

PRELIMINARY PAPER #139

DISASTERS AND EMS DELIVERY
IN THE NEXT CENTURY*

E. L. Quarantelli
Disaster Research Center
University of Delaware

1989

*This is a written version of a paper prepared for presentation at the International Conference for Emergency Healthcare Development on August 17, 1989 in Washington, DC.

Introduction

Partly using our extensive past and ongoing field research on the delivery of emergency medical services (EMS) in natural and technological disasters (see, e.g., Quarantelli 1983), we project what kind of disaster EMS will probably be needed as we move into the 21st century.

Our themes are three: (1) The future will be worse than the present insofar as the delivery of EMS in future disasters is concerned. In part this is because there is every reason to think there will be both quantitatively and qualitatively more demanding disasters in the decades to come. This will be true even though there is likely to be improvement in both general disaster preparedness planning and managing. Put another way, the disaster EMS of the future will have to cope with the different patterns of disasters of the future.

(2) The typical present day disaster EMS delivery system is not best suited even now for the handling of large mass casualty situations. Thus, different technologies must be developed in the medical area especially since many of the new ones recently created are not very relevant for disaster purposes. Furthermore, it will be necessary for social scientists to indicate optional kinds of organizational arrangements that could be used for providing disaster EMS. Given that what is in place now is both technologically and organizationally inadequate, something different will have to be innovated for future disasters.

(3) Whatever the future will bring, it will not be an homogeneous world. There is the need to keep in mind both cross-societal differences in medical technological uses and capabilities, and in vulnerabilities to disasters. A major goal therefore ought to be the development of alternative models of EMS systems which can be used in different societies to handle the more numerous and complicated disasters of the future. One model will not be enough.

Future Disasters

Even if everything in the planning and the response of disaster EMS systems were now perfect (which of course is not the case, see Tierney and Quarantelli, forthcoming), we would still have to be concerned about the future. This is because there are many reasons to think the situation we will be faced with in the future, with respect to disaster EMS delivery, will be more complicated than at present. These concerns are related to the virtual certainty of the occurrence of more and worse disasters in the decades to come.

It may seem odd, but despite all the mitigation and preparedness measures that could be taken, disasters in the future will occur more often and be worse in their impact. There are at least five sets of conditions that contribute to this bleak outlook.

1. Old kinds of natural disaster agents will simply have more to hit or impact.

It is sometime overlooked that natural disaster agents have consequences only in a social context. So, while such physical agents as hurricanes, tornadoes, floods, and earthquakes are probably not increasing (at least on any observable human time scale), what they can socially impact has and is changing.

For example, take hurricanes. The coastal areas of the United States are being subjected to unprecedented population growth, building of structures and economic development. This means that more than ever before more people and property are vulnerable to the hazards of hurricanes. By the year 2000, hurricanes can be expected to result in the greatest amount of per capita property damage in the country. Development pressures have also accelerated the threat to lives in the coastal zones; probable evacuation times in several large metropolitan areas now approach or exceed 20 hours, while state-of-the-art forecasting techniques are still striving for reliable 12 hour predictions of landfall. Given this, it is not surprising that some experts have advanced scenarios in which hurricanes could claim more than 10, 000 lives in a coastal metropolitan region.

As for floods, the picture is the same. There are more people and settlements than ever before in riverine flood plains. Where in the past there was marsh or swampy areas, there are now housing complexes and industrial parks. The same picture could be drawn for earthquakes, tornadoes and volcanic eruptions; there is simply more they could impact. Where empty space might have been hit in the past, persons and developments will be impacted in the future. There is practically nothing of a reverse pattern--permanent abandonment or withdrawal of humans from dangerous areas.

Finally, as another example, we have always had flash floods in the physical sense, but they are increasingly resulting in disasters such as the Big Thompson flood where over 100 died. This is because changes in lifestyle are leading more people to be tourists in resort areas vulnerable to such events (a similar pattern is true with respect to avalanches in ski resort areas).

Furthermore, while we have given examples just from the United States, the picture is the same everywhere in the world. One way to document the probable greater future impact is to ask the following: if the last major disaster to hit your area up to ten years ago were to hit exactly in the same way now or in the future, would there be more, less or the same kind of losses than in the previous impact? We think almost all would have to say more.

2. New kinds of technological accidents and mishaps that can lead to disasters.

To the category of (so-called) natural hazards has been added a relatively newer class of technological accidents and mishaps. There are the disasters resulting from human error and collective mistakes of groups. To the so called Acts of God, the human race has not added the Acts of Men and Women.

There are the risks associated with the production, transportation and use of dangerous chemicals. The relatively recent toxic chemical disasters in Bhopal, India and in Seveso, Italy, or the Rhine River pollution are merely the forerunners of the kinds of occasions which might be anticipated to increase in future decades.

