</tr>
<tr>
<td>Training and drills</td>
<td>3.233</td>
<td>0.436</td>
<td>0.009</td>
<td>3.621</td>
</tr>
<tr>
<td>Stockpiles</td>
<td>2.967</td>
<td>0.492</td>
<td>0.002</td>
<td>3.074</td>
</tr>
<tr>
<td>On-site rescue and medical treatment</td>
<td>3.244</td>
<td>0.412</td>
<td>0.002</td>
<td>3.147</td>
</tr>
<tr>
<td>Fully staffed workforce</td>
<td>3.373</td>
<td>0.467</td>
<td>0.012</td>
<td>3.278</td>
</tr>
<tr>
<td>Emergency command system</td>
<td>2.667</td>
<td>0.565</td>
<td>0.023</td>
<td>3.556</td>
</tr>
<tr>
<td>Crisis communication and cooperation</td>
<td>3.140</td>
<td>0.483</td>
<td>0.043</td>
<td>3.474</td>
</tr>
<tr>
<td>Evaluation and adaption</td>
<td>2.900</td>
<td>0.352</td>
<td>0.042</td>
<td>-------</td>
</tr>
<tr>
<td>Entire indicator system</td>
<td>3.223</td>
<td>0.434</td>
<td>0.000</td>
<td>3.373</td>
</tr>
</tbody>
</table>

※ Mj = “mean value of indicator j”, indicating the importance of indicator j

On the other side, the mean value (Mj) for a set of indicator also could reflect the consensus of a group of highly knowledgeable and experienced professionals on both the theory and practice aspects of disaster management. All indicators were filtered by the criteria of “extent of importance” (Mj).

Importance (Mj) for each second and third level indicator was calculated in two rounds of Delphi (Table 14).

Table 14 Mean value for each indicator in two rounds of Delphi

<table>
<thead>
<tr>
<th>Second level indicator</th>
<th>Importance of indicator (Mj)</th>
<th>Third level indicator</th>
<th>Importance of indicator (Mj)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First round</td>
<td>Second round</td>
<td>First round</td>
</tr>
<tr>
<td>A1</td>
<td>3.667</td>
<td>3.667</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>3.660</td>
<td>3.778</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>3.133</td>
<td>3.556</td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>3.000</td>
<td>3.095</td>
<td>B11</td>
</tr>
</tbody>
</table>
According to the score given by experts, Mj of all indicators were nearly 3.0 (important) in the second round, indicating the intensity of importance for each item of evaluation framework is high.

There was little change in the experts’ opinions in the intensity of importance for each indicator in two consecutive rounds. Overall, along with the evaluation of Kendall’s
these results indicated that the round 2 can be considered to reach the stopping point.

In the second round, based on the outcomes of first round and consequent modifications, there were some changes, such as, added secondary-level indicator “emergency drug”, and “evaluation and adaption” was excluded because there would be no valid records of hospital self-evaluation to review, etc.

Based on the modified Delphi, an evaluation framework was finalized (Table 15)

Table 15 An evaluation framework for hospital preparedness

<table>
<thead>
<tr>
<th>Themes</th>
<th>Sub-themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency Plan</td>
<td>• Type of emergency plan: e.g. bioterrorism and chemical events; communicable disease, etc.</td>
</tr>
<tr>
<td></td>
<td>• The accessible of plan: whether is accessible to all medical staff; promote the emergency plan</td>
</tr>
<tr>
<td></td>
<td>• Details of the plan: e.g.; a protocol to initiate the emergency plan, a classification of the role in community wide planning.</td>
</tr>
<tr>
<td></td>
<td>• The period of evaluating and revising the plan</td>
</tr>
<tr>
<td>PHE detection and identification</td>
<td>• Surveillance policy and system;</td>
</tr>
<tr>
<td></td>
<td>• Surveillance systems for different types of diseases.</td>
</tr>
<tr>
<td></td>
<td>• Analysis, report and share of surveillance information</td>
</tr>
<tr>
<td>Laboratory diagnosis capacity</td>
<td>• working procedure and policy of laboratory</td>
</tr>
<tr>
<td></td>
<td>• variety of etiology can be isolate and identified</td>
</tr>
<tr>
<td></td>
<td>• equipment</td>
</tr>
<tr>
<td>Training and drills</td>
<td>• Type of training/drills: e.g. bioterrorism and chemical events; communicable disease</td>
</tr>
<tr>
<td></td>
<td>• Evaluation for effectives of training/drills: whether assess effectives of training/drills at fixed period.</td>
</tr>
<tr>
<td>Stockpiles</td>
<td>• Emergency materials and facilities: e.g. food, water, protection facilities, emergency beds,</td>
</tr>
<tr>
<td></td>
<td>• Emergency funding: e.g. emergency funding collection and management</td>
</tr>
<tr>
<td></td>
<td>• Emergency drugs</td>
</tr>
<tr>
<td>Emergency command system</td>
<td>• Emergency command centre</td>
</tr>
<tr>
<td></td>
<td>• Emergency relevant system: e.g. whether establish emergency report system, medical treatment system, etc.</td>
</tr>
<tr>
<td></td>
<td>• Emergency committee or group</td>
</tr>
</tbody>
</table>
Fully staffed workforce
• The staff structure of critical department
• Capacity of critical staff
• Expansion of workforce surge capacity

On-site rescue and medical treatment
• On-site rescue: e.g. capacity of emergency rescue, equipment for on-site rescue (for example, ambulance, communication equipment); Emergency beds and space: e.g. license beds, isolation beds, alternative medical space, ICU, ED, etc
• Medical treatment: e.g. expert group for emergency medical treatment; treatment strategies for different diseases; equipment for medical treatment, etc.

Crisis communication and cooperation
• Communication and cooperation within hospital: e.g. within department within hospitals; within key staff within hospitals
• Communication and cooperation with other facilities: e.g. with other health facilities; with government offices for emergency; with media and public

Test of validity and reliability of indicator system

Reliability

Cronbach’s $\alpha$ and test-retest reliability were calculated to assess internal and external reliability respectively (Table 16).

Table 16 Analysis of reliability of the framework

<table>
<thead>
<tr>
<th>First-level Indicator</th>
<th>Cronbach’s $\alpha$</th>
<th>Test-retest reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency plan</td>
<td>0.802</td>
<td>0.765</td>
</tr>
<tr>
<td>PHE identification and detection</td>
<td>0.795</td>
<td>0.873</td>
</tr>
<tr>
<td>Laboratory diagnosis capacity</td>
<td>0.736</td>
<td>0.794</td>
</tr>
<tr>
<td>Training and drills</td>
<td>0.799</td>
<td>0.795</td>
</tr>
<tr>
<td>Stockpiles</td>
<td>0.754</td>
<td>0.816</td>
</tr>
<tr>
<td>On-site rescue and medical treatment</td>
<td>0.834</td>
<td>0.722</td>
</tr>
<tr>
<td>Fully staffed workforce</td>
<td>0.816</td>
<td>0.766</td>
</tr>
<tr>
<td>Emergency command system</td>
<td>0.778</td>
<td>0.722</td>
</tr>
<tr>
<td>Crisis communication and cooperation</td>
<td>0.745</td>
<td>0.756</td>
</tr>
<tr>
<td>Entire indicator system</td>
<td>0.949</td>
<td>0.806</td>
</tr>
</tbody>
</table>

Cronbach’s Alpha of first-level indicator ranged between 0.736 and 0.834, $P < 0.05$.

Test-retest reliability ranged from 0.722 to 0.873, $P < 0.05$. Thus, the indicator system
has a good internal and external reliability.

Validity

The content validity was proved by Kendall’s W. In the above section, the overall Kendall’s W was 0.610, which means that the content validity was good.

The Spearman’s correlation coefficient (rho) was used to evaluate the construct validity, which was calculated to show the strength and direction of the relationship between the two independent indicators. All the statistical computation was executed by SPSS software. The coefficient of the internal indicators ranged from 0.112 to 0.561, P < 0.05. The positively strong relationship indicated that the indicator system had a higher construct validity (Table 17).

Table 17 Relationship between two items

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.346</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.382</td>
<td>0.366</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.561</td>
<td>0.254</td>
<td>0.246</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.473</td>
<td>0.354</td>
<td>0.486</td>
<td>0.277</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.356</td>
<td>0.355</td>
<td>0.146</td>
<td>0.286</td>
<td>0.302</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0.433</td>
<td>0.371</td>
<td>0.112</td>
<td>0.312</td>
<td>0.252</td>
<td>0.498</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>0.500</td>
<td>0.356</td>
<td>0.152</td>
<td>0.351</td>
<td>0.233</td>
<td>0.416</td>
<td>0.458</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>0.454</td>
<td>0.516</td>
<td>0.504</td>
<td>0.365</td>
<td>0.364</td>
<td>0.348</td>
<td>0.341</td>
<td>0.527</td>
<td>1.00</td>
</tr>
</tbody>
</table>

1 Emergency plan; 2 Disease surveillance; 3 Laboratory diagnosis capacity; 4 Training and drills; 5 Stockpiles; 6 On-site rescue and medical treatment; 7 Fully staffed workforce; 8 Emergency command system; 9 Crisis communication and cooperation.

4.2.4 Discussion

An evaluation framework was finalized via two rounds Delphi method, consisting of 9
first-level indicators and 24 second-level indicators. The indicators system was developed around five key elements: Staff, Stuff, Space, Service and Space. Capacity of hospital preparedness not only refers to self-ability of response to PHE, but also about ability of cooperation and coordination with other organizations, community, and government which might be more important to cope with PHE effectively. This framework contains hospital’s main responsibilities in response to PHE, such as capacity of taking mass patients in a short time when PHE occurs, PHE surveillance and monitoring. Meanwhile, it also emphasizes cooperation, communication and coordination with different organizations, for example, whether hospital conduct drills with other hospitals or organizations; whether have communication system, etc. Therefore, the content of finalized indicators system is relatively comprehensive.

Additionally, the reference group includes officials from academic institutions, the health bureau and technical institutions including the CDC in Sichuan. The aim was to collect individuals from a diverse background thus bringing together a range of perspectives which could make the indicator system with authoritative.

The number of experts in each round of Delphi was 15, which met the requirements of the Delphi method. In addition, they are senior practitioners in the area of disaster management. The experts came from academia, technical institutions (hospitals and CDC), and the government, which enabled the Delphi study to obtain different perspectives, and to ensure the qualification of experts was suitable.

Furthermore, the index for the authority of the experts was assessed; it indicated that
the study approached a high profile level for the experts who had a profound understanding of the research topic. Their qualification had a close link with the validity of the Delphi study. For example, the higher the expertise of the participants, the more reliable the outcomes are. The authority of experts here was 0.825, illustrating that the proposed indicator system was reasonable. Theoretically, the Delphi process can be continuously iterated until consensus is determined to have been achieved. The value of W was assessed at 0.610, indicating a greater degree of unanimity among the various responses; thus, a consensus on topics was deemed to be achieved. The Delphi process began with a well-structured questionnaire; the design was based upon the literature review and the intensive interview outcomes. Hence, face and content validity was demonstrated as good.

Generally, Cronbach’s Alpha higher than 0.6 indicates the internal consistency is acceptable; the external reliability is good when the test-retest reliability is above 0.7 (Joseph A., et al. 2003). In the current study, both Cronbach’s Alpha and test-retest reliability of each indicator were higher than 0.7, implying that the entire indicator system had good internal and external reliability.

A scientific and reasonable measurement tool, such as Spearman’s correlation coefficient, can appropriately represent or measure the construct being investigated. Thus, the construct validity assessment illustrated that the framework had good construct validity.
4.2.5 Conclusion

An evaluation framework was developed and validated during the current research. It concisely, and comprehensively, captured the emergency preparedness activities of hospitals, helping hospitals to recognize how their daily work fits within public health emergency preparedness. However, the evaluation framework needs further assessment and adaptation for operational usage in the context of China.
CHAPTER 5 RESULTS OF QUANTITATIVE STUDY

Testing the Utility of the Framework for describing the Current Status of Hospital PHEP

5.1 Introduction

This chapter presents the results of quantitative research. First, the chapter summarises the methodology, including the sample profile, survey instrument, data collection and analysis procedures. Then, it describes the current capacity of hospital preparedness for emergencies, and compares those capacities among different grades and types of hospitals.

The study used a cross-sectional method by applying a questionnaire to survey hospitals preparedness in different regions of Sichuan province. Respondents were all from secondary and tertiary hospitals in the province of Sichuan. Forty six responding hospitals in total responded to the survey.

Instrument

An evaluation indicator system framework was created and a questionnaire was developed based on the results of Delphi method (reported in Chapter 4). The questionnaire consisted of eight sections and 76 items. The questionnaire was tested by a pilot study.

For the purpose of this study, we analyzed the data focused on the following nine
areas of interest: (1) hospital’s basic information (including hospital grade, SARS crisis experience, and number of medical staff in related departments); (2) hospital emergency plan (emergency type, accessibility, and revision and implementation of emergency plan); (3) surveillance capability: Public health emergencies detection and identification; laboratory diagnosis capacity: laboratory regulation and management, sample disposal and evaluation system, collection and disposal of suspected samples, etc.; (4) staff training (organization of public health emergencies training, curriculum development and training effectives assessment); (5) stockpiles (emergency supplies, stockpiles of drugs and materials management); (6) emergency command system (emergency command centre, the staff structure, capability of critical staff); (7) medical treatment capacity (protocol for diagnosis, treatment, and transfer of patients); (8) risk communication; (9) maintaining fully staffed workforce.

**Data collection procedures**

A questionnaire was sent to the targeted hospitals via email accompanied by an official letter from the Sichuan Health Bureau stating the importance of the survey and the requirement that each hospital designate a department director to be responsible for coordinating the completion of the questionnaire. Each questionnaire was carefully reviewed for its completeness and consistency. For those questionnaires with incomplete and/or inconsistent responses, one or two follow-up telephone calls were made to ensure completeness and consistency. The data from returned questionnaires were then transferred into a database for analysis.
Statistical analysis

Each returned questionnaire was reviewed for completeness and consistency. If no answer could be obtained, that questionnaire was considered as “no” response. For qualitative questions, each answered item was scored 1 for “yes” and 0 for “no” or “unknown”. Item scores were calculated by adding together “yes” answers. The higher the score, the better the hospital was considered to be prepared. For quantitative questions, the normality test of data was conducted by using SPSS 19.0.

All data were transferred into a database and analyzed using software SPSS. Descriptive statistics were used to present the data. Comparisons of mean scores for each of 8 emergency preparedness aspects among different levels of hospitals were performed by independent sample t test (2-tailed), with P ≤ 0.05 as statistical significance.

5.2 Results

Pilot study

A pilot study was conducted to check that the design of the questionnaire and its comprehension. It also sought to identify potential problems with the methods and logistics and to avoid misleading inappropriate or redundant questions in the questionnaire.

Two tertiary and three secondary hospitals were selected for the pilot study. Since the content of the questionnaire refers to different departments of hospitals, the director of the Medical Department or the Emergency Department was responsible for
coordinating the completion of the questionnaire; where necessary collecting information from other departments.

As a result of the pilot study, improvements were made as following to the questionnaire:

- In the section of “Laboratory diagnosis”, the questions “is there someone is on duty for 24 hours in the laboratory?” and “is there someone is on duty in 7 days a week?” are similar, and were changed into “is there someone is on duty in the laboratory every day (include weekends)?”
- In the section of “On-site rescue and medical treatment”, the question “Does hospital have facilities for medical waste and rubbish, such as boxes for used injector or other edge tool, etc.” was deleted because of Sichuan province has established medical waste centre which is responsible for collection and uniform disposal of trash from hospitals.
- In the section of “Stockpiles”, there were many indicators which were repetitive and so a new structure was applied to the question to read “does the hospital have the following protective equipment?”

Survey

Hospital information

There were forty six hospitals in total that responded to the questionnaire from 47 approached. Of all hospitals, 25 were secondary hospitals and 21 were tertiary hospitals. In terms of hospital type, 19 were teaching hospitals and 27 were
non-teaching; 38 were general hospitals (See Table 18 and Figure 15).

**Table 18 Hospital classification information**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Tertiary grade A</th>
<th>Tertiary grade B</th>
<th>Secondary grade A</th>
<th>Secondary grade B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever clinics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, designated</td>
<td>14</td>
<td>4</td>
<td>14</td>
<td>4</td>
<td>36</td>
</tr>
<tr>
<td>Yes, not designated</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>No/ Unknown</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Teaching hospital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>No</td>
<td>5</td>
<td>2</td>
<td>13</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Types of hospital*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General hospital</td>
<td>12</td>
<td>5</td>
<td>14</td>
<td>6</td>
<td>38</td>
</tr>
<tr>
<td>Specialized hospital</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>5</td>
<td>17</td>
<td>8</td>
<td>46</td>
</tr>
</tbody>
</table>

※Types of hospital: General hospital: A hospital that can treat most people and that does not limit itself to one particular type of medical problem. Types of specialised hospitals include trauma centres, women’s hospitals, children’s hospitals, rehabilitation hospitals, etc, and hospitals for dealing with specific medical needs.

Table 19 shows the numbers of health care staff and beds in the surveyed hospitals.

The average number of physicians per hospital was 444, nurses averaged 486 and the average total staff per hospital was 1547. Average bed numbers were 414 (range
40-1800). The proportion of specialty beds such as Emergency Department Beds, isolation beds and Intensive Care Unit Beds (ICU) was 2.2% (605/27879), 1.9% (529/27879) and 2.5% (692/27879) respectively. Although the mean number of the hospital licensed bed capacity is greater than 400, fewer than 40 extra beds can be added immediately during emergencies, accounting for 10% of licensed beds.

**Table 19 The numbers of health care staff and beds in the respondent hospitals**

<table>
<thead>
<tr>
<th></th>
<th>Mean±SD</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Staff (in total)</strong></td>
<td>1547.9±2073.9</td>
<td>96</td>
<td>8900</td>
<td>36222</td>
</tr>
<tr>
<td><strong>Physicians</strong></td>
<td>444.7±606.1</td>
<td>32</td>
<td>2400</td>
<td>10227</td>
</tr>
<tr>
<td><strong>Nurses</strong></td>
<td>486.3±590.3</td>
<td>33</td>
<td>2280</td>
<td>11184</td>
</tr>
<tr>
<td><strong>Licensed beds</strong></td>
<td>414.4±345.7</td>
<td>40</td>
<td>1800</td>
<td>27879</td>
</tr>
<tr>
<td><strong>ED beds</strong></td>
<td>26.3±16.5</td>
<td>12</td>
<td>188</td>
<td>605</td>
</tr>
<tr>
<td><strong>Isolation beds</strong></td>
<td>18.3±44.5</td>
<td>10</td>
<td>148</td>
<td>529</td>
</tr>
<tr>
<td><strong>Intensive care unit beds</strong></td>
<td>30.1±37.1</td>
<td>10</td>
<td>150</td>
<td>692</td>
</tr>
<tr>
<td><strong>Extra beds</strong>*</td>
<td>38.2±95.3</td>
<td>10</td>
<td>400</td>
<td>1064</td>
</tr>
</tbody>
</table>

SD, Standard deviation

*Extra beds: the numbers of extra beds can be provided when a emergency plan is initiated.

