

## **Development of Monitoring Application for Living Environment by Crowd Sourcing in the Post-Nepal Earthquake Shelters: A Consideration from Nursing Science**

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### **Abstract**

Public health risk is crucial in disaster response. Population density in evacuation sites is also a problem for survivors. Critical attention should be paid to hygiene control in shelters to maintain minimum health safety level. The study aimed to assess living environmental conditions and health risks through real time communication with local nurses and evacuees and to transfer information to other organizations where informed decisions can be made to prevent communicable diseases before an outbreak.

A toolkit was developed to create an Application Programming Interface (API) for data sharing with other health sectors and national surveillance by the Ministry of Health and WHO. Toolkit consists of simple software with paper and smartphone application, and it is in layman's terms for Nepali nurses who are the main users.

A two-day workshop was conducted with representative nurses from the disaster affected areas to collect information about shelter(s), to discuss specifications of the survey tool kit, and to provide skills training on monitoring and rapid assessment. Monitoring was conducted by trained local nurses using the toolkit in Kathmandu for 4 months at 26 Camps in 9 affected districts (Kathmandu, Gorkha, Dolakha, Sindhupalchok, Nuwakot, Rasuwa, Bhaktapur, Lalitpur), and common diseases such as diarrhea, eye problems, hypertension, and skin diseases were detected. Data were reported to appropriate organizations and were analyzed as open data sources. Accessibility and response rates differed depending on geographical and social context vulnerability. Traditional paper and telephone method for data collection took more time than the smartphone application

Crowd sourcing application for obtaining human security information using simple technology to provide actionable information through daily monitoring could impact future disaster response. Also response networking for treating signs of outbreak in real time with validated information is crucial for reducing incidence of communicable diseases. There is a need to take urgent steps for health risk reduction through improved availability of disaggregated data and develop a sustainable network as social capital to ensure that no one is left behind in disaster mitigation. Development of trans-community preparation for comparative decision making for prompt disaster response is an urgent task. It could form part of a whole health strategy including disaster risk in order to attain Sustainable Development Goals and allot the work depending on literacy and skills of the community.

### **Mapping out nursing science**

In March 2015, the "Sendai Framework for Disaster Risk Reduction 2015-2030 (SFDRR)" was adopted by the Sendai Committee at the third UN World Conference on Disaster Risk Reduction. The Framework of SFDRR has established the year 2030 global goals and objectives, such as including large-scale reduction in the number of death and victims from disasters; prioritized reduction in human man-made disasters through such measures as scientific validation of disaster risk and academic and

international cooperation; and firmly emphasized securing human safety, peace of mind, and health. Before getting excited about having a framework in place, we should pay attention to the many regular natural disasters due to climate changes that lead to subsequent manmade, complex disasters. Consequentially, damages from these multi-faceted disasters are often more complicated to restore due to large scale loss of infrastructure, system, and population. Governments and affected populations have to manage a complex, unpredictable interplay of

social, economic, and environmental shocks and disturbances in this setting. Hence, it is more cost-effective to adopt comprehensive multi-risk approaches to protect and enhance lives, livelihoods, and assets. Maintaining livable environment in times of disaster is central to disaster risk reduction efforts, especially in terms of securing health.

Emergency health situations often occur as a consequence of a primary disaster of great magnitude due to its impact on the living environment. An outbreak of communicable diseases (CD), for example, is common among displaced populations in the aftermath of a large scale disaster. This usually occurs due to poor access to basic needs such as adequate shelter, clean water and sanitation, sufficient nutrition, and primary healthcare services. In addition, the relationship between the occurrence of a disaster and an outbreak of CD is reported to be associated with the size and characteristics of the displaced populations (reference). In developing countries, lack of adequate infrastructure and resources, inexistence of disaster preparedness programs are among factors that contribute to increased risk of epidemics following a humanitarian crisis. In these countries, malnutrition represents an important public health issue, as it weakens immunity and increases vulnerability to infectious agents. Critical attention should be paid to hygiene control in shelters to maintain minimum health safety level. In this context, conditions in living environment is central to disaster risk reduction for health. Reducing risks involve changing behavior. A “people-centered” disaster risk reduction approach requires greater consideration on human behavior.

