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COORDINATED EMERGENCY MANAGEMENT: THE CHALLENGE OF THE CHRONIC TECHNOLOGICAL DISASTER

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Providing effective emergency response and mitigating the impact of disaster requires the ability to act and knowledge of what to do. Chronic technological disasters present a special challenge to emergency management because authority to act on this type of disaster agent is diffuse and often lodged within a variety of agencies operating at different levels of government. Moreover, knowledge of the likely chain of events for technological disaster is still in its infancy, when compared to the rich research base that exists for natural disaster. The authors argue that the emerging literature on chronic technological disaster reveals systematic and important differences between the reality of this type of disaster and what conventional wisdom based on natural disaster experience says about technological disaster. This study addresses characteristics of chronic technological disasters and examines how the nature of technological disaster affects the practice of emergency management.

In the Preface to her recent book, Comfort (1988, xi) notes that there has been a "shift in the definition of responsibility for disaster." No longer are disasters regarded as purely "acts of God." Rather, disasters are defined as crisis events, the occurrence and course of which are at least partially determined by decisions, actions, and too often, a lack of appropriate action well within human control. This shift in thinking has evolved in part because our experiences with natural hazards demonstrate the potential efficacy of planning, mitigation efforts, and coordinated emergency management. In addition, the increasing prevalence of accidents and disasters resulting from human intervention in the environment has provided impetus to this evolution in thinking. It is difficult to ignore human responsibility for disaster events caused by human activity, particularly if they could have been averted by engineered structures. Governmental activity devoted to safeguarding our lives and our environment is becoming increasingly important and accountable for what is or is not done to prevent technological disaster.

Strategies to reduce, mitigate, and respond to human-caused hazards have underscored the inter-disciplinary nature of disaster study. A wide array of organizations and technical disciplines are called upon both to respond and to avert technological disaster. For example, pre-disaster regulation and hazard reduction has improved the handling of toxic contaminants in the United States, but at the same time toxic and hazardous substance dangers grow as a result of increased production of chemicals, more environmental releases of chemicals through spills, greater hazardous waste generation, more air and water contamination from chemicals, and the proliferation of new hazardous materials disposal sites. Kasperson and Pijawka (1985, p. 17) observe that the "major burden of hazard management in developed societies has shifted from risks associated with natural processes to those arising from technological development and application."

Recent "right-to-know" policy initiative by the Environmental Protection Agency and state governments have targeted hazard identification as a means for building knowledge about industrial activities and the use of toxins, and are expected to promote better regulation of the production, use, and disposal of toxins and wastes. Yet, despite the clear benefits this will bring, increased public knowledge of toxins is presenting a new challenge to emergency managers and local officials. Mazmanian and Morrell (1988, p. 81) identify a new phenomenon in community behavior which they describe as "a growing climate of fear verging on chempohobia." Since Love Canal, each new discovery of an abandoned waste dump has tended to rivet public attention on the

problem and escalate pressures for cleanup and regulation. In the summer of 1988, only months after Eastman Kodak was identified as the source of an underground chemical leak, their Emergency Planning and Community Right-to-Know Act disclosure to New York State revealed that they annually emit about 24 million pounds of 65 potentially toxic chemicals into surrounding air, land, and water (Ahern 1988, p. 3). Almost immediately, numerous homes in "Kodak Park," a community very near the plant, were quickly put up for sale. Kodak responded with financial incentives that encouraged homeowners to stay and this stabilized the situation. Yet, managing citizen reaction to hazardous waste fears by encouraging them to maintain confidence in the protection afforded by regulation is a uniquely new responsibility for both government and private industry.

Suiter (1989, p. 2) points out the unique challenges of technological hazards management, noting particularly that technical hazard reduction and management will "place a premium" on the ability to "integrate environmental management and emergency management programs." Effective policy approaches require distinguishing between natural and human-made hazards, because "each category poses a different set of management problems for policy makers" (Suiter 1988, p. 2). Furthermore, research on technological emergencies not only differences between natural and technical disasters, but also differences among categories of technological events that need to be considered in planning and response.