Current status of hospital PHEP in Sichuan province

The eight aspects of hospital preparedness capacity identified in the framework described in Chapter 4 which formed the basis of the survey are detailed below.

**Capacity1: Emergency Plan**

Emergency plans establish the protocols for operation during a public health emergency. For a hospital to mobilize all emergency resources in a short period of time, contingency plans must be decided in advance. This study showed that all the targeted hospitals at least had one emergency plan, while no hospitals had emergency plans for all listed emergencies. Of all 46 hospitals, 45 hospitals had emergency
response plans that specifically addressed infectious diseases, 42 hospitals had plans for natural disasters, foodborne disease (40), and mass unidentified disease (38). Fewer hospitals had plans for nosocomial infection (22) and occupational poisoning (20), and only 11 hospitals had developed emergency plans for biological, chemical, radiological, nuclear and explosive threats (See table 20). At the time of this survey, 38 hospitals had a protocol for use of personal protective equipment, and 23 had a detailed plan for drug distribution.

Table 20 Comparison of capacity 1 (Emergency Plan) among different hospitals.

<table>
<thead>
<tr>
<th>Type of emergency plan</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numbers of hospital</td>
<td>Numbers of hospital</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>45</td>
<td>1</td>
</tr>
<tr>
<td>Mass unidentified disease</td>
<td>38</td>
<td>8</td>
</tr>
<tr>
<td>Foodborne disease</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>Occupational poisoning</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>Nosocomial infection</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>Natural disaster</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>Bio/Chemical/nuclear, etc. terror</td>
<td>11</td>
<td>35</td>
</tr>
</tbody>
</table>

Periodic review and updating of emergency plans enhances an institution’s emergency response capacity. In this regard, the survey sought responses in regard to the recency of updating of the plan. 38 hospitals had evaluated and revised their emergency plan at least once in 12 months, and 44 respondents reported that their emergency plan were accessible to all medical staff.

**Capacity 2: Surveillance**

The surveillance capacity of hospitals was assessed via two aspects: early detection and identification, and laboratory diagnostic capability. Detection and identification
of a public health emergency are amongst the most important objectives for prompt and effective public health response. Hospital laboratories not only have the task of diagnosis, but are also responsible for the surveillance of disease and reporting of disease outbreaks. Therefore, laboratory information plays an important role in the early detection of public health emergencies.

(1) Public health emergencies detection and identification

Public health emergency detection and identification is mainly collected from hospital clinic recording, disease/symptoms surveillance in the emergency room, laboratory diagnosis and death registration.

Among all the responded hospitals, 37 hospitals reported that they had developed a surveillance system for certain diseases, and all hospitals maintain epidemic reporting/registration systems, and had an outpatient log or infectious disease report card for surveillance.

Eight clinical syndromes were used in this research to evaluate the hospital’s emergency detection and identification capacity; this included the capacity to undertake routine microbiological tests, fever patients, death with unknown causes, gastroenteritis patients, influenza-like cases, atypical pneumonia and septicemia. Forty Three and the 46 respondent hospitals reported that they regularly monitored for the presence of disease in routine microbiological tests and fever patients. Similarly, most hospitals could detect and identify atypical pneumonia and influenza-like cases. In addition, nearly 32 respondents revealed that they can monitor septicemia, death
with unknown causes, and gastroenteritis patients (Table 21).

Table 21 Monitoring items in respondent hospitals

<table>
<thead>
<tr>
<th>Types of disease/symptom</th>
<th>Yes Numbers of hospitals</th>
<th>No/Unknown Numbers of hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine microbiological tests*</td>
<td>43</td>
<td>3</td>
</tr>
<tr>
<td>Fever patients</td>
<td>46</td>
<td>0</td>
</tr>
<tr>
<td>Influenza-like cases</td>
<td>46</td>
<td>0</td>
</tr>
<tr>
<td>Death with unknown causes</td>
<td>32</td>
<td>14</td>
</tr>
<tr>
<td>Gastroenteritis patients</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>Atypical pneumonia</td>
<td>39</td>
<td>7</td>
</tr>
<tr>
<td>Numbers of emergency room patients</td>
<td>38</td>
<td>8</td>
</tr>
<tr>
<td>Septicaemia</td>
<td>32</td>
<td>14</td>
</tr>
</tbody>
</table>

* Classification of pathogen detection result

There were 38 hospitals which had a designated person in charge of identifying suspicious abnormal trends and reporting surveillance information to the health administration. Checking, analyzing and summarizing monitoring information is important for identification and detection of public health emergencies. Among the targeted hospitals, 19 hospitals stated that classified and analyzed monitoring information was reported at least once per week (Table 22).

Table 22 Period of analysis of monitoring information in the respondent hospitals

<table>
<thead>
<tr>
<th>Period</th>
<th>Hospitals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday</td>
<td>12</td>
</tr>
<tr>
<td>Many times per week</td>
<td>2</td>
</tr>
<tr>
<td>One week</td>
<td>5</td>
</tr>
<tr>
<td>Every two weeks</td>
<td>13</td>
</tr>
<tr>
<td>One month</td>
<td>8</td>
</tr>
<tr>
<td>Aperiodicity</td>
<td>1</td>
</tr>
<tr>
<td>Never</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
</tr>
</tbody>
</table>

Surveillance information was shared their with the local health authority via a
network reporting system by 22 of the surveyed hospitals.

(2) Laboratory diagnosis capacity

Eight infectious diseases were selected to evaluate hospitals’ laboratory diagnosis capacity, based on the groups described by Zhang Hui, et al. (2007): (1) class A infectious diseases, according to the Law on Communicable Disease Prevention and Control of China (plague and cholera); (2) infectious diseases caused by a pathogen which can potentially be used as a bioterrorist weapon (anthrax and brucellosis); (3) infectious diseases with cause a significant threat to life and health of citizens (SARS, influenza, meningococcal meningitis, Japanese encephalitis B).

The results were demonstrated in Table 23.

<table>
<thead>
<tr>
<th>Types of infectious</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numbers of hospitals</td>
<td>Numbers of hospitals</td>
</tr>
<tr>
<td>SARS</td>
<td>42</td>
<td>4</td>
</tr>
<tr>
<td>Plague bacillus</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>Cholera</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>Anthrax</td>
<td>3</td>
<td>43</td>
</tr>
<tr>
<td>Influenza</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>Meningococcal meningitis</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>35</td>
<td>11</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>20</td>
<td>26</td>
</tr>
</tbody>
</table>

The results demonstrated that most (>35) hospitals had the capacity to identify and isolate SARS, influenza, and Japanese encephalitis. Approximately half of the targeted hospitals could identify and isolate Cholera, Meningococcal meningitis, and Brucellosis, while few hospitals had the capacity to identify and isolate Anthrax (3).
Of all respondents, only 3 tertiary hospitals could isolate and identify all eight diseases.

This survey did indicate that when faced with an emergency, 35 hospitals (of 46) could promptly enlarge the capacity of sample testing. However few (15/46) had arrangements in place for the transport of suspected samples capability to another location with more extensive capacity.

Only 24 of the responding hospitals reported that they could request laboratory testing and receive results 24 hours per day and seven days per week.

Finally centralised reporting was mostly delayed. Of all respondents, 26 had a direct electronic link to disease reporting network system to CDC or other health administrative department.

**Capacity 3: Training and Drills**

Among all the respondents, 44 hospitals reported that they had a staff training program, with variable content including the content of the emergency plan (37), medical treatment procedures (43), methods of identifying PHE (44), awareness of public health emergencies (33), personal protective measures (40), information system management (34), disinfection and sterilization (27), and principles of quarantine and isolation (26). However, none of respondents reported that their training curriculum included all above-mentioned contents (Table 24).

<table>
<thead>
<tr>
<th>Content of training</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Of all respondents, 36 hospitals had a designated person who supervised the training and drills program; 31 of which was updated regularly, and the effectiveness of training and drills was periodically evaluated in only 34 hospitals.

In addition, not all hospitals (34) conducted drills for staff. Among all listed types of drills, 34 hospitals provided drills on nosocomial infection, compared with natural disaster (30), and foodborne disease (28), occupational poisoning and mass unidentified disease (28); less than half of hospitals (20) had drills program with regard to bio/chemical terrorist attacks.

**Table 25 Comparison of capacity 3 (staff drills) among different hospitals**

<table>
<thead>
<tr>
<th>Type</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numbers of hospital</td>
<td>Numbers of hospital</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>34</td>
<td>12</td>
</tr>
<tr>
<td>Mass unidentified disease</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Foodborne disease</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Occupational poisoning</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Nosocomial infection</td>
<td>34</td>
<td>12</td>
</tr>
<tr>
<td>Natural disaster</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>Bio/Chemical/nuclear, etc. terror</td>
<td>20</td>
<td>26</td>
</tr>
</tbody>
</table>

**Capacity 4: Stockpiles and infrastructure**
(1) Special drug stockpile

A special drug stockpile is defined as storage of certain drugs for treating 30 patients with each of 8 infectious diseases for at least 7 days (Zhang hui, Huang Jian-shi, et al. 2007). In the surveyed hospitals, a majority of respondent hospitals reported that they had an adequate stockpile of drugs for influenza (30); more than half of respondents had an adequate stockpile of drugs for meningococcal meningitis and Japanese encephalitis B (27); and less than half of respondents had an adequate stockpile of drugs for plague (20), cholera (18), anthrax (17), and brucellosis (18). Only 10 hospitals had enough drugs stockpiled for all 8 kinds of infectious diseases.

The survey results revealed that 24 respondents had evaluated their stockpiles of drugs, and 28 had established a relationship with suppliers to provide emergency drug supplies. However, only 11 hospitals had signed written contracts with suppliers. Most of the surveyed hospitals possessed emergency resource reserves to respond to a sudden increase in patients, but less than half of them (23) had corresponding drug distribution programs for rational allocation of limited drugs.

(2) Personal protective equipment

Of all respondent hospitals, 23 hospitals had biohazard protective suits, 41 had safety glasses, 34 had ventilators, 26 had N95 masks, and only 2 hospitals had powered air-purifying respirators available for health care personnel and other employees. However, only 1 hospital reported that they had all of the above-mentioned types of personal protective equipment.
For protection against chemical and nuclear terrorism, 17 the current respondents stocked chemical protective suits for staff. There were 15 respondents who confirmed having radiation detection equipment, while seven of those have not tested the equipment within the previous year.

(3) Facilities

About 35 hospitals reported that they had identified additional patient care capacity, and some hospitals planned to set up temporary facilities if the hospital became unusable (e.g., without power or flooded). Strategies to sustain operations that were reported included back-up oxygen system (32), alternated power supply system (31) and water supplies (21). Many hospitals would establish alternate care areas with beds, staffing, and equipment in nonclinical space (32), inpatient unit hallways (24), or decommissioned ward space, but only four hospitals had alternative laboratories once laboratories were contaminated.

(4) Emergency funding

All hospitals had an emergency fund, and the majority of respondents could obtain financial support from state or local governments. Thirty four hospitals had in place and emergency funding management system.

Capacity 5 Medical treatment

All hospitals reported that they had capacity of taking traumatic patients from accidents or disasters as well as patients with infectious diseases. However only half
of the surveyed hospitals could admit a group of foodborne and occupational poisoning patients, and less than one third of hospitals had plans for taking nuclear/radioactive accident and bio/chemical terror casualties.

Almost all hospitals had a plan for admission and treatment of at least one type of emergency event listed in the questionnaire, but only six hospitals had plans which included all listed types of emergency events (namely infectious disease, mass unidentified disease, foodborne disease, occupational poisoning, nosocomial infection, serious accident and disaster, bio/chemical/nuclear terror).

In addition, all hospitals reported that could transfer public health emergency victims to other medical agencies for appropriate treatment. Of the surveyed hospitals, 33 hospitals had specific protocols for patient’s transfer in a public health emergency.

As for infectious disease treatment, the survey showed that 12 hospitals had medical treatment plans for all eight types of infectious diseases, and all hospitals a plan for at least one of the infectious diseases. As shown in Table 26, 36 of the surveyed hospitals had special medical treatment plans for treating SARS and 40 had plans for influenza patients. Additionally 20 had plans for the management of cholera; 18 for meningococcal meningitis; 15 for Japanese encephalitis B; and less than 14 hospitals for plague, anthrax, and brucellosis.

Table 26 The medical treatment capacity in respondent hospitals (N=46).

<table>
<thead>
<tr>
<th>Types of infectious</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numbers of hospitals</td>
<td>Numbers of hospitals</td>
</tr>
<tr>
<td>SARS</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>Plague bacillus</td>
<td>12</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>2020</td>
<td>2021</td>
</tr>
<tr>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Cholera</td>
<td>20</td>
<td>26</td>
</tr>
<tr>
<td>Anthrax</td>
<td>13</td>
<td>33</td>
</tr>
<tr>
<td>Influenza</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>Meningococcal meningitis</td>
<td>18</td>
<td>28</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>10</td>
<td>36</td>
</tr>
</tbody>
</table>

Of all respondents, about 37 hospitals were prepared to respond to the needs of vulnerable people (includes women, children, pregnant women and the disabled) in the event of public health emergency.

Availability of empty beds is a fundamental component of hospital’s surge capacity, which reflects the hospitals’ capacity to accept new patients, not only during routine operations, but also during a mass casualty incident. All responding hospitals could add extra beds for general ward, emergency department, and infectious department when an emergency plan is initiated. However, no hospitals had evaluated their ability to increase beds and equipment for emergencies.

**Capacity 6 Risk communication**

With regards to capacity for risk communication, the majority of hospitals had plans for receiving and communicating alerts from the state or local health department. Forty two hospitals reported that they had a risk communication system within the hospital; while 26 had a system to communicate information to the media, public and local governments. The result showed that most of the surveyed hospitals' response plans focused on medical treatment, transport of medical staff in a timely manner, and providing health services when an emergency event occurred, but paid less attention to health education, psychological counselling, and crisis communication.
Capacity 7 Emergency command system

As for the emergency command system capacity, all hospitals had emergency first-aid medical teams or an Emergency Department. There were 43 hospitals which had a command centre or designated personnel for public health emergency situations. Of all respondents, 24 hospitals had established an expert group for responding to emergency events, and only 13 hospitals possessed expert panels to advice on public health psychological counselling for public victims.

Capacity 8 Maintaining a fully staffed workforce

In an event of emergency, most hospitals had a plan for continuity of operations. For example, 43 hospitals would recall staff that are on days-off, or employ temporary workers (31), or rehire retired employees (30). In addition, some hospitals had a mutual aid agreement with other agencies to share health care providers (18) and to register volunteers (14) so as to expand the on-site health care workforce (Table 27).

Table 27 Capacity of expanding workforce

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hospital</td>
<td>Hospital</td>
</tr>
<tr>
<td>Recall staff is on leave</td>
<td>43</td>
<td>3</td>
</tr>
<tr>
<td>Temporary worker</td>
<td>31</td>
<td>15</td>
</tr>
<tr>
<td>Retired employee</td>
<td>30</td>
<td>16</td>
</tr>
<tr>
<td>Share health care providers</td>
<td>18</td>
<td>28</td>
</tr>
<tr>
<td>volunteers</td>
<td>14</td>
<td>32</td>
</tr>
</tbody>
</table>
5.3 Overall evaluation of preparedness among different levels of hospital

Factor Analysis was used to identify common underlying factors which most significantly affect hospital preparedness, and to verify the proposed conceptual model of hospital preparedness used in this research. Moreover, preparedness capacity between hospitals was compared by using Factor Analysis method.

Factor Analysis is a statistical approach that can be used to analyze interrelationships among a large number of observed variables $X_1, X_2,...X_n$ and to explain these variables in terms of their common underlying dimensions (is called common factors) (Connie D., Stapleton 1997). The common factors are hypothetical variables which explain why a number of variables are correlated with each other----it is because they have one or more factors in common (Alan Taylor, 2001).

It aims to: (1) reduce the number of variables and (2) detecting latent structure in the relationships between variables, and to classify variables. Factor analysis allows researchers to test theories involving variables which are hard to measure directly, or help people to establish that sets of questionnaire items (observed variables) are in fact all measuring the same underlying factor and so can be combined to form a more reliable measure of that factor (Alan Taylor, 2001).

In this study, factor analysis was used for finding the common factors which explain the correlation among variables. Factor analysis can show a group of variables which are highly associated with, and thus are representing, a common factor (Hee-Ju Kim, 2008). Through this process, the structures, dimensions, or underlying processes of
the data are also identified. Figure 16 illustrates how the structures, dimensions, or underlying process of data detected by factor analysis may be displayed.

Fig. 16 Underlying dimension, process, and structure of the data (Hee-Ju Kim, 2008)

In this model, S represents an observed variable and the term “Factor” is something which is common in the data. The arrows indicate that factors create variables and lines indicate that there is a correlation between the variables. This diagram illustrates the relationships between factors and observed variables, and how factor analysis can show the underlying process, dimensions, and structure of the data (observed variables).

There are four basic steps to carry out factor analyses: (1) generation of the correlation matrix to test whether the sample is appropriate for Factor Analysis; (2) extraction of initial factors to identify common factors; (3) rotation and interpretation; and (4) construction of scales or factor scores (Ramchander, P. 2004).
In this research, eight capacities (variables) of hospital preparedness were measured, and were tested for their correlation. The hypothetical explanation for these correlations is that there may be common underlying factors. Therefore, a factor analysis model was developed to analyze variables of the hospital preparedness evaluation framework in-depth by using SPSS software. The steps are as the following:

(1) Generation of the correlation matrix and testing for appropriateness

Kaiser-Meyer-Olkin (KMO) and Bartlett’s Test of Sphericity were used for testing whether factor analysis is suitable for the data. KMO tests whether the partial correlations among variables are small. High values (close to 1.0) generally indicate a factor analysis maybe useful with the data. The value should be greater than 0.5 for a satisfactory factor analysis to proceed.

Bartlett’s ‘test of sphericity’ tests whether the correlation matrix is an identity matrix, which would indicate that the factor model is inappropriate. It is used to test the null hypothesis that the variables in the population correlation matrix are uncorrelated. The observed significance level is 0.0000 which concludes that the strength of the relationship among variables is strong (Zhao Qi, 2009).

