NATO HANDBOOK ON THE MEDICAL ASPECTS OF NBC DEFENSIVE OPERATIONS
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PART I - NUCLEAR

ANNEX C

GENERAL GUIDELINES FOR MEDICAL SUPPORT IN NUCLEAR ACCIDENTS

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ANNEX C

GENERAL GUIDELINES FOR MEDICAL SUPPORT IN NUCLEAR ACCIDENTS

SECTION I - GENERAL

C.01. Introduction.

a. The following guidelines will be of use to medical personnel required to plan the medical support a hospital facility would provide in case of a nuclear weapons accident. They could be used by either military or civilian facilities and can act as basic background information to aid in the development of specific procedural guides.

b. Copies of the separate guidelines should be made available to hospitals in sufficient quantities so that they would be available to all personnel at the time of an accident. Thus, untrained personnel would have guidelines they could apply.

SECTION II - GUIDELINES FOR MEDICAL ADVISORS

C.02. General.

a. Selected medical personnel should be given the responsibility of planning the medical support required for nuclear weapons accidents. They should maintain up-to-date plans and be prepared to train and supervise other medical personnel. They should have prepared procedural guides available for distribution to any medical facility which may become involved in the support of such accidents. They can act as medical advisors to such facilities and can facilitate greatly the early care of patients and subsequent decontamination of medical facilities if it is required.

b. These medical advisors must also be prepared to deal with the question of how much hazard there is to the local population in the area of an accident. The hazard to be considered is the long term one to people living their entire lifetimes in the area. The guides to be used are the laws of the country or recommendations of the International Committee on Radiation Protection for protection of the population at large. These peacetime standards are very strict and would not be applied in war.

c. The potential public health hazard is fairly minimal. Neither plutonium nor uranium is soluble as an oxide and neither is incorporated into the metabolic cycles of plants. As a result there is very little chance of these elements being ingested either by animals or humans. Even if ingested, their insolubility all but completely precludes any absorption from the gastrointestinal tract. The major hazard is inhalation of the material if it is suspended in the atmosphere. Retention of such materials in the lungs can result in tissue damage as noted above in Annex B, Paragraph B. 11. However, the amounts required to cause any real risk of significant pulmonary disease are very much greater than will normally be present, particularly once material from the accident is dispersed widely on the ground. Therefore, the

inhalation hazard to people living near an accident area is minimal except during times when extensive cleanup operations are going on and materials are being resuspended in the atmosphere.

d. Monitoring of the degree of atmospheric resuspension of hazardous materials with specially designed air samplers must be carried out during such operations. If the areas of contamination and the subsequent cleanup operations are large, enough of these devices to give adequate geographical coverage is required. At times, around the clock monitoring may be essential.

C.03. Management of Contamination.

There are several methods of dealing with radioactive contamination.

a. The half life of ^{239}Pu is 2.43×10^{4} years, and that of ^{235}U is 7.1×10^{8} years so that waiting for decay is impractical (not an option).

b. Resuspension of materials into the atmosphere would be the most serious hazard and extensive monitoring would be required. Wetting down the area with airborne water tankers might be required.

c. If the levels of activity allow cleanup operations to proceed, terrain may have to be removed and buried in sealed containers. The levels to which decontamination is carried out, or the levels at which other activities such as evacuation are initiated, are laid down by individual countries for peacetime use.

C.04. Personnel Precautions.

When it is necessary to work in an environment containing significant concentrations of hazardous materials, control measures must be instituted to limit individual exposures. These measures may range from limitations on the length of time that personnel may stay in an environment to the provision of respirators and protective clothing. In certain circumstances, self-contained air supply systems may be needed. Two primary requirements must be met by any protective equipment. First, it must protect, i.e., its use should ensure safety of the using personnel; and second, the equipment must be reasonably comfortable, or it will not be used. An example of this latter problem is frequently seen in the use of protective masks or respirators, where the quality of the seal of the mask to the face determines the effectiveness of the protection. It has been found that many half-face masks, in particular, can be effectively sealed only by tightening the straps to the point of pain. As a result, users of these masks often do not tighten the straps sufficiently to obtain a seal, and therefore, are less well protected.

C.05. Protective Masks.

Protective masks may be classified in several different ways. Some of these are by their principle of operation such as filtration, by the type of face piece, half-face or full-face, and by the degree of protection. The most convenient classification is by method of operation into two broad groups: Air Supplying and Filtration Type.

a. *Air Supplying Masks.* Air supplying masks are made up of a face piece and an air

source and the necessary tubing and valves for connecting the two. A mask of this type is essential for work in spaces which are deficient in oxygen and is the only effective protection against the gaseous form of hydrogen or its isotopes. The face piece of such a breathing apparatus should be of the full-face type. The tanks should have an air supply of at least 30 minutes under conditions of normal exertion and should have both visible gauges indicating the pressure and some type of an alarm system to warn the user when expiration of the air supply is imminent.

b. *Filtration Type Masks.* Filtration type masks are relatively simple and compact since they are not dependent upon a separate air supply. There is no limitation, essentially, to the length of time they can be worn. The life time of the canister or filter system is the limiting factor. The deficiency of these masks is that they have a tendency to leak unless they are properly fitted to the face. They generally come in two forms: the half-face or the full-face form. The typical military full-face masks are generally quite effficient and afford good protection against particulate contamination. It is essential, however, that the masks chosen fit the user comfortably and without leaking. It is recommended that, where practicable, such masks be tested in a special chamber containing an irritant smoke or other suitable agent.

