CHAPTER 1

INTRODUCTION

SECTION I - DEFINITIONS

101. Purpose.

The purpose of this handbook is to provide an overview of potential biological warfare agents directed against human beings, problems that might be created during an attack in which a biological agent is utilized, and the current methods available to medical personnel for recognizing, preventing, and managing these problems. The following definitions will be used throughout this manual and are as stated in the NATO Military Agency for Standardization publication on agreed terms, AAP6:

a. *Biological Agent (BA).* The NATO definition of a biological agent is: a microorganism (or a toxin derived from it) which causes disease in man, plants or animals or which causes the deterioration of material.

b. *Biological Defense (BD).* Biological defense comprises the methods, plans and procedures involved in establishing and executing defensive measures against biological attack. (Procedures, equipment and training would be encompassed in this definition.)

c. *Biological Warfare (BW).* Biological warfare is the employment of biological agents to produce casualties in man or animals and damage to plants or material. The NATO definition then continues, to include, "or defence against such employment."

d. *Biological Weapon.* A biological weapon is an item of material which projects, disperses, or disseminates a biological agent; including arthropod vectors.

e. *Toxin.* A poisonous substance produced or derived from living plants, animals, or microorganisms; some toxins may also be produced or altered by chemical means. Compared with microorganisms, toxins have a relatively simple biochemical composition and are not able to reproduce themselves. In many aspects, they are comparable to chemical agents.

SECTION II - HISTORICAL

102. Historical Perspective.

Throughout history, infectious diseases contracted naturally have had a significant impact on military operations. The intentional dissemination of disease adds a new dimension to threats that are posed by infectious and toxic agents traditionally transmitted only by natural routes. Biological agents reportedly have been employed to a limited extent during recent military conflicts (for example, dispersion of plague bacilli during World War II and use of trichothecene mycotoxins ("yellow rain" in South East Asia); however, their use actually dates from antiquity.

SECTION III - FACTORS INFLUENCING USE OF BIOLOGICAL AGENTS

103. Scope of the Problem.

a. Biological weapons are unique in their ability to inflict large numbers of casualties over a wide area with minimal logistics requirements and by means which can be virtually untraceable. The ease and low cost of producing an agent, the difficulty in detecting its presence and protecting (and treating) its intended victims, and the potential to selectively target humans, animals, or plants conspire to make defense against this class of weapon particularly difficult.

b. The nations of NATO remain highly vulnerable to the strategic, tactical, and terrorist use of biological weapons. As the military and economic gaps between nations grow and as some less advantaged nations seek a balance of power, there maybe a tendency by these nations to overcome their disadvantage by choosing weapons of mass destruction that can be produced easily and cheaply. The purely financial advantage of employing biological weapons was clearly illustrated by a 1969 expert United Nations panel which estimated the cost of operations against civilian populations at $\$1/Km^2$ for biological weapons, versus $\$600/Km^2$ for chemical, $\$800/Km^2$ for nuclear, and $\$2{,}000/Km^2$ for conventional armaments.

104. Characteristics of Biological Agents.

a. *Characteristics.* Intrinsic features of biological agents which influence their potential for use as weapons include: infectivity; virulence; toxicity; pathogenicity; incubation period; transmissibility; lethality; and stability. Unique to many of these agents, and distinctive from their chemical counterparts, is the ability to multiply in the body over time and actually increase their effect.

b. *Infectivity*. The infectivity of an agent reflects the relative ease with which microorganisms establish themselves in a host species. Pathogens with high infectivity cause disease with relatively few organisms, while those with low infectivity require a larger number. High infectivity does not necessarily mean that the symptoms and signs of disease appear more quickly, nor that the illness is more severe.

c. *Virulence.* The virulence of an agent reflects the relative severity of disease produced by that agent. Different microorganisms and different strains of the same microorganism may cause diseases of different severity.

d. *Toxicity*. The toxicity of an agent reflects the relative severity of illness or incapacitation produced by a toxin.

e. *Pathogenicity*. This reflects the capability of an infectious agent to cause disease in a susceptible host.

f. *Incubation Period.* A sufficient number of microorganisms or quantity of toxin must penetrate the body to initiate infection (the infective dose), or intoxication (the intoxicating dose). Infectious agents must then multiply (replicate) to produce disease. The time between exposure and the appearance of symptoms is known as

the incubation period. This is governed by many variables, including: the initial dose; virulence; route of entry; rate of replication; and host immunological factors.

g. *Transmissibility*. Some biological agents can be transmitted from person-to-person directly. Indirect transmission (for example, via arthropod vectors) may be a significant means of spread as well. In the context of BW casualty management, the relative ease with which an agent is passed from person-to-person (that is, its transmissibility) constitutes the principal concern.

h. *Lethality*. Lethality reflects the relative ease with which an agent causes death in a susceptible population.

i. *Stability*. The viability of an agent is affected by various environmental factors, including temperature, relative humidity, atmospheric pollution, and sunlight. A quantitative measure of stability is an agent's decay rate (for example, "aerosol decay rate").

j. *Additionally Factors.* Additional factors which may influence the suitability of a microorganism or toxin as a biological weapon include: ease of production; stability when stored or transported; and ease of dissemination.

105. Classification.

a. *Medical. (See Annexes A and B.)* Taxonomic classification of biological agents is important to the medical services in terms of detection, identification, prophylaxis, and treatment. Biological agents which may be used as weapons can be classified as follows:

(1) *Bacteria.* Bacteria are small free-living organisms, most of which may be grown on solid or liquid culture media. The organisms have a structure consisting of nuclear material, cytoplasm, and cell membrane. They reproduce by simple division. The diseases they produce often respond to specific therapy with antibiotics.

