M9: Community Impacts Associated with Releases of Hazardous Materials

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• Chemicals:
  – > 100,000 chemicals commercially produced
  – 100s enter the market every year
  – Only approximately 7% of known chemicals have been fully investigated for health effects.

• Transportation of Hazardous Materials
  – In U.S., more than 1.5 BILLION tons (estimates in the 4 billion ton range) of hazardous chemicals are transported each year.
  – “There are more than 800,000 shipments of hazardous material daily in the United States,” said Ellen Engleman, administrator of DOT’s Research and Special Programs Administration, which regulates hazardous material transportation safety. “What we are proposing today would strengthen the safety and security of these shipments, while preserving the mobility vital to our economy.” from U.S. DOT news release, October 2001

• Nuclear Power
  – As of April 2000, 431 large-scale nuclear power plants were in operation in over 30 countries.
  – 38 new plants under construction in 13 countries.
  – In U.S., nuclear power supplies approximately 20% of power.
    • Average age: 19 years.
    • Operating life: 40 years, with option for renewal for another 20 yrs.

Functional Model of Public Health’s Response in Disasters

• Planning – learning to work cooperatively with other disciplines and understand the resources, skills, and tools that public health professionals bring to the diseased community.
• Prevention – includes activities commonly thought of as “mitigation” in the emergency management model.
• Assessment – short- and long-term ‘snapshots’ that help with decision making and enhance the profession’s ability to monitor disaster situations. The goal is to convey information quickly in order to recalibrate a system’s response.

• Response – includes both delivery of services and management of activities.
• Surveillance – includes both data collection and monitoring of disease
• Recovery – has policy, political, and social implications that are both short- and long-term.
Examples of Disasters

- Large Scale
  - Chemical
    • Bhopal
    • Minamata
  - Nuclear/Radioactive
    • Chernobyl
  - Deliberate Chemical
    • World Trade Center

- Medium Scale
  - Chemical
    • Lake Shasta
  - Nuclear/Radioactive
    • Tokaimura
    • Samut Prakan

Lowermoor Treatment Works, Cornwall England (1988)

- Replacement lorry driver accidentally added 20 tons of aluminum sulfate (alum) to clear well instead of to the alum storage tank.
- Early complaints of water problems thought to be result of process modification and testing earlier in the day. Contaminated water reached 20,000.
- System flushed. Residents noted massive fish kills.
- Human effects included mouth ulcers, skin discolorations, nausea and vomiting.
- Initial investigations in 1989 and 1991 said that no long-term health problems were likely and symptoms were likely due to anxiety.
- British Medical Journal article in 1999 stated that long-term cognitive problems were seen in survivors.

Why Do Disasters Happen?

- Widespread use of hazardous materials.
- Highly complex and interconnected systems.
- Increased movement of hazardous materials.
- Rapid industrialization.
- Inadequate training.
- Inadequate regulation.

Common Stress Reactions to Disaster: Emotional Effects

- Shock
- Anger
- Despair
- Emotional Numbing
- Terror
- Guilt
- Grief or Sadness
- Irritability
- Helplessness
- Loss of Pleasure Derived from Regular Activities
- Dissociation (e.g., perceptual experience seems “dreamlike”, “tunnel vision”, “spacey”, or “on automatic pilot”).
### Common Stress Reactions to Disaster: Physical Effects

- Fatigue
- Insomnia and/or Sleep disturbance
- Hyperarousal
- Somatic complaints
- Impaired immune system response
- Headaches
- Gastrointestinal problems
- Decreased appetite
- Decreased libido
- Startle response

### Common Stress Reactions to Disaster: Physical Effects

- Impaired concentration
- Impaired decision-making ability
- Memory impairment
- Disbelief
- Confusion
- Distortion
- Decreased self-esteem
- Decreased self-efficacy
- Self-blame
- Intrusive thoughts and memories
- Worry

### Common Stress Reactions to Disaster: Interpersonal Effects

- Alienation
- Social withdrawal
- Increased conflict within relationships
- Vocational impairment
- School impairment

### Natural vs. Technological Disaster

- Natural disasters seen as part of the order of things, i.e., “acts of God or caprices of nature.”
  - Such calamities are to be expected because we do not have and do not expect to have control of nature.
- Manmade/technological disasters seen as preventable.
  - Expectation to be able to control technology.
  - It MAY be more of a blow to suffer a technological catastrophe since it could have been prevented.
  - Issues of blame and responsibility show up more in man-made disasters. These disasters can produce much higher levels of anger and distrust than natural disasters.
January 2005 Tsunami
Kellogg employee