Application of these tests to this data demonstrates that Barlett’s test of sphericity is highly significant ($p < 0.001$), which means factor analysis is feasible. The KMO value is 0.815, which is greater than 0.5, indicating that KMO also supports factor analysis is appropriate for this data (Table 28).
Table 28 KMO and Barlett’s test of sphericity test

<table>
<thead>
<tr>
<th>Kaiser-Meyer-Olkin of Sampling Adequacy</th>
<th></th>
<th>0.815</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barlett’s Test of Sphericity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx. Chi-Square</td>
<td>505.677</td>
<td></td>
</tr>
<tr>
<td>df</td>
<td>253</td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td>0.000</td>
<td></td>
</tr>
</tbody>
</table>

(2) Identify common factors (Extraction of initial factor solution)

The mathematical process used to obtain a factor solution from a correlation matrix is such that each successive factor, accounts for as much of the variance of the observed variables as possible. The amount of variance accounted for by each factor is shown by a quantity called the ‘eigenvalue’, which is equal to the sum of the squared loadings for a given factor. In this research it was calculated through SPSS. While this initial solution is consistent with the aim of accounting for as much as possible of the total variance of the observed variables with as few factors as possible, the initial pattern is often adjusted so that each individual variable has substantial loadings on as few factors as possible (preferably only one). This adjustment is called rotation to simple structure, and seeks to provide a more interpretable outcome.

Table 29 shows all the factors extractable from the analysis along with their eigenvalues, the percent of variance attributable to each factor, and the cumulative variance of the factor and of the previous factors. Before extraction, SPSS has identified 8 components within the data set. The eigenvalues associated with each factor represent the variance explained by that particular component and SPSS also
displays the eigenvalue in terms of the percentage of variance explained (for instance, factor 1 explains 26.03% of total variance). Four factors were extracted by SPSS from all factors with eigenvalues greater than 1, accounting for almost 81% of the variance which means these four factors could represent most variance.

As shown in the final part of the Table (labelled Rotation Sums of Squared Loadings), after rotation, the eigenvalues of the factors are displayed. Rotation has the effect of optimizing the factor structure and one consequence for these data is that the relative importance of the four factors is equalized.

**Table 29 Total Variance Explained**

<table>
<thead>
<tr>
<th>Component</th>
<th>Initial Eigenvalue</th>
<th>Extraction Sums of Squared Loadings</th>
<th>Rotation Sums of Squared Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>% of Variance</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>1</td>
<td>4.43</td>
<td>26.03</td>
<td>26.03</td>
</tr>
<tr>
<td>2</td>
<td>1.48</td>
<td>19.06</td>
<td>45.09</td>
</tr>
<tr>
<td>3</td>
<td>1.37</td>
<td>18.08</td>
<td>63.17</td>
</tr>
<tr>
<td>4</td>
<td>1.28</td>
<td>17.51</td>
<td>80.68</td>
</tr>
<tr>
<td>5</td>
<td>0.81</td>
<td>6.20</td>
<td>86.88</td>
</tr>
<tr>
<td>6</td>
<td>0.73</td>
<td>5.60</td>
<td>92.48</td>
</tr>
<tr>
<td>7</td>
<td>0.67</td>
<td>5.14</td>
<td>97.62</td>
</tr>
<tr>
<td>8</td>
<td>0.57</td>
<td>2.38</td>
<td>100.00</td>
</tr>
</tbody>
</table>

(3) Rotation (Common factor Interpretation)

The idea of rotation is to reduce the number of factors on which the variables under investigation have high loadings (Alan Taylor. 2001). Rotation does not actually change anything but makes the interpretation of the analysis easier (Ramchander, P. 2004).
Briefly, this involves identifying the variables with high loadings on a given component. Usually, a brief name is assigned to each retained component to describe what it appears to measure. If the mathematical factor produced by the analysis represents some real-world construct then common themes among highly loaded questions can help identify what the construct might be.

As shown in the following Table 30, after the rotation, there are four factors and variables load very highly onto only one factor, ordering variables by loading size. Therefore, a clear pattern now emerges, for example, the three variables: early detection, laboratory diagnosis and medical treatment load highest on Factor 1. The variables that load highly on factor 2 include fully staffed workforce and staff training.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Common factors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>V1 Early Detection</td>
<td>0.820</td>
</tr>
<tr>
<td>V2 Laboratory Diagnosis</td>
<td>0.805</td>
</tr>
<tr>
<td>V3 Medical Treatment</td>
<td>0.766</td>
</tr>
<tr>
<td>V4 Fully staffed workforce</td>
<td>0.123</td>
</tr>
<tr>
<td>V5 Staff Training</td>
<td>0.091</td>
</tr>
<tr>
<td>V6 Stockpiles</td>
<td>0.385</td>
</tr>
<tr>
<td>V7 Facilities (Infrastructure)</td>
<td>0.191</td>
</tr>
<tr>
<td>V8 Emergency Plan</td>
<td>0.170</td>
</tr>
<tr>
<td>V9 Risk Communication</td>
<td>0.174</td>
</tr>
<tr>
<td>V10 Emergency Command System</td>
<td>0.123</td>
</tr>
</tbody>
</table>

The values highlighted are large in magnitude, and from this the interpretation can be made as followings:
• Factor 1: primarily a measure of Early Detection and Warning, but also increases with increasing scores for Laboratory Diagnosis and Medical Treatment, which stands for capacity of hospital’s functions of surveillance and warning and medical services before and during an emergency event, and it could be labelled “Hospital Service Factor”.

• Factor 2: this factor tends to be associated with variables of Full Staffed workforce and Staff Training with large positive loadings, which presents hospital capability of providing medical services to the public and casualties during crisis. It can be labelled “Human Resources Factor”.

• Factor 3: primarily a variable of stockpile alone, it includes emergency supplies, e.g. drugs, beds, etc. In addition, it contains activities such as building infrastructure to ensure critical facilities meet building code for high risks, e.g. floods, earthquake. This factor can be labelled “Stockpiles and Infrastructure Factor”.

• Factor 4: Emergency Plan, Risk Communication and Emergency Command System with large loadings, indicating hospital’s response capacity and attention degree. It can be identified as “Management, Direction and Coordination (MDC) Factor”.

(4) Construction of scales (Develop a factor analysis model)

A factor analysis model can be calculated by the following equation (Zhang Hui, 2005):
It is mentioned above that the aim of factor analysis is to “explain” correlations among observed variables in terms of a relatively small number of factors. Through SPSS results here, there are four common factors which could reflect the overall hospital preparedness capacity. Therefore, the total score of a hospital can be calculated by the following equation (Alan Taylor 2001):

\[
F = \frac{\lambda_1}{\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4} F_1 + \frac{\lambda_2}{\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4} F_2 + \frac{\lambda_3}{\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4} F_3 + \frac{\lambda_4}{\lambda_1 + \lambda_2 + \lambda_3 + \lambda_4} F_4
\]

\[F = \text{hospital total score}\]

\[\lambda = \text{Loading of initial eigenvalue}\]

The quantities of each factor show how much of the total variance of the observed variables is accounted for by that factor. The higher of the weight, the more important a factor is.

According to the equation, four common factors can be calculated respectively:

\[F_1 = 0.820X_1 + 0.805X_2 + 0.766X_3 + 0.123X_4 + 0.091X_5 + 0.385X_6 + 0.191X_7 + 0.170X_8 + 0.174X_9 + 0.123X_{10}\]

\[F_2 = -0.070X_1 + 0.168X_2 + 0.127X_3 + 0.759X_4 + 0.624X_5 + 0.357X_6 + 0.126X_7 + 0.157X_8 + 0.1\]

\[71X_9 + 0.150X_{10}\]
F3 = 0.185X1 + 0.040X2 + 0.066X3 + 0.171X4 + 0.151X5 + 0.666X6 + 0.696X7 + 0.237X8 - 0.21X9 + 0.369X10

F4 = 0.156X1 + 0.095X2 + 0.103X3 + 0.095X4 + 0.180X5 + 0.127X6 + 0.079X7 + 0.702X8 + 0.70X9 + 0.696X10

Therefore, a factor analysis model for hospital preparedness is developed as the following:

\[
F = 0.518F_1 + 0.173F_2 + 0.160F_3 + 0.150F_4
\]

F1: Hospital Service Capacity Factor
F2: Human Resources Factor
F3: Stockpiles and Facilities Factor
F4: MDC Factor

According to the model, the weights of 4 common factors are 0.518, 0.173, 0.160, and 0.150 respectively, which reflects that hospital service is the most important factor for hospital preparedness capacity, followed by human resources, stockpiles and facilities, and MDC (Figure 17).
This analysis of the data derived from this survey of hospitals appears to align with and validate the conceptual model derived from the literature and reinforced by the Delphi study of experts (Chapter 4 Figure 14). The four key factors identified through factor analysis may encompass the describe domains identified in the literature through simple aggregation as follows; Stockpiles and Facilities (stuff, space), Human resources (staff), Hospital Service Capacity (service), MDC (system).

**Comparison of different types of hospitals capacity from 4 common factors**

(1) Comparison between secondary hospitals and tertiary hospitals

The statistical results revealed that the tertiary hospitals had higher mean scores than secondary ones in all four common factors, and that the factor of hospital service and
human resources were statistical significant (p<0.05). (Table 31)

Table 31 Comparison of four common factors between tertiary and secondary hospitals (Mean±SD)

<table>
<thead>
<tr>
<th>Factors</th>
<th>Tertiary hospitals (n=21)</th>
<th>Secondary hospitals (n=25)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Service</td>
<td>2.25±0.67</td>
<td>1.90±1.55</td>
<td>3.172</td>
<td>0.002*</td>
</tr>
<tr>
<td>Human Resources</td>
<td>2.02±0.73</td>
<td>1.26±2.01</td>
<td>0.255</td>
<td>0.037*</td>
</tr>
<tr>
<td>Stockpiles and Facilities</td>
<td>2.08±0.54</td>
<td>1.24±2.89</td>
<td>0.510</td>
<td>0.542</td>
</tr>
<tr>
<td>MDC</td>
<td>2.04±0.77</td>
<td>1.98±0.67</td>
<td>1.132</td>
<td>0.260</td>
</tr>
<tr>
<td>Overall Capacity</td>
<td>0.26±0.49</td>
<td>0.14±0.58</td>
<td>4.108</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

* : P < 0.05

(2) Comparison between general hospitals and non-general hospitals

The mean scores in all factors of preparedness were higher in general hospitals than those in non-general ones. But only MDC was statistically significant. (p<0.05).

(Table 32)

Table 32 Comparison of four common factors between general and non-general hospitals (Mean±SD)

<table>
<thead>
<tr>
<th>Factors</th>
<th>General hospitals (n=38)</th>
<th>Non-general hospitals (n=8)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Service</td>
<td>2.05±1.31</td>
<td>1.75±1.52</td>
<td>1.108</td>
<td>0.508</td>
</tr>
<tr>
<td>Human Resources</td>
<td>2.58±2.61</td>
<td>0.99±2.12</td>
<td>1.701</td>
<td>0.748</td>
</tr>
<tr>
<td>Stockpiles and Facilities</td>
<td>1.99±2.27</td>
<td>0.31±2.21</td>
<td>1.841</td>
<td>0.872</td>
</tr>
<tr>
<td>MDC</td>
<td>2.02±2.23</td>
<td>1.96±0.71</td>
<td>2.012</td>
<td>0.023*</td>
</tr>
<tr>
<td>Overall Capacity</td>
<td>2.26±0.49</td>
<td>1.14±0.58</td>
<td>4.108</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

* : P < 0.05
(3) Comparison between teaching hospitals and non-teaching hospitals

With regard to comparison between teaching hospitals and non-teaching hospitals, the mean scores in all four factors of preparedness were higher in teaching hospitals than those in nonteaching ones, and the difference in mean scores of three factors (hospital service, human resources, MDC) was statistically significant. (Table 33)

Table 33 Comparison of four common factors between teaching and non-teaching hospitals (Mean±SD)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Teaching hospitals (n=19)</th>
<th>Non-teaching hospitals (n=27)</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital Service</td>
<td>2.15±0.70</td>
<td>1.81±0.61</td>
<td>2.798</td>
<td>0.006*</td>
</tr>
<tr>
<td>Human Resources</td>
<td>2.12±0.71</td>
<td>1.84±0.66</td>
<td>2.267</td>
<td>0.025*</td>
</tr>
<tr>
<td>Stockpiles and Facilities</td>
<td>2.23±2.27</td>
<td>1.86±0.81</td>
<td>1.919</td>
<td>0.058</td>
</tr>
<tr>
<td>MDC</td>
<td>2.10±0.60</td>
<td>1.89±0.67</td>
<td>2.007</td>
<td>0.047*</td>
</tr>
<tr>
<td>Overall Capacity</td>
<td>2.26±0.49</td>
<td>1.14±0.58</td>
<td>4.416</td>
<td>0.000*</td>
</tr>
</tbody>
</table>

*: P < 0.05

5.4 Discussion

Emergency preparedness requires planning and other actions that ensure an organization, or community responds to an emergency in a coordinated, timely, and effective manner. Hospitals may not have the ability to respond to a sudden increase in patient care demand during an emergency. As precautions avert perils, hospitals should formulate an emergency plan; identify necessary stores, beds, and equipment; and educate and train their staff in advance to prevent and treat large outbreaks of infectious disease and other mass casualty events.
Emergency plan

An emergency plan is needed before, during, and immediately after the emergency. At the time of this survey, virtually all respondents had an emergency plan. Most hospital plans focused on infectious diseases, natural disasters, foodborne disease and mass unidentified disease, while less attention was paid to preparedness for nosocomial infection and occupational poisoning. A similar trend was found with respect to including biological, nuclear radiation and other terrorist attacks. This might be because China has experienced earthquakes, floods, bird flu, etc., and thus most hospitals have strengthened their preparedness for infectious diseases and natural disasters. However, nosocomial infections and occupation poisoning events are also common in China. For instance, 120 people were infected with hepatitis C virus after intravenous injection in 2013, etc. and terrorist incidents are frequent over the last two years, e.g. Urumqi attack 2014, Kunming attack 2014, Kashgar attacks 2013. Hospitals might have to respond to various kinds of incidents, and will be required to mobilize all public health emergency resources in a short period of time. Therefore, different types of plans are needed in advance, suggesting that all hospitals should raise awareness of emergency plans, and formulate emergency plans based on analysis of possibility of an incident and also the likely scale of damage.

Surveillance

Characteristics of a public health emergency are suddenness and unpredictability, but hospitals need the ability to detect infectious disease and other mass disease outbreaks
as early as possible. Therefore, hospitals’ capacity for detecting early warning signs in a timely and accurate manner is essential.

This study indicated that most hospitals could monitor suspicious public health emergencies via recording of hospital clinic and emergency department attendances, symptom monitoring, and death registration. All hospitals above the secondary level in China were required to set up a fever clinic for monitoring SARS, influenza-like cases, and other infectious disease. Most of the hospitals could regularly train medical staff on how to report and identify suspicious public health emergencies and that the institutions possessed surveillance systems to monitor various aspects of abnormal situations.

However, only a few hospitals could report and identify all eight types of infectious diseases and less than half of the respondents classified and analyzed monitoring information regularly and share the surveillance information with the local health authority. There were statistically significant differences among various classifications of the respondents, which may demonstrate that this capacity was affected by the comprehensive strength of hospital.

Detecting public health emergency related pathogen/etiology can not only confirm clinical diagnosis, but also identify newly emerging infectious diseases. This survey indicated that many of the hospitals did not report adequate laboratory diagnostic capacities. Although hospital laboratory regulations seemed relatively good: the majority of respondents had the ability to identify SARS, influenza and Japanese
encephalitis, and could enlarge the capacity of examining specimens, only one-third of hospital laboratories had programs for dealing with suspicious samples collecting, disposal and delivery, this probably is associated with disease incidence. It is also worth noting that only four hospitals had alternative laboratory backup.

Not all the hospitals had a link to Health Alert Network, which means there were still some hospitals which couldn't share and collect information through the internet, which may cause serious delays in reporting and may potentially impede early warning of disease threats. More standardized epidemiologic forms, and around-the clock ability to request tests and receives laboratory results are required.

**Staff training and drills**

Emergency events happen suddenly and their incidence rate is relatively low, which makes most medical staff inexperienced and unprepared. When an emergency event occurs, hospital medical staff is usually the first responders and information providers, therefore, education and training are key measures to enhance hospital’s public health emergency preparedness capacity. The content of training and drills for public health emergencies should include: understanding aspects of public health incidents, medical emergency response and rescue, emergency plan, early warning, reporting and so on (Xin YT, et al., 2011).

At the time of this survey, the results indicated that most hospitals realized the importance of training and drills for medical staff, and that the majority of respondent hospitals reported that different types of training and drill programs were offered to
their staff. For training, there were majority of hospitals provided training on content of the emergency plan, awareness of public health emergencies, medical treatment, infectious disease prevention and control, and information system management; the median numbers of hospitals addressed disinfection and sterilization, as well as the principles of quarantine and isolation. Most hospitals conducted drills about general emergency events, such as natural disaster, infectious disease, etc.; however, more than half hospitals indicated that they have not organised disaster exercises within the previous 12 months. In addition, not all hospitals evaluated the quality and effectiveness of training and drills. Therefore, hospital officials must be encouraged to expand education and drills, which should be designed to address events including biochemical and nuclear, disinfection and sterilization, and the principles of quarantine and isolation.

**Stockpiles and infrastructure**

Preparedness and related management activities are of little use unless resources are available to support response activities. The goal of resource management is to identify and establish internal and external resources necessary for disaster response and recovery. Identifying resource needs, acquiring resources, and storing and distributing resources are thus key preparedness dimensions. Therefore, hospitals must have programs to ensure appropriate levels of emergency supplies including drugs, medical equipment, electricity, water and oxygen, and disinfectants.

Drug supplies are essential for emergency management and rescue. The survey shows
that a small number of hospitals had drug stockpiles for all categories of infectious disease in the survey. While a large proportion of hospitals had specific drugs for SARS, influenza, a smaller proportion had an adequate stockpile for plague, cholera, anthrax and brucellosis. This may reflect the prioritization of infectious disease prevention and control strategies in Sichuan based on the type of incidents which are more frequent. However, with the increasing trend of globalization, an infectious disease occurring in one region is prone to spreading to other regions, hospitals should prepare for responding to not only the infectious disease of immediate importance, but also those occurring rarely and emerging suddenly.

