



# Assessment of Physical Environment and Healthcare Facilities After Gorkha Earthquake in Kavrepalanchok District of Nepal

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**Abstract:** Natural disasters always pose a great challenge to the health systems and individual's health facility. In low-resource settings, disaster preparedness systems are often limited and not been well responded. If the health systems are well planned, the risk of occurrence and losses after disaster could be minimized. The devastating Gorkha earthquake 2015 destructed many health infrastructures that need to be reconstructed and maintained. Health care system of Nepal has always questionable in aspect of accessibility, availability and affordability that has been magnified by Gorkha earthquake. Field observation (FO), in-depth interview (IDI), focus group discussion (FGD), and questionnaire survey have been conducted in Kavrepalanchowk district of Nepal during 2020. Health services provided and their coverage of available health facilities is not adequate. Again, Nepalese community does not have sufficient knowledge of vulnerability of disaster and health preparedness during the disaster. The study would like to suggest for the preparation of reconstruction and recovery plan with people's awareness and resources mobilization for health infrastructure and connectivity.

**Keywords:** Physical Infrastructure, Health Facilities, Spatial Distribution, Recovery

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## 1. Introduction

Health facilities constitute the hospitals, health care centers, health posts, isolation camps, feeding centers, and other similar facilities. Health facilities are critical assets for communities both routinely and especially in response to earthquake like emergencies, disasters and other crises [1]. However, in special cases, some other facilities are also needed and are added for a quick response. There are 4282 health facilities including hospitals, health posts, community based and non-government health facilities established across the nation [2].

In April 2015, a 7.8 magnitude earthquake occurred with an epicenter 77 km northwest of Kathmandu. This earthquake flattened homes, buildings, and temples, causing widespread damage across the region and killing more than 9000 and injuring more than 22,000 people [3]. During any disasters, health care facilities as a public

service are experienced most vulnerable as demonstrated in the Gorkha earthquake in 2015. A total of 446 health institutions that includes five hospitals, twelve Primary Health Care Centers (PHCCs), 417 health posts, and twelve others were completely collapsed and 765 health facilities were partially damaged by Gorkha Earthquake 2015 [3]. On the other hand, sixteen other health facilities operated by private sectors and community institutions were collapsed. The general objective of this paper is to conduct the assessment of physical environment along with healthcare facilities after Gorkha Earthquake 2015 in Kavrepalanchowk District.

## 2. Literature Review

Every citizen shall have the right to obtain quality

health service in an easy and convenient manner and free basic health services of general emergency condition [4, 5]. Across the nation, there are wide variations in health services availability, utilization and health status across different socio-economic and geographical population groups, indicating the challenge of access and equity [6]. Drawing upon the lessons of the Gorkha earthquake 2015, government of Nepal (GoN) should revise health protocols and guidelines for improved emergency response at the central, district and local levels [6]. Available human resources and health institutions should be enhanced at different levels with pre-positioned buffer stock of medicines and supplies for effective and timely response. Also, the capacity of emergency operation centers should be enhanced and incident command system to be extended and implemented up to the local level [7]. In addition, emergency preparedness plan and disaster preparedness and response plan should be prepared and implemented at federal, provincial and local levels.

The incidence and magnitude of natural disasters including earthquakes have grown significantly, resulting in substantial economic damages and affecting or killing millions of people. Moreover, in an average of about two every minute, more than one million earthquakes occur each year globally. There is no doubt that we have achieved remarkable scientific progress in earthquake engineering during the past several years. However, achieving a high standard of health and safety against earthquakes is still a challenge for developing countries. It is because the engineering solutions for earthquake resistance are both expensive and technically demanding [8]. The economic analysis of such solutions is not often favorable compared with other development interventions.

Nepal having a low standard of buildings and infrastructure is one of the most vulnerable countries in the world to earthquakes (UNDP, 2009). It is again among disaster-prone countries in the world because it is exposed to earthquakes, floods, and landslides [7]. Nepal is one of the 20 most disaster-prone countries in the world [9]. Nepal is ranked 4th, 11th and 20th position in terms of climate change, earthquake, and multi-hazard respectively [10]. Other major disasters in Nepal are landslides, fire, drought, epidemic, storm, hailstorm, avalanches and GLOF [7].

