

# **Improving the Effectiveness of Local Emergency Management Networks: Focus on H1N1 (Swine Flu) Virus Outbreak in California**

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## **Abstract**

This study examines the disparity between formal plans and the actual networks in practice for H1N1 (Swine Flu) emergency services in a local government setting. From a survey and social network analysis, this study reveals that, surprisingly, the majority (75.0%) of respondents appear to understand the emergency management plan, particularly public health and medical service plan, only “a little.” This study also finds that public health and medical service network is characterized as Type IV (Incoherent network) which has different lead agencies in the three structures (*legal/official structure, perceived influence structure, and actual network*). This study suggests that public health and medical service network with clearly delineated leadership – that matches what really happens in practice – will be more likely to be effective because their participants have a clearer picture of the activity and communication flows.

## **Introduction**

Since Governor Arnold Schwarzenegger declared a state of emergency May 1<sup>st</sup>, 2009 to help deal with the outbreak, the H1N1 (swine flu) virus outbreak has escalated. As of September 8<sup>th</sup>, 2009, 91 hospitalized/fatal cases were reported and there have been 1,806 hospitalizations and/or fatalities, with 513 cases requiring intensive care, reported to date (CDC, 2009).<sup>1</sup> After investigating local emergency management networks of dealing with the H1N1 virus outbreak in California, this study provides management strategies of local emergency management plans and policies for state and local governments of the United States. The study uses a cognitive accuracy model (Krackhardt, 1990) to examine a disparity between planning and practice for the delivery of local and state emergency services in California. This disparity has been seen repeatedly in disasters which have struck in California such as incidences of uncoordinated wildfire response and earthquake response. These dysfunctional responses have jeopardized life and property.

Network analysis will be used in this study to reveal that actual response practice is quite different from both agency plans and the perception of participating actors.

### **Continual Problems and Failures of Emergency Management Services**

Since 9/11 and Hurricane Katrina, emergency management has been a hot research agenda because we never experienced recent catastrophic disasters before. It forces us to change existing emergency management plans because past patterns of intergovernmental cooperation or international alliances against disasters are no longer working well. Emergency management, thus far, has been considered only a function of law enforcement and fire departments, with support in the event of a major catastrophe from public health and civil defense organizations. Too often when government officials think of emergencies, they think only of response and fail to consider the other essential components of an adequate emergency management program – hazard mitigation, disaster preparedness, and disaster recovery. Emergency managers should be at the core of governmental efforts in all the components of emergency management activities, which need to be coordinated with similar efforts in the non-governmental and private sector (Comfort, 1999; Kapucu, 2006). Emergency management has been a low-priority political issue (Briechle, 1999), only getting on the public agenda during or immediately after a disaster. Emergency management operation systems are severely underfunded throughout the entire intergovernmental system (Choi, 2004; Waugh, 1990). At the local level, many emergency management organizations operate on limited budgets with part-time personnel. This situation is not much better at higher governmental levels. Current local emergency management systems are not well designed to increase their capacity building. For instance, one local emergency management study reveals that, with regard to perceptions about the degree of influence of emergency management policy, the majority (77.8%) of public organizations reflect relatively “much influence,” more than half (54.5%) of nonprofit organizations perceive that their influence is only “a little,” although by most reports nonprofit organizations play a significant role in providing emergency management services (Choi and Brower, 2006). It means more consensus building is needed to assure that all public, nonprofit, and private organizations understand and support those goals.

Emergency management has experienced intergovernmental and coordination failures. All levels of governments are supposed to share their

emergency management responsibilities (May and William, 1986). But, in reality the existing governmental response system is more accurately described as disarrayed, disconnected, uncoordinated, underfunded, and discredited. There are several reasons for this negative characterization. First, different perspectives often develop across different governmental levels. Each level of government officials tends to view the process strictly from their own vantage points in the system. These different role perceptions affect the way the entire governmental response process operates. A local emergency management system would be effective when participating agencies accurately perceive the role and responsibility of each agency within the system. Second, emergency management officials cannot control the actions of other public officials, political leaders, and private citizens. Each has its own set of rules, regulations, and policies. As a result, emergency management officials find it difficult, and sometimes even impossible, to coordinate all of this governmental activity. Finally, emergency management operations have little respect or credibility within the overall governmental system.

