Paramedic

Disaster Preparedness

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The typical exercise in disaster preparedness is based upon an aircraft incident, usually involving 100 or more simulated victims, fire suppression, crowd and traffic control, on-site emergency care, triage, and proper distribution of victims to nearby hospitals. Such exercises are usually adjudged a success; if any were termed a failure it would deserve reporting in a scientific journal. Probably the kindest words that could be said would be directed to the use of seldom-exercised communication channels and refamiliarization with mutual aid agreements.

Occasionally, disasters occur without consulting the directors of emergency care agencies. Such real exercises are events such as hurricanes, tornados, earthquakes, riots, disastrous fires, train wrecks, industrial explosions and accidents. When these real events occur, there may be generalized disaster plans that cover some of the needs of the moment. However, the extent to which these plans will be helpful often depends upon the personnel on duty and the extent to which the plans have been subjected to realistic rehearsal prior to the real event.

In the northeast region of this country, there recently was an unusual occurrence that had not been incorporated into generalized disaster planning. The event involved an electric generating plant powered by a nuclear reactor. Of immediate concern to the authorities was the announcement by the company of leakage and the possibility of rupture of pressure vessels with gross contamination to a large area. At the time, the prevailing wind was to the northeast and a major escape corridor was to the southeast into a bordering state. Approximately 150,000 people were in the area designated for possible evacuation; these included the occupants of hospitals and nursing homes, the elderly, the infirm, and the general population.

At the earliest moment that evacuation was being considered, the principals involved were mainly public health officials at the county and state levels. *Emergency care system operators were not informed* or placed on alert early in such planning. Civil preparedness officials *were* alerted and the enormity of evacuating an entire region quickly became evident. What could be expected from a mass automobile exit along popular escap routes? Should paramedic level EM vehicles be stationed along these corr dors as advanced life support stabiliz tion/first aid stations? Should emergency care transport be relega to basic life support vehicles? O more fundamental level, how does totally evacuate 150,000 people? What types of special traffic control, sanitation, fuel, food and support facilities would be needed? Are present contingency plans capable of handling such an emergency? How does one secure such an evacuated region if it is dangerous for personnel to be in the area?

Environmental Protection Agency studies conclude that the effectiveness of an evacuation depends very little on whether or not there are elaborate written plans for it. Few of the present existing plans provide for the type of evacuation measures required following a nuclear power plant accident which threatens to, or actually does, release contaminants into the atmosphere. Most disaster management planners agree that contingency plans and simple standard operating procedures are essential as a guide in the conduct of special types of evacuation such as that required for hospital and nursing home patients, pregnant women, pre-school-aged children, mental patients, the elderly and the disabled. Since these groups represent a small percentage of the population involved in a general evacuation, all forms of mass transportation should be reserved for the above-mentioned special categories of evacuees. Movement of all others can be provided by any excess mass transportation vehicles, but the principal reliance for transportation should be placed on private and government-owned passenger automobiles, trucks, and vans.

In the Three Mile Island incident, a hospital near the leaking reactor (within 30 miles) reported difficulty in obtaining reliable information. Press reports indicated that massive amounts of xenon-135 were released, yet radioactivity readings from the roof of the hospital were normal. Since few hospitals had considered themselves to be directly in the disaster zone, it was unsettling to staff to think of evacuating an entire hospital, and of course, staff were concerned for the first time about their personal safety. The situation was reminiscent of that experienced by hospitals involved in the riots of the '60s. Plans, hastily thrown together, were based upon various contingencies and time factors, e.g., what if the warning to evacuate were immediate (one hour or less) or less stringent (one day or less)? Inherent in all of this is an overriding need for current, accurate information. The common thread in accounts of past disasters is the lack of timely and accurate information to the decision-makers.