Nepal has diverse geographical setting ranging the low land of about 60 m to highest peak of the world Mt. Everest of altitude 8848 m within 200 Km width of distance [11]. History shows that Nepal had experienced numerous big and small earthquake, and approximately in every 80 years major earthquake of high magnitude occurs. Nepal lies above two tectonic plates – Indian and Eurasian plate which makes the nation vulnerable to

earthquakes. Movement of Indian plate beneath the Eurasian plate is the major cause of numerous major earthquakes in the Himalayan region including the M8.0 Nepal-Bihar Earthquake in 1934 and the M7.6 Kashmir Earthquake in 2005 [12]. A magnitude 8.1 earthquake occurred in January 1934, at the Nepal-India border with epicenter (26.50°, 86.50°E) [11]. Many researchers had already made warning for the decades that Nepal was vulnerable to a deadly earthquake, particularly because of its young geology, haphazard urbanization, poor construction practice, and a lack of disaster preparedness [13].

Over 80 percent of the affected health facilities were from the most affected 14 districts and this affected the ability of these facilities to respond to the healthcare needs of vulnerable populations, including disaster victims, particularly in remote areas. The fragile public health infrastructure and inadequately trained public health personnel can accelerate the transmission of diseases in the post impact phase of the earthquake in Nepal [14]. However, the geographical isolation of rural community impedes the provision of proper public health-care facilities and experienced medical personnel that leads to poor health condition of rural people [15]. Again, haphazard in the spatial distribution of health facilities is another factor that magnifies the deficiency of qualities of health facilities [16].

The health facilities functioning were overwhelmed and there was acute shortage of medical supplies. As a result, capacity of local health system to respond injured people in disaster-affected areas was compromised and many health infrastructures yet to be reconstructed and facilities to be recovered. Yet hospitals are destroyed and health workers are often among the major casualties in earthquake, with the result that health services cannot be provided to affected communities when they are most needed [1].

Building retrofitting is the judicious modification of the strength, stiffness and ductility of structural members or of the structural system of buildings to improve the structure's performance in future earthquakes [17]. In seismic retrofitting, it generally includes increasing its strength or ductility of individual members or introducing new structural elements to significantly increase the lateral force resistance of the structure.

### 3. Methodology

Field observation, in depth interview with the local people and experts, focus group discussion, and structured questionnaire survey were the major tools used during investigation in the field has been conducted in Kavrepalanchok district, Bagmati Province, Nepal.