There are several interesting aspects of their appearance. For instance, even localities which in the past had none or few risks from natural disaster agents, are now vulnerable to toxic chemical spills, explosions or fires if they have any roads, railways or navigable waterways. In a sense, this has reduced the geographic selectivity of possible disaster impacts. Almost all inhabited areas that are part of the industrial world have now become vulnerable to disasters. Furthermore, increasingly disasters of this kind will be of greater magnitude. For instance, from 1960 to 1980, not only has the number of tankers doubled, but their shipping tonnage has increased sevenfold. So, increasingly there is something bigger to spill, explode or burn on waterways. A recent example would be the massive Exxon-Valdez oil spill.

Then there are of course the risks associated with nuclear power. Three Mile Island suggested the potential; Chernobyl presented the reality. We may expect more along those lines. In June 1987, a retiring member of the Nuclear Regulatory Commission (James Asselstine) predicted a 45 percent change of a meltdown in a nuclear plant somewhere in the United States in the next 20 years (New York Times, June 7, 1987).

Apart from in plant nuclear plant problems there is the danger that will be generated by the transport of nuclear wastes. In the United States, by the year 2000, we will have about 47,900 metric tons of spent fuel, compared to 12,900 tons in 1985, to be shipped to a depot somewhere. Eventually there will have to be many shipments from many places to some chosen site, and that of course raises the possibility of some accident. (We leave aside here the fact that there presently is the actual transportation of military generated radioactive material--in the United States in 1979 alone there were 1,904 separate shipments totaling 54,000 plus pounds).

3. Technological advances are resulting in risks which add complexity to old threats.

There are two aspects to this--(1) preventive or protective measures which indirectly lead to possible disastrous effects, and (2) the scale of chain reactions possible in modern societies which

can turn a little accident into a catastrophic disaster.

As to the first, the following is an example. Fires in high rise buildings, in combination with the highly combustible and toxic construction and furnishing materials we presently use, have brought an additional threat dimensions to that kind of situation. We prevent people from being burned by raising the probability of their being asphyxiated. The MGM hotel fire in Las Vegas or the Dupont Plaza hotel fire in Puerto Rico are but examples of what is more likely to occur in the future.

Even plane crashes are interesting along this line. Research has shown that the ensuing fires generally kill more passengers than the crash itself. Furthermore, eighty percent of those that do die from the fire actually succumb to the gas and smoke from the light weight burning cabin material!

Then there is the chain reaction nature of some occasions which illustrate well what someone once said: "small scale failures can be produced very rapidly, but large scale failures can only be produced by time and resources are devoted to them." For example, we have always had since their coming into being, electric power and telephone system failures. In fact, they occur on a small scale almost everyday. They are recognized as normal emergencies by the public utilities. However, the 1965 blackout in the northeastern United States suggests how, in the modern world large areas of a country are vulnerable to electric grid system malfunctions. There has been nothing of this scale recently, although New York City had a major power blackout in 1977 and so have certain other cities and places in the state of Florida. But these have been relatively minor compared to what could happen given the extensive grids and networks that are involved. Not only can something in a far distant place have local effects, but the complicated linkages almost insure that sooner or later there will be large scale effects. We of course are assured that the 1965 happening cannot happen again, but then before it happened we also had similar assurances.

4. New versions of old or past threats.

In some instances, we can see new manifestations of old kinds of threats. For instance, droughts used to be thought of as a rural problem. This is no longer the case. Increasingly, in different parts of the country, urban and metropolitan localities have found themselves faced with shortages or reduced water supplies. So far we have had only emergencies coped with by reducing industrial water usage, but one day there will be a disaster if a major part or all of an urban area runs out of water or has enough only for the most necessary of water needs.

This is most likely to occur in combination with the collapse of a major tunnel, pumping station or other critical facilities of a

water supply system. This brings us also to the fact that there is an increasing risk associated with the deteriorating physical and public works infrastructure of lifeline systems in a large number of older American cities. The prevalence of decaying bridge and tunnel structures, crumbling highways, obsolete and overloaded waste water and sewerage treatment plants, worn out sewer and water mains, suggest a variety of many potential disastrous possibilities beyond the isolated and occasional accidents of the past.

A bridge collapse in Connecticut in 1983 and in New York in 1987, a major water main break in New Jersey, all happening in the last few years, are forerunners of far more such disasters in the United States in the future. If it be true as a recent report stated, for example, that 45 percent of the nation's 566,443 highway bridges more than 20 feet long are structurally deficient or functionally obsolete, future bridge collapses seem fairly probable.

We also have an aging fuel pipeline system. The network covers one million seven hundred thousand miles. In 1986, a government report stated that many of the pipelines are 30 or more years old, which in some instances is past their normal lifetime, and that there have been more than 16,000 pipeline accidents in the last decade. So far only minor disasters have occurred, such as a rupture in 1985 that engulfed a four block area of a Minneapolis, Minnesota suburb. These are warning signs of what may occur in the future.

