

Chapter 23

MEDICAL DISASTER PREPAREDNESS

AND

NUCLEAR, BIOLOGICAL, AND CHEMICAL (NBC) OPERATIONS

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INTRODUCTION

On October 23, 1983, the terrorist bombing of the Marine barracks in Beirut took the lives of 241 U.S. military personnel and wounded 112 others. This terrorist action severely stressed the peacetime military health care system in Europe and directed worldwide attention to the ability of our armed forces to respond to a wartime medical contingency. (51) A major emergency affecting a large number of people may occur anytime and anywhere. Whether a peacetime disaster or an enemy attack, lives can be saved if one is prepared for either contingency. (69,74) To do this requires one to be ready by planning and preparing for just such an event.

The United States Air Force (USAF) Disaster Preparedness Program (DPP) was created to integrate into a single program the planning and employment of resources to enable the Air Force to cope with wartime contingency disaster situations or peacetime disasters. The medical mission of the DPP during peacetime is to reduce loss of life and limb and prevent undue suffering. In times of war, the medical mission is to conserve the military strength by returning personnel to duty as soon as possible. The capability to execute the mission and respond effectively under all conditions is the key to winning the war and minimizing casualties. The medical service will play a major supporting role. (39)

A disaster is defined as an event causing widespread destruction and distress; a "medical disaster" additionally causes potentially reversible injuries or illnesses in numbers or time frames which overtake the base or community's medical services. These range in magnitude from man-made disasters, resulting from human errors, to those caused by war and natural disasters. A mass casualty consists of an overwhelming number of seriously injured or otherwise incapacitated individuals, occurring within a limited area or multiple areas, over a brief period of time, and exceeding the locally available facilities ability to provide medical care. Disaster situations include: a. enemy attack with nuclear, biological, chemical, or conventional weapons; b. accidents involving these types of weapons or their components; c. other accidents resulting in fire, explosion, or uncontrolled environmental release of toxic materials or hazardous electromagnetic radiation; d. natural disasters, such as floods, earthquakes, tidal waves, and volcanic eruptions. (4)

Medical preparedness or (readiness) in disasters requires policy, planning, and a preorganized response system. It is designed to provide instant communications, short response time, trained medical personnel, needed equipment and supplies, airlift capability, extrication and rescue technology, and authoritative leadership and communication. (62)

Planning requires an awareness of: the range of disasters which can occur, possible preventive measures, types of injuries, measures to prevent further casualties, and special problems and requirements. The principles of disaster management may be summarized as follows:

- a. Prevent the occurrence
- b. Minimize the number of casualties
- c. Prevent further casualties
- d. Rescue
- e. Provide first aid
- f. Evacuate the injured
- g. Provide definitive care
- h. Facilitate reconstruction-recovery

More importantly is the fact that these principles apply in both peacetime and wartime scenarios. (4) The intent of this chapter is to provide the field flight surgeon an updated information resource on the planning, operations, and readiness of disaster preparedness within the Air Force. It will cover primarily operations involving nuclear, biological, and chemical (NBC) weapons. The flight surgeon will know where to find specific information from Air Force regulations, manuals, pamphlets, and technical orders. Additionally, certain Army publications will be included. Another chapter will cover specific personnel, equipment, and planning issues in remote environments and should be used in conjunction with this chapter.

ECHELONS OF CARE

The Air Force Medical Service (MS) during times of war is directed to conserve the fighting strength. Historical evidence supports the conclusion that the medical service can rapidly return 35-40 percent of casualties to duty; a ready and available source for replacements. It must also be prepared to care for the sick and injured that cannot return to duty with the objective of minimizing morbidity and mortality. The standard of care will be dramatically different from that enjoyed in peacetime.

It was determined in 1979 that a four echelon system, now known as the Combat Casualty Care System (or the 4E System), would be the method used to accomplish casualty care in the combat theater. The system is patterned after the one described in the NATO HANDBOOK OF EMERGENCY WAR SURGERY (STANAG 2168) and was adopted by the USAF Surgeon General in 1980. This system is characterized by levels of medical care separated not only by distance, but by sophistication. It is not a type of facility, but the capability of delivering treatment according to severity of injury and capacity to handle numbers of casualties. Each level of care is labeled a medical echelon. Medical echelons are currently organized from one to four, with each having an incremental increase in capability of care, including support and training requirements. This current echelon system is undergoing extensive "re-engineering", but is described to permit the reader an understanding of intra-theater medical care. A new, time-based (rather than distance-based) 5 echelon model of casualty care is in the later stages of development. It is a joint initiative, and is an integral part of the DoD Medical Readiness Strategic Plan 2001. A significant policy change, involves the evacuation of patients not expected to return to full duty status within a very limited time frame (e.g. 5 to 14 days) out of the theater of war to CONUS.

During a limited or general war as projected by Defense Guidance, the four echelons of care with its attendant triage concepts will be employed to the greatest extent. This organization allows effective and efficient means of providing professional medical care to casualties close to the combat area. Considering the worldwide propagation of modern medium and long range missile delivery systems we can no longer assume totally safe zones of care (i.e., The Chinese missile SS-23 has a range of 310 miles, with speeds of 6,834 miles per hour or Mach 9 that can access most locations in a given theater of war.) To establish the echelons of care, transportation links must be considered in order to determine placement of facilities, patient evacuation, and resupply. Increasingly, air evacuation is the preferential choice. The current four echelon system is described in the following sections.

First Echelon (1E)

Initial care is provided by the casualty (self aid) or by comrades (Buddy Care). (16) This care includes nerve agent antidote, controlling hemorrhages, immobilizing fractures, protecting wounds, and performing limited decontamination. Many of the injured will require assistance to the nearest casualty collection points, or to the next echelon.

The medical capability to collect casualties at the point of injury is extremely limited in relation to the number of casualties expected. An Air Transportable Clinic (ATC) may be the first source of care for Air Force personnel at a flightline. This level of care is more than 1E, but not 2E in its capacity to treat casualties.

Second Echelon (2E)

This is the first level where medical personnel will be encountered and will have the following characteristics:

- a. Care will be located close to the site where casualties occur. Emergency care provided will include decontamination, triage and initiation of treatment such as intravenous fluids, hemorrhage control, providing an airway, protect wounds, and inserting chest tubes.
- b. Patient transportation from 2E to 3E or 4E facilities is the responsibility of 3E and 4E patient retrieval teams. They are to use their vehicles to retrieve patients from 2E areas.
- c. The Air Force Air Evacuation System will not be used for 2E patient retrieval. (Editor's Note: *The Strategic Plan 2001 calls for significant change in this regard. Frequent aeromedical evacuation of forward patients from 2E facilities is anticipated. See also pg. 23-8, Air Evacuation*).
- d. Facilities encountered at this level include:
 1. Air Transportable Hospital (ATH), 14, 25 or 50 beds.

2. 2E small or 2E medium facilities.
3. SCPS-M (Survivable Collective Protection System - Medical) or SCPS- 2.(45a) **Third Echelon (3E)**

This is the first medical facility staffed and equipped for advanced surgical care characterized by the following:

- a. This care is an extension of field care directed towards saving lives and stabilizing the seriously injured. This permits further evacuation and the return to duty of patients having mild illnesses and injuries.
- b. The 3E medical facility will ideally be located outside of the area where combat is threatened or ongoing. Access to 2E facilities must be considered in positioning this facility since 3E is responsible for 2E patient retrieval and also to the aeromedical evacuation point to 4E. They generally will be co-located with one or both of the following:
 1. ASF - Aeromedical Staging Facility.
 2. MASF - Mobile Aeromedical Staging Facility.
- c. To contend with casualties bypassing the established echelon chain, provisions for decontamination and triage will be available.
- d. When possible casualties will be regulated (between 3E and 4E) by the theater Joint Medical Regulating Office (JMRO).
- e. Facilities to be used:
 1. 250 bed Contingency Hospital.
 2. 500 bed Contingency Hospital.
 3. US Navy Hospital Ships.

Fourth Echelon (4E)

Casualties will receive comprehensive care along with the following capabilities:

- a. Patients will be kept at this echelon throughout their recovery. If they can be rehabilitated during a specified time, they will remain (time governed by theater operations plan). If not, they will be evacuated to CONUS for further treatment and convalescence (**editors note: the fifth echelon in the new Strategic Plan is CONUS based Medical Treatment Facilities**).
- b. For site location the likelihood of attack will be considered and the importance of accessibility to aeromedical staging units serving strategic aeromedical evacuation.
- c. The 4E will preferably be established in a permanent structure.

There will be a large number of combat stress casualties for which specific facilities will be provided to manage them. It is important to try and keep patients close to their unit with the understanding that they are to return when the crisis is over.(61) Stress and other types of casualties will vary in the amount of time they will be held at each echelon. Conceptually, the maximum amount of time a casualty will remain in each echelon will be:

1. 1E - NONE.
2. 2E - 72 hours for combat stress. 4-6 hours for all others.
3. 3E - all types up to 21 days.
4. 4E - up to 60 days.

The flight surgeon must be aware of several assumptions about medical care in the combat theater that applies to all levels.(36) For one, medical equipment for combat casualty care on hand (prepositioned or deployed) may for an extended period of time be the only medical equipment available. (46) Medical equipment transported with patients at the time of evacuation may not be returned. Each military DOD component will treat their own as well as casualties of other services, Allied Forces and prisoners of war (POW).

MEDICAL TRIAGE

General Considerations

Medical triage is a dynamic process of classifying or reclassifying the sick and injured according to the urgency of required treatment, types of conditions presented, and available medical capability. This system provides the greatest benefits to the most patients, in the shortest time, using the resources available. (25, 67)

Each physician or provider classifying casualties must consider the following factors:

- a. Capability and capacity of the supporting medical facility and location of other supporting medical facilities.
- b. Type of treatment procedure each casualty requires, chances for recovery, and effect of delayed treatment.
- c. Tactical and logistical aspects such as availability of aeromedical evacuation, resupply, etc.

Triage Categories

Minimal. Patients with minor injuries who require some attention, but whose injuries are so slight that they may not need a physician. Minor abrasions, lacerations, mild anxiety states, simple fractures of small bones, superficial burns, or partial thickness burns of less than 15 percent of the body are examples of this category of injury. Most of these patients can be promptly treated and returned to duty.

Immediate. Injuries demanding immediate medical or surgical attention to save their lives. Immediate treatment is imperative as long as the life threat can be quickly removed without great expenditure of time, personnel, or supplies. For many of these injuries, simple treatment is lifesaving; for example, stopping arterial bleeding, providing an airway, treating a sucking chest wound, or reducing shock.

Delayed. These injuries do not jeopardize life if definitive treatment is delayed, although recovery may take longer than if prompt care had been given. Injuries in this category usually require extensive surgery or extensive medical care, but immediate transportation to a medical facility is not imperative. Examples include closed fractures of long bones and moderate lacerations without hemorrhage.

Expectant. Patients who are hopelessly injured, or who obviously require an inordinate amount of available medical treatment resources to the detriment or neglect of other patients. Examples include extensive head injury with brain involvement or very extensive burns. As a rule, this category is not applied in a peacetime disaster unless overwhelmed with casualties.

Medical personnel must remember that triage is a dynamic process, and patients must be continually reclassified due to treatment received or to a progression of the injury or disease. It must be adapted to the situation during wartime or peacetime.

In wartime, patients with less serious injuries may be treated first, to return them to duty in minimum time. Triage is primarily oriented toward prompt return to duty, and secondly to treating and stabilizing patients for evacuation to the next higher echelon of care.

Peacetime and Natural Disasters consist of several types:

- a. Limited Numbers of Casualties. A few casualties are enough to overwhelm the limited capabilities of the response team. This team must classify and treat casualties until medical reinforcements arrive. Triage identifies the casualties who are in the immediate category. Immediate patients are treated and transported to a medical facility as soon as possible.
- b. Large Numbers of Casualties. When casualties exceed the capabilities of on-duty staff, equipment, or medical capabilities, a mass casualty situation exists. The Disaster Casualty Control Plan (DCCP) is implemented to provide a coordinated medical approach to the situation.

Triage officers examine all casualties and must readily identify all categories. For this reason a color-coded system is often used. (25) The following colors are used for standardization:

- a. Minimal - Green.
- b. Immediate - Red.
- c. Delayed - Yellow.

d. Expectant - Blue.

