Public health response to biological and chemical weapons—WHO guidance

This second edition of Health Aspects of Biological and Chemical Weapons includes information designed to guide preparedness for, and response to, the deliberate use of biological and chemical weapons. While noting that the probability of an attack with such weapons may be low, the guide underscores the magnitude of potential impacts on civilian populations and the corresponding need for public health authorities, in close cooperation with other parts of government, to develop contingency plans. Recommendations and advice draw on the expertise of many specialists around the world.

The guide has five main chapters. Advice on assessing the threat to public health posed by biological and chemical weapons is followed by a review of the characteristics of these weapons that influence dissemination patterns and help predict short- and long-term consequences. Both weapons designed to achieve warfare objectives and weapons used for terrorist purposes are covered.

The most extensive chapter, on public health readiness, sets out the principles for planning, moving stepwise from hazard identification and evaluation, through the introduction of risk reduction strategies, to the many specific actions required for an appropriate and adequate response. Details range from situations in which use of special protective equipment can actually hamper the ability to respond, through advice on the evaluation of biological hoaxes, to lessons extracted from the terrorist attack on civilians using chemical weapons in Japan. The guide also explains why response plans should be developed as an integral part of existing national emergency plans, and discusses the need for strong systems of disease surveillance that detect natural as well as deliberate outbreaks. Also included are advice on how to distinguish between biological and chemical attacks, and a recommended stepwise process for communicating with the public. Other chapters cover the preventive legal framework provided by treaties and describe international sources of assistance.

Each of 11 biological agents that might be used in an attack is profiled in terms of characteristics, such as natural occurrence, mode of transmission, incubation period, clinical features, laboratory diagnosis, medical management, and prophylaxis and therapy, that can help governments develop plans for early detection and appropriate response. Similar information is provided for representative groups of toxins and chemical agents.
Public health response to biological and chemical weapons

–WHO guidance–

Projected second edition of
Health Aspects of Chemical and Biological Weapons:

PREPUBLICATION ISSUE
FOR RESTRICTED DISTRIBUTION

November 2001

World Health Organization
EXECUTIVE SUMMARY

The development, production and use of biological and chemical weapons are prohibited by international treaties to which many WHO Member States have subscribed, namely the 1925 Geneva Protocol,1 the 1972 Biological and Toxin Weapons Convention,2 and the 1993 Chemical Weapons Convention.3 Not all have done so, however, and valid concerns remain that some may yet use such weapons. Moreover, non-state entities may try to obtain them for purposes of terrorism.

In fact, the development, production and use of biological and chemical weapons are quite difficult, and they have only rarely been used. This applies particularly to biological weapons. Even so, the magnitude of the possible effects on civilian populations of their use or threatened use obliges governments both to seek to prevent such use and to prepare response plans, which can and should be developed as an integral part of existing national emergency plans.

New technology can contribute substantially to such plans, as is evident, for example, from the increasing availability of robust and relatively simple methods of rapid and specific laboratory diagnosis by DNA-based and other molecular methods. Such methods are also widely used in the surveillance and treatment of natural disease.

The extent to which specialist personnel, equipment and medical stockpiles may be needed for protective preparation is a matter for national judgement in the light of the prevailing circumstances, including national assessments of the likelihood of attacks using biological or chemical weapons.

The danger should not be disregarded that overoptimistic evaluation of protective preparation may distract attention from the continuing importance of prevention, e.g. by the full implementation of the 1972 and 1993 Conventions.

The two Conventions include provision for assistance in the event of attack or threat of attack. The Organisation for the Prohibition of Chemical Weapons (OPCW), which is the international authority for the 1993 Convention, is making practical arrangements for providing such assistance if chemical weapons are used. As yet, however, there is no similar organization for biological weapons, but WHO, among other actors, can provide some assistance to its Member States.

Each of these matters is discussed in detail in the main body of the present report, which makes the following practical recommendations.

1) Public health authorities, in close cooperation with other government bodies, should draw up contingency plans for dealing with a deliberate release of biological or chemical agents intended to harm civilian populations. These plans should be consistent or integral with existing plans for outbreaks of disease, natural disasters, large-scale industrial or transportation accidents, and terrorist incidents. In accordance with World Health Assembly resolution WHA54.14 adopted in May 2001, technical support is available to Member States from WHO in developing or strengthening preparedness for, and response to the risks posed by biological agents, as an integral part of their emergency-management programmes.

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1 Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare.
2 Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction.
3 Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction.
2) Preparedness for deliberate releases of biological or chemical agents should be based on standard risk-management principles, starting with an assessment of the relative priority that should be accorded to such releases in comparison with other dangers to public health in the country concerned.

3) Preparedness for deliberate releases of biological or chemical agents can be markedly increased in most countries by strengthening the public health infrastructure, and particularly public health surveillance and response, and measures should be taken to this end.

4) Managing the consequences of a deliberate release of biological or chemical agents may demand more resources than are available, and international assistance would then be essential. Sources of such assistance are available and should be identified.

5) Attention is drawn to the international assistance and support available to all countries that are Member States of specialized organizations such as OPCW (e.g. in cases of the use or threat of use of chemical weapons, and for preparedness planning), and to States Parties to the 1972 Biological and Toxin Weapons Convention (e.g. in cases of violation of the treaty). Countries should actively participate in these multilateral regimes.

6) With the entry into force of the 1972 and 1993 Conventions and the increasing number of states that have joined them, great strides have been made towards “outlawing the development and use in all circumstances of chemical and biological agents as weapons of war”, as called for in the 1970 edition of the present report. However, as the world advances still further into the new age of biotechnology, Member States are reminded that every major new technology of the past has come to be intensively exploited, not only for peaceful purposes, but also for hostile ones. All Member States should therefore implement the two Conventions fully and transparently; propagate in education and professional training the ethical principles that underlie the Conventions; and support measures that would build on their implementation.

The statement by the World Health Assembly in resolution WHA20.54 of 25 May 1967 that “scientific achievements, and particularly in the field of biology and medicine – that most humane science – should be used only for mankind’s benefit, but never to do it any harm” remains as valid today as it was then.
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1 INTRODUCTION

1.1 DEVELOPMENTS SINCE THE FIRST EDITION

Thirty years have passed since the World Health Organization (WHO) published its 1970 report *Health aspects of chemical and biological weapons* (1.01), and there have been significant changes during this period. On the negative side, there has been the large-scale use of both mustard gas and nerve gas in the Islamic Republic of Iran/Iraq war; the use of these agents by the Iraqi Government against its own citizens, most conspicuously at Halabja in March 1988, and the use of sarin on two occasions (in 1994 and 1995) by the Aum Shinrikyo religious cult in public places in Japan, including the Tokyo subway (the cult also made preparations, fortunately ineffective, to use biological weapons). On the positive side, the Biological and Toxin Weapons Convention and the Chemical Weapons Convention came into force in 1975 and 1997, respectively, and the Organisation for the Prohibition of Chemical Weapons (OPCW) has started its work of supervising the destruction of chemical weapon stocks, including those of the Russian Federation and the United States, and monitoring the world’s chemical industry to prevent future misuse. These and other developments, both technical and political, over this period, led to a need for a review. This second edition is the result.

Technically, there has been further development along already identified lines rather than totally new concepts. The most important agents of biological and chemical warfare probably still include some of those listed in the 1970 edition. There have been rumours of nerve gases of still greater power than VX or VR, but the most important development in chemical weapons has been the ‘binary munition’, in which the final stage of synthesis of the agent from precursors is carried out in the bomb, shell or warhead immediately before or during delivery to the target. As for biological weapons, the genetic modification techniques foreshadowed in 1972 by the first laboratory-made “recombinant” DNA, as well as other developments in molecular biology, seem to offer possibilities for producing new biological-warfare agents. The accessibility of biological agents on a militarily significant scale has been greatly increased by advances in industrial microbiology and its greater use throughout the world.

The year 1970 was a watershed in international legal attempts to deal with the problem of biological and chemical weapons. Following the public renunciation of bioweapons by the United States in 1969, the multilateral conference on disarmament in Geneva, then called the Conference of the Committee on Disarmament, decided to consider biological and chemical weapons separately; these had previously been considered together, as in the 1925 Geneva Protocol prohibiting their use. The Conference thereupon started work on a convention banning the development, production and stockpiling of chemical weapons, leaving consideration of a counterpart treaty on chemical weapons for later. The resultant Biological and Toxin Weapons Convention (BWC) was opened for signature in 1972 and entered into force 3 years later. Concerns about the continuing threat of biological warfare, accentuated by revelations during the early 1990s about bioweapons programmes in the former USSR and in Iraq, led the States Parties to establish an ad hoc group mandated to negotiate a protocol that would strengthen the BWC, particularly through mechanisms intended to ensure compliance. The protocol has still not been agreed.

The Geneva disarmament conference intensified its efforts on the problem of chemical weapons in the 1980s, and submitted the complete draft of a chemical disarmament treaty to the United Nations General Assembly in 1992. In contrast to the biological treaty, the Convention on the Prohibition of Chemical Weapons (CWC) contained elaborate provisions on verification, to be operated through a new international organization, OPCW, with its headquarters in The Hague. CWC was opened for signature in 1993 and entered into force 4 years later.

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The threat of use of biological or chemical weapons by the armed forces of states has clearly changed since the 1970 report, and now exists mainly in regions of the world where certain states have still not joined the two Conventions. In addition, the risk that non-state entities might use such weapons remains a possibility in most areas. Vigilance and preparedness to react effectively will therefore continue to be important, as will means of rapid response by the international community. This new edition is intended as a contribution to that effort.

1.2 ORIGIN AND PURPOSE OF THE PRESENT REPORT

The first edition originated in a request from the Secretary-General of the United Nations to the Director-General of the World Health Organization in January 1969 to cooperate with a group of experts that was then being established to prepare a report for the United Nations on biological and chemical weapons and the effects of their possible use. This report was duly completed and released in July 1969 (1.02). It was based on a submission by WHO prepared by a group of consultants appointed by the Director-General, including consultants from two nongovernmental organizations engaged in the study of the subject, namely Pugwash and the Stockholm International Peace Research Institute (SIPRI). Shortly afterwards, the Twenty-second World Health Assembly, in resolution WHA22.58, requested the Director-General to continue the work (1.05). The result, which expanded the original submission to the United Nations, became the 1970 WHO report.

Since then, WHO has taken steps to keep itself informed of relevant developments. At the Fortieth World Health Assembly in 1987, the subject of chemical warfare was raised and referred to the Executive Board, which, at its eighty-first session in January 1988, noted a report by the Director-General entitled *Effects on health of chemical weapons*, based on a study updating parts of the 1970 report (1.06). Information on the health effects of chemical weapons and the availability of such information was then reviewed by a Working Group on 7–9 February 1989 (1.07).

In view of the need to be able to respond under Article 2(d) of the WHO Constitution to emergencies that might be caused by biological weapons, contacts were made by WHO towards the end of 1990 with the Swiss Federal Department of Foreign Affairs. There was also concern at that time about unpreparedness to respond to the consequences of any attack that might be made with weapons of mass destruction, and especially bioweapons, on civilians during military operations in Kuwait. This led to collaboration between WHO and the Swiss Humanitarian Aid of the Federal Department of Foreign Affairs, Switzerland, and the consequent establishment of Task Force Scorpio, a team of appropriately equipped and trained specialists that could have been dispatched by ambulance jet at short notice to an affected area (1.08). Since that time, the possible association of WHO surveillance of emerging infectious diseases and the provisions of the projected BWC protocol has been considered. More generally, as the public has become more conscious of the possibility that biological or chemical agents may be released deliberately, whether as an act of war or of terrorism, WHO has become concerned about the information on the subject available to the public health authorities of Member States. The Swiss Federal Department of Foreign Affairs has continued to support WHO’s efforts in the biological/chemical field, including the provision of financial support for the present publication.

In May 2001, the Fifty-fourth World Health Assembly, in resolution WHA54.14, requested the Director-General “to provide technical support to Member States for developing or strengthening preparedness and response activities against risks posed by biological agents, as an integral part of their emergency management programmes” (1.09). This second edition of the 1970

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6 The Pugwash Conferences on Science and World Affairs is an international organization of scientists, to which the Nobel Peace Prize was awarded in 1995: its interests have included, since the 1950s, matters of biological and chemical warfare (1.03).

7 SIPRI, funded by the Swedish Parliament, was then working, in consultation with Pugwash, on its six-volume study of the historical, technical, military, legal and political aspects of biological and chemical warfare armament and disarmament (1.04).
report has been published in response to this request of the World Health Assembly. Moreover, in view of the need for WHO to provide a complete scientific assessment on which to base technically sound advice on preparedness and response, both biological and chemical agents are covered as in the first edition, so that their similarities and differences can be identified.

The 1970 report considered biological and chemical weapons at both the technical and policy levels. It was intended not only for public health and medical authorities but also for those concerned with emergency response to the suspected or actual use of such weapons. The present second edition is intended for much the same readership: government policy-makers, public health authorities, health practitioners and related sectors, especially those concerned with risk- and consequence-management, and their specialist advisers. Not all of the material in the first edition has been included in the second, and some parts of it may still be of interest to specialists.

The second edition, like the first, contains an analysis of the health aspects of the possible hostile use of biological or chemical agents. It is intended to be applicable to countries at any level of social or economic development. The emphasis is on the effects on civilians, little attention being paid to the purely military aspects, some of which were dealt with in the first edition. It is still true that the great majority of Member States have experienced neither biological nor chemical warfare, so that, unless the situations changes dramatically, the present report may seem to be of little importance, especially when seen in the light of the emergence of new diseases, such as HIV/AIDS and Ebola virus disease, and the re-emergence of diseases previously considered to be under control in much of the world, such as tuberculosis and malaria. The report is important, however, because of the existence of risks that, historically, have been low but that are nevertheless serious enough to deserve intelligent consideration and various degrees of precautionary planning.

The present report also considers the 1972 BWC and the 1993 CWC, to which nearly three-quarters of WHO Member States are party. These two conventions and their national implementing legislation constitute a form of protection against biological and chemical weapons, and also a guide to international assistance if they are nevertheless used.

1.3 SOME WORKING DEFINITIONS

In the present report, biological weapons are those that achieve their intended target effects through the infectivity of disease-causing microorganisms and other replicative entities, including viruses, infectious nucleic acids and prions.

Some of these biological agents may owe their pathogenicity to toxic substances that they themselves generate. Such toxins can sometimes be isolated and used as weapons. Since they would then achieve their effects, not as a result of infectivity, but of toxicity, they will fall within the definition given below of chemical weapons, even though there would still be grounds for regarding them as biological weapons. The BWC covers toxins, by which it means toxins produced by any living organism, not only by microorganisms, or by any other means, including synthesis. The present report does the same, while recognizing that toxins are also covered by the CWC.

Chemical weapons are those that are effective because of their toxicity, i.e. their chemical action on life processes capable of causing death, temporary incapacitation or permanent harm. Weapons in which chemicals are used, e.g. as propellants, explosives, incendiaries or obscurants are not regarded as chemical weapons, even though the chemicals used in them may also have toxic effects. Only if producing such toxic effects is the main purpose of the weapon concerned can it be regarded as a chemical weapon. Some toxic chemicals, such as phosgene, hydrogen cyanide and tear gas, may be used for both civil and peaceful, and for hostile purposes. In the latter case, they, too, are chemical weapons.

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8 The status of individual WHO Member States under the 1925 Geneva Protocol, the 1972 Biological Weapons Convention and the 1993 Chemical Weapons Convention is set out in the attached Annex.
1.4 STRUCTURE

The main part of the report consists of six chapters. These are supported by a number of annexes that contain more detailed technical information.

Chapters 2 and 3 describe how biological and chemical agents may endanger public health. Their purpose is to identify what is essential to any planning to avert or at least to mitigate the consequences of the deliberate release of such agents.

In Chapter 4, the standard principles of risk management are used to outline the steps that Member States may take to prepare themselves for the possibility that biological or chemical agents may be deliberately released with the aim of harming their population. The intention here is to provide, not the detailed guidance of an operational manual, but a review of the components of preparedness together with a guide to sources of more detailed information.

Chapter 5 considers the part that law, both national and international, can play in preparedness planning, including its potentially vital role in mobilizing international assistance, while Chapter 6 identifies available sources of such assistance.

Supplements may be issued in due course, for two main purposes. The first would be to extend the range of topics dealt with in this report, e.g. by covering the health aspects of biological or chemical agents that might be released deliberately with the aim of harming animals or plants rather than people. The second would be to update the information presented here, and especially the annex on information resources.

2 ASSESSING THE THREAT TO PUBLIC HEALTH

Among the many emergencies or disasters to which public health authorities may be called upon to respond, not enough attention has probably been paid to the deliberate release of biological or chemical agents. For such public health authorities, the problem is one of priorities. What priority should be given to such releases as compared with other emergencies or disasters? This chapter provides an introduction to this problem and to the more detailed discussion of threat assessment in Chapter 3.

2.1 BACKGROUND

Poisons and pathogenic microorganisms are among the natural health hazards with which human beings are obliged to coexist. Difficult to perceive and therefore to avoid, they present a threat that is both insidious and damaging or deadly. Humans have survived by adaptation, partly physiological, as in the development of the immune system far back in vertebrate evolution, and partly social, as in the development of both individual and public health practices that serve to limit exposure to the dangers.

The codes of professional behaviour adopted by the military that forbid the use of poison and therefore also of disease may be regarded as a part of that same social adaptation. From the Manu Laws of India to, for example, the Saracen code of warfare based on the Koran, the Lieber Code of 1863 in the United States and the 1925 Geneva Protocol (2.01), this taboo seems so widespread, ancient and specific as to require some such explanation (2.02).

International law relating to biological and chemical warfare is considered in Chapter 5, which describes how the multilateral treaties of 1972 and 1993 on the total prohibition of biological and chemical weapons have extended that law. Underlying this extension was a widespread concern that powerful new weapons were on the verge of proliferating and spreading within a global security system poorly capable of containing the destabilization that they could cause. The United Nations, almost from its inception, has distinguished between conventional weapons and weapons of mass destruction. It defined the latter in terms of their
operating principles\(^9\) but the main concern was with their consequences, namely their potential for bringing devastation, death and disease to human societies on a scale incompatible with survival. New weapons technology might, in other words, be generating threats to humanity that called for improved forms of protection: a strengthening of social adaptation to present dangers. At its summit session in January 1992, the Security Council determined that the “proliferation of all weapons of mass destruction constitutes a threat to international peace and security”. Moreover, the 15 member states of the Council also committed themselves “to working to prevent the spread of technology related to the research for or production of such weapons and to take appropriate action to that end” (2.04).

Throughout most of the world, the public health infrastructure is stretched to its limits coping with natural health hazards. In 1998, a quarter of the world’s 53.9 million deaths were due to infectious disease, and in developing countries such disease caused one in two deaths (2.05). Against such a background, the additional threat to public health of disease caused in a country by biological or chemical warfare might be no more than a slight addition to the existing burden. Conceivably, however, it might also be on such a scale or of such a nature as to be beyond the capability of the health-care system to cope. For deliberate releases (or threats of release) of biological or chemical agents, a spectrum of threat can therefore be envisaged that ranges between those two extremes: relative insignificance at one end, mass destruction of life or mass casualties at the other. Where along this spectrum a particular biological or chemical menace is situated will be determined by its characteristics and by the vulnerability of the threatened population, reflecting such factors as the health status and degree of preparedness of that population. Particularly threatening would be the possibility of a pandemic resulting from the intentional or inadvertent release of infective agents that cause contagious disease, such as smallpox, for which effective prophylaxis or therapy may be unavailable. Towards the mass-destruction end of the spectrum, remedies or countermeasures may be beyond the resources of many countries and therefore available, if at all, only through international cooperation.

There is some historical guidance on the likelihood of such a catastrophe. Biological or chemical weapons have only rarely been used by military forces, but unsubstantiated accusations of such use have been more common. This may reflect the difficulty of proving that they have been used because of the lack of reliable information on such unverified episodes, or the readiness with which the emotions aroused by anything to do with poison gas or germ warfare lend themselves to calumny and disinformation. Biological or chemical warfare may have recurred sporadically for at least as long as their proscription. Poison is no novelty as a weapon of murder, and the deliberate pollution, for example, of water supplies is an expedient that retreating forces must often have found attractive. Only in recent times, however, thanks to advances in technology, has the position of chemical and biological weapons moved from the insignificant towards the mass destruction end of the spectrum.

2.2 TECHNOLOGICAL DEVELOPMENTS

The event that most clearly marked the emergence of this form of warfare from its prehistory took place near Ypres in Belgium on 22 April 1915, 8 months into what was becoming the First World War. Alone among the belligerents, Germany possessed the industrial capacity needed for the large-scale liquefaction of chlorine gas and, as the war progressed, it turned to this comparative advantage as a possible way out both from the trench warfare that was immobilizing its armies in the field and from the shortage of explosives brought about by enemy naval blockade. These military necessities were given precedence, in keeping with the primacy (since disavowed) given to the German legal doctrine of Kriegsraison over the ancient prohibition of the use of poisons in warfare that had been reaffirmed at The Hague less than a

\(^9\) In September 1947, weapons of mass destruction were defined in a Security Council document as “atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above” (2.03). It was this wording, proposed by the United States, that the United Nations subsequently used to differentiate the two broad categories of weapon in order to guide its work on the “system for the regulation of armaments” required under Article 26 of the Charter of the United Nations.
decade previously. On the late afternoon of that day, 180 tonnes\textsuperscript{10} of liquid chlorine contained in 5 730 pressure cylinders were released into the breeze that would carry the resultant cloud of asphyxiating vapour towards enemy lines. The available records are sparse but it is said that as many as 15 000 French, Algerian and Canadian soldiers became casualties in this onslaught, one-third of them dead. The actual numbers may have been different but, whatever they were, this was the world's first experience of a weapon of mass destruction.

This weapon polluted the air that its target population was obliged to breathe, so protection, in the form of air filters, was not impossible to arrange. The first filters contained chemicals that reacted with the poison gas, and were therefore easily circumvented as the weaponeers turned to toxicants of different chemical composition, notably phosgene, or to ways of establishing airborne dosages more than large enough to consume the reactant contained in the filter. Improved filters were then introduced in which the pollutant was physically adsorbed, as in the activated charcoal and particle-retaining paper filters of the respirators, or "gas masks", that today remain the principal and most dependable countermeasure against vapours or aerosols. By 1917, the growing efficacy of gas masks had stimulated the development of chemicals that could attack on or through the skin, the paramount example being an oily liquid known as "mustard gas". The skin is harder to protect effectively than the lungs if those protected are to remain mobile and active, but effective skin attack commonly requires much larger quantities of agent than does inhalation attack, so that the weapons are effective over a substantially smaller area. Mustard gas used in hot weather is an exception to this general rule, as even its vapour attacks the skin. This is one of several reasons why this particular chemical agent remains so menacing even at the present time.

Another way forward for the weaponeers was to use special methods of disseminating the agent chosen capable of surprising target populations before they could put on their masks. Such a result could be achieved with sudden heavy airborne concentrations of agent delivered by massed artillery or, later, by aerial bombardment. Alternatively, it could be achieved with the imperceptible airborne casualty-producing dosages that could, with the right agent, be established by upwind spray-systems or aerosol-generators. Yet here too protective countermeasures were available, some more effective than others, but, taken together, capable today of negating the mass destructiveness of the weapons, at least when used against military forces. Comparable protection of larger and less disciplined civilian populations would be much harder, but not necessarily impossible, to achieve. Countermeasures may be of the following types: (i) medical (therapy and, for some agents, prophylaxis); (ii) technical (respirators that can be worn for many hours and automatic agent-detection equipment able to give early warning of the need to mask or to enter air-conditioned protective shelter and when to leave); and (iii) organizational (specially developed intelligence systems, standard operating procedures, and training). More recently, new instruments of international law have been included in this range of measures, notably the BWC and the CWC.

Vulnerabilities nevertheless remain, especially in countries where the economic or technological base is not capable of providing everything that is needed. This is why, when chemical warfare has recurred since the First World War, it has invariably taken place within the less industrialized regions of the world, e.g. Morocco (1923–1926), Libyan Arab Jamahiriya (1930), Sinkiang (1934), Ethiopia (1935–1940), China (1937–1942), Viet Nam (1961–1975), Yemen (1963–1967) and Islamic Republic of Iran/Iraq (1980–1988) (2.06). In other conflicts, notably the Second World War, the widespread deployment of antichemical protection served to reduce the relative attraction of chemical weapons as compared with those for which protection is less effective, and there was no significant strategic or battlefield use of chemical warfare.