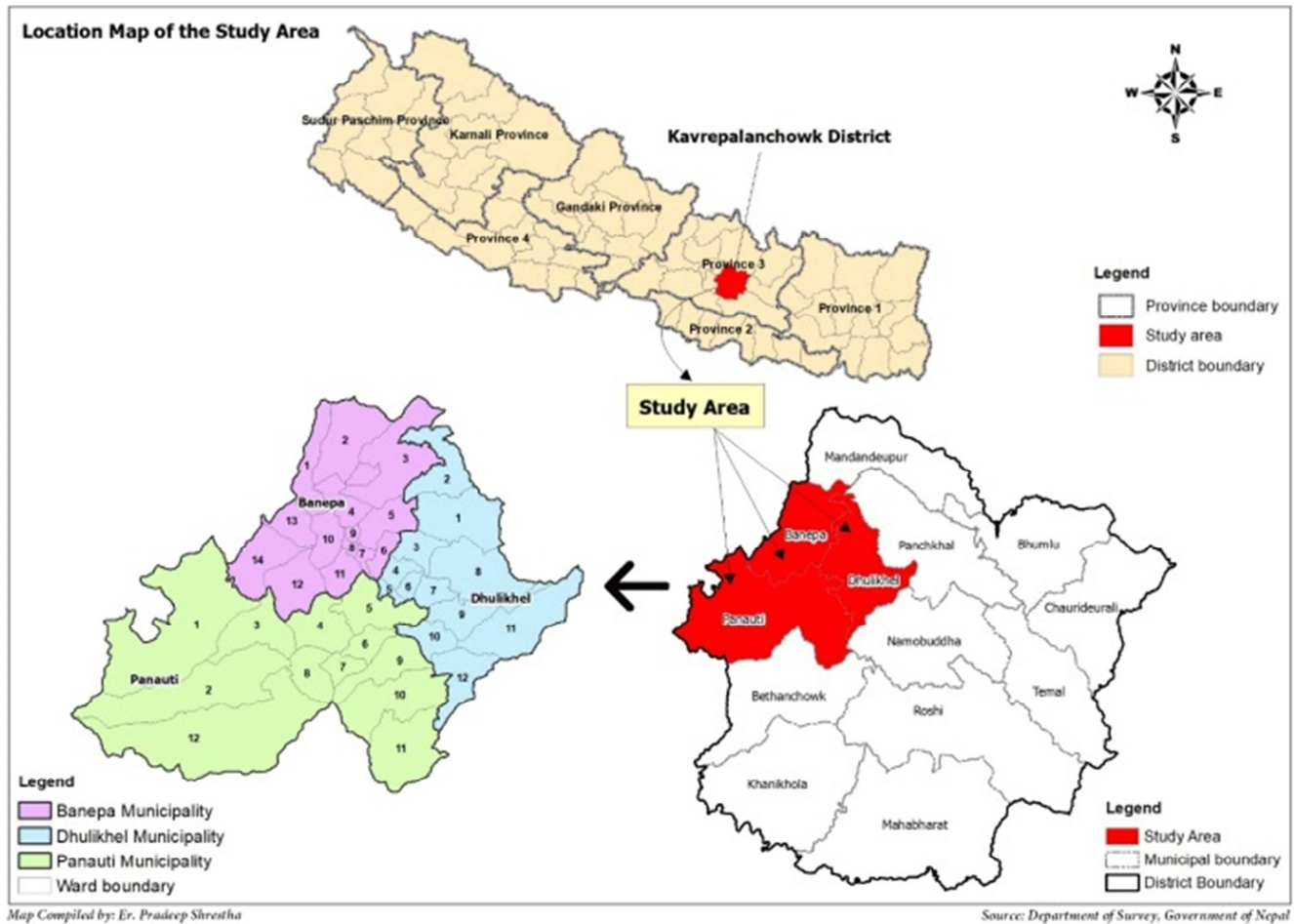


Figure 1. Map of Study Area (Source: Department of Survey, 2020).

Out of 160 health institutions providing the health services, a total of 102 respondents were interviewed who were residing in three Municipality. Relative Important Index (RII) is utilized in analyzing the retrieved primary data from the respondent. The weighted mean formula was used to calculate the index number as presented hereunder.

$$\text{Weighted Mean (W. M.)} = \frac{N(\text{V.P.}) \times 1 + N(\text{P.}) \times 2 + N(\text{F.}) \times 3 + N(\text{G.}) \times 4 + N(\text{V.G.}) \times 5}{5 \times \text{Total numbers of respondents}}$$

Where,

N= Number of Respondents

V.P. = Very Poor

P. = Poor

F. = Fair

G. = Good

V.G. = Very Good

From the above expression, W. M. value ranges from 1 to 5.

## 4. Results and Discussion

### 4.1. Access to Health Facility

Based field survey, 83% peoples have access to health care facilities, and the remaining 17% of respondents did not have access to any health care facilities. Within the study area only 65% of the health institutions have ambulance facility for transportation during emergency. More than 10% of the total respondents does not know about opening and closing time

of health institutions and even 28% of the people does not know the emergency contact number of health service providers to call during disaster and at health emergency. Only 70% patients were satisfied from the available facilities from the health service providers in the study area.

### 4.2. Health Facility During Earthquake

Many health institutions and their health facilities were badly affected during Gorkha Earthquake 2015. Out of 102 respondents, the weighted mean percentage, 90% of respondents were reported that the main cause of health problem was due to inadequate knowledge about earthquake, fatalities and their mitigation measures, and then 83% of total respondents were reported that health institutions were overloaded from injured people form earthquake. Similarly, inadequacy of health worker, people's awareness, vulnerability assessment and earthquake preparedness are the major causes of problems associated with degradation of

health service during earthquake.

#### 4.3. Priority of Health Institution Reconstruction

Collapsed health institution and the health services should be recovered as soon as possible as per the conditions of health infrastructure. It ranges from minor maintenance to reconstruction, new infrastructure and service recovery. The weighted mean percentage of 86% total respondents were reported that physical infrastructure of health institutions should be repaired, 62% of them were reported to reconstruction of building and other health infrastructure to rehabilitate the health care services. But about half of them were emphasized to new construction of health infrastructure with improved health facilities. The weighted mean percentage of rebuild the health facility is presented in figure (Figure 3).