### **Cognitive Accuracy Model in Emergency Management Networks**

Krackhardt (1990) defined "cognitive accuracy" as the degree to which an actor's perceived networks correspond to actual networks. He concluded that actors' accuracy in perceiving the influence network was significantly positively associated with the actual influence in the network. This study extends the concept of cognitive accuracy to the formal networks of local emergency management and assesses participants' collective cognitive accuracy about which participants are influential within each network. Collective cognitive accuracy as this study operationalizes it is consistent with Carley's (2002) notion of a common operational picture, in which "individuals know who was doing what, who knows what" (p.3) and so on. One would expect that when most participants perceive that network structures are comparable, then they are likely to share an accurate operational picture. Under these conditions the participants have clarity about who the central actors are and who has the needed information. Such networks can be expected to perform more effectively.

Three different kinds of emergency management network structures are examined in this study. First, Legal/official networks emphasize lead agencies designated by the local emergency management plan. Second, Perceived influence

networks identify which organizations are perceived as the most influential organization(s) within each network. Third, Actual networks comprise the channels through which communications are carried out in everyday practice. That is, those networks composed of the organizations involved in actually performing each network activity. Additionally, collective cognitive accuracy will be measured to determine the percentage of responding organizations that accurately identify the lead organization for each network. In practical terms, collective accuracy is important because it shows how well participants are aware of the networks' practices. This study would expect that networks with large numbers of participants with faulty perceptions of the network would experience communication difficulties. On the other hand, when most participants perceive that all three structures are comparable, then they are likely to share a common operational picture. Under these conditions the participants have clarity about who the central actors are and who has particular information. Such networks can be expected to perform more effectively. Figure 1 shows the conceptual framework for an effective local emergency management network.

[Insert Figure 1 about here]

Following the theoretical implications of Provan and Milward (1995, 2001) and Drabek (1985), this study hypothesizes that emergency management networks are dependent for their effectiveness on the completeness and accuracy of information that is passed through them. This study proposes that when participants have a clear and correct mental picture of the network, all participants are likely to act in concordance with each other, thus contributing to more effective actions on the part of all participants.

### **Emergency Management in California and Los Angeles**

California has long been a leader in emergency operations and disaster response. But with growing population, potential destruction by earthquakes, fires, floods, terrorism and other catastrophes becomes greater every year. In 1996, Standardized Emergency Management System (SEMS) resulted in a major revision of the California Emergency Services Act. With the Incident Command System at its foundation, SEMS emphasizes a standard organizational structure and terminology at all emergency management levels. The system was designed to enhance coordination among response organizations and facilitate the flow of emergency

information and resources within and between the organizational levels. Recently, the legislature revised the California Emergency Services Act to merge the Office of Emergency Services and the Office of Homeland Security into the newly-formed California Emergency Management Agency (State of California Emergency Plan, 2009). The new agency consolidates emergency management and anti-terrorism programs to more effectively and efficiently serve the people and political subdivisions of California.

The City of Los Angeles is the second most populous city in the United States, with a population of almost 4 million people spread across 470 square miles. Los Angeles represents 11.5 per cent of the land area of Los Angeles County, and almost 40 percent of the population (Los Angeles City Emergency Management Plan, 2008). Public health agencies have historically followed emergency medical services, fire and law enforcement lead in local emergencies. However, with increasing concern that Los Angeles is vulnerable to possible chemical, biological, or radiological attacks, as well as the dangers posed by pandemic flu and other emergent disease threats, public health is now recognized as an essential element of emergency planning and response. The City of Los Angeles does not directly provide public health services, as these services are provided by the County's Department of Health Services (DHS). However, the City plays a critical support role in assuring that public health agencies, both local and state, can efficiently and effectively perform their mission to protect the public health in emergency situations.