Vulnerabilities are not absent even in situations where the best protective measures are available. The struggle for supremacy between offence and defence that characterized the development of chemical warfare during the First World War continued after it, and the search for novel agents was one of the forms taken by that struggle. Thus, agents were sought capable

\textsuperscript{10} A metric ton equal to 1 000 kg.
of inducing new types of physiological effect from which military advantage might be gained, e.g. casualty-producing agents of low lethality, which promised to reduce the political costs of resort to armed force, or agents causing percutaneous casualty effects more quickly so that chemical weapons could be used like landmines to deny terrain to unprotected personnel. Above all, there was a search for agents of increased potency that would enable weapon-delivery systems to be used more economically and more efficiently. Toxic chemicals having effective doses measurable in tens of milligrams per person, e.g. phosgene and hydrogen cyanide, were replaced in the 1940s and 1950s by organophosphate acetylcholinesterase inhibitors (“nerve gases”) that were active in milligram or submilligram quantities, so that an order of magnitude fewer munitions would be needed for the attack of a given target, thereby conferring logistical benefit. The most important of these nerve gases and other new chemical-warfare agents are identified in Chapter 3 and described in Annex [ X ].

Beyond the nerve gases on the scale of increasing toxicity are certain toxins, such as those described in Annex [ X ], and beyond them, in the nanogram and smaller effective-dose range, are pathogenic bacteria and viruses. As understanding of the microbiology and airborne spread of infectious diseases rapidly increased during the 1920s and 1930s, so too did the idea of weaponizing microbial pathogens as a more powerful form of poison gas. By the time of the Second World War, biological weapons of this type were being studied as a natural development of chemical weapons, exploiting the same delivery technology and the same understanding of cloud physics, meteorology and airborne dispersion. Before the end of that war, the feasibility of such aerobiological warfare had been demonstrated on weapon-proving grounds in, at least, Europe and North America. There were reports, too, of field experiments in which invading forces had disseminated bacterial pathogens from aircraft over populated areas of China (2.06a, 2.06b).

Other types of biological warfare were also emerging. The vulnerability of draught animals to deliberate infection with diseases such as anthrax or glanders was exploited by saboteurs during the First World War in covert attacks on war-related transportation systems. In the interwar years, as the vulnerability of municipal infrastructures to air raids became increasingly apparent, the idea of spreading contagious disease by the bombardment of public health facilities (such as water-treatment and sewage-disposal plants) attracted attention. This, in turn, gave rise to investigations of other possible ways of deliberately initiating the spread of infectious disease. One idea was to establish foci of contagious disease that would then spread of its own accord to parts of the target population not initially exposed to the biological agent concerned. Because of the uncertainties associated with the epidemic spread of disease, such an approach could not be accommodated at all readily within military doctrine except in the context of certain types of strategic or clandestine operation. In their selection of biological agents to weaponize or to take precautions against, military staffs therefore tended to place greater emphasis on non-contagious than on contagious diseases. In the context of terrorism, however, the relative priorities may be different.

During the first half of the Cold War years, arsenals of biological weapons exploiting some of these, and other, approaches were accumulated, together with nerve gases and other chemical weapons, on both sides of the superpower confrontation. After 1970, the accumulation of biological weapons appears to have continued only on one side. The principal biological agents known with reasonable certainty to have been weaponized during the cold war are identified in Chapter 3 and described in Annex [ X ]. The biological weapons developed ranged from clandestine devices for use by special forces to those designed for large guided missiles or heavy bomber aircraft capable of generating large clouds of aerosol inhabited by live causative agents of contagious disease intended for far-distant rear targets, or of non-contagious disease for closer targets. Here were biological weapons that could, in principle, produce mass-casualty effects greatly exceeding those of the chemical weapons that their progenitors had emulated.

Weapons capable of producing effects comparable even with the life-destroying potential of nuclear weapons seemed to be emerging. The field testing, in large-scale open-air trials at sea during 1964–1968, of aerial weapons each capable of laying down a cross-wind line
source of pathogenic aerosol tens of kilometres long demonstrated the capability of infecting experimental animals at ground level up to several tens of kilometres downwind. It thus appeared that people living within areas of the order of thousands of square kilometres in size could now be threatened with disease by a single aircraft. At the same time, defence science advisers were also anticipating a new generation of chemical weapons that could attack targets of up to 100 000 square kilometres in area (2.07).

Such large-area weapons for exploiting the damage potential of chemical or biological agents also made new categories of target, such as food crops and livestock, liable to attack. At the time of the Second World War, chemicals had been discovered that were as toxic to plants as the new nerve gases were to people. These herbicides, notably derivatives of 2,4-dichloro- and 2,4,5-trichlorophenoxyacetic acid in formulations such as Trioxone and Agent Orange, were used as weapons in several conflict areas of Africa and south-east Asia during the period 1950–1975, sometimes targeted against food crops and sometimes against the forest vegetation that could furnish concealment. Certain plant and animal pathogens were also weaponized. Indeed, some of the first wide-area biological and toxin antipersonnel weapons were based on agent delivery systems originally conceived for anti-agriculture purposes.

Since the possible impacts on public health of anti-animal and anti-plant biological agents are indirect, such agents and their chemical counterparts are not described in detail, but the ability of biological agents, in particular, to endanger food security should not be disregarded.

2.3 SCIENTIFIC DEVELOPMENTS

Technological change in biological and chemical warfare has been driven by factors such as the competition between the weapon and the protection against it but also by new user requirements stemming from changes in military doctrine. More profoundly, technological change has also been driven by advances in the basic sciences within which the technology is rooted. Thus new knowledge in the life sciences is accumulating so rapidly that major changes in the nature, accessibility or efficacy of biological and chemical weapons may already be taking place. Increasing the resulting concern are certain non-military technologies that are emerging from the new science and diffusing around the world, for some of these, and notably biotechnology, are also potentially dual use, i.e. applicable also to biological and chemical warfare.

The advent of genetic engineering offers opportunities for the improvement of human health and nutrition, yet in principle it could also be used to produce novel and perhaps more efficacious biological agents and toxins as compared with those used in earlier weapons programmes. Ability to modify more or less at will the genetic properties of living organisms could allow the insertion of new heritable properties into microorganisms that will make them more resistant to the available defences, more virulent or pathogenic (2.08), easier to produce, better able to withstand the stresses of an unnatural environment, or more difficult to detect by routine assays. In so doing, the chances are high that some other valued characteristic of the microorganism would be lost, but eventually even this drawback might be overcome.

Still other aggressive possibilities may exist, e.g. weapons may be developed that could be used to harm human populations by disrupting cell signalling pathways, or by modifying the action of specific genes.

Given the range and variety of pathogens already present in nature, the advantages of basing a weapons programme on a modified organism are not immediately obvious, nor is it always true that the new biotechnologies necessarily favour the offence over the defence. Vulnerability to biological agents exists chiefly because of the current inability to detect their presence in time for prompt masking or sheltering. Rapid detection methods based on modern molecular techniques are now being brought into service, although the extent to which they have the necessary sensitivity and whether they can produce results quickly enough and exclude false positives is not clear. Moreover, the need to detect certain agents at concentrations
equivalent to one organism per breath of air continues to impose an enormous air-sampling requirement, even when polymerase chain reaction (PCR) or other amplifying methods are used. Other new biotechnologies are transforming the development of vaccines, while still others are thought to promise non-specific alternatives to vaccines. Yet there can be little doubt that the spread of advanced biotechnology and the new accessibility of information about it offer new tools to any country or hostile group intending to develop a biological weapon (2.09 – 2.16).

2.4 PRELIMINARY THREAT ASSESSMENT

In the spectrum of biological or chemical threats to the public (see Section 2.1), the far mass-destruction end may perhaps have been approached by some of the bacterial or viral aerosol weapons of the Cold War. That there should be uncertainty about this is due mainly to the demonstrable existence of increasingly severe technological constraints as development results in weapons closer to this end of the spectrum: the greater and more assured the mass destructive power sought for the weapon, the greater the practical difficulties of achieving it. There are, in short, inherent technical limitations to take into account.

Consider, for example, some of the problems of conveying an agent to its intended target. Toxic or infective materials can be spread through drinking-water or foodstuffs but, as explained in Annex [ X ], their effects would then be expected to remain localized unless the contaminated items were themselves widely distributed or unless any biological agent that had been used succeeded in initiating contagious disease. Otherwise, large-scale effects are possible if the materials can be dispersed in the form either of vapour or of an aerosol cloud of liquid droplets or solid particles that can then be inhaled. This mode of attack is subject to uncertainty. The movement of the vapourized or aerosolized agent towards and across its target would be by atmospheric transport, the agent then being moved both laterally and vertically, causing a possibly large fraction of it to miss the target. As is explained in Annex [ X ], the rate of this dispersion will vary greatly depending on the stability of the atmosphere at the time, and the direction of travel will depend both on local meteorological conditions and on the local topography. If aerosol or vapour is released inside enclosed spaces rather than in the open, the situation will, of course, be different. In addition, some agents may be unstable in the atmosphere and decay over time following their dissemination in airborne form, which process may itself also stress the agent to the point of substantial degradation or complete inactivation. Furthermore, for the agent to be retained after inhalation and to exert its intended pathological effects, other technical requirements must be satisfied. In the case of particulate material, for example, larger particles may not be able to penetrate far enough into the respiratory tract, while smaller ones may not be retained there. The optimal size range is, moreover, a narrow one, and the production and maintenance of the optimal size distribution within an aerosol cloud is subject to a variety of difficulties, not least the processes of evaporation or condensation that will be taking place as the cloud travels. These considerations apply to the aerosol dissemination of agents of both contagious disease and non-contagious disease, though an attacker might hope to rely on epidemic spread to compensate for poor aerosol presentation. That spread, too, is subject to unpredictabilities and therefore uncontrollabilities, as described in Annex [ X ].

These technical factors operate to render such large-scale forms of attack more demanding in terms of materials and skills than is commonly supposed. Large amounts of agent will need to be disseminated to be sure that a sufficient proportion will reach the target population for a period of time sufficient to cause the desired effect. Several uncertainties will affect the outcome. Micrometeorological variation in the atmosphere could result either in the agent becoming diluted to harmlessness or in the cloud missing the target due to some veering of the wind. Such attacks are bound, therefore, to be indiscriminate, the more so if agents of contagious disease are used.

Nor are these difficulties of delivery the only or even the most demanding technical problems. In the case of biological agents, there are, for example, the difficulties of selecting the appropriate strain in the first place and then of maintaining its virulence throughout culturing, harvesting, processing, storing, weapon-filling, release and aerosol travel.
The technical considerations just outlined apply to biological or chemical weapons whether used by military forces or by terrorists. Terrorist purposes, it should however be noted, might well be served by a small-scale localized attack by virtue of its potential panic effects.

The conclusion to be drawn is that, although the probability of an attack with the weapons may be low, if it nevertheless happened with, improbably, all the many imponderables and uncertainties favouring the attacker, then the consequences of the event could be great. In considering strategies for national preparedness against such attacks, therefore, the possibility of a low-probability catastrophic outcome must be weighed against that of public health hazards of higher probability but smaller magnitude. It would certainly be irresponsible to be complacent about the possible effects of deliberately released biological or chemical agents, but it would also be prudent not to overestimate them (2.17). Given the emotional shock of even an alleged threat of a biological or chemical release, it will therefore be wise for governments at least to consider how to address such dangers, should they occur, as an integral part of the national response to other threats to public health and well-being.

Technical factors are not the only consideration. Throughout much of the world, the social constraints on resort to biological or chemical weapons, including the provisions of national and international law, will increase the practical problems of acquiring and gaining advantage from such weapons. These constraints will impede access to the necessary materials, and will also obstruct those less tangible forms of assistance otherwise available from international service providers, consultants or even academics, whose corporate image, reputation or trading status would stand to suffer once their involvement became apparent. Furthermore, there would be additional justification for concerted international action against any weapons programmes. The long and continuing period during which no substantial bioattack has occurred suggests that the number of competent groups or states actually intending to use biological weapons must be very small, possibly even zero.

Even so, due preparation for such an eventuality, with a response strategy and plan held at the ready, may be thought necessary. Whether in relation to natural disasters such as earthquakes, or to large-scale accidents in industrial production, storage or transportation facilities, many countries will already have formulated a general response strategy and plan, which they will maintain and modify in the light of changing circumstances and experience. The principles of risk management for dealing with chemical or biological attacks will overlap with those for dealing with natural or man-made disasters or emergencies. Where deliberate biological or chemical releases pose additional risk-management problems, biological and chemical addenda to an existing disaster/emergency strategy and plan will suffice, in most circumstances, for civil preparedness.

2.5 CONCLUSIONS

The question of priorities was raised at the beginning of this chapter, but it is clear from the foregoing discussion that there can be no simple answer. Where, for a country’s enemies - internal or external - the balance of constraints on, and incentives to, resort to biological or chemical weapons may lie at any given moment, and hence the magnitude of the threat inherent in that balance, will surely depend primarily on circumstances peculiar to that country. There can be no general rule: national authorities will need to make their own assessments. The fact that there is a vulnerability does not necessarily mean that there is a threat.

3 BIOLOGICAL AND CHEMICAL AGENTS

Preparedness planning for biological and chemical incidents requires great care, since it is neither possible nor necessary to prepare specifically for attack by all possible biological and chemical agents. If a country is seeking to increase its preparedness to counter biological and
chemical threats, the targeting of its preparation and training on a limited but well chosen group of agents will provide the necessary capability to deal with a far wider range of possibilities. A knowledge of the general properties of this representative group of agents will enable measures to be taken against virtually any other agent. In addition to being impractical from a preparedness perspective, long and exhaustive lists of agents also give a misleading impression of the extent of possible threats. In this chapter, an approach to identifying agents of concern is described, followed by a discussion of methods of dissemination, routes of exposure, and general characteristics of biological and chemical weapons, from which conclusions are drawn to complete the threat assessment described in Chapter 2.

3.1 SELECTION PRINCIPLES

Biological and chemical weapons have been described as the “poor man’s atom bomb”, but this conveys a misleading impression of their ease of production and their utility. It is not enough for biological and chemical agents to be highly infective or highly toxic. To be effective as a weapon, an agent also needs to be stable enough to resist degradation during handling and storage, and during the energy-transfer processes that will, in most scenarios, be involved in disseminating it on its target. In use, the agent must be spread in such a way that the necessary infective or effective dosage is delivered to the target population. It must also be relatively easy to produce from readily available precursor compounds or from naturally occurring micro-organisms. Once produced, it must be weaponized and, depending on the concept of deployment and use, stored without undue risk to its possessor. The effectiveness with which the weapon is deployed will depend on the extent to which these requirements have been met, and the various operations required practised. Technology and concepts for use continue to develop. For example, many biological and chemical agents were selected in the past for their retaliatory capability, and therefore required a long storage life. However, different approaches, such as the binary concept, mean that this is no longer necessarily true for chemical agents. Precursors can be mixed to generate the agent either just before or during weapon launch, though their stability might then become a factor in the choice of agent. For biological agents, concepts of use other than retaliation could reduce the storage life required.

While thousands of toxic chemicals and pathogenic microorganisms have been investigated for their potential utility as weapons, few have been found satisfactory, and fewer still have found their way into weapons and actually been used. In these investigations, agents have been selected essentially on the basis of their suitability for military use. It is not necessary here to go into details of such use in order to provide guidance on the agents that should, or should not, be the focus of preparedness at the present time. Instead, the agents of greatest concern can be identified from the activities associated with the international biological and chemical treaties and from the historical record of biological and chemical weapons and their use, which necessarily reflect the same selection principles. A progressively sharper focus on agents of concern can be gained, firstly, from the treaty definitions of biological and chemical weapons; secondly from the lists of agents that have been negotiated to facilitate treaty implementation; thirdly from such authoritative information as is publicly available about which agents have been weaponized or stockpiled in recent times; and finally from the lists of agents known to have been used as weapons.

3.1.1 Guidance from the international treaties

The intergovernmental negotiations that culminated in the BWC and then the CWC commenced while the first edition of the present report was being prepared. In 1969, in order to determine its scope, WHO relied on the concepts of toxicity and infectivity to distinguish chemical and biological weapons from other types of weapon. It defined chemical-warfare agents as including “all substances employed for their toxic effects on man, animals and plants”, and biological-warfare agents as those “that depend for their effects on multiplication within the target organism, and that are intended for use in war to cause disease or death in man, animals or plants”. The treaty negotiators had, however, to make accommodations that required a less technical approach, since they were aiming to control technologies that were often dual-use in
character, in other words that could be used both in warfare and for peaceful purposes. For example, the negotiators could not prohibit the production of the principal lethal gas of the First World War, phosgene, without at the same time denying feedstock to manufacturers of certain plastics and other useful products; nor could they outlaw the large-scale growth of pathogenic microorganisms without threatening vaccine production. There were many such examples, so the negotiators took the general purpose for which a biological or a chemical agent was intended as the criterion of whether activities involving that agent should or should not be subject to prohibition or control under the treaties. Such a general purpose criterion is therefore to be found in those parts of both the BWC and the CWC where the scope of the treaty is defined. Thus, the prohibitions laid down in the two treaties extend to all biological agents and toxins, and to essentially all chemicals, unless they are intended for peaceful purposes, and unless their types and quantities are consistent with such purposes. In addition, the CWC uses the concept of toxicity, applying its general purpose criterion to “toxic chemicals” and “their precursors”, and defining both of these categories of chemical in broad terms. In contrast, the BWC does not seek to define the biological agents and toxins to which it applies. The actual language used in the two Conventions to define the weapons to which they apply is given in the box below.

### Box 3.1 – How biological and chemical weapons are defined in the BWC and the CWC

**Article I of the Biological Weapons Convention reads as follows:**

*Each State Party to this Convention undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain:*

1. Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes;
2. Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.

**Article II of the Chemical Weapons Convention includes the following:**

*For the purposes of this Convention:*

1. “Chemical Weapons” means the following, together or separately:
   1. Toxic chemicals and their precursors, except where intended for purposes not prohibited under this Convention, as long as the types and quantities are consistent with such purposes;
   2. Munitions and devices, specifically designed to cause death or other harm through the toxic properties of those toxic chemicals specified in subparagraph (a), which would be released as a result of the employment of such munitions and devices;
   3. Any equipment specifically designed for use directly in connection with the employment of munitions and devices specified in subparagraph (b).

2. “Toxic Chemical” means:

   Any chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals. This includes all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere.

   *For the purpose of implementing this Convention, toxic chemicals which have been identified for the application of verification measures are listed in Schedules contained in the Annex on Chemicals.*

3. “Purposes Not Prohibited Under this Convention” means:

   1. Industrial, agricultural, research, medical, pharmaceutical or other peaceful purposes;
   2. Protective purposes, namely those purposes directly related to protection against toxic chemicals and to protection against chemical weapons;
   3. Military purposes not connected with the use of chemical weapons and not dependent on the use of the toxic properties of chemicals as a method of warfare;
   4. Law enforcement including domestic riot control purposes.
In order to implement treaties of such wide-ranging scope effectively, lists of agents have been drawn up so as to focus the efforts of the implementers. The CWC includes three such negotiated lists (“schedules”) in which selected toxic chemicals and precursors are “identified for the application of verification measures”. These schedules are set out in the treaty’s Annex on Chemicals, and list 29 specific chemicals and 14 families of chemicals. Some of the families are very large indeed, running into many millions of chemicals, most of which have, however, never actually been made or characterized. For example, the dialkyl alkylphosphonates that constitute only a small fraction of the chemicals in item 4 of Schedule 2 comprise 1,668,964 different chemicals (excluding stereoisomers), of which apparently only 118 have actually been synthesized (3.01). Even the family of alkyl alkylphosphono-fluoridates, with which Schedule 1 opens, i.e. the sarin family of nerve gases, theoretically contains 3,652 members. Large though these numbers are, the CWC makes it clear that its schedules are not intended to be a definitive listing of all chemicals that constitute “risks to the object and purpose of this Convention”, but simply exemplify chemicals covered by its general purpose criterion. The BWC, which is a much shorter and simpler legal instrument, contains no analogous schedules, but such lists have been developed for inclusion in the BWC Protocol now under negotiation,11 again to exemplify, but not to define, the scope of the general purpose criterion. Several authorities, including defence agencies, have compiled such lists of potential biowarfare and bioterrorism agents in recent years. Some are listed in Table 3.1, from which it may be seen just how much variation there can be in different agent assessments.

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## Table 3.1
Biological agents variously cited as possible weapons for use against humans

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<td><strong>BACTERIA</strong> (including RICKETTSIA and CHLAMYDIA)</td>
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<td><em>Bacillus anthracis</em>, A22 (anthrax)</td>
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<td><em>Bartonella quintana</em>, A79.0 (trench fever)</td>
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<td><em>Brucella species</em>, A23 (brucellosis)</td>
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<td><em>Burkholderia mallei</em>, A24.0 (glanders)</td>
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<td><em>Burkholderia pseudomallei</em>, A24 (melioidosis)</td>
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<td><em>Franciscella tularensis</em>, A21 (tularaemia)</td>
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<td><em>Salmonella typhi</em>, A01.0 (typhoid fever)</td>
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<td><em>Shigella species</em>, A03 (shigellosis)</td>
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<td><em>Vibrio cholerae</em>, A00 (cholera)</td>
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<td><em>Yersinia pestis</em>, A20 (plague)</td>
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<td><em>Coxiella burnetii</em>, A78 (Q fever)</td>
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<td><em>Orientia tsutsugamushi</em>, A75.3 (scrub typhus)</td>
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<td><em>Rickettsia prowazekii</em>, A75 (typhus fever)</td>
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<tr>
<td><em>Rickettsia rickettsii</em>, A77.0 (Rocky Mountain spotted fever)</td>
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<tr>
<td><em>Chlamydia psittaci</em>, A70 (psittacosis)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------------------------</td>
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<td>---------------------------</td>
</tr>
<tr>
<td><strong>Fungi</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Coccidioides immitis</em>, B38 (coccidioidomycosis)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Histoplasma capsulatum</em>, B39.4 (histoplasmosis)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Viruses</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hantaan/Korean haemorrhagic fever, etc, A98.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Sin nombre, J12.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Crimean-Congo haemorrhagic fever, A98.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Rift Valley fever, A92.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ebola virus disease, A98.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Marburg virus disease, A98.4</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphocytic choriomeningitis, A87.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Junin, A96.0 (Argentine haemorrhagic fever)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Machupo, A96.1 (Bolivian haemorrhagic fever)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lassa fever, A96.2</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tick-borne encephalitis/Russian spring-summer encephalitis, A84.0/ A84</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Dengue, A90/91</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Yellow fever, A95</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Omsk haemorrhagic fever, A98.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Japanese encephalitis, A83.0</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
### Biological agent and WHO numeric code for the disease it can cause

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Western equine encephalomyelitis, A83.1</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Eastern equine encephalomyelitis, A83.2</td>
<td></td>
<td>X X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Chikungunya, A92.0</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>O’nyong-nyong, A92.1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Venezuelan equine encephalomyelitis, A92.2</td>
<td></td>
<td>X X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Variola major, B03 (smallpox)</td>
<td>X X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Monkey pox, B04</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>White pox (a variant of variola virus)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Influenza, J10,11</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

### PROTOZOA

<table>
<thead>
<tr>
<th>Protozoa</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Naeglaeria fowleri, B60.2 (naegleriasis)</td>
<td>X</td>
</tr>
<tr>
<td>Toxoplasma gondii, B58 (toxoplasmosis)</td>
<td>X</td>
</tr>
<tr>
<td>Schistosoma species, B65 (schistosomiasis)</td>
<td>X</td>
</tr>
</tbody>
</table>

### Notes

\(^a\) Diseases are identified by the numeric code assigned by the *International classification of diseases, tenth revision (ICD-10)*. Geneva, World Health Organization, 1994.

\(^b\) *Chemical and bacteriological (biological) weapons and the effects of their possible use: report of the Secretary-General*, New York, United Nations, 1969.


\(^d\) United Nations Office of Disarmament Affairs, compilation of declarations of information by BWC States Parties in accordance with the extended confidence-building measures agreed at the Third Review Conference, DDA/4-92/BW3 plus Add.1, Add.2 and Add.3: data from Section 2, *Past offensive biological R&D programmes*, of the Form F as filed by Canada, France, Russian Federation, United Kingdom and United States, 1992.


\(^f\) *NATO handbook on the medical aspects of NBC defensive operations*, AmedP-6(B), Part II – Biological, Brussels, North Atlantic Treaty Organisation, 1996.


### 3.1.2 The historical record

Toxic and infective agents that were available in the past to the armed forces of states in weaponized forms are identified in official state papers now open to the scrutiny of historians. This historical record is not complete, however, because not all former possessor states have yet made the relevant papers available, and even those that have done so have still withheld the papers of the last 20 or 30 years (the declarations received by the United Nations Special Commission on Iraq (UNSCOM) are an exception in that they include reference to weaponization during the period 1987–1991). An extensive list of antipersonnel agents can nevertheless be compiled. That given in Table 3.2 covers the period since January 1946 and is taken from an archive of collected state papers, works of historical scholarship and documentation at the University of Sussex. It is limited to agents identified in state papers as having been stockpiled or having otherwise entered the process of weaponization. For convenience, Table 3.2 groups the agents into categories that are explained and used later in this report.