This use of colors helps follow-on medical personnel to recognize patients who should be treated first, and permits medical personnel to refer to "colors" rather than categories in discussing patient priorities.

Emergency Patient Record

During wartime conditions casualties will not have medical records. Instead DD Form 1380, U.S. Field Medical Card, will provide a uniform and Department of Defense (Armed Forces) standardized means of identification, evaluation, and treatment documentation. (25)

Casualty Estimation

The USAF War and Mobilization Plan, Volume I (WMP-I), Annex F, lists average expected admission rates and outpatient rates for Battle Injuries (BI) and Disease or Non-Battle Injuries (DNBI) used for planning purposes. As stated in the WMP-I, numerous factors influence these estimates. All units, especially the Air Transportable Hospital (ATH) medical unit, should be aware of and plan for surges in casualties during post attack periods. Operations in the NBC environment will greatly alter estimates. (71)

WARTIME ROLE FOR FLIGHT SURGEONS

Flight surgeons (FS) will have an extremely important part to play during war. Activities will range from the front lines all the way back to the fourth echelon of care. (32) All FSs must know their assigned wartime role and where they will be assigned in order to insure readiness. This knowledge is essential in tailoring training required to enable the FS to fulfill the role. (56, 65). The functional areas flight surgeons may be assigned to are discussed in the following sections.

Squadron Medical Element (SME)

The SME is supervised and managed by a flight surgeon who is assigned three technicians. The equipment is usually that of an Air Transportable Clinic (ATC). The element may be required to operate out of a tent or a fixed facility and will have enough medical supplies to care for a flying unit for approximately 30 days. The flight surgeon may be required to provide casualty collection or second echelon level care. The SME will operate at squadron operations, possibly remote.

Air Transportable Hospital (ATH)

The commander of the ATH is almost always a flight surgeon. ATHs currently have approximately 130 people assigned, have surgical capability, and are considered 2E facilities. The flight surgeon's role is to serve as commander and provide direct patient care. The location and operations of ATHs will be determined according to theater conditions and command direction.

Aeromedical Staging Facility (ASF)

Flight surgeons may be assigned full or part time to an ASF. The ASF is a holding area for patients who have entered the air evacuation systems. Flight surgeons assigned here care for patients, clear them for flight, and may also accompany patients in flight to their medical destinations.

Second Echelon (2E) Facilities

The facilities providing 2E level of care will be located either on base in Survivable Collective Protection Structures- Medical (SCPS-M) or possibly in buildings of opportunity on or off base. The flight surgeon could serve in a 2E facility as commander as well as treat casualties. The flight surgeon makes aeromedical disposition of patients, cares for aircrews, and keeps commanders advised accordingly.

Third/Fourth Echelon Contingency Hospitals

These are generally larger hospitals of 250 or 500 beds located in the combat zone or in the communications zone. These hospitals have specialty capability including surgery. Flight surgeons would be assigned casualty care, aeromedical disposition of patients, and care of aircrews.

CONUS Residual Clinics

These are medical facilities that are in direct mission support at installations that remain operational in wartime. Approximately

50 installations fall into this category and must maintain aerospace medicine capability. Flight surgeons in this role would function in the traditional role as a squadron flight surgeon.

Casualty Treatment Hospitals (CTH)

CTHs are fixed USAF facilities in CONUS that will have a bed expansion in wartime to receive and care for returning casualties. Flight medicine support will be necessary to care for on base operational forces and return to duty patients requiring aerospace medicine clearance. Flying units still operational at these bases would require flight surgeon support.

MAJCOM, Special Operating Agencies, Air Staff

Aerospace medicine capability will remain a requirement at nearly all headquarters and for special operating activities. This role will be primarily in the staff support role.

Air Evacuation

There is a large requirement for flight surgeons on aeromedical evacuation missions. The current planning factor provides for flight surgeons on 100 percent of tactical (intratheater) aeromedical evacuation because it is anticipated that many patients may not be stable. (18) On strategic (intertheater) aeromedical evacuation, it is planned that a flight surgeon will be assigned to 75 percent of air evacuation missions. (33) Key to understanding the requirement for Flight Surgeon support of wartime air evacuation, is new DoD policy calling for the movement of "**stabilized**" rather than "**stable**" patients. Stabilized patients are patients who have been adequately resuscitated: have a patent airway, are not in shock, and are not actively bleeding. This new policy will allow quicker removal of patients from combat areas to more capable medical facilities, as well as decrease the number of required large in-theater medical units. This new policy also means air evacuation patients may be very sick and require significant in-flight care. Training programs for dedicated Air Evacuation Flight Surgeons (AEFS) are anticipated in the near future.

MEDICAL OPERATIONS PLANNING

All Air Force medical personnel have a specific role during contingencies. It is the responsibility of the medical unit commander to ensure that the officers and airmen know what their role is and how to do it. For this reason each FS must find the answers to several important questions. First, what are the plans that affect you? Next, where are you going and what supplies will you have? Is it a 30-day stand-alone status with prepositioned supplies or can supplies be brought to the deployment as needed? Will the supplies be adequate for expected number and types of casualties? What equipment do you have? Are your troops trained? What scenarios will you face? What are the endemic diseases? How can you diagnose and treat those endemic diseases? What preventive measures are required? Is it a joint forces operation or a small Air Force deployment? These are just a few of the basic questions that the FS must know. Familiarization with the specific war and peacetime mission plans and regulations listed below should answer them. (32)

The Wartime Concept of operations for the medical services is described in the USAF WMP-1 (War and Mobilization Plan) and Medical Support in Joint Operations Manual. (24,71) These are the general references used for the base Operations Plan (OPLAN) 355-1, the unit Disaster Casualty Control Plan (DCCP) and the unit Contingency Support Plan (CSP). (9,10,35,59,60).

War and Mobilization Plan (WMP -1)

WMP-1, Volume I, Basic Plan, Annex F-Medical. The WMP provides the Air staff and Air Force commanders current policies and planning factors for the conduct and support of wartime operations in CONUS and overseas. Annex F also includes formulas for estimating requirements for beds, casualties, and aeromedical evacuation crews. Formulas are typically prepared and applied by administrative support personnel for planning purposes and may not be consistent with the reality of the theater.

Volume III, (WMP-3) Combat and Support Forces, Part 2, Mobilization and Nonmobilization, uses deployable medical units by the Unit Type Code (UTC) and list the number of units available for overseas tasking. This code is used for planning the medical units needed to support combat forces in the theater of operations.

UTCs are the five-character alphanumeric designator that describe the specific capability which is associated with each type unit and allows organizations to be categorized into a kind or class having common distinguishing characteristics.(59)

Contingency Support Plan (CSP)

The Contingency Support Plan outlines responsibilities and describes in detail the actions required to accomplish the medical wartime mission.(25) The CSP provides guidance to medical personnel on their specific responsibilities and tasks. It states the medical response to contingencies in which the medical facility may become involved in wartime, except actions required in CONUS for survival, recovery and reconstruction (SRR). (The SRR operations are covered in the USAF SRR Plan 55 and supporting

MAJCOM Plans.)

The CSP Annexes are used to assign specific individual team responsibilities and procedures. They must answer how, where, when, and by whom that particular function is performed. Procedures required in the annexes will be supported by checklists to be used as quick references for assigned personnel. The Medical Command Center (MCC) should have copies of every checklist.

The Aerospace Medicine Service and flight surgeons may be involved in several annexes such as the aeromedical staging, deployment (ATC/ATH), or the Casualty Management Annex.

Each medical facility tailors its CSP according to the support base mission, availability of facilities, patient flow, and expected augmentation.

Disaster Casualty Control Plan (DCCP)

This plan delineates responsibilities and actions required to respond to peacetime and natural disasters.(25) Medical response to all peacetime disasters is basically the same, regardless of the precipitating circumstances. Medical personnel respond to the scene, evaluate requirements, provide emergency care, and prepare the medical facility to receive patients. The basic plan must contain references, contributing organizations, situations, assumptions, mission, and execution.

Annexes. Specific types of disasters will be discussed here. Checklists should be designed to serve as quick references to support the annexes. Copies are to be maintained in the (MCC).

Annex D, Aeromedical Services Team, is of direct interest for flight surgeons since the team chief, who is the Chief of Aeromedical Services, does the following:

- a. Supervises the operation of the crash ambulances.
- b. Supervises the activities of medical personnel at an aircraft or missile accident site, or at any other disaster site where aeromedical services crash ambulances are the initial medical response. NOTE: This team will often be the initial response group especially during daytime. The FS then is the on scene medical commander (OSMC).
- c. Supervises field triage and evacuation of casualties.
- d. Advises the MCC on field medical activities and provides initial casualty reports.
- e. Performs the aeromedical aspects of aircraft accident investigating and reporting.
- f. Trains members of this team, making sure they fully understand the principles of triage and aircraft accident investigation.
- g. Trains all emergency response and triage teams, in disaster management.

Other annexes that cover specific disaster situations include:

- a. Annex O - Civilian Disturbances.
- b. Annex P - Bomb and Terrorist Threats.
- c. Annex Q - Fire Evacuation.
- d. Annex R - Alternate Facility.
- e. Annex S - Shelter Operations.

A thorough knowledge and familiarity with the various disaster scenarios is imperative not only for initial response but in giving advice to other personnel responding first on the scene.

Designed Operational Capability (DOC)

The DOC is based on the WMP which is a MAJCOM prepared, air staff approved statement of unit readiness assessing an ability to perform its assigned wartime mission within a specific response time. (17) Verification of accuracy is essential from an FS standpoint.

The Status of Resources and Training System (SORTS). This reporting system communicates to USAF and ultimately to JCS, the readiness and capability of a unit to respond to the DOC. (17)

The JCS has developed capabilities levels (**C-Levels**) that are defined in qualitative terms and derived through quantitative criteria. C-levels indicate capability of performing wartime missions. There are five categories as follows:

- a. **C-1.** Unit possesses the required resources and is trained to undertake the full wartime mission. One should not be C-1 rated unless they know their potential destination and have properly planned for potential threats accordingly.
- b. **C-2.** Unit possesses the resources and has accomplished the training necessary to undertake the bulk of the wartime mission. One is trained and has most equipment but lacks knowledge and preparation for the potential destination.
- c. **C-3.** Unit possesses the resources but has only accomplished the training necessary to undertake major portions of wartime missions. The training accomplished fulfills the required areas of combat medicine but has not been tailored to a real world situation. Essential equipment is lacking.
- d. **C-4.** Unit requires additional resources or training to undertake its mission. Definitely not ready at any level and cannot fulfill the mission in the event of war. Will take some time to be trained and equipped.
- e. **C-5.** Unit is undergoing a service-directed resource change and is not prepared. Troops are neither trained nor has required gear been issued. Total unpreparedness.

Time-Phased Force and Deployment Data (TPFDD)(pronounced "Tip Fid"). This is a classified document. It gives the who, how, when, where, and what of deployments and is specific for each plan. It is the computer-supported data base portion of an OPLAN. It contains time-phased force data (in place and those to be deployed), non-unit related cargo and personnel data, and movement data (transportation requirements) for the OPLAN. (59) Flight surgeon involvement in the planning is imperative from a preventive medicine perspective if prophylaxis intervention is to be effective.

Base Mobility Plan. This is the document which provides detailed procedures, instructions, and comprehensive data to expeditiously deploy people and equipment. (11,12,13,14) This plan is based on AFR 28-4, USAF Mobility Planning. (10). The flight surgeon must differentiate between mobility and mobilization.

- a. **Mobility** is the capability of military forces permitting them to move from place to place and retain the ability to fulfill their primary mission.
- b. **Mobilization** is the process by which the armed forces or part of them are brought to a state of readiness for war or other national emergency. This includes assembling and organizing personnel, supplies, and material for active military service. (60)

Mobility Operating Procedure Number 17 (MOP 17)-Medical Mobility, AFR 28-4:

- a. Establishes that the Squadron Medical Element (SME) personnel will exercise the ATC periodically and states the minimum requirements for an exercise.
- b. Squadron flight surgeons' duties are specified. ATCs will be exercised at least once a year. After action reports will be submitted within 10 working days following a deployment using the format stipulated in AFR 160-25. The additional 200 pounds of preferential medical items authorized in excess of the normal 30-day level of supplies (prescribed in TA 889) will be exercised. Ensure the medical supply requirements are based on the disease threat.

