Public health response to biological and chemical weapons

WHO guidance

SECOND EDITION
PUBLIC HEALTH RESPONSE TO BIOLOGICAL AND CHEMICAL WEAPONS
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FOREWORD

The message contained in this publication is clear: countries need a public health system that can respond to the deliberate release of chemical and biological agents. Regrettably though this message may be, the use of poison gas in the Iran–Iraq war of the 1980s, the recent anthrax incidents in the United States, and the attack with sarin nerve agent, six years earlier, on the Tokyo underground, illustrate why it is necessary to prepare.

Recognizing this need, the World Health Assembly at its fifty-fifth meeting in May 2002 adopted resolution WHA55.16 calling on Member States to "treat any deliberate use, including local, of biological and chemical agents and radionuclear attack to cause harm also as a global public health threat, and to respond to such a threat in other countries by sharing expertise, supplies and resources in order rapidly to contain the event and mitigate its effects." This is but the first step. The need has been identified. What is now required are procedures to meet it, suitably resourced.

This manual describes these procedures. Written 30 years after WHO published its first report on the subject, the new volume could not be more timely. Lessons learned about the consequences following deliberate use of chemical and biological agents in a range of wars and in other crimes, serve as the foundation for its recommendations.

One consistent theme is evident throughout. It is the importance of using existing systems to protect public health and to augment these where appropriate. For example, better disease surveillance locally, nationally, and internationally will provide a surer way of detecting and responding to unusual disease outbreaks than a system geared only to detect deliberate release of candidate biological warfare agents. Similar principles apply for the provision of health care; delivery of clean water or protecting food supplies.

For those charged with protecting the health of the public and who now have also to be concerned about the deliberate use of chemical and biological warfare agents, this manual will prove invaluable. As Executive Director of WHO Communicable diseases, I am glad to be associated with this publication and both welcome and support what it has to say.

Dr David L. Heymann
Executive Director, Communicable diseases
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EXECUTIVE SUMMARY

The development, production and use of biological and chemical weapons are prohibited by international treaties to which most WHO Member States have subscribed, namely the 1925 Geneva Protocol, the 1972 Biological and Toxin Weapons Convention, and the 1993 Chemical Weapons Convention. 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 terrorist or other criminal purposes.

In fact, biological and chemical weapons have only rarely been used. Their development, production and use entail numerous difficulties and pose serious hazards to those who would seek or use them. 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 and public-health 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 widely used in the surveillance, prevention 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 and consideration of existing demands on health and emergency services generally.

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 or threatened. As yet, however, there is no similar organization for biological weapons, but WHO, among others, 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 WHA55.16 adopted in May 2002, technical support is available to Member States from WHO in developing or strengthening preparedness for, and response to, the deliberate use of biological and chemical agents to cause harm.

2) Preparedness for deliberate releases of biological or chemical agents should be based on standard risk-analysis principles, starting with risk (threat) assessment in order to determine the relative priority that should be accorded to such releases in comparison with other dangers to public health in the country concerned. Considerations for deliberate releases should be incorporated into existing public health infrastructures, rather than developing separate infrastructures.

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. Prevention of the hostile exploitation of biotechnology therefore rises above the security interests of individual states and poses a challenge to humanity generally. 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.
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AMI</td>
<td>American Media Incorporated</td>
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<tr>
<td>BSE</td>
<td>bovine spongiform encephalopathy</td>
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<td>BWC</td>
<td>Biological and Toxin Weapons Convention</td>
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<tr>
<td>CAS</td>
<td>Chemical Abstracts Service</td>
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<tr>
<td>CBS</td>
<td>Columbia Broadcasting System</td>
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<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention (United States)</td>
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<td>CPAP</td>
<td>continuous positive airway pressure</td>
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<tr>
<td>CWC</td>
<td>Chemical Weapons Convention</td>
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<tr>
<td>DMPS</td>
<td>dimercaptosuccinic acid</td>
</tr>
<tr>
<td>DMSA</td>
<td>dimercapto-1-propanesulfonic acid</td>
</tr>
<tr>
<td>ELISA</td>
<td>enzyme-linked immunoabsorbent assay</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization of the United Nations</td>
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<tr>
<td>FBI</td>
<td>Federal Bureau of Investigation (United States)</td>
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<tr>
<td>GC</td>
<td>gas capillary column chromatography</td>
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<tr>
<td>GC-MS</td>
<td>gas chromatography-mass spectrometry</td>
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<tr>
<td>GMP</td>
<td>good manufacturing practices</td>
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<td>GP</td>
<td>Geneva Protocol</td>
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<tr>
<td>HACCP</td>
<td>Hazard Analysis and Critical Control Point</td>
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<tr>
<td>HEPA</td>
<td>high-efficiency particulate arresting</td>
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<tr>
<td>HPLC</td>
<td>high-performance liquid chromatography</td>
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<tr>
<td>ICGEB</td>
<td>International Centre for Genetic Engineering and Biotechnology</td>
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<td>IHR</td>
<td>International Health Regulations</td>
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<tr>
<td>ILO</td>
<td>International Labour Organization</td>
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<td>IPCS</td>
<td>International Programme on Chemical Safety</td>
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<tr>
<td>IPE</td>
<td>individual protective equipment</td>
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<tr>
<td>MCDU</td>
<td>Military and Civil Defence Unit (OCHA)</td>
</tr>
<tr>
<td>NBC</td>
<td>National Broadcasting Company</td>
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<tr>
<td>NMEDA</td>
<td>N-methyl-D-aspartate</td>
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<tr>
<td>OCHA</td>
<td>Office for the Coordination of Humanitarian Affairs (United Nations)</td>
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<td>OIE</td>
<td>Office International des Epizooties</td>
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<td>OPCW</td>
<td>Organisation for the Prohibition of Chemical Weapons</td>
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<tr>
<td>OPIDN</td>
<td>organophosphate-induced delayed neuropathy</td>
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<tr>
<td>OSOCC</td>
<td>On Site Operations Coordination Centre (OCHA)</td>
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<tr>
<td>PAVA</td>
<td>pelargonic acid vanillylamide</td>
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<tr>
<td>PCR</td>
<td>polymerase chain reaction</td>
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<tr>
<td>PEEP</td>
<td>positive-end expiratory pressure</td>
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<tr>
<td>PFIB</td>
<td>Perfluoroisobutene</td>
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<tr>
<td>PVC</td>
<td>polyvinyl chloride</td>
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<tr>
<td>RADS</td>
<td>reactive airways dysfunction syndrome</td>
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<td>SEB</td>
<td>staphylococcal enterotoxin B</td>
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<tr>
<td>SIPRI</td>
<td>Stockholm International Peace Research Institute</td>
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<tr>
<td>TEPP</td>
<td>tetraethyl pyrophosphate</td>
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<tr>
<td>TICs</td>
<td>toxic industrial chemicals</td>
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<tr>
<td>UNDAC</td>
<td>United Nations Disaster Assessment and Coordination (OCHA)</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Programme</td>
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<tr>
<td>UNSCOM</td>
<td>United Nations Special Commission</td>
</tr>
<tr>
<td>USAMRIID</td>
<td>United States Army Research Institute for Infectious Diseases</td>
</tr>
<tr>
<td>USPS</td>
<td>United States Postal Service</td>
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<tr>
<td>WFP</td>
<td>World Food Programme (United Nations)</td>
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<td>WHO</td>
<td>World Health Organization</td>
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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), 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 Iran–Iraq War; the reported use of these agents by the Iraqi government against its own citizens, most conspicuously at Halabja in March 1988;1 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. The dissemination of anthrax spores through the United States postal system in 2001, killing five people, has now further increased fears of bioterrorism. On the positive side, the Biological 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 and factories, including those of the Russian Federation and the United States, and monitoring the world’s chemical industry to prevent future misuse. From large populations of Europe and Asia, therefore, have now been lifted the immense biological and chemical threats that existed during the Cold War, when there were large active stockpiles of chemical weapons and active preparations for continent-wide biological warfare. 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 still include some of those listed in the 1970 edition. There have been rumours of nerve gases of 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 substantially 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 biological 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 three years later. Concerns about the continuing threat of biological warfare, accentuated by revelations during the early 1990s about bioweapons programmes in the former Soviet Union 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, including verification. Work on the protocol was suspended in the latter part of 2001.

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

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headquarters in The Hague. CWC was opened for signature in 1993 and entered into force four years later.

The threat of use of biological or chemical weapons by the armed forces of states has clearly changed since the 1970 report, and is now a particular concern in regions of the world where states have still not joined the two Conventions. In addition, the risk that non-state entities might use such weapons remains a possibility. 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 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 (2). It drew from 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 Pugwash1 and the Stockholm International Peace Research Institute (SIPRI)2. Shortly afterwards, the Twenty-second World Health Assembly, in resolution WHA22.58, requested the Director-General to continue the work (5). 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 (6). 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 (7).

