community can provide background data that can be used in predicting that community's need for services given a particular event. Patients' need for medical services and their actual pursuit of such services, however, may be different.

This was demonstrated in Institute, West Virginia, (6) when a chemical plant released a plume of 23 different chemicals into the air. This action resulted in 135 people seeking care at local hospitals. In a survey of residents in 199 households (96% stratified random sample) in three communities at varying distance from the plant but within the path of the plume, researchers found that 32% of residents reported a headache, 27% reported nausea or vomiting, 25% reported burning of the eyes, and 20% reported other symptoms compatible with exposure. These symptoms were not confirmed by physician examination, since none of these people sought medical care. The results of this survey indicate that a substantial number of people may not seek medical evaluation, although medical services may be warranted. There will also be people seeking care for exposure when they were not likely to have been exposed given the release conditions (e.g., a patient who was upwind 5 miles from the release point).

In the absence of specific studies, we assume that most people requesting medical evaluation will come from 1) the "hot zone" or immediate area of the release (generally workers or responders), 2) an area affected by the plume, 3) outside the affected area. People in the third category would be those who became concerned and thought they should see a physician. Releases of substances with an extremely low odor threshold will tend to generate many health inquiries and requests for medical evaluation, even though they may not constitute a health threat.

Regardless of whether patients actually need medical evaluation and care, they will consume medical resources if they seek care. These resources include personnel time, supplies, and laboratory, pulmonary, and radiological services. Any use of these resources will have an impact upon the hospital and emergency medical services.

The internal operations of a medical facility and its capacity to provide routine care can be severely affected by chemical incidents if proper planning is not done. This disruption will be exacerbated if the staff has not been properly trained, does not have the proper information and communication systems, or is generally ill-prepared to address the situation in a timely manner.

A chemical release can even endanger medical personnel and contaminate emergency transport vehicles and hospitals. This occurs either directly (e.g., because a hospital is within a plume) or through secondary contamination (e.g., because workers mishandle contaminated patients). If a facility is contaminated (for whatever reason), it may have to be closed until it can be decontaminated. Contamination is also an issue with the handling of the deceased. The medical care response component can be lost if those responding are not trained properly.

Medical Response On Site

Medical response teams that go on site must ensure that they are informed of the presence of any hazardous materials. Situations involving hazardous materials may call for special equipment, personnel, or tactics. Response teams also need information on hazardous materials so that they will use appropriate first aid and patient stabilization procedures. Information sources should be preplanned and available 24 hours a day. Health and medical responders must remember that a pure chemical substance is rarely found at a release site because of combustion or because of the commingling of substances or their breakdown or chemical change in the environment. This evolving situation requires continual information acquisition and technical input. Information from the scene and from medical sources is particularly critical if routine procedures such as the administration of oxygen would be contra-indicated for the type of contamination or symptoms that patients have. Communication with on site personnel during the response is also critical because of possibly changing situations that may require different actions. A possible problem during emergency response is that various components of the response forces may not have compatible communications systems. Every effort should be made during the planning stage to ensure that all communications systems are compatible.

Upon arrival at the site, the medical components must establish liaison with the response leader and integrate their activities with the rest of the response force. They must **not** act independently, since doing so may disrupt the response and further endanger both the response force and the community. If the planning effort has been sufficient, the response team will know how casualties will be retrieved, the location of the patient receipt area, decontamination procedures, personal protective equipment requirements, triage procedures, protective actions for transport vehicles, and alternate transportation routes and means (if roads are closed or the air space is restricted).

There will be situations in which casualty retrieval is impossible without endangering the responders or the community. Therefore, entry into the "Hot Zone" is controlled by the response leader and the response safety officer who are responsible for ensuring that response personnel and capabilities are not lost because of an inappropriate heroic action. Proper worker health and safety protocols dictate that those using protective equipment have the appropriate medical certification.

