

CHAPTER 7

MEDICAL PLANNING AND OPERATIONS IN NUCLEAR WAR

SECTION I - GENERAL

701. Introduction.

- a. In this chapter a variety of operational problems involved in providing medical support to a multi-national land, sea, and air force will be considered. The basic organization of such a force could vary, but an essential feature would be a unified command with a single overall plan of defense. Each nation would contribute military forces and logistic support to the land, sea, and air forces in varying amounts. The medical services of these military forces, however, could be called on to give support to other elements. Although it is a basic principle that casualties of a specific military force receive treatment by medical elements of that force, it must be understood that in a rapidly changing situation, casualties could be receiving primary care in hospitals of other forces or nations.
- b. The problems facing medical planners and commanders in preparing for operations on a nuclear battlefield can be divided into two distinct categories. The first category, staff-level planning and operational activities, includes those actions which must be accomplished prior to the initiation of a nuclear war to minimize the prompt effects of enemy nuclear attacks. The second category, unit planning and operational activities, includes those actions which must be accomplished at the unit level to minimize the immediate and delayed effects of enemy nuclear attacks in order to ensure continued effective medical operations in a nuclear environment. This chapter will address itself to some of the problems unique to these categories. This discussion is not intended as an authoritative treatment of the subject matter, but rather is presented as a guide which must be amplified and modified to meet the requirements of individual users.
- c. Medical commanders may expect at least 10-20 percent casualties (including fatalities) within a division-size force which has experienced a retaliatory nuclear strike. This prediction may be understated as many of the injured will be suffering combined injuries.
 - (1) Research with animal models has led to the conclusion that the prognosis of patients suffering combined injuries will be worse than the prognosis of patients suffering the same magnitude radiation exposure. In fact, the $LD_{50/60}$ may be reduced from 450 cGy (free in air) to as low as 300 cGy (free in air).
 - (2) The inference from this information is that military personnel who receive subcasualty producing exposures of nuclear weapons effects might now require medical attention because they have received combined injuries.
- d. A nuclear weapons detonation can produce an effect which could adversely affect the capability of medical units, that being electromagnetic pulse (EMP). Unless military medical equipment developers ensure their critical electric or electronic equipment

- is hardened against EMP effects, medical operations could be thrust into very primitive conditions.
- e. Planning for nuclear battlefields should be done within the context of biological and chemical warfare as it is perceived that an enemy may employ any variety of their weaponry at any given time.

SECTION II - STAFF-LEVEL MEDICAL PLANNING AND OPERATIONAL ACTIVITIES

702. General.

The success of medical support operations in nuclear war will depend to a great extent on the adequacy of planning, training, and preparation prior to the occurrence of hostilities. As evidenced in paragraph 701c, nuclear warfare is capable of producing a huge disparity between the available medical resources and the number of patients requiring treatment. This problem will be further complicated by disruption of lines of communication, isolation of medical units, and shortages of transportation, supplies, and equipment. Experiences gained during conventional wars will, in many instances, be applicable to the conditions on a nuclear battlefield. However, unique problem areas must be identified and methods of developing solutions sought by all available means, including the use of modern techniques of war gaining and operations research. Once these methods have been developed, a rigorous training and implementation program must be instituted at all levels of medical service for both professional and nonprofessional medical personnel. Emphasis must be placed on practical, problem-related training rather than on theoretical principles.

703. Organization of the Medical Support System.

- a. Medical planners of each country must determine the type of organizational structure that best meets their country's individual and specific needs. Regardless of the type of organizational structure which is finally evolved, it must serve the functions for which it was designed and be responsive to the requirements of the armed forces it must support.
- b. The possibilities of destruction of major command and control units and or isolation of individual medical units are strong arguments for decentralization of control. However, decentralization must not be permitted to compromise the unity of the medical effort and conservation of medical resources. Both requirements can be met by the establishment of dispersed, semimobile, alternate command and control units, each of which is provided with communications systems. These control elements should be located reasonably close to other support activities. However, major logistical and tactical elements that might become targets for enemy nuclear strikes should be avoided. Some compromise must be made between:
 - (1) Convenience and immediacy of service to supported units prior to the outbreak of war; and
 - (2) The survival of medical assets so that care can be provided once war has begun.