Wing Commander's Air Base Operability (ABO) Planning Consideration Guide is established the ABO Working Groups at each base with the same ABO focal point at MAJCOM level. Identifies defense requirements that are tailored to the specific mission and theater. Covers Second Echelon (2E) planning considerations, Collective Protection Systems, and the Medical Survival Collective Protection Systems (SCPS-M) checklists. This is an ideal place for the medical community to integrate its plans into those of the air base. Flight surgeons have a role to play here and should have the chief of the ABO Working Group brief the Aeromedical Council semiannually.(45a)

Other Plans:

a. **CONUS Base Use Plan (CBUP)**. The plan that assigns responsibilities for continuing missions required of CONUS installations during wartime. (59)

b. **Medical Estimate of the Situation** is an appraisal of all factors, from a medical viewpoint, that may affect the command mission. It is used to ascertain the medical operational needs of the troops during wartime and maps the course of action to achieve the goal of readiness. The format outline is contained in the USAF Operation Planning Process Regulation. It is recommended the Chief of Aeromedical Services and the EHO review and prepare this statement annually. (9) (See figure 23-1 for the subject outline and refer to the regulation for specific details.)

c. **Joint Operations Planning System (JOPS)**. Manuals are directed by the Department of Defense and specified by the Joint Chiefs of Staff in order to implement the joint planning process. They establish the system to be used in both deliberate and time-sensitive planning of joint operations and in combined operations. (59)

d. **The Statement of Operational Need (SON)** explains the proper way to inform the MAJCOM of a particular need to enable effective completion of your wartime mission. It should be employed whenever an unsolvable problem is identified. This will expedite the research and development into a solution. (59)

The unit orderly room, wing intelligence, and Command Post are a location for most of these plans. The base master publications library usually at the Director of Administration) is a good resource for regulations, manuals, pamphlets, etc., which contain needed information. Refer to administrative personnel to find required references.

OUTLINE FOR THE MEDICAL ESTIMATE OF THE SITUATION (Suggested Format)

OPlan Title:

Medical Estimate of the Situation

References:

1. MISSION

2. SITUATION AND COURSE OF ACTION

a. Proposed courses of action

b. Characteristics of the proposed area of operations

c. Assumptions

d. Strength to be supported

3. MEDICAL SUPPORT ANALYSIS

a. Hospitalization

(1) Availability

(2) Limiting factors

b. Supply aspects

(1) Requirements

(2) Availability

(3) Resupply

(4) Whole blood

(5) Limiting factors

c. Patient Evacuation

(1) Evacuation policy

(2) Time-phased evacuation estimate

(3) Aeromedical staging requirements

(4) Patient regulating

(5) Limiting factors

d. Responsibility for types of patient evacuation

(1) Intratheater evacuation

(2) Intertheater evacuation

e. Aeromedical evacuation airlift

(1) Types of aircraft to be employed

(2) Inflight crew requirements

(3) Limiting factors

f. Other medical support to be furnished by friendly forces

g. Other limiting factors

4. COMPARISONS OF COURSES OF ACTIONS

5. CONCLUSIONS

a. Medical supportability of the Command Missions

b. Recommended course of action

c. Alternative course of action in Priority Order

d. Rationale for Conclusions

(1) Basic Missions supportability

(2) Considerations for proposed courses of action

e. Major medical support factors requiring the Commander's attention

f. Unavoidable medical support limitations

Figure 23 -1. Outline for Medical Situation Report (25)

TRAINING

Exercises

The goal of medical exercises is to ensure a realistic medical disaster response capability. Exercises are to be held according to MAJCOM and base directives.(25) Minimum exercise requirements are listed below:

- a. **Disaster Casualty Control Plan (DCCP)-Semiannually.** Must include a mass casualty exercise. This exercise should be used to realistically evaluate what you (FS) would do in a given disaster situation. Recommend the use of the Bioenvironmental Engineers (BEE) and other medical personnel to aid the base exercise evaluation teams on how to improve the medical capability to respond to potential dangers of your base and local community.
- b. **Contingency Support Plan (CSP)-Annually.**
Exercise scenarios to be used to test the DCCP and CSP are:
 1. Nuclear warfare or accident
 2. Chemical or biological warfare or accident
 3. Conventional warfare or terrorist acts
 4. Aircraft accident
 5. Natural disasters
 6. Civil disturbances
- c. **Attack Response Exercise (ARE) - Annually.** Designed to evaluate the capability of bases to accomplish wartime taskings (excluding mobility). The exercise must be consistent with the type of attack likely to occur at a base.
- d. **Major Accident Response Exercise (MARE) - Quarterly.** One during non-duty hours.
- e. **Recall Plans - Quarterly.** Overseas bases require one recall under communications outages.
- f. **Alternate Medical Facility - Annual .**
- g. **NDMS (National Defense Medical System) - Annual.** Coordinating with NDMS Supporting Hospitals.

Continuous Medical Readiness Training (CMRT)

Medical Readiness training should be realistic and prioritized to train you and your personnel in their wartime tasks. Nonproductive repetition should be eliminated. CMRT should include the unit's wartime mission and concept of operation, current threat update, Geneva Conventions, Code of Conduct, etc. In-service and on the job training should include wartime skills applicable to each job specialty. The commander must tailor CMRT to prepare the medical unit for the potential wartime theater.

More information on CMRT courses can be obtained through your MAJCOM/SG Readiness monitor, Environmental Health Officer (EHO), and the Medical Readiness Regulation as a guide.(25) Courses listed below satisfy annual mandatory requirements (unless noted otherwise, they are sponsored by the Air Force):

- a. Combat Casualty Care Course (C4)
- b. Combat Casualty Management Course (C4-A)
- c. Combat Advanced Trauma Life Support Course sponsored by the Navy in Okinawa.
- d. Medical Management of Chemical Casualties Course- Army.
- e. Medical Effects of Nuclear Weapons Course - Defense Nuclear Agency.
- f. Medical Defense Against Biological Warfare and Highly Communicable Diseases - Army

- g. Chemical Warfare Defense (CWD) Training - Base level. (Allows the FS to know what the troops learn.)
- h. Combat Arms Training - Base level. (Requires a briefing on the Law of Armed Conflict, Geneva Conventions, and Code of Conduct which can be found in the AFP 169- 10, of the same name.) (22,37)
- i. Credit for CMRT can be obtained for actual operational deployment, a JCS (e.g., REFORGER, TEAM SPIRIT, BRIGHT STAR.), or MAJCOM exercise.
- j. Other courses should be given credit for CMRT if they substantially augment skill development required in your unit's mission.

Combat Medicine Training

Required for all physicians, dentists, EHO, physicians assistants, and nurses on a biennial basis covering the following topics:

- a. Threat and Future Battlefield Environment
- b. Hypovolemic Shock, Field Resuscitation Measures
- c. Wartime Anesthesia
- d. Gunshot Wounds and Vascular Injuries
- e. Orthopedic Injury Management
- f. Burn Management
- g. Chemical Casualty Management
- h. Aeromedical Evacuation and Staging
- i. Infectious Diseases of War
- j. Neurological Injuries
- k.. Combat Psychiatry
- l. Maxillofacial Injuries
- m. Triage and Initial Evaluation
- n. Emergency Management of the Airway
- o. Nuclear Casualty Management
- p. Field Sanitation and Hygiene
- q. Hypo-hyper thermal Stress Injuries

NOTE: This list is not conclusive. The subject of DNBI -Disease Non -Battle Injury should be addressed by physicians from a preventive medicine standpoint based on the endemic threat for the unit's wartime mission (i.e., yellow fever, dengue, malaria, etc). A short course on dermatology (skin diseases encountered in combat) is encouraged. Additionally, lectures from After - Action Reports on lessons learned from deployments should be included. There are several Army Field and Training manuals that address the subject well. Consult the EHO.

JOINT OPERATIONS

The concept of joint operations is based on an organizational structure consisting of at least two branches of the armed services. A theater of operations is a geographic area in which military action occurs and may be the total territorial extent of a war. The

application of the concept of joint operations results in a unified command. The theater commander is responsible for combat operations involving all branches and support services within the theater. (1)

The medical mission of the Air Force component is to provide to participating forces the medical support necessary to maintain the highest degree of combat readiness and effectiveness and to provide aeromedical evacuation. (24) All services' branch commanders will become a part of the Theater Commander's staff and will assist in the planning for these operations. A joint staff may consist of five or more principal functional sections: personnel (J-1), military intelligence (J-2), operations and training (J-3), logistics (J-4), and civil affairs (J-5), etc. Lettering is dependent on the branch of service. (54)

MEDICAL INTELLIGENCE

A sound decision depends upon timely, accurate, and usable information. Wartime decisions carry great responsibility. These decisions affect not only the lives of our personnel but the potential outcome of any conflict. Decision makers ask questions that need answers. Information must be evaluated and analyzed before decisions are made. The medical corps relies heavily on appropriate medical intelligence to be prepared for the specific environment.

Medical Intelligence (MI) requires the following characteristics: a. timeliness, b. accurateness, c. usability, d. adequateness. (38,54) Most "finished" intelligence is not derived from a single source, but an evaluation of bits and pieces of information from various sources. All intelligence functions of the Department of Defense fall under the supervision of the Defense Intelligence Agency (DIA).

The primary provider of medical intelligence is the Armed Forces Medical Intelligence Center (AFMIC) at Ft. Detrick, Maryland. AFMIC is a triservice center with a multidisciplined, scientific and medical staff that evaluates and issues medical intelligence for the DIA. Several useful publications are published by AFMIC. These are:

- a. Medical Capability (MEDCAP) Study - contains information needed for deployment.
- b. Health and Threat Summary (HATS) - useful for "enroute" deployment briefings.
- c. The Quick Reference (QR) - are sent upon request quickly to support deployment operations.
- d. AFMIC Weekly Wire - general information as health alert.
- e. AFMIC Bulletin Board Service DSN 343-3625 - unclassified, but must gain prior access approval.

Format for giving a medical intelligence briefing is provided in AFP 169-11, Command, Control, Communication, and Intelligence. (See figure 23-2.)

MEDICAL INTELLIGENCE BRIEFING (Suggested Format)

1. Mission Statement. A clear, concise statement defining the purpose of the briefing.
2. Performance Degradation Due To Climate:
 - a. Major medical problems which will result from environmental extremes in the area of operations.
 - b. Countermeasures:
 - (1) Food and fluid.
 - (2) Medications.
 - (3) Uniform requirements
 - (4) Hygiene.
 - (5) Potential for troop acclimatization.

3. Performance Degradation Due To Psychological Stress.
4. Performance Degradation Due To Disease:
 - a. Significant diseases in the deployment area with *current* epidemiological data.
 - b. Countermeasures:
 - (1) Immunizations.
 - (2) Prophylactic medications.
 - (3) Vector Control.
 - (4) Hygiene.
 - (5) Limited troop exposure.
 - (6) Treatment medications.
5. Performance Degradation Due to Dangerous Animals:
 - a. Major threats.
 - b. Countermeasures:
 - (1) Troop education.
 - (2) Limited troop exposure.
 - (3) Treatment medications.
6. Summary Statement. An estimate of the anticipated effectiveness of the medical countermeasures with RE-EMPHASIS on the requirement for COOPERATION from *ALL LEVELS OF COMMAND*.

Figure 23-2. A Generalized Outline of a Predeployment Medical Intelligence Briefing. Mission specific modifications should be added. (25)

COMMAND, CONTROL, COMMUNICATION, AND INTELLIGENCE (C3I)

A medical treatment facility cannot function without adequate command and control. This command and control is necessary in peacetime and becomes even more critical during times of conflict. Contingencies or disasters tend to create chaos and confusion which can cause a unit to cease functioning unless adequate command and control is exercised. It must flow up and down the chain of command and laterally. (See figure 23-3.)