Medicine storage will fall short of demand with sudden increases in volume associated with mass patients or casualties. Nearly half the hospitals had a plan of medication distribution, and a similar number of respondents set up emergency-drug-supply system with a pharmaceutical factory or company. The diversity of public health emergencies is considerable, it is impossible for hospitals to reserve sufficient and the variety of drugs required, therefore, it is suggested that all hospitals could set up a catalogue of drugs stockpiles based on local incidents and should cooperate with other hospitals and pharmaceutical manufactures to enrich drugs categories and maintain medicine supply.

Protecting the health and safety of medical personnel is a top priority during an emergency or disaster. Personal protective equipment is known to be crucial to respond effectively to a large-scale infectious disease incident. The safe use of personal protective equipment and appropriate allocation of limited personal
protective equipment supplies during periods of insufficient resources are important components of disaster preparedness for hospitals. In the survey, most hospitals allocated the general protective equipment and could provide training of personal protective measures for health care workers and other employees. However, few hospitals stocked equipment for protecting medical personnel from radioactive contamination.

The ability of adding extra beds reflects the hospital’s capacity to accept patients not only during routine operations, but also during an emergency. The study indicated that hospitals had the ability to surge ordinary hospital beds in Sichuan province. The survey results show that different hospitals could provide different numbers of extra beds. Additionally, all responding hospitals could add extra beds in the department of infectious disease and isolation ward, which are the important departments of accepting mass patients. However, some hospitals admitted that their extra beds might not be enough to meet the demands. Meanwhile, about two-thirds had plans for establishment of alternate care areas with beds, and equipment in nonclinical spaces. It is recommended that hospitals should develop adequate surge capacity by such means as opening unused areas, doubling up inpatient rooms, cancelling elective admissions and procedures, and using alternate areas for extra critical care space.

For other facilities, emergency medical installations, back-up oxygen systems, alternated power supply systems and waterworks were investigated in the survey. The study indicated that many hospitals were operating at or near full.
Medical treatment capacity

A sudden, large-scale emergency outbreak requires hospitals to have the ability to meet increased demand for medical care that exceed expectations. In this survey, more than half the respondents showed that their physicians were aware of current public health emergency protocols. The survey results indicated that all hospitals had capacity for taking mass casualty and infectious disease patients. Most hospitals had transfer and treatment procedures for infectious diseases, and could take responsibility for rescue service, transport the medical staff in a timely manner, and provide priority health services to vulnerable populations.

Not all hospitals had plans of admission and treatment for all listed emergency events. For infectious diseases, there were only a small proportion of hospitals have specific medical treatment plans for plague, anthrax and brucellosis. Although nuclear/radiation accidents, bio/chemical terror seldom happen in China, with the increasing trend of globalization, suggesting that it is necessary to formulate the corresponding plans.

Risk communication

In a public health crisis or emergency, effective risk communication can help people cope, make decisions, and return their lives to normal. Risk communication, is an important part of a public health emergency response. Effective communication is necessary to ensure complete, transparent and prompt information exchange, and to help hospitals make timely responses and reduce serious consequences. Therefore,
hospitals need to communicate and cooperate with other local health agencies, functioning as a networked public health provider. The survey revealed that if an emergency occurred, most hospitals reported that they could communicate within the hospital. Yet, only half the respondents share information with media, public and local governments. This lack of cross-institutional interaction indicated that the ability of hospitals to coordinate with other agencies in preparation for, or in the event of an emergency was generally poor, suggesting that communication and coordination between hospitals and community agencies should be strengthened.

Emergency command system

The goal of a command system is to develop, test, and improve decision-making and response capability using an integrated incident command system in the hospital. When an emergency occurs, hospitals need to identify and command different sectors within hospitals, and manage all resources to respond effectively in a short time.

In the survey, most hospitals above secondary level had command systems for public health emergencies. However, this might be insufficient for responding to public health emergencies effectively without specialist guidance, especially when mass unidentified disease outbreaks occur. Besides, only a few hospitals possessed an expert group which played important roles in making decision. Hospitals at the same level could develop expert group together via network system share information, which may avoid repetitiveness of establishing expert group independently.

Fully staffed workforce
A fully staffed workforce means people who can perform optimally under stressful circumstances. This represents a new role for much of the public health workforce, including operations-ready medical staff and volunteers. During an emergency, any planned role for reallocation must rely on the expectation that few staff members will move. In order that a sufficient number of frontline staff will remain, therefore, a fully staffed workforce is necessary to affect the quality and effectiveness of hospital response to emergency events, and that they also may be in a position to intervene earlier to diminish the growth rate of the surge.

The results indicated that most hospitals had an arrangement for maintain sufficient staffing levels throughout an emergency, but only a few hospitals had a mutual aid agreement with other organizations and the registration of volunteers. Existing (and creating new) registers of medical personnel who are willing to volunteer their assistance in the event of a disaster surge, will assist they note the difficulties of mobilization in scenarios in which transport infrastructure is damaged.

5.5 Summary

This chapter presents the quantitative findings of this study into the evaluation of hospital public health emergency preparedness in Sichuan and the current status of preparedness capacity among the surveyed hospitals. Descriptive statistics were used to compare the emergency plan, surveillance, training and drills, stockpiles and infrastructure, medical treatment capacity, risk communication, emergency command system, and fully staffed workforce at different levels of hospitals. The research
questions sought to find the main influencing factors of hospital preparedness capacity, and also sought to identify gaps among different types and levels of hospitals.

Through analysing the evaluation framework, four common influencing factors were identified which mainly affect hospital preparedness capacity, namely hospital service capacity factor, human resources factor, stockpiles and facilities factor, emergency awareness factor. Comparison of hospitals preparedness capacity using these four factors, revealed that tertiary-grade, teaching and general hospitals performed better than secondary-grade, non-teaching and non-general hospitals with statically significant.
CHAPTER 6 GENERAL DISCUSSION

6.1 Introduction

Previous chapters (Chapter 4-5) have discussed the major findings in relation to interpretation, and the public health implications of these studies. This chapter aims to discuss the key findings of the intensive interview and Delphi study (reported in Chapter 4), and the results of survey (Chapter 5) in the context of the literature and to apply those findings to public policy strategies. The findings generally support and build on concepts from the literature and form a comprehensive insight into the design of an evaluation framework for hospital public health emergency preparedness. The chapter also identifies the limitations of this research and makes recommendations for future research directions.

The purpose of this study was to develop a comprehensive evaluation framework of hospital preparedness capacity for public health emergencies, and to validate it by using it to assess the current status of hospital preparedness in Sichuan province. The objectives of this study were:

(1) Define public health emergency preparedness and identify its key elements;

(2) Develop an assessment framework with a set of indicators;

(3) Utilize the framework to test its validity and functionality by applying it to assess rural hospitals in Sichuan province;

(4) Examine rural hospitals preparedness capacity in China, and identify the contributing factors;
6.2 Research Context

Research on hospital public health emergency preparedness is a relatively new area of research in China (Hong Chen, 2011). The studies carried in to date China may be categorised into 2 categories:

(1) Theoretical studies

Much of this discussion explores hospital preparedness and discusses the problems based on the authors own work or research experience. For example, Weilin He, et al. discussed hospitals’ role and function in public health emergency and describe those roles as: rescue and medical treatment, report and release information promptly and accurately; Crisis communication and cooperation with other facilities such as government agencies, CDC, and other medical institutions. (WeiLin He, et al. 2004).

Xiaomei Jiang, et al. considered that hospitals are more vulnerable than other kinds of facilities in PHE, mainly due to their complex combinations of utilities, surgical and diagnostic equipment, and hazardous materials, along with ever-changing visitors and patients in various conditions of physical and mental health, and therefore, hospitals are the important institutions to prevent, control, and deal with PHE. (Xiaomei Jiang, et al. 2005)

This discussion in the literature proposes suggestions for hospital emergency response planning, emergency systems and stockpiles. For example Kuiwen Hu, et al. proposed that staff awareness of PHE should be intensified and an emergency report system should be established and developed (Kuiwen Hu, et al. 2004). XL, Xu reported that
the key elements for structuring hospital PHE preparedness system including command system of effectiveness and preciseness, reasonable staff structure, advanced equipment and sufficient drug stockpiles (XL XU, et al. 2006). Xianrong Luo and Youhong Ma, et al. reported that an emergency plan, education and drills, emergency management system, emergency stockpiles are critical factors affecting hospital preparedness capacity (Xianrong Luo, 2006; Youhong Ma, et al. 2008)

(2) Empirical studies

Studies into the assessment of hospital PHE preparedness capacity in China mainly began between 2006 and 2007 (Yantao Xin, et al. 2011), Hui Zhang (Hui Zhang, 2007), Dexiang Zhu (Dexiang Zhu, 2006) developed evaluation instruments with indicators, and assessed hospital emergency preparedness in Beijing and Guangdong province respectively.

Feng Xu, et al. sought to assess the requirements of local community hospital preparedness and capacity development. They developed a two-level indicator system including 6 first level indicators, 19 second level indicators (Feng Xu, et al. 2010).

Qi Zhao sought to assess county-level hospital preparedness for PHE, they identified emergency plans, warning and monitoring, laboratory diagnosis, information release and communication, coordination system, training and drills, on-site rescue, as the important factors affecting county-level hospital preparedness capacity building (Qi Zhao 2009).

Xiaozhi Yang (Xiaozhi Yang, et al., 2008), Decheng Liu (Decheng Liu, et al., 2010)
sought to develop an evaluation framework and indicator system for military and special hospitals. They used a scaling method, “Health care institutions preparedness assessment questionnaire” (designed by China Concord Medical Science University), to investigate secondary-level hospitals in Guangxi. This questionnaire addressed human resources management, beds, emergency stockpiles, emergency plan, and so on (Xiaozhi Yang, et al. 2008; Decheng Liu 2010).

Zhonghua Wang undertook a study to investigate the current status of mental health hospital preparedness capacity (Zhonghua Wang 2010).

Xiao Wang analyzed and identified the key influencing factors for military hospital preparedness, including emergency plan, command system, cooperation with local government, and training (Xiao Wang 2007).

These descriptive, theoretical and empirical reports suggest progress in the understanding of hospital preparedness. However, there remained deficiencies in that conceptual understanding and in the methods available for use in measuring preparedness. Most instruments were designed by the researchers themselves and their reliability and validity was not tested. Similarly the evaluation indicators are not sufficiently comprehensive and there is a lack of consensus on the key elements of hospital public health emergency preparedness.

The evaluation of public health emergency preparedness is complicated by problems of definition. There is no definition of adequacy of preparedness and no agreed measure of adequacy (Nelson C, et al. 2007). Knudson reported that the terms
“disaster management,” “disaster plans,” “emergency management,” “crisis management and emergency planning” were often used interchangeably with the term “emergency preparedness” (Knudson D, 2005). Kuntz found similar disparities in the usage of these terms in her study of the preparedness of rural health departments in Montana (Kuntz S, et al., 2004).

The challenges facing researchers, policy makers and health leaders are ambiguous and uncertain preparedness goals, a lack of agreement about what the measures should aim at and how they should be interpreted (Nelson C, et al. 2007; Lurie N, Wasserman J, 2006). While efforts have been made to assess progress made by public health preparedness programs in general, there is lack of evidence-based performance measures of population-based “preparedness”. There is further little consensus on the definition of the word itself as it relates to public health (Lurie N, Wasserman J, 2006).

Adini, et al, emphasized that maintaining emergency preparedness of medical organizations is not a static effort, but a dynamic framework (Adini, et al. 2009).

Throughout the world, comprehensive efforts to develop key indicators, which enable the reliable and valid assessment of the status of emergency preparedness, are underway (Adini, 2005). However, in the absence of clear definitions and adequate performance metrics, it is difficult to assess the effectiveness of past investments, engage in continuous quality improvement of current efforts or design and target future efforts (Nelson, 2007; Stephen S. 2007; P. Joseph, et al. 2012).
6.3 A Theoretical Framework for Defining the Concept of PHEP

This thesis firstly sought to identify how the public health emergency preparedness should be defined. It sought to clarify the concept of public health emergency preparedness by developing a conceptual framework and identifying its key dimensions in order to describe what hospitals do to prepare for, respond to, and recover from public health emergencies.

Emergencies happen suddenly and often unpredictably, it is difficult to reveal effective performance of hospital preparedness in emergencies. In addition, the preparedness required for dealing with emergencies is different from the normal or static situation. To identify an outcome measure for responding to incidents, it is paramount to identify and define metrics for the various components of that preparedness.

The concept of hospital public health emergency preparedness was defined as a consequence of Study 1 as: “the planning and actions that enable hospital to prevent, protect against, quickly respond to, and recover from public health emergencies in a timely, coordinated and effective way. It involves a coordinated and continuous process of planning and implementation that relies on measuring performance.”

The themes identified in this interpretive review were intricately linked and likely to have a combined effect on hospital preparedness capacity. The translated themes and subthemes allude to the complex, dynamic linkages in the hospital preparedness activities. This thesis considered there is a multi-component approach proposed in the
existing literature, which could take into account the interactions and dependencies necessarily entailed by an effective health systems’ response to a disaster: “It is not simply beds or ventilators, but appropriately trained personnel (staff), comprehensive supplies and equipment (stuff), facilities (structure), and infrastructure (space), of imperative importance, integrated policies and procedures (systems) to develop optimized sustainable health care capacity” (Samantha K. Watson, et al. 2013). Based on this approach, the translated themes could be distilled into a whole, more complete interpretation.

Therefore, compared with other evaluation tools, the framework proposed in this research combines features of two existing approaches, the multi-component approach for sustainable health organizations, and the model of life cycle of public health emergencies (pre-, during, post-incident). The key components of model include: “staff”, “stuff”, “service”, “space”, and “service”.

It proposes various health activities which form a comprehensive preparedness and response system. It provides a concise, broadly applicable vision of what a prepared hospital looks like and describes public health emergency preparedness activities. For instance, the breadth of hospital’s “system” (preparedness, planning, coordination, after-action adaptation, and development of incident action plans) can be illustrated by the framework. Prior to an incident, the hospital is required to focus on setting up a comprehensive plan that encompasses all potential threats so as to organize their response to emergencies. During an incident response, the incident command system may clarify which operations might be best addressed with public health agency
resources and expand emergency planning. After an incident, evaluation of the operational responses may identify gaps in operational capabilities and areas to be improved. An action plan will be improved, or adapted, which may help optimally apply or allocate resources.

Additionally, there are interactions among all of the subcomponents of the interwoven domains to be considered. Critical points of failure exist when subcomponents are not synchronized. For example, supply of equipment must include the requisite and appropriately trained personnel to run the equipment. Without plans to use alternate facilities, the stuff and the staff may find themselves with inadequate resources to provide patient care. As volunteers arrive on the scene there may be no process to credential, (just-in-time) train, and optimize their skill set to support the event.

In summary, based on the identified primary themes and sub-themes, we developed a model to depict our understanding of public health emergency preparedness (Figure 14). The model draws heavily from concepts developed in the emergency management field. The proposed model ties together the core emergency preparedness competencies developed for hospitals. To the best of our knowledge, the model addresses these critical components involved in assessing hospital preparedness capacity to respond to all-hazards events.

6.4 An Evaluation Framework for Measuring Hospital PHEP

An evaluation framework was developed and validated through two-round Delphi study to address the research question2:“how hospital public health emergency
preparation could be assessed?”

As with attempts to identify lists of the key elements of preparedness, the development of common preparedness standards will have to rely in large part on expert judgment and consultation with thought leaders from health departments and organizations (Nelson, 2006). However, the existing reports often provide little detail on the criteria or decision making processes used to identify the preparedness constructs and measures featured in the reports. Therefore, more efforts are required to employ a more systematic approach to elucidate the expert views.

The Delphi study conducted as part of this research sought to identify those key elements for hospital preparedness. Upon completion of the Delphi study, 8 themes and 24 sub-themes for a final version of assessment framework were identified on consensus. As the Delphi results have already been discussed in Chapter 5 (Qualitative study), this section mainly addresses the rationality and utility of the framework.

6.4.1 Rationale

Intensive review of the literature shows that the limitation of many of tools reviewed is that they do not specify the elements that must be assessed. There have been attempts to address this issue and researchers have specifically addressed activities required of the preparation of an emergency plan (Burkle FM, 2003), staff (Klein RN, et al. 2005), equipment and infrastructure preparation (Rotz LD, et al. 2000), training and exercises (Hogan DE, et al. 1999).

In this research, the Delphi study identified that the framework should include: (1)
emergency plan; (2) surveillance; (3) training and drills; (4) stockpiles; (5) emergency command system; (6) fully staffed workforce; (7) onsite rescue and medical treatment; (8) crisis communication and cooperation. All of these elements concluded can contribute to a higher level of emergency preparedness (Adini, 2009). Therefore, the proposed framework can serve as an effective mechanism for a hospital to evaluate its readiness and preparedness. It also meets the main rationale of the assessment of emergency preparedness: to promote effectiveness and raise professionalism.

Measurement and analysis of an indicator system is difficult (Hong Chen, 2011). Generally, assessments are evaluated and selected on the basis of (a) validity, the extent to which they really measure the attributes they seek to measure; (b) reliability, the extent to which they provide consistent measures over time and across raters.

Golden-Biddle and Locke (2007) described validity in terms of three factors: authenticity, plausibility and criticality: “Authenticity convinces readers that the researcher was indeed part of the culture by using features such as vignettes and in vivo codes. Plausibility allows readers to accept the findings by having them “make sense” to them. Finally, criticality further convinces readers by causing them to re-examine their own assumptions that they had its nature, provides significant opportunity to validate the researcher’s understanding of observations and implications.”

“Triangulation using different data sources” is outlined as a strategy for validating data and constructs (Creswell, 2005). Triangulation is the use of two or more research
methods to investigate the same thing (Fellow & Liu, 2008). As Esterberg (2002) stated, “if you have access to interview data, observational data, and historical documents, your analysis is likely to be much sounder than if you rely on only one source of evidence”. The analysis of various data is likely to be much sounder than relying on only one source of evidence (Esterberg, 2002).

Triangulation was achieved in this study through combination of intensive interviews and Delphi study. In this research, an initial draft of an evaluation framework for hospital preparedness capacity was proposed based on the literature review and intensive interview results. This draft framework, along with key components, was further discussed, revised and finalized through a two-round modified Delphi method.

Validity of assessment is the degree to which it measures what it is supposed to measure. There are many different types of validity: (1) face validity is an estimate of whether a test appears to measure a certain criterion; (2) Content validity is a non-statistical type of validity that involves “the systematic examination of the test content to determine whether it covers a representative sample of the behaviour domain to be measured”. (3) Construct validity refers to the extent to which operationalizations of a construct do actually measure what the theory says they do. (4) Empirical validity is assessed by evaluating the extent to which a measure relates to other measures consistent with theoretically derived hypotheses concerning the concepts being measured (Carmines and Zeller, 1979).