704. Mobility of Medical Support.

Forward medical support elements should be fully mobile with organic transportation and communication systems. Medical elements and facilities located in "rear areas" will not require the same degree of mobility. However, these elements should be organized to obtain some degree of flexibility through the use of dispersed facilities and mobile augmentation teams to concentrate the medical effort in areas of the greatest need. Adequate provisions must be made for coordination with other support type elements to obtain the auxiliary support services which are essential to the accomplishment of the medical support mission.

705. Coordination with Other Allies.

Traditionally, direct medical support has been provided by the medical services organic to the armed forces of each country. This concept will require some modification in nuclear war to conserve medical resources and achieve maximum utilization of critical support services. In particular, cooperation between the medical services of different countries will be essential. Mutual medical support plans should be established between allied forces operating in adjacent sectors. Such plans should be simple and easily implemented and should include provisions for periodic review and revision to keep step with changes in troop levels and unit deployment. A key element in these plans is standardization of equipment and supplies. Standardization of color coding and other methods of identification, not dependent upon language, are essential. Key medical personnel in command and staff elements should establish liaison with their allied counterparts and should be kept aware of the amount and type of medical support available and planned.

706. Casualty and Damage Assessment.

- a. The staffs of combat units generally have an efficient system of casualty and damage assessment. Rear area support type facilities are generally lacking in this capability and may have problems in predicting the number of casualties as a result of an enemy nuclear strike. However, this information is necessary for adequate medical support and must be made available to medical staff officers. Further, the basic casualty estimations should be broken down into types of casualties in order that total bed requirements can be more accurately predicted, particularly in view of the prolonged hospitalization associated with the treatment of patients with burns and combined injuries. One enemy nuclear strike on a given area can produce casualties far in excess of the treatment capability of local medical resources. The effectiveness and adequacy of the rescue, evacuation, and treatment effort during the first 24 hours after such an attack are critical. Area commanders must be informed rapidly of the magnitude of the damage and the estimated medical load in order to provide rescue and treatment resources in sufficient quantities or request the proper assistance from higher headquarters, adjacent units, or allied units.
- b. Various systems of casualty and damage assessment have been developed. Most such systems are rather involved and depend on many variables such as method and time

of delivery, type of burst, size of weapon, weather and climatic conditions, wind direction and speed, fallout dose rate, etc. The gathering and complication of such data are time consuming and may not be accomplished until many hours after the disaster. Consequently, medical planners must develop a system of casualty estimation which will provide rapid and reasonably accurate estimates of the number and types of casualties produced by a given enemy nuclear attack.

- c. An aerial reconnaissance and survey with photomapping of the target area is the simplest and most rapid way to estimate damage. By noting the degree of damage to structures within the target area, personnel trained in assessing physical damage from nuclear weapons can rapidly construct an area overlay depleting the radius from ground zero for selected blast and thermal parameters. By combining this overlay with other pertinent data such as population density, warning time, type of structures, time of day, etc., it is possible to rapidly predict the casualty load with a reasonable degree of accuracy.
- d. Prompt radiation effects cannot be determined by aerial reconnaissance. However, significant prompt radiation, even from tactical size standard fission weapons (the size used in Japan), occurs only within the area of severe blast damage and hence alone does not exclusively create a significant number of patient casualties. As well, it is believed that enemy targeting is based upon maximizing the blast effect of nuclear detonations by use of air bursts. This would argue for their using relatively large yield weapons; weapons for which ionizing radiation is the least far-reaching effect. If the enemy develops and employs enhanced radiation weapons, one would predict a significant number of patient casualties suffering ionizing radiation exposures without other physical injury. Residual radiation does present a problem, both to survivors and to rescue and medical personnel coming into the area. Appropriate survey and protective measures must be taken to minimize this danger to survivors and rescue-medical personnel. Medical planners of each NATO country must consider the problems of casualty and damage assessment and develop a system which is best suited to their country's individual requirements.