The medical component must also be prepared to provide preventive health services to the other response forces in the form of physiological and psychological monitoring. Heat and cold stress symptoms are not uncommon, and the team must be prepared to assist those with these symptoms, as well as those affected by psychological stress. In addition, the medical team must be alert for early symptoms of exposure and the effects of contamination. Record keeping is critical. The data items and recording system should be predefined during the contingency planning process. The medical team must also be prepared to amend the data collection instrument to meet the issues posed by the event. In all cases, a listing, or registry,

of responders should be established so that medical follow-up can be initiated if required.

Every effort should be made to decontaminate the casualties before transporting them. For people with chemical exposures, the most important means of treatment is generally to remove them from the exposure site and decontaminate them. This requires close coordination between on site emergency workers and the health care providers who will be receiving the patient. Once the contamination problem is eliminated and exposure has been terminated, the only problems that remain--and they are not small ones--are those of managing the symptoms, assessing the physiologic impact, and providing appropriate follow-up care.

In some cases involving large numbers of casualties, patients may need be treated in the field. The medical staff that might have to be dispatched to such a release, should receive detailed training in how to handle such a situation. If not, the team will be ill prepared and the patients will be ill served. Members of the medical team must be prepared to assist patients without being equipped or supported as they are in a hospital facility. Planners must recognize that deployment of personnel can significantly reduce the capabilities of the dispatching hospital even as the overall health threat and public scrutiny intensify.

HEALTH DEPARTMENT PERSONNEL

Health department personnel must be prepared to assess the situation, define action levels for identified contaminates, and advise the response leader on actions necessary to protect the population. They also must be prepared to help the response leader define the overall threat. Health departments have the traditional responsibility for public health. This responsibility together with health laws and regulations give health department officials the authority to order several actions, including forced evacuation. Health department personnel must also be prepared to provide sanitation and food safety services if evacuation shelters are opened. In many communities, health departments are charged with determining when the environmental contamination has been reduced to a level safe enough for the population to return. This task is critical and requires input from a variety of organizations and specialties, since most of the literature and standards on hazardous exposure are based on the working population, not the general public. Health department information and communication systems needs must be planned. Coordination with the other response components is mandatory.

The assets of many health departments include epidemiologists who can contribute significantly to the documentation of the overall health impact of a release. (See the chapter An Epidemiological Approach to the Management of Chemical Incidents.) If the response forces have functioned as a full team, then appropriate environmental sampling will have been done. Public health professionals should be present on site to define what sampling is necessary to monitor the environment for health purposes. Through appropriate sampling and analysis, epidemiologists can reconstruct the

exposure and dose profile of those in the environment during the release. If this is not done, then they have to rely on plume dispersion models, which are generally unconfirmed. Informed medical care, coupled with environmental sampling results, can lead to an informed public. When properly done the public will know that all that could have been done was done.

Many health departments have access to veterinarians who can prove invaluable in assessing and defining the distribution of the contaminant and its health impact. By using animals in the plume footprint as surrogates for humans, veterinarians can estimate the exposure of humans to substances of concern. Animals can also provide the first responders in the area an indicator of the severity of the chemical release, particularly if the animals are symptomatic. Veterinarians can also assist in defining the potential impact of a contaminant on the food chain. If livestock are in the area, they should be examined prior to their release to the marketplace for consumption. The same holds true for fowl, eggs, vegetables, fish, and grain crops. It is important that those officials responsible for food safety have input into the emergency response planning process.

HOSPITALS AND MEDICAL CARE FACILITIES

To ensure that patients' needs are met, hospital officials must develop emergency response plans for use in hospitals. Such plans can be divided into procedures for the protection of the physical facility, protection of the staff, and medical care.

The hospital or medical facility may be threatened directly by a release that could contaminate it (e.g., if the plume, explosion, or fire ball involves the hospital.) Members of the hospital staff should review their facility to determine whether it can be sealed from exposure to a contaminant. They should also determine the length of time and the resources necessary for hospital evacuation, locate alternate medical care facilities, and make contingent arrangements to transport patients there.