This Health Emergency Response Plan is designed to provide a blueprint for city agencies to follow in responding to a major public health emergency. Response to health emergencies requires collaboration among many agencies including the City's constituent departments, Los Angeles County departments, state and Federal agencies, and non-governmental organizations (NGOs). The Plan is designed to address all threats to public health including those posed by terrorist attack, natural disaster, or technological accident. The plan provides response guidance for any level of health emergency that may be declared, up to and including catastrophic incidents, and to address Emergency Support Function #8. Public health and medical services are provided in accordance with ESF #8, which provides the mechanism for coordinated Federal assistance to supplement state and local resources in response to public health and medical care needs, including veterinary and/or animal health issues when appropriate. There are three levels of Public

Health Emergencies. The level of response is directly related to the level of the emergency as follows:

- Level 1: A minor to moderate incident wherein local resources are adequate and available. A Local Emergency may or may not be declared
- Level 2: A moderate to severe emergency wherein local resources are not adequate and mutual aid may be required on a regional or even statewide basis. A Local Emergency Declaration and a Governor's State of Emergency Proclamation will be proclaimed
- Level 3: A major disaster wherein local resources are overwhelmed and extensive State and/or Federal resources are required. A Local Emergency Declaration and a Governor's State of Emergency Proclamation will be proclaimed. Typically a Presidential Declaration of a Federal Major Disaster or Emergency will be requested.

## **Methodology**

This study uses a network analysis of Los Angeles emergency management services. During May-June 2009, a survey is sent to the agencies<sup>2</sup> associated with Los Angeles emergency management plan to measure network centrality, density, and centralization. According to Director of Emergency Network Los Angeles (ENLA) and Los Angeles County Emergency Management plan, 10 voluntary organizations and 22 public agencies are involved with emergency management services with the county. This inside knowledge of the network suggests that the organizations initially identified by the county emergency operation center director constituted the network in practice because they confirmed each other's participation. From their responses this study conducts a network analysis using the software program UCINET VI - developed by Borgatti, Everett, and Freeman (1992) - to describe relationships between the participants.

The survey contained two parts. In the first part respondents were asked to evaluate the overall quality and effectiveness of the system, their satisfaction with the system, their level of influence within the system, and their perceived level of understanding of the plan. The second part was intended to gather information about specific relationships in order to construct network analyses. Participants<sup>3</sup> are asked to identify: a) which organizations they considered to be most influential in the activities of dealing with the swine flu virus outbreak, and, b) which organizations they engage with directly in performing the activities. Respondents

were provided a list of organizations that potentially participate in seven emergency management functions<sup>4</sup> and public health and medical services.

This study measures a network centrality concept. Centrality identifies the most important actors in a network. This study uses indegree centrality to measure the relative centrality of the organizations. Freeman (1979) clarifies three common types (degree, between, and closeness centrality) of centrality. Several comparisons suggest indegree centrality as the most appropriate measure for this study because it eliminates individuals' biased perceptions of their own influence.

## **Findings**

The survey was completed by 26 (81.2%) of 32 network organizations. Data were ultimately not collected at two public agency and four nonprofit organizations. Although this appears to leave the network partially incomplete, responses from the first 26 organizations indicate that none of the missing organizations is an influential actor in seven emergency management functions, and public health and medical service network. Since the network analyses showed that the six non-respondents are essentially non-participants in most of the emergency management functions and public health and medical service network, their inclusion in the formal plans was primarily for symbolic rather than operational purposes. Each of the 26 participating organizations has been given a number by which it is described throughout the network analysis results section. Use of a number rather than organization name is intended to preserve confidentiality.