707. Logistical Support System.

- a. The success of medical support effort depends to a great degree on the adequacy of prewar logistical planning and preparation. Logistical plans should provide not only for medical supplies and equipment but also general supplies, food, clothing, water purification apparatus, radiation detection and measurement instruments, communications equipment, and modes of transportation.
- b. The location of medical resources is extremely crucial. Resources must be close to the area of probable greatest need without being concentrated in areas likely to become targets for enemy attack. This means that medical planners must compromise between dispersal and the capability of the logistical system to move supplies and patients. Medical planners should take advantage of the various stages of military preparedness, which may precede the actual outbreak of hostilities, to implement dispersal and augmentation plans which have been developed. Extensive pre-positioning during peacetime is not practical because of the problems associated

- with long-term maintenance of medical equipment and medications in storage.
- c. Conservation of limited supplies requires efficient stock control procedures. Modern automatic data processing systems can achieve the necessary degree of control when properly used. However, when automatic data processing equipment is employed, consideration must be given to the establishment of protected sites, alternate facilities, and hardening to reduce vulnerability. Only a limited number of computer facilities will be available, and their protection is essential. Their practicability in theaters of operation has not been demonstrated.
 - d. The supply system must also be prepared to provide for increased demands for certain types of medical and general supplies and equipment, e.g., whole blood, blood expanders, burn kits, dressings, individual protective clothing, decontamination equipment, radiac instruments, etc. Much careful thought must be given to both short- and long-range supply, equipment, and maintenance requirements.

708. Personnel and Medical Unit Requirements.

It is highly probable that entire medical units including large hospitals will be lost or will become incapable of functioning because of large-scale losses in personnel and equipment. Hospitals should be dispersed away from potential nuclear target areas to improve the probability of these facilities surviving nuclear weapons attacks. This mitigation technique, however, cannot be relied upon to prevent significant loss of medical treatment capability. Consequently, planning for whole unit replacement must be considered. These units would come from existing military hospitals or from reserve civilian units, depending upon relative availability and the mobilization plans of the individual country.

709. Command Radiation Guidance.

- a. Line commanders at all levels will require advice from medical advisors concerning the effects of accumulated doses of radiation on the health of their personnel and the hazards of potential exposures when operations must be conducted in areas contaminated with fallout. This advice must be practical and based upon an understanding of the requirements of the mission as well as knowledge of the diversity of human response to radiation. The effects of radiation must not be either minimized or exaggerated, and their proper place relative to the other hazards of combat must be understood.
- b. STANAG 2083 has been established, incorporating the most recent guidance on the operational effects of radiation exposures.
- c. If exposures can be maintained below 150 cGy by using the procedures prescribed in STANAG 2083, the overall effectiveness of combat units will not be significantly degraded. However, if the exposures become relatively large (as may occur when an aggressor uses nuclear weapons), then tactical commanders must be advised of their forces' capability to continue the fight. Figures 7-I and 7-II provide an estimate of the combat effectiveness of combat units as functions of *acute* dose and time postexposure. These figures have been developed from subhuman primate studies at the Armed Forces Radiobiology Research Institute (for times less than 60 minutes,

postexposure) and from an assessment of how radiation sickness signs and symptoms will affect the performance of combat tasks (for times greater than 60 minutes, postexposure). An expansion of the information contained in the figures is presented in Table 7-I. The prediction associated with those identified as being "combat effective" is that they will be suffering radiation sickness signs and symptoms of such a nature that they will be able to maintain their performance of at least 75 percent of their preexposure performance level. Those predicted as being "performance degraded" could be operating at a performance level between 25 and 75 percent of their preexposure performance. Those predicted as being "combat ineffective" should be considered as being capable of performing their tasks at 25 percent (at best) of their preexposure performance level. Of course, these predictions are based on combatants suffering only one stressor, that being ionizing radiation exposures. The prediction of performance capacity of those having received ionizing radiation exposures will now have to be considered together with how other stressors (conventional injury, endemic disease, continuous duty (sleeplessness), time in combat, fatigue, etc.) might affect the total performance capability of the force. Also, other refinements to the method should be considered; by example, the description of all tasks as being either physically demanding or physically non-demanding may be too simplistic. For instance, tasks which require great, continuous concentration (e.g., monitoring of radar screens) may not fit well into these gross categories.