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 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 who could have been dispatched to an affected area by air ambulance at short notice (8). More generally, as the public has become more conscious of the possibility that biological or chemical agents may be released for hostile purposes, 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 provide support for WHO’s efforts in the biological/chemical field, including 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” (9). A year later, in resolution WHA55.16, the Assembly requested the Director-General “to continue to issue international guidance and

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1 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 (3).

2 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 (4).
technical information on recommended public health measures to deal with the deliberate use of biological and chemical agents to cause harm” (10). This second edition has been published in response to these requests from the World Health Assembly.

The 1970 report considered biological and chemical weapons at 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. This 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 present report also considers, in Chapter 5, the 1972 BWC and the 1993 CWC, to which the majority 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 the weapons are nevertheless used.

1.3 Some working definitions

The definitions of biological and chemical weapons contained in the BWC and CWC are set out in section 3.1.1 below, on pages INSERT. For the purposes of this report, however, biological weapons are taken to be those that achieve their intended target effects through the infectivity of disease-causing microorganisms and other such entities, including viruses, infectious nucleic acids and prions. Such weapons can be used to attack human beings, other animals or plants, but it is with human beings that the report is primarily concerned.

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 as a result not of infectivity but of toxicity, they fall within the definition given below of chemical weapons, even though they are also biological weapons within the meaning of the BWC. Microorganisms are not the only life forms that can generate toxins. The BWC, where it refers to toxins, means toxic substances produced by any living organism, even when such substances are actually produced by other means, including chemical synthesis. The present report gives the same meaning to toxins as does the BWC, while recognizing that toxins are also covered by the CWC.

Chemical weapons are taken to be those weapons that are effective because of the toxicity of their active principles, i.e. their chemical action on life processes being capable of causing death, temporary incapacitation or permanent harm. They too can be used against human beings, other animals or plants, but again this report is focused on their effects in human beings. Weapons in which chemicals such as propellants, explosives, incendiaries or obscurants are the active principles are not regarded as chemical weapons, even though the chemicals may also have toxic effects. Only if producing such toxic effects is an intended purpose of the weapon can it be regarded as a chemical weapon. Some toxic chemicals, such as phosgene, hydrogen cyanide and tear gas, may be used both for civil purposes and for hostile purposes. In the latter case, they, too, are chemical weapons.

1.4 Structure

The main part of the report consists of six chapters. These are supported by seven 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 in any planning to avert or at least mitigate the consequences of the deliberate release of such agents.

In Chapter 4, 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.

References


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


2. ASSESSING THE THREAT TO PUBLIC HEALTH

Among the many emergencies or disasters to which public health authorities may be called upon to respond is the deliberate release of biological or chemical agents. For public health authorities, the problem this raises is one of priorities. What priority should be given to preparedness for such releases as compared with other emergencies or disasters and the regular needs of public health? This chapter provides an historical 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 or to alleviate the illness they cause.

Historically, 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 (1), this taboo seems so widespread, ancient and specific as to require some such explanation (2).

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 and destructiveness, 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 their 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" (4).

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 (5). It poses a major threat to economic development and the alleviation of poverty. 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

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1 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" (3). 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. Note, however, that, as is described in Chapter 5, the BWC and the CWC are not limited to weapons of mass destruction.
mass casualties at the other. Where along this spectrum a particular biological or chemical menace is situated will be determined by the characteristics of the agent and the way it is used, 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 hygienic measures, 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. Unsubstantiated accusations of use have been more common, but this may reflect the difficulty of proving that they have or have not 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 its 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, owing 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, eight 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 decade previously. On the late afternoon of that day, 180 tonnes of liquid chlorine contained in 5730 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 new 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 now.
Another way forward for the weaponeers was to use special methods of disseminating the chosen agent, 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, the CWC, and the Statute of the International Criminal Court.

Vulnerabilities remain of course, especially in countries where the economic or technological base is not capable of providing even rudimentary protection. 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), Tripolitania (1930), Sinkiang (1934), Abyssinia (1935–1940), Manchuria (1937–1942), Viet Nam (1961–1975), Yemen (1963–1967) and Islamic Republic of Iran/Iraq (1982–1988) (6). 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 against which protection is less effective. There was no significant strategic or battlefield use of chemical warfare in that conflict.

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 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 substantially fewer munitions might be needed to attack a given target, thereby conferring logistic advantage. The most important of these nerve gases and other new chemical-warfare agents are identified in Chapter 3 and described in Annex 1.

Beyond the nerve gases on the scale of increasing toxicity are certain toxins, such as those described in Annex 2, 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 (7–8).
Other concepts of biological warfare were being considered. 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 thought was to establish foci of a 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 objective and the consequent choice of agent may be different.

During the first half of the Cold War era, 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, preparations to produce biological weapons appear to have continued on one side only. The principal biological agents known with reasonable certainty to have entered the process of weaponization during the Cold War are identified in Chapter 3 and described in Annex 3. The biological weapons developed ranged from devices for clandestine 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, even tens of thousands, of square kilometres in size could now be threatened with disease by a single aircraft. At the same time, some defence science advisers were anticipating a new generation of chemical weapons having a comparable area-effectiveness (9).

Despite the variety of these different weapon concepts, the chief lesson here from history is that biological warfare and, to a somewhat lesser extent, chemical warfare remained a perverse enterprise of extremely rare occurrence, notwithstanding the elaborate preparations made during the Cold War.

Large-area weapons for exploiting the damage potential of chemical or biological agents made new categories of target, such as food crops and livestock, open 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 offer 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 Advancing science

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. New knowledge in the life sciences is now accumulating so rapidly that major changes in the nature, accessibility or efficacy of biological and chemical weapons may already be possible. 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. In fact, as the old armament imperatives of the Cold War recede, the threat may not be increasing, but it is unfortunately true that the duality of the new science is making the threat seem larger.

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 aggressive 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 characteristics into microorganisms that will make them more resistant to the available defences, more virulent or pathogenic, better able to withstand the stresses of an unnatural environment, or more difficult to detect by routine assays. In so doing, experience shows that other necessary characteristics of the microorganism are likely to be lost; but perhaps not invariably so.

Genetic engineering also offers the possibility of making accessible toxic substances that have hitherto been available in quantities far too small for hostile use. For example, the fact that recombinant technology has been used to insert genes for a number of non-microbial toxins into microorganisms, leading to toxin expression, could enable those toxins to be produced on a large scale.

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 great range and variety of pathogens already present in nature, it is not immediately obvious why a weapons programme might be based on a modified organism. Nor is it always true that the new biotechnologies necessarily favour offence over 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 generality, and whether they can produce results quickly enough and exclude false positives, are not clear. Moreover, the need to detect certain agents at exceedingly low concentrations 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 and therapeutics, while still others are thought to promise nonspecific alternatives to vaccines. An example to be mentioned here is the recent emphasis on blocking pathways of pathogenesis that are common to many infective agents, such as overproduction of cytokines. Such measures may become more important against both natural and deliberately caused infections because they are generic rather than specific to a particular pathogen, and because pathogens are less likely to be able to evade such measures by natural or artificial mutation.

Yet, overall, 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 (11–18).

2.4 Preliminary threat assessment
Appraisals and priorities will certainly differ from country to country, but it seems clear from what has just been related that prudent Member States will have at least some organization and some plan in place to deal with deliberate releases of biological or chemical agents. It is true that the existence of vulnerability does not necessarily mean the existence of threat. Yet in that spectrum of menace to the public postulated earlier in this chapter, the far mass-destruction end has already been approached by some of the bacterial or viral aerosol weapons of the Cold War. Nor is catastrophe on the scale implicit in such weapons the principal threat with which public health authorities must concern themselves. One lesson from the still-unresolved “anthrax letters” episode in the United States (see pages INSERT below), is the havoc that can be caused by very much smaller-scale and less technically elaborate releases of biological agents. There is a somewhat similar lesson in the fact that the chemical agent that has thus far figured most commonly in deliberate releases in the United States has been, not some deadly nerve gas, but butyric acid, which is a malodorant. So public health authorities may not be at fault if they assess that the threat of less than full-scale attack using only simple means of agent delivery may be the most worrisome possibility of all.

A salient factor here is the demonstrable existence of increasingly severe technological constraint as that far mass-destruction end of the spectrum has been approached: the greater and more assured the area-effectiveness sought for the weapon, the greater the practical difficulties of achieving it. There are, in short, inherent technical limitations that the threat assessment should 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 4, 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. 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 outcome may be less uncertain or difficult to predict, meaning that such smaller-scale attacks are much less subject to technological constraint. A further major consideration is that many 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. 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 and even within the respiratory tract. 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. However, that spread, too, is subject to unpredictabilities of its own, and therefore to uncontrollabilities. In addition, such spread, if detected early, can be limited by hygienic and prophylactic measures.