Reducing risks involves changed behavior and lifestyle during a temporary settlement period after disaster. A “people-centered” approach to disaster risk requires greater human behavioral consideration on how people interpret and live with risks, and how individual perception, knowledge, attitude contribute to putting them in vulnerable situations.

Definition of nursing states that nurses share with other health professionals and those in other sectors of public service the functions of planning, implementation, and evaluation to ensure the adequacy of the health system for promoting health, preventing illness, and caring for ill and disabled people within the total health

care environment. Local nurses are crucial in disaster response, and training nurses to obtain human security information through use of ordinary technology to provide actionable information will impact the future practice of disaster response from experiences of daily monitoring. They have to pay more attention the hygiene control to maintain minimum health safety. They might know that to change societal behavior reforms in institutional policies and procedures must co-evolve with health environment changes related to people’s beliefs, norms and values that provide a motivating force for a particular type of behavior.

The presentation aims to explore how the data collected by local nurses could become the basis of the daily community health information system, which could be the monitoring model and benchmark of Nepal toward SFDRR from the point of view of nursing science. Nepali local nurses gather first-hand information from evacuees in shelters and transmit data in near real-time communication to other health organizations. They would make informed decisions on preventing communicable diseases before an outbreak, through action research which assesses living-environmental conditions and health risks, to improve the quality of reporting system in shelters, to enhance organizational development through teamwork around data collection, and to improve the quality of care by linking community and government surveillance records.

### **Settings**

Monitoring was conducted by trained local nurses using the toolkit in Kathmandu for 4 months at 26 Camps in 9 affected districts (Kathmandu, Gorkha, Dolakha, Sindhupalchok, Nuwakot, Rasuwa, Bhaktapur, Lalitpur) (Fig, 1).

### **Implementation**

The Japan-Nepal team for this research started a collaborative work of risk assessment and monitoring of CD cases and reproductive health in remote Nepalese districts that were affected by the mega earthquake in April 2015. An onsite inspection and fieldwork by the team in remote areas during the last trimester of 2015 made the team realize that no proper relief had been provided to a number of disaster-affected areas. Evacuees with health problems did not benefit from any medical assistance, and, in areas without a rural primary health center, they rarely visited health care providers based in health facilities

