

This chapter implements STANAG 2866

CHAPTER 4

MEDICAL ASPECTS OF NUCLEAR, BIOLOGICAL, AND CHEMICAL WARFARE

Section I. NUCLEAR

4-1. General

With small yield tactical nuclear weapons, there will be comparatively large numbers of casualties from initial radiation, possibly combined with the blast effects. Burn injuries will be more common as the weapon yield increases. The types of injuries associated with nuclear warfare are—

a. Flash Injury. The intense light of a nuclear fireball can cause flash blindness. The duration of blindness depends upon the length of exposure and the light conditions. However, even at night it is unlikely that flash blindness will last more than a few minutes. Most individuals can continue their mission after the short recovery period. Severe cases may have retinal and optic nerve injuries that lead to permanent blindness; these cases will require evacuation to an MTF.

b. Blast Injury. As mentioned in Chapter 2, blast injuries consist of two types—

- Primary injuries due to overpressures such as ruptured eardrums and lungs.
- Secondary injuries such as lacerations and puncture wounds, as well as translational injuries from the severe winds.

c. Thermal Injury. Thermal injuries are generated by—

- Direct thermal radiation (flash burns and eye injuries).
- Indirect (flame) effects.

d. Radiation Injury. Casualties produced by ionizing radiation alone or with other injuries will be common. Radiation complicates treatment by its synergistic action. The short duration of field medical treatment limits the ability to determine the patient's total radiation exposure. Additionally, total exposure may not be received at one time, but as the result of several operations in contaminated regions. Table 4-1 summarizes radiation injuries and the effects of the radiation on the operational effectiveness of personnel.

Table 4-1. Radiation Injuries and Effects of the Radiation on Operational Effectiveness of Personnel

DOSE RANGE (cGy)	INITIAL SYMPTOMS	TIME OF INITIAL SYMPTOMS (BEGINNING/ ENDING)	PERFORMANCE CAPABILITY (MID-DOSE RANGE)	MEDICAL PROBLEMS	FINAL DISPOSITION WITHOUT MEDICAL CARE	CLINICAL REMARKS
0-70	NONE TO SLIGHT INCIDENCE OF TRANSIENT HEADACHE AND NAUSEA. VOMITING IN UP TO 5% OF PERSONNEL IN UPPER PART OF DOSE RANGE.	6-12 HOURS	COMBAT EFFECTIVE	NONE	DUTY	MILD LYMPHOCYTE DEPRESSION WITHIN 48 HOURS AT UPPER END OF RANGE. MINIMAL OR NO SYMPTOMS.
70-150	TRANSIENT MILD NAUSEA AND VOMITING IN 5 TO 30% OF PERSONNEL.	2-24 HOURS	COMBAT EFFECTIVE	NONE	DUTY	MODERATE DROP IN LYMPHOCYTE, PLATELET, AND GRANULOCYTE COUNTS. INCREASED SUSCEPTIBILITY TO OPPORTUNISTIC PATHOGENS.
150-300	TRANSIENT MILD TO MODERATE NAUSEA AND VOMITING IN 20-70% OF PERSONNEL. MILD TO MODERATE FATIGABILITY AND WEAKNESS IN 25 TO 60% OF PERSONNEL.	2 HOURS- 2 DAYS	DT:PD FROM 4 HOURS UNTIL RECOVERY UT:PD FROM 6 HOURS UNTIL 1 DAY AND 6 WEEKS UNTIL RECOVERY.	MEDICAL CARE MAY BE NEEDED (AT 3 TO 5 WEEKS) FOR 10 TO 50% OF PERSONNEL TO ATTEND TO INFECTION, BLEEDING, AND FEVER.	DUTY, LESS THAN 5% DEATHS AT LOW END OF EXPOSURE RANGE. AT HIGH END OF RANGE, DEATH MAY OCCUR IN UP TO 10% OF PERSONNEL.	IF THERE ARE MORE THAN 1.7×10^8 LYMPHOCYTES PER LITER 48 HOURS AFTER EXPOSURE, IT IS UNLIKELY THAT AN INDIVIDUAL HAS RECEIVED A FATAL DOSE.