5. Various kinds of new risks and hazards which are developing.

Let us give two general possibilities with respect to new kinds of risks and hazards that are developing.

For example, what about the certain disasters that are going to be produced by biotechnology, especially genetic engineering (DNA). Basically this involves altering the blueprint of any living organism--plant, animal or human--and creating new characteristics, some of which are very useful (e.g., there have been created various kinds of oil and chemical waste eating bacteria that can be used to clean up spills). However, there clearly are all sorts of potential disaster occasions in this. There can and will be the creation of, or the escape from control, of some altered organism that cannot be checked by present known means. Some of the oil-chomping organisms that have been created for cleanup purposes could go ahead and attack lubricants on all machinery. Our ability to custom design living organisms almost insures that one day there will be some almost Frankensteinian like bacteria, plant or animal let loose on the world.

Then there all the disastrous consequences that are linked to the computer revolution. Use of computers undoubtedly have improved disaster planning and managing. But, and it is an important but, our increasing dependence on computer technology will magnify future disasters and turn some minor emergencies into major

disasters. When the technology fails, and it will fail at times, what will those who have come to depend on them, do? We know of one chemical disaster where, because the computer monitoring system failed, it took hours before the surrounding population was warned; in precomputer days the warning would almost certainly have been issued hours earlier. Also, more important, many sectors of government and business as well as the medical world are increasingly computer based for the data and information they need to function, sometime literally from minute to minute. It can be predicted with certainty that such systems will, for various reasons, cease to function or function incorrectly. We will then have a really new kind of disaster--a computer disaster.

The Need for Innovation

As research has established, there are serious flaws and problems in present day disaster EMS systems (see Taylor, 1977; Butman, 1982; Quarantelli, 1983; Tierney, 1985). If what is in place now, is not good enough now, it will be even less suited for future disasters.

What is needed is improvement both in the medical technologies and in the social organizational arrangements that could be used in disaster situations. There is a need to be innovative in making use of medical technological advances and to work out better institutional and organizational arrangements to deliver disaster EMS. Persons in the medical area need to be involved, but they must understand that new technologies are means not ends. There is also more to better EMS than new technologies. Social scientists who recognize the reality rather than the ideal of disaster situations must also be involved. New organizational arrangements for delivering disaster EMS need to be suggested.

The need for innovations in medical technology to some extent is created by the newer kinds of disasters that will become more prevalent. For instance, the newer technological types of disasters we noted earlier, can be qualitatively more medically demanding than certain other kinds of disasters. For example, chemical poisonings and radiation contaminations often require complex and sophisticated kinds of medical treatment. They can and frequently do put much more of a strain on EMS than the "ordinary" disaster. Often, in these kinds of newer disasters, many material things, equipment, land can be polluted and contaminated in different ways than usual. The cleanup is not only usually more costly but requires more specialized knowledge than is the case, say after hurricanes or floods. Also, in some instances, there are second order effects; e.g., health consequences can surface years later. There might be cancer cases which would not be the kind of long run results of most natural disaster agent. So qualitatively, these kinds of disasters can be rather different in that they seem to require the use of more and better medical technologies.

Undoubtedly the recent medical technologies already in being can be adapted or new ones can be developed which can be useful for field use in large scale disasters. The specifics of these have to be left to people in the medical health sector. However, we can argue that if any technology is to result in any improvement in disaster EMS, the innovations must be created by those who are interested in actual field use, not simply in more advanced technology. Head-imaging devices, for example, be they improved CAT scanners, M.R.I. units, or PET and BEAM machines, can, undoubtedly be developed. But what is needed for use in the field in disasters are probably not bigger and more complex devices (although with imagination it is possible to visualize field computers linked to fixed hospital equipment that might be useable and useful). If the intent is to improve diagnoses and treatment, the new technologies have to be of the kind into which field information can be fed, assuming that the disaster EMS system model moves in a direction which we have suggested elsewhere (i.e., out from the hospital in the initial stages, see Quarantelli, 1983).

There seems to be an interesting paradox here. Many recent improvements in medical technologies are markedly less applicable in disaster situations than in everyday medical care. Such technologies are very good for everyday use (in medial diagnosis and treatment). But they are too costly, unwieldy, require such specialized knowledge and personnel, etc., to be quickly and efficiently used at times of massive casualties. The new is not necessarily better than the old. Again, let us overstate for emphasis, a parallel. All physicians in the past were general practitioners and could provide EMS treatment at times of disasters; many specialist physicians today, particularly those who have been practicing a specialty a long time, are almost useless in the field from an emergency care perspective at times of disasters. Similarly, the newer technologies are probably better in some absolute sense, but that does not mean that they are relatively as useful in disaster situations.