Hospitals in the *receiving* region were contacted relatively early by public health officials who requested as many available beds as possible. One such hospital official was trained in radiation hazards and wanted to know if patients sent to his hospital would be ward-type patients, intensive care, needing operations, etc.? He also requested information on the radiation hazards; for example, were the patients, equipment, vehicles, etc., contaminated, irradiated or neither? If contaminated by isotope, it would not be useful to contaminate an entire hospital for the care of a few patients; other arrangements would have to be made. If irradiated, the patients could be received but if the rad dosage were lethal would not triage principles order a low priority to their removal? Even crude estimates would be helpful in estimating receiving hospital capacity.

Finally, what types of regional or national support could be supplied by trained chemical warfare, NRC, and other personnel experienced in identifying radiation source, presence, and intensity, and the need for decontamination and proper employment of such facilities?

Public health officials familiar with large area natural

continued on page 76

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PARAMEDIC COLUMN *from page 63*

disasters have said that the services of greatest benefit to the stricken population are proper provision of food, shelter, clothing, and security. Emergency medical care also is important, but it is difficult to match need with capability because of obvious logistical problems (time and location).

In the United States, we are taking a second look at large sources of nuclear radiation and attempting to rewrite disaster plans, taking into account mass evacuation of regions as well as the large-scale care of both contaminated and irradiated victims.[1] It would seem worthwhile for all agencies to consider such planning since most areas are potentially in the path of such incidents as described here.

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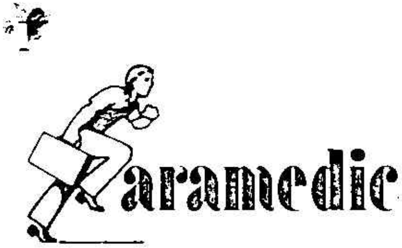

Paramedic

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In most EMS systems there is an annual exercise termed a disaster drill, designed to test the plan by which such emergencies are to be managed. It is characteristically built around a simulated transportation disaster (e.g., plane crash, train wreck, tanker truck fire). Almost always there are 50-150 "victims," and as much equipment as can be conveniently mustered. The drill is usually attended by a number of "brass," "bigwigs," and, of course, the press. Almost always the exercise is termed a success although the critiquing session may offer comment on certain aspects of the exercise.

The disaster drill should have a number of written objectives against which trained observers or referees can make an evaluation. Thus, if the exercise is focused on response times by vehicles, teams, types of personnel, etc., these must be indicated and so graded. Similarly, if patient identification, segregation, on-scene treatment, and appropriate transport is a feature of the exercise then this also must be included as a gradable feature. There must be clear-cut criteria in order for the evaluation to grade the response as "appropriate or inappropriate," or "satisfactory or unsatisfactory." Obviously, in this type of grading system, the referee must provide a rationale for, and written comment about, the grade he has designated.

Development of disaster exercises requires a great deal of pre-planning and organization, and a large number of highly skilled referees who have very specific tasks to accomplish during the exercises. Finally, ideal requisites must be set for the exercise, against which the teams' performance can be matched.

This type of exercise can be judged from the onset by the ratio of participant to referee. It is my feeling that there should be at least as many referees as participants; thus, if there are fire management teams comprising four to six vehicles and two to three times as many men, there should be referees roughly equal to this number with specific tasks to accomplish during the exercise. Utilizing this methodology, there can be fewer victims and a large number of referees and the exercise can be run through more than once in the same test day. For example, have approximately 10 victims and see how one or two crews perform in this situation. Put the crews through their initial recognition, initial disposition, selection of victims for immediate triage to a nearby collection or treatment point, etc. Then stop the exercise at this point and rerun it for other crews. This approach and the more common, one-time through larger scale operation are obviously useful; however, I believe that quantifiable data can be obtained from the smaller scale approach, whereas it is difficult, if not impossible, to obtain such data from the other type.

