

Early Warning System for Disasters within Health Organizations: A Mandatory System for Developing Countries

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ABSTRACT

Background: Disaster identification and alert systems can be processed in different ways. An early warning system is designed to detect impending danger and send appropriate and clear signals to at risk communities and organizations at the right time and in an unambiguous way. This study aimed to determine early warning system for disaster within health organization in Iran.

Methods: This article presents the findings of a mixed-methods study of early warning systems for disaster management within the health organizations in Iran. During the years 2011 to 2012, a sample of 230 health managers was surveyed using a questionnaire and 65 semi-structured interviews were conducted with public health and therapeutic affairs managers who were responsible for disaster management.

Results: A range of problems were identified. Although there is a multi-agency alert system within the health organizations, other indicators of early warning system are not satisfactory. Furthermore, standard messages which are used to alert organizations are not used under the current system.

Conclusion: Some activities such as memorandum of understanding among different stakeholders of disaster response and education of staff and communities could improve the response to disasters within the health organizations.

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Introduction

The need for an early warning and disaster detection system is obvious and repeatedly mentioned by researchers¹⁻⁸. Signals can be differentiated in two dimensions. The first dimension pertains to the source of a signal and the second pertains to the nature of a signal. With regard to the first dimension, signals of impending trouble can originate from either inside or outside an organi-

zation. With regard to the second dimension, signals can be either technical (they are recorded by remote sensing devices), or noticed by people (Fig. 1).

In general, all of the four kinds apply to every organization. The second stage is that once a signal is picked up, in order to be recognized, certain criteria must be specified such that if defined levels of intensity for

those criteria are exceeded, then an alarm is triggered. Once an alarm is sounded, then it must be heard and understood by the right person, organization, or instrument. Signals go off frequently in organizations, but if there is no one there to recognize, record or pay attention to them, they are not acted upon⁹. It is important that information on the disaster situation is disseminated and that communities are reminded of safety measures to be taken. Ensuring that systems planned for are in place and in working order and reviewed is vitally important¹⁰.

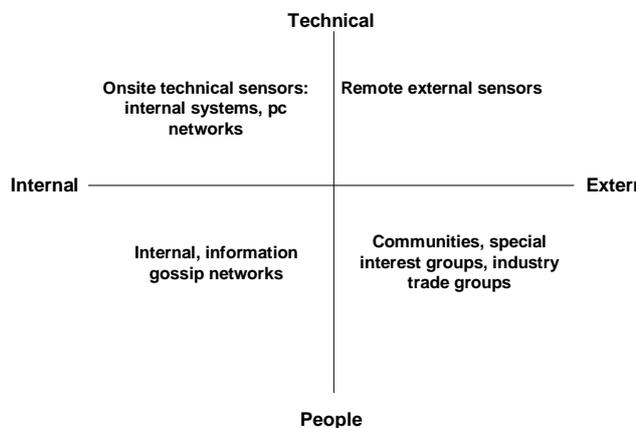


Fig. 1: Types of warnings (Mitroff, 2004:72)

With regard to warning signals and early warning system the following are key principals and components;

- All disasters should ideally be preceded by pre-agreed early warning signals
- Signals are not self-amplifying or self-blocking. They are part of and reflection of the overall structure of an organization and does not exist by themselves
- Signal detection is a direct reflection of our priorities that is also necessitates signal detectors
- As different types of disasters send out different types of signals, different disasters require different detectors
- There are four kinds of signals which apply to every organization: Internal technical signals; internal people signals;

external technical signals; and external people signals

- Every signal detector needs a signal monitor. Once an alarm is sounded, then it must be heard by the right person who knows what to do with it. Also signals have to be transmitted to the right people⁶.

The aim of quantitative phase of this study is survey the early warning system in place to support health organizations in Iran. And the qualitative phase of this study tries to understand to what extent the current system of early warning is able to pick up accurate information and then transfer such information to the right people and organizations at the right time and in the right manner.

Materials and Methods

A mixed-method, based on qualitative and quantitative data collection, was adopted for this study. Although mixed-methods studies are time consuming, they have several advantages¹¹. The validation of research data and methods through triangulation, encouragement of creativity that could stimulate further work, expansion of the scope of the study, and more confidence in the results are among the benefits of using a combination of methods¹². This study had two parts: semi-structured interviews and a cross-sectional survey using questionnaires. These two processes were performed by the authors in a single period of time simultaneously.