For some of the toxic chemicals included in Table 3.2, an indication of relative importance historically in possessor state programmes can be gained by considering the quantities of the different agents that have been declared to OPCW as part of the obligatory declarations required from States Parties to the CWC. These declared quantities are given in Table 3.3, which shows that an aggregate total of 69,863 tonnes of chemicals have been declared as chemical weapons to OPCW by its Member States. Of this total, 5,422 tonnes had been verified as destroyed by 31 December 2000. Table 3.3 also indicates the quantities of the various chemicals declared. These declared stockpiles are subject to the monitoring provisions of the CWC, and are thus under international control.

The information on the actual use of toxic and infective agents for hostile purposes may be even less complete than that on weaponization or stockpiling, not least because of the role of these agents in clandestine warfare, on which official records are often sparse. Moreover, there have been occasions when it has been reported that chemical and biological weapons have been used when in fact they were not, the reports originating either in misperception or other error, or in the intention to deceive. Table 3.4 summarizes the record of antipersonnel use, taken from the same archive as that used for Table 3.2. Its entries are restricted to those instances since 1918 in which the fact of use can be regarded as indisputable, and in which the toxic or infective agents employed have been properly identified. The use of anti-plant or anti-animal agents is not included. Table 3.4 includes in its last two entries the use of toxic or infective antipersonnel agents by non-state entities, including episodes regarded as acts of terrorism, on which the historical record is even sparser than that for the possessor state programmes.

Taken together, Tables 3.2, 3.3 and 3.4 suggest that the number of agents actually weaponized or used is considerably smaller than the number of agents described in the literature on biological and chemical warfare. Nevertheless, for the representative group of agents mentioned on section 3, it seems necessary to add only three further agents: variola major, i.e. smallpox virus, perfluoroisobutene, a toxic agent now produced as a by-product in the chemical industry in tens of thousands of tonnes per year, and the chemical psychotomimetic agent lysergide, also known as LSD. Further information on the representative group of agents is given in Annexes X1, X2 and X3.

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12 The archive is the Sussex Harvard Information Bank, which is maintained at SPRU, University of Sussex, UK, by the Harvard Sussex Program on CBW Armament and Arms Limitation (see [www.sussex.ac.uk/spru/hsp](http://www.sussex.ac.uk/spru/hsp)).
Table 3.2: Toxic and infective antipersonnel agents stockpiled or otherwise weaponized for state forces since 1946 according to official documents of possessor states

<table>
<thead>
<tr>
<th>Tear gases, other sensory irritants, and other disabling chemicals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>− 10-chloro-5,10-dihydrophenarsazine (adamsite, or DM)</td>
</tr>
<tr>
<td>− o-chloroacetophenone (CN)</td>
</tr>
<tr>
<td>− a-bromophenylacetonitrile (larmine, BBC or CA)</td>
</tr>
<tr>
<td>− 2-chlorobenzalmalononitrile (CS)</td>
</tr>
<tr>
<td>− dibenzoazepine (CR)</td>
</tr>
<tr>
<td>− oleoresin capsicum (OC)</td>
</tr>
<tr>
<td>− 3-quinuclidinyl benzilate (BZ)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Choking agents (lung irritants):</th>
</tr>
</thead>
<tbody>
<tr>
<td>− phosgene</td>
</tr>
<tr>
<td>− chloropicrin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blood gases:</th>
</tr>
</thead>
<tbody>
<tr>
<td>− hydrogen cyanide</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vesicants (blister gases):</th>
</tr>
</thead>
<tbody>
<tr>
<td>− bis(2-chloroethyl) sulfide (mustard gas)</td>
</tr>
<tr>
<td>− 2-chlorovinyldichloroarsine (lewisite)</td>
</tr>
<tr>
<td>− bis(2-chloroethylthioethyl) ether (agent T)</td>
</tr>
<tr>
<td>− tris(2-chloroethyl)amine (a nitrogen mustard)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nerve gases:</th>
</tr>
</thead>
<tbody>
<tr>
<td>− ethyl N,N-dimethylphosphoramidocyanidate (tabun, or GA)</td>
</tr>
<tr>
<td>− O-isopropyl methylphosphonofluoridate (sarin, or GB)</td>
</tr>
<tr>
<td>− O-1.2,2-trimethylpropyl methylphosphonofluoridate (soman, or GD)</td>
</tr>
<tr>
<td>− O-cyclohexyl methylphosphonofluoridate (cyclosarin, or GF)</td>
</tr>
<tr>
<td>− O-ethyl S-2-diisopropylaminoethyl methylphosphonothiolate (VX)</td>
</tr>
<tr>
<td>− O-ethyl S-2-dimethylaminoethyl methylphosphonothiolate (medemo)</td>
</tr>
<tr>
<td>− O-isobutyl S-2-diethylaminoethyl methylphosphonothiolate (VR)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Further toxins:</th>
</tr>
</thead>
<tbody>
<tr>
<td>− Ricin</td>
</tr>
<tr>
<td>− Saxitoxin</td>
</tr>
<tr>
<td>− Clostridium botulinum toxin</td>
</tr>
<tr>
<td>− Staphylococcal enterotoxin</td>
</tr>
<tr>
<td>− Aflatoxin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bacteria and rickettsiae:</th>
</tr>
</thead>
<tbody>
<tr>
<td>− <strong>Bacillus anthracis</strong></td>
</tr>
<tr>
<td>− <strong>Francisella tularensis</strong></td>
</tr>
<tr>
<td>− <strong>Brucella suis</strong></td>
</tr>
<tr>
<td>− <strong>Burkholderia mallei</strong></td>
</tr>
<tr>
<td>− <strong>Burkholderia pseudomallei</strong></td>
</tr>
<tr>
<td>− <strong>Yersinia pestis</strong></td>
</tr>
<tr>
<td>− <strong>Rickettsia prowazeki</strong></td>
</tr>
<tr>
<td>− <strong>Coxiella burnetii</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viruses</th>
</tr>
</thead>
<tbody>
<tr>
<td>− Venezuelan equine encephalitis virus</td>
</tr>
</tbody>
</table>
### Table 3.3 Aggregate quantities of chemical agents declared to the OPCW by its Member States, as of 31 December 2000

<table>
<thead>
<tr>
<th>Chemical agent</th>
<th>Total declared (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category 1 chemical weapons</strong></td>
<td></td>
</tr>
<tr>
<td>Agent VR</td>
<td>15 558</td>
</tr>
<tr>
<td>Agent VX</td>
<td>4 032</td>
</tr>
<tr>
<td>Degraded sulfur mustard (toxic waste)</td>
<td>1</td>
</tr>
<tr>
<td>Difluor (precursor DF)</td>
<td>444</td>
</tr>
<tr>
<td>EDMP (precursor QL)</td>
<td>46</td>
</tr>
<tr>
<td>Lewisite</td>
<td>6 745</td>
</tr>
<tr>
<td>Medemo</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Mustard gas</td>
<td>13 839</td>
</tr>
<tr>
<td>Mustard/lewisite mixtures</td>
<td>344</td>
</tr>
<tr>
<td>OPA</td>
<td>731</td>
</tr>
<tr>
<td>Runcol (HT)</td>
<td>3 536</td>
</tr>
<tr>
<td>Sarin (GB)</td>
<td>15 048</td>
</tr>
<tr>
<td>Soman (GD)</td>
<td>9 175</td>
</tr>
<tr>
<td>Tabun (GA)</td>
<td>2</td>
</tr>
<tr>
<td>Unknown</td>
<td>4</td>
</tr>
<tr>
<td><strong>Category 2 chemical weapons</strong></td>
<td></td>
</tr>
<tr>
<td>Chloroethanol</td>
<td>302</td>
</tr>
<tr>
<td>Phosgene</td>
<td>5</td>
</tr>
<tr>
<td>Thiodiglycol</td>
<td>51</td>
</tr>
</tbody>
</table>

13 Based on figures from the OPCW annual report for 2000 (3.02), rounded to the nearest tonne.
14 Chemical weapons on the basis of Schedule 1 chemicals and their parts and components. See Table 3.2 for their chemical identities.
15 Methylphosphonyl difluoride (binary nerve-gas component)
16 Ethyl 2-diisopropylaminoethyl methylphosphonite (binary nerve gas component).
17 Including mustard gas in oil product.
18 A mixture of 72% isopropyl alcohol and 28% isopropylamine (binary nerve-gas component).
19 A reaction product containing about 60% of mustard gas and 40% of agent T.
20 Chemical weapons on the basis of all other chemicals and their parts and components. Category 3 chemical weapons comprise unfilled munitions and devices, and equipment specifically designed for use directly in connection with employment of chemical weapons.
### Table 3.4 Some verified instances of hostile use of antipersonnel toxic and infective agents since 1918

<table>
<thead>
<tr>
<th>Period</th>
<th>Agent</th>
<th>Location of use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1919</td>
<td>Adamsite diphenylchloroarsine (a sensory irritant) mustard gas</td>
<td>Russian Federation</td>
</tr>
<tr>
<td>1923–1926</td>
<td>Bromomethyl ethyl ketone (a tear gas) chloropicrin mustard gas</td>
<td>Morocco</td>
</tr>
<tr>
<td>1935–1940</td>
<td>Chlorine ω-chloroacetophenone diphenylchboroarsine mustard gas</td>
<td>Ethiopia</td>
</tr>
<tr>
<td></td>
<td>diphenylcyanoarsine hydrogen cyanide lewisite mustard gas</td>
<td></td>
</tr>
<tr>
<td></td>
<td>phosgene Yersinia pestis</td>
<td></td>
</tr>
<tr>
<td>1937–1945</td>
<td>ω-chloroacetophenone diphenylcyanoarsine hydrogen cyanide lewisite</td>
<td>China</td>
</tr>
<tr>
<td></td>
<td>mustard gas phosgene Yersinia pestis</td>
<td></td>
</tr>
<tr>
<td>1963–1967</td>
<td>ω-chloroacetophenone mustard gas phosgene</td>
<td>Yemen</td>
</tr>
<tr>
<td>1965–1975</td>
<td>2-chlorobenzalmononitrile</td>
<td>Viet Nam</td>
</tr>
<tr>
<td>1983–1988</td>
<td>2-chlorobenzalmononitrile sarin mustard gas tabun</td>
<td>Islamic Republic of Iran/</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iraq</td>
</tr>
<tr>
<td>1984</td>
<td><em>Salmonella enteritidis</em> serotype <em>typhimurium</em></td>
<td>United States</td>
</tr>
<tr>
<td>1994–1995</td>
<td>Sarin</td>
<td>Japan</td>
</tr>
</tbody>
</table>

*Source.* Documents and materials held in the Sussex Harvard Information Bank at SPRU—Science and Technology Policy Research, University of Sussex, United Kingdom.
3.2 DISSEMINATION OF BIOLOGICAL AND CHEMICAL AGENTS

In any release of a chemical or biological agent, the nature and degree of hazard will depend on a multitude of factors, including, among other things, the agent and the amount released, the method by which the agent is disseminated, factors that influence its toxicity, infectivity or virulence both during and after its release, its movement and dilution in the atmosphere, and the state of protection and susceptibility of those exposed. Two different types of general hazard are usually distinguished, namely inhalation hazard and contact hazard, with different characteristic implications for protection (see Chapter 4). A brief summary is given here of the methods of dissemination of biological and chemical agents that may create an inhalation or contact hazard to unprotected persons. The principles governing the atmospheric dispersion and travel of vapour and particulate clouds are discussed in Annex [X].

The methods of dissemination that may be used depend on the physical and chemical properties of the material to be dispensed, including those that might cause the decomposition or inactivation of chemicals or toxins or, for infective agents, the loss of viability or more subtle changes that primarily affect only virulence.

For chemical agents, an inhalation hazard may be created by the dissemination of the agent as a vapour, as liquid or solid particles sufficiently small to be respirable, as a spray that evaporates to form a vapour while still airborne, or as a spill or spray that is deposited on surfaces and subsequently evaporates to form a vapour. For some agents, vapours or respirable particles may also present a hazard to sensitive mucous membranes, especially those of the conjunctiva. For chemical agents able to act percutaneously, a contact hazard may be created by sprays or spills of less volatile agents deposited directly on people or on surfaces with which people are likely to come into contact. A chemical agent may be disseminated mechanically by spraying or rupturing a container, by using explosives, or by a thermal process in which a pyrotechnic composition is used as the source of heat. Pyrotechnic dissemination is effective only for heat-resistant and non-combustible agents, which may evaporate initially and then condense as a suspension in air of respirable particles, creating principally an inhalation or conjunctival hazard.

For infective agents, the principal hazard to people will be from inhalation. For many infective agents, the hazard is greatest if the agent reaches the target population in the form of particles within a narrow size range, i.e. small enough to penetrate to the alveoli in the depths of the lungs but not so small that most of the particles fail to be deposited and instead are mostly exhaled. Contact with an infective agent and its entry into the body via a wound or via mucous membranes may also present a hazard, although generally much less than that from inhalation. Infective agents may be disseminated as respirable particles by explosives or by sprayers or other generators specially designed to produce particles in the respirable size range.

Particles in this size range and smaller have such low gravitational settling velocities that the movement in the atmosphere of a cloud of such particles is like that of a vapour cloud. A particulate cloud of this type is a colloidal suspension of matter in air, and is known as an aerosol. For both vapours and aerosols, the rate of deposition depends not on gravity but rather on chemical and physical forces that might bind the molecules or particles to the specific surfaces with which they come into contact, thereby removing them from the cloud. Although wind and other mechanical disturbances may resuspend deposited particles, the amount resuspended is likely to be small and even that will be bound to soil or other particles of diameter too large to be respirable. In consequence, exposures to respirable particles resulting from resuspension will generally be much lower than those caused by the initial cloud.

As a particulate or vapour cloud is carried down-wind, eddy currents in the atmosphere cause it to spread both horizontally and vertically (up to the top of the atmospheric mixing layer, if such a layer is present) at a rate that depends strongly on the degree of atmospheric turbulence, resulting in lower dosages at greater down-wind and cross-wind distances from the source. Nevertheless, if the atmosphere is relatively stable, and depending on the nature and
amount of the agent, dosages may reach hazardous levels even many kilometres down-wind of the source.

3.3 ROUTES OF EXPOSURE

3.3.1 Respiratory system

The principal hazard from chemical agent vapors and aerosols is respiratory, although certain chemical agents, notably the mustards and certain sensory irritants, also pose a particular hazard to the conjunctiva.

The region of the respiratory system where the inhaled vapour of a chemical agent is adsorbed and the efficiency of its adsorption depend on the solubility properties of the agent. Vapours of water-soluble agents are largely adsorbed in the nasal passages and the upper regions of the respiratory system. Water-insoluble vapours are able to penetrate more deeply and may be adsorbed in the most distal part of the respiratory system—the alveolar spaces. If dispersed as an aerosol of a non-volatile agent or as an agent adsorbed to a non-volatile carrier material, the site of deposition will depend on the size of the aerosol particles, as discussed below for biological agents.

Some agents, including mustard, phosgene and chlorine, damage lung tissues at the site of adsorption, while others, such as the nerve agents, penetrate respiratory tissues and are carried through the bloodstream to act on specific target receptors, as in the peripheral or central nervous system.

For chemical agents that are not significantly detoxified during the period of exposure, the severity of hazard depends on the total amount inhaled. For some chemicals, however, notably hydrogen cyanide, significant detoxification occurs in the body within minutes, so that inhalation of a given amount within a short time may cause severe intoxication or death while inhalation of the same amount over a longer time would not. Most of the chemical agents listed in Table 3.2, however, including mustard and the nerve agents, are essentially cumulative in their toxic effects, except perhaps for exposures extending over many hours.

The principal hazard to persons exposed to a passing cloud of a biological aerosol would also be respiratory. This is because the amount of aerosol deposited in the respiratory system would be much greater than that deposited elsewhere on the body and because the respiratory system, although provided with impressive natural defence mechanisms, is nevertheless vulnerable to infection by the agents of concern, while unbroken skin is not. It is also the case that for many agents of concern infection via the inhalatory route generally leads to more severe disease than does cutaneous infection. Nevertheless, if agent finds its way to a lesion, cutaneous infection may result from aerosol particles deposited on bodily surfaces or on surfaces with which the person comes in contact.

The region of the respiratory system where inhaled particles are deposited depends on their size. As an approximation, the particles in a biological agent aerosol are taken to have unit density and spherical shape. Such particles with diameter \( ca 10 \mu m \) and larger are almost entirely deposited by inertial impaction on the fimbriae of the nose, in the nasal cavities and in the upper thoracic airways. After deposition, they are transported to the nose or to the back of the throat by mucociliary action, to be expelled in nasal secretions or to be swallowed or expelled by coughing or expectoration. Such clearance protects the lungs from infectious agents deposited in the respiratory airways. Additional protection results from the action of antimicrobial substances present in mucus and from the action of phagocytic cells. Some infectious agents, however, including the viruses of influenza and smallpox, have special adaptations that enable them to infect the oropharyngeal and respiratory mucosa.
Smaller particles, in the range 1–5 µm in diameter, may also be trapped in the nasal passages but a substantial percentage of them will escape inertial impaction and pass beyond the respiratory airways to reach the alveoli, where they may deposit by gravitational sedimentation. It is here, in the approximately 500 million alveolar sacs with a total surface area of approximately 100 m², that most biological agents of concern, if disseminated as aerosols sufficiently fine to reach the alveoli, may initiate infection. Because of their lower gravitational settling velocities, inhaled particles with diameters below 1 µm in diameter are not likely to deposit by sedimentation but may nevertheless deposit on alveolar surfaces, owing to Brownian motion.

Consistent with their gas-exchanging function, the alveoli lack ciliated epithelium and therefore lie beyond the mucociliary surface of the respiratory airways. Instead, alveolar clearance of insoluble particles is mainly achieved by mobile phagocytic cells, the alveolar macrophages, or by polymorphonuclear leukocytes which are subsequently engulfed by alveolar macrophages. Macrophages that have engulfed deposited particles may, by processes that are poorly understood, reach the respiratory airways and be removed from the lungs by mucociliary transport. Particles may also be transported by macrophages or pass as free particles to regional lymph nodes, to be retained there or to enter the lymphatic drainage, passing through the thoracic duct into the bloodstream.

Alveolar clearance appears to have half-times ranging from hours to many days or longer, depending on the nature of the particle. Most microorganisms and viruses engulfed by macrophages are inactivated and digested. Some microorganisms, however, are endowed with features that enable them to resist phagocytosis or to survive or multiply within macrophages. Spores of \textit{B. anthracis}, for example, are able to germinate in macrophages, which may transport multiplying bacteria to regional lymph nodes where further proliferation and passage of bacteria into the bloodstream can initiate systemic infection.

### 3.3.2 Skin

Several chemical agents, such as the liquid agent VX, are able to penetrate the skin and cause systemic effects. Others, such as the blister agent mustard, either as a liquid or as vapour, cause more local effects, and, in addition, may render the underlying tissues vulnerable to infection. As a general rule, the thinner, more vascular, and moister the skin, the more prone it is to attack and penetration by such agents. High relative humidity promotes penetration. As penetration into and through the skin is not immediate, removal or decontamination, if accomplished within minutes after exposure, can greatly reduce the toxic effects of such agents.

Although aerosol particles do not tend to settle on surfaces and may pass without harm to the skin, except perhaps for hairy areas, the much larger particles that occur in a spray or a coarse dust are deposited more efficiently.

### 3.3.3 Digestive system

Biological and chemical agents can enter the digestive system via contaminated food or drinking-water, by hand-mouth contact after touching contaminated surfaces, or by swallowing of respiratory mucus after the accumulation of larger aerosol particles in the nose/throat and upper airways. Of all exposure routes, this is the easiest to control, provided that the contaminated sources are known (or at least suspected). Simple hygienic measures and control of supplies of food and drinking-water can significantly reduce the risk of exposure. If chemical agents are ingested, the delayed onset of symptoms (compared with respiratory exposure) and the increased prevalence of systemic rather than localized effects may lead to the conclusion that the persons affected were suffering from a disease or general malaise or even that they had been exposed to a biological agent.

Since particle size ceases to be of importance after deposition on surfaces, even non-respirable aerosols can contaminate food supplies or drinking-water at long distances from the
point of agent release. The problems presented by the direct biological contamination of food, water or other ingestible material are considered in Annex [X].

3.4 CHARACTERISTICS OF BIOLOGICAL AGENTS

The chief characteristic of biological agents is their ability to multiply in a host over time. It is this that gives them their aggressive potential. The disease that they may cause results from the multifactorial interaction between the biological agent, the host (including the latter’s genetic constitution, nutritional status and the immunological status of the population to which it belongs) and the environment (e.g. sanitation, temperature, water quality, population density). The consequences of using biological agents to cause disease will reflect these complex interactions.

Biological agents are commonly classified according to their taxonomy, the most important taxa being fungi, bacteria and viruses. Such classification is important to medical services because of its implications for detection, identification, prophylaxis and treatment. Biological agents can also be characterized by their other features, notably their infectivity, virulence, lethality, pathogenicity, incubation period, contagiousness and mechanisms of transmission, and stability, all of which influence their potential for use as weapons. The definition of these terms given below in general follow those of J M Last, A dictionary of epidemiology, fourth edition, Oxford University Press, 2001.

The infectivity of an agent reflects its capability to enter, survive and multiply in a host, and may be expressed as the proportion of persons exposed to a given dose who become infected.

Virulence is the relative severity of the disease caused by a microorganism, i.e. the ratio of the number of clinical cases to the number of infected hosts. Different strains of the same microorganism may cause diseases of different severity, e.g. infection due to Brucella melitensis is usually more severe than infection due to B. suis or to B. abortus.

Lethality reflects the ability of an agent to cause death in an infected population. The case-fatality rate, i.e. the proportion of patients clinically recognized as having a specified disease who die as a result of that illness within a specified time (e.g. during outbreaks of acute disease), provides useful information on the clinical management of cases.

Pathogenicity reflects the capacity of a microorganism to cause disease, and is measured by the ratio of the number of clinical cases to the number of exposed persons.

The incubation period is the time elapsing between exposure to an infective agent and the first appearance of the signs and symptoms of disease associated with the infection. This is affected by many variables, such as the initial dose, virulence, route of entry, rate of replication, and the immunological status of the host.

For those infections that are contagious, a measure of their contagiousness is the number of secondary cases following exposure to a primary case in relation to the total number of exposed susceptible secondary contacts. The mechanisms of transmission involved may be direct or indirect. Thus transmission may, for example, result from direct contact between an infected and an uninfected person, or it may be mediated through inanimate material that has become contaminated with the agent, such as soil, blood, bedding, clothes, surgical instruments, water, food or milk. There may also be airborne or vector-borne secondary transmission. Airborne transmission can occur through coughing or sneezing, which may disseminate microbial aerosol. Vector-borne transmission can occur via biting insects, other arthropods, or other invertebrate hosts. The distinction between types of transmission is important when methods for controlling contagion are being selected. Thus, direct transmission can be interrupted by appropriate handling of infected persons, while the interruption of indirect
transmission requires other approaches, such as adequate ventilation, chlorination of water, or vector control.

**Stability** is another important characteristic of biological agents. It refers to the ability of the agent to survive the influence of environmental factors such as air pollution, sunlight and extremes of temperature or humidity.

### 3.5 CHARACTERISTICS OF CHEMICAL AGENTS

As with biological agents, chemical agents may be classified in a variety of different ways depending on the type of characteristic that is of primary concern. This can lead to potentially confusing differences in the way that such agents are grouped and referred to in different commentaries or manuals. The most common characteristics are described below in order to introduce and explain frequently used terminology.

A common form of classification of chemical agents is according to the degree of effect, e.g. harassing, incapacitating or lethal. A **harassing agent** disables exposed people for as long as they remain exposed. They are acutely aware of discomfort caused by the agent, but usually remain capable of removing themselves from exposure to it unless they are otherwise constrained. They will usually recover fully in a short time after exposure ends, and no medical treatment will be required. An **incapacitating agent** also disables, but people exposed to it may not be aware of their predicament, as with certain psychotropic agents, or may be rendered unable to function or move away from the exposed environment. The effect may be prolonged, but recovery may be possible without specialized medical aid. A **lethal agent** causes the death of those exposed.

This is not a particularly precise way of classifying agents, as their effects will depend on the dose received and on the health and other factors determining the susceptibility to adverse affects of the individuals exposed. Tear gas (e.g. CS or CN), usually a harassing agent, can be lethal if a person is exposed to a large quantity in a small closed space. On the other hand, nerve agents, which are usually lethal, might only incapacitate if the target were exposed to no more than a low concentration for a short time. Protective measures may be aimed at reducing the level of the effect if total protection is not possible. For example, the use of pretreatment and antidotes in a nerve gas victim is unlikely to provide a complete “cure”, but may well reduce what would have been a lethal effect to an incapacitating one.

Another form of classification is according to the route of entry of the agent into the body (see section 3.3). **Respiratory agents** are inhaled and either cause damage to the lungs, or are absorbed there and cause systemic effects. **Cutaneous agents** are absorbed through the skin, either damaging it (e.g. mustard gas) or gaining access to the body to cause systemic effects (e.g. nerve agents), or both. An agent may be taken up by either or both routes, depending on its physical properties or formulation.