Regarding the quality of emergency management services in Los Angeles, the majority (76%) of informants appeared to be "satisfied" (35.0%) or "neutral" (40%). Interestingly, whereas 66.7 % of public organization informants appear to be "satisfied", 66.7 % of nonprofit informants are only neutral. ( $t=-2.985$ ,  $p<.05$ ). In other words, nonprofit organizations tend to evaluate the quality of emergency management services in Los Angeles less favorably.

Surprisingly, the majority (75.0%) of all organizations appear to understand the emergency management plan, particularly public health and medical service plan, only "a little." The comprehensive management plan describes the responsibilities and missions of each organization when emergency situations occur in Los Angeles. Thus, one would expect that staff members of organizations related with emergency management services should understand the plan.

As for comparison of legal/official network, perceived influence structures, and actual networks, the Los Angeles emergency management operates seven

primary functions. Only two of seven perceived influence structures identify the lead agency from the emergency management plan as the most influential (see Table 1). Five emergency management functions – management/command, logistics, finance/information, information/public affairs, and liaison functions – however, have the most influential organizations that are different from the legal or official lead agencies. Particularly, public health and medical service network has different perceived influence structures, and actual networks from the emergency management plan as the most influential.

[Insert Table 1 about here]

As for collective cognitive accuracy of “perceived” and “actual” public health and medical service networks, Table 1 presents the results of calculations for collective cognitive accuracy and correlations among variables. We calculated centrality scores for the designated lead agency in both the perceived influence structures and actual networks. Centrality within perceived influence structures is a percentage of respondents who designate the lead agency to be most influential within that public health and medical services networks. Collective cognitive accuracy within the perceived influence structure is the percentage of organizations that agree about the most influential actor in the network. That is, this measure indicates the percentage of participants who have an accurate picture of the most influential actor in this structure.

Overall, both perceived and actual accuracy against the legal/official structure is relatively low when lead agencies of the legal/official structures are different from the highest centrality organizations of perceived influence structures and actual networks, as shown in Table 1. For example, perceived and actual accuracies about the public health and medical service network are zero. This means that designated lead agencies for the network are perceived by nobody as either most influential or as participants in actual network communication. Figure 2 portrays the public health and medical service network. In the Legal Plan agency #18 is designated as the lead agency. Network participants perceived that agency #8 was most influential. Network analysis revealed, however, that agency #9 has the highest indegree centrality. This agency is the most central in communications and activities within the network, but the participants have substantial misperceptions about how the actual network operates. It can be argued that centrality and influence do not necessarily coincide, but earlier studies and conceptual pieces have established a substantial relationship between them (e.g.,

Freeman, 1979; Krackhardt, 1990).

[Insert Figure 2 about here]

### **Discussion: Network Effectiveness and Collective Cognitive Accuracy**

This study extends the theoretical implications from Provan and Milward (1995) and suggests that emergency management networks depend for their effectiveness on the relative completeness and accuracy of information that is passed through them. This study submits that when participants have clear mental pictures of the network all participants are likely to obtain more accurate information, thus contributing to more effective action on the part of all participants. In order to clarify further discussion, this study has classified four types of emergency networks according to the extent that legal structures, perceived structures, and actual networks are the same (see details Choi and Brower, 2006). This study is more interested in Type I and IV. Type I is the group for which legal designation most closely compares with actual practice and perceived influence. Type IV is the group that possesses the least coherence related to designated leadership. We note that accurate perceptions affect not only individuals' abilities to get what they want they also have consequences for groups and organizations (Casciaro, 1998).

By extending the findings to the network effectiveness question suggested by Provan and Milward (1995), it can be suggested that Type I has relatively high network effectiveness as compared to other Types. In the California Los Angeles emergency management networks, Type I has only management-command function. In other words, it may be argued that network effectiveness is closely related with the concepts of centrality and collective cognitive accuracy for each network. Contrastingly, when participants are unclear about the leadership in a particular network, the network is likely to be decentralized and less effective.