Table 4-1. Radiation Injuries and Effects of the Radiation on Operational Effectiveness of Personnel (Continued)

DOSE RANGE (cGy)	INITIAL SYMPTOMS	TIME OF INITIAL SYMPTOMS (BEGINNING/ENDING)	PERFORMANCE CAPABILITY (MID-DOSE RANGE)	MEDICAL PROBLEMS	FINAL DISPOSITION WITHOUT MEDICAL CARE	CLINICAL REMARKS
300-500	TRANSIENT MODERATE NAUSEA AND VOMITING FROM 50% TO 90% OF PERSONNEL. MODERATE FATIGABILITY IN 50% TO 90% OF PERSONNEL MOST LIKELY.	2 HOURS-3 DAYS	DT: PD FROM 3 HOURS UNTIL DEATH OR RECOVERY. UT: PD FROM 4 HOURS UNTIL 2 DAYS, AND FROM 2 WEEKS UNTIL DEATH OR RECOVERY.	AT 2-5 WEEKS FOR 10-60% OF PERSONNEL; INFECTION, BLEEDING, FEVER, ULCERATION, LOSS OF APPETITE AND DIARRHEA.	DUTY AT LOW END OF EXPOSURE RANGE, LESS THAN 10% DEATHS. AT HIGH END OF EXPOSURE RANGE DEATH MAY OCCUR IN MORE THAN 50% OF PERSONNEL.	MODERATE TO SEVERE DROP OF LYMPHOCYTES MODERATE DROP IN GRANULOCYTE AND PLATELET COUNTS. LOSS OF HAIR AFTER 14 DAYS. PURPURA AFTER ABOUT 3 WEEKS.
500-800	MODERATE TO SEVERE NAUSEA, VOMITING, FATIGABILITY, AND/OR WEAKNESS IN 80-100% OF PERSONNEL.	WITHIN THE FIRST HOUR	DT: PD FROM 1 HOUR UNTIL 3 WEEKS. CI FROM 3 WEEKS UNTIL DEATH. UT: PD FROM 2 HOURS TO 2 DAYS, AND 7 DAYS UNTIL 4 WEEKS. CI FROM 4 WEEKS UNTIL DEATH.	AT 10 DAYS TO 5 WEEKS FOR 50-100% OF PERSONNEL; INFECTION, BLEEDING, FEVER, LOSS OF APPETITE, ULCERATION, DIARRHEA, NAUSEA, VOMITING, FLUID AND ELECTROLYTE IMBALANCE, HYPOTENSION.	AT LOW END OF EXPOSURE RANGE DEATH MAY OCCUR IN MORE THAN 50% AT 6 WEEKS. AT HIGH END OF EXPOSURE RANGE, DEATHS MAY OCCUR IN 90% AT 3-5 WEEKS.	PRACTICALLY NO LYMPHOCYTES AFTER 2 DAYS. SEVERE DROP IN GRANULOCYTE AND PLATELET COUNTS LATER.

Table 4-1. Radiation Injuries and Effects of the Radiation on Operational Effectiveness of Personnel (Continued)

DOSE RANGE (cGy)	INITIAL SYMPTOMS	TIME OF INITIAL SYMPTOMS (BEGINNING/ ENDING)	PERFORMANCE CAPABILITY (MID-DOSE RANGE)	MEDICAL PROBLEMS	FINAL DISPOSITION WITHOUT MEDICAL CARE	CLINICAL REMARKS
800-3000+	SEVERE NAUSEA, VOMITING, FATIGABILITY, WEAKNESS, DIZZINESS AND DISORIENTATION. MODERATE TO SEVERE FLUID AND ELECTROLYTE IMBALANCE, POSSIBLE HIGH FEVER AND COLLAPSE.	WITHIN THE FIRST 3 MINS UNTIL DEATH.	DT:PD 45 MINS UNTIL 3 HOURS. CI 3 HOURS UNTIL DEATH. UT:PD 1 HOUR UNTIL 7 HOURS. CI 7 HOURS UNTIL DEATH.	3 MINS UNTIL DEATH.	1000 cGy: 100% DEATH AT 2-3 WEEKS.	BONE MARROW TOTALLY DEPLETED IN 2 DAYS.