C.06. Protective Clothing.

a. The purpose of protective clothing is to keep contaminating material away from the skin of the individual and to assist with decontamination.

b. In common practice, the protective clothing requirements are not strictly met and most protective clothing is only partially protective. For instance, protective clothing is readily penetrated by tritium.

(1) Coveralls made of closely woven materials are generally used. Two pair of such coveralls are usually worn, along with cotton or rubber gloves, rubber boots, and protective caps or hoods. All openings, such as where the gloves overlap the sleeves, are sealed, usually with adhesive masking tape. It has been found that untreated cotton fabric is a reasonably effective barrier to dust and that it is easily decontaminated by normal laundering procedures. Furthermore, water vapor can penetrate the fabric, thus enabling normal body cooling mechanisms to function.

(2) The clothing must be worn with an efficient full-face mask in order to achieve reasonable protection against particulate aerosols with a high percentage of very small particles. Finally, clothing worn for protection against particulate contamination will become contaminated itself and must be removed as an individual leaves a contaminated area. The way in which the clothing is removed must be carefully supervised so personnel do not contaminate themselves during the procedure.

C.07. Decontamination of Equipment.

In most cases of contamination of equipment and buildings, the material will be removed by a mixture of normal house cleaning methods. Vacuum cleaners which can handle wet material

and have high efficiency filters are particularly useful. Some surfaces may require repeating scrubbing and vacuuming before they are free of contamination. Obviously, these procedures must be carried out or supervised by specially trained personnel.

SECTION III - GUIDELINES FOR MEDICAL FACILITIES

C.08. Guidelines for Medical Personnel Involved in the Rescue and Evacuation of the Injured at a Nuclear Accident Site.

a. When an accident involving a nuclear weapon occurs, there is a definite probability that a number of casualties with result. The number should be small, but the injuries may be severe and multiple, much like those sustained in serious vehicle accidents. *Emergency personnel sent to an accident site must be well trained in first aid of trauma.* By the time medical personnel arrive at the scene, initial rescue may have been effected and some first aid given. The medical personnel should assist in further rescue operations and begin evacuation to the *closest medical facility* as soon as possible. They should notify the receiving facility of the nature of the accident and the number and type of patients involved.

b. The radiation given off by plutonium or uranium is short range alpha and is not a hazard to attending personnel unless the actual radioactive material itself is inhaled. Nonmedical personnel already on the scene may direct medical personnel to wear protective masks. These directions should be complied with because there may be an inhalation hazard at the accident site. Standard military protective masks are excellent protection. They should be worn by personnel inside ambulances until the patients are brought to the medical facility. Hospital personnel can wear a standard surgical mask with safety.

c. After the patients have been brought to a medical facility and turned over to hospital personnel for further care, ambulance personnel and the ambulances should be decontaminated. Decontamination of personnel should be started as soon as possible, even if monitoring facilities are not available. These personnel must not be released, however, until monitoring is possible and indicates that they are no longer contaminated. This requires special alpha sensitive radiation equipment, *not* generally available at hospitals. This equipment must be obtained from teams at the accident site.

(1) The place for decontamination of ambulance personnel can be the same place used by other hospital personnel such as the Emergency Room Staff, ideally away from the Emergency Room.

(2) The place should have two entrances and a shower. There should be a number of laundry bags setup and tagged. The personnel should strip off all clothing, putting them in appropriate bags. If necessary, large tags should be attached to the clothing. Personal item, such as watches and jewelry, should be put in plastic bags. Their protective masks should also be put in a special bag.

(3) A complete set of clean clothing should be made available. If this is not possible, clean scrub suits should be provided personnel until such time as clean clothing can be obtained. Complete monitoring is essential after showering.

C.09. Guidelines for Nursing Service and Emergency Room Involved in Initial Care, Resuscitation, and Admission of Contaminated Patients.

a. Basically, any medical facility must have a plan for the handling of patients which does not change fundamentally the operation of the facility or techniques of patient care. This is best accomplished by restricting changes in basic operations to those which are absolutely essential. The most important objective is to give injured patients proper, efficient, and rapid care without spreading contamination. Restriction of contamination is best accomplished by restricting and controlling traffic in the facility.

b. A traffic diagram to be used in case contaminated patients must be handled should be developed by each medical facility and should be posted in the emergency room area.

c. If there is a choice of rooms in which patients can be treated, contaminated patients should be treated in that room to which they can be brought without crossing main thoroughfares in the building.

d. If the hospital has been warned of possible contamination, the route over which the patients are to be brought may be covered with paper. After the patients are in the treatment room, this paper should be carefully rolled up by personnel wearing caps, gowns, masks, and gloves. The paper then should be put in tagged bags. The process can be repeated as often as necessary. If patients are brought in over uncovered floors, immediately cover the floors with paper and leave in place until personnel with the proper monitoring equipment arrive to help evaluate the hazard. Traffic over the paper must be limited to that which is absolutely essential.

e. There should be several laundry hampers in the treatment rooms and in the adjacent hallways which are tagged so that all linens and clothing can be properly identified for later decontamination.

f. *A treatment team should be organized to function much as do operating room teams.* This system requires a moderate amount of prior planning and training so that it will function smoothly and effectively.