Time, both in terms of speed of onset and duration of the event, seems to be a key distinguishing factor among technological disaster events (see Couch and Kroll-Smith, 1985). Sometimes the so-called intractable problems of technological hazards are actually attributable to the chronic, enduring nature of some of these events. Chronic events are likely to "pose the most taxing problems" because "of the issues involving the effect of the media on public sentiment, the seemingly prolonged scientific assessment process necessary to determine an appropriate response ... and finally, the lack of easy, immediate answers" (Suiter 1988, p. 2). Swift impact, sudden onset events and slow developing, protracted events represent two primary types of crisis that can be referred to as **episodic versus chronic**.

A growing debate among disaster research scholars concerns whether chronic technological disasters are fundamentally different from natural disasters. Some have argued that we should employ a generic approach to disasters, considering them as a broad class of crisis occasions that bring forth collective responses largely independent of the disaster agent (see Tierney 1981, Pp. 331-342 and Quarantelli 1985, 1987). Other researchers argue that disaster event qualities do make a difference. Such characteristics as suddenness, power, predictability, and the physical context of the site are among the many variables recently identified as important in explaining variations in human responses to extreme stress (see for example, Gill 1986; Kliman, Kern and Kliman 1982). Kroll-Smith and Couch (1989) have recently extended the event-quality perspective arguing that a sociological theory of disasters must seriously consider the reciprocal impacts of physical agents (of whatever type) on built, modified and natural environments and the individual's, and group's, perceptions and experiences of those impacts.

Reviewing that debate is not our purpose, but we do insist that more research of disasters is turning up important distinctions between events that are chronic and events that are episodic. These difference must be considered in emergency management.

Our knowledge of episodic-type disasters is historically rich and intellectually sophisticated, but this is not yet true for chronic-type technological disasters. Most of what we know about chronic disasters is based upon evidence from Love Canal, Times Beach, Centralia, and similar large scale events. While chronic technological disasters are as yet relatively few in number, each reveals patterns and similarities. Integrating knowledge of the commonalities of chronic technological disasters into local emergency planning and response practices is necessary and worthwhile.

This study focuses upon the character of technological disaster and emergency responses to it. We are also concerned with the actions taken by emergency managers that either ameliorate or aggravate problems posed by this type of incident. We begin by distinguishing categories of technological hazard.

CLASSES OF TECHNOLOGICAL HAZARDS

Technological hazard events are generally classified into three groups; the environmental accident, the environmental risk, and the chronic environmental emergency (Kasperson and Pijawka 1985; Suiter 1989). An **environmental accident** occurs when a hazardous substance is released or when release is imminent. Immediate emergency response is required to minimize losses. Examples of this type of event include an accident at a nuclear facility (Three Mile Island, Chernobyl), a chemical spill (Bhopal), or a transportation accident with potential contamination (Halifax munitions explosion). Such occurrences are episodic, sudden, and have an immediate impact, similar to patterns experienced in natural disasters. However, the effects may be prolonged in some cases and uncertainty may surround the extent of the damage or the best means of abatement, as in the case of Three Mile Island. Nonetheless, the obvious emergency nature of the event requires immediate action.

Standing in sharp contrast to the immediacy of crisis apparent in some hazardous substance disaster events are two other classes of technological hazard. Ambiguity and disagreement about danger often characterize incidents in the **environmental risk group** and in the **chronic environmental emergency** group. For both groups, risk may be defined as the probability of experiencing harm but less clear is whether an "emergency" can be said to exist. Both categories of crisis are characterized by exposure of a particular population to environmental contaminants, but the distinction between the two classes rests largely on whether the contact is defined as dangerous enough to warrant intervention.

For environmental risk, a "non-emergency" status is in effect when exposure to hazardous substances is thought to be so low that it no longer poses a thereat to human life. For example, routine and permitted releases of pollutants to the air, water, and soil, as well as discharges of slightly radioactive materials from nuclear power plants, hospitals, or industrial facilities, are non-emergencies. These hazards are not viewed as representing major failures of technology and are typically addressed by established management structures and practices, including regulation (Kasperson and Pijawka, 1985; Zimmerman, 1985). Exposure of the population to the hazardous substance may be episodic, such as through minor accidents or occasional planned releases. However, the contact with the substance may also be chronic, with repeated or sustained exposure over long periods. These occurrences are further characterized by uncertainty about long-term health effects.