Of course the situation is far more complex than we have stated. It could be argued that we have far more personnel now than in the past who can help in providing certain aspects of emergency medical care--for instance, apart from nurses, there are various paramedical specialists. It might also be argued that some of the newer kinds of available drugs might partly balance off an inability to use the newer technologies at times of disasters. However, speaking generally, we do believe that certain advances in medicine, especially in its technologies, have been of the kind that are increasingly irrelevant as resources at times of mass casualties, and that on balance, there has not been an equivalent gain for the disaster EMS area.

Developing a disaster EMS system is not just a matter of technological innovation or adoption, or even solely of medical knowledge. It is a question of how resources can be organized, of

how planning can be instituted, and of how response can be made more adequate. These are matters to which social and behavioral scientists, especially disaster researchers can contribute. Much EMS planning in the United States, for example, often conjures up an ideal situation of how the EMS system could operate in a disaster. Unfortunately, this ideal situation is one that will seldom appear in an actual disaster. There will, for instance, be loss of control of the EMS system of entry of patients into the system. Good disaster EMS can be no better than the assumptions which are made about organizational and group behavior at such times. Working together, social science disaster researchers and medical and technological experts can assure that the assumptions will be valid ones.

Cross-societal Differences

Finally, we need to note that the disasters of the future and the development and use of medical technologies are not all going to be the same everywhere around the world. There are now and increasingly so cross-societal differences in these two matters. One implication of this is that we will need different types of models of disaster EMS delivery for such different social settings.

The great bulk of disaster research clearly suggests that generic planning, rather than agent specific or country specific planning, is the best strategy to follow. Nonetheless, there are some differences that should be taken into account. For example, not all societies are equally subject to disaster risks, whether natural and/or technological (see Sapir and Lechat, 1986). Of course in the long run, even in this there may be more of an equalization of exposure to threats, as practically all societies come to be vulnerable to toxic chemical, nuclear radiation and biogenetic engineering risks. However, differential societal vulnerabilities is probably a fact-of-life for a long time to come. Clearly social systems subject to more and damaging kinds of disaster agents will have to have better disaster EMS planning.

It is probably in the medical technology area that societal differences will be most marked. Currently there are huge gaps between medically and technologically rich societies and poorer societies. This kind of gap probably will widen even further in the future. To compound the problem, many of the more disaster vulnerable countries in the world are also those that are low on a medical/technology scale.

In fact, we can categorize all societies as falling into one of four types according to their disaster vulnerability (high or low) and their medical/technology status (rich or poor):

STATUS OF
MEDICAL TECHNOLOGY

	Rich	Poor
DISASTER VULNERABILITY	High ++	+ -
	Low - +	- -

The point of the chart is to highlight the obvious: for example, that societies which fall in the second quadrant (+-) must plan and prepare for disaster EMS in somewhat different ways than societies which fall in the first (++) or the third (-+) quadrants. Some studies by the Disaster Research Center have found that the handling of massive burn cases in some developing countries reflect a lower standard of care than treatment of similar cases in societies with more medical resources. The principles of treatment may be universalistic. But the practice of treatment reflects the capabilities of the societies involved. This is simply another way of saying we cannot expect to develop only one model of disaster EMS. There has to be the development of alternative models of EMS which reflect not only disaster vulnerabilities but also the resources which can be brought to bear.

In conclusion, we must recognize that no solution is ever final or perfect. Even now we can project different kinds of EMS needs and problems in the future. There are also usually different options for attaining efficiency and effectiveness in service delivery. It is important that at present we look in the past to see how and where we can improve so we will do better in the future. However, past experiences should not be our sole guide. They can only serve as starting points. We also need to plan for the future which we can be certain will be different from the past. Imagination is needed for that kind of projection. We have tried our hand at that in this paper. Our effort in that direction may not eventually prove totally correct, but we hope to have at least provide some clues.

Bibliography

Butman, Alexander H.

1982 Responding to the Mass Casualty Incident: A Guide for EMS Personnel. Westport, CT: Emergency Training Institute.

Quarantelli, E. L.

1983 Delivery of Emergency Medical Services in Disasters: Assumptions and Realities. New York, NY: Irvington. (copies can be obtained from the Disaster Research Center).

- Sapir, Debarati Guha and Michel F. Lechat
1986 "Reducing the impact of natural disasters: Why aren't we better prepared?" Health Policy and Planning 1:118-126.
- Taylor, Verta (ed.)
1977 "The delivery of emergency medical services in disasters." Special Issue. Mass Emergencies 2:135-204.
- Tierney, Kathleen J.
1985 "Emergency medical preparedness and response in disaster: The need for interorganizational coordination." Public Administration Review 45:77-84.
- Tierney, Kathleen J. and E. L. Quarantelli
forthcoming "Needed innovation in the delivery of emergency medical services--present and future." Disaster Management.