These technical factors operate to render such large-scale forms of attack more demanding in terms of materials and skills than is commonly supposed. Particularly for non-transmissible agents or chemicals, 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, including testing it, and then of maintaining its virulence throughout culturing, harvesting, processing, storing, weapon-filling, release and aerosol travel.

The conclusion to be drawn is that, although the probability of a large-scale high-technology biological/chemical attack may be low, if it nevertheless happened with, improbably, all the many imponderables and uncertainties favouring the attacker, 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 disregard the possible effects of deliberately released biological or chemical agents, but it would be prudent not to overestimate them (20). Given the emotional shock of even an alleged threat of a biological or chemical release, it will therefore be wise for Member States 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 biological attack has occurred suggests that the number of competent groups or states actually intending to use biological weapons must be small. Indeed, the element of intent is central to the probability of use, and itself is susceptible to inhibitions including those of morality and the threat of apprehension and punishment.

Yet the “anthrax letters” episode in the USA provides serious warning against complacency on this score, especially if one asks what the consequences might have been had the anthrax mailer sent a thousand letters instead of just a few. History is not always a reliable guide to the future. Therefore, preparation for the eventuality of some form of deliberate agent release, with a response strategy and plan held at the ready, will surely 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.

Beyond that, Member States should also consider preparing themselves to treat any deliberate use, even the most local use, of biological or chemical agents to cause harm as a global public health threat, and to respond to such a threat in other countries by sharing expertise, supplies and resources in order rapidly to contain the event and mitigate its consequences. The fact that there is vulnerability, however, does not always mean that there is threat.

References


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3. BIOLOGICAL AND CHEMICAL AGENTS

Careful advance planning is essential if a Member State or other country is adequately to manage the threat or the consequences of deliberate releases of biological or chemical agents. A central consideration in such preparedness planning is that 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 the effects of biological and chemical attacks, 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. Knowledge of the general properties of this representative group of agents will enable certain 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 initiated in Chapter 2.

3.1 The representative group of agents

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. In order to be selected for weaponization, a candidate agent should have characteristics that are capable of countervailing the technical limitations that would otherwise render the weapon carrying the agent unattractive to users, such as the technical limitations just described in Chapter 2. So the agent will need 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. Once disseminated, the agent must be capable of establishing field dosages that are infective or toxic over a predictable area. It must also be relatively easy to produce from readily available precursor compounds or from naturally occurring or genetically modified microorganisms. Once produced and, depending on the agent, further processed and formulated, it must be filled into munitions or dissemination devices, or held ready for such filling, and be storable without undue risk to its possessor. If an agent is insufficiently stable in storage, certain expedients are available, such as, in the case of some chemicals, the use of “binary” munitions that are uploaded, not with toxic agent, but with separate containers of precursors, these being adapted to mix and generate the agent either just before or during weapon launch. For biological agents, a “warm” production base rather than a large stockpile has been relied upon in past offensive military programmes.

While many thousands of toxic chemicals and hundreds of pathogenic microorganisms have been investigated for their potential utility as military weapons, relatively few have been found capable of meeting military requirements of the kind just specified, and fewer still have found their way into weapons and actually been used. The task facing public health authorities of identifying a representative group of agents against which to prepare might therefore be thought relatively straightforward. However, the deliberate agent releases against which public health authorities would need to prepare might include attacks by non-state entities whose agent-selection principles could differ from the military ones. For example, accessibility, not overall aggressiveness and stability in storage, might be the dominant criterion in their choice of agent. Also, the types of impact sought could differ from those that direct military operations. In other words, the rank order in which public health authorities assess the different agent threats (e.g. 1) may not be the same as that of military authorities. In the present study, the representative group has been compiled by applying a progressively sharper focus to possible agents of concern: firstly, the broad treaty definitions of biological and chemical weapons; secondly, the lists of agents that have been negotiated to facilitate treaty implementation, or, in the case of the BWC, proposed therefor; thirdly, such authoritative information as is publicly available about which agents have been weaponized or stockpiled in recent times; fourthly, agents known to have been used as weapons; and finally, considerations regarding non-state entities. This selection process is now described.
3.1.1 Scope of the international treaties

The broadest catchment of agents of concern, and therefore the starting point for the selection process, is to be found in the treaties that outlaw possession of biological and chemical weapons. 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 devise definitions that used a broader 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 Box 3.1 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:
(a) 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;
(b) 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;
(c) 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.)

[...]  

9. “Purposes Not Prohibited Under this Convention” means:
(a) Industrial, agricultural, research, medical, pharmaceutical or other peaceful purposes;
(b) Protective purposes, namely those purposes directly related to protection against toxic chemicals and to protection against chemical weapons;
(c) 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;
(d) 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 by providing transparency for the agents that all States Parties could agree had potential for use as chemical weapons. 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 (2). Even the family of alkyl alkylphosphonofluoridates, with which Schedule 1 opens, i.e. the sarin family of nerve gases, theoretically contains 3652 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 to exemplify chemicals thought to pose a particular risk of being used in a manner contrary its general-purpose criterion.

The BWC, which is a legal instrument much shorter and simpler than the CWC, contains no analogous schedules, but such lists have been developed for inclusion in the BWC Protocol were its negotiation to be completed. The purpose of these lists, too, would again be to exemplify, but not to define, the scope of the general-purpose criterion. Several other authorities, including defence agencies, have compiled lists of biological agents judged most likely to be employed for hostile purposes. Some of these lists are shown in Table A3.1 in Annex 3, from which it may be seen just how much variation there can be in different agent assessments.

3.1.2 Historical experience

Toxic and infective agents that were available in weaponized forms in the past to the armed forces of states are identified in official state papers now open to the scrutiny of historians. This historical record is not complete, however, because former possessor states have not yet made all of 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, albeit not yet entirely verified, to weaponization during the period 1987–1991). An extensive list of antipersonnel agents can nevertheless be compiled. That given in Table 3.1 covers the period since January 1946 and is taken from an archive of collected state papers, works of historical scholarship and other documentation at the University of Sussex. It is limited to agents identified in state papers of the country concerned as having been stockpiled or

1 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).
having otherwise entered the process of weaponization. For convenience, Table 3.1 groups
the agents into categories that are explained later in this chapter.

For some of the toxic chemicals included in Table 3.1, 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 of
chemical weapons required from States Parties to the CWC. These declared quantities are
given in Table 3.2, which shows that an aggregate total of 69 863 tonnes of chemicals have
been declared as chemical weapons to OPCW by its Member States. These declared
stockpiles are subject to the monitoring provisions of the CWC, and their destruction under
agreed protocols is observed by OPCW officials. By 1 May 2002, a total of 6740 tonnes had
been destroyed.

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 3.3 summarizes the record of antipersonnel use, taken from
the same archive as that used for Table 3.1. 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 identified. The use of anti-plant or anti-animal agents is not
included. Table 3.3 includes in its last three entries the use of toxic or infective antipersonnel
agents by non-state entities – acts of terrorism on which the historical record is still more
sparse.

Tables 3.1, 3.2 and 3.3 list 40 different biological and chemical agents, which is a number
considerably smaller than the number of agents described in the literature on biological and
chemical warfare. Not all of the 40 are readily accessible only to state forces, for among them
are widely used industrial chemicals. For inclusion within the representative group of agents,
some may be disregarded on grounds of close similarity to one another. It seems necessary
to add only four further agents. These are: variola major, i.e. smallpox virus; the fungal agent
that causes coccidioidomycosis; 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. Although none of these four additional
agents is listed in Table 3.1, all four are known to have been studied for possible
weaponization including, in some cases, actual field trials as well as laboratory study.

Described in Annexes 1, 2 and 3 are 26 of the 44 agents, which thus include those from
among which a public health authority may reasonably select its representative group of agents.
Table 3.1  Toxic and infective antipersonnel agents stockpiled or otherwise weaponized for state forces since 1946 according to official documents of their 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>α-chloroacetophenone (CN)</td>
</tr>
<tr>
<td>α-bromophenylacetonitrile (larmine, BBC or CA)</td>
</tr>
<tr>
<td>2-chlorobenzalmalononitrile (CS)</td>
</tr>
<tr>
<td>dibenzoxazepine (CR)</td>
</tr>
<tr>
<td>oлеоresin 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-isobutyl S-2-diethylaminoethyl methylphosphonothiolate (VR)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Toxins*a</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>Bacillus anthracis</td>
</tr>
<tr>
<td>Franciscella tularensis</td>
</tr>
<tr>
<td>Brucella suis</td>
</tr>
<tr>
<td>Burkholderia mallei</td>
</tr>
<tr>
<td>Burkholderia pseudomallei</td>
</tr>
<tr>
<td>Yersinia pestis</td>
</tr>
<tr>
<td>Rickettsia prowazeki</td>
</tr>
<tr>
<td>Coxiella burnetii</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viruses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Venezuelan equine encephalitis virus</td>
</tr>
</tbody>
</table>

*a In addition to those already listed, namely OC and hydrogen cyanide.