In this research, the relatively high qualification of panellists and the degree of
consensus after two consecutive rounds Delphi contributes to the level of face and content validity. Spearman’s rho was calculated and showed that there was a strong correlation between two independent variables, indicating the evaluation framework has good construct validity.

In the assessment of the framework’s empirical validity, the results indicated that there were statistically significant differences in overall preparedness capacity. These were higher in the tertiary hospitals than secondary level ones, which reflect the practical capacity of hospitals. This diversity also indicates that the evaluation framework is practical as means of assessing hospitals preparedness capacity.

It is important to determine a questionnaire’s reliability in order to ensure the robustness of this research. Cronbach’s α and test-retest reliability were calculated for assessing internal and external reliability respectively. Cronbach’s alpha is considered as the most common measure of internal consistency in a questionnaire (Sasaki, 1996). Test-retest reliability is one of the simplest ways of testing the stability and reliability of an instrument over time. It is measured by administering a test twice at two different points in time. This type of reliability assumes that there will be no change in the quality or construct being measured. In most cases, reliability will be higher when little time has passed between tests. In this research, Cronbach’s α and test-retest coefficient reached the good level, concluded that the evaluation framework with indicator system has good consistency.

In summary, an evaluation framework will only be valuable if it is tested (P. Joseph
Gibson, et al. 2012). This study used the modified Delphi method to identify key elements of public health emergency preparedness, and to further develop a measurement tool for hospital evaluation. In the light of the results of the literature review and Delphi study, an evaluation framework with eight key components was developed. We then sought to validate it by testing its rationality via statistical methods. These results indicated that the framework produced by the Delphi method was appropriate and valid for the research.

6.4.2 Utility

The framework describes hospital public health emergency preparedness activities comprehensively within the disaster life cycle, and defines the work of hospital’s response to ordinary and extraordinary public health emergencies. Therefore, it is proposed that the framework could be applied to support the following hospital’s critical activities.

*Pre-planning, coordination, quality improvement*

Because it is comprehensive and process oriented, the framework can form the basis of a hospital’s development and response planning. The framework’s structure supports emergency planning, cooperation, communication with other health and non-health organizations before and during incident, and after-action thus optimizing recovery strategies, resource coordination and adaption of incident action plans. For instance, during a multiagency incident response, the framework may clarify which operations might be best addressed with public health agency resources.
Health services improvement

The framework can help identify and bridge gaps in medical treatment plans. It can present hospital service capacity (such as epidemiology and laboratory function, health care) as a measure that enables the proportion of surge cases that the available resources can accommodate to be quantified. Therefore, potential shortfalls of the existing capacity could be estimated.

Training and drills

The evaluation framework is also useful for explaining public health emergency preparedness to new public health staff and to external partners. The prevention and protection, response, and recover process groups provide a sensible framework for staff that may be not familiar with public health operations. The framework illustrates the breadth of preparedness activities and supporting materials, and can then provide additional detail for processes of interest.

Resource prioritization

By providing a detailed view of public health emergency preparedness, the framework may help identify shortcomings or, conversely, opportunities for investments that will support further development. This is especially useful when explaining how new resources may be optimally managed. For example, a grant application could explain how enhancements will improve related processes and strengthen the hospital’s overall preparedness may be more successful than applications lacking a systems oriented justification.
Evaluating how specific scenarios flow through the framework may identify gaps and areas for improvement. The framework’s robustness might best be tested by using it to describe incidents that vary with respect to threat (biological, chemical), occurrence (natural, or intentional), and scope (local, national). PHEP framework are required that must allow for the evaluation of public health threats and interventions (P. Joseph Gibson, et al. 2012). Although specific processes may change over time, however, we believe that the framework structure will remain robust.

### 6.5 Factors Contributing to Hospital PHEP

Maintaining the emergency preparedness of hospital is a comprehensive activity. (Adini, et al. 2006). Therefore, assessment of the overall hospital preparedness capacity should include a large number of various factors.

Factor analysis is usually used to summarize the information contained in a large number of variables into a smaller number of factors. In this research, the purpose of factor analysis is to reduce a list of variables under investigation to focus on a smaller set of core elements. Through establishing a regression model, there were four common factors were identified to represent the overall hospital preparedness capacity.

**Factor 1: hospital service capacity factor**

Hospitals play an important role in disaster response, including incident identification, early detection, identification, and intervention at the local level. They also contribute to ongoing surveillance and reporting during public health emergency outbreaks as
well as triage and treatment of victims during and after incident. Furthermore, early identification is inseparably related to medical treatment for managing bioterrorist events or infectious disease outbreaks. For instance, the ability to test and receive laboratory results around-the-clock and early diagnosis can support appropriate medical treatment plans for patients in a timely manner.

In the factor analysis model, early detection, laboratory diagnosis and medical treatment were identified as the Hospital Service Capacity factor with the largest weight: 0.518, reflecting it is the most impactful factor contributing to the hospital preparedness capacity. The result indicates that opportunities for improving the hospital capacity to respond to public health emergencies should focus firstly on the need for reinforcing surveillance systems and medical treatment capability.

**Factor 2: Human resources factor**

There is a wide degree of consensus regarding the central importance of maintenance of sufficient staffing levels throughout an emergency event. Skilled, well-trained personnel constitute a critical resource for effective response. Although a regional response that calls upon private and public resources is required for a public health emergency, hospitals still face the challenge of inadequate staffing levels (Matthew D. 2010). In the statistical model, used in this research, there were two variables comprised factor 2 which had high weights, namely fully staffed workforce and staff training. Thus a robust workforce is the second most important factor for hospital preparedness capacity. To develop a robust workforce in support of public health
emergency preparedness, not only requires the conditions that support the recruitment and retention of adequate staff, but also ensure efficient training and drills program to meet the demand.

Factor 3: Stockpiles and Facilities Factor

Stockpiles typically include a very wide range of items, including beds, ventilators, and other medical apparatus, pharmaceuticals, and a range of other essential resources. Facilities (infrastructure) denote medical spaces, treatment areas, laboratory, air filtration, built-in radiation protection, and blast-protected walls, etc. These two variables with large positive weight (0.160) were categorized as Stockpiles and Facilities and represents hospital supportive resources. Identifying resource needs, acquiring resources, and storing and distributing resources are key dimensions for preparedness. The factor also includes efforts designed at mobilizing resources to continue with operations if key resources are destroyed. For example hospitals must prepare for the possibility that an alternate facility will be required.

Factor 4: Management, direction, and coordination factor (MDC)

In the factor analysis model, the variables of emergency plan, risk communication and emergency command system also has large positive loadings, which reflects hospital’s organization and responsibilities as a significant contributor to public health emergency preparedness. This was defined as the MDC Factor. This factor included the development of a communications plan, different types of emergency plans for all potential threats, the establishment of command system, protocols and procedures,
responding to security issues and crowd control, regular testing and support, and addressing the interoperability of multiple responding departments and personnel. This factor of preparedness makes it possible for hospitals to manage both preparatory activities and response processes effectively.

### 6.6 The Current Status of Hospital PHEP in Sichuan Province

This section discusses the preparedness capacity of hospitals in rural areas of Sichuan in relation to the available literature in order to answer the research question three: “how does the level of hospital preparedness capacity in rural areas of China?”

Sichuan is a high risk province which frequently occurred public health emergencies, and the types of emergency events are mainly earthquakes, infectious diseases. Therefore, based upon the research results and local government reports, although hospital medical staff was provided training, the content of training should be strengthened. According to the characteristic of Sichuan, the content of training should focus on onsite rescue, medical staff and volunteer management, safety protection. Drills should be conducted and cooperated with other organizations (e.g. fire department, CDC), which may improve cooperation and coordination among different organizations for effective response.

Additionally, shortage of medicine stockpiles was reported by the surveyed hospitals as a common issue when emergencies happened. Since Sichuan has a large mobile population, weather is hot and humidity, some respiratory infectious diseases and food poisoning will be likely to happen. Then, it is possible for medicine storage to
not only be sufficient for general emergency events, but also those occurring rarely.

In the survey, only few numbers hospitals had an expert group. In order to cope with emergencies effectively, it is possible for hospitals to develop an expert group which would provide technical support.

According to the “hospital classification system” of the Ministry of Health of People’s Republic of China, all hospitals in China are classified into three levels: primary, secondary, and tertiary hospitals based on their capabilities in providing medical care, education, and conducting medical research. Hospitals are also classified according to the types of services they provide: general hospitals and non-general hospitals. “General hospital” means a hospital that provides general acute care services, including emergency services. “Non-general hospital” means a subclass of hospital that is primarily or exclusively engaged in the care and treatment of one of the following categories: (1) patients with a cardiac condition; (2) patients with an orthopaedic condition; (3) patients receiving a surgical procedure; and (4) any other specialized category of services that the secretary of health and human services designate as a specialty hospital. Hospitals can be further classified by determining whether they are a community hospital or a teaching hospital. Community hospitals are local, general hospitals. Teaching or academic hospitals are hospitals that are associated with a medical school or nursing school.

Through comparing different types of hospitals’ preparedness capacity on the four common factors identified in this research, the results indicate that tertiary hospitals
performed better than secondary level hospitals in the factor hospital service, human resources, and stockpiles and facilities. However, it also identified that tertiary hospitals may be not always better than the secondary hospitals in all aspects. The results showed that general hospitals achieved a higher score than non-general hospitals in hospital service, human resources, stockpiles and facilities. It also revealed that different types of non-general hospitals may be more prepared in identifying lines of authority and responsibility. In comparing teaching and non-teaching hospitals, the mean score of teaching hospitals is higher in the aspects of hospital service and human resources.

Moreover different type of hospital setups may affect the adaptation of hospital PHEP system. For example, emergency fund is one of key elements for hospital preparedness system. Capacity of stockpiles, e.g. equipments, medicine, etc. depend on emergency fund. According to the research results, all public hospitals could obtain financial support from state and local government. While, for private hospitals, emergency funding management system may be different from public hospitals. How to raise sufficient fund would be a challenge for private hospitals. Hospitals setup may affect other aspects of building a sustainable preparedness system as well, such as communication and coordination system with other hospitals. A preparedness network at provincial or national level should be established in future.

In summary, different types of hospitals are performed differently in this study because of their functions and missions. This may be larger hospitals received greater assistance. It is impossible to require all hospitals have the same capacity. To maintain
high level of preparedness for all hospitals, a minimum preparedness requirement, for instance, planning and policies, staff and infrastructure, skilled staff, training and drills (Adini, 2009), should for basis to be applied to all types of hospitals for effective response to public health emergencies.

The results of the study indicate that the majority of hospitals in the rural area are moderately well prepared for a public health emergency event:

(1) Establishment of emergency command, communication and coordination system, while types of emergency plans are limited.

A few previous studies have investigated specific aspects of hospital emergency communication and coordination systems. In 2005, in four regions including Beijing, Shandong, Guangxi, and Hainan, 76.1% of hospitals above the secondary level were prepared to set up the emergency command centre/office, and 90.3% of hospitals had an emergency plan for infectious disease, while only 18.7% had plans for bio/chemical terror. With regard to communication, nearly 60% of respondents reported a lack of communication and coordination between hospital departments, and limited timely forecasting, public communication and effective regulation of public health emergency (XingmingLi, et al. 2008).

Research in Guangzhou revealed that all hospitals above the secondary level had established emergency command centre/office and about 92.6% of hospitals had at least one emergency plan. However the contents of emergency plans were mainly focused on infectious disease outbreaks and natural disaster with less focus on
bio/chemical terror. For the capacity of communication and coordination, there were 85.2% of hospitals which could communicate and coordinate across institutions (Xinhua Liu, 2011)

This research examined rural hospitals in Sichuan province in 2013. The results indicated that all targeted hospitals developed an emergency plan, but the numbers for biological, chemical, radiological, nuclear and explosive threats were still relatively low. Most hospitals had command systems and formed preparedness networks for public health emergencies, and they could communicate within hospitals.

Thus hospitals in different regions of China have made efforts to enhance planning and preparedness and to coordinate capability. Additionally, there is a greater perception of risk from emergencies due to natural hazards and infectious diseases than from human made disasters, which limits the content and scope of emergency plans. With a greater emphasis on all-hazards preparedness and less emphasis on specific threats, emergency plans which address specific hazards may be a moot issue for rural hospitals in China.

(2) Surveillance systems was developed to support epidemiology and laboratory functions, however the laboratory diagnostic capacities and analysis of monitoring information remain inadequate.

In the study, it is concluded that hospitals’ preparedness capacity in epidemiology was better that those reported in Beijing, Shandong, Guangxi, and Hainan (2005) and Guangdong (2009). This may reflect the fact that in 2005, there were only 55.5% of
hospitals that had syndromic surveillance systems for certain diseases. Around 70.0% of respondents monitored fever and atypical pneumonia cases and only 38.7% of hospitals could classify and analyse monitored information regularly. An estimated 47.4% of hospitals shared their surveillance information with the local health authority and other institutions.

In 2009, research showed that most hospitals (80%) in Guangdong had developed public health emergency detection and identification systems, about 85% could identify fever patients and atypical pneumonia cases and about 63.1% could summarise information; a level higher than that found in 2005.

Since 2009, all hospitals above secondary level in China are required to monitor fever and influenza-like cases (Dexiang Zhu, 2009). This survey indicated that in Sichuan most could report surveillance information to health administration. However, the period required for analysing and reporting the information is still an issue for the effectiveness of surveillance.

This research also found that the laboratory function was insufficient. Recent articles (Hong Chen, 2011; Xingming Li, 2009; Qi Zhao, 2009) suggested that hospitals should establish laboratory pathogenic surveillance networks nationwide, which will develop, maintain and strengthen an integrated domestic and national network of laboratories to respond quickly to public health emergencies.

(3) Fully staffed workforce was maintained, the content of training and drills should be diversified.
Fully staffed workforce includes operations-ready workers and volunteers who have the skills and capabilities to perform optimally in a public health emergency. There is a wide degree of consensus regarding the central importance of maintaining sufficient staffing levels throughout a surge scenario's duration (James W, Samantha K, et al. 2013), and the majority of studies have concentrated on the need to mobilized hospital staff in China. Xinghua Liu (2009) and Qi Zhao (2009) reported respectively that most health institutions in Guangdong, Jiangxi, Jiangsu, Fujian, Yunnan, Gansu, and Ningxia provinces had emergency response teams; mainly for infectious disease responses. Besides, most hospitals had developed a response plan to maintain sufficient human resources during an emergency, e.g. recall off-duty employees (Xinghua Liu, 2009; Qi Zhao.). While, some studies are beginning to consider education and training as key measures to enhance staff’s ability of public health response, it has been proposed that a series of activities of training, drills, and exercises should be designed to ensure emergency operations will be carried out effectively when disaster strikes (Adini, 2009; Jeannette Sutton, 2006; Hui Zhang, 2005). The issue with respect to training and drills is usually that the content of training varies but broadly includes: (1) understanding aspects of public health emergencies; (2) reporting early warning, communication, medical treatment; (3) legislation concerning medical emergency response; (4) information management (Yantao T Xin, Keyi Y Xu, 2011).

This research indicates that most hospitals had a preparedness capacity in regard to maintaining sufficient staff in the event of a disaster and in developing emergency
response team and command systems which could mobilize additional human resources. In addition, all hospitals provided various training and drills for hospital staff, and the content addressed awareness of public health emergencies, on-site rescue and medical treatment, principles of quarantine and isolation, infectious disease prevention and control, etc. However, the effectiveness of these training and drill programs needs to be periodically evaluated, and the content of these programs could be more diversified to give scenarios of varying severity and risk.

(4) Stockpiles and infrastructures were insufficient to meet the demands

Hui Zhang reported that most hospitals were short of equipment, such as beds and had insufficient for a substantial numbers of patients who may present to hospitals within a relatively short period of time (Hui Zhang, 2005). Hong Chen (2012), Fan Liping, Zhao qinghua, et al. (2012) showed that although all hospitals had a stockpile of drugs, personal protective equipment, beds, ambulances, etc., the quantity and variety couldn't meet a sudden increase in demand.

This research reported that all hospitals possessed emergency resources reserves, personal protective equipment, and had the capacity to create “alternate sites”, for instance through the use of non-clinical areas (waiting areas, corridors) as treatment spaces in the event of a surge. However they still faced many problems. For example, not all of them had corresponding drug distribution programs to provide priority to vulnerable people. Besides, not all hospitals could prepare for back-up facilities when key resources are destroyed. This may be affected by economic level and the
classification of the hospital. The need for hospitals and health systems to develop and maintain an emergency stockpile is widely acknowledged but may be severely undermined by economic pressure (Avery et al. 2008). Therefore, to strengthen hospital’s ability to provide public health emergency, the local government should take measures to tighten policy guidance and to increase input into rural hospitals’ emergency preparedness capacity construction.

6.7 Using the Framework for Driving Improvement in PHEP

Although there are efforts to improve the preparedness of hospitals in China, there are still tremendous gaps between these efforts and the preparedness status of rural hospitals, as evidenced by the findings in this research. Thus, several recommendations are offered.

First, there must be a standardized method to consistently measure preparedness across all hospitals. The framework represented a valid and well considered measurement tool and should be considered as a consistent standard.

Second, professional organizations should utilize the findings from this research to create a broader forum for discussion about the critical issues of disaster preparedness facing rural acute care hospitals in China. There also must be more sharing of best practices.

Third, hospital officials must explore feasible alternatives for surge capacity in the event of a disaster. Community and public health forums should be conducted to involve all entities, not just hospitals.
Fourth, healthcare officials must be encouraged to access available government funding for preparedness in areas of vulnerability, such as surge capacity and staffing. Grants and other funding streams also should be pursued.

Fifth, rural hospitals managers should build and maintain local and state partnerships in an effort to access crucial resources in the event of a disaster, particularly as related to surge capacity and staffing.

Finally, hospital officials must be encouraged to expand education and drills. Education and drills are needed, particularly in the area of surge capacity.

This study served to quantify the levels of preparedness for rural hospitals in China. Further research is necessary to build on these finding. The frameworks should be further validated across various provinces and in other jurisdictions outside of China. It should also be tested against more long term objective measures of hospital performance in disasters.

6.8 Summary

This chapter presented a discussion on major qualitative and quantitative findings, with particular reference to the findings in Chapters 4 and 5.