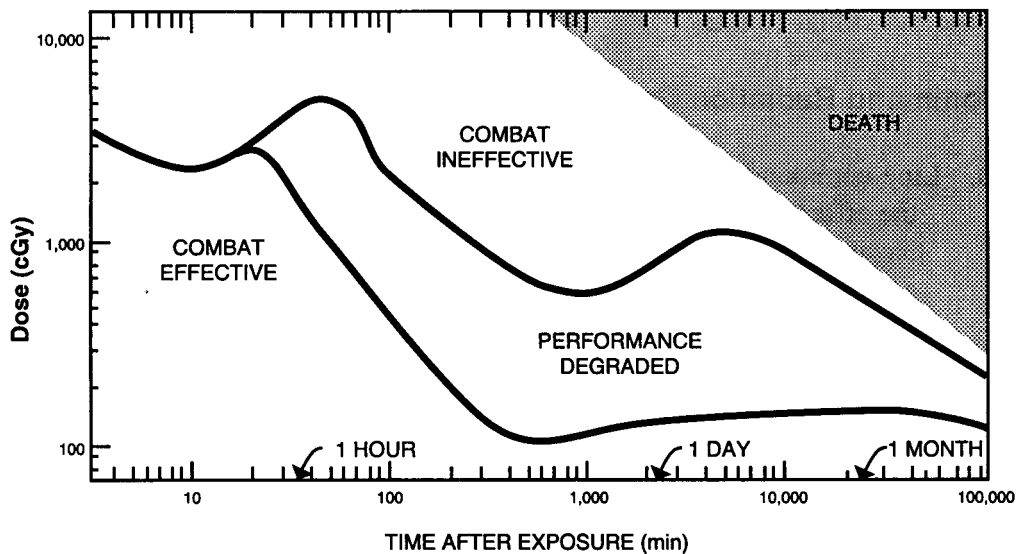


Figure 7-I. Expected Response to Radiation for Physically Demanding Tasks

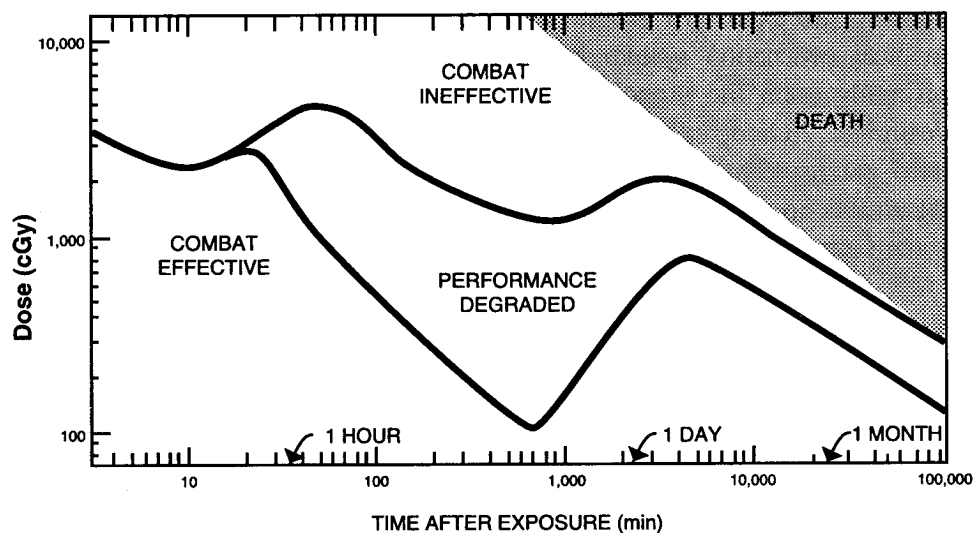


Figure 7-II. Expected Response to Radiation for Physically Undemanding Tasks

SECTION III - MEDICAL UNIT PLANNING AND OPERATIONAL ACTIVITIES

710. General.

Like the medical support system as a whole, the planning and operations of a field medical unit are keyed to the nature and functions of the forces the unit supports. While the problems to be confronted by medical units on the nuclear battlefield will be similar in some respects to those associated with conventional warfare, there are some dramatic differences. These include the vastly increased numbers of casualties to be handled, the need to operate in fallout, and the requirements to treat and decontaminate contaminated patients. These problems and other matters related to unit planning and operations are described in this section.