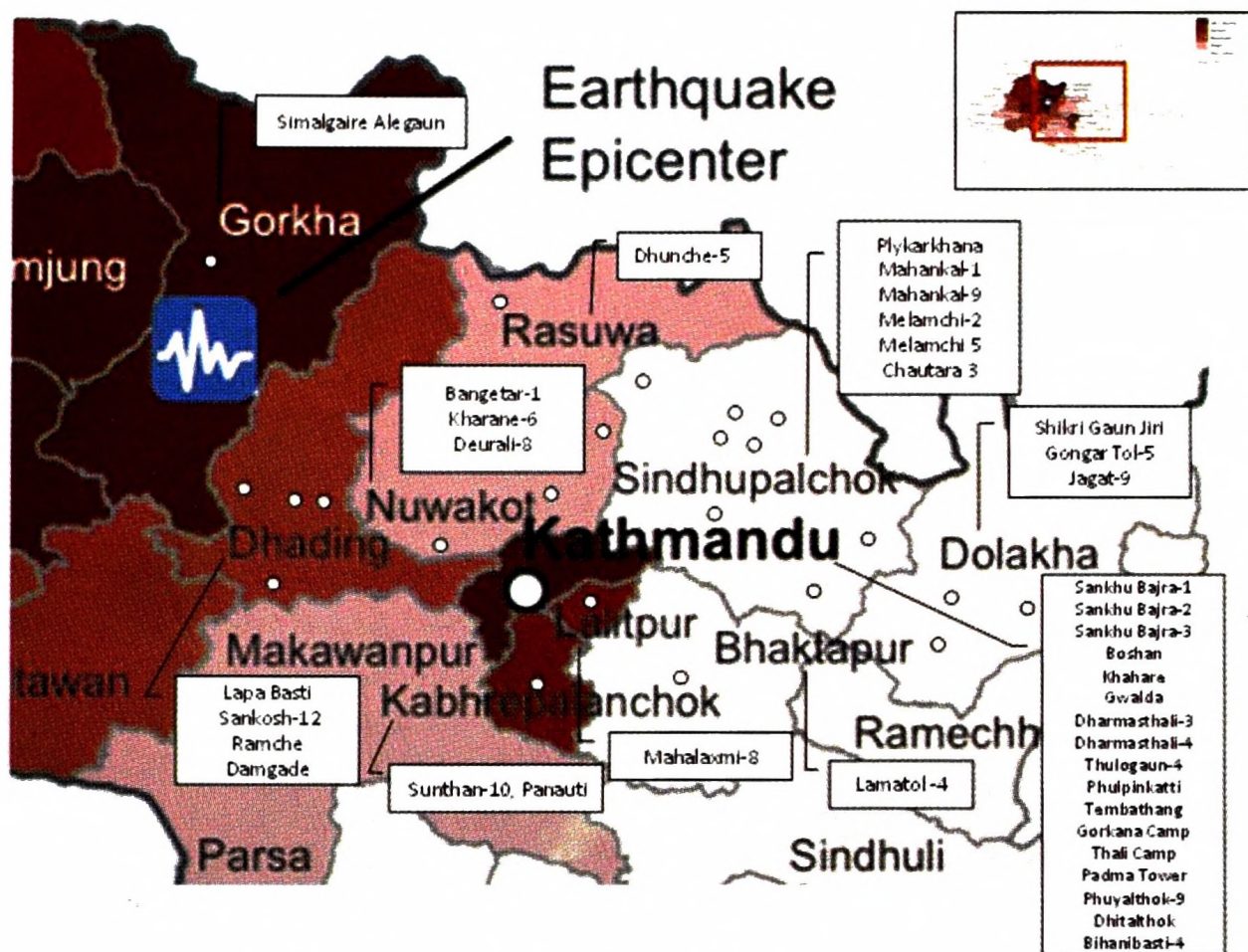


Fig. 1. Location map of the Shelters monitored

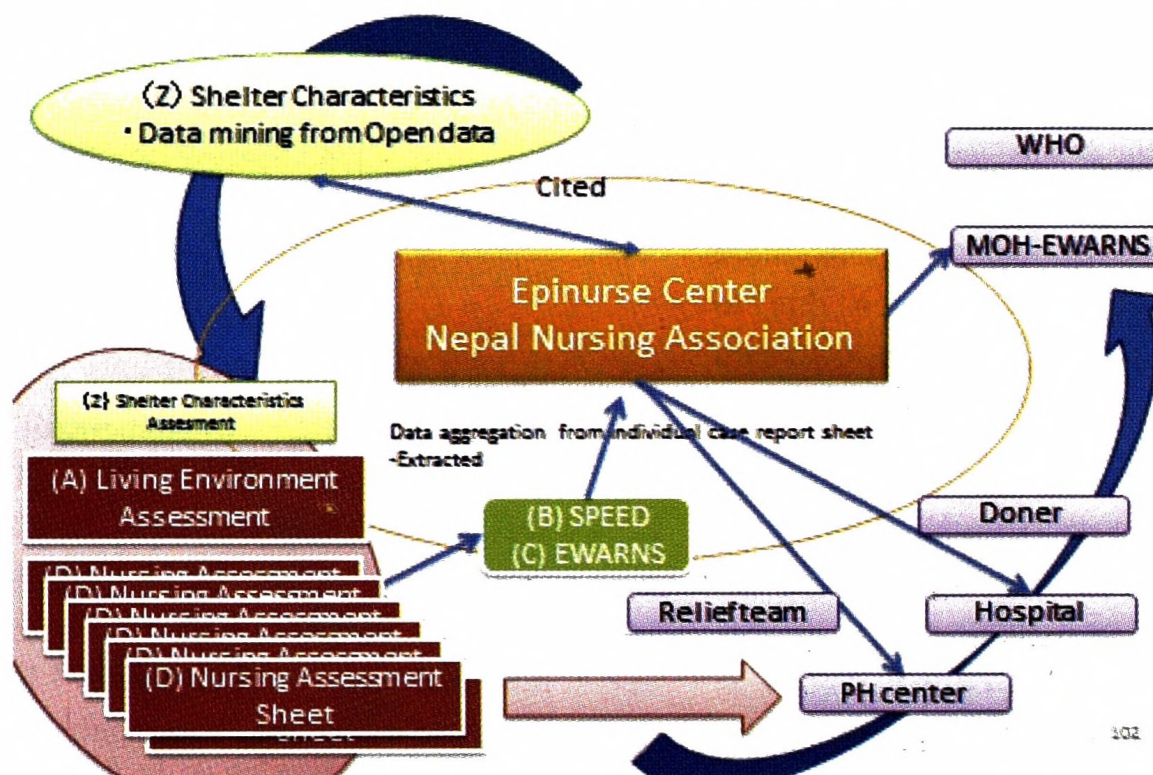


Fig. 2. Framework of the study

Moreover, pregnant evacuees delivered babies in village shelters built by villagers themselves. Such health and security issues occurring in disaster-affected communities in remote areas were not being monitored, and there were looming threats of outbreaks of CD cases among local population and neighboring districts

The health risk assessment is carried out by local nurses who visit the shelters in the earthquake affected districts. These nurses called EpiNurse carry a tool kit to do monitoring. The toolkit consists of simple software with paper and smartphone application, and it is in layman’s terms for Nepali nurses who are main users. The items in this toolkit include living environment assessment

and item of Surveillance in Post Extreme Emergencies and Disasters (SPEED), which was conceptualized to provide real time health information reporting after a disaster developed by WHO/WPRO, and a post-disaster early warning alert and response network (EWARN), which have been used by Ministry of Health (Appendix.1).

In this way, the toolkit was developed to create an Application Programming Interface (API) for data collection and sharing with other health sectors and national surveillance by Ministry of Health and Population (MoHP), and WHO. Site-specific thresholds based on historical data could not be calculated because of the absence of pre-disaster surveillance data.

Any unexpected event reported through the event-based surveillance was treated as an alert. A follow up network was established with WHO and MoHP to deal with signs of outbreak (Fig. 2).

#### Setting

A two-day workshop was conducted with representative nurses of the disaster affected areas on collecting information about shelters, specifications of the survey tool kit, and skills training on monitoring and rapid assessment.

#### System Performance

Periodical shelter to shelter visits by volunteer nurses in these areas to conduct CD risk assessment with the use of EpiNurse Center and health status assessment tools as well as relief needs inventory for community members and the monitoring of cases with potential risk of CD outbreak is of utmost importance at the post-disaster recovery phase; such events should be reported to governmental agencies and health clusters as well, so that they can be informed about real living conditions and health needs of disaster-affected communities in remote areas. The results showed that accessibility and response rates differed depending on geographical and social context vulnerability. Traditional paper and telephone method for data collection took more time than the smartphone application due to accessibility. To solve this problem, we developed new application collaborated with the local NPO as in Fig. 3.

#### Discussion

Surveillance was limited by the relatively small sample size and sampling method. However, this is a broad study that included all affected districts that are geographically represented. All participants were local nurses who worked and lived in the community and were likely to be familiar with conditions of the study areas. The process of the post-disaster action research is complex and challenging for many reasons. Development of trans-community preparation for comparative decision making for prompt disaster response is an urgent task.

There is also a need for health risk reduction through improved availability of disaggregated data and development of a sustainable network as a form of social capital in disaster mitigation. Crowd sourcing application for obtaining human security information using simple technology to provide actionable information through daily

monitoring could impact future disaster response.