To start with, this chapter discussed the concept of hospital PHEP. This included a synthesis of the themes of PHEP based on the peer-reviewed publications, and the development of a proposed conceptual framework, which helps to understand the profound relationship among activities of PHEP.
Moreover, the Delphi method penetrated into identifying the key indicators for developing an evaluation framework, and validated the framework’s rationality and usage. Through a two-round Delphi, an agreed framework was finalized, along with 8 first level indicators and 24 second indicators. The framework concisely yet comprehensively captures the emergency preparedness activities of hospitals. It describes the processes within 3 time periods which can help hospital’s workers recognize how their daily work fits within emergency preparedness. It can reflect the flexibility and complexity of PHEP, and its level of specificity is also useful in planning, training, system development, etc. activities.

Eight elements of preparedness were examined across respondent rural hospitals. The results showed that there was a substantial improvement compared with previous studies, however, there remained gaps in rural hospital preparedness for public health emergencies.

Hospitals at all levels should enhance their management of disasters including updating and revising of emergency plans, strengthening communication and cooperation with other local agencies, enhancing the capacity of abnormality monitoring and laboratory diagnostic capability for infectious diseases; improving the treatment program for various PHE scenarios and strengthening psychological intervention and risk communication capabilities.

Finally, healthcare authorities should institute a formal preparedness assessment tool incorporating the questions describe in the present study that would allow them to
identify deficiencies.
CHAPTER 7 CONCLUSION

7.1 Introduction

This research sought to develop a framework to help validate hospital preparedness for public health emergencies. The proposed framework was based on concepts reported in the published literature but consolidated through a Delphi study of stakeholder perceptions and validated by using the framework to measure the resilience of hospitals in rural areas of Sichuan Province in China.

The research background, questions and objectives were introduced in Chapter 1. Chapter 2 presented an extensive literature review to lay a solid theoretical foundation. The aims, objective and research methodologies targeted at the research questions were detailed in Chapter 3. Chapter 4 reported the outcome of the Delphi study of key expert opinions. Chapter 5 reported the outcomes of the use of the proposed resilience framework to measure the level of preparedness. Chapter 6 discussed all the implications of the findings for theory and practice.

This final chapter of the thesis seeks to apply the findings of this research towards health service development via a set of recommendations aimed at improving the quality of hospital PHEP. Further, this Chapter addresses the research limitations and identifies the directions for future research.

7.2 Contribution

The evaluation framework proposed in this study provides hospitals with a practical
tool that facilitates the understanding of PHEP activities and supports decision-making for hospital PHEP investment. The ultimate aim is building the sustainability of hospital in disasters. Because a deep analysis of hospital PHEP activities is useful information for the decision-making process, it is believed that the evaluation framework developed by this research can help guide hospital policy makers in moving towards sustainability. Through the evaluation conducted here, this research has identified consensus on what health services need to do during a public health emergency and how those services may be better prepared to do those things.

Additionally, this research provides a comprehensive understanding and description of hospital PHEP, and confirms the key dimensions of PHEP which could be used to develop new research surveys or improve the current tools. The framework proposed in this research has been organized around key dimensions of preparedness activities. Based on the results, it suggests that the development of broadly applicable PHEP metrics is quite feasible. These discussions are intended to serve as a foundation for the development of comprehensive assessment strategies for hospitals.

The studies of hospital PHEP are relatively rare in China, especially in rural areas. This study examined the current status of hospital PHEP in rural Sichuan province by using the proposed framework, and examining the contributing factors. They may help in constructing plans and strategies to enhance hospital PHEP capacity in the future.
7.3 Limitations

Our study has a number of limitations:

Firstly, the experts were self-selected and not necessarily representative. However their knowledge and skills in this field which was the reason behind their selection means that they are best placed to contribute to a deep understanding of the factors influencing preparedness.

Secondly, the sample size of 46 hospitals are relatively limited. The small sample size precludes a statistical analysis of before and after data, and may not fully represent the PHEP of all hospitals, thus limiting the generalizability of the results. However, the data points enumerated in the questionnaire and the format of the questionnaire will provide a good foundation for future research, and also will help hospitals examine their current level of preparedness. Because there were some hospitals which didn’t respond or complete the survey, and some hospitals had to be excluded for ineligibility for hospital classification, then to some extent, the survey may not represent the broad range of hospitals.

Thirdly, selection bias also may have occurred. For example, those respondents who did not complete the questionnaire may have been less interested and less prepared than hospitals willing to take time to discuss preparedness issues.

Fourthly, there may be respondent reporting bias as a self-report method was used, in which the Emergency Department Director may have presented a favourable image of his or her facility. The results are limited by the respondents’ knowledge about
specific topic areas. There also may be a tendency to over exaggerate the true PHEP capacity, therefore, the hospitals may have been even less prepared than reported here.

Fifthly, the study was conducted over almost 12 months, during which time there may be some changes on PHEP of the surveyed hospitals. Many of participating hospitals were in the process of receiving government financial support to purchase decontamination trailers, supplies, and personal protective equipment during the period of study. Therefore, it is possible that our results would differ accordingly if the study were performed again.

Finally, only quantitative data were collected to measure PHEP capacity of hospitals. Most questions are designed with a “yes” “no” or “unknown” answer which may restrict the collected data to these three categories. Thus the degree of compliance is not measured in this format.

7.4 Future Research Directions

This study served to quantify the levels of preparedness for rural hospitals in China. Further research is necessary to build on the findings of this study.

- The framework should be further validated across various provinces and in other jurisdictions outside of China.
- It should also be tested against more long term objective measures of hospital performance in public health emergencies.
- Finally, the aim of research is to guide preparedness and response, thus focus
should also be placed on the development of practical guidelines and tools that may facilitate improvement.

In future, hospital PHEP research in China should make efforts to (1) establish a universally accepted standard of prepared PHEP which is accepted by policy makers and stakeholders, particularly those charges with evaluating the capacity of the public health and safety systems (Zhao Qi, 2009; Fan Liping, 2012); (2) endorse a theoretical structure for further studies, (3) integrate research of different disciplines into a more in-depth understanding of the concepts. Therefore, researchers should give more attention to basic concepts, principles and methods, their application to public health incidents and disasters, and the key function systems required to develop emergency resilience of hospitals.

7.5 Conclusion

To date, a major obstacle to the development of hospital PHEP capacity is the absence of consensus regarding the clarity of understanding and definition of key terms. Work is needed to generate robust conceptual and analytical frameworks, along with innovations in data collection and methodological approaches.

The purpose of this doctoral study was to develop an agreed evaluation framework for hospital PHEP, and to test its validity and utility by using it to assess the current status of hospital PHEP in rural areas of Sichuan province. This framework’s integration into the model of the disaster life cycle and incorporation of multiple approaches for sustainable health organizations may facilitate robust response to public health
emergencies.

There are five basic domains (Structure, Staff, Stuff, Space, and Service) which were proposed for constructing the sustainable PHEP framework. This framework identifies response processes required to address an incident that threatens to overwhelm the routine capabilities of a hospital.

The qualitative results revealed that the processes should contain 8 functional areas or capabilities related public health, namely, emergency plan, disaster surveillance, training and drills, stockpiles, emergency command system, onsite rescue and medical treatment, fully staffed workforce, and crisis communication and cooperation.

The framework also revealed the interactions among these functions or capabilities, and suggesting a need for greater attention to these dynamic linkages. Therefore, the framework in comparison with others in the literature is more explicit in capturing how hospitals prepare for and respond to public health emergencies. Combining comprehensiveness with specificity is especially useful in defining PHEP. It also provides a framework for pre-planning, coordination, quality improvement, training and drills and resource prioritization.

**The uses of the framework**

The tool has been positively evaluated for identifying the activities that are required at each stage of the Prevention Preparedness Response and Recovery cycle.

Prevention and preparedness are generally considered profitable strategies since they result in capacity building, safe land use planning, emergency planning and (as
needed) safe retrofitting of existing facilities. Promoting proactive prevention and preparedness may be one of the most valuable benefits of the use of the framework.

Fig. 18 The uses of the tool

Fig. 18 summarizes the potential uses of the tool. Training in the methodology and logic behind the tool stimulates preventive action and post-incident thinking. As mentioned in the chapter 6 (the utility of the framework), the framework can then result in sustainable and safe pre-planning, in safety planning of facilities and in capacity building. After the incident, “lessons learned” from evaluations of large-scale incidents may be translated into remedial actions within the structure of this framework.

First, a general disaster reduction strategy may be followed, e.g. by enhancing the ability of natural systems to neutralize potential natural threats.

Secondly, preparedness should also encompass training of field team members, back office experts and country representatives. A highly relevant comment from those
exposed to the tool as part of this research was that experience with the tool may
stimulate national authorities to reconsider their disaster preparedness and response
legislation, and also stimulate collaboration between environmental experts and
disaster managers.

**The concept to operational capability**

A coherent conceptual and analytical framework would be an important step toward
creating a defined research space to enhance the development of evidence and to
inform policy and practice. It can easily cross-walk the policies and procedures that
differ across regions and assist in prioritizing resources for critical services.

This research assessed the capability of rural hospitals in Sichuan, and explored the
issue of PHEP among rural hospitals. While disasters can occur in both urban and
rural areas, a recent study found that (Zhao Qi, 2009), in China, the rural hospitals
was ill-prepared for a large scale disasters because of limited resources and capacity,
and therefore, they are more vulnerable to public health emergencies. In the survey,
eight elements of preparedness, in addition to overall preparedness, were examined
across hospitals of Sichuan province. The four factors were identified that contributed
strongly to hospital PHEP. It is anticipated that improving these factors will lead to
high level of preparedness.

The results indicated that rural hospitals have a need for collaborative planning for
different types of emergencies and for the equipment and supplies required to meet
surge needs.
Hospital PHEP capacity can be quantified, in terms of the severity, acuity, duration, magnitude or volume, and nature of the event. It then may be possible to measure the speed and adequacy of the potential response. Besides, once the sub-issues within the domains are defined and validated during planning, we can move seamlessly into the operational phase through the use of an integrating hub.

In conclusion, growing evidence suggests that hospital PHEP has substantially improved in recent years, but more improvement is needed. Future events and disasters, such as terrorist attacks and emerging infectious diseases, will require hospitals and other health care providers to prepare well to respond. Additionally, to enhance hospital preparation for dealing with public health emergencies, governments should increase investment in the construction of infrastructure to create and sustain appropriate hospital PHEP capacity.
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Appendices

Appendix A

The Survey Questionnaire
Evaluation Hospital Preparedness for Public Health Emergencies in High Risk Areas of Sichuan (China)
QUESTIONS FOR INTENSIVE INTERVIEW

The structure questions for intensive interview are as follows:

1. What are the ingredients or constituents or elements of hospital public health emergency response preparedness

2. Please give us your opinions about the particular environments and challenges of major hospitals in rural areas of China regarding to the hospital preparedness for public health? (e.g., hospital culture and social beliefs, policy and plans for disaster management, management mechanism, management procedures, costs of preparation, governance frameworks, socio-economic frameworks)

3. Please give us your opinions, comment or modification recommendations on the content in regard to suitability of the measurable items (with regard to the special situation in China) and the readability of the survey instrument.
QUESTIONNAIRE FOR THE FIRST ROUND OF DELPHI STUDY

Dear participants:

First of all, thank you so much for your consideration as an expert of our reference group in Delphi study.

The main function of the reference group in this study is to give your opinions on each potential item in the questionnaire which is used for establishing an evaluation framework of hospital public health emergency preparedness in China. The reference group aims to make it more useable and more adapted to the Chinese situation. We have already sent you our detailed research background and the questionnaire (seen in the attachment).

All the domains and items in this questionnaire were derived from the related literatures with the recent decade. It is supposed to be filled by key emergency hospital staffs in China to give their assessments on the importance of items from hospital perspective.

This is the first round of Delphi study, please rate each item in the questionnaire, and feel free to give comments or modifications to the indicator system.

Instructions

(1) Please assess each item by given a score: very important=4, important=3, moderately important=2, of little importance=1, of no importance=0. Tick “√” on the corresponding blank space.

(2) Please give us your opinions, comments or medication recommendations on the content in regard to suitability of the measurable items.

(3) Please feel free to contact us if you have any questions.
# QUESTIONNAIRE FOR THE FIRST ROUND OF DELPHI STUDY

**Evaluation of hospital PHE preparedness in city and county of China**

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1. **Emergency plan**
   1.1 Type of emergency plan
   1.2 The plan are accessible to all medical staff
   1.3 Details of the plan
   1.4 The period of evaluating and revising the emergency plan

**Modification and Comments**

2. **Surveillance and warning**
   2.1 **Disease surveillance**
      2.1.1 Monitoring network
      2.1.2 Type of surveillance event
      2.1.3 Analysis and management of information
   2.2 **Laboratory diagnosis capacity**
      2.2.1 Working procedure and policy of laboratory
      2.2.2 Varieties of etiology can be isolated and identified
      2.2.3 The structure of laboratory staff
      2.2.4 Technical plant

**Modification and Comments**

3. **Training and drills**
   3.1 **Emergency training**
      3.1.1 Type of training
      3.1.2 Evaluate the effectiveness of training
   3.2 **Drills**
      3.2.1 Type of drills
      3.2.2 Drills cooperation with multiple agencies
      3.2.3 Evaluate the effectiveness of drills

**Modification and comments**
4 Stockpiles
4.1 Stockpiles of emergency supplies
4.2 Management of emergency supplies

Modification and comments

5 Emergency command system
5.1 Emergency command centre
5.2 Emergency relevant system
5.3 Emergency committee or group

Modification and Comments

6 On-site rescue and medical treatment
6.1 On-site rescue
6.1.1 Capacity of emergency rescue
6.1.2 Specific procedures for transfer of seriously patient in emergency
6.1.3 Equipment for on-site rescue
6.2 Medical treatment
6.2.1 Expert group for emergency medical treatment
6.2.2 Treatment strategies for different disease
6.2.3 Equipment for decontamination, isolation and protection to infectious diseases and chemical contamination
6.2.4 Equipment for medical treatment

Modification and Comments

7 Crisis communication and cooperation
7.1 Crisis communication and cooperation within hospitals
7.2 Crisis communication and cooperation with other facilities
7.2.1 with other health facilities
7.2.2 With government offices for emergency
7.2.4 With media and public

Modification and Comments

8 Fully staffed workforce
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<td>9.2</td>
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<td>10.2</td>
<td>Emergency funding management</td>
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Modification and comments

9 Evaluation and adaption

9.1 Evaluation of hospital capacity

9.2 Experience learning

Modification and comments

10 Funding

10.1 Emergency funding collection

10.2 Emergency funding management

Modification and Comments
PERSONAL INFORMATION OF EXPERT

Dear hospital key personnel/health care professionals:

Please provide your name and contact details, we need some of your personal information and evaluation criteria for the purpose of assessing the results in this project. Please note that all the information which may cause individually identifiable will be treated confidentially. Any identifiable information will not be available to anyone except for the research team. Individual responses to questions will be non-individual identifiable in the results of this project.

1. Key personnel information

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2. Experience in your working area (please tick “✓” in the corresponding space of the form. You can choose more than one answers)

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<th>Familiar</th>
<th>More familiar</th>
<th>Very familiar</th>
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3. Key personnel evaluation criteria (please tick “✓” in the corresponding space of the form. You can choose more than one answers)

<table>
<thead>
<tr>
<th>Evaluation criteria</th>
<th>To what extent do you rely on these criteria to give your evaluations</th>
</tr>
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<tbody>
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<td>Experience</td>
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<tr>
<td>Literature</td>
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</tr>
<tr>
<td>Instinct</td>
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</tbody>
</table>

Thanks again for your consideration and valuable advice!

Date:       month/  year
QUESTIONNAIRE FOR THE SECOND ROUND OF DLEPHI STUDY

Dear participants:

First of all, thank for providing precious suggestions in the first round of Delphi study. After calculating the results of the first round, there are 8 first level indicators, 22 second level indicators, and 37 indicators were identified. In this round, please re-evaluate the listed items, thank you very much!

Research Background

We are trying to establish an evaluation framework for hospital PHEP. The reference group aims to make it more usable and more adapted to the Chinese situation. All the domains and items in this questionnaire derived from the related literatures within the recent decade. It is supposed to be filled by key emergency hospital staffs in China to give their assessments on the importance of items from hospital perspective.

This is the second round of Delphi study, please rate each item in the questionnaire, and feel free to give comments or modifications to the indicator system.

Instructions

(1) Please assess each item by given a score: very important=4, important=3, moderately important=2, of little importance=1, of no importance=0. Tick “√” on the corresponding blank space.

(2) Please give us your opinions, comments or medication recommendations on the content in regard to suitability of the measurable items.

(3) Please feel free to contact us if you have any questions.
# QUESTIONNAIRE FOR THE SECOND ROUND OF DLEPHI STUDY

<table>
<thead>
<tr>
<th>Indicator system</th>
<th>Importance</th>
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<tbody>
<tr>
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<td>Of no importance</td>
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</table>

1 Emergency Plan

1.1 Type of emergency plan

1.2 The accessible of plan to all staff

1.3 Evaluation and updating of emergency plan

**Moderation and comments:**

2 Surveillance and warning

2.1 Disease surveillance

2.1.1 Monitoring system

2.1.2 Type of surveillance event

2.1.3 Analysis of information

2.1.4 Report of information

2.2 Laboratory diagnosis capacity

2.2.1 Working procedure and policy of laboratory

2.2.2 Varieties of etiology can be isolated and identified

2.2.4 Technical equipment

**Moderation and comments:**

3 Training and drills

3.1 Emergency training

3.1.1 Content of emergency training

3.1.2 Evaluation of effectiveness of training

3.1.3 Coverage of staff training

3.2 Emergency drills

3.2.1 Content of drills

3.2.2 Evaluation and adaption of drills

**Moderation and comments:**

4 Stockpiles

4.1 Emergency funds

4.1.1 Emergency funds budget
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<th>Title</th>
<th>Subsection</th>
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<td>4.2.1</td>
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<td>Emergency drugs</td>
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<td>4.3.1</td>
<td>Supplies system of emergency drugs</td>
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<td>4.3.2</td>
<td>Distribution system of emergency drugs</td>
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<tr>
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<tr>
<td>5</td>
<td>Emergency command system</td>
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<td>5.1</td>
<td>Emergency command centre</td>
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<td>Moderation and comments :</td>
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<tr>
<td>6</td>
<td>On-site rescue and medical treatment</td>
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<tr>
<td>6.1</td>
<td>On-site rescue</td>
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<td>6.1.2</td>
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<td>6.1.3</td>
<td>Equipment for on-site rescue</td>
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<td>6.1.3</td>
<td>System of transfer patients</td>
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<td>Medical treatment</td>
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<td>6.2.1</td>
<td>Treatment strategies for different disease</td>
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<td>6.2.2</td>
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<td>6.2.3</td>
<td>Treatment plans for different emergencies</td>
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<td>6.2.4</td>
<td>Beds of emergency department</td>
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<td>6.2.5</td>
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<td>6.2.6</td>
<td>Beds of ICU</td>
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<tr>
<td>6.2.7</td>
<td>Beds of isolation ward</td>
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<tr>
<td>6.3</td>
<td>Infectious disease treatment</td>
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</tbody>
</table>
6.3.1 Scale of department of infectious disease
6.3.2 Quarantine measures
6.3.3 Protective equipment

**Moderation and comments :**

7 Crisis communication and cooperation

7.1 Crisis communication and cooperation within hospitals

7.2 Crisis communication and cooperation within hospitals

7.2.1 with other health facilities

7.2.2 With government offices for emergency

7.2.3 With media and public

**Moderation and comments :**

8 Public emergency education

8.1 Public emergency education department

8.2 Public emergency education plan

8.2 Way of education

**Moderation and comments :**
四川省医院突发公共卫生事件应对能力评估体系研究

Evaluation Hospital Preparedness for Public Health Emergencies in High Risk Areas of Sichuan (China)
第一轮专家咨询问卷

尊敬的专家:
您好! 首先感谢您在百忙之中抽出时间参与我们的专家咨询!