If substantial impacts are identified, and if it is believed that the situation will worsen without action, an environmental risk may be redefined as crisis or emergency. The **chronic technological emergency** may evolve either from an "upgraded" risk situation or from actions taken when a major toxic waste site is initially discovered. As before, the element of time is a critical variable. How risk is defined, and how available and feasible abatement is, affects response actions. Solutions and recovery operations may be years or even decades away.

CHRONIC VERSUS EPISODIC DISASTERS

Disaster Events: Phases of Activity and Characteristics

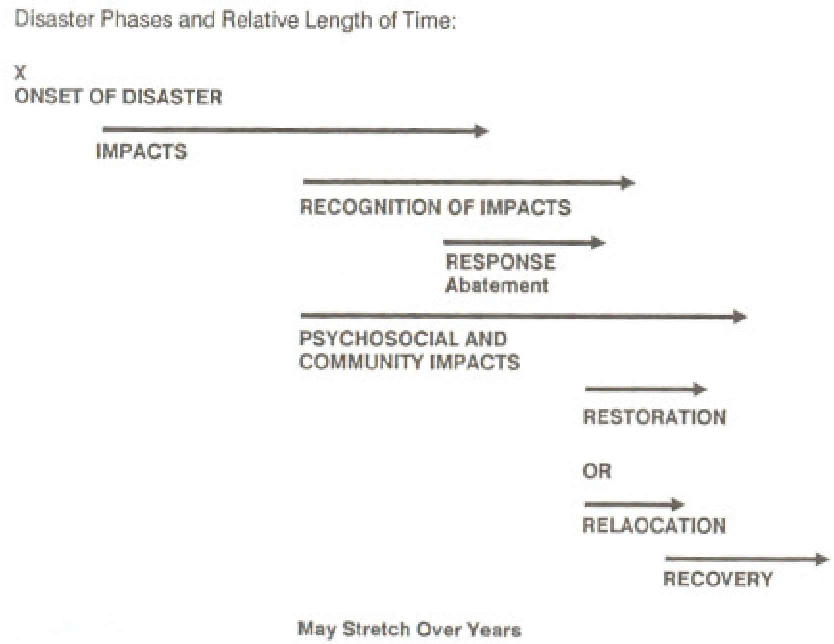
Figure 1 details the usual chain of events for an episodic disaster. Most of us are already quite familiar with the sequence of reactions and

Figure 1
Episodic Disaster Chain of Events

events which occur when a natural disaster strikes. The patterns for episodic technical emergencies are in many ways similar. The onset of the disaster is swift and the agent of destruction slowly recedes. Secondary damage, such as flooding in the aftermath of earthquakes, are common. In the crisis stage and immediately after, the danger is obvious and a visible trail of destruction provides ample evidence of the emergency incident. In the response phase, there frequently is an altruistic outpouring of community help aimed at minimizing further loss - searching and rescuing victims - and feeding, clothing, and housing the displace. Then debris is cleared and essential community functions are restored. Once a state of normalcy returns, activities devoted to long-term, reconstruction begin. At this time businesses are restored, people return to work, commerce resumes and community recovery is underway.

Activities are far less orderly and predictable in chronic technological disaster. As Figure 2 shows, in the onset of the event when the hazard

Figure 2
Chronic Disaster Chain of Events



agent is introduced, there is a recognition that the danger may be prolonged. At the same time that residents and experts begin to acknowledge the emergency posed by the hazard, they must also decide the extent and actual risk presented by the hazard. They must also consider abatement actions at this time. From the time that the hazards is first recognized and through the period of "reconstruction," the hazard agent continues to pose a threat and can continue to cause damage. Risk assessment in this case yields great confusion and debate. Even secondary impacts of the event become controversial. If, for example, a newly discovered toxic waste dump threatens a community and removal or containment is not feasible, nearby residents may have to be relocated. Some relocations are made necessary as a result of mismanaged cleanup or containment operations. In the case of the Centralia mine fire, affected residents were offered relocation help after 23 years of unsuccessful attempts at abatement.