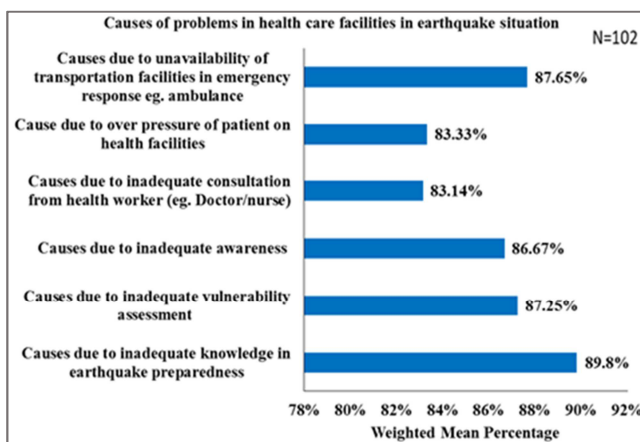


Figure 2. Responded cause of problems in health facility in earthquake situation (Field Survey, 2020).

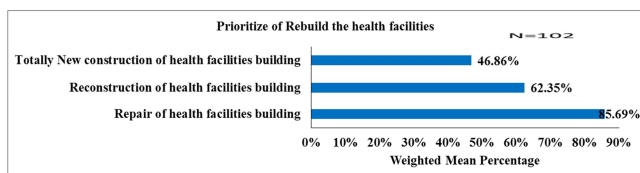


Figure 3. Responded prioritize of health service recovery (Field Survey, 2020).

#### 4.4. Health Services During Provide During the Period of Earthquake

Health camp, mobile emergency service and emergency response were expected from the health entities. Weighted mean percentage of 57% of total respondents were reported that it is necessary to provide emergency response to the affected community during the period of an earthquake and around 56% of total respondents were reported that the health institutions should establish health camp, emergency service, medical ward close to the community during the emergency rescue period of earthquake. The weighted mean percentage of services provided during the period of the earthquake is presented in figure (Figure 4).

#### 4.5. Impact on Health Care Facilities Due to Earthquake

Earthquake had affected the health care facilities structurally and non-structurally. About 74% health institutions had been damaged structurally and non-structural elements were damaged in 72% of health institutions. 70% of total respondents were reported that it has affected the transportation facility to go to the hospital. Health situation of the beneficiaries has been worsened as the quality of health care facilities was reduced due to effect of earthquake. Earthquake preparedness activities in health sector were also affected due to the effect of earthquake on health facilities. The weighted mean percentage of impact on health care facilities due to earthquakes is presented in figure (Figure 5).

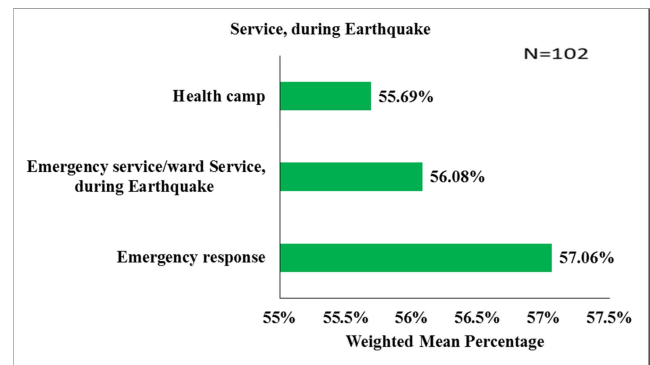


Figure 4. Expected health services during earthquake (Field Survey, 2020).