A variation on this theme might be the sand table or mock-up exercise drill where fire prevention forces and medical rescue personnel participate together in the evaluation of a large disaster scene. It is my impression that at such combined operations, fire suppression often lays out the access or approach routes, triage or medical rescue areas, ambulance routes, etc., without a great deal of consideration for the real needs of these medical collection points and types of personnel to be utilized therein. For example, a collection point is needed for lightly injured victims where there are a large number of personnel who can offer comfort, blankets, shelter, etc., while these victims are being observed for latent injury and eventual transport to definitive medical care, if necessary. Meanwhile, the more seriously injured are being collected, offered appropriate emergency treatment, and transported to appropriate facilities on a more urgent basis. All too often, people are transported depending upon the volume of the screams or proximity to open seats or stretchers.

My final comment relates to the purely medical treatment aspect of mass casualty situations and proper utilization of basic and advanced life support personnel, rescue personnel, medical and nursing personnel, and logical escalation of EMS activities at the scene. In most situations, a fairly basic level group arrives first on the scene, oftentimes the police, who recognize the scope of the situation and invoke the disaster plan. Criteria for establishment of medical support points near the disaster scene should be identified in the minds of fire and police officials since they are oftentimes the sole determinant of such.

Appropriate use of emergency medical personnel also comes to mind. Fire rescue personnel are trained and equipped to operate in forward areas. Doctors and nursing personnel are not. The disaster situation is essentially a military operation and should be kept as such. Thus, ranking fire and police officers should be in charge of personnel working in the forward areas. It is seldom necessary for a physician (such as myself) to go into these areas even though he is equipped and trained to work with paramedics in this environment, if necessary. I see the physician's function as one of support; he will usually be on the periphery of the situation, perhaps at a medical control point, and will go forward only if requested and for specific purposes.

As the triage areas are set up, these should be under the direction of a senior medical officer (such as a fire surgeon) with a pyramiding set-up for the involvement of additional doctors and nurses. By pyramiding, I mean the utilization of paramedics (and nurses as they arrive) to dispense immediate emergency care and continuing observation to patients in the triage area (some call this a "casualty collecting point"). The paramedics and nurses in turn call upon the physician for specific assistance or diagnostic skills as required. Thus, as one gradable item, I would look at the involvement of a physician at the side of one particular victim for prolonged periods as being inappropriate use of such personnel at this type of scene. Rather, I see his function as moving between rows of paramedics and nurses who are taking care of victims and being immediately accessible for specific corroboration of diagnosis or occasionally for a technical skill such as intubation, clamping of a major bleeder, and the like.

As another gradable item, I would look upon the utilization of physician personnel in carrying out mundane tasks such as the taking of blood pressures, starting of IVs, etc., as again being inappropriate use of these personnel at the disaster scene.

The initial response is carried out by basic rescue and emergency care personnel. With the arrival of trained medical teams and particularly leaders, I would like to see more organization and efficient use of medical back-up personnel. These objectives must be clearly stated in the pre-exercise briefings; they must be identified to referees as gradable items; and the exercise should be run through several times in order to take full advantage of the practical teaching and learning opportunities made available during disaster drills.

In the Commentary section of the last issue of this journal, there appeared a spirited exchange of letters regarding an article questioning the time spent on the scene evaluating a patient. The author of the article correctly advises EMS systems to evaluate their operations and to be critical of protocols no matter how well founded they seem to be. His unfortunate choice of two example cases did little to illustrate the point in terms of acceptable current practices. I support his stand on evaluation and critical scrutiny of any and all practices in the search for improvement or supporting evidence. ●

Volunteer squad

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There has been much discussion over the years about the role of the EMT in the emergency medical services system. More recently, the discussion has turned to the development of the EMT as a professional; that is, whereby one can make a career in EMS, working up the ladder. Many professions, in an effort to become more "professional," have sought stricter state licensing, and restricted entry into the profession. Historically, EMT training programs have been rather non-selective. Ominously, one respected observer recently made the following comments: "To accept housewives, schoolteachers, coaches, and scouts in EMT training programs downgrades the importance of the program to the EMT. EMTs, whether voluntary, municipal, or commercial, are *professionals*, and we must nurture this feeling of pride in being a professional."[1] "Students attend medical school to become doctors, nursing school to become nurses, and law school to become lawyers. Students should attend EMT training programs to become working EMTs."[2]