Hospitals can also be contaminated by patients who are provided care. Therefore, hospitals must make provisions to segregate contaminated patients until their contamination reduction is completed. The hospital may be overwhelmed by large numbers of patients and relatives requesting medical examination and care. If a large-scale release of hazardous material occurs and the general public is exposed, many people will experience some minor symptoms (watering eyes, skin irritation, nausea, dizziness, etc.). Because most patients will travel to a hospital by their own means, authorities will have trouble balancing the patient load among the different hospitals in the area. One hospital may be completely overwhelmed while others have only a few patients. Hospitals should have mutual agreements with nearby hospitals to handle and control overflow. Plans for proper security and crowd control must also be established.

Triage

A triage system must be developed so that patients in urgent need of treatment receive priority at a facility. Reviewing the status of a patients and providing care is not a simple task for physicians dealing with chemical exposures and trauma. On the one hand, patients must be decontaminated or the facility and staff may be compromised, preventing others from receiving care. On the other hand, failure to address major injuries, such as a severe head injury, may result in a patient's condition deteriorating. Deciding who needs immediate treatment is a difficult choice for physicians to make, and a triage system is necessary to help them make that choice. Such a system will be tested with the influx of volunteer patients with minor symptoms arriving at the hospital prior to the first patients arriving via medical transports. These volunteer patients will present due to the need for decontamination and care. Continual reassessment of the patients and the workload assignments is a major requirement of any triage system.

Laboratory

Laboratories can play an important role during emergency responses to chemical releases by providing hospital staff members with the toxicologic information they need to assess and manage patients. Before a release occurs, laboratories should be cognizant of the baseline level of various chemical contaminants among members of that population. The collection of appropriate samples to establish a baseline for the individual or to assess the level of impact is extremely important. The time frame in which the physiological impact can be assessed is measured in hours from the time of exposure. In other cases, specimens should be collected only after sufficient time has passed to allow the anticipated marker to reflect the impact of exposure. The changes in the bio-marker may also resolve within hours. Laboratory personnel, and their Information systems, are critical in determining when and what samples should be collected from the patients. Without a carefully collected history and baseline data for individual patients, physicians may have trouble interpreting the results. This is particularly true for many of the tests that have not been standardized for the population. The quality control and quality assurance measures used in the laboratories are also critical in assessing the status of patients.

Other Services

Other specialized services of a facility may be required in order to effectively treat patients exposed to contaminants. Because these services may not be available 24 hours a day, the response plan should include a means of acquiring the services of off-duty staff members. A list of information sources and consultants to address issues requiring advanced expertise should be developed. Knowing what one does **not** know is extremely important. You cannot fault people for asking for help, but you can criticize them for not realizing that a situation has exceeded their capabilities.

The resources of hospitals are another health and medical issue. Some hospitals are simply not designed to handle large numbers of casualties, while others can only provide selected services. All of these limitations need to be considered by those

developing a community's response plan. The response forces must also be aware of a hospital's limitations.

Hospital personnel are used to taking protective actions to ensure that etiologic agents are not passed from staff members to patients or from patients to staff members. They are used to wearing gloves, masks, and outerwear. They are also used to decontaminating their hands. In dealing with a chemically contaminated patient, staff members must initiate action to prevent their exposure to the chemicals that may be found on the patients and the equipment with which the patients have come in contact. Although the protective equipment necessary for dealing with contaminated patients may be different from the protective equipment hospital personnel usually use, the concepts of protection are basically the same. However, for their own protection, hospital personnel should receive additional training on the proper procedures and equipment to use in treating contaminated patients. Information on the substance released and information from the release site are of vital importance in choosing the correct protective equipment, decontamination procedures, diagnostic tests, medications, and medical procedures.

Record keeping is critical in documenting how facilities treat patients seen as a result of a chemical release. These records help medical planners to define the magnitude of the impact of the release on the community and to prepare for the next release. If the diagnostic and screening services are appropriately linked to the location of the patient when the exposure occurred and to the environmental sampling results, the data gathered could make an important contribution to medical science and to our understanding of the health threat posed by a particular event. Proper documentation of service can also help hospitals defend themselves against law suits that are often filed shortly after a chemical spill.