Table 3.2  Aggregate quantities of chemical agents declared to the OPCW by its Member States, as of 31 December 2001
<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>Difluor (precursor DF)</td>
<td>444</td>
</tr>
<tr>
<td>EDMP (precursor QL)</td>
<td>46</td>
</tr>
<tr>
<td>Isopropanol/isopropylamine (precursor OPA)</td>
<td>731</td>
</tr>
<tr>
<td>Lewisite</td>
<td>6 754</td>
</tr>
<tr>
<td>Mustard gas</td>
<td>13 839</td>
</tr>
<tr>
<td>Mustard/lewisite mixtures</td>
<td>334</td>
</tr>
<tr>
<td>Runcol (agent HT)</td>
<td>3 536</td>
</tr>
<tr>
<td>Sarin (agent GB)</td>
<td>15 048</td>
</tr>
<tr>
<td>Soman (agent GD)</td>
<td>9 175</td>
</tr>
<tr>
<td>Tabun (agent 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>11</td>
</tr>
<tr>
<td>Thiodiglycol</td>
<td>51</td>
</tr>
<tr>
<td><strong>Chemicals declared as “riot control agents”</strong></td>
<td></td>
</tr>
<tr>
<td>Adamsite</td>
<td>Agent CN</td>
</tr>
<tr>
<td>Chloropicrin</td>
<td>Agent OC</td>
</tr>
<tr>
<td>Ethyl bromoacetate</td>
<td>Pepperspray [sic]</td>
</tr>
<tr>
<td>vanillylamide</td>
<td>Pelargonic acid</td>
</tr>
</tbody>
</table>

\[a\] Based on figures from OPCW annual report for 2001 (3), rounded to the nearest tonne. Excludes chemicals declared in quantities of less than one tonne. One such chemical was the nerve-gas O-ethyl S-2-dimethylaminoethyl methylphosphonothiolate, also known as médémo or EA 1699.

\[b\] The CWC Verification Annex, in Part IV(A) para 16, defines Category 1 as “chemical weapons on the basis of Schedule 1 chemicals and their parts and components”. See Table 3.1 for their chemical identities.

\[c\] Methylphosphonyl difluoride (a binary nerve-gas component).

\[d\] Ethyl 2-diisopropylaminoethyl methylphosphonite (a binary nerve-gas component).

\[e\] A mixture of 72% isopropanol and 28% isopropylamine (a binary nerve-gas component).

\[f\] Including “mustard gas in oil product”.

\[g\] A reaction product containing about 60% of mustard gas and 40% of agent T.

\[h\] “Chemical weapons on the basis of all other chemicals and their parts and components.” The CWC goes on to define Category 3 chemical weapons as comprising “unfilled munitions and devices, and equipment specifically designed for use directly in connection with employment of chemical weapons”.

\[i\] For chemicals declared as “riot control agents”, the CWC requires disclosure of their chemical identity but not the quantities in which they are held.
Table 3.3  Antipersonnel toxic and infective agents whose hostile use since 1918 has been verified

<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>Russia</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 (a choking agent), 2-chloroacetophenone, diphenylchlorarsine, mustard gas, phenyldichlorarsine (a vesicant), phosgene</td>
<td>Abyssinia</td>
</tr>
<tr>
<td>1937–1945</td>
<td>2-chloroacetophenone, diphenylcyanoarsine (a sensory irritant), hydrogen cyanide, lewisite, mustard gas, phosgene, Yersinia pestis</td>
<td>Manchuria</td>
</tr>
<tr>
<td>1963–1967</td>
<td>2-chloroacetophenone, mustard gas, phosgene</td>
<td>Yemen</td>
</tr>
<tr>
<td>1965–1975</td>
<td>2-chlorobenzalmalononitrile</td>
<td>Viet Nam</td>
</tr>
<tr>
<td>1982–1988</td>
<td>2-chlorobenzalmalononitrile, sarin, tabun</td>
<td>Islamic Republic of Iran/Iraq</td>
</tr>
<tr>
<td>1984</td>
<td>Salmonella enteritidis, typhimurium, serotype</td>
<td>United States</td>
</tr>
<tr>
<td>1994–1995</td>
<td>sarin</td>
<td>Japan</td>
</tr>
<tr>
<td>2001</td>
<td>Bacillus anthracis</td>
<td>United States</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 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 airborne dissemination of biological and chemical agents that may create an inhalation or...
contact hazard to unprotected persons. Considered elsewhere in this study are certain other methods of agent dissemination, including dissemination through drinking water and food. For biological agents there is also the possibility of using arthropod vectors.

The methods of airborne 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 inhalable, 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 inhalable 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 inhalable particles, creating principally a respiratory or conjunctival hazard.

For infective agents, the principal hazard to people will be from inhalation. This may be so even for agents for which this is not the natural route of infection. For many infective agents, the risk is greatest if the agent reaches the target population in the form of particles within the narrow aerodynamic size range where particles are small enough to penetrate to the alveoli in the depths of the lungs but not so small that most of them fail to be deposited and instead are mostly exhaled. Contact with an infective agent and its entry into the body via a lesion or via mucous membranes may also present a risk, although generally less than that from inhalation. Infective agents may be disseminated as inhalable particles by dispersal of presized powder, by explosives or by sprayers or other generators specially designed to produce particles in the inhalable size range.

Small particles may 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 at a rate that also depends on surface roughness and on meteorological factors. It is the effective aerodynamic diameter that is the proper measure of size in regard to the settling and impaction propensities of small particles. Only for solid spheres of unit density does the effective aerodynamic diameter reduce to actual diameter. This distinction may be important for lyophilized materials that are largely hollow or for chemical agents that are very dense. Wind and other mechanical disturbances may resuspend deposited particles, but the amount resuspended is likely to be small and even that may be bound to soil or other particles of larger diameter. In consequence, exposures to inhalable particles resulting from resuspension of particles deposited from an aerosol 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 agent vapours and aerosols is respiratory, although certain chemical agents, notably the mustards and 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. For an aerosol of a non-volatile agent or for an agent adsorbed to a non-volatile carrier material, the site of deposition will depend on the size and density 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 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. 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 an 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 aerodynamic diameter. As an approximation, the particles in a biological agent aerosol are taken to have unit density and spherical shape. Such particles with diameter around 10 µm and larger are almost entirely deposited by inertial impaction on the fimbrae 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, spitting or sneezing. Such clearance protects the lungs from particulates including infective agents deposited in the respiratory airways. Additional protection against infective agents results from the action of antimicrobial substances present in mucus and from the action of phagocytic cells. Some infective agents, however, including the viruses of influenza and smallpox, have special adaptations that enable them to infect the oropharyngeal and respiratory mucosa. Infection by such agents may therefore result, not only from inhalation of contaminated particles, but also by hand–mouth and hand–nostril transfer from contaminated materials and surfaces.

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 300 million alveoli with a total surface area of some 140 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 are not likely to deposit by sedimentation but, if not simply exhaled, may nevertheless deposit on alveolar surfaces, owing to Brownian motion (4).

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 remain permanently in the alveolar connective tissue or, 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 has 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 *B. anthracis*, for example, are able to germinate in macrophages, which may transport bacteria to regional lymph nodes where 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 by washing, wiping 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 over the skin without depositing, 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 Oronasal mucous and conjunctiva

The mucosal tissues of the conjunctiva and the nasal passages are particularly sensitive to attack with irritant agents and the conjunctiva is especially sensitive to blister agents. Also, some infective agents, including variola, influenza and certain other viruses may enter through the oronasal mucous and, perhaps, the conjunctiva.

### 3.3.4 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 are suffering from a disease or general malaise or even that they have been exposed to a biological agent.

The problems presented by the direct biological contamination of food, water or other ingestible material are considered in Annex 4.
3.4 Characteristics of biological agents

The chief characteristic of biological agents defined as in section 1.3 above on pages INSERT is their ability to multiply in a host. It is this that gives them their aggressive potential. The disease that may be caused results from the multifactorial interaction between the biological agent, the host (including the latter's immunological, nutritional and general health status) 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 classified according to properties that may determine their utility for hostile purposes, such as ease of production or resistance to prophylactic and therapeutic measures. More generally they can be characterized by such other features as infectivity, virulence, incubation period, lethality, contagiousness and mechanisms of transmission, and stability, all of which influence their potential for use as weapons.

**Infectivity** of an agent reflects its capability to enter, survive and multiply in a host, and may be expressed as the proportion of persons in a given population exposed to a given dose who become infected. The dose that, under given conditions, infects half the population receiving it is termed the ID50. Doses higher or lower than this will infect a larger or smaller proportion of such a population. For some pathogens the ID50 may be many thousands or more of infective cells or virus particles while for others it may be only a few. It cannot be ruled out that even a single infective cell or virus particle can initiate infection, albeit with correspondingly low probability.

**Virulence** is the relative severity of the disease caused by a microorganism. Different strains of the same species may cause diseases of different severity. Some strains of *Francisella tularensis*, for example, are much more virulent than others.