711. Unit Mobility.

- a. With the changes in transportation capabilities and associated concepts of operations, the mobility of modern military forces has a tremendous impact on how a medical unit must function. It is essential that the medical facilities which are operating in close support of highly mobile forces be as mobile as those forces. This imposes severe restrictions on how long they can retain patients in one location. An efficient and flexible plan of evacuation is absolutely essential in order that forward medical facilities retain mobility.
- b. The classical concept of military medical care has been that a chain of surface or ground evacuation is available. Using helicopter evacuation, immediate casualty collection points may be bypassed so that wounded personnel can be taken directly

to well-equipped hospital facilities located relatively far to the rear reducing the need for an extensive ground evacuation system. However, reorganization of the medical evacuation system in which the intermediate elements are deleted, based primarily upon the proposed use of helicopter evacuation, may not be possible or desirable. Helicopter evacuation may become severely limited if nuclear weapons are used extensively, and the success of helicopter evacuation is certainly affected by weather conditions and enemy air capabilities. Therefore, a ground based evacuation system must be planned for, since it could easily become the primary means of evacuation.

Table 7-I. Biological Response to Nuclear Radiation and Medical Care of Casualties

Dose range (cGy free in air)	Onset and duration of initial symptoms	Performance (mid range dose)	Medical care and disposition
0 to 70	From 6 to 12 hours: none to slight incidence of transient headache and nausea; vomiting in up to 5 percent of personnel in upper part of dose range.	Combat effective.	No medical care, return to duty.
70 to 150	From 2 to 20 hours: transient mild nausea and vomiting in 5 to 30 percent of personnel.	Combat effective.	No medical care, return to duty.
150 to 300	From 2 hours to 2 days: transient to moderate nausea and vomiting in 20 to 70 percent; mild to moderate fatigability and weakness in 25 to 60 percent of personnel.	DT:PD from 4 hours until recovery. UT:PD from 6 to 20 hours; PD from 6 weeks until recovery.	At 3 to 5 weeks: medical care for 10 to 50 percent. At high end of range death may occur to more than 10 percent. Survivors return to duty.
300 to 530	From 2 hours to 3 days: transient nausea and vomiting in 50 to 90 percent; moderate fatigability in 50 to 90 percent of personnel.	DT:PD from 3 hours until death or recovery. UT:PD from 4 to 40 hours and from 2 weeks until death or recovery.	At 2 to 5 weeks: medical care for 10 to 80 percent. At low end of range less than 10 percent deaths; at high end death may occur for more than 50 percent; survivors return to duty.
530 to 830	From 2 hours to 2 days: moderate to severe nausea and vomiting in 80 to 100 percent of personnel. From 2 hours to 6 weeks: moderate to severe fatigability and weakness in 90 to 100 percent of personnel.	DT:PD from 2 hours to 3 weeks; CI from 3 weeks until death. UT:PD from 2 hours to 2 days and from 7 days to 4 weeks; CI from 4 weeks until death.	At 10 days to 5 weeks: medical care for 50 to 100 percent. At low end of range death may occur for more than 50 percent at 6 weeks. At high end death may occur for 99 percent of personnel.
830 to 3000	From 30 minutes to 2 days: severe nausea, vomiting, fatigability, weakness, dizziness, and disorientation; moderate to severe fluid imbalance and headache.	DT:PD from 45 minutes to 3 hours; CI from 3 hours until death. UT:PD from 1 to 7 hours; CI from 7 hours to 1 day; PD from 1 to 4 days; CI from 4 days until death.	1000 cGy: at 4 to 6 days medical care for 100 percent; 100 percent deaths at 2 to 3 weeks. 3000 cGy: at 3 to 4 days medical care for 100 percent; 100 percent deaths at 5 to 10 days.
3000 to 8000	From 30 minutes to 5 days: severe nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, and headache.	DT:CI from 3 to 35 minutes; PD from 35 to 70 minutes; CI from 70 minutes until death. UT:CI from 3 to 20 minutes; PD from 20 to 80 minutes; CI from 80 minutes until death.	4500 cGy: at 6 hours to 1 to 2 days; medical care for 100 percent; 100 percent deaths at 2 to 3 days.
Greater than 8000	From 30 minutes to 1 day: severe and prolonged nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, and headache.	DT and UT:CI from 3 minutes until death.	8000 cGy: medical care needed immediately to 1 day; 100 percent deaths at 1 day.