In providing services to patients who have been exposed, members of the attending staff can use their observational skills to provide vital information to the on site response team leaders. Information on the location of patients when they were exposed can help investigators determine the location and the extent of the contamination. The symptoms of patients may vary significantly depending upon the level of contamination and the physiologic reaction of patients to the contaminant. Classification of these symptoms by severity can provide additional information to the control team. Occasionally the symptoms may not match those reported in the literature for the substance that was released. When this occurs, the situation should be reported to the site, since on-site medical personnel may be dealing with an unreported chemical or one generated by an environmental modification such as a fire or a commingling of the primary substance with other chemicals. When the response team is dealing with a release of unknown substances, information on patients' symptoms can prove useful in identifying the substance released. The response team leader needs to receive feedback from the receiving hospitals on a routine basis.

The medical management of chemical exposures and the overall treatment and

follow-up concerns are discussed in the chapter, "Medical Management of Chemical Disasters."

To ensure that the resources required for these actions are available, officials must make detailed contingency plans. For example, exposure to a vapor plume may compromise people's respiratory systems, thus necessitating the use of respirators to maintain ventilation. If a large number of patients are received, more respirators may be needed. Hospitals or treating facilities should have agreements in place with other organizations to provide the needed extra equipment.

The health and medical components must ensure that a spokesperson is available to handle media inquires, and a system must be in place for coordinating information releases to the media and to the public. Only information regarding hospital activities should be released unless the public affairs officer assigned to the event asks the health professional to provide additional information. The public affairs officer should be aware of, and have input to, any media releases.

Members of the medical component must remember that improvisation and flexibility of response actions are often the key to success in the face of changing conditions. Preparedness activities enhance the ability of the emergency team to adapt and to ensure that medical response objectives are attained.

PUBLIC HEALTH AND MEDICAL COMMUNICATION

In addition to performing the activities described above, health professionals may be called upon to inform the general public about the nature and magnitude of a health threat. When doing so, they must remember that everyone views an event from a different perspective, and one person's perception of a situation may not match that of another.

A basic understanding of the communication process is required to ensure that efficient and effective communication occurs. The communication process during a response is highly complex and may involve:

- Vision
- Hearing
- Smell
- Touch

Seeing emergency response vehicles leaving the garage in the night indicates something is wrong, or at least different. Hearing an explosion, or seeing a fireball is not in the general routine of most individuals. The sudden smell of a strong odor, accompanied by a burning of the eyes and nose, implies that there could be danger. When these events happen, nonverbal communication has occurred, and the individual may feel threatened.

Communication is strongly linked to the decision process. Action decisions regarding

the situation are based on the individuals' assessment of risk. These decisions are based on the information available at the time.

The responders assess the risk of approaching the release from a given geographic direction. Corporate officials assess the threat to their company, community, or careers. The media may attempt to determine if the release is worth reporting. The public in the immediate area, on the other hand, are trying to determine if they are threatened, or if their families will be harmed by the release. All individuals base their assessment on their information base. This information base is supported or refuted by their analysis of the situation confronting them at the moment. The analysis may be based on scientific or engineering knowledge and concepts. Their analysis may also be based on past experiences. Regardless of the basis for the analysis, additional information generally is sought from "trusted" colleagues, friends, or relatives to assist in analyzing the problem or situation.

Trust plays a critical role in the assessment performed by the public. The individual receiving the information must trust those who are providing the information on the event, if they are to respond appropriately.

A document entitled Public Knowledge And Perceptions of Chemical Risks In Six Communities: Analysis Of A Baseline Survey (7) published by the U.S. Environmental Protection Agency reported the results of a survey that was conducted to compare various groups used as sources of environmental information as to their trustworthiness

and perceived expertise. The percentage or respondents giving the various groups the highest rating in these categories is reflected in the following table:

PERCEPTION OF INFORMATION SOURCES*

	Amount Rec'd.. % "A Lot"	Trust % "A Lot"	Knowledgeable % "Very"
News Reporters	27	27	17
Environmental Groups	21	40	53
Friends/Relatives	7	34	9
Local Emergency Planning Committee	6	28	33
State Government	6	12	29
People You Know Who Work for a Chemical Industry	5	19	30
Local Government	5	11	22
Federal Government	4	12	36
Chemical Industry Officials	3	8	58
Doctors	3	46	27

*Comparisons of Trends Only; No Significance Tests Conducted

The survey indicated that the public receives more information from reporters than from any other source, although reportes are perceived as being less knowledgeable about environmental issues than many other sources. The survey also showed that chemical industry officials are viewed as the most knowledgeable concerning the risks of chemicals but are not seen as very trustworthy. The health personnel have the highest trust level but are not perceived as being very knowledgeable about chemical risks.