NOTES:

1. DT — DEMANDING TASKS.
UT — UNDEMANDING TASKS.
PD — PERFORMANCE DEGRADED (25% TO 75% OF NORMAL PERFORMANCE).
CI — COMBAT INEFFECTIVE (LESS THAN 25% OF NORMAL PERFORMANCE).
DOSES ARE MIDLINE TISSUE DOSES FREE IN AIR (WHOLE BODY DOSES).
2. THE LD 50/60 DAYS DOSE HAS BEEN ASSUMED TO BE ABOUT 450 cGy IN COMPLYING THIS TABLE.
3. THE MORTALITY ESTIMATES ARE FOR UNTREATED, OTHERWISE FIT AND WELL-NOURISHED YOUNG ADULTS.
4. PERFORMANCE COULD BE FURTHER DEGRADED WHEN RADIATION IS COMBINED WITH THE WEARING OF IPE, CHEMOPROPHYLAXIS, OR OTHER STRESSOR.
- 5.

4-2. Management of Nuclear Patients

a. Management. Management of soldiers injured from the immediate effects of nuclear weapons (flash, blast, thermal) are the same as for conventional battlefield injuries, although the injury severity may be increased. First aid (self-aid, buddy aid, and combat lifesaver [CLS]) for lacerations, broken bones, and burns are performed as prescribed in FM 21-11.

b. Mass Casualty. Amass casualty situation is developed by a nuclear attack; that is, the number of patients requiring care exceed the capabilities of treatment personnel and equipment. **EXAMPLES:** One combat medic has two patients requiring immediate lifesaving procedures; he can only provide needed procedures for one. Thus, correct triage and evacuation procedures are essential. Triage classifications for nuclear patients differ from conventional injured patients. Nuclear patient triage classifications are as follows:

- **Immediate treatment group (T1).** Those requiring immediate lifesaving surgery. Procedures should not be time-consuming and should concern only those with a high chance of survival, such as respiratory obstruction and accessible hemorrhage.
- **Delayed treatment group (T2).** Those needing surgery, but whose conditions permit delay without unduly endangering safety. Life-sustaining treatment such as intravenous fluids, antibiotics, splinting, catheterization, and relief of pain may be required in this group. Examples are fractured limbs, spinal injuries, and uncomplicated burns.
- **Minimal treatment group (T3).** Those with relatively minor injuries who can be helped by untrained personnel, or who can look after themselves, such as minor fractures or lacerations. Buddy care is particularly important in this situation.
- **Expectant treatment group (T4).** Those with serious or multiple injuries requiring intensive treatment, or with a poor chance of survival. These patients receive appropriate supportive treatment compatible with resources, which will include large doses of analgesics as applicable. Examples are severe head and spinal injuries, widespread burns, or high doses of radiation; this is a temporary category.

Table 4-2 provides radiation dosage, degradation of treatment, and treatment priorities for radiation and combined injuries.

Table 4-2. Radiation Dosage and Degradation of Treatment Priority

SERIAL	STARTING PRIORITY	FINAL PRIORITY		
		LESS THAN 150 cGy	150-550 cGy	OVER 550 cGy
1	RADIATION ONLY	DUTY OR T3	T3**	T4
2	T1	T1	T1 or T4*	T4
3	T2	T2	T2 or T4*	T4
4	T3	T3	T3**	T4
5	T4	T4	T4	T4

* Select T4 in the case of full or partial thickness burns covering more than 18 percent of the body surface, or trauma which would either result in significant infection or be categorized as severe but not immediately life threatening, such as a fractured femur. This is a clinical decision and not necessarily subjectively reproducible.

** Includes the probable requirements for antibiotics and transfusion at a later time. So this classification does not suggest that the patient is not in need of treatment, but rather that he does not need immediate specialized care.