Key:
CI = Combat Ineffective (less than 25% performance)
DT = Demanding Task
PD = Performance Degraded (25 to 75% performance)
UT = Undemanding Task

712. Rescue and Damage Control.

- a. The location of the injured, when tactical units are dispersed and highly mobile or if rear area logistical units are severely hit, may be quite difficult, since nuclear detonations can be so devastating in their effects that groups of casualties can be produced without the means to communicate their location and medical needs. This problem can be prevented only by the establishment of extensive communications systems, with a reserve capacity, which are hardened against the effects of EMP. The efficiency and rapidity with which location, rescue, and evacuation of the injured are accomplished will significantly affect the numbers of military personnel returning to duty and the numbers of survivors from an enemy nuclear detonation.
- b. Rescue operations, damage control, and medical operations are complementary and should be closely coordinated. However, it should be borne in mind that even with outside medical augmentation, the medical load will be overwhelming and every effort should be made to conserve these resources so as to provide medical care for the maximum number of injured personnel. Therefore, medical unit personnel should not be taken from primary patient care duties and used to perform rescue and damage control operations. Rescue and damage control personnel should be designated, trained, and equipped to render basic lifesaving first aid.
- c. Rescue efforts may have to be conducted in the presence of fallout contamination or with the possibility of fallout arriving at a later time. Qualified radiation monitors should be available to evaluate radiation dose rates and provide specific recommendations to the commander as to the hazards present. Where there is radiological contamination, radiation dose rates may be so high that rescue operations become very hazardous, and must be conducted with caution by members of organized rescue squads specially trained and equipped to assess radiological hazards. Close coordination should be established between medical elements and rescue, evacuation, and damage control elements to facilitate establishing consolidated staging, treatment and evacuation sites in areas of relative safety from residual radiation, secondary explosions, fires, etc.

713. Handling Large Numbers of Casualties.

- a. When there are very large numbers of patients to be cared for, the application of effective techniques of evacuation, of efficient medical management, and particularly of efficient sorting and classification of patients becomes increasingly important in order to insure optimum utilization of available medical resources. The problem of handling large numbers of casualties is not limited to hospitals. It exists at all levels throughout the entire chain of medical evacuation, and the basic principles of triage and patient classification must be understood by all medical personnel. (See AMedP-7(A), paragraph 107.) Since situations vary so greatly, rigid classification procedures must be avoided. Flexibility in the application of these principles must be an established part of medical guidance and training.
- b. It may become necessary for all hospitals to be able to establish and operate a continuous minimal treatment facility as part of the regular operational plan. This

minimal treatment facility would be used to house those patients who cannot return to duty and who do not require or warrant hospitalization in the regular or intensive treatment part of the hospital. This is necessary since, whether patients in an evacuation chain are hospitalized or not, they must be held somewhere and accounted for. They must be housed, fed, and given at least minimal care, and they must be near definitive medical care so that they can receive additional medical treatment in an efficient manner when time and resources permit.

- c. In such a minimal treatment facility, the emphasis would be on self-care since the staffing would have to be minimal.

714. Unit Operations in Fallout.

- a. Whenever large areas are contaminated by fallout, operations of all units, including medical, will be hampered to varying degrees, depending upon the level of contamination. When a serious radiation hazard exists, medical unit commanders will be faced with the question of whether to continue operation and accept hazardous exposures to their personnel or to take shelter, an action which may seriously reduce their unit's ability to care for patients. In order to make the correct decision, they will require adequate information, and this, in turn, necessitates them having the following capabilities:
 - (1) An effective radiation monitoring capability to correctly measure the radiation hazard.
 - (2) The ability to make rapid estimates of the future dose and dose rates expected.
 - (3) Satisfactory communication with other units and higher headquarters to report the fallout situation and to receive fallout warnings, information, guidance, and orders.
- b. Data required to permit proper situation analysis and decision making include:
 - (1) Whether the unit is or will be in a fallout area.
 - (2) Expected time of arrival of fallout, or if the fallout has arrived, how long before it will essentially all be on the ground and radiation dose rates begin to decline.
 - (3) The maximum radiation dose rates expected.
 - (4) The adequacy of existing or immediately available facilities as fallout shelters.
- c. Evaluation of these data together with the operational situation permits proper command decisions to be made relative to moving the unit, diverting patients to other medical treatment units, moving into fallout shelters, or remaining in place and continuing normal operations.