If the public perception of the situation does not match the information they are given, and is not confirmed by the beliefs of others, then the public analysis of the situation will be different. They will not follow the advice or directions they are provided. In addition, if nonverbal communication (such as responding in shirt sleeves) of responders does not match the verbal messages (evacuate the area because of high risk of harm), then the mixed message will result in confusion, and instructions may not be followed.

The primary concern of the medical community should be to provide information to many different groups so as to allow a proper assessment of the health threat during

the initial phases of a response. Planners must assume that the information needs of community members are similar to those of the response team except that the information presented to the community members should be in simpler, less technical language. The same basic communication concepts apply, however, no matter who the target audience is.

Each and every communication should have a well-defined purpose. Some communications, such as status reports, are for information only. Other communications are designed to request an action on the part of an individual or group. All communication should be designed to meet a specific objective.

Appropriate communication requires preparation. In most cases, a community's planning efforts should have led to the development of some standard information releases for the most probable situations. These announcements require health and medical input and testing to ensure that the proper message is conveyed with only minimal misunderstanding.

"Communications systems" are used to convey messages, and "decision systems" ensure that those who must decide to use the communications systems and act on the message can do so in a timely manner. The use of these systems must be planned and practiced if the process is to work smoothly. If the mayor is responsible for ordering an evacuation, then a communication system must be in place for the mayor to receive information, analyze it, and deliver the approval in time for action to occur. Timing of communication is critical. In addition to considering the relationship of time to the release, planners must take into account the time required for each decision and information step of the communication process.

All communications must be aimed at a specific audience. It does little good to tell the general public that "the IDLH will be exceeded if the release continues." On the other hand, such a message would be appropriate if directed at members of the public health community.

Communication must always be a two-way process. There is a difference between "hearing" and "listening." People may hear what is said, but, they may not be listening to the instructions provided in the message. Thus, health officials must constantly assess the actions of those receiving their message in order to determine whether they are actively listening to the message.

In all cases, time is required. The communicator requires TIME to:

- Analyze the situation.
- Decide to communicate.
- Prepare the communication.

- Transmit the message.

The receivers of the message require TIME to:

- Receive the message.
- Analyze the communication.
- Verify the analysis -- in their own minds and through further communication with trusted individuals. The verification process also includes an attempt to ensure that the individual plan of action is appropriate and will be supported by others.
- Act.

In all cases, information must be shared. Information withheld from elected or corporate officials, the media, and the public will cause problems later. Members of the public generally underestimate the risks associated with a release or are unaware of potential health threats. They feel betrayed when a chemical release occurs. The public tends to respond actively, not passively, when a release does occur. They need complete, accurate information if they are to respond appropriately. To ensure that they have such information, communicators must do the following:

- Know the audience (receivers). The message must be consistent with the receivers' information base and appropriate to the issues they face.
- Avoid using technical jargon or acronyms. The use of technical jargon does not enhance a communicator's creditability. It merely indicates that the communicator has problems conveying information to the general public.
- Be honest and "Tell it like it is"! Communicators should convey what is known and what is being done to resolve a hazardous situation. The situation can and will change, and response personnel must be prepared to change their communications at a moment's notice.
- Listen to the responses of the people receiving the message.
- Be responsive to the needs and expectations of the community. Communicators must remember that members of the public had an expectation that their families and homes would be safe.
- Remember that although members of the public may be "ignorant" of the situation, they are not stupid. Communicators must not condescend to their audience.