Figure 3 summarizes the differences between the phases of activity which distinguish chronic technological emergencies from episodic disasters (illustrated in Figures 1 and 2). One of the most significant features of chronic events is that the onset of emergency or disaster is typically slow, with periodic impacts. Unlike natural disaster, which often strikes with great force leaving a visible trail of destruction, and unlike spectacular technological accidents such as commercial aviation crashes or dam failures, chronic technological hazards tend to "creep up" on

Figure 3
Chain of Events: Episodic Verus Chronic Disasters

CHARACTERISTICS OF THE EVENT	Type of Disaster	
	EPISODIC	CHRONIC
Speed of Onset	Rapid	Prolonged
Scope of Impact	Varies	Varies
Speed of Recognition of Crisis	Rapid	Slow
Duration of Primary Impact	Short	Prolonged
Known Technology for Recovery/Abatement	Yes	Often Not

people with few or no discernible effects. Because there is no obvious moment of critical need owing to prolonged period of impact, it becomes easy to underestimate the extent and implications of such disasters.

Figure 4
Determinants of Community to Disaster: Episodic Versus Chronic Events

VARIABLES AFFECTING COMMUNITY RESPONSE	Type of Disaster	
	EPISODIC	CHRONIC
Source of Aversive Agent Or Precipitating Event	Originates Outside of the Community	Emerges From Within the Community
Evidence of Disaster Impacts	Clearly Visible	Frequently Invisible
Victimization	Typically Random	Discernable Pattern
Government Action	Timely Response Generally Well Defined Policies	Delayed or Ambiguous Response Policy Vacuum

Individuals and Family Impacts of Chronic Disasters

Psychological stress tends to be prolonged for people enduring chronic technological hazards. In episodic disaster circumstances the rebuilding process clearly signals the beginning of healing and the end of the event and its effects. In chronic technological disasters, recovery is delayed, in part, because of the insidious indeterminate character of this type of event (LaPlante 1988). Based upon evidence from Love Canal and Centralia, Couch and Kroll-Smith (1985, p. 570) conjecture "if a disaster is human-technical in origin and advances slowly and erratically, then the coping style of the victim population can be expected to reflect the chronic persistent nature of the disaster agent. Anxiousness and delusion, or the readiness to hold onto perceptions contradicted by available evidence and common sense, may become embedded in the character structure of some or all of the residents." A number of researchers report that helplessness, powerlessness, anxiety, difficulty in problem-solving and moralization are evidenced by populations subjected to enduring stress (Bolin, 1985; Edelstein, 1988; LaPlante, 1988).

It is important to note that episodic events, particularly those which are natural in origin, rarely lead to long-term disruption of the physical community and the lives of its residents, even if the damage sustained is extensive. In contrast, the prolonged period of threat and high uncertainty often means that communities affected by chronic technological disaster will face lengthy or even permanent dislocation. Even when temporary or permanent relocation is not necessary, people may undergo profound changes in their perception of the efficacy of governmental safeguards to protect them, in their relationships with neighbors and friends, and perhaps most troublesome, in their very concept of self-worth (Couch and Kroll-Smith 1988).

An exacerbating element in chronic technological emergencies is the tendency of these crises to remain invisible or closed to sensory confirmation. As Erikson (1988) points out, technological disasters "contaminate rather than merely damage." He argues that the human response to agents which pollute and taint will be qualitatively different than those which result in wreckage. Unlike a natural disaster which can be viewed as "an act of God," the technological disaster arouses anger and the psychological need to place blame. Blame may be lodged with those whose acts are believed to have caused the event, or with the public officials who failed in their responsibility to safeguard citizens (Baum, 1987; Kroll-Smith and Couch, 1989; Levine, 1982). Prolonged official inaction, ineffective official action, and delays precipitated by the need for legislative response all contribute to an effected public's feelings of anger.