715. Performance of Mission in a Radiologically Contaminated Environment.

- a. Medical units required to remain in areas of high dose rates can survive and continue their patient care activities if adequate shelter is available to shield against radiation. Many materials available on the battlefield afford substantial shielding (Table 7-II). Use of some of these materials, such as concrete, requires significant engineer

support and prior construction. Earth, however, affords excellent protection and can be-employed with a minimum of engineering effort.

*Table 7-II. Shielding Properties of Common Materials
from Fallout Gamma Radiation*

Material	Half-value layer thickness*
Steel	2 cm
Concrete	6 cm
Earth	8 cm
Water	12 cm
Wood	22 cm
* Thickness required to reduce the incident dose or dose rate by one-half.	

- b. In some cases it is unnecessary to do any construction since there may be structures and terrain features already available which will afford excellent protection from radioactive fallout. Tunnels, caves, culverts, overpasses, ditches, ravines, and heavily constructed buildings are examples. In the case of existing buildings, below ground basements give the best protection. With a minimum of effort, windows and overhead floor can be sandbagged or covered with dirt to provide additional protection.
- c. It should be a matter of policy for mobile medical units to locate in or near existing shelter whenever possible. When either fixed facilities or mobile units are unable to locate near existing shelter, adequate shelter must be constructed. Elaborate shelters are not required since normally they need to be occupied continuously only during the period of high radiation dose rates.
- d. It will be very difficult to predict accurately the rate of fallout decay. Therefore, decisions relative to operations in fallout areas should be based on actual survey data. However, it will not be possible or desirable to expose personnel to do area monitoring when dose rates are very high. Therefore, a reliable method of estimating fallout decay is required. Assuming a single nuclear detonation, Table 7-III demonstrates a simple and reasonably accurate method of estimating residual radiation decay. It must be noted that these calculations are most accurate only after all fallout is on the ground and the dose rate is beginning to decrease.

Table 7-III. The 7:10 Rule for Residual Radiation Decay

Time after detonation (hr)	Amount of radiation remaining	Dose rate decay (cGy/hr)
1	-	1000
7	1/10	100
49	1/100	10
343	1/1000	1

716. Field Expedient Fallout Shelters.

a. There are a number of field expedient fallout shelters. The more common ones are briefly described and discussed below.

(1) *The Dozer Trench.* Here a trench of about 2.7 meters wide and 1.2 meters deep is dug with the aid of a dozer. It is estimated that one dozer with its operator could cut six 30 meter trenches in about 5 hours. About 0.6 m of trench would be required for each person to be sheltered; thus, in 5 hours, shelters could be constructed for approximately 300 patients and personnel. Protection and comfort can be improved from unit resources as time passes by digging the trench deeper, undercutting the walls and erecting tents over some portions of the trench. Such trenches should provide adequate fallout shelter for most fallout situations.

(2) *Dug-In Tents of a Mobile Hospital.* The tents of a mobile hospital could be dug in to a depth of approximately 1.2 meters and would provide more comfort than the dozer trench described in the above paragraph. Such dug-in tents, however, have two principal drawbacks. First, they offer far less radiation protection than dozer trenches and second, they require considerably more in the way of engineering efforts.

(3) *Vehicle-Earth Shelter.* A very effective shelter, combining the use of unit vehicles and dirt, can be constructed for mobile medical units with organic transportation. For example, two large tents can be joined end to end and a shallow trench dug around them for the vehicles. The dirt is piled carefully on the outside of the trench. An additional 15-cm trench is dug for the outer wheels of the vehicles. This combination of dirt and vehicles can give as much as 80% protection if fallout contamination is collected and removed from inside the rectangle thus created. Tent liners and ponchos can be used for this purpose. This expedient method of erecting shelter requires about 2 hours to build and can be occupied or evacuated in a matter of minutes. As with other expedient shelter, it could be constructed at the time the unit occupies the position.

b. Regardless of the type of shelter employed, an effective system must be developed to accomplish certain actions required for the efficient operation of the shelter. In the case of medical units involved in the active care of patients, it is probably advisable

to separate the shelter management functions from those of patient care. Those individuals assigned the responsibility of shelter management must provide for such essential functions as radiological monitoring, safe food and water, monitoring water storage facilities to prevent leakage and contamination, arranging for sleeping facilities, controlling fire hazards, enforcing health and sanitation rules, and providing for waste disposal. Shelter management plans must be developed prior to occupying shelters and must be familiar to all assigned personnel.