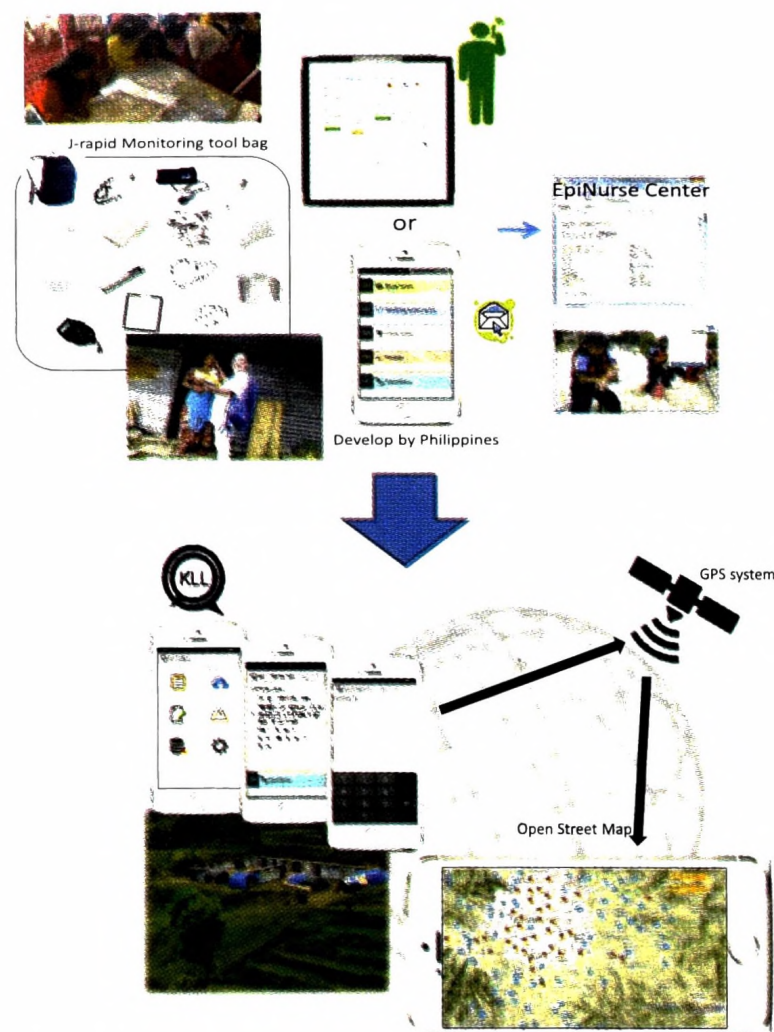


Fig. 3. Initial tool kit on Monitoring and customized tool based on lesson learned

During monitoring training, the EpiNurses were educated on the purpose of the study and became committed to usage of the new tool. This enabled them to maintain a sense of control, build further support during implementation, and also minimized resistance to change. As well as solving the immediate practical problems after disaster, a significant outcome was that the research process helped initiate, develop and maintain new opportunities for professional dialogue as nurses, community leader and other stakeholders such as local government, central government and relief organization worked towards the common goal of improving health care for community people. This process helped in building a team in a hierarchal environment where professionals were not used to this mode of operating in daily situation. EpiNurses had the opportunity to work in new ways with community workers and social workers who were usually at different work places within the health system. In local communities, nurses collect information about and mitigate CD risks. The data produced and their improved quality confirm the claim that this information can assist with allocation of resources, establishment of budgetary and long-

term planning, and productivity measurement and allotment of the work depending on literacy and skills of the community. Capacity building for participants to coordinate actions and interventions effectively and carry out periodical onsite risk assessment was crucial. Effective leadership may be also necessary to manage improvement in reconstruction settings. Being members of every part of the health care system, they can become critically needed leaders in emergency management and disaster preparedness. Nurses can manage disaster hospitals as well as community setting. They can play a vital role in restoring public health (water, sanitation, food, and shelter) under disaster condition, identifying high risk and vulnerable population and dealing with the unique needs of children in disaster. Without formal education and drilling, competency cannot be developed in disaster nursing. It was difficult for local nurses to make decisions on how to create a system that would allow smooth cooperation between stakeholders. Nurses who discovered other health problems and responses on site reported them to EpiNurse center.