Phase 1: Qualitative Phase

Purposive non-random stratified sampling was used. A total of sixty-five public health and therapeutic affairs managers in different levels of the health organizations were interviewed. The interviews were semi-structured and conducted face-to-face by the first author. The protocol followed for the interviews consisted of asking the participants about their background, the nature of their activities, their commitment and type of activities their organization normally conducted

regarding early warning and informing personnel and public, preparedness, response and recovery.

A total of sixty-five interview performed this study. Interviews were performed in the managers' office and lasted between 20 and 78 minutes, averaging approximately 46 minutes. Prior to the recording of the interviews, their consent was obtained and confidentiality assured. The majority of the interviewees agreed to record the interviews. The interviews were then transcribed. After the interviews were over, they were transcribed and a version of the transcription was sent to the interviewee for confirmation. Framework analysis was used next and then thematic analysis was implemented with Atlas.ti 5.5 software, a software package designed to facilitate the analysis of qualitative data, was used. Framework analysis developed by Ritchie¹³. The authors coded all segments of the text and compiled themes according to these codes. During this process, ideas expressed by interviewees were reconstructed into meaningful categories, combining same or similar codes. By induction, we identified new significant ideas that emerged from the interviews.

To increase the robustness of the analysis, triangulation technique was used¹⁴. The results of the analysis were discussed with some of the interviewees and their comments and suggestions were considered for the final analysis.

Phase 2: Quantitative phase

In this qualitative phase, a random sample survey of 230 health managers across the country was carried out. The response rate was of about 50%, as 114 completed questionnaires were collected. The questionnaire included participant opinion related of early warning approach (Appendix 1) and used a five-point Likert scale. Validity and reliability of the questionnaire of the study was determined using content validity and test-retest method. Hence, after searching in scientific references and using opinion of the professionals, the questionnaire was validated. In order to determine the reliability of the ques-

tionnaire, 9 questionnaire were distributed in a 10 – days period, and homogeneity of the answers was calculated. Retest coefficient of the questionnaire was 89% ($r = 89\%$), this shows its reliability.

After consultation with a statistician and the literature it was decided to assign a value of 1 to 5 for completely disagree, to completely agree respectively. It was decided to consider 70 percent of total score ($5 \cdot 70 = 3.50$) as a criterion to accept a variable and one sample, one tail *t*-test was performed to test the hypothesis for each question. SPSS software was used for data analysis.

Results

Overall, 50% of interviewees were male, and 75% of them were found to hold a 15 years experiences or above. Based on the qualitative results, danger identification and alert systems can be processed according to different routes. It was reported by the majority of the interviewees that the most frequent route for early warning in their system are coordinating centre (This office is trying to distribute casualties and those patients who need special care such as Intensive Care Unit (ICU) or Coronary Care Unit (CCU) among hospitals. This office has up to date information about available beds at different hospitals), and disaster management centre. The most frequent communication tools are mobile and landline telephones and pagers. There were some discussions with participants concerning expansion and restructuring of the alert system so as to move towards an ideal alert system. Some senior managers highlighted the fact that the system should include sensors, warning and alerts. In designing such a system they believed that interaction, cooperation and collaboration between different organizations are necessary.

“...sensors, early warning and alert systems are important. While we start at local level to design and set up our sensors

for early warnings, we must consider horizontal and longitudinal cooperation and collaboration across all involved organizations. This means health house, should have horizontal interaction with village governor and voluntary forces. There should also be longitudinal interaction across all involved health center. Health center should collaborate with city governor, Red Crescent and other voluntary organizations. All should function under the control of a network manager who should in turn liaise with regional and city governors, Red Crescent and voluntary organization centralized command centers. There should also be effective liaison with the leadership within medical universities.”

Different tools for warning purposes are used in different countries. In Iran, colour codes (Red, yellow and orange are three common color codes. Yellow color code means the organization must make sure all equipment are in place and ready to use; orange code means the organization must recall 60% of personnel and mobile teams and equipment must be ready and finally red color means the organization must be ready in full capacity) are supposed to be used. The majority of interviewees when were asked if they use this system in real emergency or manoeuvres, responded negatively.

