

THE PREVALENCE AND EFFECTIVENESS OF CENTRALIZED MEDICAL RESPONSES TO MASS CASUALTY DISASTERS*

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INTRODUCTION

Centralized coordination of the emergency medical response to disaster situations is commonly advanced as the ideal, but no research has examined the prevalence of such responses or rated the relative effectiveness. This paper reports an exploratory study which allows some initial impressions and tentative conclusions in regard to this issue.

Perhaps Holloway has stated the ideal conceptualization most directly:

While disaster scene response, transportation, and hospitals comprise the resources needed to get the disaster victim from site of injury to the road to recovery, without an efficient communications and command system to tie these resources together the medical disaster effort will be far from satisfactory (1971).

He further adds that such a system must have “a central coordinating point where information can be received, evaluated, decisions made, and action taken” (Holloway, 1971). A number of others writing on disaster medical services have implicitly or explicitly adopted similar positions (Bouzarth and Mariano, 1968; Murphy, 1972; Sutherland, 1975).

A variety of research, on small groups (Caplow, 1964), organizations (Price, 1968) and disasters (Barton, 1970), indicates that centralized communication and control arrangements are often the most effective way of organizing social units in order to accomplish a task, although specific situations may be handled more effectively with other arrangements. This research was intended, in part, to find out if this is true for medical responses as well.

STUDY DESIGN AND METHODOLOGY

As part of a larger study by the Disaster Research Center at Ohio State University of the delivery of emergency medical services in mass casualty situations, comparative data was available for actual interorganizational responses to ten mass casualty situations which occurred during the one-year period from May 1, 1975 to May 1, 1976. These included four transportation accidents, three tornadoes, two explosions, and one poison gas exposure. These ten cases represent the major such events involving around 50 or more casualties and occurring within the time period.

Ten case studies were constructed from over

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160 tape-recorded interviews with organizational officials, over 110 documents, and over 40 sets of observations and debriefings. This analysis is based upon the classification of response patterns found in the descriptive case studies, and the preparation of quantitative tables showing patterns of association between the occurrence of centralization and the occurrence of various situational characteristics. The final product of the analysis was a causal model which depicts the principal relationships discovered in this exploratory analysis. This model shows the factors influencing whether casualty-handling organizations exhibited centralized or independent patterns of control and communication.

FINDINGS

The principal finding was that centralization is relatively rare. Only one case exhibited full centralization, while two other cases exhibited centralization of subtask areas (such as rescue, transportation, or treatment). None of the others exhibited any centralization, and five out of the remaining seven showed no evidence of direction of any organization by another organization. This analysis will focus upon the situational factors which are associated with centralized responses as opposed to independent ones.

In examining the situational factors which were associated with the occurrence of centralized responses versus totally independent responses, we considered community demography, type and size of the EMS components, magnitude of the EMS disaster, and effectiveness of the EMS response. The following propositions summarize the findings.

1. *As the magnitude of the task increased, a centralized response was less likely.* This can be illustrated by examining Table I. In situations with less than 60 casualties only centralization was found, while in situations with over 120 casualties no centralization was found. Since the number of casualties treated and admitted at hospitals was *not* found to be related to the

TABLE I

Response Table: Total Number of Injuries

	Total Number of Injuries		
	1-60	61-120	Over 120
Response Type			
Independent	0	2	3
Centralized	2	1	0

occurrence of centralization, it seems that the magnitude of the task rather than its specific demands was more important for determining the type of interorganizational response.

2. *As the complexity of the resource base decreased, a centralized response was more likely.* The availability of resources can be expected to increase with increasing population. Table II illustrates how centralized responses were more common than independent ones in cities under 100,000 in population. In contrast, no centralized responses were found in cities with populations over 500,000. The larger cities tended to have great amounts of resources dispersed in more complex patterns than was the case for the smaller cities. This complexity seemed to undercut the advantages of numerous resources by making them more difficult to mobilize.