**The incubation period** is the time elapsing between exposure to an infective agent and the first appearance of the signs of disease associated with the infection. This is affected by many variables, including the agent, the route of entry, the dose and specific characteristics of the host.

**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).

For those infections that are contagious, a measure of their **contagiousness** is the number of secondary cases arising under specified conditions from exposure to a primary case. 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 droplets or aerosol. Vector-borne transmission (primary or secondary) can occur via biting insects, 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 individual hygienic practices and precautions and by proper handling of infected persons, caregivers and other contacts. The interruption of indirect transmission requires other approaches, such as adequate ventilation, boiling or chlorination of water, disinfection of surfaces, laundering of clothing or vector control.
Stability may refer to the ability of the aerosolized agent to survive the influence of environmental factors such as sunlight, air pollution, surface forces and drying while remaining infective. It may also refer to stability during production or to stability during storage.

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 the literature. 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 principal intended 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 temporarily blinded or 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 opioids and certain other 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 individuals 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 below, pages INSERT). 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 hazardous 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 that needs to be occupied soon afterwards. Surfaces are generally not contaminated, and the primary danger is from inhalation, and only 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-blistering
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 or other centrally acting agents (e.g. the disabling agent BZ and the fentanyl opioids). This type of classification is used in Table 3.1 on page INSERT above.

3.6 Consequences of using biological or chemical weapons

3.6.1 Short-term consequences

The most prominent short-term effect of biological or chemical weapons is the large number of casualties that they can 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, including possible terror and panic, of a civilian population to biological or chemical attack may be 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 who may present at medical facilities (see Chapter 4). An 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 4.2). The “anthrax letters”episode in the United States at the end of 2001, in which at the time of writing both the perpetrator and the motive remain to be discovered, provides some insight into the short-term consequences of biological agents being deliberately released (see Appendix 4.3).

Details of the short-term injuries caused by the various biological and chemical agents can be found in Annexes 1, 2 and 3.

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, are more uncertain and less well understood.

Some biological and chemical agents have the potential to cause 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 been the subject of specific scientific monographs (5–6). They may extend the potential for harm of biological or chemical weapons beyond their immediate target both in time and space. For many agents too little is known about their long-term effects for reliable predictions to be made.

Such uncertainty carries over into the planning of medical countermeasures, and little more can be done than to outline the various possibilities needing further study. 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 may be involved. However, useful pointers to what the consequences might be can 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 and some infective agents is well known. The occurrence of chronic debilitating pulmonary disease in victims of
exposure to mustard gas was reported after the First World War (7). This has also been described in reports on the current status of Iranian casualties from Iraqi mustard gas during the Iran–Iraq War of the 1980s (8–9). 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 were still occurring as late as 12 years after all exposure had ended (10). Details of long-term effects caused by other toxicants are given in Annexes 1 and 2. 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 3 provides further information.

The **delayed effects** in persons exposed to certain biological and chemical agents, depending on the dose received, may include carcinogenesis, teratogenesis and perhaps mutagenesis. Certain 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 suited to 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 chemicals of particular concern, 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 good evidence of a significant increase in cancer of the respiratory tract among workers following prolonged low-dose exposure in factories producing mustard gas (11). Experiments with animals and epidemiological data for human populations show that the incidence of chemical carcinogenesis by many carcinogens depends on a power of the duration of exposure. Single exposures are therefore expected to be much less carcinogenic than months or years of exposure to the same total dose. 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 that could be received by pregnant women in civilian populations that might be exposed to them. Little attention has been given to the possibility that known chemical and biological agents might cause detrimental heritable mutations in humans. Several chemicals are reported to cause such changes in 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 other non-human hosts, such as rodents, birds, 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 persistent reservoirs. *Salmonella* strains can do likewise in domestic animals. A particular concern would be that a deliberate release of variola for hostile purposes could cause resurgence of smallpox, which was finally eradicated from natural occurrence in the 1970s, bringing special benefit to developing countries.

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 adverse long-term effects on human health via reductions in the quality and quantity of the food supply derived from plants or animals. They could also have major economic impact, either through direct effects on agriculture or through indirect effects on trade and tourism.
The broad conclusion to be drawn from the foregoing analysis is that there are great
difficulties associated with assessing the long-term health effects of exposure to chemical and
biological agents. Confounding variables may affect the results of studies, and it may be
difficult to distinguish genuine long-term effects of exposure 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
cau sed by the herbicide Agent Orange to people exposed in Viet Nam, where the chemical
was widely used in the 1960s and early 1970s during the Viet Nam War (12). 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 and a plethora of nonspecific somatic and psychological symptoms) are said to
have been caused by exposure to chemical agents, among other possible causes (13).
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
may lend themselves to psychological warfare (which is a military term for attacks on morale
including terrorization) 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 be better able to understand the harmful
effects of conventional weapons than those of toxic or infective materials.

The emergence and spread of long-range 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 Iran–Iraq
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 Gulf 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 relatively small group of agents, identified through
the evaluation process that it describes, 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 can allow timely protective measures to be taken in the areas that may be affected.

Skin exposure is a problem relating mostly to chemical agents and would usually occur only in
the immediate vicinity of a release. Here, an important element of protection will be protective
clothing. Skin protection may be required against both direct liquid exposure and high vapour concentrations. If a vapour risk exists, respiratory protection using adsorptive filters will also be required and in some cases evacuation of people from the hazardous area can be effective.

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 possible long-term consequences.

References


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4. PUBLIC HEALTH PREPAREDNESS AND RESPONSE

4.1 Background

The initial response to a deliberate release of infective or toxic agents targeted against 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 emergencies or disasters (1). These principles, which are outlined in Appendix 4.1 below, can be used to identify areas needing particular attention when biological or chemical agents are involved. They are described further in a recent WHO publication (2). The chapter thus provides an outline of the matters that will need to be considered. Further sources of detailed information are given in Annex 6.

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.

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 can 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 evacuation, 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 some victims are likely to move around in the symptom-free incubation period after exposure, cases of the disease may appear in different locations, even distant ones, and the full picture may 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 and the normal pattern of infectious disease in the locality concerned, 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. A sizeable 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 the timeliness 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. Further, it can 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 zoonotic.

A greater role in disseminating information on disease outbreaks and other health events is now being played by the media and certain interest groups, notably the Program for Monitoring Emerging Diseases (ProMed)\(^1\) now run by the International Society for Infectious Diseases in the United States. 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* (3).

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

\(^1\) See [http://www.promedmail.org](http://www.promedmail.org).
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 pattern 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 and 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.

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

4.2 Preparedness

4.2.1 Threat analysis

Threat analysis 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 likelihood or precise nature of the threat, and general preparedness measures will therefore usually be required. Judgements may 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 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.

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. Chapter 3 has identified a group of agents representative of those that may be of particular concern.

The level of threat that exists is also a function of the potential vulnerability of the community concerned. Vulnerability analysis will identify potential scenarios as well as 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). 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 international assistance (see Chapter 6 for sources of such assistance).

4.2.2 Pre-emption of attack

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 in war is considerably reduced by the mere existence of 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 possible vulnerabilities could produce. Ill-considered publicity given to the perceived threat of biological or chemical terrorism might have the opposite effect to that desired.

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.

An 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 be aided by concerted national and international efforts to monitor and control dual-use technology and equipment as, in the case of chemical and toxin attacks, by full implementation of the CWC, including its general purpose criterion. 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 deterring would-be users of biological or chemical weapons.

4.2.3 Preparing to respond

Pre-emptory efforts notwithstanding, the risk of a biological or chemical attack cannot be eliminated completely, and could have serious consequences if it occurred. 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 physicians, 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 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 could 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
sharing of information immediately an unusual incident is suspected. Education and training must cover the general characteristics of biological and chemical agents; the clinical presentation, diagnosis, prophylaxis and treatment of diseases that may be caused by deliberate agent-release; and sample handling, decontamination and barrier nursing. Training, planning and drills should be directed at 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 attack. 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 that 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 (or a network of laboratories in large areas) in which potential agents can be identified. 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 if regional laboratories have the necessary equipment and staff for that purpose. New diagnostic technologies mean that biological agents can be identified quickly, perhaps 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 not only result 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 contributing to spread of the disease.

Where a particular need for equipment, antidotes, antibiotics or vaccines has been identified, pre-attack stockpiling and planning of distribution systems, or designation of sources of rapid supply, 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 be justified only 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 logistic 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 vital 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 Annex 5.

4.2.4. Preparing public information and communication packages

If it is to have any chance of success, 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 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. 5–6). 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.

4.2.5 Validation of response capabilities

As with preparation for any high-consequence but low-frequency incident, it is a major challenge to prove and validate response capabilities if they are not being constantly practised or used. Realistic training simulations are a useful tool (7–9), and must be evaluated critically to identify areas that can be improved.