A further classification is based on the duration of the hazard. **Persistent agents** will remain in the area where they are applied for long periods (sometimes up to a few weeks). They are generally substances of low volatility that contaminate surfaces and have the potential to damage the skin if they come into contact with it. A secondary danger is inhalation of any vapours that may be released. Persistent agents may consequently be used for creating obstacles, for contaminating strategic places or equipment, for area denial, or, finally, for causing casualties. Protective footwear and/or dermal protective clothing will often be required in contaminated areas, usually together with respiratory protection. Mustard gas and VX are persistent agents. **Non-persistent agents** are volatile substances that do not stay long in the area of application, but evaporate or disperse rapidly, and may consequently be used to cause casualties in an area which needs to be occupied soon afterwards. Surfaces are generally not contaminated, and the primary danger is from inhalation, and secondarily from skin exposure. Respirators will be the main form of protection required. Protective clothing may not be
necessary if concentrations are below skin toxicity levels. Hydrogen cyanide and phosgene are typical non-persistent agents.

Finally, chemical agents are often grouped according to their effect on the body, the classes being differentiated according to, for example, the primary organ system that is affected by exposure. Typical classes include: nerve agents or “gases” (e.g. sarin, VX, VR); vesicants or skin-blasting agents (e.g. mustard gas, lewisite); lung irritants, asphyxiants or choking agents (e.g. chlorine, phosgene); blood gases or systemic agents (e.g. hydrogen cyanide); sensory irritants (e.g. CN, CS, CR); and psychotropic agents (e.g. the disabling agent BZ) (see Table 3.2).

### 3.6 CONSEQUENCES OF USING BIOLOGICAL OR CHEMICAL WEAPONS

#### 3.6.1 Short-term consequences

The most prominent immediate effect of biological or chemical weapons is the large number of casualties that they cause, and it is this characteristic that determines most preparedness strategies. The potential for overwhelming medical resources and infrastructure is magnified by the fact that the psychological reaction of a civilian population to biological or chemical attack is likely to be far more serious than that caused by attack with conventional weapons. Psychological support strategies combined with risk communication are an integral part of the services needed to manage the many exposed and non-exposed casualties that may present at medical facilities (see Chapter 4). A graphic and instructive illustration of the nature of the short-term consequences of urban attack with chemical agents is provided by the 1994–1995 terrorist attacks in Japan in which the nerve gas sarin was used (see Appendix 4.1).

Details of the short-term injuries caused by the various biological and chemical agents can be found in Annexes X1–X3.

#### 3.6.2 Long-term consequences

The possible long-term consequences of the use of biological or chemical weapons, including delayed, prolonged and environmentally mediated health effects, long after the time and place that the weapons were used, have generally received less attention in the literature than the more obvious short-term consequences discussed above.

Some biological and chemical agents have the potential for causing physical or mental illnesses that either remain, or only become evident, months or years after the weapons have been used. Such effects have long been recognized, and have indeed been the subject of specific scientific monographs (3.03, 3.04). They may extend the potential for harm of biological or chemical weapons beyond their immediate target area both in time and space. Users may seek to exploit this characteristic of the weapons for offensive purposes, but for many agents too little is known about their long-term effects for reliable predictions to be made.

Such uncertainty also affects the planning of medical countermeasures, and little more can be done than to outline the various possibilities needing further study. The unanticipated long-term effects of agents may prove more harmful than the immediate effects. Non-military experience with disease-causing organisms, or with the presence of certain chemicals in the environment, may not be helpful guides to the effects of those same agents under the quite different conditions of deliberate release, in which greater quantities are usually involved. Useful pointers to what the consequences might be can, however, sometimes be provided by the study of the effects of occupational exposure to chemicals. Organophosphate insecticides, e.g. methyl parathion, are hazardous for humans, and both the methods of treatment and the probable long-term effects of poisoning may be similar to those for nerve gases such as sarin.
The long-term health consequences of releases of biological or chemical agents may include chronic illness, delayed effects, new infectious diseases becoming endemic, and effects mediated by ecological changes.

The potential for **chronic illness** after exposure to some toxic chemicals is well known. The occurrence of chronic debilitating pulmonary disease in victims of exposure to mustard gas was reported after the First World War (3.05). This has also been described in reports on the current status of Iranian casualties from Iraqi mustard gas during the Gulf War of the 1980s (3.06, 3.07). Follow-up of Iranian victims has revealed debilitating long-term disease of the lungs (chronic bronchitis, bronchiectasis, asthmatic bronchitis, pulmonary fibrosis, large airway obstructions), eyes (delayed mustard gas keratitis with blindness), and skin (dry and itchy skin, with multiple secondary complications, pigmentation disorders, and structural abnormalities ranging from hypertrophy to atrophy). Deaths from pulmonary complications are still occurring at the time of writing, approximately 12 years after all exposure had ended (3.08). Details of the long-term effects caused by particular toxic chemicals are given in Annex [X]. Biological agents, including some of the agents of particular concern, may also cause long-lasting illness. *Brucella melitensis* infections, for example, which are typically more severe than brucellosis due to *B. suis* or *B. abortus*, especially affect bones, joints and heart (endocarditis). Relapses, fatigue, weight loss, general malaise and depression are common. *Francisella tularensis* infections result in prolonged malaise, and weakness may last for many months. The viral encephalitides may have permanent effects on the central and peripheral nervous system. Annex [X] provides further information.

The **delayed effects** in persons directly exposed to biological and chemical agents, include carcinogenesis, teratogenesis and mutagenesis. Both biological and chemical agents have been strongly implicated in the causation of cancer in humans, but it is not yet known whether infection by any of the microorganisms likely to be used in biological weapons can be carcinogenic in humans, and only limited information is available on the ability of certain classes of chemicals to cause cancer, mainly in experimental animals. For example, some compounds of military interest, such as mustard gas, are alkylating agents, and many such agents have been found to be carcinogenic. While the evidence suggesting carcinogenesis after a single acute exposure to sulfur mustard is equivocal, there is stronger evidence of a significant increase in cancer of the respiratory tract among workers following prolonged low-dose exposure in factories producing mustard gas (3.09). Certain chemicals and infective agents can cause severe damage to the developing human fetus, thalidomide and the rubella virus being particularly well-known examples. It is not known whether any of the specific chemical or biological agents considered here will have teratogenic effects at the doses likely to be received by pregnant women in civilian populations that might be exposed to them. Insufficient attention has been given to the possibility that known chemical and biological agents might cause detrimental mutagenesis in humans. Several chemicals are reported to cause such changes in both experimental organisms and cultured human cells.

If biological agents are used to cause diseases that are not endemic in the country attacked, this may result in the **disease becoming endemic**, either in human populations, or in suitable vectors such as arthropods and in other non-human hosts, such as rodents, equids or cattle. *Bacillus anthracis* spores are highly resistant to environmental degradation, and can persist, particularly in soil, for long periods. By infecting and reproducing in animals, they can establish new foci. Microbes causing gastrointestinal infections in humans, such as *Salmonella* and *Shigella*, can establish long-term reservoirs. *Salmonella* strains can do likewise in domestic animals.

Finally, there is the possibility of **effects mediated by ecological change**. New foci of disease might become established as a result of ecological changes caused by the use of biological agents infective for humans and animals, or as a result of the use of anti-plant agents. These could have profoundly adverse long-term effects on human health via reductions in the quality and quantity of the food supply derived from plants or animals.
The broad conclusion to be drawn from the foregoing analysis is that there are enormous difficulties associated with assessing the long-term health effects of exposure to chemical and biological agents. Confounding variables often affect the results of studies, and it is frequently difficult to distinguish genuine long-term effects of exposure (which, by nature, are often non-specific) from background occurrence of the same symptoms due to a wide spectrum of other causes. Conflicting data and inconclusive results often make it impossible to reach definitive conclusions.

Examples of the difficulties in determining the existence of long-term effects of chemical exposure have been provided by the ongoing investigations of medical problems apparently caused by the herbicide Agent Orange to people exposed in Viet Nam, where the chemical was widely used in the 1970s during the Viet Nam War (3.10). Investigations have paid special attention to the contaminant 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which is produced during manufacture and is persistent in the environment, detectable at elevated levels in sampled lipid and body fat, and highly toxic to certain experimental animals. In a more recent example, and with even less scientific evidence for a cause-effect relationship, chemical exposures of a variety of types were among the many factors suggested as potential causes of the so-called Gulf War syndrome. In both cases, a wide range of long-term symptoms and adverse health effects (including carcinogenesis, teratogenesis, mutagenesis, and a plethora of non-specific somatic and psychological symptoms) are said to have been caused by exposure to chemical agents, among other possible causes (3.11). Despite intensive investigation, definitive explanations have not yet been found in either case.

3.6.3 Psychological warfare aspects

Apart from their ability to cause physical injury and illness, biological and chemical agents can be used in psychological warfare because of the horror and dread that they can inspire. Even if the agents are not actually used, fear of them can cause disruption, even panic. Exacerbation of such effects can be expected from the exaggerated accounts of biological and chemical weapons that may arise in some circles. People may also be better able to understand the harmful effects of conventional weapons than those of toxic or infective materials. These matters are considered in greater detail in Annex [ X ].

The emergence and spread of long-range ballistic missile delivery systems has increased the vulnerability to biological or chemical attack felt in cities, where the population may seem largely unprotectable, and this in turn has increased the psychological warfare potential. This was demonstrated in Teheran during the “war of the cities” in the final stage of the Gulf War of the 1980s when the threat – which never became a reality – that missiles might be used to deliver chemical agents reportedly caused greater alarm than the high-explosive warheads actually used ever did. There was a further example of this during the Kuwait War of 1990–1991, when it was feared that Scud missiles aimed at Israeli cities might be armed with chemical warheads. In addition to military and civil defence personnel, many civilians were issued with antichemical protective equipment and trained in procedures for chemical defence. Considerable disruption was caused since all missile strikes were regarded as chemical until proven otherwise, despite the fact that no chemical warheads were actually used by Iraq.

3.7 ASSESSMENT AND CONCLUSIONS

This chapter has introduced the wide variety of toxic and infective agents that could be used for hostile purposes. It has proposed that a considered and realistic approach to evaluating the threat identifies a relatively small group of agents that should form the focus of protective preparation. Preparedness can thereby be built against essentially all agents.

Of the various methods available for the release of biological and chemical agents, the major risk results from their dissemination as aerosols or, for some chemicals, as vapour. Respiratory protective equipment and means of predicting the potential spread of the airborne
agent so that preventive and protective measures can be taken in the areas that may be affected are therefore essential.

Skin exposure hazards are caused mainly by chemical agents and will usually occur in the immediate vicinity of a release. Here, the mainstay of protection will be protective clothing. Skin protection may be required against both direct liquid exposure and high vapour concentrations. If a vapour hazard exists, respiratory protection using adsorptive carbon filters will also be required. Contaminated areas will need to be located, demarcated, and decontaminated.

By understanding the general properties and potential consequences of the use of biological and chemical agents, a balanced approach to preparedness may be achieved. A preparedness programme should make provision not only for the immediate casualty-producing potential of such agents, but also for the long-term consequences that may not appear for many years.

4. PUBLIC HEALTH PREPAREDNESS FOR BIOLOGICAL OR CHEMICAL INCIDENTS AND RESPONSE

The initial response to a deliberate release of infective or toxic agents targeted to civilian populations is largely a local responsibility in many parts of the world. Local authorities are in the best position to deal with such events, and will generally be held accountable should the incident be mishandled. While national and international resources will be important in the long term, it is the responsibility of local officials to ensure that response systems and plans are in place before an incident actually occurs.

This chapter provides a framework that local and national authorities can use in planning the response to incidents in which biological or chemical agents may have been released deliberately. It is not intended to provide an in-depth review of all the technologies and other matters involved, or a manual for use in training. The goal is rather to demonstrate that the standard principles of risk management are as applicable to biological or chemical incidents as they are to other hazards, and that these principles can be used to identify areas needing particular attention when biological or chemical agents are involved. It thus provides an outline of the matters that will need to be considered. Further sources of detailed information are given in Annex [X]. As far as chemical attacks are concerned, States Parties to the CWC, which have thereby become Member States of the OPCW, have access to international aid in their preparedness activities. Assistance in assessing needs and specific training can be obtained by contacting the International Cooperation and Assistance Division of the OPCW Technical Secretariat. For biological attacks, Article VII of the BWC makes some provision for assistance if a State Party is exposed to danger as a result of a violation of the Convention. For further information on this and other sources of international assistance, including WHO, see Chapter 6.

Preparedness also needs to cover situations in which a threat has been made that biological or chemical agents are to be released. While such a threat may be a hoax, the authorities concerned need to be able to allay public fears as well as to take appropriate action to locate and neutralize any suspect device.

There may be a close relationship between the public health preparedness that is to be discussed in this chapter and the preparedness of military forces to protect their capabilities and operations against biological or chemical warfare. While it may be possible, however, for some countries adequately to warn, encapsulate and otherwise protect the disciplined, centrally commanded, healthy adults who make up combat forces in an active theatre of war, the protection of a civilian population, especially in peacetime, is an altogether different matter. Indeed, there may be danger in holding out a prospect of adequate civil protection that is actually unrealistic, for it may detract from efforts at prevention.
4.1 PLANNING PRINCIPLES

The first to respond to an attack with a toxic substance having immediate effects are likely to be the police, fire departments and emergency medical personnel on or near the scene. In contrast, the first to respond to an initially undetected attack with an infective or toxic agent having only delayed effects are more likely to be regular health-care providers, including nurses, physicians and hospital accident and emergency personnel, who may be located in widely separated places.

While chemical weapons will place a great burden on public safety personnel and biological weapons on the public health infrastructure, they can both place an extraordinary burden on the local health-care delivery system.

Because victims of a chemical attack may be affected immediately, a rapid response will be required, in which the main emphasis will be on contamination control and early medical treatment. Emergency personnel will have to locate and identify the contaminated area immediately (the “hot zone”) and may have to act within minutes if lives are to be saved. On the other hand, a covert release of a biological agent will be more likely to become apparent over a longer period of time, e.g. days or even weeks, and will probably take the form of the appearance of cases of infectious disease. Because victims are likely to move around in the symptom-free incubation period after exposure, cases of the disease might appear in different parts of the country (or world), and the full picture might become evident only after information, medical reports, and surveillance data from many areas have been combined. Biological agents that are transmissible from person to person can also generate clusters of secondary outbreaks. Depending on the nature of the organism involved, the attack might initially appear to be a natural outbreak of disease.

These differences need to be borne in mind in planning public health preparedness for biological and chemical incidents. However, in the early phases of an incident, it may not be clear whether the causative agent is biological or chemical, or possibly a mixture of the two. As a result, first responders may find themselves needing to manage both types of incident before the relevant specialists for biological or chemical incidents become involved.

In order to prepare for biological or chemical attack, the authorities concerned should be encouraged to make maximum use of existing emergency-response resources, and to adopt an approach that is consistent with the principles on which the management of any other type of public health emergency is based. While attacks with biological and chemical agents will have some special features, they do not necessarily require the formation of completely new and independent response systems. A well designed public health and emergency-response system is quite capable of responding to a limited biological or chemical attack and can take the measures necessary to mitigate its effects. An attack with a chemical agent will be very similar to a major hazardous materials accident. A community’s existing capability to respond to such an accident is therefore an essential component of preparedness for such an attack. A biological agent attack will generally have the characteristics of a disease outbreak, so that city, state and regional public health authorities must be involved in the response, which will have much in common with the infection-control strategies used in any outbreak of disease.

Routine sensitive and near real-time disease surveillance systems are thus essential in both disease outbreaks and those caused by biological agents. Such systems should be in place well in advance of an attack, so that the background disease prevalence in the area concerned is known. The performance of a surveillance system in terms of its response to naturally occurring outbreaks of disease provides an indication of its probable contribution during deliberately caused outbreaks. A national centre can detect a national outbreak not noticed in any individual region and it can also economically provide epidemiological expertise for investigating the causes and sources of outbreaks. It can also contribute to both biological and chemical defence, as the epidemiological techniques used in the investigation of both types of attack are similar (although possibly more often relevant in biological attacks). Establishing mechanisms for the
routine exchange of information between the public health and veterinary sectors is very important as many biological agents are zoonoses.

A greater role is now being played in disseminating information on disease outbreaks and other health events by the media and certain interest groups, notably the Program for Monitoring Emerging Diseases (ProMed) now run by the International Society for Infectious Diseases in the United States (see [http://www.promedmail.org](http://www.promedmail.org)). WHO collects, verifies and disseminates information on outbreaks of diseases of international public health concern, and this information is available on a restricted basis to WHO's partners in the Global Outbreak Alert and Response Network and Member States weekly; once officially notified, the information is published electronically through the World Wide Web and in printed form in the *Weekly epidemiological record* (4.01).

Functioning and efficient poisons centres have proved to be invaluable for authorities charged with the management of accidents involving chemicals or individual cases of poisoning. The immediate availability of chemical and toxicological information and expertise will be equally valuable in managing a chemical incident.

Confirming that a covert release has taken place may be a particularly difficult task. Routine emergency-call monitoring systems (which continually track the frequency, nature, and location of emergency calls) are a useful management tool, and may be of great value in drawing attention to an unusual outbreak of symptoms, possibly indicating a deliberate release of biological or chemical agents.

The danger of making the response to biological and chemical incidents the task solely of dedicated specialized response units is that the relative infrequency of call-out could lead to the deterioration of skills. More seriously, excessive centralization may risk increasing the time taken to react. Mobilization of a specialized biological and chemical unit throughout a region can never match the 24-hour availability and general emergency-management experience of existing response and public health services. It is true, however, that certain activities will need to be carried out by specialists (e.g. sampling and analysis for the definitive identification of the agent involved). This suggests that a readiness and response strategy should aim at enabling the local public health, emergency-response and other authorities (fire brigade, ambulance services, police force, and civil defence) to respond to, and manage the incident scene in its early phases, specialized functions being performed later by a dedicated mobile biological and chemical response unit. Exceptionally, the prepositioning of special response units may be necessary for highly visible events (e.g. the Olympic Games) that might be a target for terrorists.

In this approach, the planning of a response system should meet the needs of the following two categories of service provider: (i) the standard emergency response personnel, who will be responsible for the primary response, and (ii) the specialists who will perform specialized functions to supplement the primary response. A third group that needs to be considered in planning is the local population itself. A response strategy is not complete unless the population has been given the information it needs before any incident occurs, together with training in what they should do after an attack. Finally, the medical treatment centres (usually hospitals) that may receive large numbers of casualties (both exposed victims and those who think that they may have been exposed), should be ready to deal with this situation.

The ability to respond to biological or chemical incidents depends on: (i) **preparedness** (what needs to be considered long before an incident takes place); and (ii) **response** (what needs to happen after a warning of a pending release is received, or after the release has actually occurred).
4.2 RISK MANAGEMENT

A systematic and logical framework is needed to structure the planning process, and to identify the areas that require attention. This can be provided by adopting the step-by-step approach of risk management as follows:

1. Identify the hazards.
2. Evaluate the hazards to determine the probability and severity of the initial risk.
4. Quantify the residual risk, and decide what risk is acceptable.
5. Monitor the risk-management programme, and repeat the process as required.

These steps can be used to identify areas of activity during both the pre-attack “preparedness” phase, and the post-warning or post-attack “response” phase. While the terminology used in connection with biological or chemical incidents may be different from that generally used in risk management (and there may also be some hazard-specific technical considerations), the principles remain the same. They are first considered here in regard to preparedness.

4.2.1 Identify the hazards

This step, and the hazard-evaluation step that follows, are commonly referred to as “threat analysis”. This is a multidisciplinary activity, with inputs from the country's law-enforcement, intelligence, and medical and scientific communities. It is aimed at identifying those who may wish to use biological or chemical weapons against the population, the agents that may be used, and the circumstances under which they may be used. This is an exercise that is broad in its scope, and requires active liaison between law-enforcement, security and health agencies (typically centralized state institutions) with the local authorities. It will only rarely be possible to identify the threat precisely, and general preparedness measures will therefore usually be required. Judgements will usually need to be made on the basis of a general appraisal of national or local circumstances.

Even if specific biological or chemical hazards cannot be identified, general improvements in public health (and in the ability to respond to outbreaks of disease) will automatically improve a population’s ability to manage biological incidents. The ability to manage industrial chemical accidents will provide resources that can be diverted, if needed, to managing a chemical incident.

4.2.2 Evaluate the hazards

If specific potential hazards can be identified, the probability of an incident occurring and its consequences must be evaluated. Justified and well motivated decisions on resource allocation can be made only after this has been done.

The level of risk that exists is also a function of the potential vulnerability of the community concerned. Vulnerability analysis will identify weaknesses in the system that may be exposed to biological or chemical hazards, and will determine the current ability to respond to, and manage the emergency (4.02). This, in turn, requires an assessment of needs and capability. When potential scenarios have been identified in the preceding steps, it will be possible to determine the resources required to respond to such incidents. Response requirements must be determined for each of the actions identified below in respect of biological and chemical incidents. When identified needs are measured against currently available resources, in what is called “gap analysis”, certain deficiencies will be revealed. It is then that a country inexperienced in defence against biological and chemical weapons is most likely to need expert assistance (see Chapter 6 for sources of such assistance).
4.2.3 Introduce risk reduction strategies

This section covers risk reduction in the pre-incident phase of preparedness.

Pre-emption of an attack

As in all risk-management exercises, the most desirable risk-reduction strategy is avoidance of the hazard altogether. In the present context, this would mean pre-emption of an attack before it occurs. More broadly, the establishment of a biological and chemical response system is in itself a pre-emptive risk-reduction strategy. Historical precedent suggests that the risk of biological or chemical attack is considerably reduced by the mere existence of an effective ability to respond to, and manage an incident. If an aggressor knows that an attack will be quickly and effectively dealt with, the incentive to perpetrate such an attack will be considerably diminished. A balance needs to be struck between the level of visibility that such a vigilance and response system needs in order to serve as a deterrent, and the potentially negative results that the demonstration of concern about the threat could produce. If ill-considered publicity is given to the perceived threat of biological or chemical terrorism, this might have the opposite effect to that desired. Some biological hoaxes have been inspired by media or government statements about the threat of bioterrorism.

Pre-emption of terrorist use of biological or chemical agents presupposes, first and foremost, accurate and up-to-date intelligence about terrorist groups and their activities. As the agents may be manufactured using dual-use equipment, and as the equipment required for manufacture need not be large or particularly distinctive (as seen from outside the facility), technical means of acquiring intelligence, such as reconnaissance satellites, are of little use. Intelligence on terrorism, therefore, relies heavily on human sources. While large-scale national development and production programmes and facilities for the manufacture of biological and chemical weapons are relatively easy to identify, terrorist activities may be much less conspicuous and therefore more difficult to detect.

Another important prerequisite for pre-emption is the existence of national legislation that renders the development, production, possession, transfer or use of biological or chemical weapons a crime, and that empowers law-enforcement agencies to act where such activities are suspected before an actual event occurs. For details of how this is dealt with in the CWC and BWC, see Chapter 5.

Pre-emption of attacks will also be aided by concerted national and international efforts to control the availability of both tangible and intangible information. This can range from “cookbook”-type information on the Internet purporting to explain to laymen how to make biological or chemical weapons, to intergovernmental monitoring and control of dual-use technology and equipment. The international norm that has been established by the majority of countries by their acceptance of the principles of the BWC and the CWC may be a decisive factor in dissuading would-be users of biological or chemical weapons.

Preparing to respond

Pre-emptive efforts notwithstanding, the risk of a biological or chemical attack cannot be eliminated completely, and it could have serious consequences if it occurs. Accordingly, a preparedness programme may be necessary, and this will require the acquisition of equipment and supplies, the development of appropriate procedures, and training. Communities will need to examine their existing hazardous materials' protocols, public health plans, and the current training of the police, firefighters, emergency medical service personnel, and public health personnel, including epidemiologists, veterinarians and laboratory staff. These will have to be adapted in the light of the features unique to deliberately released biological or chemical agents.

Most civilian health-care providers obviously have little or no experience of illnesses caused by biological and chemical weapons, and may therefore not suspect, especially in the early phases of an incident, that a patient’s symptoms may be due to such weapons. There is therefore a need to train health-care workers in the recognition and initial management of both biological and chemical casualties, and for a rapid communication system that allows real-time
sharing of information when an unusual incident is suspected. Education and training must cover the general characteristics of biological and chemical agents; the clinical presentation, diagnosis, prophylaxis and therapy for the most important biowarfare diseases; and sample handling, decontamination, and barrier nursing. Training, planning and drills must prepare physicians and staff for the management of mass casualties, providing respiratory support to large numbers of patients, the large-scale distribution of medication, and supporting the local authorities in vaccination programmes. Providing the necessary education and training is expensive and may also be manpower-intensive, yet may be the most cost-effective method of medical preparation for biological terrorism. Such training will also be the cornerstone of an approach to prevent anxiety and fear in health-care workers, something that might be expected after a bioweapons event, and which could disrupt the provision of health-care services.