3. *As interorganizational expertise was more available, a centralized response was more likely.* Two rough indicators of interorganizational coordination expertise are the availability of senior organizational officials (typically more

TABLE II

Response Table: Population Size

	Population Size		
	Under 100,000	100,000-500,000	Over 500,000
Response Type			
Independent	2	0	3
Centralized	3	0	0

prevalent during the day than during the evening) and the scope of any interorganizational coordinating centers (more expertise is required if a variety of organizational types are coordinated). As shown in Table III, centralized responses were as likely as not when mass casualty incidents occurred during the day shift, but centralized responses occurred only a minority of the time when disasters occurred during the evening shift. This indicator captures both the availability of personnel resources and also the presence of senior officials and specialized boundary personnel. Table IV shows that the scope of normal interorganizational coordination is a good predictor of centralized disaster response. If normal coordination was limited to one type of organization (ambulances), then a noncentralized response occurred in an overwhelming majority of the cases. If, in contrast, several organizational types were included in normal coordination, a centralized response occurred most of the time. The availability of experienced personnel and the breadth of their experience were thus found to be related to the occurrence of centralized response.

4. *If the resources used were less complex interorganizationally, a centralized response was more likely.* This is most dramatically indicated by the effect of the number of participating ambulance services upon the occurrence of centralized responses. As can be seen in Table V, the use of only one or two ambulance services did not elicit a centralized response in any of the cases looked at. In

contrast, the use of five or more ambulance services more often than not resulted in a centralized response. At first glance such a finding appears paradoxical. However, there are two important factors. First, in most cases the number of ambulance vehicles used was roughly the same for similar size disasters regardless of the size of the community. Therefore, major cities comprise those cases involving only one or two ambulance services. However, these ambulance services are very large complex organizations able to handle ordinary emergencies independently. Thus, on a routine basis they did not coordinate their activities with each other or the hospitals to which they were taking patients. Second, although coordination would appear to be harder to achieve when several organizations are involved, this situation tended to be found in the smallest communities. These communities had the fewest resources but were, therefore, more likely to recognize the virtues of cooperation and most likely to have the relationships and past experience to pull it off.

5. *If a response was centralized, it was more likely to be effective.* Two measures of effectiveness were utilized. Both focused upon the experience of the hospital receiving more casualties than any other hospital. The first was a subjective evaluation by hospital staff and personnel in other key organizations of whether or not the hospital received too many casualties for it to cope with in a reasonable

TABLE III

Response Table: Work Shift

Response Type	Work Shift	
	Day	Evening
Independent	2	3
Centralized	2	1

TABLE IV

Response Table: Scope of Emergency Medical Coordination

Response Type	Scope of Coordination		
	Ambulance	Ambulance & Hospital	Ambulance Hospital Police & Fire
Independent	3	1	1
Centralized	1	0	2

TABLE V

Response Table: Ambulance Services Used

Response Type	Number of Ambulance Services Used		
	1-2	3-4	5-6
Independent	3	1	1
Centralized	0	1	2

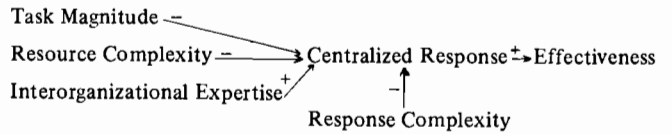
manner (subjective overload). The second was an objective index showing whether this hospital receiving the most casualties also received more than its share of the most serious casualties as measured by admissions (severity allocation). We felt that combining an extraordinary number of patients with a high number of seriously injured ones was likely to hamper provision of the highest quality treatment. Therefore, those attempting coordination would be expected to try to avoid such situations because of their potentially adverse effects. Table VI shows the results for the subjective overload measure. No centralized responses were associated with overloaded hospitals, while noncentralized responses were more likely than not to result in overload. Similarly, Table VII shows the results for the severity allocation measure. No centralized responses result in poor severity allocation, while half the noncentralized responses do. It would seem that centralized responses do yield the results that are claimed for them. A centralized response was always effective by the two measures used here.

TABLE VI

Response Table: Hospital Overload

Hospital Overload	Response Type	
	Independent	Centralized
No	2	3
Yes	3	0

The relationships summarized in the previous paragraphs can be used to construct a hypothesized causal model which could be tested in future research.



DISCUSSION

The implications of these findings will be discussed in regard to three issues: the prevalence of centralized responses, the usefulness of centralized responses, and the practical implications of the relative infrequency of centralized responses.