The fundamental principle underlying the development of EMS in this country is that the patient truly is first. We have seen cases where decisions were made for the good of the health care delivery institution, not for the patient. The raison d'être for an EMT going into training programs, and spending the hours to acquire the skills, is to help the patient. The goal of the National Association of EMTs, in its efforts to raise the professionalism of the EMT, is that the quality and level of care delivered to patients is the highest possible. In the halls of Congress, in the offices of DHEW, in community after community across the country, many words have been spoken and written about the dream in which every American is able to receive high quality emergency medical services from well-trained and motivated EMTs, nurses, and physicians. In this dream, a variety of trained personnel and institutions join together to focus their resources, skills, and attention to the patient's needs; in an emergency, every patient receives the highest possible quality of care.

Response time is also of prime importance in the delivery of emergency health care. In a compact city such as Seattle, Washington, a four or five-minute response time is a practicality. Yet that city takes pride in the fact that over 125,000 of its citizens have taken the time to take CPR training courses. In less densely populated areas, such short response times are not a practicality. Just as a cadre of trained citizens improves the chances for survival of heart attack victims, so does the presence of trained EMTs on the roads and highways improve the chances of victims of accidents and medical emergencies. Dr. Justin Myrick of the Georgia Institute of Technology is now working under a federal research grant to develop the concept of rural emergency care coordinators—trained volunteers who would be a community resource person and first responder to emergencies. Yet even this person, and the community, will benefit from the assistance of a cadre of trained citizens.

The notion that restrictive entry to EMT courses is necessary to professionalize the work we do is ludicrous at best, and dangerous at worst (although, because of financial considerations and limited resources, it may perhaps eventually be necessary to restrict entry).

Our role in patient care is secure, is special, and deserving of respect and pride. Let us not become involved in our own egos, but rather let us develop and expand our skills in order to serve our patients and communities the best we can.

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Emergency Medical Services Following a Nuclear Reactor Accident

Introduction. The recent accident at the Three Mile Island Nuclear Station has centered the attention of the public and news media on the consequences and management of an accident involving a uranium-fueled reactor. The incidence and possibility of such events is constantly debated; however, little attention has been devoted to the management of such accidents if they actually occur. The purpose of this article is to review the scientific and medical background, as well as guidelines which have been published to date. Additionally, specific recommendations will be made involving the integration and operation of emergency medical services.

Background. The most probable serious accident involving a commercial nuclear plant is that of a large release of radioactivity into the atmosphere. Exposure to the off-site population may involve direct penetrating radiation (as in a chest x-ray) or contamination (radioactive particles). Direct radiation from a nuclear plant is usually of a very low order of magnitude unless one is within a mile of the reactor facility itself. The more important consideration involves the ultimate fate of the atmospheric release in terms of radioactive contamination. Radioactive releases from nuclear plants are composed primarily of fission products; these are a mixture of noble gases as well as radioactive iodines. Noble gases are inert biologically and do not enter into the metabolic cycle. In this manner, they contribute only a small fraction of the dose that the off-site population may receive when comparison is made to the radioactive iodines.

Radioactive iodine is of much more biological importance, due to possible internal radioactive contamination either by inhalation or the oral route. Approximately 30% of iodine taken into the body will be trapped by the thyroid gland. The major form of radioactive iodine is iodine-131, which is eliminated from the body both by biological mechanisms and by physical decay of the isotope. Physical half-life of iodine-131 is eight days.*

**Physical half-life refers to the amount of time a given amount of isotope takes to decay to half of the previous amount.*

While significant controversy exists about the exact magnitude of the risk, the UNSCEAR Report[1] concludes that it is evident that thyroid cancers are induced by radiation and probably at dose levels of less than 10 rads.** The possibility of, and actual occurrence of, thyroid cancer will be the major biological hazard and public health liability. Fortunately, thyroid carcinoma is a relatively benign neoplasm with a five-year survival rate in excess of 85%.