- Avoid hypothetical speculations. Explain what the situation is -- not what might occur. Speculation from official sources leads to rumors, which in turn causes valuable time to be used in bringing the "decision system" of the responders (including the public) under control.

- Remember that other people are not your adversaries--even though they may react hostilely under the stress of an emergency situation. Some people may criticize a company, the government, or the response team. They may also make suggestions about how future response actions can be improved. Listen to the issues they raise and the suggestions they make and provide a time in the future for people to discuss those issues that can be deferred.

Regardless of the target audience, communicators must be the first to:

- Admit there is a problem and give the bad news. Doing these two things will indicate to your audience that you are aware of the situation and that you are forthright and credible.

- Listen to criticism and do not argue with those who are criticizing. Take the comments in the context offered. Do not blame others for the problems you may face; just take action to correct any deficiency.

- Indicate that information is limited. This is critical for the medical community, since much of the information will be "limited." The public and the response forces will better accept such limitations if they trust the provider of the information and perceive that every effort is being made to obtain more complete information. A level of trust must be established prior to the event. This does not mean, however, that they will be happy.

Credibility and trust are hard to earn and easy to lose!

To remain effective, communicators must not make promises that they may not be able to keep. Everyone likes to give assurances and good news. However, a promise such as "the evacuation will be over in 2 hours," will destroy a communicator's credibility if the promise is not kept. After one broken promise, any trust that a communicator has built up will be undermined, and all future messages will be questioned.

The development of a full communication strategy is key to any preparedness effort. Plans and response procedures define what information will be required, the source of the information, and the means and timing of the communications. Planners must also develop a feedback mechanism to ensure that any communication is appropriately assessed and acted on.

A communication strategy must include plans for communicating with all groups affected by a hazardous chemical release, including industry and response workers, community leaders, official agencies, the media, and the public--before, during, and after a release. Simply having communication devices such as telephones, radios, or computers accounted for in an emergency response plan does not ensure that the "communication system" will work. The plan and all segments of the decision and communication strategy must be tested.

SUMMARY

The cornerstone of public health and medical care is, or should be, prevention. And the prevention of injury or death from the unplanned release of hazardous chemicals necessitates that emergency response planning include all groups that may become involved should such a release occur. This planning requires the active involvement of health professionals in identifying potential health issues within the community and within the response process. Once these issues are identified, appropriate strategies to address them can be developed. However, the best plan in the world will be of little use if the health professionals and other responders carrying out the plan are not trained adequately. A plan is a reference document or a structure for the response force. Training and team building with the response forces is mandatory.

The public and response forces expect that the health and medical community will be prepared and that appropriate health services and follow-up will be provided when required. Preparedness activities are essential ingredients in the protection of the health and well-being of communities.

REFERENCES

1. Binder, S. Deaths, Injuries and Evacuations from Acute Hazardous Materials Releases. American Journal of Public Health 1989; Vol 79, No. 8.

2. National Response Team. Hazardous Materials Emergency Planning Guide. United States-1987. Washington, D.C.: 1987; National Response Team publication no. NRT-1.

3. Organisation for Economic Co-Operation and Development. Guiding Principles for Chemical Accident: Prevention, Preparedness and Response. Paris, France: 1992; OECD publication no. OECD/GD (92) 43.

4. National Response Team. Criteria for Review of Hazardous Materials Emergency Plans. United States-1988. Washington, D.C.: 1988; National Response Team publication no. NRT-1-A.

5. United Nations Environment Programme, Industry and Environment Office. APELL: Awareness and Preparedness for Emergencies at Local Level: A Process for Responding to Technological Accidents. Paris, France: 1988; United Nations publication no. E.88.III.D.3 - ISBN 92 807 1183 0 -00900P.

6. U.S. Public Health Service--Centers for Disease Control. Chemical Release--Institute, West Virginia. United States-1985. Atlanta, Georgia: 1985; EPI-85-74-2.

7. Environmental Protection Agency. Public Knowledge and Perceptions of Chemical Risks in Six Communities: Analysis of a Baseline Survey. United States-1990. Washington, D.C.: 1990; EPA publication no. EPA-230-01-90-074.