4-3. Handling and Managing Radioactively Contaminated Patients

a. Radiologically Contaminated Patients. Soldiers from fallout areas may have fallout on their skin and clothing. Although the soldier will not be radioactive, he may suffer radiation injury from the contamination. Removal of the contamination should be accomplished as soon as possible; definitely before admission into a clean treatment area. The distinction must be made between a radiation injured soldier and one who is radiologically contaminated. Although soldiers may have received substantial radiation exposure, this exposure alone does not result in the individual being contaminated. Normally, contaminated soldiers do not pose a short-term hazard to the medical staff, rather the contamination is a hazard to the soldiers' health. However, without patient decontamination, medical personnel may receive sufficient exposure to create beta burns, especially with extended exposure.

b. Handling Radiologically Contaminated Patients. To properly handle radiologically contaminated soldiers, medical personnel must first detect the contamination. Two detectors, the AN/PDR27 and the AN/VDR2, are used to monitor patients for contamination. Generally, a reading on the meter twice the current background reading indicates that the patient is contaminated. Monitoring is conducted when potentially contaminated soldiers arrive at the MTF. This monitoring is conducted at the MTFs receiving point before admitting the patient. Contaminated patients must be decontaminated before admission.

c. Decontamination. Radioactive decontamination is easy. Removing all outer clothing and a brief washing or brushing of exposed skin will reduce 99 percent of contamination; vigorous bathing or showering is unnecessary. Do not let radiological contamination interfere with immediate lifesaving treatment or the best possible medical care. See Appendix C for details on patient decontamination.

d. Treatment. Treatment procedures for radiation injuries are described in FM 8-9 and the NATO Handbook "Emergency War Surgery."

Section II. BIOLOGICAL

4-4. General

The impact of biological warfare on HSS may be a few patients with diarrhea, or a mass casualty situation. The first indication of a BW attack or use will most likely be patients arriving at an MTF with an illness. The routes of entry for BW agents are the same as endemic diseases (that is, through inhalation, ingestion, or percutaneous inoculation). Biological agents are most likely to be delivered covertly and by aerosol. Other routes of entry are thought to be less important than inhalation, but are nonetheless potentially significant.

a. Aerosol.

(1) *Inhalation.* Inhalation of agent aerosols, with resultant deposition of infectious or toxic particles within alveoli, provides a direct pathway to the systemic circulation. The natural process of breathing causes a continuing flux of biological agent to exposed individuals. The major risk is pulmonary retention of inhaled particles. Droplets as large as 20 microns can infect the upper respiratory tract; however, these relatively large particles generally are filtered by natural anatomic

and physiological processes, and only much smaller particles (ranging from 0.5 to 5 microns) reach the alveoli efficiently.

(2) *Ingestion.* Food and water supplies may be contaminated during an aerosol BW attack. Unwary consumption of such contaminated materials could result in disease.

(3) *Percutaneous.* Intact skin provides an excellent barrier for most, but not all, biological agents. However, mucous membranes and damaged skin constitute breaches in this normal barrier through which agents may readily pass.

b. *Contamination of Food and Water.* Direct contamination of food and water could be used as a means to disseminate infectious agents or toxins. This method of attack is most suitable for sabotage activities and might be used against limited targets such as water supplies or food supplies of a specific unit or base.

c. *Other Considerations.*

(1) *Arthropod-borne.* The spread of diseases by releasing infected arthropods such as mosquitoes, ticks, or fleas. These live vectors can be produced in large numbers and infected by allowing them to feed on infected animals, infected blood reservoirs, or artificially-produced sources of a BW agent.

(2) *Long-term survival of infectious agents.* Preservation of toxins for extended periods and the protective influence of dust particles onto which microorganisms adsorb when spread by aerosols have been documented. Therefore, the potential exists for the delayed generation of secondary aerosols from contaminated surfaces. To a lesser extent, particles may adhere to an individual or to clothing, creating additional exposure hazards.

(3) *Person-to-person.* The spread of potential biological agents by person-to-person has been documented. Man, as an unaware and highly effective carrier of a communicable agent, could readily become a source of dissemination (for example, plague or smallpox).