In addition, careful analysis of actual incidents, wherever they occur, should provide valuable information that could 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, a serious 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. Further information on this incident is given in Appendix 4.2 below.

The deliberate use of biological agents to cause harm has fortunately been rare. In 1984, and apparently with a view to influencing a local electoral process, a religious cult known as the Rajneeshees caused 751 people in a small town in Oregon, United States, to become ill by using cultures of Salmonella enterica typhimurium bacteria to contaminate the salad bars of 10 restaurants over a period of some two months (9–10). More recently, and with far more media exposure, letters containing Bacillus anthracis spores were distributed in the United States postal system. This incident is described in Appendix 4.3 below.

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 the release, if any, actually 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.

Early identification of the nature of the hazard. If a device or unusual package is found, it will be 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 presence of explosives, either as the primary hazard or as the disseminating charge for a toxic/infective agent, must also be considered, together with the possibility of the device containing a radioactive hazard. The appropriate specialists can then be called in to help in managing the incident, and the appropriate protective equipment selected. For example, an oronasal 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.

Risk reduction and/or neutralization. Depending on the nature of the device, the possibility of reducing the risk, or neutralizing the potential hazard, through containment or other mitigation and neutralization approaches should be considered. Whether it should be managed on-site or moved to a specialized facility would be a decision for specialists (equipment is available that allows on-site controlled and contained detonation of devices, together with decontamination of toxic/infective contents). Wherever possible, sampling for analytical and forensic purposes should be accomplished before destructive neutralization.

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. The differentiation of deliberate releases from natural morbidity is discussed in Annex 3.
### 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>Unusual 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>Sick or dying animals</td>
<td>Sick or dying animals</td>
</tr>
<tr>
<td>Devices, unusual liquid spray or vapour</td>
<td>Suspicious devices or packages Droplets, oily film Unexplained odour Low clouds or fog unrelated to weather</td>
<td>Suspicious devices or packages</td>
</tr>
</tbody>
</table>

*Source: Adapted from references 11 and 12.*
4.3.3 Response to biological incidents

Table 4.2 summarizes the major activities involved in responding to biological incidents. The sequence of events is based on application of the internationally accepted principles of risk analysis (see Appendix 4.1 for more detail on risk analysis).

Table 4.2 Major response activities for biological attack

| Assess the risks                        | Determine that a release has occurred or an outbreak is taking place |
|                                       | Identify the nature of the agent involved (hazard identification) and develop a case definition |
|                                       | Evaluate the potential outbreak spread and assess current and delayed case-management requirements, having regard to the possibility that the infection may be contagious (risk characterization) |

| Manage the risks (introduction of risk-reduction/control measures) | Protect responders and health-care workers |
|                                                                  | Introduce infection-prevention and control procedures |
|                                                                  | Conduct case triage |
|                                                                  | Ensure medical care of infected cases |

| Monitor all activities | Decide whether local and national resources are adequate or whether international assistance should be sought |
|                       | Implement active surveillance to monitor the effectiveness of the prevention and control procedures, follow up the distribution of cases (time, place and person), and adjust response activities as needed |
|                       | Repeat the risk-assessment/management process as required |
|                       | Implement longer term follow-up activities |

| Communicate the risks | Implement a risk-communication programme for the affected population that conveys information and instructions as needed |

The following discussion summarizes some of the most important considerations in the activities listed in Table 4.2. Sources of more detailed information that may be needed by response planners are given in Annex 6. 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 (13).

**Determination that a release has occurred or an outbreak is taking place**

All outbreaks of infectious disease should be considered natural events unless there is good reason to suppose otherwise (see Annex 3). 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, particularly whether the release was overt or covert. A covert release, just like any other outbreak of disease, will be detected only 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 could have been the result of a deliberate release. The importance of routine surveillance and the
prompt investigation of all outbreaks so that warning can be given that an unusual outbreak may be under way have 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. Significant advances will have to be made in technology before such methods can be made widely accessible, and they may therefore not be available for some time.

The extent to which laboratory support will be able to aid initial diagnosis and treatment will depend on both 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 immediately 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 on the steps to be taken.

Once the agent is identified, it is important to develop an initial hypothesis as to the exposure that is causing disease (source of the agent and mode of transmission). This hypothesis should be tested with clinical, laboratory or environmental data, field investigations and application of analytical epidemiology tools in comparing subgroups of the population.

**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 ongoing 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. For example, investigators of the accidental release of anthrax spores in 1979 from the military biological facility in Sverdlovsk, Soviet Union, were able to use aerosol spread analysis to show the striking occurrence of cases of pulmonary anthrax in persons located within specific isopleths originating from the point of suspected release (14–15).

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.
Protection of responders and health-care workers

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 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 (12, 16–17).

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 for 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 (contagious) 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 gymnasias, sports arenas or at home.

Immediate decontamination for people who may be exposed to biological attack is not so critical as it is for chemical casualties, since biological agents are non-volatile, are 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 periods (18). 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. Hypochlorite 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 (19). 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, formaldehyde vapour produced by heating paraformaldehyde, or other disinfecting fumigants. 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 (20).

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 into and out of the area, 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) (21), 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 preventive 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 3).

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 an 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 generally takes several weeks to develop fully 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 or identified, 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 available hospital beds 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.

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 exceed 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.

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, oronasal particulate or smog masks, or even improvised multilayer cloth filters, will provide some degree of protection.

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 at each level of responsibility 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 described above for biological incidents, by following the steps of the risk analysis process. This process is described in more detail in Appendix 4.1.
### Table 4.3  **Major response activities for chemical attack**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assess the risks</strong></td>
<td>Use rapid chemical detection and identification techniques to determine the causative chemical agent (hazard identification). Recruit the aid of specialists for definitive identification, needed for forensic and legal purposes. With initial response initiated (see below), activate more detailed assessments regarding dose–response relationships, exposure assessment and risk characterizations (see Appendix 4.1)</td>
</tr>
<tr>
<td><strong>Manage the risks</strong></td>
<td>Protect responders</td>
</tr>
<tr>
<td>(Introduction of risk-reduction/control measures)</td>
<td>Control contamination: establish “hot-zone” scene control to limit contamination spread conduct immediate operational decontamination onsite, and decontamination of all persons leaving the “hot-zone” Conduct casualty triage Ensure medical care and evacuation of casualties Conduct definitive decontamination of the site</td>
</tr>
<tr>
<td><strong>Monitor all activities</strong></td>
<td>Decide whether local and national resources are adequate, and whether international assistance should be sought Continuously monitor the residual hazard level on the site, and adjust response activities as needed Repeat the risk-assessment/management process as required Implement follow-up activities (e.g. of long-term injuries and rehabilitation)</td>
</tr>
<tr>
<td><strong>Communicate the risks</strong></td>
<td>Implement a risk-communication programme for the affected population that conveys information and instructions as needed</td>
</tr>
</tbody>
</table>

The following discussion summarizes some of the most important considerations in the activities listed in Table 4.3. Sources of more detailed information that may be needed by response planners are given in Annex 6.

### Hazard identification

Detection and identification are necessary 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 Gulf 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. Such investigative procedures have been practised but not yet invoked.

In an overt chemical release, an important component of exposure assessment is the prediction of the spread of the agent cloud. This will be useful 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 to varying degree 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 indicate where effects are likely to be greatest and to direct the deployment of resources.

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

While such models may be useful as planning tools, their limitations must also be appreciated. Results tend to be more accurate when wind speeds are higher, wind speed and direction are constant, and local topography is relatively flat. Wide and commonly occurring variations in these and other relevant variables, however, often reduce the accuracy of predictions to the level of generalized estimates.

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. An 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. A more detailed discussion of the issues surrounding protection can be found in Annex 5.
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, bypassing 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 bromide) 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. They will normally be used only 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 6.

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 (see Chapter 6). Because of the instability of some chemicals and the transient nature of their effects, this assistance must be mobilized as quickly as possible.

**Monitoring of the residual hazard**
There will be an ongoing 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 Iran–Iraq War of the 1980s (22–23).

**Risk communication and distribution of information**
If it is suspected that the hazard may spread to affect the downwind 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 section 4.3.4 for sealed areas for protection from biological agents, and with the same limitations).

**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, firefighters, 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.

**References**


APPENDIX 4.1: PRINCIPLES OF RISK ANALYSIS

Responding to biological or chemical attacks is a multidisciplinary and complex task. With an array of issues and questions, a means of ordering and prioritizing an approach to response is needed. The requisite response activities, and a logically ordered sequence for their implementation, can be identified using the risk analysis approach. This is an organized way in which to identify and evaluate hazardous conditions, and to take actions to eliminate, reduce or control the risk(s) posed by such conditions. These steps can be used to structure planning, and to identify areas needing attention during both the pre-attack “preparedness” phase, and the post-warning or post-attack “response” phase (and is the way in which the preceding chapter was structured). Although some detailed considerations for biological and chemical agents may differ (e.g. population vulnerability may be a more important consideration for biological than for chemical agents), the basic principles of approach remain the same.