Prevalence of Centralization

Only three out of the ten cases exhibited any type of centralization. This centralization tended to be based upon normally centralized coordination and was found in small communities (under 30,000) which have limited medical resources. The small size of the available cases did not permit controlling for city size so that differential factors between small and large cities could be identified. However, the basic relationship between size of community and type of response is strong enough to conjecture on the factors underlying the relationship. In

TABLE VII

Response Table: Severity Allocation

Severity Allocation	Response Type	
	Independent	Centralized
Higher Severity (poor)	2	0
Average or Lower Severity (good)	2	2

general, smaller communities combine both the capability and the need for cooperation across a wide range of activities, since the scarcity of resources is an integral part of everyday life. In contrast, the larger cities have far more available resources on an everyday basis than they are likely to need. Often, these resources are concentrated in a few massive organizations in any particular sector. The relative self-sufficiency of such superorganizations in everyday emergencies makes it difficult for them to cooperate if the need ever arises, because they do not do so on an everyday basis. A mass casualty situation typically involves more casualties than a single ambulance service or hospital can handle on a routine basis. Extraordinary efforts are required, and the response is considerably facilitated if other organizations help. In smaller cities, such cooperation is readily available if it is needed, but in larger cities it is not there whether it is required or not. The result is that centralized responses do not occur.

Usefulness of Centralization

The least surprising result of the study was the general effectiveness of centralized responses. Perhaps the only surprise was that no ineffective centralized responses were found. It is likely, however, that such cases will be found when larger numbers of cases are examined. As was previously indicated, the other disaster, small group, and organizational literature had suggested that centralization was usually but not always the most effective way of coordination.

Implications

Perhaps the major implication is that one should not be pessimistic about the lack of centralized responses. True, there is relatively little that can be done in most places about such a lack of coordination, because various situational factors on an everyday basis determine the occurrence of centralization. How-

ever, one can take comfort in three things. First, large-scale mass casualty disasters are relatively rare in American society. Approximately ten or fifteen cases with over forty injuries in a one-year period in the entire U.S. is a very small number. Therefore, planning for events of such magnitude does not make much sense on a cost-effectiveness basis for most communities. However, cities in more disaster-vulnerable areas probably require some degree of prior planning, since disasters causing a dozen or more casualties are not uncommon and frequently require the mobilization of additional resources. This is especially true for the largest cities, since heavy concentrations of people increase both the probability of occurrence of and the number of injuries from transportation accidents and other technological disasters. For most cities, though, the planning effort would be better invested in upgrading the everyday operational EMS setup to a centralized operation with procedures extendable to the larger casualty situations. Although political and economic factors often make total centralization unfeasible, even limited progress in this direction can dramatically improve both daily and disaster EMS results.

Second, the types of places which exhibit centralization are the ones which need it most often. The small resource communities recognize their interdependence and manage to achieve centralized responses. The largest communities have sufficient resources, and they seldom need to coordinate their activities. However, other compelling arguments, as noted above, could be made for investing in planning in these largest cities.

Third, noncentralized responses are just about as likely to be effective as not. This means that the odds are still pretty good that things will come out all right anyhow. In fact, although the effectiveness ratings were poor for a number of situations and indicated that the conditions were ripe for difficulties, a majority of these responses fortunately did not encounter any serious problems.

CONCLUSION

This exploratory study examined the occurrence of centralized responses to mass casualty situations and their relative effectiveness. Centralized responses occurred a minority of the time but were effective when they did occur. These centralized responses tended to occur in smaller communities (with limited resources) and in which such cooperation would be necessary. The largest cities (with vast resources) tended to cooperate badly, and centralized responses were nonexistent. In consequence, responses were less effective.

The relative rarity of mass casualty disasters makes planning for them largely unprofitable for most communities, and efforts would likely be better expended towards a centralized normal EMS operation which could be utilized in mass casualty situations. For the most part, the type of response seems to be appropriate to the size of the community in which it occurs. Small communities recognize their interdependence, and their natural cooperation often leads to centralization. Larger communities have sufficient resources concentrated in a few large organizations and seldom is there any need for interorganizational coordination. Finally, non-centralized responses in these rare events are as likely to be effective as not. Therefore, a majority of the responses to these events were effective regardless of prior planning and training.

In conclusion, it is hoped that this limited

and exploratory study has shown the value of further research into the nature and prevalence of mass casualty situations. The results are tentative but they show the existence and consequences of a general lack of preparation for mass casualty situations in most communities. At the same time they show the effectiveness of centralized responses, and the importance of normal centralization is enhanced when one realizes the degree to which it facilitates the handling of mass casualty situations. Finally, the relative lack of research on disaster medical situations makes studies like this imperative, so that planners and operational personnel can have a firmer basis for making the crucial decisions they are faced with every day.

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