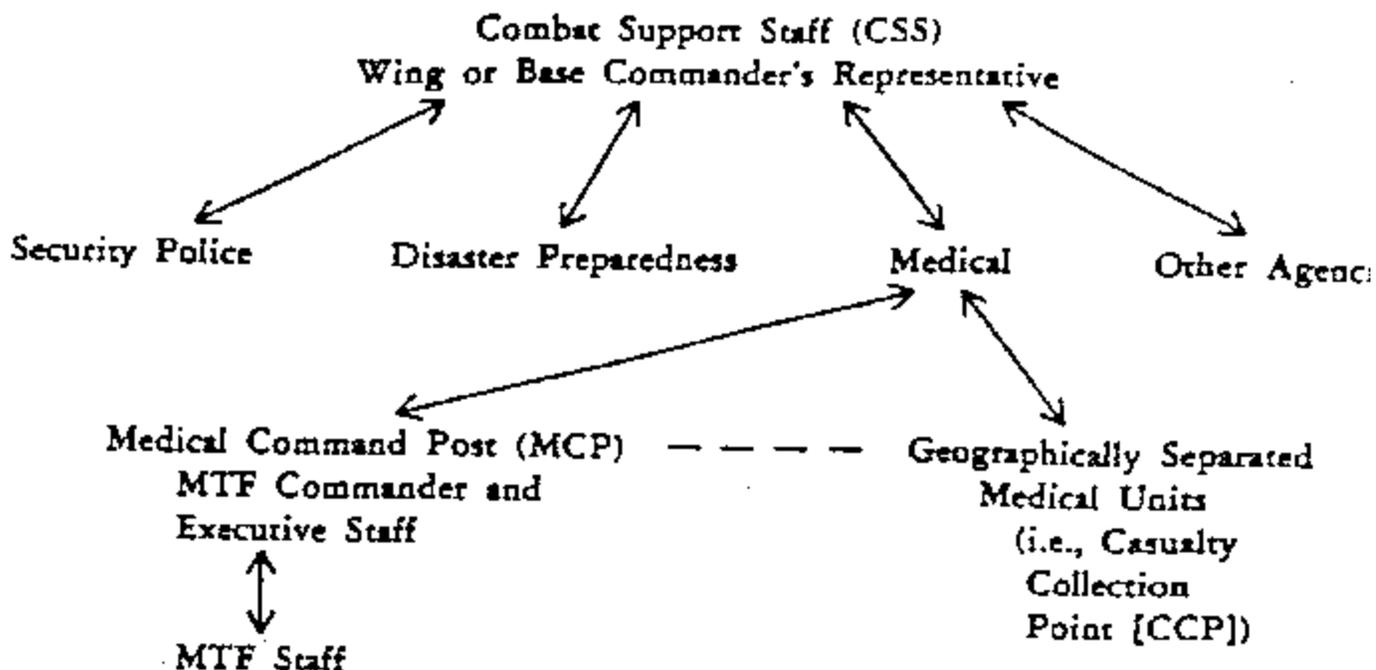


Figure 23-3. Command and Control During Contingency Operations (25)

The medical representative to the base combat support staff will keep the information (intelligence) flowing to the medical control center (MCC) on all developing problem situations. This will include the commanders efforts to control civil disturbances and disaster relief operation, especially overseas. (45)

Effective communication is the core of the command and control process. A breakdown in communication can jeopardize and cause the breakdown of command and control. Communication systems are likely to be flooded during contingency operations therefore messages should be brief and to the point. Radio communications systems use their own language consisting of "prowords." A list of these can be found in the C3I pamphlet. (38)

A communication skill that may be required by aeromedical team members during combat operations is requesting emergency tactical aeromedical evacuation of casualties (DUSTOFF). A sample format for proper DUSTOFF requests can be found in this same pamphlet. (38)

AIR FORCE BLOOD PROGRAM

The Air Force Blood Program is an integral peacetime and wartime part of the Armed Services Blood Program which is coordinated by the Director of the Armed Services Blood Program Office (ASBPO) who in turn reports to the Deputy Assistant Secretary of Health Affairs (Medical Readiness). Various directives define the role of the Air Force program with the premier being AFR 160-26, Air Force Blood Program.(26) The Armed Services Blood Program is truly "purple suited" and it is one of the best examples of interservice cooperation. Blood drawn on military installations by medical laboratory personnel stays in the military medical system to help "our own." This is not the case of civilian organizations who draw on military installations.

The Air Force maintains 38 worldwide Blood Donor Centers (BDCS). These are in charge of the collection of blood from active duty and retired military personnel, military dependents, and DOD civilians. At certain "trip points" in the heightening of hostilities when requested by the Commander in Chief, the Director ASBPO will task the Services' Surgeons General to provide blood to the Armed Services Whole Blood Processing Laboratories (ASWBPL). The function of the ASWBPL is to reconfirm blood groups and type (reconfirm Rh negatives only) and to ship the products to the theaters. (34)

LOW INTENSITY CONFLICT

Low Intensity Conflict (LIC) is the political-military confrontation between contending states or groups below conventional war and above the routine, peaceful competition among states. It is waged by a combination of means employing political, economic, informational, terrorism, kidnapping, hijacking, and military instruments. LIC are often localized in the Third World, but contain regional and global security implications.

As military forces prepare for war, it is well to consider the most dangerous war is the war we are least likely to fight. High intensity wars between superpowers and their allies will be avoided until there is no other choice. It is a fact that insurgency and other forms of LIC are widespread among nations of the world, to include many nations which might be considered vital to our national interests. Military medical capability is considered most valuable when used to assist the host country in nation-building efforts prior to the onset of open hostilities. The use of military medical capability in such a conflict may be the most cost-effective, least controversial, and most valuable means of employing military forces in furthering US national interests. (64)

NUCLEAR OPERATIONS

Introduction

Los Alamos, New Mexico saw the first nuclear detonation in the year 1945. Months later this new weapon would be used to end World War II in Japan with the detonations in Hiroshima and Nagasaki, Japan. This was the product of intense research and discoveries in atomic physics leading to the harnessing of this new energy. The devastation in the aftermath forever changed history and our perspective on war. (2)

On the first day alone the single 12+Kiloton(KT) weapon used on Hiroshima killed 45,000 people and left over 90,000 casualties. The blast all but eliminated the existing medical facilities and medical personnel in the cities. The combination of conventional injuries superimposed on the new radiation injury greatly increased the mortality of victims and led to the entity known as **Combined Injury**.

Four years after the first U.S. detonation, the Russians detonated their first atomic weapon. With it came the nuclear arms race. The 1950's brought continuous improvement to atomic weapons and, in 1952 the first hydrogen bomb was tested in the Pacific, nearly vaporizing an entire island. The threat of a nuclear war is an increasing reality of the times. Six nations have built and exploded a nuclear weapon. A host of others either are capable of constructing, current construction is suspected, or they will have the capability within 10 years. In the hands of some of these nations or terrorist groups the possibility of their use is a real viable option. (53)

Medical personnel in the military must deal with the possibility of facing a nuclear blast or nuclear accident, whether weapon, reactor, etc., involving release of radioactive material, coupled with their effects on the environment and all living humans. (51,52)

Understanding the post exposure effects will be important in determining points of intervention, allowing better management of injuries to reduce the logistical drain resulting from large numbers of nuclear casualties. Knowledge of the medical consequences for military personnel is essential for contingency planning in order for the human component of operational systems to remain effective.

Nuclear Detonations

Energy released from a nuclear explosion unlike a chemical reaction results from the nuclear reaction, fission, and fusion. The composition of the nucleus changes, becoming unstable, and is eventually releasing an enormous amount of energy to regain a balanced state. To produce a nuclear explosion, a weapon must contain an amount of plutonium or uranium exceeding the mass necessary to support a critical chain reaction. Fission is a continuous production of energy, emitting free neutrons which in turn produce other fission events, long enough to build up an explosive amount of energy. (28)

Effects of Nuclear Explosion

Energy from a nuclear explosion is transferred to surroundings in three distinct forms: blast, thermal radiation, and nuclear radiation. Temperatures of several tens of million degrees centigrade develop in the immediate area of the detonation. Initial pressure ranges up to millions of atmospheres. Fission material is vaporized and the energy is released as electromagnetic radiation mainly in the form of x-rays. In an atmospheric detonation, absorption of the x-rays by the atmosphere generates an enormous amount of heat and forms a brilliantly hot sphere of air which is called the fireball. A fireball from a 1-megaton (MT) air burst increases its diameter to a maximum of 2200 meters within 10 seconds while rising in the atmosphere at a rate of 100 m/sec. This fireball compresses the surrounding atmosphere severely, producing a powerful blastwave. (See figure 23-4) The electromagnetic radiation released is similar in its spectrum to that of sunlight and is usually called thermal radiation. The combination of the upward movement and cooling of the fireball that no longer emits thermal radiation forms the characteristic mushroom cloud. Condensed droplets of water give it the typical white cloudlike appearance. When there is a surface burst, this cloud also contains large amounts of dirt and debris giving the cloud a dirt brown appearance. The dirt and debris becomes contaminated with radioisotopes or is activated by neutron radiation and falls to earth as fallout. The nuclear cloud from a 1-MT

surface burst will reach an altitude over 20,000 meters and have a mean lateral diameter of 35,000 meters. (2,28)

Types of Bursts

Nuclear explosions are generally classified as air bursts, surface bursts, or subsurface bursts. Effects of blast, heat, and nuclear radiation will be determined by the altitude at which the weapon is detonated. (25)

Air Burst. An explosion in which the weapon is in the air at an altitude below 30,000 meters such that the fireball does not contact the surface of the earth. The altitude can be varied to obtain maximum blast and thermal effects plus desired radiation effects. More than 50 per cent of the energy may appear as blast, approximately 35 per cent as thermal energy and nuclear radiation about 15 percent. Exposed skin can be burned for many kilometers away and eye injuries even further away. There is essentially no *local* fallout from an air burst.

Surface Bursts. A weapon detonated on or slightly above the surface of the earth so that the fireball touches the land or water surface. The area affected by blast, thermal radiation, and initial nuclear radiation is less extensive than an air burst, except in the region of ground zero. Here the fallout can be a hazard over a much larger downwind area than that which is affected by blast and thermal radiation.

Subsurface Bursts. An explosion in which the point of detonation is below the surface of land or water. Cratering usually develops on the surface but if the burst does not penetrate the surface the only other hazard will be from ground or water shock. Local fallout will be heavy if penetration occurs.

Biophysical and Biological Effects

Blast Injuries. Direct blast injury is produced from the overpressure forces which can reach several atmospheres of magnitude. Rapid compression from the shockwave front followed by the resulting decompression (negative) phase can result in severe injuries primarily at the junction of tissues of different densities (bone and muscle) or the interface between tissue and air spaces. The lung and gastrointestinal system being very susceptible, can suffer severe hemorrhages or air embolism. Eardrums can rupture at 5 pounds per square inch (PSI) while lung damage can occur at 15 PSI. Exposure to 50 PSI can be lethal. (28) (See figures 23-4 and 23-5.)