Banda Aceh Shore, Indonesia
Weather Underground

Kalutara Beach, Sri Lanka (before and receding waters before wave)
Weather Underground

2004 Gulf Coast Alabama Hurricane Ivan Damage
Weather Underground
Characteristics of Toxic Disasters

- May “announce” themselves or may be insidious.
- Have the potential to affect large numbers of people.
- Can have long-lasting effects.
- Can cross political borders.
- May occur anywhere, and socio-economic status may not protective.

In the United States, 17 incidents have released sufficient volumes of chemicals with such toxicity that potential consequences could have been worse than Bhopal (had location/situation been different).

Implications for Long-Term Disaster Recovery (from The Long Road to Recovery, 1996)

- Crisis Morphology
  - Industrial crises do not end. They simply change form and content. (They are not delineated in time and space).
- The Permanence of Victims
  - Victims are permanently victimized because of their socially structured position of disadvantage.
- Revising Stage Models of Disasters
  - The seeds of crisis are sowed many years prior to a triggering event. Study of antecedent conditions may hold the key to crisis prevention.

Psychosocial Impacts of Toxic Disasters

- Community Effects
  - Natural disasters may have identifiable low point after which “things tend to get better.”
  - Technological disasters often have a conflict community develop.
- Social Stigma
- Widespread and Chronic Effects
  - Natural disasters typically have identifiable low point after which “things tend to get better.”
  - Difficult to identify start of recovery in technological disasters.

Case Study: Train Derailment near Dunsmuir, California, July 14, 1991

The town of Dunsmuir, California lies near the base of Mt. Shasta along the Sacramento River. At approximately 9:40 pm on July 14, 1991, a 6000-foot long train operated by Southern Pacific Railroad derailed outside of Dunsmuir. The train had 4 diesel electric locomotives and 97 cars, 86 of which were empty. A car containing metam sodium landed partially inverted in the water, sending approximately 19,000 gallons of the chemical into the Sacramento River. Developed during World War Two, metam sodium is a herbicide that is used as a soil fumigant. When it interacts with water, it breaks down quickly into several byproducts, including methyl isothiocyanate (MITC), methylamine and hydrogen sulfide. These breakdown products are immediately released as a gas and are respiratory irritants. MITC has some similarities to methyl isocyanate (MIC), the chemical that caused serious respiratory effects in victims of the 1984 Bhopal, India, chemical disaster.
Howard Sarasohn, Deputy Director of the California Department of Fish and Game stated:

“… the damage caused by the spill took a number of different forms. As the plume of airborne contaminants moved down the river, all plants and animals in its path were exposed, as were all life forms in the river as the waterborne plume moved down it. We observed that virtually all of the plants and animals in the river were killed instantly: fish, algae, plankton, insects, and other organisms. It literally sterilized the stream. Many of the effects were visible in the form of dying fish and, of course, the foliage began to turn brown and fall off.”

In addition, according to statements by Southern Pacific, a report of an odor and burning, teary eyes, came in early that morning from Dunsmuir, as did word of a light yellow-green plume being spotted about a half-mile south of Southern Pacific’s Dunsmuir yard office. By noon, the California Highway Patrol closed a major highway adjacent to the Sacramento River after complaints of discomfort from fumes. A mandatory evacuation of Dunsmuir was also ordered by the City Manager, but this was downgraded to a voluntary evacuation about an hour later.

In testimony before Congress, Kristi Osborn from Concerned Citizens of Dunsmuir said the following:

“Most people, if notified at all, were told that evacuation was voluntary and definitely not necessary. This included some pregnant women and senior citizens with preexisting health conditions. Traffic on the freeway was stopped and rerouted, but if you were local, it was perfectly safe to be here. After the freeway was reopened, travelers were told to drive through Dunsmuir without stopping, and they were told not to use their air conditioners or vents and keep their windows shut tight. It was safe for us to live here, but it was not safe for motorists to breathe while driving through. When we complained about the double standard, the people traveling through were no longer warned. We had hoped instead for some concern over the townspeople.”