研究背景
我们目前正在构建“四川省医院突发公共卫生事件应对能力评估体系”。随着全球各类灾害及突发事件的频繁发生，医院应急医疗管理的重点已经由灾后的恢复重建逐渐转变为包括灾前防范及准备、灾难过程中及时响应、灾后恢复改善的全过程、系统化管理。因此，近年来发达国家开始逐步重视“医院灾难应对能力”这一理念。“医院灾难应对能力”是指医院对灾难及突发事件的吸收能力、缓冲能力及应对、恢复能力。增强医院灾难应对能力有助于我们迅速化解一般突发事件的影响，在严重的灾难后也能够有效地应对，尽快地恢复。目前，我国缺乏全面、综合、系统的医院突发公共卫生事件应对能力评估体系，而建立有效的评价工具，是提高医院灾难应对能力，最终提升社区整体抗灾能力的有效途径和必要条件。

本次专家咨询法的目的是通过专家达成共识的方法，确立及完善医院灾难应对能力评估体系，从而帮助我们确定评估指标及权重，优化评估重点，建立适用于我国各级医院的评估体系。本研究共包括两轮专家咨询法，您正在参加的是第一轮，请您对指标体系的各指标给出相应的评价。这些指标源自十年来国际相关领域的文献综述。

填表说明
得知您是这方面的专家，希望借助您的丰富经验对指标体系中的一、二、三级指标的重要性给予相应的评价，并提出宝贵的建议。

具体评价方法如下:
[1] 请对各指标的重要性进行评价，在每个问题后对应的选项中打“√”，其中“不重要”，表示在评价医院灾难应对能力时，该指标不起任何作用；“极重要”，表示在评价医院灾难应对能力时，该指标是必须具备的。例如，如果您认为“应急制度”极重要，则在对应的第五个空格中打“√”。

[2] 如果您觉得所提供的指标存在不合理或遗漏，请在相应的空白处提出您的宝贵意见。

[3] 如果您对本次专家咨询存在任何疑问之处，请与我们联系。
## 二级以上医院应对突发公共卫生事件能力评估专家咨询表

<table>
<thead>
<tr>
<th>指标体系</th>
<th>重要性</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>不重要</td>
</tr>
</tbody>
</table>

### 1.1 应急预案
1.1 应急预案种类和内容
1.2 应急预案的普及
1.3 应预案更新

### 2 监测与预警
#### 2.1 疾病监测
2.1.1 监测制度
2.1.2 监测事件的种类（如不明原因肺炎）
2.1.3 监测信息的汇总与报告

#### 2.2 实验室检测能力
2.2.1 实验室工作制度
2.2.2 实验室检测致病源种类
2.2.3 实验室人员结构
2.2.4 实验室技术设备

### 3 应急培训与演练
#### 3.1 应急培训
3.1.1 应急培训种类
3.1.2 应急培训效果的考核

#### 3.2 应急演练
3.2.1 应急演练种类
3.2.2 应急演练资料备查
3.2.3 应急演练评估

### 4 后勤保障
#### 4.1 应急资金管理
4.1.1 应急资金预算
4.1.2 应急资金管理

#### 4.2 应急物资
4.2.1 应急物资储备
4.2.2 应急物资管理

### 5 应急机构
#### 5.1 应急指挥部设置

#### 5.2 应急相关科室设置
<table>
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<tr>
<th>5.3 应急专家组</th>
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<tbody>
<tr>
<td>修改建议：</td>
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<table>
<thead>
<tr>
<th>6 现场救援和医疗救治</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 现场救援</td>
</tr>
<tr>
<td>6.1.1 紧急救援能力</td>
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<tr>
<td>6.1.2 现场救援设备</td>
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<td>6.2 医疗救治</td>
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<td>6.2.1 不同种类疾病救治方案</td>
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<tr>
<td>6.2.2 医疗救治设备</td>
</tr>
<tr>
<td>6.2.3 传染病与生化污染消毒、隔离及防护设施</td>
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| 修改建议：     |

<table>
<thead>
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<th>7 信息沟通与合作</th>
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<tbody>
<tr>
<td>7.1 院内与其他科室信息沟通与合作</td>
</tr>
<tr>
<td>7.2 院外信息沟通与合作</td>
</tr>
<tr>
<td>7.2.1 与其他卫生机构</td>
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<tr>
<td>7.2.2 与政府相关管理机构</td>
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<td>7.2.3 与媒体及大众</td>
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</tbody>
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| 修改建议： |

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<thead>
<tr>
<th>8 应急人员</th>
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<tbody>
<tr>
<td>8.1 应急人员结构</td>
</tr>
<tr>
<td>8.2 应急人员能力</td>
</tr>
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<td>8.2 扩大应急人员能力</td>
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</tbody>
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<table>
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<th>9 评估与改进</th>
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<tbody>
<tr>
<td>9.1 应急能力评估方案</td>
</tr>
<tr>
<td>9.2 经验总结</td>
</tr>
</tbody>
</table>

| 修改建议： |
第二轮专家咨询问卷

尊敬的专家：
您好！首先感谢您参与我们的第一轮专家咨询并提出了宝贵的意见。经对第一轮所有专家的意见进行统计汇总，共筛选出8个一级指标，22个二级指标，37个三级指标，希望您能再次对以下指标的重要性给予评价，我们将非常感谢！

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<table>
<thead>
<tr>
<th>指标体系</th>
<th>重要性</th>
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<tbody>
<tr>
<td></td>
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</table>

### 1 应急预案
1.1 应急预案种类
1.2 应预案的普及
1.3 应预案评估与更新

**修改建议：**

### 2 监测与预警
2.1 疾病监测
2.1.1 监测制度
2.1.2 常规监测事件的种类（如不明原因的死亡人数、急性哮喘发作人数、发热人数等）
2.1.3 监测信息的汇总
2.1.4 监测信息的报告
2.2 实验室检测能力
2.2.1 实验室工作制度
2.2.2 实验室分离、检测致病源种类的能力
2.2.3 实验室人员结构
2.2.4 实验室技术设备（例如空气室或头罩）

**修改建议：**

### 3 应急培训与演练
3.1 应急培训
3.1.1 应急培训内容
3.1.2 应急培训效果的考核
3.1.3 接受培训人员的覆盖面
3.2 应急演练
3.2.1 应急演练内容
3.2.2 应急演练评估与改进

**修改建议：**

### 4 后勤保障
4.1 应急资金管理
4.1.1 应急资金预算
4.1.2 应急资金管理
4.2 应急物资
4.2.1 应急物资储备
<table>
<thead>
<tr>
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<td>4.3 应急药品储备</td>
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<td>4.3.1 药品保障机制</td>
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**修改建议：**

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<thead>
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<tr>
<td>5.1 应急指挥部门人员</td>
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<tr>
<td>5.2 应急相关科室设置</td>
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<td>6.1 现场救援</td>
</tr>
<tr>
<td>6.1.1 急救应急预案</td>
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<td>6.1.3 现场救援设备（急救车辆、通讯设备）</td>
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<tr>
<td>6.1.4 重症病人转诊和途中监护</td>
</tr>
<tr>
<td>6.2 医疗救治能力</td>
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<tr>
<td>6.2.1 不同种类疾病救治方案</td>
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<td>6.2.2 医疗救治设备</td>
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<tr>
<td>6.2.3 不同突发公共卫生事件所致疾病的院内治疗方案</td>
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<tr>
<td>6.2.4 急诊科床位</td>
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<td>6.2.5 临时应急可加床位</td>
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<td>6.2.6 ICU 床位</td>
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<tr>
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</tbody>
</table>
专家个人信息

尊敬的专家：

您好！

为了方便和及时对专家咨询结果进行评价，我们需要了解您相关的个人信息以及您对本次咨询问卷作出的判断依据，请分别填写以下表格。

1 专家个人信息

<table>
<thead>
<tr>
<th>姓名：</th>
<th>性别：</th>
<th>学历：</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>单位：</td>
<td>职称：</td>
<td>职务：</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>电话：</td>
<td>电子信箱：</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 您对突发公共卫生事件应对工作的熟悉程度（请在相应空格中打“√”，可多选）
不熟悉 了解一点 熟悉 比较熟悉 很熟悉

3 您对本次调查的判断依据（请在相应空格中打“√”，可多选）

<table>
<thead>
<tr>
<th>判断依据</th>
<th>依赖程度</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>没有</td>
</tr>
<tr>
<td>工作经验</td>
<td></td>
</tr>
<tr>
<td>理论</td>
<td></td>
</tr>
<tr>
<td>参考文献</td>
<td></td>
</tr>
<tr>
<td>直觉</td>
<td></td>
</tr>
</tbody>
</table>

再次感谢您的参与以及宝贵意见！！！

日期：年/ 月
THE QUESTIONNAIRE FOR THE SURVEY

The Questionnaire for Investigating Hospital PHEP in Sichuan Province

Instructions

1. Survey Objective: To examine the current status PHEP of hospitals above secondary level, and provide suggestions for the future research and making policy.

2. Public health emergencies in this research are defined as: events that occur unexpectedly and can cause or potentially cause mass destruction to the public’s health.

3. Each hospital is required to designate a department director to be responsible for coordinating the completion of the questionnaire.

4. Most questions in the questionnaire are mainly in two types: (1) Choice questions (including some multiple choice questions). (2) Fill-in questions: please fill in the relevant content on the underline.

5. When you finish the questionnaire, please return it by email. Email address: sunny.tree.t@gmail.com

6. Please free to contact us if you have any questions.

Thank you for your time and patience!
Part 1 Basic Information

1.1 Name of hospital: ___

1.2 Address: ___

1.3 Hospital grade: ___

1.4 Number of staff in total, and: ___

<table>
<thead>
<tr>
<th>Staff category</th>
<th>Total</th>
<th>Education Background</th>
<th>Positional Title</th>
<th>Major</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Phd</td>
<td>Master</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Undergraduate</td>
<td>Senior</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other</td>
<td>Junior</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clinical</td>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

|                     | Phd   | Master   | Undergraduate | Other |
|                     |       |          |               |       |

1.5 Dose this hospital have infectious disease ward? □ Yes □ No □ Unknown

1.6 Dose this hospital have accepted and cured SARA patients? □ Yes □ No □ Unknown

1.7 Is this hospital a teaching hospital or not? □ Yes □ No □ Unknown

1.8 Does this hospital have fever clinic? □ Yes □ No □ Unknown

Part 2 Emergency Plan

2.1 Type and updating of emergency plan

2.1.1 Does this hospital have the following emergency plan? (If all are chose “No”, jump to 3.1)

<table>
<thead>
<tr>
<th>Type</th>
<th>Whether has emergency plan</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Infectious disease</td>
<td>□</td>
</tr>
</tbody>
</table>
2.1.2 Have the hospital ever evaluated or adapted the emergency plan/files/handbook?

☐ Yes ☐ No ☐ Unknown

2.2 Accessible of emergency plan

2.2.1 Have the hospital offered training or publicity regarding to the content emergency plan which mentioned above?

☐ Yes ☐ No ☐ Unknown

2.2.2 Are these emergency plans accessible to all the medical staff?

☐ Yes ☐ No ☐ Unknown

2.2.3 By what means that medical staffs can get to know these plans?

☐ Printed files ☐ Hospital website ☐ Training ☐ Conference ☐ Other

Part 3 Surveillance and Warning

3.1 Disease surveillance

3.1.1 Has this hospital developed early warning system for pubic emergencies?

☐ Yes ☐ No ☐ Unknown (If choose “No” or “Unknown”, please jump to the question 3.2)
3.1.2 Does this hospital have infectious disease report or register system?

□ Yes □ No □ Unknown

3.1.3 Does this hospital have outpatient log or infectious disease report card?

□ Yes □ No □ Unknown

3.1.4 Types of monitoring items

<table>
<thead>
<tr>
<th>Type of disease/symptom</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine microbiological test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numbers of fever patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influenza-like cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numbers of unexplained pneumonia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numbers of gastroenteritis patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numbers of septicemia / infectious shock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numbers of unexplained death toll</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Numbers of emergency room patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1.5 Analysis of surveillance information

3.1.5.1 Does this hospital have worker that in charge of public emergencies report?

□ Yes □ No □ Unknown

3.1.5.2 How often does the hospital summarize the monitoring information?

□ everyday □ many times per week □ once week □ every two weeks □ every month □ one month □ Other □ Unknown

3.1.5.3 Does the hospital share surveillance information with other medical organizations?

□ Yes □ No □ Unknown

3.2 Capability of Laboratory
3.2.1 Does laboratory have critical operation specification or manage system?

☐ Yes  ☐ No  ☐ Unknown

3.2.2 Is there technical staff is on duty in laboratory everyday (include weekends)?

☐ Yes  ☐ No  ☐ Unknown

3.2.3 Types of etiology

3.2.3.1 Could laboratory test the following etiology?

<table>
<thead>
<tr>
<th>Types</th>
<th>Whether could test or not</th>
<th>Whether has relevant training for testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Plague bacillus</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Cholera</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Anthrax</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Influenza</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Meningococcal meningitis</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
<tr>
<td>Brucellosis</td>
<td>Yes ☐ No ☐</td>
<td>Yes ☐ No ☐</td>
</tr>
</tbody>
</table>

3.2.3.2 Does laboratory provide necessary proactive equipments to workers?

☐ Yes  ☐ No  ☐ Unknown

3.2.3.3 Can the hospital enlarge the capacity of sample disposal when faced with an emergency?

☐ Yes  ☐ No  ☐ Unknown

3.2.3.4 Does the hospital have the alternated laboratory?

☐ Yes  ☐ No  ☐ Unknown

3.2.3.5 Does the hospital have the protocol of transportation of suspected samples to other medical organizations?
3.2.3.6 Does the laboratory have the capacity of testing and receiving the samples around the clock?

☐ Yes  ☐ No  ☐ Unknown

3.2.3.7 Does the hospital have a direct electronic link to disease reporting network system?

☐ Yes  ☐ No  ☐ Unknown

**Part 4 Training and Drills**

**4.1 Emergency training**

4.1.1 During 2012~2013, did the hospital provide any following trainings? (if all answers are "No", jump to 4.2)

<table>
<thead>
<tr>
<th>Content of training</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content of emergency plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical treatment procedures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methods of identifying PHE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awareness of public health emergencies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal protective measures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information system management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>disinfection and sterilization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>principles of quarantine and isolation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.1.2 Does this hospital evaluate the effectiveness of training periodically?

☐ Yes  ☐ No  ☐ Unknown

4.1.3 Does the hospital have the designated person in charge of training work?

☐ Yes  ☐ No  ☐ Unknown
4.2 Emergency drills

4.2.1 Does this hospital have some relevant drills?

☐ Yes ☐ No ☐ Unknown

4.2.2 During 2011～2012, does the hospital have the following drills?

<table>
<thead>
<tr>
<th>Type of emergency plan</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious disease</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Mass unidentified disease</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Foodborne disease</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Occupational poisoning</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Nosocomial infection</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Natural disaster</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Bio/Chemical terror</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other:</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

4.2.3 Does this hospital evaluate the effectiveness of drills periodically?

☐ Yes ☐ No ☐ Unknown

Part5 Stockpile

5.1 Emergency funds

5.1.1 Does this hospital have emergency fund stockpile plan?

☐ Yes ☐ No ☐ Unknown

5.1.2 Does this hospital have funds emergency management system?

☐ Yes ☐ No ☐ Unknown

5.1.3 Does this hospital have emergency funds?

☐ Yes ☐ No ☐ Unknown
5.1.4 Where is the emergency fund mainly from?

☐ financial fund for special purposes  ☐ local health department  ☐ hospital self-collected

5.1.5 Does the emergency fund meet emergency work needs?

☐ No  ☐ Basically  ☐ Yes

5.2 Emergency material management

5.2.1 Does this hospital have a worker in charge of emergency material management?

☐ Yes  ☐ No  ☐ Unknown

5.2.2 Does the hospital have a plan for emergency material stockpile?

☐ Yes  ☐ No  ☐ Unknown

5.2.3 Does the hospital draw up a regulation for emergency materials management?

☐ Yes  ☐ No  ☐ Unknown

5.3 Emergency drugs stockpile

5.3.1 Does this hospital have a certain sum of drugs? (“a certain sum “means could cure 30 people for 7 days?)

<table>
<thead>
<tr>
<th>Types</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Plague bacillus</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Cholera</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Anthrax</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Influenza</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Meningococcal meningitis</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>☐</td>
<td></td>
</tr>
<tr>
<td>Brucellosis</td>
<td>☐</td>
<td></td>
</tr>
</tbody>
</table>

5.3.2 Does the hospital have a certain amount of antibiotics?
5.3.3 If the drugs are limited when emergency occurs, does hospital have a proper drug distribution?

☐ Yes ☐ No ☐ Unknown

5.3.4 Does the hospital a drug-supply system with drug suppliers?

☐ Yes ☐ No ☐ Unknown

5.3.5 Does the hospital have the following back-up medical installations?

<table>
<thead>
<tr>
<th>Type</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back-up oxygen system</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Alternated power supply system</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Alternated water works</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Back-up heating and ventilating system</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

5.3.6 Does the hospital have alternated care areas to enlarge the capacity of receiving patients?

☐ nonclinical space ☐ inpatient unit hallways ☐ decommissioned ward space

5.4 Personal protective equipment

5.4.1 Does the hospital have the following protective equipments for medical staff?

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>High efficiency particulate masks</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>HEPA filter</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Protective eyewear</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Isolation gown</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Biological protective gown</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Chemical protective gown</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
5.4.2 Does the hospital have Bio/Chemical gown for medical staff?