It is not easy to visualize the contribution of nursing due to the wide range of flexible activities in the community. Through interdisciplinary work, the EpiNurse center helped to improve the accuracy of data recorded by nurses. With data recorded by the very person providing care, risks of communicable diseases would decrease. The increased accuracy of data at the EpiNurse Center also may be explained by the increased accountability of nurses toward collected data. Fluid data that were previously not collected such as living environment were now available, could be aggregated and used in a national reporting system by crowdsourcing and IoT. The reciprocal process, in which the researcher and practitioners informed each other, established new knowledge and effective problem-solving actions using technology. As a result of the research team working directly with the nurses as health professionals who know the community, they demonstrated increased professionalism. The national nursing association should be supportive of such simple changes that enhance the working environment for nurses in a sustainable way. Improved science and technology allows quicker coordination, communication, and results. The SFDRR signals a clear mandate to the science,

technology, and innovation community to be human centered to improve the resilience of communities and save lives.

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**(A) Living Environment Assessment**

Estimate population	Toilets available	Acceptable cleanliness
Estimate population under 5 years	Adequate number of toilets	Blanket or other items
Type of shelter	Distance toilet – dwelling place	Unusual symptom
Security/safety assured	Hand-washing facilities	Unusual disease/event, outbreak...
Type of drinking water source	Soap available	Health care services on site
Adequate water supply	Clothing	Psychological support/counseling
Safe and clean food items provision	Non-food item	Nursing care
Kitchen	Source of light (electricity)	Characteristics of this shelter
Appropriate waste storage	Acceptable spacing	

**(B) Surveillance in Post Extreme Emergencies and Disasters (SPEED)**

1. Fever (FEV)
2. Cough, colds or sore throat with or without fever (ARI)
3. Fever with rash (MEA)
4. Fever with spontaneous bleeding (i.e. nose bleeding, gum bleeding) (AHF)
5. 12 months and over: sudden onset of fever (> 38° C) with severe headache and stiff neck;< 12 months: fever (> 38° C) with bulging fontanel, or refusal to suckle (MEN)
6. Fever with headache, muscle pains and any of the following: eye irritation, jaundice, skin rash, scanty urination (LEP)
7. Yellow eyes or skin with or without fever (AJS)
8. Fever with other symptoms not listed above (FOS)
9. Loose stools, 3 or more in the past 24hrs with or without dehydration (AWD)
10. Loose stools with visible blood (ABD)
11. Open wounds and bruises/burns (WBS)
12. Fractures (FRS)
13. Skin disease (SDS)
14. Animal bites (ANB)
15. Eye itchiness, redness with or without discharge (CON)
16. Spasms of neck and jaw (lock jaw) (TET)
17. High blood pressure >140/90 (HBP)
18. Known diabetes (KDM)
19. Difficulty in breathing and wheezing (AAA)
20. Floppy paralysis of the limbs which occurred recently in a child < 15 years who is previously normal (AFP)
21. Visible wasting with or without bipedal pitting edema (AMN)

**(C) Early Warning Alert and Response System (EWARS)**

- |                                       |                                    |
|---------------------------------------|------------------------------------|
| 1. Influenza Like Illness             | 5. Suspected cholera               |
| 2. Severe Acute Respiratory Infection | 6. Fever with Jaundice             |
| 3. Acute Watery Diarrhoea             | 7. Fever with rash                 |
| 4. Acute Bloody Diarrhoea             | 8. Fever without rash and jaundice |

**J-rapid Monitoring tool bag**

- Bag
- T Shirts
- Stethoscope
- Sphygmomanometer-B.P
- Towel
- Basal thermometer
- Alcohol
- Torch
- Globes
- Mask
- Weight machine
- Soap
- Measuring tape
- Tablet