Radiation-induced thyroid carcinoma can be prevented by blocking the thyroid with stable potassium iodide, thus preventing the entry of radioactive iodine isotopes into the thyroid. The National Council on Radiation Protection and Measurements has analyzed the use of potassium iodide to block the thyroid in the event of a nuclear reactor accident and concluded that it may be very effective.[2] Recently, the long-term medical and legal implications of a large release of radioactive iodine were analyzed[3] and medical guidelines were developed to

***A rad is a unit of absorbed radiation.*

be used in case such an accident occurred. The models indicate that even in the event of an accident significantly larger than the one which occurred at the Three Mile Island Nuclear Station, the natural occurrence of thyroid carcinoma in the population at large will substantially exceed the number of radiation-induced carcinomas. Certainly, after an accident, medical evaluation of the population at large is of importance and these measures have also been discussed elsewhere.[3]

Often the major concern of the population in cases of low level radiation release involves radiation-induced carcinomas. Current statistics indicate that any individual in the United States has approximately a 23% chance of developing cancer during his lifetime. The induction rate of nonfatal radiation-induced carcinomas is approximately 500 cases per million people exposed to one rad of radiation. This would mean that if an individual did receive one rad of exposure (approximately seven times the annual background radiation dose), his risk of developing cancer of all forms will increase from 23% to 23.05%.

Initial Accident Response. Following a nuclear accident, there are several possible actions which can be taken by state health agencies to reduce the radiation dose to a surrounding population. These are:

- Requesting that the population remain indoors;
- Evacuation;
- Thyroid blocking with potassium iodide;
- Confiscation and control of the food distribution chain to prevent consumption of products contaminated by iodine-131.

Population Requested to Remain Indoors. Such an action would be of use only in the event of a low-level release of radioactivity (this action was initially suggested during the Three Mile Island accident). Difficulties would be created, such as the obtaining of food, and medicines such as insulin. Minor illnesses will cause greater psychological concern to the public, exaggerated by the fear of leaving their residences. Most people are aware that "radiation exposure" by massive doses of radiation (over 100 rads) can induce nausea and vomiting, which can make having a simple viral gastroenteritis terrifying. These problems will create an increased demand for emergency medical services.

Evacuation. Evacuation can be difficult to organize, particularly on short notice, One problem that arises is discussed by Hans and Sell, who state that many people prefer to remain in their homes rather than flee. Sightseers and volunteer help often present a significant evacuation problem. In the Middletown experience, there was an approximate population increase of 1,000, due to the influx of news media reporters.

Emergency medical services personnel were called upon to evacuate a nursing home. Although the situation didn't arise during the Three Mile Island incident, in some instances, depending on the direction of the atmospheric release, it may be necessary to evacuate a small hospital, which may be more than a community rescue service can handle in a short time. Therefore, additional ambulances may be needed from nearby cities and towns. In all evacuation situations, it will be necessary for EMS personnel to enter an area of possible atmospheric iodine contamination.

Evacuation is usually directed by Civil Defense authorities and police agencies; therefore, it is essential that a mechanism of communication between EMS people and those directing the evacuation exist. Another problem which must be considered is the possibility of a wind shift, which may cause the atmospheric release to change direction, necessitating the closing of certain evacuation routes on short notice.

Thyroid Blocking with Potassium Iodide. From the NCRP report, it is clear that potassium iodide is very effective in blocking the thyroid's ability to trap radioactive iodine.[2] A 130 mg tablet is most effective when administered two to three hours prior to exposure; however, even if it is given two to three hours following exposure, it may reduce the ultimate thyroid radiation dose by a factor of three.

Currently, the Food and Drug Administration has not made potassium iodide legal for use in reactor accident emergencies, although it apparently intends to do so and has published a notice in the Federal Register announcing this intent. It is of interest that many over-the-counter cough syrups contain a significant amount of stable iodide, and can be used to block the thyroid if potassium iodide tablets are not available. Potassium iodide is essentially non-toxic with the only exception of the induction of hyperthyroidism in those few people in the population who have a non-toxic nodular goiter.