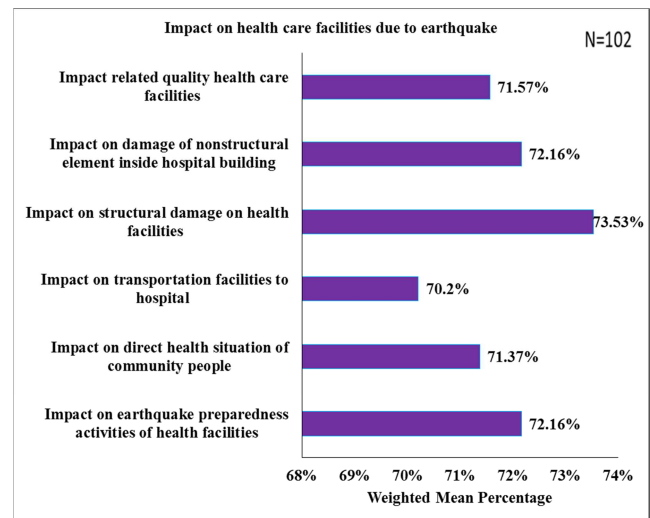


Figure 5. Impact on health facilities due to earthquake (Field Survey, 2020).

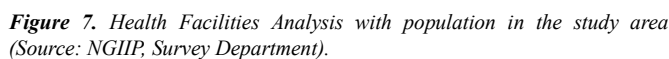
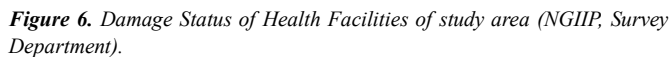
#### 4.6. Damages of Health Facilities

In the study area, 18 health related building were completely collapsed, 23 were found partially damaged and 55 had superficial damage wherever only six health related building were intact without any damages. Completely collapsed, partially damaged, superficial damage and no damage status of health institutions is presented in (Figure 6).

#### 4.7. Coverage of Health Services

Nowadays, accessibility to the medical institutions has

Seven governmental and non-governmental hospitals were serving health facilities for three municipalities. Among them one hospital was district hospital owned and operated by the government, so the government hospital is necessary to be established to provide affordable and reliable health services from low to the middle-class community. Again, it was found that health facility is only centralized in the urban area that need much longer travelling time to the rural community.



Out of 102 responded, the weighted mean percentage, around 94% of total respondents were focused on public awareness on earthquake preparedness and earthquake resilience structural measure as the solution and 89% of total respondents were reported that the solution as an effective contingency plan in earthquake situation to improve the combination between health facility and community. Early warning system in the community, rapid response medical

**Suggested solution to improve health care mechanism during earthquake**

N=102

Solution	Weighted Mean Percentage
Solution as Early warning system	90%
Solution as stand by rapid response team	89.8%
Solution as emergency response plan of health care facilities	89.22%
Solution as emergency roster of human resources (Doctor, Nurses etc.)	89.41%
Solution as effective contingency plan in earthquake situation	88.63%
Solution as regularity on adequate funding to health care facilities	89.02%
Solution as non-structural measures for preparedness	89.61%
Solution as earthquake resistance/resilience structural measures	93.33%
Solution as public awareness on earthquake preparedness	93.73%

86% 87% 88% 89% 90% 91% 92% 93% 94% 95%

**Weighted Mean Percentage**

## 4.9. Discussion

The main purpose of the IDI is to obtain and gain the depth knowledge about information and awareness, technology and performance of health facilities and combination of both. The findings of IDI with respect to the checklist and open-ended questionnaire are: there is lack of staff of trained manpower, equipment and tools, tents, food, medicines, and so on.

Difficult to manage the transportation, supply of relief materials, and medicines/ vaccine, faced the lack of staff preparedness and planning to communicate with the community. Furthermore, week reparation of disaster management plan, lack of knowledge about the national action plan for the safety of health facilities. Most of the hospitals/ health posts rejected offers of medicine and doctors. Furthermore there are maximum problems to manage pregnant women during the period of the earthquake. Awareness, self-consciousness to the emergency condition, and support to others during a disaster are also the emerging problems after earthquake 2015 in the study area.

## 5. Conclusions

Damages of health infrastructure and its connectivity, inadequacy of health workers mobilizations, people's awareness, and lack of vulnerability assessment and earthquake preparedness are the major problems associated with degradation of health service during earthquake. Health situation of the beneficiaries had been worsened as the quality of health care services was reduced. Early warning system in the community, rapid response medical team in emergency response plan each health institutions, adequate funding mechanism for effective resource mobilization in emergency could be part of contingency plan of the local government. Hospital services localized only at urban area that need much longer travelling time for the rural community. It is recommended to establish hospitals for affordable and reliable healthcare services to cover urban as well as rural community.

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