In the first place, metam sodium was not contained in the emergency response manual that is compiled by the Department of Transportation…. Second, the material safety data sheet (MSDS) that is available in almost every workplace is largely inadequate. Lack of information about long-term effects and releases of the substances at high levels and poor quality assurance are the major shortcomings. So, even though an MSDS was quickly available, the information provided was inadequate. Third, because metam sodium is a pesticide, much of the detailed data about its toxicity are considered to be ‘trade secrets’.”

Dr. Lynn Goldman, from the California Department of Health Services, complained that inadequacies in available information hampered efforts by public health officials to protect the public:

“The lack of complete and timely health information left some residents disillusioned and angry. As citizen group leader Kristi Osborn put it, “When can we trust our public health officials? They have destroyed their credibility, and there is no way to take our fear away.”

A preliminary evaluation of the spills health effects by the California Department of Health Services (Goldman) noted the following impacts:

“Many more minor illnesses were observed in the aftermath of the spill. A review of emergency room records between July 15 and July 31 found a total of 252 visits, compared to 8 visits the first three weeks of August. The most common symptoms that occurred were nausea (51%), headache (44%), eye irritation (40%), throat irritation (26%), dizziness (23%), vomiting (22%), and shortness of breath (21%).”
In addition, workers who were brought in to clean up the spill in and near the river on July 21 and 22 developed unusual skin rashes on the feet and ankles, despite the fact that contamination levels were thought to be extremely low.

Finally, Dr. Lynn Goldman also expressed concern about the psychosocial impacts of the accident:

“The community may be experiencing considerable stress, as a result of the spill, the relocation, and the uncertainties that they have had to experience. This can cause symptoms during the immediate period but can also have significant long-term medical consequences.”

Southern Pacific has taken steps to help the community of Dunsmuir recover from the chemical spill:

- Offered to fund the re-stocking of the river.
- Opened a community assistance office in Dunsmuir and opened two claims offices.
- Settled over 500 claims.
- Paid for over 500 physical examinations in a community of 2100 people.

The railroad paid approximately $2 million on the cleanup and for individual and community assistance. They also worked with Dunsmuir on a public relations campaign to encourage the return of tourists. This included promotional train trips for Southern Pacific employees and others with the proceeds going to the restoration efforts within the community.

In the view of Kristi Osborn of Concerned Citizens of Dunsmuir, making the town whole would be difficult. In the aftermath of the accident, Osborn said the town was split:

“Tourism, and fishing in particular, have been vital to the town’s economy. The town is built around the river, physically, economically, and emotionally. However, Dunsmuir is also a railroad town. Train memorabilia is everywhere. Generations of families have made their livings with Southern Pacific. Now, sadly the community is divided, and it is difficult for some to choose sides.”

“We didn’t cause this disaster, but we are paying for it with our everyday lives.” Concluded Osborn: “We all want to forget the spill, but we, as people who have been forced to live in the midst of the disaster, have changed. The spill affects our lives daily and will for a very long time.”

Senator Barbara Boxer used the House Government Operations subcommittee to investigate just how an accident of this magnitude could occur. The more she looked at the methods of risk assessment used by the EPA and the Dept. of Transportation, the more confused the whole issue became. The Coast Guard considered metam sodium extremely hazardous because it becomes poisonous when mixed with water, but the Dept. of Transportation didn’t consider it a problem. “When Boxer asked whether Don Clay (EPA official) might want to add the pesticide, metam sodium, to its list of hazardous chemicals if it killed people as well as fish, Clay replied: “The number of fish killed or the number of people killed is not the criterion we use”. Boxer stared in disbelief, then said: “This is an outrage. I’m stunned”. (Press Democrat). The most startling bit of information to come out of these hearings was the under-reported testimony of Linda Fisher, EPA assistant administrator of pesticides and toxic substances. She admitted that the EPA had studies dating from 1987 that linked metam sodium with birth defects in lab animals. But the EPA hadn’t bothered to read these reports since EPA policy required reviewers to “read only manufacturers summaries of studies on chemicals with potential adverse affects. Even if read, birth defects were not enough to warrant the hazardous chemical designation.” (Press Democrat)
At 6:05 AM, July 31, 2003, an 86-car Union Pacific freight train derailed three miles north of Dunsmuir, California. Fifteen cars jumped the track and a few ended up in the Sacramento River. Fortunately, the toxic chemical tankers, which made it to the water, were empty and did not rupture. This derailment, one of three in the Dunsmuir area over the last year, raised hackles when word got out that one of the train’s cars contained 18,000 gallons of hydrochloric acid. The local community was outraged as were fishermen. “We dodged a bullet,” Curtis Knight, Northeastern Representative of Cal-Trout who lives in nearby Mt. Shasta said. “If that car had ended up in the river, we would be right back to ’91,” he said.