Because early diagnosis of both biological and chemical exposure will be important in the choice of treatment and response, preparation should include the establishment of a reference laboratory in which potential agents can be identified by means of other molecular technologies and classical clinical laboratory methods. In addition to the need for diagnosis for purposes of medical treatment, samples obtained from a delivery system or the environment, or from patients will require forensic analysis. Earlier diagnosis will be facilitated, especially in more geographically isolated countries, if regional laboratories have the necessary equipment and staff for that purpose. New molecular diagnostic technologies mean that biological agents can be identified more quickly, and even at the attack site. Such state of the art techniques may not, however, be available everywhere.

Failure adequately to prepare the health-care system and its staff for biological attack may result not only in late detection of an outbreak, but may also facilitate the spread of an outbreak caused by an agent transmitted by person-to-person contact. Should the local health-care facilities and personnel be perceived as unable to manage the outbreak and the clinical cases, the population, including potentially infectious patients, may travel long distances to seek treatment, thus helping to spread the disease.

Where a particular need for equipment, antidotes, antibiotics or vaccines has been identified, pre-attack stockpiling and planning of distribution systems to make them available to the exposed population will be necessary. The financial cost of such stockpiles, depending on the items chosen and the quantities stockpiled, may then be very high indeed. Spending such large sums exclusively on responding to possible attack with biological or chemical weapons can only be justified when there is an extremely unusual and very specific threat. In high-risk situations, the supply to each person or family of protective equipment (e.g. respiratory protection), antidotes (e.g. syringes loaded with antidotes for self-injection) or antibiotics can be considered. The cost and logistical burden of this type of preparation may be prohibitive, however, and may not be feasible in poor countries or those in which large numbers of people will need protection. In such cases, and depending on the agent involved, selective protective measures may still be considered for high-risk groups (e.g. prophylactic antibiotics for those most likely to be, or having been, exposed).

It is of vital importance not to make the mistake of assuming that availability of equipment is synonymous with the ability to respond, or that a community without all the latest equipment is doomed to failure. Furthermore, ensuring the availability of specialized equipment is generally a more important part of preparation for chemical attack than for biological attack. The use of biological and chemical protective equipment requires special training, and the adaptation of existing procedures for emergency management. Without careful development of the necessary procedures and intensive training, the introduction of such equipment can hamper the ability to respond, and can even be dangerous. Some of the problems associated with the use of protective equipment are described in Appendix 4.1.

Preparing public information and communication packages
A plan for providing information to the public and thus demystifying the subject of biological and chemical weapons needs to be drawn up well before an incident occurs if it is to
have any chance of success. A five-step process for communicating with the public is shown in Figure 4.1. If this is to be effective, the public needs to know how they are expected to act if an attack takes place, long before any such attack occurs. The communication plan may include radio and television broadcasts, or the distribution of brochures to the public describing the potential threat in plain unemotional language. Clear advice should be given on how the alarm will be raised, and what to do if that happens. Excellent examples of such communication packages are available (e.g. 4.03, 4.04). A well constructed media plan is essential, both as part of the pre-incident education process, and to avoid overreaction after an incident. It must contain explicit and exhaustive instructions on channels of communication and clearance procedures for potentially sensitive information. Of course, any public preparedness or information programme needs to be evaluated in the context of the specific local circumstances, including the possibility that too much information may be counterproductive, or even dangerous.
Figure 4.1
A five-step process for communicating with the public *

* Source: adapted from (4.07)

1. Develop communication strategy
   - What are our communications objectives?
   - Overall goal(s)
   - Prioritize
     - To whom?
     - What message?
   - What media are we going to use to communicate?

2. Identify information needs and sources and those responsible for collecting and communicating it
   - Set up information collection system
   - Designate lead communicator
   - Designate the person(s) to communicate with the media
     (a single scientifically knowledgeable authoritative individual who feels at ease with the media should be selected)
   - Develop “generic” messages before an outbreak

3. Select communication mechanisms
   (these will depend on communication infrastructure in the emergency area)
   - News releases
   - Public service announcements
   - Talk shows, including call-in programmes
   - Advertisements, flyers, circulars
   - Local community personnel: emergency management committee members, service clubs, voluntary organizations, and police and fire-department officers
   - Already-planned community events

4. Send message
   - Key messages and important releases should be broadcast repeatedly throughout the day (prime time is usually 6:00-8:00 and 17:00-19:00)
   - Electronic and print media have deadlines: determine best times for releases
   - Media representatives should be informed of the time and place of releases and briefings
   - Hold regular briefings at a fixed time
   - Be as open and complete as possible
   - Journalists respect someone saying honestly “I don’t know”
   - Journalists do not respect hiding of information: the information will eventually be known and the person(s) who hid it will lose credibility

5. Monitor and evaluate
   - Monitor media messages during and after emergencies
   - Surveys
   - Questionnaires
   - Formal reviews after emergencies
4.2.4 Quantify the residual risk, and decide what risk is acceptable

Once the risk-reduction measures discussed above have been adopted, it is necessary to reassess the residual risk, and decide whether the preventive and preparedness measures adopted have been effective, and are adequate. The level of residual risk that can be accepted will depend on the circumstances of the region concerned. One country may need to address a significant risk of terrorist use of biological or chemical agents by devoting considerable resources to response. In a different part of the world, the assessed low risk of biological or chemical incidents will not justify major expenditure, and acceptance of a reduced ability to respond may be justified. Such decisions are clearly extremely difficult to take, and will be influenced by political factors as well as by practical considerations.

4.2.5 Monitor the risk management programme, and repeat the process as required

As with all risk-management programmes, constant monitoring is required to ensure that the strategies adopted are proving to be adequate. This implies continuous evaluation of both the threat-analysis process and the ability to respond. Realistic training scenarios must be evaluated critically to identify areas that can be improved. Careful analysis of actual incidents, wherever they occur, should provide valuable information that should help the international community to respond, and the lessons learned should be incorporated into future planning. Since the first edition of this report was published, the first recorded incident of terrorist attack on civilians in which chemical weapons were used occurred in Japan. This incident warrants careful analysis, as many lessons on the nature of, and response to civilian attacks with chemicals can be learned. For example, the fact that most of the victims went to hospitals on their own initiative, using their own transport, has important implications for the distribution of triage and decontamination facilities. The movement of mobile units to the incident scene means that their services will not be available for those who take themselves to hospital. Further information on this incident is given in Appendix 4.2.

The conclusion to be drawn from this discussion is that preparations for responding to a biological or chemical attack should be based on the same principles that apply when preparing for any disaster or emergency. These are described in a recent WHO publication (4.07).

4.3 RESPONSE

4.3.1 Response before any overt release of a biological or chemical agent

If a warning of an impending release of biological or chemical agents is received, a number of activities can and should be carried out before this happens. The sequence in which these activities are performed will depend on the particular circumstances of the incident. The first indication of an incident may be a warning, or the finding of an unusual device or unusual materials as a result of normal activities within the community such as the response to a fire or the discovery of a strange package. One or more of the following may then be required:

- **Analysis of the available information.** All the information available needs to be assessed by an appropriate group including the police, the intelligence services and technical experts who should have been trained to work together to analyse such information by means of realistic and credible exercises. Such a small group of analysts and experts will be able to evaluate the threat or the information on the incident and advise on appropriate action and
the mobilization of specialist assistance, and may also help to avoid inappropriate responses to hoaxes.

- **Initiation of a search procedure.** If sufficient information was given in the warning and the analysis warrants such action, it may be appropriate to search for a suspect device at a particular location. It may also be appropriate to search for those responsible for the warning or for witnesses who may have seen them.

- **Establishment of a cordon.** Again depending on the circumstances and the information available, it may be appropriate to evacuate people from the area at risk and to establish an exclusion zone.

- **Hazard reduction and/or neutralization.** If a device or unusual package is found, the possibility of reducing or neutralizing the potential hazard through containment or other mitigation and neutralization approaches should be considered.

- **Early identification of the nature of the hazard.** It is important to decide as soon as possible whether the impending hazard is chemical or biological in character (or even a mixture of the two). The appropriate specialists can then be called in to help in managing the incident, and the appropriate protective equipment selected. For example, an oro-nasal mask may provide adequate protection against a particulate biological hazard while a respirator and full protective clothing may be required to protect against a persistent chemical agent.

### 4.3.2. Distinguishing features of biological and chemical incidents

In the earliest phases of a release (and particularly if it is covert), it may be difficult to distinguish between a biological and a chemical attack. As a general rule, chemical attacks are more likely to produce simultaneous and similar symptoms in a relatively restricted area near the point of release relatively soon after release. Biological attacks are more likely to result in the appearance of ill individuals at medical centres and/or doctors’ surgeries over a longer period of time and a much larger area. Symptoms resulting from exposure to chemicals with delayed effects will obviously be much more difficult to distinguish from those of an infectious disease. While there are no definitive and invariable distinguishing features, the indicators shown in Table 4.1 may help in deciding whether a biological or chemical attack has taken place.
Table 4.1
Differentiation of biological and chemical attack

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Chemical attack</th>
<th>Biological attack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidemiological features</td>
<td>Large numbers of patients with very similar symptoms seeking care virtually simultaneously (especially with respiratory, ocular, cutaneous or neurological symptoms, e.g. nausea, headache, eye pain or irritation, disorientation, difficulty with breathing, convulsions and even sudden death)</td>
<td>Rapidly increasing disease incidence (over hours or days) in a normally healthy population</td>
</tr>
<tr>
<td></td>
<td>Clusters of patients arriving from a single locality</td>
<td>Unusual increase in people seeking care, especially with fever, respiratory, or gastrointestinal complaints</td>
</tr>
<tr>
<td></td>
<td>Definite pattern of symptoms clearly evident</td>
<td>Endemic disease rapidly emerging at an unusual time or in an unusual pattern</td>
</tr>
<tr>
<td>Animal indicators</td>
<td>Dead or dying animals</td>
<td>Sick or dying animals or fish</td>
</tr>
<tr>
<td></td>
<td>Absence of insects normally present</td>
<td>Unusual swarms of insects</td>
</tr>
<tr>
<td>Devices, unusual liquid spray or vapour</td>
<td>Suspicious devices or packages</td>
<td>Suspicious devices or packages</td>
</tr>
<tr>
<td></td>
<td>Droplets, oily film</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unexplained odour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low clouds or fog unrelated to weather</td>
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</tr>
</tbody>
</table>

Source: adapted from references 4.08 and 4.09.

4.3.3 Response to biological incidents

Responding to a biological attack is a multidisciplinary and complex task, which will require cooperation between civil-defence, emergency-response, law-enforcement, public-health and medical personnel. The normally difficult tasks of dealing with an outbreak will be made even more difficult by the special problems arising from the deliberate origin of the incident.

With such an array of issues and questions, a logical means of ordering and prioritizing an approach is needed. The requisite response activities, and a logically ordered sequence for their implementation, can be identified by following step by step the principles of the risk-management process, as shown in Table 4.2.
Table 4.2
Sequence of implementation of response activities (biological attack)

<table>
<thead>
<tr>
<th>Standard risk management step</th>
<th>Actions required in responding to a biological attack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify the hazards</td>
<td>Determine that a release has occurred, or an outbreak is taking place</td>
</tr>
<tr>
<td></td>
<td>Identify the nature of the agent involved</td>
</tr>
<tr>
<td></td>
<td>Develop a case definition and follow up the distribution of cases (time, place and person)</td>
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<td></td>
<td>Define the population at risk</td>
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<td></td>
<td>Develop an initial hypothesis as to the exposure that is causing disease (source of the agent and mode of transmission)</td>
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<tr>
<td></td>
<td>Test the hypothesis with clinical, laboratory or environmental data; conduct field investigations and apply analytical epidemiology tools in comparing subgroups of the population</td>
</tr>
<tr>
<td>Evaluate the hazards to determine the probability and severity of the initial risk</td>
<td>Evaluate the potential outbreak spread, and assess current and delayed case-management requirements, having regard to the possibility that the infection may be contagious</td>
</tr>
<tr>
<td>Introduce risk-reduction strategies</td>
<td>Implement a risk-communication programme for the affected population that conveys information and instructions as needed</td>
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<tr>
<td></td>
<td>Order the necessary supplies and provide the personnel required</td>
</tr>
<tr>
<td></td>
<td>Protect responders and health-care workers</td>
</tr>
<tr>
<td></td>
<td>Introduce infection-prevention and control procedures</td>
</tr>
<tr>
<td></td>
<td>Conduct case triage</td>
</tr>
<tr>
<td></td>
<td>Ensure medical care of infected cases</td>
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<tr>
<td>Quantify the residual risk, and decide what risk is acceptable</td>
<td>Decide whether local and national resources are adequate, and whether international assistance should be sought</td>
</tr>
<tr>
<td>Monitor the risk-management programme, and repeat the process as required</td>
<td>Implement active surveillance to monitor the effectiveness of the prevention and control procedures, and adjust response activities as needed</td>
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<tr>
<td></td>
<td>Implement follow-up activities</td>
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</table>

The various actions identified in Table 4.2 are dealt with in greater detail below. Since responses to both natural and intentionally caused outbreaks will follow similar lines, the information given below focuses specifically on the problems posed by outbreaks that have been caused deliberately. Information on public health action in emergencies caused by epidemics is available in a WHO publication (4.10). Sources of more detailed information that may be needed by response planners are given in Annex [ X ].
Determination that a release has occurred or an outbreak is taking place

All outbreaks of infectious diseases should be considered natural events unless the contrary can be proved. Initiating a response to an intentional outbreak thus requires prior confirmation that a release has actually occurred, or the suspicion that an outbreak has been caused deliberately. Many factors will influence the decision to initiate such a response and particularly whether the release was overt or covert. A covert release, just like any other outbreak of disease, will only be detected when patients begin to present at medical facilities. The existing surveillance system should be able to detect the outbreak and an epidemiological investigation will then be triggered. The results of the investigation, coupled with clinical, laboratory or environmental data, may indicate that the outbreak may be the result of a deliberate release. The importance of routine surveillance and the prompt investigation of all outbreaks so that warning may be given that an unusual outbreak may be under way has been discussed in section 4.1 above. A threatened or overt release will generate response requirements more akin to those in the early stages of a chemical release, described below. While it is probable that signs and symptoms in people and animals will provide confirmation that a release has taken place, the sampling and detection of biological agents in environmental substrates may also be required.

Identification of the agent involved

Prompt identification of the agent involved is required to ensure that the appropriate preventive and medical measures are taken. Because some agents may cause a contagious infection, it may not be advisable to wait for laboratory confirmation of the identity of the agent. It may then be necessary to introduce risk-reduction strategies soon after starting the investigation of the outbreak.

The development of sensitive and rapid methods of detecting and identifying biological agents in the environment will be difficult because of the large number of potential agents, and significant advances will have to be made in technology before such methods can be made widely accessible. They may therefore not be available for some time. The problem is particularly acute for those highly infective agents that can create a high probability of disease at doses as low as $10^{-100}$ organisms inhaled.

The extent to which laboratory support will be able to aid initial diagnosis and treatment will depend both on the level of pre-incident preparation, and the availability of a network of diagnostic laboratories. The nature of the biological sample required, and the specific laboratory techniques required for agent identification, will vary according to the nature of the organism suspected. Definitive identification of a biological agent used in a deliberate attack will also be forensically important. Detailed analysis of the organism and its properties may allow it to be traced to a source laboratory. This is a highly specialized activity, distinct from the basic diagnostic procedures needed in outbreak management, and is often outside the immediate interests and responsibility of the public health sector.

Biological hoaxes may be difficult to evaluate or confirm because of the long incubation periods of biological agents. One proven method of increasing the likelihood of identifying a hoax accurately is to establish a small on-call committee of experts who have trained together and are able to evaluate the situation quickly and efficiently by telephone conference or computer link at very short notice (see also section 4.3.1). The committee should include a biologist and a physician who are familiar with the classification of threat agents, representatives of law-enforcement agencies and possibly the military, a forensic psychologist, a representative of the public health community, and the on-scene authorities. A group such as this, furnished with all the information available at the time, can make the best decision possible regarding the steps to be taken.

Evaluation of potential spread

If the incident involves the release of a biological aerosol, computer modelling may help to predict the spread of the aerosol particles. The first steps must, however, be to gather information on the wind direction and speed and on possible sources of the aerosol. With an on-
going outbreak, retrospective analysis may indicate that cases originate from specific areas, and may be a valuable indicator of an up-wind site of original release.\(^{21}\)

It is unlikely that re-aerosolization of biological agents will be a significant problem after biological attack. Respirable particles will either be carried by the wind or lifted into the atmosphere and diluted following release. Larger particles will mostly fall to the ground, and be inactivated by the elements. Continued primary spread of the agents from the area of deployment of a biological weapon is therefore less likely than it is following a chemical attack.

If the release involves an agent that has potential for person-to-person transmission, an epidemic is likely to spread through secondary outbreaks. Standard epidemiological methods should then be used to predict the probable spread of the disease, and medical resources mobilized and deployed accordingly.

**Risk communication and information distribution**

Because of the potential for widespread fear and panic following a biological incident, the provision of clear and accurate information on the risks to the public is essential. People must be told that medical evaluation and treatment are available, and how to obtain them. If preventive measures are available to minimize the chance of exposure and infection, the public must be clearly and rapidly informed.

If the incident involves the release of a potential airborne agent from a specific point, and if there is time to issue a warning, an appropriately prepared room or building may possibly provide some protection from a biological agent cloud for those living nearby. A sealed area may be improvised by moving into a single room and sealing openings with adhesive tape. Wet towels or clothing can also be pressed into gaps to make a seal. Such improvisation, however, needs to be accompanied by an understanding of its limitations, including its potential dangers. Thus, simulations have shown that improvised shelter within buildings may only be beneficial initially, and that the total dose of the substance indoors may eventually approach or even equal that receivable outdoors. People should therefore leave the shelter as soon as the cloud has passed, but this will not be easy to determine in the absence of agent detectors. If improvised protection is to be recommended, it must be well considered, communicated, understood, and practised before any release actually occurs. Sources of further information can be found in Annex [X].

It is unlikely that military or approved industrial masks will be widely available (or indeed, appropriate) for the local population. If respiratory protection is considered appropriate, oro-nasal particulate or smog masks, or even improvised multilayer cloth filters, will provide some degree of protection.

**Protection of responders and health-care workers**

The protection of responders and health-care workers is obviously essential. In addition to compromising the ability to manage the incident, the occurrence of infection in health-care workers may lead to the perception among the population that health centres and hospitals themselves constitute a high-risk source of infection. This may discourage potentially infected persons from seeking treatment from the local health-care providers, and lead them to travel to other health-care facilities, thereby increasing the risk of secondary transmission if the infection is contagious.

During the spread of a biological aerosol, the primary route of exposure will be via the airways and respiratory tract. Respiratory protection will then be the most important component of physical protection. Particulate filters are generally adequate for biological agents (in contrast

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\(^{21}\) Investigators of the accidental release of anthrax spores in 1979 from the military biological facility in Sverdlovsk (former USSR) were able to use aerosol spread analysis to show the striking occurrence of cases of pulmonary anthrax in persons located within specific isopleths (see p.*** originating from the point of suspected release (4.11, 4.12).
to the activated-charcoal or similar filters that will be needed for the filtration of air contaminated with chemical vapour).

Most of the agents of special concern do not cause contagious disease, but some do, and if these become established in the population, the spread of aerosol droplets, contact between infected body fluids and mucous membranes or broken skin, and even ingestion may all be involved in the secondary spread of the agent. Universal precautions for dealing with potentially infective materials should therefore always be taken. The protection of responders should be based on the standard principles of barrier nursing and infection control (4.09, 4.13, 4.14).

Vaccination or prophylactic antibiotic treatment of those involved in response may have to be considered. This is more likely to be useful in the management of any secondary spread of the infection than the primary manifestations of the attack. Pre-attack vaccination of health-care providers may be considered if appropriate vaccines are widely available (e.g. for smallpox, plague and possibly anthrax).

Infection control

If agents of transmissible diseases are released, basic hygiene and infection-control measures, e.g. washing hands after contact, avoiding direct contact with secretions from infected individuals, keeping exposed persons away from public places, and isolating suspected or symptomatic cases may be essential in limiting secondary spread. The dissemination of such basic information on the precautions necessary, not only to health-care providers but also to the general public, will be an important step in infection control. The population should be told what signs and symptoms to watch out for and who to call or where to go if they appear. Lack of specificity in such advice to the public may result in local health facilities becoming overwhelmed by uninfected patients.

Large-scale evacuation as a preventive measure is not likely to form part of the response to biological incidents. Where contagious disease is involved, it may aggravate the situation by increasing both the spread of infection and the number of secondary outbreaks. Movement of patients should be restricted to the minimum necessary to provide treatment and care.

Special measures may be required to limit the nosocomial spread of such diseases as the viral haemorrhagic fevers (e.g. Ebola or Marburg), plague and smallpox. The frequent suggestion that special rooms under negative pressure should be provided is impractical because of the sheer number of probable cases. Provision may be made to care for patients at sites other than health-care centres, such as gymnasia, sports arenas or at home.

Decontamination is not as important for biological casualties as it is for chemical ones, since biological agents are non-volatile, difficult to re-aerosolize and leave little residue on skin or surfaces. Many pathogens deposited on surfaces will rapidly die, though some may survive for longer (4.15). However, it would be prudent to be prepared to decontaminate both materials and persons, particularly if a site of release can be identified. Defining a “hot zone” (as in hazardous-materials incidents) may be extremely difficult or impossible, and it may not be possible to define the contaminated zone until the outbreak has been characterized. At or near the release point of a biological agent, where large particles may have been deposited, area decontamination (or whole-body decontamination of persons who were present in the area) may be appropriate. Decontamination solutions used for chemical decontamination will usually also be suitable for biological decontamination. Chlorine is the recommended disinfectant for use in outbreak response. An all-purpose disinfectant should have a concentration of 0.05% (i.e. 1 g/litre) of available chlorine, a stronger solution with a concentration of 0.5% (i.e. 10 g/litre) available chlorine being used for example, in suspected outbreaks of Lassa and Ebola virus diseases. The use of the solution with 0.5% available chlorine is recommended for disinfecting excreta, cadavers, and spills of blood and body fluids, and that of the solution with 0.05% available chlorine for disinfecting gloved or bare hands and skin, floors, clothing, equipment and bedding (4.16). Most experts now agree that water, or soap and water may be adequate, and probably safer, for the removal of most biological agents from human skin. Buildings can be
decontaminated by means of chlorine-based liquid sprays or formaldehyde vapour produced by heating paraformaldehyde. Because of the lack of other effective tools, the decontamination of a building may be psychologically beneficial. It may, however, be extremely difficult to certify that a building is clean after an agent release. In addition to the standard principles of barrier nursing referred to above for highly transmissible agents, the disposal of waste materials, safe burial practices, and cleaning or disinfection of patients’ clothing should be considered (4.17).

Where transmissible disease agents are involved, quarantine of the affected area via the establishment of a sanitary cordon may need to be considered. The coordinated efforts of several public service groups will be required to inform the people affected, control water and food supplies, regulate the movement of people in and out of the community, and establish medical services.

In addition, where there is a danger of the international spread of human diseases, the provisions of the International Health Regulations (IHR) (4.18), currently under revision, should be borne in mind. The IHR provide an essential global regulatory framework to prevent the international spread of diseases through permanent preventative measures for travellers and cargo, and at border crossing points.

**Triage**

Any suspected or actual dissemination of biological agents is likely to lead to large numbers of people seeking care. The development of scientifically sound case definition(s) suitable for the local circumstances and the definition of the population at risk of becoming ill are very important for triage (the initial reception, assessment, and prioritization of casualties). Such information can generally be gathered from the epidemiological description of the outbreak, or sometimes from more specific surveys. Fear and panic can be expected in genuinely symptomatic patients, the public, and the health-care providers involved. All health-care facilities will need to plan in advance for dealing with overwhelming numbers of people seeking care or advice simultaneously, and to ensure that resources are used to help those who are most likely to benefit. Both psychological support and active treatment of anxiety will play an important part in the triage process.

**Medical care**

The specific medical treatment of exposed individuals will depend entirely on the nature of the organism involved (see Annex [X]).

Immunization or prophylactic antibiotic treatment of certain segments of the population (contacts, health-care personnel and first responders) against potential biological agents may be warranted. This treatment will depend on the availability of such treatment and its effectiveness against the agent involved, e.g. immunization will be an important means of controlling and outbreak of smallpox or plague, and all those who enter hospitals where patients are housed and treated should be immunized against these diseases.

Because immunity takes several weeks to develop after vaccination, drugs (antibiotics) and symptomatic care may be the mainstay of management. Immune serum may be used to confer passive immunity.

If stockpiles of antibiotics or vaccines have been prepared, plans for their distribution must be activated. In essence, the choice is either to take the drug to the potentially exposed person or for the person to come to the drug. The latter option generally requires fewer personnel. The stocks should be larger than needed to treat only those exposed because it may be difficult to distinguish between those who have actually been exposed and those who simply believe themselves to have been exposed. Cases may be much greater in number than the total number of hospital beds available, and additional care facilities may need to be established.
International assistance
The management of a large-scale outbreak, whether of natural, accidental or intentional origin, will be beyond the resources of many countries. An early decision to enlist the assistance of international aid (see Chapter 6) may save many lives. WHO is able to offer public health assistance to countries experiencing outbreaks of infectious disease, and such aid will be available regardless of the source of the outbreak.