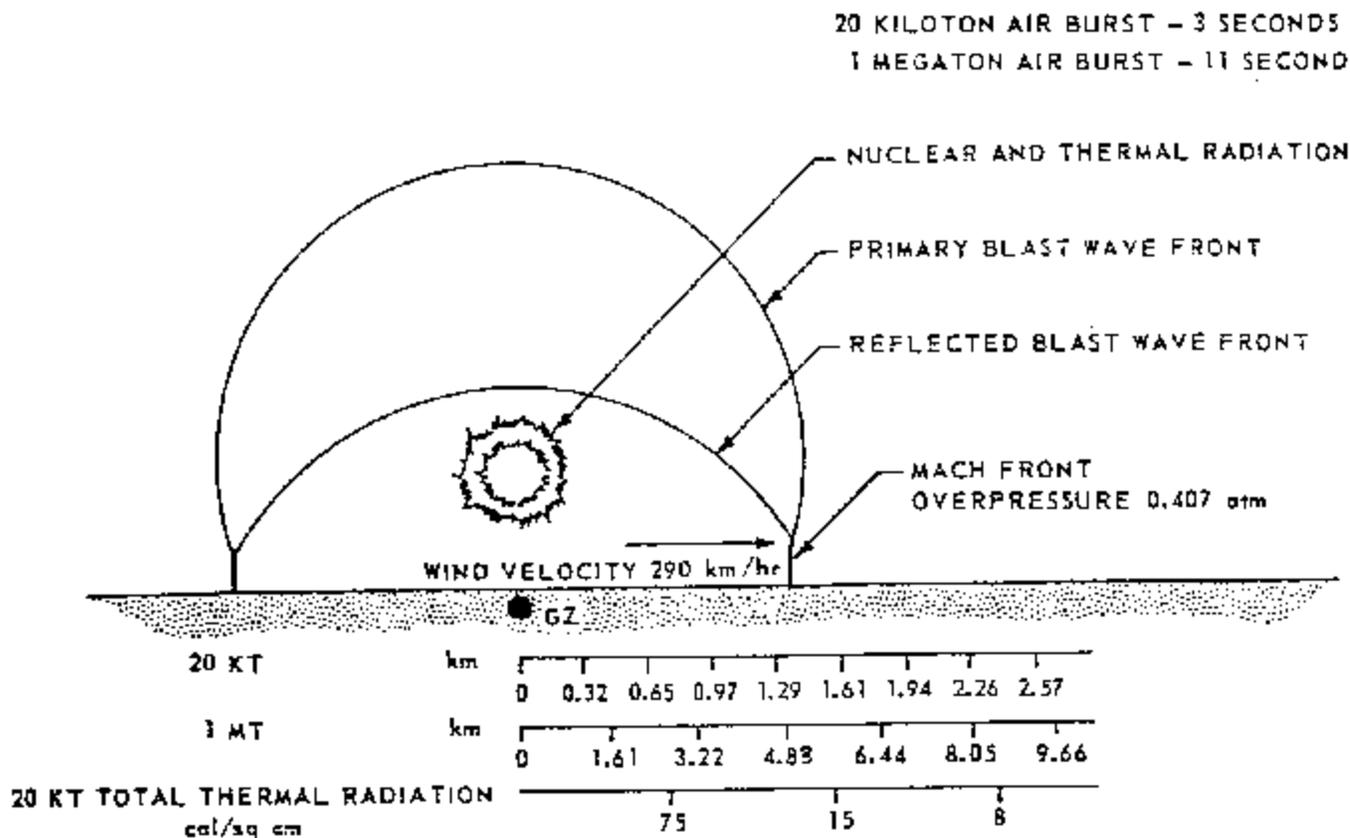


Figure 23-4. Chronological Development of an Air Burst: 3 Seconds after 20-kiloton Detonation; 11 Seconds after

1- megaton Detonation (28).

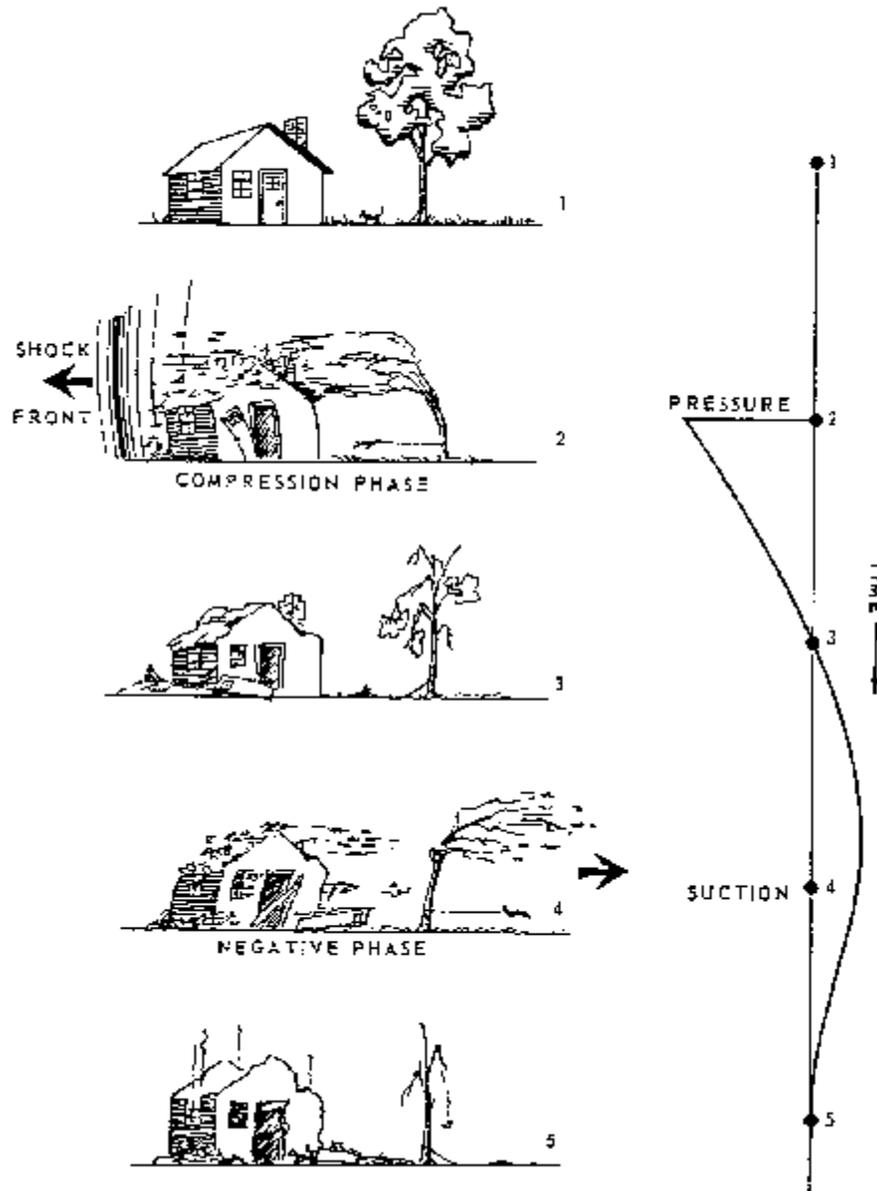


Figure 23-5. Variation of Blast Effects Associated with Positive and Negative Phase Pressure with Time (28).

The (indirect) blast wind drag forces though short in duration, develop winds reaching several hundred kilometers per hour. Injuries are caused either by missiles or crush injuries as the body is displaced against objects or structures.

Thermal Injuries. Thermal radiation produces injury in two ways: direct absorption to exposed surfaces (flash burns) and indirectly from fires starting in the environment (flame burns). Close to the fireball the thermal output will be so great all objects are incinerated. Indirect or flame burns result from clothing igniting. Exposures to ambient fires will vary depending on the flammability of building structures. Production of hot gases from fires can produce respiratory (tract) system burns that have a high rate of mortality.

Ocular injuries fall into two main categories: *temporary flash blindness* and *permanent retinal scarring*. In daylight hours flash blindness can last 2 minutes but at night effects last longer especially in recovering dark adaptation. Retinal scarring is dependent on the fireball being directly in the field of vision. Location of the scar on the retina will determine to what degree vision will be affected.

Ionizing Radiation. Four types of radiation are associated with biological systems; gamma radiation most important, then neutron, beta, and the lesser being alpha.

- a. Gamma rays have deep penetrating ability with deposition of energy in its entire path resulting in total body irradiation.
- b. Neutron radiation can also result in whole-body irradiation. In tissue about 70 to 85 per cent of the entire fast neutron energy is transferred to hydrogen recoil nuclei.
- c. Beta particles are high speed electrons which lose most of their energy after penetrating only a few millimeters of tissue. If on the skin, the basal stratum will be affected leaving a superficial thermal burn. Internally, damage is significant when inhaled.
- d. Alpha radiation consists of heavy, positively charged particles fully absorbed within the first 20 micrometers of an exposed tissue mass. If ingested or inhaled, absorption is far more damaging locally (i.e., alveoli and intestinal tract).

Cellular Effects of Ionizing Radiation

Cellular radiation damaging effects, whether direct or indirect, are basically similar for different kinds and doses of ionizing energy. Cells go through various stages of transformation resulting in cytolysis and cell death. Cellular function varies from delays in phases of the mitotic cycle, disrupted cell growth, changes in permeability, to changes in motility. Active proliferating cells are most sensitive to radiation. Radiosensitivity of cells vary inversely with the degree of differentiation. Radiation induced chromosome damage has profound long-term effects. Mutation rates vary with the dose received, most being lethal.

Organ sensitivity to radiation depends on its component tissue sensitivities. Delayed effects may appear months to years after irradiation with a variety of effects that involve almost all tissues or organs. There is an accelerated aging or life shortening process. In general, it occurs at a rate of 10 days per rad when the daily dosage exceeds 25 rads of single, high dose rate irradiation. Exposure to radiation may either increase the absolute incidence of cancer or accelerate onset time of cancer appearance, or both. Cataracts may begin from 6 months to several years after exposure. Chronic radiodermatitis is a product of outer skin exposures for longer duration and can be reduced through adequate hygiene. (28) (See figure 23-6.)

Acute Radiation Syndrome (ARS)

ARS refers to the sequence of disorders that occur weeks after receiving a substantial dose (>100 rad) of ionizing radiation to the entire body or a large part of the body. It involves primarily three major organ systems: hematopoietic, gastrointestinal, and central nervous system (CNS). The cardiovascular system is included with CNS. Severity is dose dependent. Hematopoietic changes take place at dosages exceeding 100 rads, with over 200-300 rads being potentially life threatening. The gastrointestinal (GI) symptomatology is noted with doses in excess of 500 rads, while cardiovascular and central nervous system trauma is found with doses over 1000 rads. (2)

ORGANS	RELATIVE RADIOSENSITIVITY	CHIEF MECHANISM OF PARENCHYMAL HYPOPLASIA
Lymphoid organs, bone marrow, testes and ovaries, small intestine	High	Destruction of parenchymal cells especially the vegetative or differentiating intermitotic cells
Skin, Cornea and lens of eyes, Gastrointestinal organs: cavity, esophagus, stomach, rectum	Fairly high	Destruction of vegetative and differentiating intermitotic cells of the stratified epithelium
Growing cartilage Fine vasculature Growing bone	Medium	Destruction of proliferating chondroblasts Damage to the endothelium Destruction of connective tissue cells and chondroblasts or osteoblasts
Mature cartilage or bone, lung, kidneys, liver, pancreas, adrenal gland, pituitary gland	Fairly low	Hypoplasia secondary to damage to the fine vasculature and connective tissue elements
Muscle Brain Spinal cord	Low	Hypoplaia secondary to damage to the fine vasculature and connective tissue elements, with little contribution by the direct effects on parenchymal tissues

Figure 23-6. Relative Radiosensitivities of Various Organs Based on Parenchymal Hypoplasia (28).

The syndrome is normally divided into three stages:

- a. **Prodrome or initial toxic period** begins hours after exposure presenting symptoms of nausea, vomiting, anorexia, headache, malaise, diarrhea, warmth, and itching. This can occur with doses as low as 50 rads, but is always present if it exceeds 400 rads.
- b. **Latent period** is a time of well being or an asymptomatic phase. There is a regression of prodromal symptoms. If the dose was less than 400 rads, latent period lasts 2-3 weeks but less than 1 week if greater than 600 rads.
- c. **The period of manifest disease** is signaled by the return of prodrome symptoms. The significance of the damage to organs becomes apparent. Skin epilation occurs at 3 weeks with exposures of less than 350 rads but is complete and permanent at doses greater than 700 rads. At doses over 1,000 rads, second degree skin damage occurs with desquamation, blisters, and ulcers that slowly heal with atrophy and scarring. Exposures of 0 to 100 rads are considered a subclinical category.
- d. There is a fourth **period of late effects** that occupies the rest of the patient's life till death.

The three organ syndromes are described as follows:

a. **Hematopoietic syndrome**, (100-800 rads) primarily expressed as pancytopenia. There is atrophy of bone marrow, spleen, and lymph nodes. Red blood cell precursors are most sensitive, followed by lymphocytes, then by platelets. Adult lymphocytes decline rapidly during the first 45 hours at doses below 200 rads. The speed of the fall is prognostic. A count of zero by day 4-5 is a bad sign and a rise in numbers in 2-3 weeks being good. Platelets begin falling at 2-3 days. Pancytopenia effects seen are: malaise, fatigue, headache, chills, fever, pneumonia, colonic ulceration (produces diarrhea and bleeding) and hemorrhages.