Claire Cooper, The Sacramento Bee, Calif. Knight Ridder/Tribune Business News

Jun. 18, 2003--SAN FRANCISCO--A federal appeals court Tuesday curtailed California's power to take steps to prevent another lethal train derailment near Dunsmuir, saying conditions there aren’t so unusual that the federal government can’t handle them.

The decision overturned a state finding that the steep, curvy stretch of railroad in Shasta County, where a Southern Pacific train left the...

Dunsmuir 10 years later Upper Sacramento River alive after deadly pesticide spill; Glen Martin / SF Chronicle 9Jul01: SOME SPECIES MISSING

“Most of the pieces are back in place,” Martz said, “but a few are missing, and may remain that way.” Most significant among these are the mollusks that once inhabited the affected area. The spill was particularly hard on small gastropods and bivalves, and may well have extinguished one or more species. “Mollusk recolonization has literally occurred at a snail's pace,” Martz said. Also absent are signal crayfish, a crustacean that was common in the river prior to the spill. “We have no idea why they haven't come back, but since they weren’t native to the system — they're an introduced species — we don’t consider it especially problematic,” he said. There’s no doubt that the Upper Sacramento's ecosystem is somewhat simpler than it was before the spill, Martz said, “but it's still a very rich system.” Some particularly good news: The river’s insect populations have rebounded to extravagant levels. Aquatic insects constitute a significant chunk of the food web for most riverine systems, and the Upper Sacramento was no exception. Gigantic hatches of stone flies, caddis flies and mayflies sustained not just the abundant trout — but salamanders, frogs and songbirds as well. Indirectly, the hatches also supported the ospreys, mink and otters that preyed on the fish and amphibians.

Case Study: Pipeline Explosion, Bellingham, Washington, June 10, 1999

Olympic Pipe Line Company owns and operates a 400-mile system of pipes that carry gasoline, diesel and aviation fuel from several refineries to users in the Puget Sound area of Washington State. This series of pipelines, some sections of which are 35 years old, supplies all the aviation fuel used at the Seattle-Tacoma International Airport. The pipe that ruptured was a 16-inch flexible, high-strength steel pipe. It was designed to withstand external loads of soil, rail and car traffic, and the pressure of the fuels flowing within.
On June 10, 1999, at 3:18 p.m., Olympic Pipe Line operators at the Renton, WA, control room began switching the operation to supply fuel to a new customer. They had difficulty starting one of the pumps, and the computers that control a series of valves and pumps began malfunctioning. At 3:24 pm, one of the computers crashed. At 3:28 p.m., the backup computer system started up at the same time that a valve in the line closed. The quick closing of the valve caused a pressure surge of up to seven times the normal operating pressure to go back up the pipe. According to initial reports, due to the extreme pressure, a 27-inch gash occurred at a weakened spot in the line. (Later reports in the *Bellingham Herald* on October 2, 1999 stated that a simulation of the line indicated that the pressure in the line at the time of the rupture may not have been above normal operating pressures).

The rupture occurred near Whatcom Creek, close to the local water treatment plant. The computer malfunction also caused the pumps at the start of the pipeline to shut off, thus preventing fuel from continuing to enter the pipeline. Operators were unaware of the break and so at 3:46 p.m., they restarted the pumps, sending fuel into the broken line. At 4:29 p.m., a leak alarm sounded in the control room. In the meantime, Bellingham residents, starting at 4:24 p.m., called the fire department to report the strong odor of gasoline. At 4:31 p.m., the operators started another pump, sending additional fuel into the line. At 4:32 p.m., the pumps shut down automatically, another alarm sounded, and operators began closing off the pipe (*The Seattle Times*, June 11, 1999, June 3, 2000b). At 5:02 p.m., the massive fire is reported (*The Seattle Times*, June 12, 1999, June 24, 1999, June 3, 2000b). About 280,000 gallons of gasoline were pumped into Park Creek and Whatcom Creek during this spill.
Shortly before the explosion, the Bellingham Fire Department began responding to the calls regarding the strong gasoline odor. When they approached the park, the firemen saw the fumes rising from the creek. According to firefighter Ryan Provencher, “the creek had turned yellow, a ‘river of gasoline’” (The Seattle Times, June 13, 1999a). The firefighters immediately began closing off the streets and evacuating the surrounding area. Neighbors also began to alert others. When the gasoline exploded, the fireball reached 30,000 feet into the air and “the fire raced half a mile down the creek until it ran out of fuel.” The hottest part of the fire burned itself out in an hour but hotspots remained for another 48 hours. According to Whatcom County’s fire chief Gary Crawford, “You can tell how hot it got. It singed the hills behind it. We had some 2,000-degree heat” (The Seattle Times, June 11, 1999).