(2) *Viruses.* Viruses are organisms which require living cells in which to replicate. They are therefore intimately dependent upon the cells of the host which they infect. They produce diseases which generally do not respond to antibiotics but which may be responsive to antiviral compounds, of which there are few available, and those that are available are of limited use.

(3) *Rickettsiae.* Rickettsiae are microorganisms which have characteristics common to both bacteria and viruses. Like bacteria, they possess metabolic enzymes and cell membranes, utilize oxygen, and are susceptible to broad-spectrum antibiotics. They resemble viruses in that they grow only within living cells.

(4) *Chlamydia.* Chlamydia are obligatory intracellular parasites incapable of generating their own energy source. Like bacteria, they are responsive to broad-spectrum antibiotics. Like viruses, they require living cells for multiplication.

(5) *Fungi.* Fungi are primitive plants which do not utilize photosynthesis, are capable of anaerobic growth, and draw nutrition from decaying vegetable matter. Most fungi form spores, and free-living forms are found in soil. The

spore forms of fungi are operationally significant. Fungal diseases may respond to various antimicrobial.

(6) Toxins. Toxins are poisonous substances produced and derived from living plants, animals, or microorganisms; some toxins may also be produced or altered by chemical means. Toxins maybe countered by specific antisera and selected pharmacologic agents.

b. *Operational.* It may be considered useful to classify biological agents by the effects they produce in an operational context, in order to provide guidance to the field commander on the consequences for continued operational effectiveness. Annex C of this manual provides guidance for such a classification scheme by individual agent. Operational categories should incorporate all recognized variables likely to impact on effectiveness, to include lethality, transmissibility, and persistence.

106. Dissemination.

Dissemination is the process by which infectious diseases or toxins are dispersed to cause disease or intoxication. The same routes of entry pertinent to natural spread of diseases (that is, through inhalation, ingestion, or percutaneous inoculation) are also relevant when their etiologic agents are delivered intentionally by weapons. Biological agents are most likely to be delivered covertly and by aerosol. Other routes of entry are thought to be less important than inhalation but are nonetheless potentially significant.

a. *Aerosol.*

(1) *Respiratory Exposure (Inhalation).*

(a) Inhalation of agent aerosols, with resultant deposition of infectious or toxic particles within alveoli, provides a direct pathway to the systemic circulation. The natural process of breathing causes a continuing influx of biological agent to exposed individuals. The major risk is pulmonary retention of inhaled particles. Droplets as large as 20 microns can infect the upper respiratory tract; however, these relatively large particles generally are filtered by natural anatomic and physiological processes, and only much smaller particles (ranging from 0.5-5 microns) reach the alveoli efficiently (Figure 1-I). Still smaller droplets are inhaled, but they are not efficiently retained in humans.

(b) Aerosol delivery systems aim to generate invisible clouds with particles or droplets between 0.5 and 10 microns in diameter which can remain suspended for long periods. Smaller sized particles are not efficiently retained by the human respiratory tract and are relatively unstable under ambient environmental conditions. Infection by the respiratory route may induce disease at doses lower than those generally associated with naturally-acquired infections by the oral route. The subsequent illness may differ from the natural pattern, and the incubation period may be much shorter.

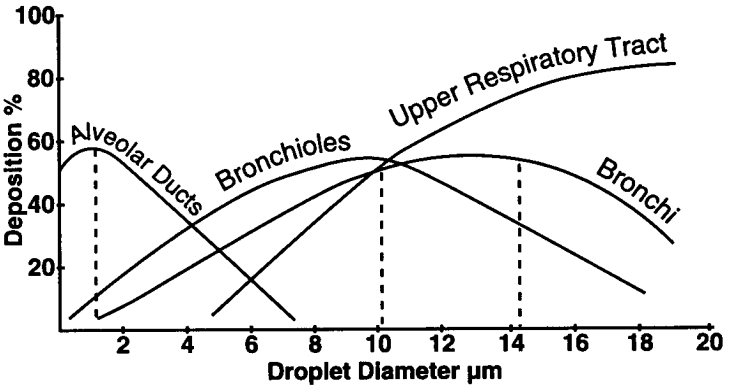

Figure 1-I. Droplet Size and Penetration of Respiratory Passages

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

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

b. *Contamination of Food and Water.* Direct contamination of consumables, such as drinking water, foodstuffs, or medications, could be used as a means to disseminate infectious agents or toxins. This method of attack would be most suitable for sabotage activities and might be used against limited targets such as water supplies or food supplies of a military unit or base. Filtration and adequate chlorination significantly reduce this hazard as it pertains to water.

c. *Other Considerations.*

(1) Attempts might be made to spread typical vector-borne diseases by releasing infected natural (or unnatural) arthropod hosts such as mosquitoes, ticks or fleas. These live vectors can be produced in large number and infected by allowing them to feed on infected animals, infected blood reservoirs, or artificially-produced sources of a biological agent.

(2) Long-term survival of infectious agents, preservation of toxin activity during extended periods, and the protective influence of dust particles onto which microorganisms adsorb when spread by aerosols have all been documented. The potential exists, therefore, for the delayed generation of secondary aerosols from previously contaminated surfaces. To a lesser extent, particles may adhere to an individual or to clothing creating additional but less significant exposure hazards.

(3) Person-to-person spread with certain potential biological agents has been documented. Humans, as unaware and highly effective carriers of a communicable agent, could readily become a source of dissemination (for example, with plague or smallpox).