717. Handling of Radiologically Contaminated Patients.

When fallout occurs, insufficiently sheltered personnel will become contaminated. If these personnel are not wounded or sick, decontamination will be accomplished at unit level under common supervision and is not a medical responsibility. If wounded personnel become contaminated, hospitalization becomes more complicated, since fallout contamination can be hazardous both to the patient and to attending medical personnel.

- a. Radiologically contaminated patients are those whose outer body surfaces have been contaminated with fallout from a nuclear detonation. These fallout residues, in the form of dust, ashes, dirt, or mud, will be loosely adherent to the clothing and skin of the patient; and, once these residues have been removed, the patient does not present a radiation hazard. The patient will not be radioactive him or herself. Thorough and systematic patient decontamination will be required. However, decontamination should not precede or interfere with lifesaving procedures required to resuscitate a severely injured patient and prepare him or her for surgery. Instead, decontamination should be an integral part of these procedures. Furthermore, care must be taken to avoid the accidental formation of a real hazard due to the accumulation of contaminated waste material in the area where the decontamination procedures are carried out. Thus, effective procedures for decontamination, controlled by monitoring and associated with proper control of contaminated waste, must be developed and employed.
- b. There are three distinct hazards associated with radiologically contaminated patients. These are the whole-body gamma hazard, the beta contact hazard, and an internal hazard from inhalation and ingestion of contaminated material. Whether considered from the viewpoint of the patient or those who must handle and treat the patient, these hazards are not of equal importance. It is necessary to determine which is the most important, or governing hazard in order to determine the best way to handle the patients.
- c. Potentially, the most important hazard is the whole-body gamma since this radiation has a long range in air. However, the whole-body gamma hazard should be considerably reduced by the time the patient reaches a medical facility. Two factors account for this reduction: shake-off and radiological decay. Shake-off refers to the loss of contamination from the patient's outer body surfaces as he or she walks, is carried, or otherwise transported from the place of injury to the medical facility. Again, this is possible since fallout residues are loosely adherent. Radiological decay refers to the process by which radioactive material decays to form stable, nonradioactive elements. The decay of residual radiation associated with a nuclear

detonation is very rapid in the early hours after its formation. Additionally, the whole-body gamma hazard to persons handling the patient is several orders of magnitude less than the exposure to the patient due to geometric considerations.

- d. The beta contact hazard presents a significant problem, primarily to the patient. If radiological contamination is permitted to remain on the skin surfaces for extended periods of time (several hours to days), beta skin burns may occur. Resembling first- and second-degree heat burns, these burns affect only those skin surfaces directly in contact with the radiological contamination. Gently brushing or washing the particles off the skin will eliminate the hazard to the patient. Wearing rubber gloves and surgical masks, and practicing good hygiene, including dust removal will eliminate the hazard to medical personnel who must handle or treat the patient.
- e. Under conditions of nuclear war, the minute quantities of radioactive material which might be transferred to the mouth, inhaled, or absorbed through wounds, represent a very minor hazard in comparison with the other hazards, therefore, chelation therapy is very unlikely to be used.

718. Patient Decontamination.

The practical decontamination of radiologically contaminated patients is easily accomplished without interfering with the required medical care. Ninety to ninety-five percent of the decontamination can be accomplished by simply removing the outer clothing and shoes. This can generally be accomplished prior to admission without interfering with medical treatment. Once removed, contaminated clothing can be placed in bags, tagged, and removed to a remote section of the medical facility to avoid creating a hazard due to concentration of such contamination. The clothing can be decontaminated or disposed of by qualified personnel as time permits. The second phase of decontamination consists of washing or wiping the patient's face and hands. This should leave the patient 98% decontaminated. This simple task can be accomplished prior to admission, later on the ward, or elsewhere in the medical facility as the situation dictates. The third phase of decontamination consists of washing the hair, or clipping the hair and washing the scalp. The third phase need only be accomplished if the patient arrives without headgear and/or monitoring indicates that the hair is contaminated.