A blood sample taken at exposure time initially will alert as to severity and progression of disease when subsequent samples are taken and compared. Physicians can be alerted with this parameter for planning and selection of patient treatment modality. Additionally, this gives the triage category and aids in deciding who to air evacuate and who stays. (57,67)

b. **Gastrointestinal (GI) Syndrome** (800-3,000 rads) with clinical effects being seen at doses over 500 rads with small intestinal epithelium most sensitive and colonic the less. The villi are bare, resulting in vomiting, diarrhea, fluid loss, malabsorption, and entrance of bacteria. Diarrhea is bloody and watery. There is also abdominal distention, dehydration, and both circulatory and renal failure. Death occurs in 1-2 weeks. The epithelia can recover if the dose is less than 1,300 rads, but it will be very slow if more radiation is received.

c. **Central Nervous System (CNS) Syndrome** (over 3000 rads) occurs when doses exceed 2,000-3,000 rads, death occurs within hours to days from CNS and cardiovascular system damage. Doses of 2,000-10,000 rads damage the vascular epithelia leading to increased (intractable) permeability resulting in tremendous volume loss to extravascular spaces. Shock ensues then death. Man receiving doses over 10,000 rads is presumed to suffer direct CNS damage with cell death and progressive cerebral edema. Victims present with malaise, weakness, ataxia, and seizures prior to death. (57)

Treatment

Hematopoietic Syndrome. Whole blood (and other blood products) have to be irradiated prior transfusion to prevent graft-versus-host reaction. Antibiotics should not be given prophylactically. Only if fever starts without a focus identified, should they be started. Isolation rooms should be used for these patients.

GI Syndrome. You should basically treat symptomatically with transfusions, fluid replacement, and antibiotics. Prophylactic sterilization of the gut is suggested. Indications for bone marrow transplant is limited. Unless all of the patient's own marrow is wiped out, or after whole body irradiation exceeding 800 rads, it is not recommended. New treatment modalities to stimulate autologous marrow through growth factors and macrophage- stimulating factors are receiving intense study. Use of reverse isolation in a sterile room is suggested.

CNS Syndrome (and Cardiovascular). Only supportive care need be given. (53)

Combined Injuries

A large number of patients will have combined radiation and combat injuries or combined with concomitant diseases or stress. Traumatic wounds heal very slowly due to the pancytopenia. This prolongs hospitalizations and increases morbidity and mortality. Burn patients present incredible problems for care.

Psychological Aspects of Nuclear Warfare

In the aftermath of the detonation, there will be numerous psychiatric patients to deal with. There is a transient, fluid state of emotional disruption for which fear is a prime ingredient, followed by panic in some cases. One may observe stunned mute behavior, uncontrolled flight, tearful helplessness, apathetic depression, inappropriate activity, increased tension, or preoccupation with somatic representations. These disturbances may last minutes, hours, days, and sometimes weeks. The majority of these disorders do not require elaborate treatment, with the best being preferably immediate and within the patient's unit. (28,61)

Nuclear Accidents Response Program

There have been two important non-nuclear weapons accidents in the recent years. The nuclear power plant explosion at Chernobyl in the Russia is perhaps the most severe recorded accident. There were 30 deaths with over 300 hospitalized due to injuries. Over 90,000 people evacuated and relocated, and over 10,000 reindeer slaughtered. In Brazil, the central town of Goiana had a prolonged exposure to Cesium-137 for over 75 days before being discovered. Here, there were seven deaths and numerous exposures which included ingestion of the isotope.

The procedures used in the **Nuclear Weapon Accident Response Program (NARP)** are contained in AFP 355-2. It consolidates directives of the Defense Nuclear Agency on procedural guidance and technical information should such an event occur.

The NARP also defines the responsibilities of other government agencies such as the Department of Energy (DOE) who control research and development, and transport of nuclear weapons, and the Federal Emergency Management Agency (FEMA). (40)

When there is an unexpected nuclear weapons accident, a **"Broken Arrow"** is declared. A nuclear reactor accident is a **"Faded Giant."** (20)

Organized responses to nuclear mishap hazards and thorough preplanning for such an event is imperative to include decontamination. (47,50) These procedures should be exercised regularly. (48,49,51)

Other Regulations

Protection of Air Force personnel from the effects of ionizing radiation during routine, nonemergency conditions is extremely important. The control of Radiological Health Hazards regulation covers this aspect of peacetime radiation exposure. (27) Recording procedures for occupational exposures to ionizing radiation are an ongoing monitoring program. (29,30) An Air Force handbook covering ground accident responses also gives guidance for handling nuclear mishaps. (17) A personnel dosimetry program records, monitors, and follows all Air Force personnel exposed to ionizing radiation in a central registry. (31) There is a Personnel Reliability Program for those working with nuclear weapons. (15)

BIOLOGICAL WARFARE

Introduction

A biological agent is a microorganism or toxin of biological origin which causes disease in man, plants or animals. Biological operations do not, of themselves, constitute a new kind of warfare. As far back as 2,500 B.C., the Chinese were using poison tipped arrows and spears derived from a living source. The troops of the Spanish conqueror Francisco Pizarro introduced smallpox to the indians of South America. It is said that the blankets contaminated with smallpox were used in the 18th century against the North American Indian tribes. (28)

During World War II both the Nazi's and Japanese conducted biological warfare experimentation on prisoners of war. More recently, reports and some evidence of "Yellow rain" was used by Vietnamese (backed by Soviets) against the local population of Kampuchea (formerly Cambodia) since 1975. There have been reports that in 1979 an accidental release of anthrax occurred within the Microbiology and Virology Institute in Sverdlovsk, the Soviet Union, after a pressurized system exploded. The unconfirmed reports state that perhaps 1,000 cases of anthrax (mainly pulmonary) occurred with many fatalities. This has been denied by Soviet clinicians speaking at a conference held at the Johns Hopkins School of Medicine in Baltimore. (58) They claimed ingestion of contaminated meat to be the source. Pulmonary anthrax is unlikely to be caused by anything other than inhalation.

The Law

On June 17, 1925 many nations met in Geneva to sign the Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous, or Other Gases, and of Bacteriological Methods of Warfare. This treaty was to prohibit first time use of such agents. Ft. Detrick was established as a biological warfare research and development center in 1943.

President Nixon renounced all offensive research and development activities of biological agents in October 1969. For the next 2 1/2 years, agents, munitions, and seed stocks underwent demilitarization. The United States restricted biological research to defensive measures. (42,48) On April 10, 1972, the Convention on The Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and their Destruction was held. This was approved and signed by President Nixon in 1975.(58,70) All United States munitions using biowarfare agents were destroyed.

BioTechnology has advanced tremendously in the field of nucleic acid (DNA) technology and genetic engineering. New research methods in developing recombinant vaccines have opened a whole new field in biological agent research. It is important to remember that unlike other weapon systems where defensive measures and retaliatory capabilities exist (i.e., nuclear, chemical, and conventional), this is not the case with biological weapons. (58)

Indications of Biological Attack

The following are some of the ***indicators of possible biological attack***:

- a. High numbers of acutely ill patients should raise suspicion levels. Epidemiologic investigations may indicate a point source with a high attack rate.
- b. Aerosols are a convenient vehicle for spread of these agents. Use would coincide with wind direction and would be predictable. (19)
- c. Simultaneous exposure to multiple or exotic agents for the region would be suspicious.
- d. A high number of sick and dead animals may be present.
- e. Attack may have been witnessed.

Selection of organisms for potential use as biowarfare agents is dependent upon their:

- a. Infectivity - minimum infective dose should be small.
- b. Contagiousness - use of non-transmissible agents affords the aggressor the ability to occupy the area without observing special precautions.
- c. Lethality - produce disease with high mortality.
- d. Incubation period - preferably less than 24 hours.
- e. Susceptibility of target population - choosing an agent with no available vaccine and no immunity.
- f. Agent with antibiotic resistance to common drugs (i.e., genetic engineering).

General characteristics of biological agents are: silent, incapacitating, and unpredictable.

Planning Considerations

Medical response to biological attack includes (70):

- a. Recognition.
- b. Identification of agent and its epidemiology.
- c. Casualty handling.
- d. Treatment and Protection.

Planning for such an event will consider:

- a. Medical intelligence information of the enemy's capability and willingness to use biological weapons requires constant updating. This can be strategic, tactical, and medical.
- b. Confirmation of the capability to launch a biological attack by the enemy indicates a true threat exists. All attacks will then be considered biological.
- c. Equipment and training must be available to detect these agents at the lowest organizational level.
- d. Warning must be timely.
- e. The organization must obtain, maintain, and know how to use the individual protective equipment ensemble (suits) and supplies.
- f. Training **must** be realistic and practical!
- g. Organizations must have sufficient defensive supplies (i.e., prophylaxis, therapy, sanitation and hygiene).
- h. Planners must recognize that instituting biological defensive measures will diminish operational capabilities (the unit readiness).
- i. Water and food supplies must be guarded especially against terrorists and sabotage.

Casualty Management

Consideration must be given to the following:

- a. A successful attack would produce a mass casualty situation whose numbers are not in the amounts of nuclear or chemical attacks. Plans call for treatment by unit medical personnel.
- b. It is anticipated that the vast majority of cases will need no special equipment, intravenous fluids, oxygen or elaborate drug regimens. Conventional wounds present direct portals of entry for biological agents, complicating the clinical picture.
- c. Adequate treatment would depend on the agent. This may consist of broad spectrum antibiotics and supportive therapy where indicated. There is no reason to believe that all exposed will become casualties at the same time, since the complex factors of dosage, host resistance, relative immunity, and chemoprophylaxis would influence responses. Secondary cases are probable among contacts of the patients unless precautions are implemented i.e., isolation procedures.
- d. Patient load generated can therefore be anticipated to follow a characteristic time distribution curve (epidemiologic pattern) which permits planning.
- e. The percentage of medical personnel unavailable due to illness resulting from the attack may be the same statistic as that of the population as a whole unless substantial disease develops as a result of their exposure during patient care. Therefore, the greater the number of casualties, the less medical personnel available to take care of them.
- f. The successful detection and identification (i.e., culturing, etc.) of agents will be enhanced by requesting special assistance. (Consult addresses below.) A better and more rapid diagnosis can be attained in this fashion. (28) Specific diagnosis and treatment can only be accomplished by identifying the pathogen/toxin.
- g. Troops must be informed and have a thorough understanding of these agents with their effects and the countermeasures to be employed, to reduce the psychological effects of such weapons. An awareness with an adequate appreciation of the threat in combination of a high degree of mental discipline will be the best defense against panic.

Defense

A defensive posture for biowarfare must include: education, implementation of a medical defense system, field manuals (and management), intelligence, and readiness. (42)

Active defense involves the following activities:

- a. Destroy enemy biological facilities.
- b. Identify agents.
- c. Intercept enemy weapon (delivery) system.

Passive defense involves minimizing and reducing casualties through the use of public health practices and principles. (Medical Operations.) This included these items:

- a. Before the attack (start by being clean)
 1. Immunizations
 2. Personal hygiene
 3. Physical conditioning
 4. Area sanitation (a medical responsibility)
- b. During an attack (staying clean)
 1. Mask
 2. Seek cover
 3. Cover-up (protective clothing)
- c. After the attack (Get clean again)
 1. Prevent further casualties resulting from secondary contamination and exposure
 2. Decontaminate
 3. Treatment of injured
 4. Replace items that cannot be decontaminated

The medical response to biological agents will be:

- a. Chemoprophylaxis - prophylactic antibiotics;
- b. Passive immunity- natural host resistance of some individuals;
- c. Chemotherapy - antibiotics to treat disease;
- d. Immunoprophylaxis - generic vaccines and combination vaccines;
- e. Providing symptomatic and supportive care until definitive therapy can be provided.