LaPlante (1988) has extended the model of community level disaster events usually employed in disaster impact analysis (which originally was defined by Haas et al., 1977), to consider individual and household recovery explicitly. She argues that "the household recovery process is distinct from, yet related to, the community pattern." The speed and eventual extent of individual and household recovery is by definition an individualized process, dependent upon numerous variables which include whether loved ones have died, the extent of other losses sustained, and the response of friends as well as community toward victims. Progress toward recovery will also depend upon pre-disaster resources, including not only financial but also personal variables which affect coping ability (see discussion Bolin, 1985; LaPlante 1988).

Distinguishing community level recovery from household recovery reveals why some expected community responses are curiously absent in chronic technological disasters and why victim behavior is so atypical in communities experiencing chronic technological disaster.

Group Emergence and Response

Compounding problems for victims of chronic technological emergencies is the fact that government officials, helping organizations, and even friends and neighbors may delay their response, or not respond at all. Failures in response contribute to poor or delayed risk identification. Even after the hazard has been recognized by all parties, the decision process used to define risk level may postpone governmental response. The confusion and debate generated in the community during this risk definition stage engenders conflict rather than the altruism associated with the shared community perception of emergency in episodic disaster settings.

Indisputable danger, visible impact, and undeniable destruction evidenced when episodic disasters strike, serve to assure consensus among survivors that something catastrophic has happened. Such a consensus is the first step in creating a therapeutic community environment. Chronic technological emergencies, however, are marked by contradictory sensory evidence and disputable official evidence regarding the scope and seriousness of the problem. This confused state of affairs depresses volunteer and relief agency response.

"Emergency" problems by definition demand immediate action. If an aversive agent creates sudden and unexpected demands on a community, it will also call forth a rehabilitative response directed towards reducing the state of emergency. In chronic emergencies, the aversive agent creeps up on the community slowly, creating little tangible evidence of danger, and people, therefore, disagree on whether a state of emergency exists. This and the instinctive fears people have who believe, but cannot be certain, they are threatened, lays the foundation for conflict and stigmatization of victims. All this is quite different from the consensus and shared beliefs evident in the immediate wake of episodic, especially natural, disasters.

The therapeutic community and helping networks so familiar to us in natural disaster literature simply do not develop in chronic events (Cuthbertson and Nigg, 1987; Kroll-Smith and Couch, 1989; Levine, 1982). Problems that require immediate and apparent responses, such as a tornado or a chemical spill, produce a "present orientation" that serves to suppress past communal conflicts. In chronic technological disasters problems which divide people tend to inflame old disagreements or existing community discord. People become prone to remembering other occasions when they disagreed with their neighbors or with local officials. In the face of chronic technological disaster, communities tend to divide rather than unite.

Groups that emerge in chronic technological emergencies tend to form on the basis of shared beliefs about health dangers and suspicions about governmental response. These groups frequently escalate the social conflict. At Love Canal, three different groups emerged around shared perceptions of danger (Levine, 1982). Kroll-Smith and Couch (1989) argue that these behavior patterns are predictable because of the inability of experts to agree on what risk is posed. Residents of Centralia, Love Canal, and other threatened communities find themselves in the difficult position of having to define the threat posed by the event on their own. In these communities, competing definitions arise, each new piece of evidence is used by different groups to bolster their arguments and each group assumes the views (if not the moral character) of the others are deficient. Stigmatization of victims is common in chronic technological disasters owing to the victim's contact with the risk area or to the victim's participation in emergent group activities (Levine 1982; LaPlante and Kroll-Smith, 1988).

Researchers have found in numerous policy arenas, besides disaster policy, that groups emerge when people collectively perceive that government has failed to act on what they believe is a public problem. A "generalized belief" or "perspective" helps define the situation and guide action. Shared perceptions can increase communication in an extreme crisis (Wolensky and Miller, 1981). Shared perceptions are an important social psychological ingredient that can facilitate new patterns of friendships. This can dampen the social psychological consequences of victim stigmatization (Edelstein, 1988).