Type I networks are likely to have both of these properties. It may be argued that accurate information is a critical resource in emergency management networks, and the participants in Type I networks are more likely than those in other networks to know where to obtain such information. Moreover, networks in which the legal, perceived influence structures, and actual networks most closely coincide are likely to be stable networks. Identifying the most central agency means that network participants know where to obtain accurate information and thus waste

less time and increase efficiency (Casciaro 1998). We need to make efforts to increase the number of Type I networks because accurate information is a critical resource in emergency management networks, and the participants in Type I networks are more likely than those in other networks to know where to obtain the information and resources they need.

### **Implications and Conclusions**

Policy makers and researchers can benefit substantially from a practical understanding of key concepts of especially network effectiveness and collective cognitive accuracy. With regard to network effectiveness, local government policy makers need to consider how closely the systems in practice match the formal emergency management plans. Closely related is the question of collective cognitive accuracy, that is, the extent to which participants have a clear operational picture of the actual networks in use. In examining these questions, four types of networks suggested in this paper will be useful frameworks for identifying effective and ineffective networks. That is, Type IV (Incoherent Networks) should be of great concern. Type I is also important, but successively less problematic. In practical terms, emergency management offices and managers should want to have Type I structures because, in general, under emergency conditions better decisions will be made when the designated lead agency is, in fact, the central actor in the network. In terms of collective action, therefore, all participants are likely to get the most satisfying results from Type I networks.

Often there may be justifications or explanations for actual networks that differ from the planned structures: Decision authority may be statutorily placed with an agency that is not necessarily structured to facilitate the flow of communications; the lead agency may coordinate closely with the agency that facilitates communications; and so on. In many instances, however, participants may have taken on roles that have never been changed in the formal plans, they may have created “work-arounds” to overcome the barriers in antiquated plans, or the aptitudes of particular individuals may have moved them and their agencies into central roles in the network. Discussions among participants who know the history and the evolution of the system can uncover these situations, especially when aided by the pictorial depiction of the actual network in practice. Participants must recognize that interorganizational networks such as these are not static. Moreover, we remind that network adaptation is not only about structural locations of actors but about how networks learn and how tasks are distributed (Carley,

2002).

In short, the analysis suggests that public health and medical service network with clearly delineated leadership – that matches what really happens in practice – are more likely to be effective because their participants have a clearer picture of the activity and communication flows. It follows that networks with ambiguous or poorly understood communication patterns are those that are most likely to fail under pressure during a disaster or emergency situation. Moreover, policy makers can change the local emergency management plan or scenario to create more desirable network structures through this kind of empirical investigation.

## NOTES

<sup>1</sup> Effective August 12, 2009, local health departments have been asked to report hospitalized cases of pandemic (H1N1) 2009 as weekly aggregate numbers. Intensive care unit (ICU) cases and fatal cases continue to be reported with individual case report forms. A total of 152 pandemic (H1N1) 2009 deaths have been reported to the California Department of Public Health to date. (See more detailed information from [www.cdph.ca.gov](http://www.cdph.ca.gov))

<sup>2</sup> There are two methods for network boundaries: the “realist” and “nominalist” approaches (Laumann, Marsden, and Prensky, 1983). Boundaries in the nominalist approach are set according to the theoretical concerns of the researcher. A version of the “realist” approach is based on the subjective perceptions of the actors regarding who has membership in the network.

<sup>3</sup> In order to determine the characteristics of emergency management networks in Los Angeles, a survey was sent to the network participants. Key respondents were executive directors or managers. These individuals were identified from records within the Comprehensive Emergency Management Plan. Executives and managers were assumed to have the most accurate information about their organizations’ actual activities and more power to make decisions about such activities than others in their organizations. Responses were gathered in person and electronically.