Monitoring the outbreak
Because of the delay in the onset of symptoms, the movement of exposed individuals during the incubation period, and the possibility that a transmissible disease agent has been used, outbreaks may affect a large area. Efficient and coordinated collection of national data will therefore be necessary to track the outbreak, and to direct resources to the areas most in need. Again, good public health and near real-time surveillance programmes will be essential in monitoring, irrespective of whether the causative agent has appeared naturally or been spread deliberately.

Follow-up activities
The sequelae of a biological attack may be present for many years after the incident. Careful case identification, record keeping, and monitored follow-up will be required both from the practical viewpoint of comprehensive medical care, and because of the need to study such incidents and improve preventive and response measures. Outside the medical field, follow-up forensic or arms-control activities may also be appropriate.

Command, control and communication
The response mechanisms described for biological incidents may involve a large number of different groups. Effective coordination and training are essential if such a multidisciplinary response is to be successful. The person who will be in overall command must therefore be identified in advance and must be an individual who is able to exert the necessary authority over the various parties involved in the response. This requirement may be in conflict with other considerations, e.g. the law-enforcement officers who usually take overall responsibility for the response in criminal incidents may not have the necessary background and expertise to deal with biological or chemical incidents. A high-level, authoritative overall command, directly supported by appropriate trained technical and specialist advisers who will ensure that the specific features of the incident are given appropriate consideration, must therefore be established.

4.3.4 Response to chemical incidents
The activities required in response to a chemical attack can be identified, as before, by following step by step the principles of the risk-management process (see Table 4.3).
Table 4.3  Sequence of implementation of response activities (chemical attack)

<table>
<thead>
<tr>
<th>Standard risk management step</th>
<th>Actions required in responding to a chemical attack</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify the hazards</td>
<td>Use rapid chemical detection techniques to determine and/or improve immediate operational response measures</td>
</tr>
<tr>
<td></td>
<td>Bring in specialists for the definitive identification, needed for forensic and legal purposes.</td>
</tr>
<tr>
<td>Evaluate the hazards to determine probability and severity of the initial risk</td>
<td>Evaluate the nature and magnitude of the chemical release detected, and how it may affect response.</td>
</tr>
<tr>
<td>Introduce risk-reduction strategies.</td>
<td>Predict the spread of the hazard, and assess current and delayed casualty-management requirements</td>
</tr>
<tr>
<td></td>
<td>Implement a risk-communication programme for the affected and surrounding population, conveying information and instructions as required</td>
</tr>
<tr>
<td>Protect responders</td>
<td>Control contamination:</td>
</tr>
<tr>
<td></td>
<td>• establish “hot-zone” scene control to limit contamination spread</td>
</tr>
<tr>
<td></td>
<td>• conduct immediate operational decontamination on-site, and decontamination of all persons leaving the “hot-zone”</td>
</tr>
<tr>
<td></td>
<td>• conduct casualty triage</td>
</tr>
<tr>
<td></td>
<td>• ensure medical care and evacuation of casualties</td>
</tr>
<tr>
<td></td>
<td>• conduct definitive decontamination of the site</td>
</tr>
<tr>
<td>Quantify the residual risk, and decide what risk is acceptable</td>
<td>Decide whether local and national resources are adequate, and whether international assistance should be sought</td>
</tr>
<tr>
<td>Monitor the risk-management programme, and repeat the process as required</td>
<td>Continuously monitor the residual hazard level on the site, and adjust response activities as needed</td>
</tr>
<tr>
<td></td>
<td>Implement follow up activities (e.g. of long-term injuries and rehabilitation)</td>
</tr>
</tbody>
</table>

The various actions identified in Table 4.3 are dealt with in greater detail below.

**Chemical detection and identification**

Detection and identification refers to the processes used to determine the nature of the chemical hazard being confronted, if any. It begins with the reasoned and logical application of observation skills, including the analysis of all the available information, the appearance and function of delivery devices, the appearance and odour of the substance itself (if it is an overt release), and the signs and symptoms of those who have been exposed. It is instructive to note that, after the terrorist chemical attacks in Japan, the recognition of characteristic symptoms by emergency medical personnel provided the first indication that nerve gas had been released. This clinical diagnosis guided response activities for some time before analysis confirmed the nature of the chemical used (see Appendix 4.2).

Detection strategies may include the use of a variety of devices that can provide an early indication of the agent involved. This is needed to guide initial operational response activities. A large variety of devices are available, ranging from simple colour-changing paper to sophisticated electronic contamination monitors. The choice of detection equipment must be guided by the preparedness phase risk assessment, and specific local requirements. Detection
strategies must be linked to warning or alert mechanisms that will be used to activate response, whether by primary responders, specialist responders, or the population. Decisions are needed on the basic philosophy of response activation. The approach whereby all suspicious incidents are treated as chemical attacks until proved otherwise may be warranted in high-risk scenarios (as exemplified by the Israeli attitude towards Scud missiles during the Kuwait war). Lower-risk scenarios may be more efficiently dealt with by an approach calling for further response only if chemical detection tests are positive.

Definitive identification of chemicals used will involve a longer-term forensically based analytical process, requiring the use of sophisticated laboratory facilities. Such identification will be needed both as evidence and to determine the appropriate strategic response. As with other crimes, chemical attacks require the integration of the forensic investigation with rescue and medical operations. Response personnel must operate without disturbing the integrity of the crime scene, while forensic investigators need to allow rescue efforts to proceed effectively. For example, responders must be careful to maintain chain of custody procedures with clothes and personal effects that may be removed as part of the decontamination process. This will allow later use of such objects in an international investigation or a criminal trial.

Under the provisions of the CWC, Member States of OPCW can initiate an “investigation of alleged use”, whereby an international inspection team will undertake a complete investigation of an incident, including sampling followed by analysis, making use of a worldwide network of laboratories accredited specifically for this purpose.

Evaluation of the chemical hazard spread prediction, and casualty management requirements.

Further hazard analysis will be based on the results of detection activities, an evaluation of agent characteristics, and assessments of potential hazard spread, to quantify the expected consequences of the incident. As described in detail in Annex [X], the chemical agents of concern can vary enormously in their environmental persistence, toxicity and effects on victims.

In an overt chemical release, an important component of the risk assessment is the prediction of the spread of the agent cloud. This is the basic first step required in deciding where to focus protective and incident-management procedures. A variety of computerized prediction models are available to assist with this process. Depending on their sophistication, they take account of agent characteristics, nature of release (point or line source, instantaneous or continuous), initial concentration, wind and weather conditions, and topography to produce predictions of spread. Isopleths indicate the position of expected concentrations over time, and can be used to decide where effects will be greatest, and to direct the deployment of resources. Further details are provided in Annex [X].

Where high-risk areas have been identified during the preparedness phase, it is possible to use computerized models that take the specific local topography and population distribution into account. This enables precise information to be generated on the numbers of casualties that may result as the cloud spreads, and the available medical resources to be deployed to appropriate sites.

Risk communication and distribution of information

If it is suspected that the hazard may spread to affect the down-wind population (as predicted in the hazard evaluation step above), a warning and public address system will need to be activated. This may provide evacuation instructions, or information on what people should do to protect themselves against the potential spread of the hazard. Even if the hazard is not expected to spread, a large-scale incident is likely to generate widespread fear and public reaction. Rapid distribution of accurate and helpful information is essential if panic is to be avoided.

Depending on circumstances, it may be considered advisable for the population to stay indoors, and to close all windows and doors. A sealed area might be improvised (as described in 4.3.4 for sealed areas for protection from biological agents, and with the same limitations).
Protection of responders

Individual protective equipment (IPE) must be available to responders, and must allow them to carry out a wide range of activities in a contaminated area without becoming casualties themselves. Many types of IPE are available, ranging from simple aprons and half-mask respiratory protection to fully encapsulating self-contained impermeable ensembles. The types that are stockpiled, and the choice of IPE for particular incidents, will depend on the risk assessment and the nature of the chemicals involved. In areas where the threat is significant, it may be necessary to make collective protection facilities available, i.e. large protected areas supplied with filtered air where people can shelter without the need for IPE. The outstanding example of this approach can be found in Switzerland, where threat assessments during the Cold War era led to the construction of a network of public and private collective protection facilities capable of sheltering the majority of the population in times of need.

Contamination control

The most distinctive element of disaster management for chemical incidents is contamination control, which requires:

- the rapid establishment of a well demarcated “hot zone” (with clearly visible “clean” and “dirty” areas;
- the limitation of contamination spread by means of strictly controlled entry and exit procedures;
- on-site decontamination procedures, ensuring that all persons or items leaving the dirty areas are cleaned and monitored before entering the clean environment.

Patients should be decontaminated as soon as possible, and before transport to specialized facilities (to avoid the contamination of vehicles and overburdened accident and emergency departments). However, the nature of human response to mass casualty incidents is such that many patients are likely to arrive at medical centres on vehicles other than those of the emergency services, by-passing on-site decontamination facilities. For this reason, triage at casualty reception centres should also incorporate decontamination.

Triage

Triage will need to include casualty-reception procedures suitable for contamination control purposes, since conventional triage techniques will not be adequate during a chemical incident. Normally, medical personnel separate the triage and treatment phases of a response, but because of the rapidity of onset of effects with some chemical agents, responders to a chemical incident may be required to triage and administer antidotes simultaneously. As with any mass casualty situation, it will be necessary to ensure that potentially limited resources are used to help those who are most likely to benefit from them. This can lead to difficult triage decisions, requiring the attention of the most experienced clinical personnel available. Depending on the casualty load, it may be necessary to activate additional accident and emergency departments and hospital beds to handle the sudden influx. It must be expected that many more will seek treatment than were actually exposed. Psychological support teams should be available to provide assistance, thereby reducing the number of people occupying hospital beds.

Medical care and evacuation of casualties

Medical care includes prophylaxis (pre-exposure treatment measures for high-risk personnel to prevent or minimize the effects of exposure), diagnosis, and treatment.

There are not many examples of true prophylaxis, but certain medications (e.g. pyridostigmine) can improve the response to treatment of those affected by nerve agents. However, such medications can have adverse side-effects, and case-by-case decisions on their use will be needed. Such medications will normally only be used by military personnel in wartime, or by emergency responders who must be able to work in a high risk area known to be contaminated with liquid nerve agent.
Specific diagnostic aids may be required for detecting exposure to chemical warfare agents, ranging from established techniques, such as the observation of typical symptoms and the measurement of acetylcholinesterase activity (after nerve agent exposure), to newer advanced techniques, such as the detection of specific DNA adducts (after mustard gas exposure).

Initial prehospital treatment will provide symptomatic and life-saving support to allow decontamination and transport to medical centres. If the nature of the substance is known, specific treatment protocols may be required for on-site emergency antidote administration (possibly using auto-injectors), and definitive treatment of the medium- and long-term effects of exposure. As for all response measures, detailed discussion of medical protocols is outside the scope of this publication, but references to the relevant literature can be found in Annex [X].

**Definitive decontamination**

The decontamination strategies described above are aimed at meeting immediate operational needs, and minimizing the spread of contamination during response activities. Once the immediate manifestations of the incident have been dealt with, a final decontamination of the site will be required. This is a specialized activity, and will usually need to be handled by specialist response units.

**International assistance**

National authorities will have to decide at an early stage whether to seek international assistance, either for the management of the incident, or in order to draw international attention to it. As for many other aspects of the response to a chemical incident, Member States of OPCW have access to a carefully considered package of international assistance measures. Because of the instability of some chemicals and the transient nature of their effects, this assistance must be mobilized as quickly as possible (see also Chapter 6).

**Monitoring of the residual hazard**

There will be an on-going need to evaluate the hazard remaining in the contaminated area, the risk it poses to response activities, and when the area can be reopened to the public without further risk. Monitoring must continue until the “all clear” has been sounded, i.e. after definitive decontamination and certification of the removal of all residual hazard. This will be the task of specialists in the management of hazardous materials incidents.

**Follow-up**

While the immediate problem after a chemical attack will be the management of the acute effects of exposure, some chemical agents have long-term effects that may appear over a period of many years (see section 3.6.2). Well organized and well administered follow-up programmes are therefore required, not only for the benefit of the patients, but also for the advancement of medical science in this area. An outstanding example of what may be required is the extensive patient follow-up programme still being implemented by Iranian public health authorities, many years after the exposure of individuals to chemical weapons during the Gulf War of the 1980s (4.19, 4.20).

**Command, control, and communication**

The response mechanisms described above may involve a large number of different groups. Effective coordination of this multidisciplinary response is essential for successful results. As mentioned in the preceding discussion, response is likely to involve the usual primary responders (ambulance teams, fire fighters, police, etc), specialist responders (such as military chemical defence units) and the public. Overall site command must be assigned to an authority able to exercise the control required to limit the hazard and to achieve the required coordination of all the groups involved.
APPENDIX 4.1: PROBLEMS RELATED TO PROTECTION

Modern biological and chemical protective equipment has made it possible to survive in many types of toxic environment. Such protection, however, may be achieved only at the cost of a significantly reduced ability to function. The focus of the threat posed by the biological and chemical weapons of possessor states (though not necessarily by those of such non-state entities as may possess them) has shifted since the 1980s from the cooler climates of Europe to less temperate regions of Africa and Asia. Experience and training in these regions has led preparedness analysts to realise that high-technology protective equipment in less temperate environments can impose significant functional burdens on those using it. In selecting protective equipment for biological and chemical preparedness, therefore, a balance has to be struck between the degree of protection necessary with the potential hazard concerned and the resultant increase in difficulty of the functions to be carried out by those wearing such protective equipment. There may, of course, be considerable differences between the protection requirements of response teams dealing with civil incidents and those of military personnel, who may need to operate for long periods in a toxic biological or chemical environment.

The key to the successful use of protective equipment, whether by civil incident response teams or military forces, is familiarity through repeated training in using the equipment. In extended operations in which protective equipment is required, the following problems need to be carefully considered.

Heat stress
When biological and chemical protective clothing is worn, insulation is increased, evaporation of sweat from body surfaces is reduced, and the body consequently suffers a significant decrease in its natural ability to lose heat. The problem can be so severe, especially if impermeable protective clothing is being worn, that fatal heat stroke is a possibility after less than 1 hour. Supervisors of responders or emergency services must be aware of the need for careful monitoring of this problem and of the methods of avoiding it, e.g. by planned work/rest cycles, or the use of specialized cooling equipment. A further problem associated with wearing a respirator is the effort required to breathe against the resistance of the filter canister. This can severely limit the work rate possible, and also significantly increases the psychological stress experienced (see below).

Psychological stress
Apart from the physiological stresses mentioned above, individuals wearing protective clothing can experience great psychological stress. This may even be more important in limiting performance than the physiological problems. Stress results from fear of the chemically or biologically contaminated environment, the claustrophobic effects of protective clothing (especially the respirator), the potential impairment of the ability to communicate with colleagues, the general discomfort of wearing the often bulky clothing, perceptions of the increasing physiological stresses (heat and breathing stress), and of the reduced ability to function and perform tasks which may be necessary for survival. As a result, decision-making may be impaired.

Ergonomic difficulties
The nature of chemical protective clothing creates many ergonomic problems that may interfere with the performance even of simple tasks. Thick rubber gloves cause problems with any task requiring fine touch (computer operation, medical examination, etc.), and bulky clothes hamper movement in restricted spaces (e.g. ambulances). The lenses of the masks may be incompatible with optical equipment, and medical personnel may experience extreme difficulty in carrying out even basic procedures of patient management (cardiopulmonary resuscitation, airway management, etc.).
**Side-effects of medication**

Certain medications that are commonly used in biological and chemical defence can create problems of their own. Pyridostigmine is frequently used as a pretreatment drug for nerve-gas poisoning. It is intended to be taken before exposure in order to improve the chances of survival if a nerve-gas attack actually materializes. Pyridostigmine can, however, have side-effects of its own, such as diarrhoea, intestinal cramps and visual problems. The most common item of medical equipment used in chemical defence worldwide is the autoinjector. Although the contents of the different types may vary, the medication generally used is atropine, which is the antidote required after nerve-gas exposure. However, if atropine is injected in the absence of nerve-gas poisoning, it can have significant side-effects such as increased heart rate, disturbances of the heart rhythm, dry mouth and decreased sweating (causing even more severe heat stress), and blurred vision.

**Logistics problems**

The logistics associated with the issue of protective equipment to the personnel needing it can also be a problem. Some equipment, once removed from its sealed packaging or contaminated, cannot be readily decontaminated, and consequently is unsuitable for reuse. If large numbers of personnel require protective equipment, this can be extremely costly.

**Conclusions**

Response teams dealing with civil incidents may be less affected by the problems described above since they are likely to be deployed for shorter periods, and are better able to allow personnel to rest outside the contaminated area without loss of efficiency. In a situation in which the military are involved, however, some of the problems associated with use of protective equipment for extended periods might arise even when biological or chemical weapons have not been used, e.g. when preparations are being made in anticipation of an attack. Such preparations may in themselves be a significant disadvantage for the defending party, and may even be the reason that the threat was made by the aggressor. However, a state that elects not to defend or protect itself from biological and chemical weapons might be vulnerable to the full effects of such weapons and to the mass casualties that they produce. It is instructive to note that no major attack with biological or chemical weapons has yet been made on countries with forces that are well equipped and trained for biological or chemical warfare.

Successful preparedness, including biological and chemical threat assessment, contingency planning and preparation for a biological or chemical incident, calls for a strategy that is both justified by, and relevant to, the potential threat. Overreaction to a threat could be the very effect sought by an aggressor.
APPENDIX 4.2: THE SARIN INCIDENTS IN JAPAN

On 20 March 1995, a terrorist group launched a coordinated attack with the nerve gas sarin on commuters on the Tokyo subway system. This highly publicized attack killed 12 people and caused over 5 000 to seek care. Without the prompt and massive emergency response by the Japanese authorities, and some fortunate mistakes by the terrorist group, the incident could have been much more devastating. While this is the most widely publicized incident of this type, it is not the first nerve-gas attack in Japan. In June 1994, 7 people were killed and over 300 injured in an attack by the same group on a residential apartment building in Matsumoto. In December 1994, an opponent of the group was murdered by the skin application of VX.

This Appendix provides a brief summary of the background and features of these incidents and the lessons learned from them. It draws heavily on a number of excellent and comprehensive reviews that have appeared in the international literature. (4.1.1 – 4.1.6).

Background

The Aum Shinrikyo sect was the brainchild of Chizuo Matsumoto, whose childhood aspirations apparently included the leadership of Japan. In 1984, he started a small publishing house and yoga school, which gradually developed into a cult. He renamed himself Shoko Asahara (“Bright Light”), embarked on a course of cult expansion, with increasingly bizarre teachings and rituals for devotees, and ultimately subversion with the aim of achieving supremacy for his followers in Japan. The group attracted a surprisingly large international membership numbering in the tens of thousands, and actively recruited graduate scientists and technicians to develop armament programmes which were highly ambitious in their scope. Plans included the development and use of biological and chemical weapons.

Aum Shinrikyo’s chemical weapons made worldwide news after the Tokyo subway attack in 1995, but a quest for biological weapons actually predated the chemical programme. Despite the expenditure of large sums of money and great efforts to acquire the means to develop and disseminate biological agents, attempted attacks (with botulinum toxin in April 1990 and anthrax in 1993) failed, fortunately causing no noticeable effects on the target population of Tokyo.

The cult had more success with its chemical programme, which was launched in 1993, and reportedly cost around US $30 million. After experiments with VX, tabun, soman, mustard gas, hydrogen cyanide and phosgene, the cult’s final choice was the nerve gas sarin, and a plan was developed for the production of about 70 tonnes of this substance at the Aum Shinrikyo’s facilities in Kamikuisiki, at the foot of Mount Fuji.

The Matsumoto incident

During 1994, Aum Shinrikyo was involved in legal proceedings concerning a land purchase, and a gas attack on the overnight premises of the three judges involved was planned for 27 June of that year, apparently to pre-empt an unfavourable ruling. An improvised sarin-dissemination system was used, consisting of a heater, fan and drip system, sarin vapour being vented from the window of a disguised delivery van. After a 20-minute release period, the gas spread over an elliptical area measuring about 800 by 570 metres (most effects occurring within a smaller area of 400 by 300 metres). While the judges survived, 7 unfortunate residents died as a result of the attack, there were 54 other hospital admissions, and 253 persons sought care at outpatient facilities. In the absence of formal identification of the toxic substance, doctors could rely only on what they observed to guide treatment, namely clinical symptomatology consistent with organophosphate poisoning. On 4 July, an official report revealed that the cause of the poisoning had been the chemical warfare agent sarin, which had been identified by gas chromatography-mass spectrometry (GC-MS) in a water specimen taken from a pond in the affected area. No evidence found at that time incriminated Aum Shinrikyo.
The Tokyo incident

The Japanese authorities were collecting increasing evidence suggestive of Aum Shinrikyo’s interest in chemical weapons. Ironically, they had been unable to prevent the suspected acquisition or production of chemical weapons since such activities were not illegal at that time. The pretext for a raid on the suspected production plant was provided when evidence linked an Aum member to a suspected kidnapping, but cult members employed by the authorities warned Asahara of the imminent raid, for which the police was being trained in chemical defence. In an apparent attempt to dissuade the police from making the raid, an attack on the Tokyo subway system was hastily planned. On the morning of 20 March 1995, five two-man teams carried out the attack, each team consisting of one getaway driver and one subway rider. Four subway riders carried two double-layered plastic bags and one rider carried three, each bag containing about half a litre of sarin. The sarin was only about 30% pure because it had been hastily produced for use in the attack. Five subway lines converging on the station of Kasumigaseki (where many Japanese government buildings and the Tokyo Metropolitan Police Department are located) had been selected. At around 08:00, i.e. during peak commuting time, the 5 assailants placed their sarin-filled bags on the train floor, pierced them with sharpened umbrella tips, and left the trains several stations away from Kasumigaseki.

The first emergency call was received by the Tokyo fire department at 08:09, and before long, the emergency services were inundated with calls for aid from the numerous subway stations where affected passengers were disembarking and seeking medical help. A total of 131 ambulances and 1 364 emergency medical technicians were despatched, and 688 people were transported to hospital by the emergency medical and fire services. More than 4 000 people found their own way to hospitals and doctors using taxis, private cars, or on foot. The lack of emergency decontamination facilities and protective equipment resulted in the secondary exposure of medical staff (135 ambulance staff and 110 staff in the main receiving hospital reported symptoms).

Having initially been misinformed that a gas explosion had caused burns and carbon monoxide poisoning, medical centres began treating for organophosphate exposure based on the typical symptomatology encountered, supported by the results of tests indicating depressed acetylcholinesterase activity in symptomatic victims (see Annex [ X ]). An official announcement by the police that sarin had been identified reached the hospitals, via the television news, about 3 hours after the release.

Overall, 12 heavily exposed commuters died, and around 980 were mildly to moderately affected, while about 500 required hospital admission. More than 5 000 people sought medical assistance.

The lessons of these attacks

Much can be learned from the analysis of these attacks, at both the general level (i.e. in terms of the international threat), and at the specific level (i.e. in terms of the immediate effect and response).

- **Magnitude of the event.** While the human consequences of the attack should not be underestimated, they should also not be exaggerated. The frequently encountered casualty toll of “over 5 000” must be seen in its true perspective. The attack was serious – 12 people died, 54 were severely injured, and around 980 were mildly to moderately affected. The majority of the 5 000 seeking help, many of them with psychogenic symptoms, were (understandably) worried that they might have been exposed. This demonstrates the value of rapid information dissemination via the media in reassuring the public. It also shows the importance of effective triage at receiving centres in ensuring that medical resources are reserved for those who really have been exposed. Before this attack is taken as evidence of the effectiveness of toxic

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22 Of the 11 bags, only 8 were actually ruptured: 3 were subsequently recovered intact. It is estimated that around 4.5 kg of sarin were released.
chemicals in the hands of terrorists, however, the figure of 12 dead should be compared with the
death tolls of recent terrorist attacks using conventional explosives, such as the bombing of the
United States embassies in Nairobi and Dar es Salaam (257), the federal building in Oklahoma
City, USA (168), and the United States Marine barracks in Lebanon (241). These, in turn, must
now be regarded as relatively slight in comparison with what happened on 11 September 2001,
when hijacked long-haul passenger aircraft were flown into the Pentagon in Washington, DC,
and into each of the twin towers of the World Trade Center in New York City. Equally, it
should be realised that the sarin casualty figures might have been many times worse.

• The utility of chemical weapons in achieving terrorist objectives. While many
reports (particularly in the media) have touted the sarin incidents as evidence of a frightening
new era in terrorist methodology, a sober assessment of the actual results shows otherwise. It is
true that, prior to 11 September 2001, this was one of the most highly publicized terrorist attacks
in history. The result for Aum Shinrikyo, however, can hardly be judged as a success. The
immediate objective of the attack was the disruption of an anticipated raid on cult premises and,
on a broader level, the incitement of social upheaval. In fact, the raid was delayed only for 48
hours, the Japanese Government remained firmly in power, and most of the cult’s senior
members are now in prison.