Governmental Response and Management

The need for central coordination and management of these chronic, human-caused emergencies is clear, but the authority is often less distinct. Toxins management usually falls within the purview of environmental and health agencies, while other kinds of chronic technological hazards fall within the jurisdiction of other state and federal organizations (see Zimmerman, 1988 for a review of emergency types and agencies likely to be involved). In Centralia, for years, responsibility was shuffled among local, state, and federal agencies ranging from the Bureau of Mines to the U.S. Environmental Protection Agency. The Pennsylvania Emergency Management Agency was only involved peripherally, and even then for only short periods (LaPlante and Kroll-Smith, 1988).

Policy decisions that must be made in an mergency are always difficult, particularly in conditions of great uncertainty. In chronic technological emergencies there may be a moment of critical need or it may pass unrecognized. This makes immediate response action appear premature or irrational. Sometimes indistinct lines of authority and the absence of guidelines can result in a "vacuum" such that not official, agency, or level of government assumes responsibility.

A study by Wolensky and Miller (1981) about community perceptions of local officials' roles in normal circumstances versus community perceptions of those same roles in disaster circumstances, turned up two distinct orientations. "Citizens expected a custodial orientation in the everyday situation" but an active one in disaster, and they "uniformly demanded a more rational, concerted, and what we can call an active role" during disasters (p. 483). This contradiction creates a predictable Catch-22 situation because the ordinances and local charters which give authority are defined in the everyday setting and may fail to empower the emergency manager to assume an active role in a disaster.

Wolensky and Miller (1981) argue that communities must "make conscious decisions about the type of government they want, paying special attention to that organization's ability to coordinate new resources and meet new demands during disasters (p. 501). We would add that chronic technological disasters underscore the need for flexibility and authority to meet unique circumstances. Empowerment must come not only from the local citizenry, but through state and federal policy coordination in emergency and environmental management.

Despite a past reliance on environmental and public health agencies to oversee response to technological hazards, Zimmerman (1985) views emergency powers in recent laws as potentially providing a more active role for local emergency managers in technological events.

CONCLUSION

Our developing experience with technological hazards, particularly chronic events, underscores the argument of many natural hazards researchers--that we must build flexibility into emergency management planning and practice (see Kartez and Lindell, 1987). We have long realized that each disaster has within it commonalities. Yet, chronic technological disasters seem to be showing us that "common core" of expected post-disaster behaviors are not apparent. Instead, there are new and different sets of human responses to this type of disaster agent. Chronic technological disaster demands new or adapted approaches to planning for, and response to, emergencies.

In discussing planning for natural and technical disasters, Kartez and Lindell (1987, p. 487) cite a failure to learn from one's own experience as a major impediment to better preparedness. The chronic nature of some technological hazard agents permits enough time for adaptation and improved coordination. But the duration of time also presents two challenges to conventional emergency management practice. First, the protracted period of threat can sometimes lull officials into believing that an emergency no longer exists and that people are no longer in danger. Second, the emergency response plan implemented at the start of the incident may set out a pattern of life for the affected population that becomes routine.

Chronic technological disasters suggest that the distinction between acceptable risk and emergency may be more a matter of expert definition than an objective state of affairs. Consequently, in the early stages of impact - at time when danger, risk, and health effects of exposure are still being investigated - citizens discover themselves in a state of "limbo." Emergency mangers must appreciate the human reactions and responses to this period of uncertainty.

Uncertainty and conflict created by official indecision may trigger a public response seemingly independent of the hazard threat itself. This can happen whether or not an official emergency is ever declared. Community conflict produced by differing perceptions and measurements of threat can substantially alter the relationship of people to their government. Love Canal, Centralia, and Times Beach show that substantial human suffering can take place long before there is public, or official, recognition of a problem. Natural and technological disasters will continue to affect countless lives. How seriously they are affected depends on our ability to recognize and mitigate all manifestations of damage through enlightened, flexible, and coordinated emergency management.

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