4-5. Management of Biological Warfare Patients

a. *Management.* Management of patients suffering from the effects of BW agents may include the need for isolation. Barrier nursing for patients suspected of suffering from exposure to BW agents will reduce the possibility of spreading the disease to health care providers and other patients. Specimens must be collected and submitted to the designated supporting laboratory for identification.

b. *Mass Casualty.* A BW agent attack can produce a mass casualty situation at all echelons of HSS. A major problem with a BW mass casualty situation is that HSS personnel are more susceptible to becoming a casualty to BW agents. Also, the ill patient may be the first indicator that a BW agent has been dispersed.

c. *Decontamination.* Biologically contaminated patients require some degree of detail. Contamination can be removed by use of a diluted disinfectant solution, or a 0.5 percent chlorine solution. See Appendix C for details on patient decontamination.

d. *Treatment.* Specific treatment is dependent upon the BW agent used. Patients are treated for symptomatic presentation. Field Manuals 8-9 and 8-33 provide additional information on treatment.

Section III. CHEMICAL

4-6. General

Health service support operations in a CW environment will be complex. In addition to providing care in protected environments or while dressed in protective clothing, medical personnel will have to treat chemical injured and contaminated patients in large numbers. Types of injuries associated with chemical warfare are—

a. *Nerve Agent Injury.* Nerve agent injuries are classified as mild, moderate, and severe. Classification is based upon the signs and symptoms presented in the individual. The individual may only be having minor problems, or may be convulsing and exhibiting severe respiratory distress. Some individuals can return to duty after receiving a single injection of the Mark I; others may require multiple doses of the Mark I, CANA, and assisted ventilation.

b. *Blister Agent Injury.* Individuals exposed to blister agents may not know that they have been exposed to the agent for hours to days later. The first indication of exposure may be small blisters on the skin. Others will have immediate burning because of the high level of exposure. The individual with a few small blisters or reddening of the skin can continue the mission. An individual suffering mild injuries may require admission to a MTF for treatment, then returned to duty; whereas, the individual with severe injuries may have to be evacuated out of the theater.

c. *Incapacitating Agent Injury.* Incapacitating agents produce injury by depressing the CNS, or stimulating the CNS. These agents affect the CNS by disrupting the high integrative functions of memory, problem solving, attention, and comprehension. Relatively high doses produce toxic delirium which destroys the ability to perform any task.

d. *Blood Agent Injury.* Blood agents produce their effects by interfering with oxygen use at the cellular level. The agent prevents the oxidative process within cells. In high concentrations there is an increase in the depth of respiration within a few seconds. The patient cannot voluntarily hold his breath. Violent convulsions occur after 20 to 30 seconds with cessation of respiration within 1 minute. Cardiac failure follows within a few minutes. Inhalation is the usual route of entry.

e. *Lung-Damaging Agent Injury.* Lung-damaging (choking) agents attack lung tissue, primarily causing pulmonary edema. The principle agents in this group are phosgene, diphosgene, chlorine, and chloropicrin.

4-7. Management of Chemical Agent Patients

a. *Management.* Movement of chemical agent casualties can spread the contamination to clean areas. All casualties are decontaminated as far forward as the situation permits. All patients must be decontaminated before they are admitted into a clean MTF. The admission of one contaminated patient into an MTF will contaminate the facility; thereby, reducing treatment capabilities in the facility.

b. *Mass Casualty.* As with other NBC weapon/agent employment a mass casualty situation is presented when chemical agents are employed. Additional HSS personnel and equipment

must be provided in a short period of time if the level of care is to be maintained. Treatment at far forward MTFs is limited to life-or limb-saving care. Patients that can survive evacuation to the next echelon of care are not treated at the forward facility. This provides time for treating those patients that cannot survive the evacuation time.

c. *Decontamination.* Decontamination of chemically contaminated patients requires the removal of their contaminated clothing and the use of a variety of decontamination kits and solutions. See Appendix C for details on patient decontamination.

d. *Treatment.* Field Manual 8-285 provides treatment procedures for chemical agent patients.