All participants seemed to believe that to increase the performance of early warning system Memorandum of Understanding (MOU) must be signed by all involved stakeholders. There was also a need expressed that the language used in warning in one organization might not be understandable in another organization. Thus, warnings should be translated into a simple, unambiguous language.

“We must have stronger links with other organizations. At the moment some of the warnings are not rigorous or effective. For

example the weather organization might say we will have heavy rain but does not specify the exact place. Also, sometimes the language they might use is not understandable for me and I cannot decide how much I should be ready.”

The importance of community education and sensitisation about different alert systems: how to make a distinction and how to use the alert system was highlighted by the managers. One senior manager shared his experience of observing significant different degrees of system failure during disasters across communities. Those which had proper systems and backing education fared better compared to those with poor and inadequate systems. Another senior manager described a case where there was involvement of auxiliary health worker (Health worker in a health house is called Behvarz. Usually a village in Iran has a health house and in each health there are male and female personnel who may work separately or jointly) in the warning of his community at an early stage, and how this saved many lives.

“In the Lorestan earthquake I know a village which just one person died, whereas the whole village was destroyed completely. Auxiliary health worker in the village had knocked at all houses at night and asked or forced them to sleep outside their home. The reason for this was that there was a four Richter scale earthquake the night before and it was supposed to be a warning for a bigger earthquake. The only person, who died was an old lady who didn't come out of her home.”

Based on the quantitative results in the survey, we asked respondents about the following six statements to test the early warning system and ask them to choose how much they agree or disagree using the five-point Likert scale: ‘our organization has early warning signal detection systems for any dis-

aster or at least the most likely disasters (Big bang, rising tide...); we have a 24 hour alert system using automatic pager system or telephone cascade; our plans contain arrangements to communicate with relatives of casualties and personnel; we register all related hazards in-outside organization; a special team or committee studies previous warning signals inside and outside the organization and tracks potential warning signals; and our

organization is part of multi-agency plan for warning and informing the public'. Results regarding the last statement show that respondents believe they have multi agency plan for warning the public (the "agree" mode was predominantly chosen). But, for all the other questions, the respondents disagreed with the statements (Table 1). This means that other early warning criteria were not met by the organizations.

Table 1: Early warning indicators in health organization in Iran based on interviewer opinion

	Early warning indicators	Respondents (n)	Mode
1	24 hour alert system	112	Disagree
2	Plans contain communication with relatives of casualties, personnel	112	Disagree
3	Early warning signal detection systems	113	Disagree
4	A special team studies previous warning signals in-outside the organization	112	Disagree
5	Register all related hazards in-out	112	Disagree
6	Organization as a part of multi-agency plan for warning and informing public	112	Agree

Appendix one: Questionnaire

Please indicate the extent of your agreement or disagreement with the items below (disaster=major incident).

[Five-level Likert scale was: Strongly Agree / Agree / Neutral (or I don't know) / Disagree / Strongly Disagree].

- Our organization has early warning signal detection systems for any disaster or at least the most likely disasters (Big bang, rising tide...)
- A special team or committee studies previous warning signals inside and outside the organization and tracks potential warning signals (risk assessment)
- We have 24 hour alert system of automotive pager system or telephone cascade
- We register all of hazards inside and those outside which are related and important to our organizational objectives

- Our plans contain arrangements to communicate with relatives of casualties and personnel
- Our organization is part of multi-agency plan for warning and informing the public