☐ Yes ☐ No ☐ Unknown

5.4.3 Did the hospital ever assess the function of protective equipments before?

☐ Yes ☐ No ☐ Unknown

**Part 6 Emergency Command System**

**6.1 Emergency commend system setting**

6.1.1 Does this hospital set up emergency office or relevant department is responsible for emergency cooperation and coordination?

☐ Yes ☐ No ☐ Unknown

6.1.2 Is there a hospital’s manager responsible for emergency management? Position ____

☐ Yes ☐ No ☐ Unknown

6.1.3 Does hospital’s manager direct and inspect the emergency work?

☐ Yes ☐ No ☐ Unknown

6.1.4 Does the hospital have experts groups?

☐ Yes ☐ No ☐ Unknown

6.1.5 If have, ☐ country level ____ (numbers of experts) ☐ provincial level ____ ☐ municipal level ____ ☐ county level ____

6.1.6 Does the hospital provide advices on public health emergency psychological counseling, medical intervention, health guidance, etc. for medical staff and victims?

☐ Yes ☐ No ☐ Unknown
Part 7 On-site rescue and medical treatment

7.1 On-site rescue

7.1.1 Numbers of ambulances ______

7.1.2 Number of staff in emergency medical first-aid teams (or Emergency Department): ______

7.1.3 Will the hospital transfer patients to other hospital if they can’t get the relevant medical treatments in this hospital?

☐ Yes  ☐ No  ☐ Unknown

7.1.4 Does the hospital have relevant plan for transferring patients?

☐ Yes  ☐ No  ☐ Unknown

7.2 Medical Treatment

7.2.1 Hospital beds in total: _____, the numbers of extra bed could be added____:

   ICU beds____, the numbers of extra bed could be added____

   Emergency Department beds____, the numbers of extra bed could be added____

   Isolation ward beds____, the numbers of extra bed could be added____

Did the hospital ever evaluate the ability of increasing beds and equipments for emergencies?

☐ Yes  ☐ No  ☐ Unknown

7.2.2 Does the hospital have the relevant medical treatment plans for patients from the following emergency event?

<table>
<thead>
<tr>
<th>Type of emergency plan</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infectious disease</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Mass unidentified disease</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Foodborne disease</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Occupational poisoning</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>
7.2.3 Does the hospital have the relevant medical treatment plans for patients from the following infectious diseases?

<table>
<thead>
<tr>
<th>Types</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>SARS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plague bacillus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cholera</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anthrax</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influenza</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningococcal meningitis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brucellosis</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.2.4 By which mean the hospital will maintain the sufficient numbers of staff during an emergency event?

<table>
<thead>
<tr>
<th>Types</th>
<th>Yes</th>
<th>No/Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recall staff is on leave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary workers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retired employee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share health care providers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volunteers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.2.5 Can hospital provide priority in medical treatment for children, pregnancy, and old people?
Part 8 Crisis communication

8.1 Has this hospital set up system for crisis communication and cooperation within hospital other department?

☐ Yes ☐ No ☐ Unknown

8.2 Does this hospital have a system for communicate with other health facilities, government offices or media?

☐ Yes ☐ No ☐ Unknown

8.3 Does the hospital have other emergency departments or organizations’ contact way?

☐ Yes ☐ No ☐ Unknown
突发公共卫生事件医院应对能力调查表

填表说明

1. 调查目的：了解某省各级医院突发公共卫生事件应对能力现状，为确定将来医疗机构突发公共卫生事件应急工作措施、培训和重点项目提供科学依据。

2. 调查范围：各级医院

3. 调查中规定的突发公共卫生事件是指突然发生，造成或者可能造成社会公众健康严重损害的重大传染病疫情、群体性不明原因疾病、重大食物和职业中毒以及其他严重影响公众健康的事件。

4. 各级医院要有专人负责此项工作，组织协调相关科室专业人员填写具体内容。填写内容要真实，不遗漏问题，各项内容要有存档材料备查。调查表单位领导审定、签名后，加盖单位公章上报。

5. 请直接在该调查表电子文档中填写

6. 填写方式：调查表中有两种类型的问题：（1）选择题：除非有黑体字注明“此题可多选”外，其它选择题均为单选题（即选择一个答案），请在每个问题后符合医院情况的选项（□）/后“√”；（2）填空题：请在每个问题后的下划线处填写相关数据/内容。

7. 注意调查表中某些问题的逻辑跳转。

8. 请务必在规定时间内完成调查。调查表完成后通过电子邮件回复。Email：sunny.tree.t@gmail.com。

9. 填写过程中如有任何疑问，请与调研组联系。

感谢您对调查工作的协助和支持！
一、医院基本情况

1.1 医院名称：__________
1.2 医院地址：__________
1.3 医院等级（如三甲、二乙等）：_________
1.4 全院职工总数：_______人，其中：

<table>
<thead>
<tr>
<th>人员类别</th>
<th>合计</th>
<th>学历</th>
<th>职称</th>
<th>专业</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>博士</td>
<td>硕士</td>
<td>本科</td>
</tr>
<tr>
<td>1.4.1医生</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4.2护理人员</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.4.3医技人员</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.5 贵院有无传染病病区：□有□无□不知道
1.6 贵院是否收治过 SARS 病例：□是□否□不知道
1.7 是否为教学医院：□是□否□不知道
1.8 有无发热门诊：□有□否□不知道

二、应急预案

2.1 应预案种类与更新

2.1.1 贵院是否制定以下应急处理预案？（如果全部选择“否”，则跳至4.1题）

<table>
<thead>
<tr>
<th>种类</th>
<th>是否制定该应急预案</th>
</tr>
</thead>
<tbody>
<tr>
<td>传染病疫情</td>
<td>□</td>
</tr>
<tr>
<td>新发传染病/群体性不明原因疾病</td>
<td>□</td>
</tr>
<tr>
<td>群体性不明原因疾病</td>
<td>□</td>
</tr>
</tbody>
</table>

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食源性疾病爆发 □  □
职业中毒 □  □
医源性感染爆发 □  □
灾害事故 □  □
生物/化学恐怖 □  □
其它（请注明）： □  □

2.1.2 贵院是否对制定后的应急预案/手册/文件进行过评估或者修订？
□ 是 □ 否 □ 不知道

2.1.3 如是，多少时间评估修订一次？____半年______

2.2 应预案的普及

2.2.1 贵院是否针对以上应急处理预案进行宣传或培训？□ 是 □ 否 □ 不知道

2.2.2 如果有医疗救治预案，在突发公共卫生事件发生前临床医生是否知晓这些最新方案？
□ 是 □ 否 □ 不知道

2.2.3 贵院工作人员可通过哪些途径获得应急处理预案？（此题可多选）
□ 印刷资料 □ 医院内部网站 □ 培训 □ 会议 □ 其它（请注明）：

三、监测与预警

3.1 疾病监测

3.1.1 贵院是否建立了突发公共卫生事件预警系统？□ 是 □ 否 □ 不知道（回答“否”或“不知道”请跳转3.2）

3.1.2 贵院是否有传染病登记/报告制度？□ 是 □ 否 □ 不知道

3.1.3 贵院是否有门诊日志及传染病报告登记簿或报告卡？□ 是 □ 否 □ 不知道

3.1.4 监测事件的种类

<table>
<thead>
<tr>
<th>贵院是否对以下情况进行监测？</th>
<th>是</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>微生物检测报告</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>急诊入院人数</td>
<td>□</td>
<td></td>
</tr>
</tbody>
</table>
发热人数 □ □
流感样病例数 □ □
不明原因死亡人数 □ □
胃肠炎病人数 □ □
败血症/感染性休克人数 □ □

3.1.5 监测信息分析与处理

3.1.5.1 贵院是否有人员负责传染病等突发公共卫生事件报告工作？□是□否□不知道

3.1.5.2 能否及时将监测的异常信息上报上级主管卫生行政机构？□是□否□不知道

3.1.5.2 医院监测系统进行信息汇总的时间间隔是：
□每天□一周数次□每周□每两周□每月□其他□不知道

3.1.5.3 贵院是否能与当地卫生部门/其它机构共享异常病例所提供的信息？
□是□否□不知道

3.2 实验室检测能力

3.2.1 贵院实验室是否有严格的操作规程和管理制度？□是□否□不知道

3.2.2 贵院实验室是否每天（包括周末）24小时都有技术人员值班？□是□否

3.2.3 检测致病源种类

3.2.3.1 贵院实验室能否检测出以下致病源？

<table>
<thead>
<tr>
<th>病原生物种类</th>
<th>目前是否开展检测</th>
<th>是否曾接受培训</th>
</tr>
</thead>
<tbody>
<tr>
<td>霍乱弧菌</td>
<td>是□否/不知道□</td>
<td>是□否/不知道□</td>
</tr>
<tr>
<td>SARS冠状病毒</td>
<td>是□否/不知道□</td>
<td>是□否/不知道□</td>
</tr>
<tr>
<td>鼠疫</td>
<td>是□否/不知道□</td>
<td>是□否/不知道□</td>
</tr>
<tr>
<td>炭疽热</td>
<td>是□否/不知道□</td>
<td>是□否/不知道□</td>
</tr>
<tr>
<td>流行性感冒</td>
<td>是□否/不知道□</td>
<td>是□否/不知道□</td>
</tr>
<tr>
<td>流行性脑脊髓炎</td>
<td>是□否/不知道□</td>
<td>是□否/不知道□</td>
</tr>
<tr>
<td>乙型脑炎病毒</td>
<td>是/否/不知道</td>
<td>是/否/不知道</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------</td>
<td>--------------</td>
</tr>
<tr>
<td>布鲁氏菌</td>
<td>是/否/不知道</td>
<td>是/否/不知道</td>
</tr>
</tbody>
</table>

3.2.3.2 实验室是否为工作人员提供必要的防护用品？□是□否□不知道

3.2.3.3 如果紧急需求量显著增加，贵院的实验室是否具备能迅速扩大处理和检测标本的能力？□是□否□不知道

3.2.3.4 一旦贵院的实验室被污染，是否有备用的实验室可供使用？□是□否□不知道

3.2.3.5 是否可以将可疑标本安全的进行院外运送？□是□否□不知道

3.2.3.6 实验室检测结果能否保证第一时间识别突发事件？□是□否□不知道

3.2.3.7 贵院是否能通过网络直报系统与当地卫生部门/其它机构共享提供的信息？□是□否□不知道

四、应急培训与演练

4.1 应急培训

4.1.1 2012～2013 年贵院工作人员是否参加以下内容的培训？（注：如果医院工作人员没有参加过任何培训，则跳至4.2 题。）

<table>
<thead>
<tr>
<th>突发公共卫生事件</th>
<th>是</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>突发事件预案相关内容</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>医疗救治措施</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>传染病的预防与控制</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>突发公共卫生事件背景知识</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>个人防护方法</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>检疫隔离规则</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>信息系统管理</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>消毒进化原则</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
4.1.2 贵院是否对培训效果进行定期考核评估？□是□否□不知道

4.1.3 是否有专人负责与突发公共卫生事件有关的培训□是□否□不知道

4.2 应急演练

4.2.1 贵院是否开展或参加过相关应急演练？□是□否（“否”，请跳至 5.1）

4.2.2 2011～2012 年贵院是否开展或参加以下应急演练？

<table>
<thead>
<tr>
<th>应急演练</th>
<th>是</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>突发公共卫生事件</td>
<td></td>
<td></td>
</tr>
<tr>
<td>传染病（如 SARS 和禽流感等）</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>新发传染病/群体性不明原因疾病</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>食源性疾病爆发</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>职业中毒</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>医源性感染爆发</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>灾害事故</td>
<td>□</td>
<td></td>
</tr>
<tr>
<td>生物/化学恐怖</td>
<td>□</td>
<td></td>
</tr>
</tbody>
</table>

4.2.3 贵院是否对演练效果进行考核评估？□是□否□不知道

五、后勤保障

5.1 应急资金管理

5.1.1 贵院是否制定应急资金储备计划？□是□否□不知道

5.1.2 贵院是否制定应急资金管理制度？□是□否□不知道

5.1.3 贵院是否设有应急资金？

□有，□无

5.1.4 贵院的应急资金来源（此题可多选）：

□市财政专项拨款 □当地卫生行政部门拨款 □医院自筹

5.1.5 贵院的应急资金是否可以满足工作需要？□不可以□基本能够□能够

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5.2 应急物资管理

5.2.1 贵院是否有专人负责应急物资储备管理？□是□否□不知道

5.2.2 贵院是否制定应急物资储备计划？□是□否□不知道

5.2.3 贵院是否制定应急物资管理制度？□是□否□不知道

5.3 应急药品储备

5.3.1 贵院是否进行过药品储备评估□是□否□不知道，以及是否储备有治疗一定数量（“一定数量”是指储备有治疗某种传染病或中毒情况30人7天的药品量）的药品？

<table>
<thead>
<tr>
<th>种类</th>
<th>是</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>霍乱弧菌</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>SARS 冠状病毒</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>鼠疫</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>炭疽热</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>流行性感冒</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>流行性脑脊髓炎</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>乙型脑炎病毒</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>布鲁氏菌</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

5.3.2 贵院是否储备有一定数量的抗生药品？

□是□否□不知道

5.3.3 在应对突发事件时，如果药品供给有限，贵院是否有相应的药品分配方案？

□是□否□不知道

5.3.4 贵院是否与某些药品供应商建立了应急药物供给系统？

□是□否□不知道

5.3.5 贵院是否应急资源储备？□是□否□不知道（否或不知道请调至第六部分）

5.3.6 包括下列哪些资源？
5.3.7 在发生紧急情况时，当院内空间紧缺，贵院是否可以通过以下方式扩大接收病人能力？

□住院部走廊 □废弃的病房 □其他非临床区域

5.4 个人防护用品

5.4.1 贵院是否有下列防护设备以供工作人员和医务人员使用？

<table>
<thead>
<tr>
<th>种类</th>
<th>是</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>高效微粒空气过滤器</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>动力空气进化口罩</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>防护镜</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>呼吸机</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>其他</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

5.4.2 贵院是否有生物化学防护服供工作人员使用？ □是 □否 □不知道

5.4.3 贵院是否对个人防护设备进行过功能检测？ □是 □否 □不知道

六、应急机构与人员

6.1 应急指挥部门设置与人员构成

6.1.1 贵院是否成立应急处理办公室（或相当的职能部门）负责本院应急协调或处理工作？

□是（跳至 6.1.3 题） □否

6.1.2 贵院是否有领导分管应急工作？ □是，________（注明分管领导的行政职务） □否
6.1.3 贵院领导是否定期现场检查指导医院应急工作？□是□否

6.1.4 贵院有无专家进入各级应急专家委员会/组？□有□无（则跳至 6.1 题）

6.1.5 如有（此题可多选）：□国家级：__人□省级：__人□市级：__人□县级：__人

6.1.6 贵院是否向受害者以及家属提供心理服务、保健指导、隔离措施信息、医疗干预？
□是□否□不知道

七、现场救援和医疗救治

7.1 现场救援

7.1.1 贵院有救护转运车：___辆

7.1.2 医疗急救队人数：___人（如果没有成立明确的医疗急救队，以医院急诊科人数为计）

7.1.3 如果突发事件中的受害者不能在贵院得到治疗，是否将其转到相应医院进行救治？
□是□否□不知道

7.1.4 如是，是否有转移病人的具体方案？
□是□否□不知道

7.2 医疗救治

7.2.1 医院病床数：

医院病床总数：___张，负压病房：__间，应急时可增加普通床位___张

急诊科病床数：__张，应急时可增加床位数：__张；

传染科病床数：__张，应急时可增加床位数：__张；

重症监护病床数：__张，应急时可增加床位数：__张。

贵院是否对大量急诊病人或者病人数量急剧增加时，医院增加床位和相应的设备进行评估？
7.2.2 贵院是否有接收和治疗以下突发事件中受害者的具体方案 / 治疗手册？

<table>
<thead>
<tr>
<th>突发公共卫生事件</th>
<th>是</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>传染病（如 SARS 和禽流感等）</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>新发传染病/群体性不明原因疾病</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>食源性疾病爆发</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>职业中毒</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>医源性感染爆发</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>灾害事故(烧伤、外伤)</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>生物/化学恐怖</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

7.2.3 贵院是否有接收和治疗以下传染病中受害者的具体方案 / 治疗手册？

<table>
<thead>
<tr>
<th>类型</th>
<th>是/否</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>霍乱弧菌</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>SARS 冠状病毒</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>禽流感</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>炭疽热</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>流行性感冒</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>流行性脑脊膜炎</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>乙型脑炎病毒</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>布鲁氏菌</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

7.2.4 突发事件发生时，贵院是否采取以下措施来解决人力资源不足

<table>
<thead>
<tr>
<th>方式</th>
<th>是</th>
<th>否/不知道</th>
</tr>
</thead>
<tbody>
<tr>
<td>召回正在休息工作人员</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>聘请本院退休职工</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
7.2.5 发生突发事件时，贵院是否能够优先为儿童、孕妇、老人以及残疾等弱势群体提供服务？□是□否□不知道

八、危机沟通与合作

8.1 贵院是否建立院内各部门应急沟通协调工作制度？□是□否

8.2 贵院是否主动与其他应急相关部门（如新闻媒体、疾控等）进行沟通协调？□是□否

8.3 贵院是否有其他应急相关部门的联系方式？□有□无
Appendix B

Ethical Clearance

Dear Miss Rong Tang

Project Title: Evaluation and analysis of hospital preparedness for public emergencies in Sichuan (China)

Ethics Category: Human - Low Risk
Approval Number: 1300000014
Approved Until: 6/02/2016 (subject to receipt of satisfactory progress reports)

We are pleased to advise that your application has been reviewed by the Chair, University Human Research Ethics Committee (UHREC) and confirmed as meeting the requirements of the National Statement on Ethical Conduct in Human Research (2007).

I can therefore confirm that your application is APPROVED. If you require a formal approval certificate please respond via reply email and one will be issued.

Decisions related to low risk ethical review are subject to ratification at the next available UHREC meeting. You will only be contacted again in relation to this matter if UHREC raises any additional questions or concerns.

Whilst the data collection of your project has received QUT ethical clearance, the decision to commence and authority to commence may be dependent on factors beyond the remit of the QUT ethics review process. For example, your research may need ethics clearance from other organizations or permissions from other organizations to access staff. Therefore the proposed data collection should not commence until you have satisfied these requirements. Please don't hesitate to contact us if you have any queries.

We wish you all the best with your research.

Kind regards

Janette Lamb on behalf of the Chair UHREC
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