Consultants that are available include:

- a. US Army Medical Institute of Infectious Diseases (USAMRIID), Ft. Detrick, Maryland. AV: 343-2604
- b. USAF Epidemiology Laboratory (USAFSAM), Brooks AFB, Texas. AV: 240-2604
- c. With headquarters approval: Centers for Disease Control, Atlanta, Georgia. COM: (404)-639-3331 (Main Lab)
(AV: 925-1110 Dobbins AFB for patch)

Threats

The new definition of biological weapons states that it is the use of microorganisms or toxins derived from living organisms including those engineered against humans, animals, or plants. (70)

Old Diseases

Listed below are the classic agents and their respective diseases that have classically been considered for biological warfare:

Bacteria

- a. *Bacillus anthracis* - Anthrax
- b. Brucella group-Brucellosis
- c. *Francisella tularensis* - Tularemia
- d. *Pasteurella pestis* - Plague
- e. *Vibrio cholerae* - Cholera
- f. *Corynebacterium diphtheriae* - Diphtheria
- g. *Salmonella typhi* - Typhoid fever

Protozoa

- a. *Entamoeba histolytica* - Amebic dysentery
- b. *Giardia lamblia* - Dysentery

Rickettsiae

- a. *R. prowazeki* - Epidemic typhus
- b. *R. mooseri* - Endemic typhus
- c. *R. rickettsii* - Rocky Mountain Spotted fever
- d. *Coxiella burnetii* - Q fever

Viruses

- a. Group A Arboviruses
 - 1. Eastern Equine encephalitis
 - 2. Venezuelan equine encephalitis
- b. Group B Arboviruses
 - 1. Yellow fever
 - 2. Dengue fever
- c. Ungrouped Arboviruses
 - 1. Rift Valley fever
 - 2. Lassa fever

Fungi

- a. *Coccidioides immitis*
- b. *Histoplasma capsulatum*

New Diseases

There is a growing concern for the advances in genetic engineering and recombinant DNA experiments that permit the isolation, purification and production of toxin fragments originating from living organisms. There are a host of newly discovered toxic substances being looked at. (70) These can be divided into broad groups:

Zootoxins are agents from animal sources. Examples are:

- a. Ichthyosarcotoxins (fish), globe and puffer fish produce Tetrodotoxin - a neurotoxin which blocks the entrance of sodium channels halting nerve impulses to muscles.

Mytilotoxins (bivalves) derived from dinoflagellates that produce Saxitoxin (Gonyolax) - a neurotoxin similar to tetrodotoxin. These organisms are concentrated by clams, oysters, and other filter feeders.

Reptiliatoxins (reptiles) (67)

- a. Snakes - neurotoxins of two types:
 - 1. Postsynaptic - cobras, sea snakes
 - 2. Presynaptic - South American rattlesnake (crotoxin), African Krait (alpha-bungarotoxin), Australian taipan (taipoxin), Australian tiger snake (notexin)
 - 3. Necrotic toxins - Pit viper (myotoxin A)
- b. Lizards

Arthropodatoxin

- a. Scorpions - neurotoxin
- b. Centipedes
- c. Spiders

Phytotoxins (from plants)

- a. Non-protein, crystalline
 - 1. Aconitine from wolfsbane
 - 2. Atropine from jimson weed
 - 3. Solanine from night shade
 - 4. Tyramine from mistletoe
- b. Proteins
 - 1. Abrin from precatory bean
 - 2. Taxin from yew
 - 3. Sambunigrin from elderberry
 - 4. Cicutoxin from water hemlock

Mycotoxins (fungi) (6)

- a. Toad stools (Amanita species), one of the most potent toxins known to man. Muscarine, Ibotenic acid, Alpha amanitin.
- b. Ergot (Claviceps species)
 - 1. Ergonovine
 - 2. Ergonovine
 - 3. Lysergic acid, and some 10 other toxins
- c. "Yellow Rain" (Fusarium species) 35 species
 - 1. 37 types of toxins - Trichothecenes are low molecular weight, non-antigenic, stable, and heat resistant
 - 2. Examples include T2, Nivalenol, Dioxynivalenol, and Monoacetyl nivalenol.
 - 3. The mechanism of action involves interference with protein synthesis and cellular respiration. Cells death results with rapidly dividing cells especially susceptible.
 - 4. Signs and Symptoms
 - (a) Gastrointestinal - vomiting, hemorrhages
 - (b) Bone marrow - pancytopenia, anemia, spontaneous hemorrhages due to thrombocytopenia
 - (c) Liver - no clotting factors
 - (d) Lungs - cough and pulmonary hemorrhages
 - (e) Skin - edema and erythema, blistering, pruritis, necrosis

Others (neurotoxins)

- a. Palytoxin from soft coral animal (coelenterate)
- b. Polytoxin from pink coral
- c. Batrachotoxin from poison dart frog
- d. Tetrodotoxin from egg of California newt
- e. Neurotoxins from the kokoi frog and the giant toad *Bufus marinus*

CHEMICAL OPERATIONS

Introduction

The use of incendiary chemicals, called "Greek Fire," were used as early as 1,200 BC. A form of Greek fire was employed by General Patrick Gilmore during the American Civil War. (55) World War I saw the use of many agents such as chlorine gas and phosgene, but none as damaging as the blister producing mustard gas in 1917. Nerve gases though not used in World War II were found to be stockpiled by Nazi Germany. The 1950's witnessed the invention of mentally incapacitating agents that are "non-lethal." Riot control agents such as CS ("tear agents") and herbicides were used in Vietnam in support of tactical operations to flush out guerrillas from hiding. (26)

A very toxic form of mustard gas was used by Egypt in the Yemen War of 1963-67. In Kampuchea, (formerly Cambodia) Vietnamese troops were reported to have used chemical agents against these troops. As recent as the conflict between Iran and Iraq, commonly known as the Gulf War, employment of chemical agents by Iraq towards Iran was reported in 1983-84. (53) Chemical weapons are now available not just to major powers but to third world nations, many lacking the scruples to abstain from their use. A United States Defense Department study released in 1984 indicated that 14 to 16 nations had possession of chemical agents. The numbers are still growing since the manufacture of these arms is easy.

The United States has a manual providing doctrinal guidance for the employment of anti- personnel chemical agents. (41,42) The decision to employ lethal or incapacitating agents is a matter of national policy. The following are chemical agents employed by the United States in chemical operations: Nerve agents GB and VX; blister agents HD; incapacitating agents BZ; and riot control agents CS and CN.

The Military Chemistry and Chemical Compounds regulation also discusses the physical, chemical, and physiological properties of agents. It also covers specific decontaminants for use against chemical agents. (43)

The NATO Handbook covering the medical aspects of NBC defensive operations covers practically every aspect of chemical weapons in a single volume. (28) A reference on chemical treatment on patients should be available to every flight surgeon. (23)

Factors Influencing Employment of Chemical Agents

To use chemical agents effectively requires a knowledge of their physical, chemical, and toxicological properties. These chemical weapons are divided into two main categories: **Persistent** agents continue to pose a hazard for a considerable amount of time after delivery by remaining a contact hazard or slowly vaporizing to produce an inhalation hazard. **Non-persistent** agents disperse rapidly, presenting an immediate short duration hazard.

Effectiveness is the general term characterizing chemical agents and is composed of such criteria as suitability, toxicity, irritancy, etc. The duration of effectiveness also takes into account the physical characteristics of the agent, amount delivered and its physical state, weapon used for delivery, and the terrain and weather. Effectiveness is also dependent on the ability of the target population to either neutralize or counter the agent. (28)

The field behavior of chemical agents is dependent on weather conditions such as **wind, temperature, air stability, humidity, and precipitation**. The influence of these variable conditions depends on their additive influence and is locally affected by the topography, vegetation, and soil. (19) Vapors and small particles are carried by the wind while large particles and liquid drops fall out in a ballistic type trajectory and are quickly deposited on the ground. The volatility of an agent is the quality based on the ability to vaporize and the speed it does so. Some volatile agents once deposited on the ground may re-release the agent again into the atmosphere. Munitions and delivery system determine the size and travel of an agent. Diffusion of the agent is determined by weather and terrain. Light winds and low turbulence allow high local concentrations while high winds and some strong turbulence reduce the concentration and increase coverage by carrying away plus diffusing the agent cloud. The LD₅₀ is the dose that kills 50 per cent of the exposed population. The LI₅₀ then is the dose which incapacitates 50 per cent of those exposed.

Routes of Absorption

Chemical agents may enter the body via several routes. The respiratory tract can absorb gases, vapors, and aerosols after inhalation, along any part of the tract. Aerosol particles depending on their size will be retained in lower alveolar areas. Droplets can be absorbed from skin and mucous membranes. Vapors of certain volatile agents can also penetrate skin and contaminate food and drink which can then be absorbed through the GI tract. Wounds and abrasions also increase agent penetration. (23)

Classes of Chemical Agents

Choking Agents (Lung Damaging Agents): Chemical agents that attack lung tissue and primarily cause pulmonary edema are placed in the class of lung damaging agents. (69) The toxic action of phosgene is characteristic of all lung damaging agents and is the most dangerous of the group. It is a colorless gas with a smell resembling new mown hay. It is readily soluble in organic solvents and fatty oils, plus it hydrolyzes in water to form hydrochloric acid. It is considered the one most likely to be employed in the future. (28)

a. **Agents:**

1. Phosgene (CG) - Carbonal chloride
2. Diphosgene (DP) - Trichloromethyl chloroformate
3. Chlorine (CL)
4. Chloropicrin (PS)

b. **Mode of Action:** The carbonyl group reacts to form free radicals in the lungs capable of damaging proteins and enzymes in the capillary walls. This leads to local areas of emphysema and atelectasis, followed by massive outpouring of fluid into the alveoli.

c. **Clinical picture:** Early signs and symptoms are generally limited to the eye, nose, and throat irritation, along with tearing and coughing. Symptoms subside in 15 to 30 minutes provided the exposure is light and quickly terminated. If the exposure is prolonged, repeated, or severely high, the patient will present with pulmonary edema within 2-24 hours. Death will be prompt at this stage if not aggressively and properly treated.

d. **First Aid:**

1. Terminate exposure (mask) and if possible evacuate from the area. (23,72)
2. Upon reaching a clear area, unmask and irrigate eyes with copious amounts of water.
3. Gargle with 2 per cent solution of sodium bicarbonate (mix 1 pound baking soda in 5 gallons water).
4. Seek medical attention when situation permits or if breathing becomes difficult.

e. **Treatment protocol:**

1. Forty per cent oxygen by mask, adjust concentration as needed by the clinical status.
2. Aminophylline 0.5 g IV (for bronchospasm).
3. Intermittent mechanical ventilation with positive end expiratory pressure (IMV-PEEP) may be required if the patient requires intubation.
4. Corticosteroids should be considered for inflammation and swelling:
 - (a) Cortisone 300 mg P.O., every 24 hours, or
 - (b) Prednisone 60 mg P.O., every 24 hours, or
 - (c) Hydrocortisone 100 mg IV, slow infusion.
5. Antibiotics if there is infection, **NOT** prophylactically.
6. Monitor for shock and acidosis.

Blood agents (Cyanogen Agents): Blood agents kill by first liberating the cyanogen group (CN-group) molecule from the compound and it is this fraction which disrupts the cytochrome oxidase enzyme system thus interfering with cell respiration. (69) Central nerve cells are most sensitive to tissue anoxia and therefore present with early symptomatology. Cyanogen agents present as a colorless liquid smelling of bitter almonds. They are readily absorbed through mucous membranes and intact skin.

a. **Agents:**

1. Hydrogen cyanide (AC) - called "Flash."
2. Cyanogen chloride (CK) - called "Canister Cracker."

b. **Clinical picture:** Signs and symptoms are very rapid in onset with death occurring in 1 to 2 minutes. Patients will present with headache, dizziness, confusion, labored breathing, and eyes bulging with dilated pupils. These signs are rapidly followed by hyperemia, especially noted in the fingernail beds. Finally, there are violent convulsions, paralysis of the respiratory centers leading to coma, and death as the final outcome. Cyanogen chloride can also cause a profound pulmonary edema.

c. **First Aid:**

1. Terminate exposure (mask) and evacuate area if possible.
2. On reaching a clear area unmask and irrigate eyes with water.
3. Gargle with a 2 per cent solution of sodium bicarbonate.
4. Seek medical attention --immediately.
5. Amyl nitrite is no longer authorized for field use. A good treatment agent is 4- dimethylaminophenol but is not yet approved by the US Food and Drug Administration.

d. **Treatment protocol:**

1. Sodium nitrite 3 per cent solution - 10 ml IV, infused over 4 minutes.
2. Sodium thiosulfate 25 per cent solution 25 ml through the same needle given over 10 minutes.
3. If pulmonary edema develops treat as with phosgene.
4. Monitor for shock and acidosis.