Impacts of the Bellingham Pipeline Explosion
The immediate impact was on the families of the three boys that were killed. Katherine Dalen was speaking of her son Stephen Tsirovas. “You worry about cuts and insect stings. You don’t worry about the water burning them to death” (The Seattle Times, July 28, 1999). Firefighters called Wade King and Stephen Tsirovas “unwitting heroes,” for if the blast had not happened where it did and if the gasoline had traveled further downstream, the loss of life and property would have been “significantly greater.” According to one Bellingham firefighter, the fire department found “highly explosive bubbles of gasoline fumes in the sewer system that could have blown up the city’s entire sewer system” (The Seattle Times, June 13, 1999b).

In the days following the explosion, the community impacts became apparent. City leaders called the accident “the most devastating thing we’ve ever had happen to this community. This has shaken the community’s sense of security to the core” (The Seattle Times, June 17, 1999). Reaction among the evacuees to the initial emergency response to the incident was mixed. Evacuation notification was called ‘haphazard,’ and residents accused officials of taking “an hour to broadcast a warning on the emergency broadcast system. People were left wondering whether their health was threatened by the thick cloud of black smoke” (The Seattle Times, June 13, 1999b). Residents have talked among themselves about ‘getting back to normal,’ but normal was different. Before the disaster, few residents even knew about the pipeline, but now they knew where it was located (a hundred yards from the middle school) and what was in it (The Seattle Times, June 13, 1999a, June 17, 1999).
Residents near the pipeline have also been affected. One resident commented several days after the explosion that “the park was a quiet sanctuary for residents across the region, including her own family. But innocent sounds now jar her emotionally. ‘Whenever I hear a jet go over, it’s like thunder and feels like the explosions. My nerves are rattled. Some nights I’ve woken up and it smells like smoke. It’s definitely on my mind a lot.’” Another person, whose home is near the pipeline, but not near the area where the pipe ruptured, said that “now he wonders just how old the pipeline is and whether the earth piled on top of the pipeline from new construction projects … could become a problem” (Bellingham Herald, June 16, 1999).

In addition to the human costs of the disaster, the explosion killed more than 30,000 fish in Whatcom Creek (The Seattle Times, June 17, 1999). “As the fire burned and the water temperature rose, the oxygen was sucked out of the water. Some of the fish tried to dive, some hid in the rocks, and those who tried to get to air on the surface were burned to a crisp (The Seattle Times, June 13, 1999). Prior to the accident, the creek had been the focus of a restoration effort, including attempts to bring back fish that were listed as threatened under the Endangered Species Act (The Seattle Times, June 17, 1999).

Strengthening Preparedness and Response Capabilities

It is clear from the previous discussions that social, psychological and other community impacts are among the most significant consequences of major accidents involving hazardous materials. At the present time, however, states and localities across the U.S. are only beginning to recognize such issues and fully integrate them into preparedness and response mechanisms. For example, response plans and protocols rarely devote adequate attention to the psychosocial effects of contamination incidents. When psychosocial content is included, it is usually limited to generic information about disasters, debriefing, and mental health. Plans rarely include specific information about contamination incidents and the complex psychosocial challenges, immediate and longer term, that they pose.

Finally, there is the issue of information. In considering ways to reduce the community impacts of major hazardous materials transport accidents, information stands out as a crucial factor. Research suggests that an early lack of accurate information can contribute to both anger and fear. Such a situation may increase long-term psychological morbidity, undermine trust, and damage public confidence, all greatly hindering individual and community recovery after a major accident.