• The ease of acquisition and use of biological and chemical weapons. Despite its
ample financial resources, equipment and expertise, and years in which to develop its weapons,
Aum Shinrikyo attempted but failed to use biological agents effectively (4.1.6a, 4.1.6b, 4.1.6c)
and achieved only relatively limited success with its chemical programme. Aspirant terrorists
thinking of using biological or chemical weapons may well find these results a deterrent, not an
encouragement.

• The importance of national legislation on chemical weapons. Despite compelling
evidence of the cult’s growing interest in chemical agents, which started well before the Tokyo
subway attack, no Japanese laws prohibited its activities at the time, and pre-emptive action
could therefore not be taken. Since the entry into force of the CWC in 1997, however, all
Member States (including Japan) have been able to share their experiences and planning
concepts to fulfil their obligation to enact and implement legislation forbidding persons on their
territory, or under their jurisdiction, from undertaking any activities that are prohibited to the
State Party itself.\(^\text{23}\) When such legislation has been introduced, pre-emptive action against
terrorist groups developing or using chemical weapons can be taken. Likewise, the entry into
force of the BWC in 1975 has obliged all its States Parties (including Japan) to take the
measures necessary for its implementation.

• The importance of detection and identification abilities. In both the Matsumoto and
Tokyo incidents, medical staff had to rely on clinical observation to guide their initial treatment
of victims. If portable detection apparatus had been available to emergency-response personnel,
this would have facilitated the earlier identification of the nature of the event. The follow-up
forensic and legal process was considerably aided by the laboratory identification of sarin using
sophisticated GC-MS techniques available to the police forensic toxicologists (4.1.7). In an
interesting development of new biomedical testing methods, scientists in the Netherlands were
later able to retrieve sarin from the stored blood samples of 10 out of 11 of the victims of the
Tokyo incident, and from 2 out of 7 samples from the Matsumoto incident – unequivocal
evidence of exposure to sarin (4.1.8).

• The importance of decontamination abilities and protection. About 10% of the
ambulance staff who responded to the incident reported symptoms of exposure, as did 110
members of the staff at the major receiving hospital (although these symptoms were generally
mild). This was due to the lack of decontamination facilities on site, and of protective
equipment for initial responders and hospital staff. Before this is taken to mean that high-level
protection is always required, it should be remembered that the figure of 10% mildly affected

\(^{23}\) See also Appendix 5.2
also means that 90% were not affected at all. A reasonable conclusion is that the availability of protective equipment would have been of considerable benefit to responders. However, an approach based on graded protection appropriate to the level of contamination is required to prevent the unnecessary immobilization of helpers due to the ergonomic problems of wearing protective clothing (see Appendix 4.1). Rapidly deployable decontamination equipment is needed both on site (to avoid secondary contamination of emergency transport), and at receiving facilities. However, it is important to remember that the majority of people who sought medical help did so on their own initiative, and using their own transport. This would effectively have negated much of the utility of on-site decontamination systems, even had they been available, as they would generally be used for victims being treated in the course of evacuation by the emergency services.

- **The importance of command, control and communication.** Communication channels available to emergency-response personnel were not able to cope with the flood of calls that the attack precipitated. In particular, overload prevented effective communications between the on-site and mobile emergency medical technicians with their supervising hospital-based doctors, whether to seek medical instructions or to determine which hospitals could receive patients. As a result, a number of patients did not benefit from interventions such as airway support, intubation or intravenous therapy until after they arrived at hospitals. The timely provision of accurate information to responders is crucial to their own safety, and to their ability to provide appropriate assistance. Preplanned systems for tapping the expert knowledge of experienced toxicologists, poison information centres, and chemical warfare specialists would have been of major assistance to the receiving medical facilities. A single responsible local authority with the ability to communicate with, and coordinate the activities of, the various response elements would have been a considerable advantage. Complicated formalities and the need for high-level approval prevented the rapid mobilization of the specialists in chemical defence within the Japanese military.

- **The readiness of medical personnel to handle chemical casualties.** The majority of the Tokyo hospital staff, like medical personnel in most parts of the world, were not trained in the care of casualties caused by chemical weapons, and had no immediate access to treatment protocols for the victims of such weapons. This is not something that can be left to military specialists, as it is the local hospitals that will be the first to receive the casualties. The inclusion of the effects of chemical weapons and training in the treatment of the resulting casualties in the standard medical curricula, and in the training of first responders and the staff of local hospital accident and emergency departments, is an essential component of medical preparedness for responding to chemical incidents.

**Conclusions**

The release of sarin by a terrorist group in Japan resulted in a highly publicized incident with mass casualties. In scale, however, it did not approach the human and environmental toll that has resulted from a number of recent terrorist attacks using conventional explosives, and it falls far short of what happened in Washington DC and New York, USA, on 11 September 2001. Despite many difficulties, emergency units and local hospitals were able to achieve a remarkably rapid response, without which the casualty figures might have been considerably higher. While analysis of the event reveals a number of important lessons for authorities to consider when preparing for such incidents, it also reveals many of the technical difficulties associated with toxic chemicals and their limitations as weapons for use by terrorist groups.
5 LEGAL ASPECTS

National and international law were identified in Chapter 2 as an essential component of the array of measures serving to protect against the hostile release of biological or chemical agents, and to help to mitigate the consequences should such a release nevertheless take place. The present chapter describes the pertinent features of that law. At the international level, the most important legal instruments are the BWC and the CWC. Both provide for international cooperation in order to prevent the use of chemical and biological weapons, and for assistance and cooperation where breaches of these treaties are suspected, especially when such weapons have been used. The chapter begins with an account of the Geneva Protocol of 1925, which for several decades was the principal international treaty in the field. The two Conventions are then described in turn, information being given about the international obligations that they establish and the national measures required to fulfil those obligations.

5.1 THE 1925 GENEVA PROTOCOL

At least since the early 1600s, international law has condemned what would nowadays be regarded as biological or chemical warfare, instances of which have been reported since antiquity. Subsequent development of that law (5.01) can be seen in the Brussels Declaration of 1874, which outlawed, inter alia, the use of poison or poisoned weapons, and again at the Hague Peace Conference of 1899, where agreement was reached to “abstain from the use of projectiles the sole object of which is the diffusion of asphyxiating or deleterious gases”. The 1899 Conference also adopted a convention that enunciated in treaty form the Brussels Declaration’s prohibition of the use of poison or poisoned weapons in land warfare, a prohibition that was later included in the 1907 Hague Convention IV concerning the laws and customs of war on land. Following the extensive use of chemical weapons, such as chlorine and mustard gas, during the First World War, the international community agreed to strengthen the existing legislation on these weapons so as to prevent their future use. This led Member States of the League of Nations to sign the Protocol for the prohibition of the use in war of asphyxiating, poisonous or other gases and of bacteriological methods of warfare on 17 June 1925, during the Conference for the Supervision of the International Trade in Arms and Ammunition and in Implements of War. This treaty, which is usually referred to as the Geneva Protocol of 1925, entered into force on 8 February 1928, and France is its depositary. By the beginning of 2001, it had 132 States Parties, including the five permanent members of the United Nations Security Council but not including 60 WHO Member States.24

The Geneva Protocol prohibits “the use in war of asphyxiating, poisonous, or other gases and of all analogous liquids, materials or devices” and also “extends this prohibition to the use of bacteriological methods of warfare”. The prohibitions set out in the Protocol are now considered to have entered customary international law and are therefore binding even on states that are not parties to it. However, the Geneva Protocol prohibits only the use of such weapons, not their possession. Moreover, since many States Parties at the time reserved the right to use the weapons in retaliation against an attack with such weapons, the treaty was in effect a no-first-use agreement. There were also States Parties that reserved the right to use the weapons against states not party to the protocol. For this reason, a comprehensive prohibition of the weapons themselves came to be considered necessary.

5.2 THE 1972 BIOLOGICAL WEAPONS CONVENTION

When discussion of biological and chemical weapons at the Geneva disarmament conference began in the late 1960s, at the time when the first edition of this report was being prepared, there was much debate on whether the comprehensive prohibition of the weapons covered by the Geneva Protocol should be sought or, initially, the prohibition only of biological weapons. The United States, at that time not yet party to the Geneva Protocol, declared its

24 See Annex [ X ]
unilateral renunciation of biological and toxin weapons during 1969–1970. This encouraged the international community to adopt the **Convention on the prohibition of the development, production and stockpiling of bacteriological (biological) and toxin weapons and on their destruction.** Opened for signature on 10 April 1972 and entering into force on 26 March 1975, the BWC had 144 States Parties as of October 2001, including the five permanent members of the United Nations Security Council but not including 30 WHO Member States. The United Kingdom, the United States and the Russian Federation are the depositaries of the treaty.

5.2.1 **International obligations**

The BWC is designed to complement the prohibition of the use of biological weapons embodied in the Geneva Protocol. In Article I, it identifies items that each State Party “undertakes never in any circumstances to develop, produce, stockpile or otherwise acquire or retain”. As has already been noted in Chapter 3, these items are not defined simply as biological weapons or biological-warfare agents. They are instead defined as: “(1) Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes; (2) Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.” The scope of the Convention is thus specified according to a criterion of general purpose. Such an approach was adopted so as not to obstruct the many biomedical and other non-hostile applications of microbial or other biological agents and toxins, while at the same time enabling the Convention to cover any as-yet-unknown products of biotechnology and of scientific research that might find use as weapons. The treaty does not define either the “biological agents” or the “toxins” to which it refers, but it is clear from the proceedings both of its negotiation and of its subsequent review conferences that these terms are not restricted to human pathogens but extend to other animal and plant pathogens, and that, in addition, the toxins are not limited to microbial products but include all toxic substances produced by living organisms even when they are actually produced synthetically.

Another important obligation is set forth in Article II, which requires States Parties to destroy or divert to peaceful purposes all agents, toxins, weapons, equipment and means of delivery. This disarmament provision must be fulfilled no later than 9 months after the entry into force of the Convention for the State Party concerned. The BWC also requires States Parties to facilitate the exchange of equipment, material and scientific and technological information for the use for peaceful purposes of bacteriological (biological) agents and toxins (Article X), keeping in mind that the treaty prohibits the transfer of agents, toxins, weapons, equipment or means of delivery specified in Article I to any recipient whatsoever (Article III).

The operation of the BWC has been reviewed at intervals of 5 or 6 years. States Parties reaffirmed during their review conferences that the Convention was sufficiently comprehensive to encompass all new scientific and technological developments. They also instituted confidence-building data-exchanges in order to strengthen the BWC by enhancing transparency. The Third Review Conference, in 1991, extended these data-exchanges to include information on “past activities in offensive […] biological research and development programmes [since 1 January 1946]”, and in the first year thereafter 5 States Parties affirmed that they had had such programmes, disclosing particulars. The 5 states were Canada, France, the Russian Federation, the United Kingdom and the United States. The periods of activity declared for the offensive programmes all terminated before the entry of the BWC into force except for the declaration by the Russian Federation, which specified “1946 to March 1992” as the period of activity.

The Third Review Conference also established an Ad Hoc Group of Government Experts (VEREX) to identify and examine potential verification measures from a scientific and technical standpoint. The VEREX Report was considered by a special conference convened in 1994 for this purpose. The conference established an Ad Hoc Group “to consider appropriate measures, including possible verification measures, and draft proposals to strengthen the

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25 See attached Annex
convention, to be included, as appropriate, in a legally binding instrument, to be submitted for the consideration of the States Parties”. The Ad Hoc Group is expected to report to the Fifth Review Conference in November 2001.

5.2.2 National implementation

The BWC stipulates that each State Party is obliged to take any necessary measures to implement the provisions of the Convention within its territory or any territory under its control anywhere (Article IV). Besides the basic obligations mentioned above, there are other areas where national measures are necessary if there is to be full implementation of the BWC. States have long taken measures to implement the obligation under Article III not to transfer to anyone agents, toxins or other items specified in Article I. In contrast, the implementation of Article X on measures for promoting technical cooperation in the field of biological activities has received relatively little direct attention.

Among their national measures under Article IV, some States Parties have enacted implementing legislation. For example, the United Kingdom introduced the Biological Weapons Act in 1974, Australia the Crimes (Biological Weapons) Act in 1976, New Zealand the New Zealand Nuclear Free Zone, Disarmament, and Arms Control Act in 1987, and the United States the Biological Weapons Anti-Terrorism Act in 1989, while already in 1972, long before the BWC had entered into force in France, that country had enacted Law No 72-467 prohibiting the development, production, possession, stockpiling, acquisition and transfer of biological or toxin weapons.

Information on national measures is the subject of one of the confidence-building data-exchanges that BWC States Parties have agreed during review conferences, and the declarations made in accordance with it constitute the only readily available synoptic reference on the topic. Adopted by the Third Review Conference in 1991, it asks States Parties to provide annual returns of information about “legislation, regulations or other measures” on three different topics, namely, activities prohibited under Article I of the BWC, exports of pathogenic microbial agents and toxins, and imports of the same. Between 1992 and 1997, 46 (one-third) of the States Parties provided such information, 37 of them declaring the existence of specific measures in at least one of the three areas, and 26 declaring that they had enacted legal measures in all three areas. Examples of such legislative measures are given in Appendix 5.1.

5.3 THE 1993 CHEMICAL WEAPONS CONVENTION

The CWC was negotiated over a period of more than 20 years, during which time related agreements were also concluded, notably the restrictions on warfare conducted with chemicals toxic to plant life set out in the 1977 Convention on the prohibition of military or any other hostile use of environmental modification techniques, and the reaffirmation of the Geneva Protocol by the 149 states represented at the Paris Conference of 1989 on the Prohibition of Chemical Weapons. The Convention on the prohibition of the development, production, stockpiling and use of chemical weapons and on their destruction (5.02) was opened for signature on 13 January 1993, entered into force on 29 April 1997 and, as of June 2001, had 143 States Parties, including the 5 permanent members of the UN Security Council but not including 19 WHO Member States. The CWC creates an elaborate regime to ensure compliance, and specifies in detail how its obligations are to be implemented; it also establishes an international organization (OPCW) to oversee its operation.

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26 This means that 143 states had deposited their instruments either of ratification of the CWC or of accession to it. An additional 31 states had signed the treaty, but not yet ratified their signature.

27 See attached Annex
5.3.1 International obligations

The CWC prohibits the development, production, acquisition, stockpiling, retention, transfer and use of chemical weapons. It also forbids States Parties to assist, encourage or induce anyone to be involved in such outlawed activities. Like the BWC, the CWC uses a general purpose criterion to define its scope, so that States Parties have the right to conduct activities involving toxic chemicals for purposes not prohibited under the CWC. Similarly, the provisions of the CWC must also be implemented in such a way as to avoid hampering the economic and technological development of the States Parties.

The CWC stipulates that the States Parties must totally destroy their existing stockpiles of chemical weapons and the related production facilities located on their territory or under their jurisdiction or control within 10 or, under certain conditions, 15 years after the CWC’s entry into force. This destruction process must be completed in such a way as to ensure the safety of the population and the protection of the environment.

Finally, the CWC establishes an international system for verifying compliance. This relies on several types of verification techniques and methods that allow for the protection of national security. This verification machinery, which includes declarations by the States Parties, routine inspections as well as means (such as challenge inspections) to investigate allegations of violations of the treaty, is operated by OPCW. The main element of the system is factual information obtained through verification procedures in accordance with the Convention that are independently conducted by OPCW Technical Secretariat, sufficiency of such information being essential for successful operation (5.03).

While less than 40% of the States Parties are directly affected by the routine verification regime, all States Parties participate in the security benefits conferred by the Convention. Accordingly, arrangements are in place for the delivery to OPCW Member States of assistance against the use and threat of use of chemical weapons (see Chapter 6). Such international cooperation is agreed between OPCW and the United Nations and will be extended to other international organizations. Cooperative measures in accordance with the CWC also extend to advice on the implementation of the Convention and in those areas in which the Technical Secretariat of OPCW has considerable expertise (5.04).

5.3.2 National implementation

The CWC requires its States Parties to promulgate implementing legislation. Under Article VII, paragraph 4, States Parties are required to establish a National Authority. The twin pillars of the Convention’s verification regime are thus (1) the OPCW Technical Secretariat (through which compliance is verified) and (2) the National Authority (through which compliance is demonstrated, including compliance with those obligations not overseen by the Technical Secretariat). The National Authority is essential to the success of the verification regime. As the national focal point for liaison with OPCW and with other States Parties, the national collection point of data and the facilitator of national implementation, effective National Authorities are essential to the effectiveness of the Convention itself. To meet its basic obligations, a State Party must be in a position to carry out the following 8 fundamental functions, all of which involve its National Authority to a greater or lesser extent: (1) submit all the required declarations; (2) communicate with OPCW; (3) cooperate with other States Parties; (4) facilitate OPCW inspections; (5) respond to OPCW requests for assistance; (6) protect the confidentiality of classified information; (7) monitor and enforce national compliance; and (8) cooperate in the field of chemical activities for purposes not prohibited under the Convention, including the international exchange of scientific and technical information, and chemicals and equipment for the production, processing or use of chemicals for purposes not prohibited under the Convention.

28 The language that the CWC uses to specify the weapons that it covers is quoted and discussed further in section 3.3.1 and Box 3.1.
Implementing legislation is normally necessary in order to enforce the prohibitions imposed on states by Article I of the CWC, to compel the submission of the information needed for an accurate national declaration, and for export/import controls. The requirements are described further in Appendix 5.2. Experience in the first 4 years of implementation has shown that comprehensive implementing legislation is essential to the reporting of reliable, complete information by States Parties. A survey of national implementing legislation showed that, in addition to the areas specified in Article VII, paragraph 1 (prohibitions, penal measures, extraterritorial application to nationals), several States Parties have found it necessary to enact legislation in 14 other areas (legal assistance; definition of chemical weapons; declaration obligations; the regime for scheduled chemicals (regulation of Schedule 1 production/use; criteria for Schedule 2 and 3 declarations; import/export controls); licensing of industry; access to facilities; inspection equipment; application of inspectors’ privileges and immunities; confidentiality; liability; mandate of the National Authority; enforcement powers of the National Authority; samples; and primacy of the Convention) (5.05, 5.06).

Four years after the entry into force of the CWC, 38% of States Parties had met their obligation to inform OPCW of the legislative and administrative measures taken to implement the Convention. At its fifth session (May 2000), the Conference of the States Parties encouraged States Parties that are in a position to do so to offer assistance to other states parties in their efforts to fulfil their obligations under Article VII (5.07).

5.4 CONCLUSIONS

Through its contribution both to preventing the release of biological or chemical agents for hostile purposes and to consequence-mitigation should such release nevertheless occur, the legal regime just described stands alongside the measures of protective preparation described in Chapter 4. A complementarity is evident. Civilian populations are vulnerable to deliberate releases of biological and chemical agents to such a degree that this complementarity needs to be strengthened. Clearly, prevention and protection can be no substitute for one another but can, instead, be mutually reinforcing. The conclusion must be, then, that an emphasis on the one should not become a detraction from the other, for a danger is bound to exist that confidence in protective preparation may seem to diminish the value of preventive preparation. Full and complete implementation of the 1972 and 1993 Conventions is therefore an objective that needs continual affirmation and national support.
APPENDIX 5.1: BWC IMPLEMENTING LEGISLATION

1. Legislation concerning activities prohibited under Article I of the BWC, the external application of such legislation, and the definition of “biological weapons”

**Australia:** *Crimes (Biological Weapons) Act 1976*

The Act makes it unlawful for Australians to develop, produce, stockpile or otherwise acquire or retain microbial or other biological agents or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes; or weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.

The Act extends to the acts of Australian citizens outside Australia.

Contravention of the Act is an indictable offence.

**New Zealand:** *New Zealand Nuclear Free Zone, Disarmament and Arms Control Act 1987*

Section 8 of the Act states:

“Prohibition of biological weapons - No person shall manufacture, station, acquire or possess, or have control over any biological weapons in the New Zealand Nuclear Free Zone.”

‘Biological weapon’ is defined as “any agent, toxin, weapon, equipment or means of delivery referred to in Article I of the Convention”.

**United States of America:** *Biological Weapons Anti-Terrorism Act (1989)*

Paragraph 175. Prohibitions with respect to biological weapons

“(a) IN GENERAL. - Whoever knowingly develops, produces, stockpiles, transfers, acquires, retains, or possesses any biological agents, toxin, or delivery system for use as a weapon, or knowingly assists a foreign state or any organization to do so, shall be fined under this title or imprisoned for life or any term of years, or both. There is extraterritorial Federal jurisdiction over an offense under this section committed by or against a national of the United States.

“(b) DEFINITION. - For purposes of this section, the term “for use as a weapon” does not include the development, production, transfer, acquisition, retention, or possession of any biological agent, toxin, or delivery system for prophylactic, protective, or other peaceful purposes.”

2. Legislation regulating exports of agents and toxins

**Australia:** *The Quarantine Act (1908) and Regulations, the Biological Control Act (1984) and Regulations, and the Therapeutic Goods Act (1989) and Regulations.*

*The Quarantine Act 1908 and Regulations* require prior permission before a biological agent may be imported. Under the provisions of Section 13 of the Act, goods of biological origin, including human pathogenic microorganisms and toxins, may only be imported into Australia if approval has been given by the Director of Human Quarantine. Import conditions vary, depending on the nature of the organisms and the risks involved. High-risk organisms, such as serious pathogens of humans, animals and plants which might be considered as potential biological weapons, will only be permitted under the most stringent high security conditions. Very few imports are approved and these will generally be needed for diagnostic research in preparation for emergency responses to specific serious exotic disease incursions. Penalties for the
importation of controlled goods without a permit, and for breaches of permit requirements, are severe and may include a fine or imprisonment or both.

*Biological Control Act (1984) and Regulations*
“This Act [...] provides powers additional to those of the Quarantine Act in order to regulate the release of biological agents for the control of pests, diseases and weeds.”

*Therapeutic Goods Act (1989) and Regulations*
The Act covers the import and export of therapeutic goods and will include pathogenic microorganisms where these are included in vaccines for human use.

**Brazil:** Law no. 9.112 (1995) (unofficial translation)

Article 1 – This Law regulates transactions related to the export of sensitive goods and services directly related to such good.

…

Article 2 – The goods covered by the previous Article will be including in the Lists of Sensitive Goods that will be periodically updated and published in the Federal Government Gazette *(Diário Oficial da União)*.

Article 3 – The export of the following items will depend on prior formal authorization issued by the competent federal entities in compliance with the regulations established and published in the Federal Government Gazette *(Diário Oficial da União)*:

I – goods included on the Lists of Sensitive Goods; and
II – services directly linked to goods included on the Lists of Sensitive Goods.

…

Article 4 – Under the aegis of the Office of the President of Brazil, the Interministerial Commission for Controlling Exports of Sensitive Goods is established, consisting of representatives of the federal entities involved in the process of exporting the goods covered by this Law.

…

Article 6 – The export of sensitive goods and services directly linked thereto, if in violation of the provisions of this Law and its Regulations, will subject the violator to the following penalties:

I - warning;
II – fine of up to twice the value equivalent to that of the transaction;
III – loss of the goods covered by the transaction;
IV – suspension of the right to export for a period of six months to five years;
V – cancellation of qualification to work with foreign trade, in case of repeat offenses.

…

Article 7 – Individuals who fail to comply with this law either directly or indirectly, through either action or omission, will be committing a crime.

Penalty – imprisonment of one to four years.
APPENDIX 5.2: CWC IMPLEMENTING LEGISLATION

1. Legislation to enforce the prohibitions of Article I, including penal provisions

Article VII of the CWC provides that specific legislation must be in place prohibiting actions that would contravene a State Party’s obligations under Article I. Any natural and legal person on the territory of a State Party shall be prohibited under penal law, for instance, to develop, produce or otherwise acquire chemical weapons, to transfer such weapons to anyone, to use them or to assist others in committing such crimes. Penalties will include both criminal and administrative sanctions. For consistency with the Convention, the national legislation should incorporate the definition of chemical weapons as contained in the Convention. The Convention requires States Parties to extend the application of these penal provisions to actions undertaken anywhere by natural persons possessing their nationality. Furthermore, States Parties shall assist each other and cooperate to prosecute those who contravene the prohibition of chemical weapons worldwide. The fulfilment of these obligations will contribute significantly to the achievement of the object and purpose of the Convention, namely to prevent the use of toxic chemicals as a means of warfare or as a terrorist threat. As these are the most basic violations of the very purpose of the Convention, penalties should be severe enough to deter possible violators. Legislation already promulgated by States Parties specifies that the most serious violations shall be punished by life imprisonment.