The risk analysis approach is generally accepted to consist of risk assessment, risk management and risk communication. In this Appendix, risk assessment and risk management are further described in as much as they are applicable to chemical incidents. Risk communication has been detailed in the preceding chapter.

Risk assessment
Risk (threat) assessment includes hazard identification, hazard characterization (dose–response), exposure and consequence assessment, and risk characterization.

The first, and perhaps most difficult step in the process is to identify all hazardous conditions. Risk cannot be controlled unless hazardous conditions are recognized before they cause injury, damage to equipment or other accident. Once a hazardous condition is recognized it must be evaluated to determine the threat or risk it presents. The level of risk is a function of the probability of exposure to the hazard and the severity of the potential harm that would be caused by that exposure. Some hazards may present very little risk to people or equipment (e.g. a toxic chemical well enclosed in a strong container). Other hazards may cause death or serious injury if not controlled (e.g. a toxic chemical that has spilled into a busy workspace). In these two examples, the former situation carries a much lower probability of exposure than the latter. Even though the hazardous chemical may be the same substance, and the harm caused by exposure would be similar, the lower probability of exposure in the first situation results in a lower risk.

Chemicals generally can be divided into two groups: (i) chemicals causing toxic effects for which it is generally considered that there is a dose, exposure or concentration below which adverse effects will not occur (e.g. a chemical causing organ-specific, neurological/behavioural, immunological, non-genotoxic carcinogenesis, reproductive or developmental effects); and (ii) chemicals causing other types of effect, for which it assumed that is some probability of harm at any level of exposure – this currently applies primarily for mutagenesis and carcinogenesis. Many chemicals have been evaluated and the literature offers guidance values of levels of exposure below which it is believed that there are no adverse effects (i.e. threshold substances) and risks per unit exposure for those chemicals for which it is believed that there is a risk for health at any level of exposure (i.e. non-threshold substances).

Exposure or precursors of exposure such as concentrations in air, water or food can be measured and/or modelled. Transport and fate of chemical agents depends on their physico-chemical properties and can vary dramatically. During the risk-assessment phase of an incident, it is important to measure and/or model actual or future concentration/exposure/dose, as well as the spread of the causative chemical agent.

Risk characterization aims to provide a synthesis of the intrinsic (eco)toxicological properties of the causative chemical derived from hazard identification and dose–response relationship assessment with the actual or prognostic exposure. It takes into account uncertainties and provides the major input for making risk-management decisions. The process involves comparison of the outcome of the dose–response relationship assessment with the outcome
of the risk assessment in order to characterize the risk that populations are faced with, in order to recognize potential adverse health outcomes (e.g. there is a high, moderate or low risk).

**Risk management**

Risk management encompasses all those activities required to reach and implement decisions on risk reduction or elimination. Once a risk has been characterized, an informed decision can be made as to what control measures, if any, are needed to reduce the risks or eliminate the hazard. Control measures can consist of any action for risk reduction or elimination. Usually, however, control measures involve reducing the probability of occurrence or the severity of an incident. When toxic chemicals or infectious organisms are involved, control measures usually include administrative measures, engineering controls or physical protection. There is more detailed discussion of these measures in Annex 5. Control measures must be implemented before personnel or equipment are exposed to the hazardous condition. When controls are implemented, care must be taken to ensure that new hazardous conditions are not introduced as a result of the control measures.

There is no such thing as “no risk”. It may not always be possible to control all hazardous conditions completely. When some risk remains, a conscious decision must be made at the proper level as to whether the remaining risk is an “acceptable risk”. The concept of “acceptable risk” should not be unfamiliar as it is part of daily life. Everyone accepts a certain degree of risk in order to accomplish something beneficial. There is risk associated with flying on a commercial aeroplane. Most people (but not all) will accept the very small chance of an aeroplane accident in exchange for being able to reach their destination quickly.

The potential benefit to be gained from accepting a risk must always be worth the potential consequences of the risk itself. In some case, a high potential benefit may justify acceptance of a risk that would normally be unacceptable. Unnecessary risk, risk taken without a potential benefit, or risk taken without an appropriate risk assessment must not be accepted. The decision to accept risk must always be made at the proper level. If the evaluated worst-case result of an accident during a particular activity was, for example a minor injury, it might be appropriate for an on-site supervisor or area manager to accept the risk and to proceed without further hazard control measures. At the other end of the spectrum, a decision that could place the lives of many people in jeopardy should be made only at the highest level of authority. Of course, one never plans for an injury. Risk-reduction measures are always applied. What is referred to here is the consequence of an unexpected occurrence of an accident, despite taking reasonable precautions. If the residual risk is still assessed as being too high, the risk-control process needs to be repeated to lower the probability of occurrence or consequence of exposure even further.

A fundamental principle must always be observed when addressing “acceptable risk”. The number of personnel exposed to a hazardous condition, the amount of time for which they are exposed, and the level/concentration of hazard to which they are exposed must always be kept to the absolute minimum required to accomplish the task.

When applying the concept of “acceptable risk” to the possibility of chemical or biological attack, 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.

When a risk management process is being implemented, it is crucial that the control measures should be evaluated and monitored continuously to ensure that they are working as planned. If it is found that the control measures are not effective, they must be changed or modified immediately. Effective control measures should be recorded for use in controlling similar hazardous conditions in the future. Lessons should be learned by studying simulation
exercises, or similar hazards or incidents in other areas/countries, and adapting one’s own risk-management programme accordingly.
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 more than 5000 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 more than 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 (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 that 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 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 five assailants placed their sarin-filled bags on the train floor, pierced them with sharpened umbrella tips,1 and left the trains several stations away from Kasumigaseki.

The first emergency call was received by the Tokyo fire department at 08:09, and the emergency services were soon 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 1364 emergency medical technicians were dispatched, and 688 people were transported to hospital by the emergency medical and fire services. More than 4000 people found their own way to hospitals and doctors using taxis and 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 1). An official announcement by the police that sarin had been identified reached the hospitals, via the television news, about three 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 5000 people sought medical assistance.

Observations

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 5000” 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 5000 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 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

1 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.
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 outside Washington, DC, and into each of the twin towers of the World Trade Center in New York City, killing, it is now believed, more than 3100 people. Equally, it should be realized 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, before 11 September 2001, this was one of the most highly publicized terrorist attacks in history. The result for Aum Shinriko, however, can hardly be judged 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 for only 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 Shinriko attempted but failed to use biological agents effectively (7–9) 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 fulfill 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. 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 (10). 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 (11).

• 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). A contributing factor was 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% reporting mild effects also means that at least 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 as a result of the ergonomic problems of wearing protective clothing (see Annex 5). Rapidly deployable

1 See also Appendix 5.2.
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 have effectively 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. Pre-planned 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 untrained 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. Inclusion of the effects of chemical weapons and treatment of the resulting casualties both in 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 the United States on 11 September 2001. Despite many difficulties, Japanese 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.

**References**


During the autumn of 2001, several letters containing spores of *Bacillus anthracis* were sent through the United States postal system, causing 11 cases of inhalational anthrax, five of them fatal, and 11 confirmed or suspected cases of non-fatal cutaneous anthrax. The first onset, of cutaneous anthrax, occurred in late September and the last, of inhalational anthrax, in mid-November. Of the four letters that were recovered, one was addressed to a television newscaster, another to the editor of a newspaper, both in the city of New York, and two were addressed to United States senators in Washington, DC.

Twenty of the 22 patients were exposed to work sites that were found to be contaminated with anthrax spores. Nine of these had worked in United States Postal Service (USPS) mail-processing facilities through which the anthrax letters had passed. Two patients, both with fatal inhalational anthrax, had no known exposure to contaminated mail or contaminated premises.

Polymerase chain reaction (PCR) tests and DNA sequencing indicated that all attacks involved the same strain of *B. anthracis*. A year after the attacks, two United States mail-processing facilities remained shut down pending decontamination, and accountability for the letters remains a mystery.

This appendix outlines some of the relevant background and summarizes information about the letters, the patients, the public health response, and the clean-up operations. Sources include reports and publications by the United States Centers for Disease Control and Prevention (CDC), the United States Federal Bureau of Investigation (FBI), and the USPS, as well as United States Congressional hearings, official statements to the press, the medical literature, and accounts of USPS officials and postal workers.

**Background**

In 1990, immediately before the Gulf War, the United States’ concern about potential anthrax attacks led to the vaccination of more than 100,000 military personnel. In 1995 this concern was again aroused when the United Nations Special Commission (UNSCOM) learned that Iraq had been developing and testing anthrax weapons during the Kuwait War. In 1998, a programme was initiated to vaccinate all United States military personnel and a Presidential Decision Directive further defined the authority and responsibilities of United States government agencies for responding to possible biological or chemical terrorist attacks on United States civilian centres. This reaffirmed and refined a 1995 Directive designating the FBI, as assigned by the Department of Justice, as the lead agency in charge of investigation and overall response management, with authority to designate other government agencies as lead agencies for specific operational tasks. By 2001, with federal assistance, most American state and large-city governments had begun to develop plans to deal with bioterrorism and many had staged mock attacks to test local emergency response capacity.