Blister Agents (Vesicants): Mustard is the most well known of this group. They are able to penetrate cell walls of tissue and many materials such as wood, leather, rubber, and paints, etc. (69) They persist especially in cold temperate conditions. Exposure produces cytostatic, mutagenic, and cytotoxic effects. They produce tissue necrosis on contact, destroy cellular DNA, produce proteolysis, enzyme inactivation, change capillary permeability producing hemoconcentration, and release other toxic substances from within the cell. Bone marrow depression occurs leading to lymphocytopenia and eventually to immunosuppression leaving victims susceptible to sepsis.

Cutaneous manifestations are divided into four phases: *latent period, erythema, vesication, and necrosis*. Apart from mucous membranes, the most sensitive areas are the face, arm-pits, genitals, neck, the skin between the fingers, and nailbeds.

a. **Agents:**

1. Distilled Mustard (HD): Bis (2-chloroethyl) sulfate
2. Nitrogen Mustard (HN-1): 2,2 dichloroethylethylamine
3. Nitrogen Mustard (HN-2): 2,2' dichloro-N- methyl-diethylamine
4. Nitrogen Mustard (HN-3): 2,2',2" trichloroethylethylamine

b. **Clinical picture:**

1. There is usually no pain on first contact except for the eyes. (Ocular injury may result in blindness in many cases.) Initial signs may not appear for 4 to 48 hours except for pain.
2. From 8 to 12 hours symptom presentation post exposure may be similar to phosgene but with erythema and edema of the skin. Also muscular cramping (particularly the face), cold clammy skin, and rapid but feeble pulse may be present.
3. Low white blood cell count from bone marrow depression is a common finding.
4. Severe cases present with cyanosis, stupor, cold extremities, bloody diarrhea, vomiting, low urine output (with albuminuria and hematuria), and convulsions.
5. Complications resulting from pulmonary edema and opportunistic infections have a high mortality.

c. **First Aid:**

1. Terminate exposure (mask) and evacuate area if possible.
2. Upon reaching a clear area, remove all clothing and wash skin if possible. (23,28)
3. Gargle and irrigate skin with a 2 per cent solution of sodium bicarbonate.
4. Seek immediate medical attention if ocular problems, breathing difficulties, or blisters over more than 10 per cent of the body develop.
5. Blisters of the groin and arm pits should be seen by a physician.

d. **Treatment Protocol (69):**

1. All eye injuries require examination and definitive care by an ophthalmologist.
2. Treat patients as having chemical burns.
3. Blisters larger than 1 inch in diameter require aspiration and debridement. (Chemical agent may persist in the vesicle fluid and pose some problems for medical personnel.)
4. Pulmonary edema - treat as with phosgene.
5. Antibiotics only if indicated. **NOT** prophylactically.

Arsines (Vesicants): Arsines possess the free radical $AsCl_2$ which on contact produces tissue necrosis by disrupting sulfhydryl groups from essential enzymes that control cell growth, reproduction, and metabolism. (69) Lewisite is the best known of this class of agents. It is a colorless and odorless liquid capable of penetrating the skin hence the vesicant properties. Once inside, it can act as a systemic arsenical poison. There are changes in capillary wall permeability resulting in hemoconcentration, necrosis, gangrene, shock, coma and death.

a. **Agents:**

1. Lewisite (L): Dichloro (2-chlorovinyl) arsine
2. Blue Cross (PD): Phenyldichloroarsine
3. Dick (ED): Ethyldichloroarsine
4. Methyl Dick (MD): Methyl dichloroarsine
5. Arsine (SA): Arsenic trichloride

b. Clinical picture:

1. Initial signs other than pain may not be apparent for 6 to 48 hours.
2. Patients initially present with what appears to be Phosgene and Mustard exposure with the addition of muscular cramping (especially the face), cold clammy skin, and rapid feeble pulse. Necrosis is deeper and pain more intense than mustard.
3. Ocular symptoms similar to mustard but the risk of permanent blindness is higher with arsenical agents.
4. There will be signs of cyanosis, stupor, and cold extremities.
5. Vomiting, diarrhea, low urine output, and convulsions are late signs.

c. First Aid: Same as for Blister agents.

d. Treatment protocol:

1. Pulmonary edema if it develops, treat as with Phosgene.
2. Blisters, should they develop, treat as with blister agents.
3. Systemic poisoning is treated by chelation therapy using Dimercaprol (British Anti-Lewisite: B.A.L.) if indicated.
4. Watch for shock and acidosis.
5. Antibiotics if needed. **NOT** prophylactically.

Nerve agents strongly inhibit the cholinesterase group of enzymes in the body. Acetyl cholinesterase being one of the most important and found everywhere acetyl choline is found. Acetyl choline, being the chemical mediator for transmission of nerve impulses in cholinergic synapses, is found in the CNS, heart, neuromuscular ganglia, and parasympathetic nerve endings. (69) Binding and thus inactivation of acetyl cholinesterases is almost irreversible, producing an accumulation of acetyl choline in the neural endplates. To replace the enzyme requires new synthesis.

a. Agents:

1. Tabun (GA): Ethyl N,N-diethyl phosphoramido cyanidate
2. Sarin (GB): Isopropyl methylphosphonofluoridate
3. Soman (GD): Pinacolyl methylphosphonofluoridate
4. V/A Agent (VX): O-ethyl S-(2-diisopropylaminoethyl)methyl phosphonothioate

b. Clinical picture:

1. Patients present with pin point pupils (miosis), difficulty focusing, headache, salivation, rhinorrhea and mild wheezing with mild or short term exposures.
2. Systemic absorption (severe exposure) presents with salivation, nausea, vomiting, abdominal cramps, and involuntary defecation. There is chest wheezing, dyspnea, and cough. Signs of increased sweating, bradycardia, lacrimation, involuntary micturition, skeletal twitching, and fasciculations are also seen.
3. Ataxia, convulsions, and Cheyne Stokes' respiration may produce respiratory failure.
4. Death is functional and caused by asphyxia from blocking of air passages with copious secretions or muscle spasm.

c. First Aid:

1. Prophylaxis before entering an area suspected of nerve agent contamination is recommended. A regimen of pyridostigmine tablets; one tablet by mouth every 8 hours should be initiated.
2. Terminate exposure (mask) and if practical evacuate area.
3. Auto-inject one 2-PAM chloride and one atropine injector. If symptoms persist, using 10 minute intervals, inject an additional 2-PAM chloride and atropine auto-injectors. (Note: diazepam may also be incorporated in the auto injectors in the future. Guidelines may change with new research.)
4. When in a clear area, remove all clothing, scrub all skin, gargle and irrigate eyes with 2 per cent solution of sodium bicarbonate.
5. Seek immediate medical attention.

d. Treatment protocol:

1. Maintain atropinization for 24 hours; titrate dose against secretions. Injections of 2 mg IM at 15-minute intervals may be required until full atropinization is achieved.
2. 2-PAM chloride 1g IV STAT and repeated in 30 minutes. This dosage may be repeated twice within each 24-hour period if respirations do not improve.
3. Pulmonary edema, should it develop, is treated by postural drainage or catheter suction; avoid respiratory depressants.

4. Convulsions, diazepam 2 to 10 mg IV, infused at 1 mg per minute as needed.
5. Watch for shock and acidosis.

Mission Oriented Protective Postures

A defense against chemical warfare is individual protective equipment (IPE) which protects against all known chemical and biological agents and toxins. This suit ensemble consists of several layers of clothing that is tightly sealed. Personnel pay a price for all the protection in that they cannot work as well, as fast, or for long periods while wearing the equipment.

The need to balance protection with the threat, equipment imposed degradation, and mission urgency has led to the concept of Mission Oriented Protective Postures (MOPP).(44) The MOPP regulation provides guidance for selecting and using these protective postures. Additionally, there are charts with instructions covering estimation of requirements for personnel maximum time work schedules in MOPP 4 conditions. Consideration is given to light, moderate, and heavy work rates under different temperatures and humidity. (21)

Commanders can raise or lower the level of protection through five levels (MOPP 0 through MOPP 4). This flexible system allows different protective postures that can be used according to the tactical situation. (44)

The MOPP levels are described as follows:

MOPP 0: Used during periods of increased alert. Chemical warfare individual protective equipment (IPE) and field gear are issued to the individual, prepared for use, and kept readily available. Reaction time required to don equipment is about 8 minutes.

MOPP 1: The overgarment and helmet are worn; other IPE and field gear are carried or kept at hand. Used when attack is possible and is automatically assumed in alarm condition Yellow.

MOPP 2: The same as above with the overboots worn. Used when attack is probable, alarm condition Yellow.

MOPP 3: All body-protective IPE and field gear except gloves are worn. Used in alarm condition Black. MOPP 3 should not be used if liquid agent contact is possible or blister agent vapors present.

MOPP 4: All body-protective IPE is worn. Used when attack is imminent or in progress (alarm condition Red) and in alarm condition Black when liquid agents or blister agent vapors are present or possible.

The problem of heat stress during MOPP-4 exercises and contingencies can be partially overcome by acclimatization and realistic training. Individuals who are experienced at doing their wartime tasks in IPE can be very effective during a conflict even though burdened by IPE.

The FS plays an integral role in providing medical guidance to the line commanders on the use of IPE. Encourage realistic training in IPE to facilitate acclimatization and skill development of our personnel.

Chemical weapons are highly effective against untrained and undisciplined personnel. The IPE is very efficient when personnel are experienced in its use. Casualties would be minimal in military forces thoroughly proficient in using the MOPP concept. Potential adversaries have little to gain and a lot to lose if they initiate chemical weapon attacks against a well equipped and prepared military force.

Consultation for Heat Stress Problems can be obtained at:

Chemical Defense Branch
USAF School of Aerospace Medicine
Brooks AFB, Texas, 78235 AV: 240-3814 (Ask for the Thermal Group)

CHEMTREC

The FS should plan and exercise for peacetime chemical accidents involving industrial chemicals used on base and in the adjacent community. Chemical Transportation Emergency Center (CHEMTREC) is an organization of industrial chemical manufacturers who can provide rapid medical information and advice on toxic chemical treatment.

Plans should be developed to provide treatment capability for United States munitions accidents should any be stored on base or transit the base prior use. Enemy action against United States forces or accidents could disrupt chemical weapons requiring

implementation of such plans.

CHEMTREC information data:

Emergency Phone: 1-800-424-9300
Day-to-day information (non-emergency): (202) 328-4218
Manager, CHEMTREC
1825 Connecticut Avenue, NW
Washington DC. 20009

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24. Air Force Manual 160-20, Medical Support in Joint Operations
25. Air Force Regulation 160-25, Medical Readiness Planning and Training
26. Air Force Regulation 160-26, Air Force Blood Program.
27. Air Force Regulation 160-132, Control of Radiological Health Hazards.
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29. Air Force Regulation 161-8, Control and Recording Procedures- Occupational Exposure to Ionizing Radiation
30. Air Force Regulation 161-17, USAF Occupational and Environmental Health Laboratory (OEHL) Services
31. Air Force Regulation 161-28, Personnel Dosimetry Program and the USAF Master Radiation Exposure Registry
32. Air Force Regulation 161-33, The Aerospace Medicine Program
33. Air Force Regulation 164-5, Worldwide Aeromedical Evacuation
34. Air Force Regulation 168-3, Operational Procedures for Military Blood Donor Centers, Armed Services Whole Blood Processing Laboratories, and Blood Transshipment Centers
35. Air Force Regulation 168-4, Administration of Medical Activities
36. Air Force Regulation 168-12, Standard Policies, Definitions, and Data Presentations Relating to Fixed Medical Treatment Facilities and Patient Accountability
37. Air Force Pamphlet 169-10, Law of Armed Conflict, Geneva Conventions and Code of Conduct
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39. Air Force Regulation 355-1, Planning and Operations
40. Air Force Pamphlet 355-2, Nuclear Weapon Accident Response Procedures (NARP)
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42. Air Force Regulation 355-5, Armed Forces Doctrine for Chemical Warfare and Biological Defense, no longer used but may be of value.
43. Air Force Regulation 355-7, Military Chemistry and Chemical Compounds
44. Air Force Regulation 355-8, Mission-Oriented Protective Postures
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