If potassium iodide is made legally available, it undoubtedly will be stored in public places around nuclear reactor facilities, and it is possible that, in the event of a release, emergency medical services personnel may be called upon to distribute potassium iodide, again requiring entry into an area of possible atmospheric release. In the Three Mile Island accident, emergency measures were taken to manufacture and deliver a quarter of a million potassium iodide doses in case it was needed.[5]

Alteration of the Food Distribution Chain. It is unlikely that EMS personnel will become involved in this possible countermeasure; this aspect is usually handled by the Environmental Protection Agency and the state Department of Agriculture. However, it becomes fairly obvious that, regardless of the countermeasure employed, emergency medical services will be required more often than normal. The major health hazard in such accidents is ingestion or inhalation of radioactive iodine and measures will need to be taken to prevent such occurrence.

Health Protection of Emergency Medical Personnel. In order to scientifically determine the proper actions to be taken, the magnitude of the atmospheric release needs to be known. Unfortunately, this data often is not available or is at best incomplete. Initial accident data are difficult to obtain due to the confusion and uncertainties which exist in such circumstances. Computer models have been designed to attempt to predict the path of the release and environmental samplings will undoubtedly be made both by the utility involved and by the regulatory agencies. Unfortunately, even such sampling takes several hours to perform and analyze.

It would be medically prudent, due to the low toxicity of potassium iodide and its effectiveness in blocking the thyroid, for personnel continually entering and re-entering an area of largely unknown hazard, to take potassium iodide (130 mg is usually sufficient).

It is usually unnecessary to consider respiratory protection since respirators generally are not available to EMS personnel; moreover, the major purpose of respirators would be to remove the radioiodine, which hopefully already will be blocked from the thyroid by the stable potassium iodide. Additionally, there is little absorption of radioiodine through the skin and the wearing of coveralls, hoods, boots, and gloves is largely unnecessary. Time may be expected to be of the essence, and will be the major logistical form of protection in such instances.

continued on page 69

behavior and respond appropriately.

Summary. In caring for children it is important to remember that all children have similar reactions to the stress of illness or injury. A basic understanding of how children react at different ages is invaluable, but may not prepare you for all the problems you will encounter. There are some important general considerations to remember when caring for a child:

- Don't be afraid to touch him.
- Don't be afraid to talk with him.
- Be honest.
- Look beyond surface behavior for the cause.
- Prepare him for events when possible.
- Offer him whatever control of the situation that you can.

Emergency personnel must remember that children are individuals. While each child reacts in his own way, an understanding of typical children's reactions to illness and injury can help emergency personnel to better understand and respond without adding stress to an already difficult situation, and in so doing, make the experience one of growth for the child in developing essential skills in coping with stress and injury. ●

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NUCLEAR ACCIDENT *continued from page 56*

In the evacuation of the nursing home, as occurred in Middletown, Pennsylvania, the prudent approach is to take potassium iodide orally, proceed to the nursing home, and accomplish evacuation of patients as quickly as possible. As mentioned previously, such efforts may need to be coordinated with police and Civil Defense personnel. During evacuation, roads may be sealed off which were open on initial entry into the area. All ambulances will need to be equipped with appropriate communications equipment. Upon reaching the designated safe destination, the patient may be removed from the ambulance, monitored with a standard Geiger counter, and placed in the new facility. If the ambulance is not going back into the evacuation area, both the ambulance personnel and the ambulance should also be monitored.

Conclusion. Following an accidental atmospheric release from a nuclear power plant, the major biological hazard of consequence is concentration of radioactive iodine by the thyroid gland. Emergency medical services personnel can expect to be called frequently into an area of largely unknown atmospheric hazard. In such instances, stable potassium iodide should be administered to EMS personnel and they should proceed to accomplish the given tasks as quickly as possible. Communication with regulatory agencies and evacuation authorities is of paramount importance. Within two weeks of such activity, an effort should be made to ascertain the presence of radioactive iodine within an individual's thyroid.[3]

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