(1) All members of this team should wear caps, gowns, masks, and gloves.

(2) The physician and the assistant, if required, would be restricted to the area immediately around the patient.

(3) Circulating personnel in the room would bring supplies to the physician but would not touch the patient or the equipment being used by the treatment team. *These personnel would not leave the room.*

(4) There should be other circulating personnel who would bring supplies to the room but who would not enter the room.

g. The treatment priorities of a contaminated patient will vary with the seriousness and nature of the basic injuries. While life saving resuscitative measures are progressing, certain decontamination procedures can be carried out without compromising the basic care of the patient.

(1) The patient's clothing should be removed carefully and put into a tagged bag for later decontamination or disposal. Valuables should be put into a tagged bag (preferably plastic) and held in a specially designated place for

monitoring and decontamination. They should not be mixed with the valuables of other patients.

(2) The patients must be thoroughly washed off, especially exposed surfaces. The rinse water must be collected. Disposal later must be done in accordance with the limitations of the laws of the country in which the accident occurred. Consultation with expert personnel from among those at the accident site will be necessary to assure that this is done properly.

h. *Normal surgical management of wounds will be more than adequate for removal of radioactive contamination and special procedures are not required.* Again, the rinse water or sponges should not be disposed of until expert consultations have been obtained. Material objects from the wounds must be saved and if separable from the rest of the waste, put in specially marked bags. These fragments will be studied by technical experts and require special disposal.

i. Patients should be admitted to specially designated wards or rooms and kept in semi-isolation to prevent or limit spread of contamination.

(1) All personnel should put on gowns and gloves, caps and masks, and shoe covers to enter room and remove them after each visit.

(2) All waste materials and linens must be marked and monitored.

j. Frequent monitoring by trained health physics personnel will be required to determine when it is proper to discontinue isolation techniques.

k. If the patient urinates, the urine should be saved for analysis for radiological contamination. Normal urinalyses can be done on portions of the sample with safety, but the laboratory should be notified that there is a potential contamination with radioactive material. It is essential that a record be kept by the laboratory of the volumes of urine so that later calculations can be made of estimated body burdens of radioactive materials by appropriate laboratories. Fecal samples should also be taken and retained in addition to nose blows and swabs.

C.10. Guidelines for Operating Rooms Involved in Care of Contaminated Patients.

a. Among the patients from a nuclear accident, there will probably be a number who are severely enough injured to require extensive surgical care. These patients may be contaminated with any of a variety of materials, both radioactive and nonradioactive. Most of these materials will not constitute a significant hazard to operating room personnel, providing certain fairly simple precautions are taken. The basic organization and routine of the operating room should not be changed. However, in order to minimize and restrict contamination, certain additional precautions should be taken.

b. Since the hazard from any contaminating material will be respiratory, all personnel in the operating room area should wear masks in place at all times when potentially contaminated patients are being cared for. When monitoring personnel and equipment are available, they will be able to advise the operating staff when it is safe to unmask. The staff should not unmask until so advised.

c. It would be preferable to restrict the use of operating rooms so as to limit potential contamination. However, this may not be possible if there is a significant number

of accident victims requiring surgery. Once an operating room has been used for the surgical care of nuclear accident patients, monitoring and decontamination will be necessary before it can be used for normal surgical cases. Therefore, the Surgical Service must be prepared to lose the use of the rooms involved for the period of time necessary to accomplish these procedures. In some instances, it may be practical for a hospital to set up a temporary operating room close to, but not in, the regular operating room area. In other instances this will not be possible.

d. The actual surgery can be managed according to Standard Operating Procedures for handling cases contaminated with infectious hazards with the following additions or exceptions.

(1) All waste material will be saved in suitable containers. Large plastic bags are the most suitable since they do not leak if properly handled. These must be tagged so that they can be identified later and examined by qualified personnel from among the technical teams responsible for salvage and disposal at a nuclear accident.

(2) When personnel remove their surgical gowns, caps, and gloves, they must be considered as contaminated also. They must be removed carefully and the people assisting in their removal must be capped, gowned, and wearing gloves. The masks should be put in a specially marked container.

(3) All personnel must shower completely after working on such cases and must not be released from the area until after monitoring. This monitoring is essential and must be done by qualified personnel with special equipment. These personnel will come from the technical teams working at the accident site.