Discussion

Early warning system serves as a key component of disaster preparedness¹⁵. It includes early warning signal detectors, damage control and warning systems. Disaster mechanism refers to the fact that virtual disasters send out warning signals far in advance of their actual occurrence. Once a signal is picked up, a primary alert assessment determines whether the signal reaches the threshold suggesting imminent or potential danger. If an alarm is sounded, it must be heard by the right persons, organizations, or instruments⁹. It is acknowledged that a warning system is essential so that people may receive the maximum benefit from pre-disaster planning, or for example to receive timely warning of attack^{16, 17}. Several ministries appear to have some parts to play

in the early warning process and there is fragmentation of responsibility among different organizations². Multi-agency plans for warning the public have not been considered. Stakeholders including agencies and organizations which are expected to take action, and those likely to be affected by an extreme event are not cooperating and coordinating their activities. A research project in Saudi Arabia found similar results showing that ministries did not have any clear responsibility in the early warning system^{17, 18}. Health authorities must collaborate with other involved organizations to understand the accuracy and timing of warnings, in order to develop mechanisms for coordination during an extreme event. A system should be developed in collaboration with all relevant stakeholders to ensure that the issues of greatest concern are identified and addressed, thus increasing the likelihood of good preparedness.

Furthermore as signals may originate from external or internal sources and warning could come from different internal and external sources⁶ an MOU or Memorandum of Agreement (MOA) between health organizations and other organizations such as police, armies, and municipality is required. Warnings come from different sources to the relevant health response organization such as hospitals, health centres and medical universities. After receiving the alert, an alert assessment must be performed and if it is necessary a control room is set up. The control room assesses the needs and priorities. This is done by a team or individual who, depending on the magnitude of the disaster, may alert or summon other organizations and disaster stakeholders to assist. The most important parts of this model are a pre-agreed MOU or MOA, alert assessment mechanisms in place, control rooms set aside and methods to describe damage or needs assessment. It is also important that key assets, key personnel, alert codes, pre-agreed statements, pre-agreed forms, and communication tools and strategies such as mobile phones must be in place and functioning. This also applies to internet,

wireless communication and other communication systems.

Based on approach of world health organization, early warning system must be designed to inform the people and local authorities for confront of adverse condition and conduct the effective efforts to reduce the negative effects of disaster¹⁹. One of the basic requirements of effective measures has the adequate infrastructure with in health organization and political willingness. The governments according to their circumstances must be have forecasting of the event, prediction of Predict control methods, an effective efforts to increasing the health outcomes and finally timely response and evaluation of the national health disaster plan²⁰.

Early warning signal detection systems, registration of all related hazards both inside and outside organizations, and the existence of a special team or committee to study previous warning signals and tracks potential warning signals are the main infrastructure to identify and forecast events. Creating an infrastructure to predict imminent events and their health impacts is not adequate by itself for developing an early warning system¹⁸. An appropriate response plan including alert systems, pagers, telephone cascades, communication with the relatives of casualties and personnel is also immensely important in disasters. These infrastructures need enormous improvements under the current system. A study of early warning system of flash floods in Iran supports these findings.

The study suggested that the system needs functional improvements in the domains of risk knowledge, monitoring/warning, dissemination/communication, and response capacity¹. Different tools are used to alert or warn systems in different countries; some countries use colour codes and some use standard messages²¹. The benefit of using these codes or standard messages is that everybody and all organizations whether it is a hospital, a fire brigade, an emergency department or the police can understand it. In Iran, color codes are supposed

to be used. But they are not used in real emergency or during exercises.

Based on our finding, in Iran the most frequent route for early warning in the system are coordinating centre, and disaster management centre and the most frequent communication tools are mobile telephones, landline telephones and pagers. The importance of the community education about different alert systems; how to make a distinction; and how to use the alert system was highlighted in the study. The community-based training needs to be concise and professionally relevant. It should be integrated into existing healthcare education programs and continuing education training²².

Limitation

The current study is the first of its kind to have been conducted within health organizations in a developing country. Lack of a comprehensive approach about early warning system, and lack of a comprehensive understanding and complete knowledge about different aspects of the disaster management were found as the most important restrictions.

Conclusion

In our country to improve the existing situation novel solutions are needed such as: MOU among different stakeholders in disaster response; education of staff and communities; rehearsal and exercises; using standard messages and language to warn. Our research investigated a wide range of issues related to health disaster management such as organization, planning, early warning, communication, resources and culture. For the present paper, we focus on findings related to early warning. Protocols and standards for planning and rehearsals; public policy actions emphasizing the importance of disaster management are required. There is also a need to create a national networked database for disaster related information, which would improve the response to disasters within the health organizations and the communities in developing countries such as Iran.

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Competing interests

The authors declare that there is no conflict of interest.

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