States may find it difficult to comply with their obligation under Article VII, paragraph 2, to respond to requests from other States Parties for cooperation and legal assistance. The modalities of such cooperation and legal assistance may include: (1) extradition; (2) mutual legal assistance in penal matters; (3) transfer of prisoners; (4) seizure and forfeiture of illicit proceeds of crime; (5) recognition of foreign penal judgements; or (6) transfer of penal proceedings. There is no customary practice in international cooperation and legal assistance in criminal matters; the modalities and procedures are normally prescribed in bilateral treaties or partially in a few multilateral instruments. Thus States Parties to the CWC need to check whether their municipal law and their various treaties concerning different forms of mutual legal assistance concluded with other states will allow for cooperation in this regard. If a State Party seeks mutual legal assistance and encounters obstacles, certain other non-judicial coercive techniques may be available based on comity or cooperation through organizations such as Interpol (5.2.1).

2. Regulating and monitoring the relevant chemical industry and exports of specific chemicals

States Parties shall by law require public and private entities or persons to report if they are producing, or in some cases consuming or processing, chemicals specified in the Convention when threshold limits are exceeded. On the basis of this information, States Parties will be able to fulfil their obligation under the Convention to submit full and accurate declarations to OPCW on national activities related to chemicals listed in the schedules of the CWC. To maintain a nationwide overview of activities regulated by the CWC and ensure complete declarations, some States Parties have promulgated legislation subjecting producers of chemicals to licensing.

From the entry into force of the Convention, States Parties were required to notify OPCW 30 days in advance of any transfer of a Schedule 1 chemical to or from another State Party, and were prohibited from transferring Schedule 1 chemicals to or from states not party. From 29 April 2000, the transfer of Schedule 2 chemicals to states not party to the Convention was also prohibited. Appropriate measures of States Parties must also ensure that Schedule 3 chemicals transferred to states not party to the Convention shall only be used for purposes that are not prohibited. Each State Party’s National Authority must negotiate and conclude facility agreements with OPCW governing the procedures for the implementation of verification activities by the Technical Secretariat in certain declared facilities. In order to perform these tasks, the National Authority must identify the sites, both public and private, that have to be declared and for which data for inclusion in the state's initial and annual declarations must be
provided. Contacts with chemical industry associations and searches of commercial databases, and those of universities and hospitals, will usually be necessary to obtain the necessary information on the national activities that may be relevant to the Convention.

Among the steps taken to solve this problem, the OPCW Technical Secretariat and the Secretariat of the Organisation of Eastern Caribbean States have developed a pesticide regulation model act in which the provisions required to implement the CWC are incorporated. The result, a draft Pesticides and Toxic Chemicals Control Act and Regulations (i) allows the parliaments concerned to consider the regulations for pesticides and toxic chemicals in a single step; (ii) ratification of, and accession to the CWC will be facilitated; (iii) a single interministerial agency in each country will be responsible for pesticides and toxic chemicals and serve as the National Authority under the Convention; (iv) the CWC will be enforceable in the subregion. (5.2.2)
6 INTERNATIONAL SOURCES OF ASSISTANCE

The international community has made preparations through several organizations to support governments of states against which chemical or biological weapons might be used. These preparations may also be of assistance to governments of states subject to terrorist attack. The assistance available can be categorized as:

(a) the application of international law;
(b) practical protection against the weapons themselves (provision of equipment, material and scientific and technical information; and
(c) medical and other assistance in order to prevent potentially massive harm to the population attacked by such weapons.

The principal organization providing political support is the United Nations (see section 6.1). In the case of chemical attack the Organisation for the Prohibition of Chemical Weapons (OPCW) (see section 6.2) will also be important for its members. If in the future an organization is established under the BWC, this will play a role in the case of biological attack.

Practical assistance in providing protection against chemical weapons can be provided by OPCW (see section 6.2). The BWC also requires its States Parties to come to each other’s assistance in certain circumstances (see section 6.3).

General medical assistance can be provided in either case by the World Health Organization (WHO) (see section 6.4). The Food and Agriculture Organization of the United Nations (FAO) (see section 6.5) and the Office International des Epizooties (OIE) (see section 6.6) can be asked to provide assistance if an attack was made on plants (FAO) or animals (FAO and/or OIE), rather than human targets. Where local resources are insufficient to cope with the humanitarian aspects of the situation, it may be appropriate to call on the United Nations Office for the Coordination of Humanitarian Affairs (see section 6.1.2) or the major nongovernmental organizations.

Each of the above-mentioned agencies is considered briefly below.

A chemical or biological attack may overwhelm the available medical resources and pose serious logistical and organizational problems. It may then be appropriate to turn to the armed forces for help, including those of other countries. In humanitarian emergencies (e.g. refugee crises or natural disasters), such forces have supported relief efforts when invited to do so under the aegis of the United Nations (see section 6.1.2).

6.1 UNITED NATIONS

The use or threat of use of chemical or biological weapons by one state against another will clearly constitute a threat to international peace and security, and will therefore fall within the responsibility of the United Nations Security Council, to which the facts should promptly be reported. Both the BWC and the CWC make provision for the involvement of the Security Council when there are allegations that biological or chemical weapons have been used, and arrangements have been made for these allegations to be investigated (see below).

6.1.1 Investigation of alleged use

The United Nations General Assembly, under its resolution 42/37C of November 1988, mandated the Secretary-General to investigate “reports that may be brought to his attention by any Member State concerning the possible use of chemical and bacteriological (biological) or toxin weapons […] in order to ascertain the facts of the matter…”. Under the terms of the resolution, the Secretary-General has established a panel of experts available to carry out on-site investigations. A group of qualified experts, appointed pursuant to the resolution, has provided a report setting out guidance as to how such investigations might be carried out (6.00).
The above procedure also applies to investigations of the alleged use of biological weapons. The Chemical Weapons Convention (CWC), which entered into force on 29 April 1997, obliges OPCW (see section 6.2) to investigate any alleged use of chemical weapons against a State Party. For investigations relating to allegations of the use of chemical weapons brought to the Secretary-General by a state not party to the CWC, OPCW is obliged to cooperate with the Secretary-General in accordance with Article II.2(c) of the Relationship Agreement between the United Nations and OPCW signed on 17 October 2000.

Investigations of the alleged use of chemical weapons conducted by the United Nations up to the end of 2000 can be summarized as follows:

1981–1982: Asia. Investigations took place long after the alleged attacks had taken place so that on-site visits were not possible; the results were inconclusive (6.1).

1984–1988: Islamic Republic of Iran. Investigations took place within days of the alleged attacks, on-site visits were made and samples taken; Iraq was identified as the perpetrator (6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9).

1987–1988: Iraq. Chemical injuries to Iraqi soldiers were verified by the investigators (6.5, 6.6, 6.8), who reported finding no conclusive evidence of how the injuries had been caused (6.10).

1992: Mozambique. Investigations were made more than a month after the alleged attack; no proof was found of the use of chemical weapons (6.11).

1992: Azerbaijan. The investigation was requested by the state accused of resort to chemical warfare in order to demonstrate its innocence; a timely on-site visit did not reveal any proof of use of chemical weapons (6.12).

1993: Iraq. Investigation of the alleged internal use of chemical weapons did not reveal any proof of such use (6.13).

In the period covered, the Secretary-General was not asked to conduct any investigations of the alleged use of biological weapons other than toxins. (However, one consultation concerning an alleged use was carried out under the BWC, see p. ****.)

It is clear from the foregoing that it is essential for the request for an investigation to be made to the Secretary-General immediately after the incident concerned has taken place to minimize the likelihood of degradation of the evidence.

6.1.2 Humanitarian assistance

If an attack is made on a large scale with serious consequences for the population, humanitarian assistance can be sought from the United Nations. The Emergency Relief Coordinator of the United Nations has been mandated by General Assembly resolution A/RES/46/182 of 14 April 1992 to serve as the central focal point and coordinating official for United Nations emergency relief operations. The Coordinator is also the Under-Secretary-General for Humanitarian Affairs and is supported by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA).

OCHA-Geneva has established an emergency-response system for coordinating actions taken by the international community to deal with natural disasters and environmental emergencies, including technological accidents. It is responsible for mobilizing and coordinating international disaster response and can be contacted on a 24-hour basis in case of emergency.

In humanitarian emergencies, OCHA can:

• Process requests for assistance from Member States.
• Organize, in consultation with the government of the affected country, a joint inter-agency assessment mission.
• Serve as the central coordinating body with governments, intergovernmental organizations, nongovernmental organizations and the United Nations specialized agencies concerned for all emergency relief operations.
• Provide consolidated information on all humanitarian emergencies.
• Actively promote, in close collaboration with the concerned organizations, the smooth transition from relief to rehabilitation.

OCHA has a Military and Civil Defence Unit (MCDU), which is the focal point in the United Nations humanitarian system for the mobilization and coordination of military and civil-defence assistance whenever these are needed in response to humanitarian emergencies.

OCHA is also in a position to provide a United Nations Disaster Assessment and Coordination (UNDAC) team and set up an On Site Operations Coordination Centre (OSOCC) in collaboration with OPCW to facilitate the coordination of all international emergency humanitarian assistance.

Member States can send requests for information and/or international assistance in natural disasters or environmental emergencies directly to the OCHA office in Geneva, or through the United Nations Resident Coordinator in the country concerned.

The World Food Programme (WFP) was established in 1963 as the food aid arm of the United Nations to provide, upon request, food aid and related services to meet emergency, protracted relief and recover and development needs.

WFP could provide, consistent with its policies and when given resources by donors, emergency food and associated logistical services in response to humanitarian disasters arising from the use of biological or chemical weapons. These include situations where: crops or food supplies are destroyed or rendered unsafe; large-scale environmental damage affects people's livelihoods; outbreaks of debilitating diseases threaten longer-term food security; or populations are displaced. WFP could provide assistance to countries whose food security is threatened by these conditions and where the government concerned does not have the capacity to respond. This is facilitated by the presence of WFP field offices and food stocks in over 80 countries.

In the event of longer-term impacts on food security, WFP could incorporate activities to address the needs of victims of biological or chemical weapons in its recovery and development programmes. When potential threats to food security arise from the use of biological or chemical weapons, these could be factored into ongoing early warning and contingency planning exercises.

6.2 ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

Article X, paragraph 8, of the Chemical Weapons Convention reads as follows: 

Each State Party has the right to request and, subject to the procedures set forth in paragraphs 9, 10 and 11, to receive assistance and protection against the use or threat of use of chemical weapons if it considers that:

a) chemical weapons have been used against it;29
b) riot control agents have been used against it as a method of warfare; or

c) it is threatened by actions or activities of any State that are prohibited for States Parties by Article I.

Article X, paragraphs 9, 10 and 11, require the Director-General of OPCW to take immediate action on receipt of a request. He shall, within 24 hours, initiate an investigation and

29 This provision does not specify the source of the attack, which could either be another state or a non-state entity such as a terrorist group.
submit a first report within 72 hours to the Executive Council. If required, the time for the
investigation can be extended repeatedly by additional 72-hour periods. A new report must be
submitted after each such period. The Executive Council is required to meet within 24 hours
after receiving an investigation report to consider further action, including supplementary
assistance. At the first Conference of the States Parties to the CWC in May 1997, the
Organisation established a voluntary fund for action under Article X and invited States Parties
to inform the Technical Secretariat of the assistance that they may elect to provide in
accordance with Article X, paragraph 7. As of 31 December 2000, the voluntary fund had
received about Euros 600 000 in contributions, and approximately 40 States Parties have made
more or less specific offers of assistance in kind, ranging from protective equipment to putting
assistance teams of battalion strength at the disposal of OPCW.

The assistance pledged to be delivered through OPCW, on request, can be divided into
two main categories: hardware (mainly protective equipment) and a variety of assistance teams.

Hardware offered by Member States consists largely of personal protective equipment,
especially for use by civilians. The delivery of such equipment to a requesting State Party will,
at best, take several days, possibly more than a week, after which the State Party concerned will
have to distribute the equipment within the country.

The use of personal protective equipment requires training. To facilitate such training, a
series of courses has been arranged for chief instructors by the Swiss Government in
collaboration with OPCW. Such chief instructors should then be able to train local instructors
who, in turn, can train the exposed population in the appropriate use of personal protective
equipment.

Other assistance-related training courses are also being arranged by the Technical
Secretariat of OPCW, in cooperation with various Member States. These include, for example,
courses for medical personnel, courses in the use of analytical equipment, and courses on the
conduct of emergency assistance and rescue operations. Information on such courses, and how
to apply to attend them, is available on the OPCW web site.

Assistance teams that can be made available by Member States to assist in case of need
include, inter alia, medical teams, detection teams, decontamination teams, and teams for
providing the necessary infrastructure support for assistance operations. Some air transport has
also been offered; however, it is expected that the costs of transporting the teams may have to be
covered to some extent by the Voluntary Fund for assistance.

Article X, paragraph 5, requires the OPCW Technical Secretariat to establish and
maintain a data bank for the use of any requesting State Party, containing freely available
information on protection against chemical weapons as well as such other information as may
be provided by States Parties. This data bank has now been established, and is indexed by a
database using the CDS-ISIS database software developed by UNESCO. At present, requests
for information from the data bank have to be addressed directly to the OPCW Technical
Secretariat, but it is planned to make the database available through the Internet.

Article X, paragraph 5, further requires the Technical Secretariat to provide expert
advice on how a State Party can improve its protection against chemical weapons. This
provision affords an opportunity to ask for assistance without having to accuse any state of
using chemical weapons. To implement this provision, a protection network has been
established, currently consisting of approximately 40 specialists on various aspects of chemical
protection who are nationals of some 20 Member States. A State Party can request help from the
protection network free of charge: specialists will be paid by the Member States putting them at
the disposal of OPCW, which will cover the travel costs.

Within the framework of Article X, paragraph 5, the Secretariat can also, on request,
arrange national or regional courses on protection, workshops, etc.
6.3 BIOLOGICAL WEAPONS CONVENTION

Article VI of the Biological Weapons Convention reads as follows:

(1) Any State Party to this convention which finds that any other State Party is acting in breach of obligations deriving from the provisions of the Convention may lodge a complaint with the Security Council of the United Nations. Such a complaint should include all possible evidence confirming its validity, as well as a request for its consideration by the Security Council.

(2) Each State Party to this Convention undertakes to cooperate in carrying out any investigation which the Security Council may initiate, in accordance with the provisions of the Charter of the United Nations, on the basis of the complaint received by the Council. The Security Council shall inform the States Parties to the Convention of the results of the investigation.

The provision of assistance is provided for under Article VII of the Convention, which reads:

Each State Party to this Convention undertakes to provide or support assistance, in accordance with the United Nations Charter, to any Party to the Convention which so requests, if the Security Council decides that such Party has been exposed to danger as a result of violation of the Convention.

These obligations are not elaborated further in the Convention. Negotiations to establish implementing procedures for them through a protocol to the Convention have been taking place within an ad hoc group of States Parties (see section 5.2.1).

Provision for consultation is also made in Article V, which reads:

The States Parties to this Convention undertake to consult one another and to cooperate in solving any problems which may arise in relation to the objective of, or in the applications of the provisions of, the Convention. Consultation and cooperation pursuant to this article may also be undertaken through appropriate international procedures within the framework of the United Nations and in accordance with its Charter.

At their second review conference in 1986, the States Parties established a procedure for convening a formal consultative meeting to facilitate any such cooperation and thus improve the implementation of this article. A meeting of this type was convened in 1997 to resolve a dispute in which Cuba had alleged that the United States had been waging biological warfare against it by means of phytophagous insects (6.2).

6.4 WORLD HEALTH ORGANIZATION

WHO is a specialized agency of the United Nations with 191 Member States. Its Secretariat includes a headquarters in Geneva, six regional offices and 141 country offices. According to its Constitution, the functions of the Organization are, inter alia, to:

- Act as the directing and coordinating authority on international health work.
- Furnish appropriate technical assistance and, in emergencies, necessary aid upon the request or acceptance of governments.
- Provide information, counsel and assistance in the field of health.
- Develop, establish and promote international standards with respect to food, biological, pharmaceutical and similar products.

The use of chemical or biological weapons may result in extremely serious public health and medical emergencies, including a sudden and significant increase in numbers of cases and deaths from a variety of diseases. In view of its mandate outlined above, WHO would play a critical role in dealing with any such emergency.
WHO first became officially involved in the control of biological and chemical weapons in 1969, in response to a request from the Secretary-General of the United Nations to cooperate with the United Nations Group of Consultant Experts on Chemical and Bacteriological (Biological) Weapons in the preparation of a report on this subject.

A number of WHO programmes provide technical assistance on various relevant aspects of public health, such as preparedness for, and response to, complex humanitarian emergencies (e.g. natural disasters, chemical or radiological accidents); surveillance of communicable diseases, including global outbreak alert and response; chemical safety; food safety; and mental health. These programmes rely heavily on the technical and scientific support of WHO’s network of collaborating centres.

WHO contributes to global health security in the specific field of outbreak alert and response by: (i) strengthening national surveillance programmes, particularly in the field of epidemiology and laboratory techniques; (ii) disseminating verified information on outbreaks of diseases and, whenever needed, following up by providing technical support for response; and (iii) collecting, analysing and disseminating information on diseases likely to cause epidemics of global importance. Several epidemic diseases coming within the scope of WHO’s surveillance and response programme have been associated with biological warfare. Guidelines on specific epidemic diseases, as well as on the management of surveillance programmes, are available in printed and electronic forms; an updated listing of these documents is accessible through the World Wide Web. WHO is responsible for the administration of the International Health Regulations (IHR), a global framework (politically neutral and technically competent) within which national and global surveillance and response networks can operate in a timely and coordinated way. A revised version of the IHR is in preparation that will take account of global developments during the last 30 years of the 20th century.

The International Programme on Chemical Safety (IPCS), a joint venture of the United Nations Environment Programme (UNEP), the International Labour Organisation (ILO) and WHO, which was established to carry out and disseminate evaluations of the effects of chemicals on human health and the quality of the environment, produces guidelines and training material on preparedness for, and response to chemical incidents of technological origin, that would also be applicable if chemical agents were released deliberately. IPCS provides technical support for national chemical safety programmes, including the establishment or strengthening of chemical information centres able to provide advice on chemicals and toxic exposure on a 24-hour basis. The INTOX programme of IPCS, which includes an electronically linked network of about 120 centres in 70 countries, allows rapid access to toxicological, analytical and clinical expertise. Such a mechanism will also be useful in the identification of, and response to incidents involving chemical agents used in warfare.

6.5 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FAO is an autonomous agency of the United Nations system with 175 Member States, and of which the European Union is also a member organization. Its constitution requires, inter alia, that FAO shall furnish such technical assistance as governments may request, and organize, in collaboration with the governments concerned, such missions as may be needed to assist them to fulfil the obligations arising from their acceptance of the recommendations of the United Nations Conference on Food and Agriculture and the constitution of FAO.

FAO has not formally been involved in the control of biological and chemical weapons, but is, however, prepared to play an active part within its broad mandate in providing technical and humanitarian assistance. In recent years, FAO has contributed significantly in emergency relief and rehabilitation when droughts, floods, earthquakes, hurricanes, locust swarms, livestock plagues, war, civil strife, and natural and man-made disasters have caused immense suffering to the populations affected.

30 See section 1.2.
6.6 OFFICE INTERNATIONAL DES ÉPIZOOTIES

OIE (the World Organization for Animal Health) is composed of the official veterinary services of 157 countries. Its three main goals, established since its foundation in 1924, are: (i) to inform governments of the occurrence and course of animal diseases worldwide, and of ways to control these diseases; (ii) to provide international coordination of research on, and control of, important animal diseases; and (iii) to work towards the harmonization of trade regulations for animals and animal products.

Although OIE has no programmes or activities with the specific objective of preventing or reacting to biological warfare, the on-going sharing of information on the occurrence, prevention and control of animal diseases, including zoonoses, is relevant to this objective. Senior animal health officials from all countries meet annually to discuss recent scientific developments and to agree on matters of international importance affecting public veterinary services.

OIE has established an information system to collect and disseminate information on outbreaks of animal diseases that are the most serious from the animal and public health viewpoints. The urgency of dispatching information varies according to an internationally agreed classification of disease as List A and List B diseases.\(^{31}\)

OIE has an emergency fund that is available for sending missions to developing countries in need of urgent technical assistance to investigate and control outbreaks of animal diseases. Such assistance is usually provided in cooperation with other international organizations such as WHO and FAO.

Information from OIE, including current animal disease reports, an abstract of the previous year’s epidemiological and disease control situation, and the *International animal health code* are available on the World Wide Web.

6.7 NONGOVERNMENTAL ORGANIZATIONS

Nongovernmental organizations are non-profit-making, voluntary citizens’ groups at the local, national or international levels, including scientific bodies and professional associations. Task-orientated and driven by people with a common interest, they perform a variety of services and humanitarian functions, bring citizens’ concerns to the attention of governments, monitor policies, and encourage political participation at the community level. They provide analysis and expertise, serve as early warning mechanisms and help to monitor and implement international agreements. Some are organized around specific issues, such as human rights, the environment or health. Their possible involvement in the prevention and control of the health consequences of chemical and biological weapons will depend on their goals, their location and their mandate. If an accident or incident involving chemical/biological agents occurs, it is very likely that, in addition to the local administrations, they will be actively involved in providing care to the affected populations.

\(^{31}\) *List A diseases* are transmissible diseases that have the potential for very serious and rapid spread, irrespective of national borders, which are of serious socioeconomic or public health consequence and which are of major importance in the international trade of animals and animal products. *List B diseases* are transmissible diseases that are considered to be of socioeconomic and/or public health importance within countries and which are significant in the international trade of animals and animal products.
6.8 CONTACT INFORMATION

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Internet: http://www.oie.int

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Internet: http://www.wfp.org

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Telephone: +41 22 791 21 11
Facsimile: +41 22 791 31 11
Internet: http://www.who.int
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5.07 Decision on national implementation measures taken by the Organisation for the Prohibition of Chemical Weapons conference of the states parties at its fifth session, OPCW document C-V/DEC.20, 19 May 2000. [place and year of publication, and publishers.] [check]


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6.2 *Report of the formal consultative meeting of states parties to the convention on the prohibition of the development, production and stockpiling of bacteriological (biological) and toxin weapons and on their destruction*. Formal Consultative Meeting of States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction. BWC/CONS/1, 29 August 1997.
ANNEX

STATUS OF WHO MEMBER STATES UNDER THE CBW TREATIES

The table below sets out which of the WHO member states are (+) or are not ( ) full parties to the international treaties that afford protection against CBW attack or threat of attack, namely the 1925 Geneva Protocol (GP), the 1972 Biological and Toxin Weapons Convention (BWC), and the 1993 Chemical Weapons Convention (CWC). The table also shows (|) which member states have signed a treaty but not yet ratified it. The information given is current as of mid 2001.

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◆ — Guinea acceded to the BWC on 29 July 1992. This fact has not been recorded in BWC/CONF.V/INF.1 dated 26 October 2001.

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Further notes:
1. The Holy See is not a WHO member nor a UN member. The Holy See is a state party to the Geneva Protocol and the CWC but it has not signed the BWC.
2. Liechtenstein is not a WHO member but it is a member of the UN. Liechtenstein is state party to the Geneva Protocol, the BWC and the CWC.
3. Puerto Rico and Tokelau are WHO associate members but not UN members. Puerto Rico and Tokelau are not states parties to the Geneva Protocol, the BWC nor to the BWC.

Sources
- Geneva Protocol: Communication dated 22 June 2001 from the government of France, which is the depositary of the treaty.
Public health response to biological and chemical weapons—WHO guidance

This second edition of *Health Aspects of Biological and Chemical Weapons* includes information designed to guide preparedness for, and response to, the deliberate use of biological and chemical weapons. While noting that the probability of an attack with such weapons may be low, the guide underscores the magnitude of potential impacts on civilian populations and the corresponding need for public health authorities, in close cooperation with other parts of government, to develop contingency plans. Recommendations and advice draw on the expertise of many specialists around the world.

The guide has five main chapters. Advice on assessing the threat to public health posed by biological and chemical weapons is followed by a review of the characteristics of these weapons that influence dissemination patterns and help predict short- and long-term consequences. Both weapons designed to achieve warfare objectives and weapons used for terrorist purposes are covered.

The most extensive chapter, on public health readiness, sets out the principles for planning, moving stepwise from hazard identification and evaluation, through the introduction of risk reduction strategies, to the many specific actions required for an appropriate and adequate response. Details range from situations in which use of special protective equipment can actually hamper the ability to respond, through advice on the evaluation of biological hoaxes, to lessons extracted from the terrorist attack on civilians using chemical weapons in Japan. The guide also explains why response plans should be developed as an integral part of existing national emergency plans, and discusses the need for strong systems of disease surveillance that detect natural as well as deliberate outbreaks. Also included are advice on how to distinguish between biological and chemical attacks, and a recommended stepwise process for communicating with the public. Other chapters cover the preventive legal framework provided by treaties and describe international sources of assistance.

Each of 11 biological agents that might be used in an attack is profiled in terms of characteristics, such as natural occurrence, mode of transmission, incubation period, clinical features, laboratory diagnosis, medical management, and prophylaxis and therapy, that can help governments develop plans for early detection and appropriate response. Similar information is provided for representative groups of toxins and chemical agents.