<sup>4</sup> The seven primary functions are: Management/Command (overall emergency policy and coordination through the joint efforts of governmental agencies and private organizations), Operations (coordinating citywide operations in support of the response to the emergency through implementation of the organizational level action plan), Planning/Intelligence (collecting, evaluating and disseminating information, developing the organizational level action plan in coordination with other EOC functions, and maintaining documentation), Logistics (providing facilities, services, personnel, equipment and materials), Finance/Administration (financial activities and administrative aspects not assigned to the other functions), Information/Public Affairs (the development of information about the emergency to be provided to the public through the print and broadcast media), and Liaison (coordinating city and non-city agencies that may have a temporary role and/or representation in the EOC).

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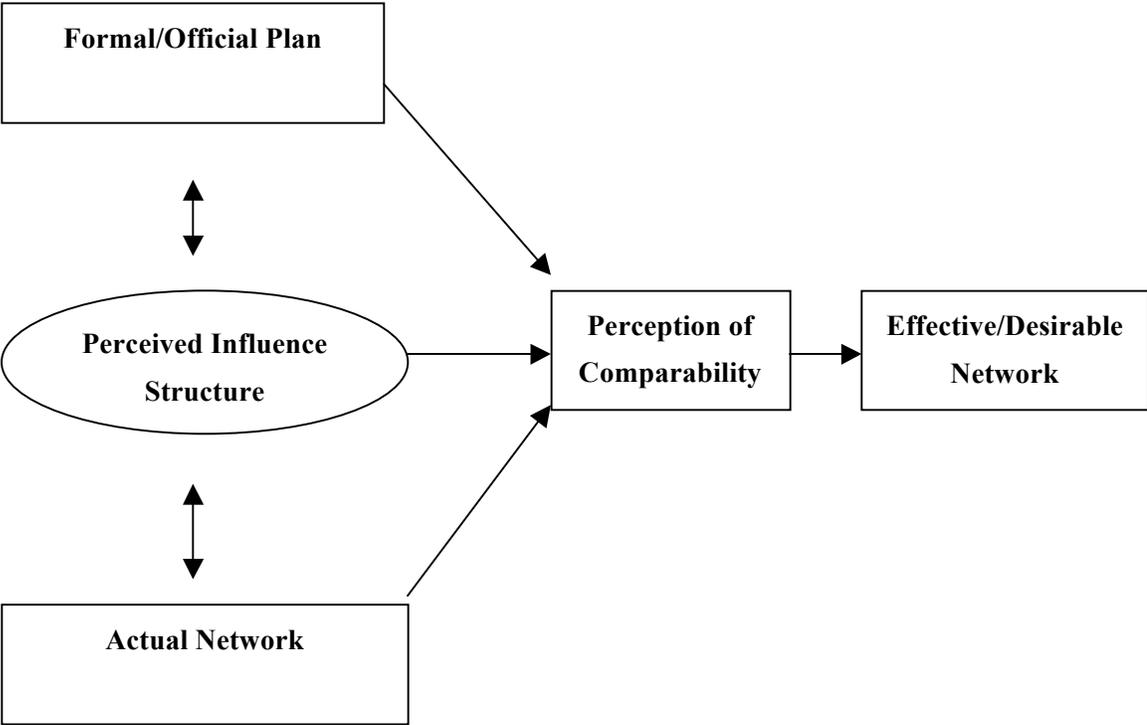
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**Table 1. Accuracy of Legal/Official Structure, Perceived Influence Structures, and Actual Network**

Primary Functions & Network	Legal or official Structure (Agency No.)	Perceived Influence Structure (Accuracy)	Actual Network (Accuracy)
Management-Command	1,2	45	29
Operations	1,2	69	45
Planning/Intelligence	1,2	35	37
Logistics	6	25	24
Finance/Administration	15	28	24
Information/Public Affairs	17	32	27
Liaison	11	24	19
Public Health and Medical Services	18	12	13

**Figure 1. Framework for Effective Local Emergency Management Network**



**Figure 2. Graph of Actual Network, Public Health and Medical Services**