Starting in 1997, the United States experienced an increasing number of anthrax threats and hoaxes that, by the end of 1998, were almost a daily occurrence. Prominent among these were envelopes containing various powders and materials sent through the postal service to abortion and reproductive health clinics, government offices, and other locations. Until the events of autumn 2001, none of these materials tested positive for pathogenic *B. anthracis* nor had there been a case of inhalational anthrax in the United States since 1976.

In Canada, after several anthrax hoax letters there, the Defence Research Establishment Suffield conducted experiments during February–April 2001 to estimate the hazards arising from opening a letter containing spores of *B. anthracis*. The Canadian researchers used as a simulant spores of non-pathogenic *B. globigii*, donated by the United States Department of Defense, Dugway Proving Ground, Utah. It was found, contrary to the expectation of those conducting the tests, that large numbers of spores were released into the air upon opening an envelope containing even as little as a tenth of a gram of spores, and that large doses would be inhaled by an unprotected individual in the room in which the letter was opened. The ensuing report, released in September 2001, also warned that envelopes not thoroughly
sealed could pose a threat to individuals in the mail-handling system. Following the United States anthrax-letter attacks, however, it was realized that anthrax spores might escape even from fully sealed envelopes, depending on the type and grade of paper.

Dose–response measurements over a range of doses of anthrax spores to cynomolgus monkeys conducted in the pre-1969 United States offensive biological weapons programme had shown that under the experimental conditions employed, the inhalational median lethal dose (LD₅₀) was about 4000 spores. Although other measurements carried out with monkeys under various experimental conditions gave a wide range of LD₅₀ values and although there are no reliable dose–response data for inhalational anthrax in any human population, it was subsequently assumed for military planning purposes that the human LD₅₀ was approximately 8000–10 000 spores. While it is self-evident that doses below the LD₅₀ will infect less than 50% of an exposed population, it is not known whether inhalation of even a single spore can initiate infection, albeit with very low probability. Uncertainty regarding dose–response relationships for human populations continues to make hazard prediction for inhalational anthrax problematic.

In contrast to inadequate or insufficiently appreciated knowledge regarding the dispersibility of dry spore powders, the permeability of sealed envelopes and dose–response relationships, effective medical measures for prophylaxis and therapy of cutaneous and inhalational anthrax were established and published in the medical literature well before the anthrax-letter attacks. Long experience with human cutaneous anthrax had shown it to be readily curable with several antimicrobials. Although penicillins were recommended for treatment of cutaneous anthrax, recent studies of experimental inhalation anthrax in monkeys led to the designation of doxycycline and ciprofloxacin as the antimicrobials of choice, both for prophylaxis in cases of known or suspected exposure and, if given soon after the onset of clinical disease, as therapy. Because of the possible retention of infective spores in the lungs for many days before an infection starts, suggested by United States monkey studies and human data from the 1979 Sverdlovsk (former Soviet Union) epidemic, it was recommended that antimicrobial therapy be continued for as long as 60 days following inhalatory exposure.

The anthrax letters
All four of the recovered spore-containing envelopes were sealed with tape and postmarked from Trenton, New Jersey. Envelopes, postmarked 18 September 2001, were addressed to a National Broadcasting Company (NBC) television newscaster and to the editor of the New York Post at their New York City offices. Two other envelopes, postmarked 9 October 2001, were addressed to Senator Tom Daschle and Senator Patrick Leahy at their Washington offices. All four recovered envelopes were postmarked and sorted at a mail-processing facility in Hamilton Township, near Trenton, before being sent to other processing and distribution centres. Those addressed to the two senators were processed at the Brentwood facility in Washington. Both facilities were found to be heavily contaminated with anthrax spores.

There are indications that at least three additional anthrax letters were sent but were lost or discarded. There were confirmed cases of cutaneous anthrax at the offices of American Broadcasting Company (ABC) and of Columbia Broadcasting System (CBS) Television News in New York and of inhalational anthrax at American Media Incorporated (AMI) in Boca Raton, Florida. Positive nasal swabs were obtained and environmental contamination was found at all three sites, and contamination was found at several mail-processing facilities through which their mail passed. Individuals at all three locations fell ill before 9 October, making it possible that three unrecovered letters were posted together with the two recovered letters of 18 September.

Both of the letters postmarked 18 September contained identical hand-printed messages in block letters that included the words “TAKE PENACILIN NOW” [sic], and both letters postmarked 9 October contained identical messages with the words “WE HAVE THIS ANTHRAX”. Given that penicillin has historically been a recommended antimicrobial therapy against anthrax, that the strain used was subsequently found to be sensitive to penicillin, and that identification of the pathogen would facilitate appropriate therapy, it appears that the perpetrator sought to convey information that would enable the recipients to take protective action.
All four recovered letters included the words “ALLAH IS GREAT” and the date “09-11-01”, the
day of the aircraft attacks on the World Trade Center in New York and the Pentagon in
Virginia, apparently with the intention to portray the sender as an Islamic terrorist.

The two letters dated 18 September and the letter addressed to Senator Daschle were
recovered from the offices of their addressees, but the letter to Senator Leahy, which had
been misdirected by a mechanical error to the State Department, was discovered in
November only after a search of unopened government mail collected from the United States
Capitol. This was collected in 635 rubbish bags that were then sealed and individually
sampled for anthrax spores. Sixty-two bags were found to be contaminated, one far more
than the others. Individual examination of the letters it contained then led to the discovery of
the Leahy letter.

The anthrax strain was identified as the variant called Ames, originally isolated from a
diseased cow in Texas in 1981 and sent to the United States Army Research Institute for
Infectious Diseases (USAMRIID) at that time. From there, it was distributed to laboratories in
the United States, the United Kingdom, Canada, and elsewhere. The 9 October letters
contained a highly pure preparation of anthrax spores, almost entirely free of debris, while the
18 September material was decidedly less pure, containing an appreciable proportion of
vegetative $B. \text{anthracis}$ cells. No additives have been confirmed to have been present.
Carbon isotope ratio analysis of the material in the Leahy envelope indicated that it had been
produced within the two years preceding its mailing.

The patients
On or about 25 September, an assistant in the office where the NBC anthrax letter had been
received and taken into custody by the FBI developed a lesion diagnosed by her physician as
possibly being cutaneous anthrax, but this was not confirmed by laboratory testing until 12
October. The first case to reach public notice was that of an AMI photo editor in Florida. After
an illness of several days, he died of inhalational anthrax on 5 October, one day after
laboratory confirmation of the diagnosis by the Florida Department of Health and CDC.
Although the federal authorities at first considered naturally occurring anthrax infection to be a
possibility, the discovery of environmental contamination at AMI caused the FBI on 7 October
to declare the site a crime scene. On 1 October, a second AMI employee, a mailroom worker,
was hospitalized with a misdiagnosis of community-acquired pneumonia, later diagnosed as
anthrax by laboratory testing on 15 October. He recovered and was discharged on 23
October.

Of the 22 confirmed or suspect cases, 12 (eight inhalational and four cutaneous) were mail
handlers. These included 9 USPS workers, 2 media company mailroom workers, and an
employee in the State Department mailroom through which the Leahy letter had mistakenly
passed. An additional case of cutaneous anthrax was a Texas laboratory worker engaged in
testing samples from the outbreak.

Recorded onsets of symptoms fall into two clusters, 22 September–1 October and 14
October–14 November, with a 12-day gap between with no recorded onsets (Table 4.4). The
two clusters may reflect the two dates on which the recovered letters were posted. Most of the
inhalational cases (9 of the 11) were in the second cluster, six of them being USPS workers.
This concentration of inhalational cases in the second cluster and among postal workers may
reflect differences in the spore preparations; greater inhalatory exposure in mail-processing
facilities, where sorting and cleaning operations generate aerosols, and/or differences
between work sites in the time elapsed between exposure and the start of antimicrobial
prophylaxis.

In the first cluster, 22 September–1 October, seven patients developed confirmed or
suspected cutaneous anthrax. None of these cases was diagnosed by laboratory testing until
12 October or later. Overall, the time between onset and laboratory diagnosis ranged from 2
to 26 days for cutaneous anthrax and from 3 to 16 days for inhalational anthrax, with
laboratory diagnosis becoming more prompt as the outbreak progressed. Although cutaneous
anthrax was diagnosed by laboratory testing in two workers at the Hamilton mail-processing
facility on 18 and 19 October (after which the facility was closed), the risk from leaking envelopes was not understood by officials in time to prevent inhalational anthrax in two Hamilton employees and in four employees at Brentwood (which closed on 21 October), two of whom died.

The last two cases, both inhalational and both fatal, had recorded onsets of 25 October and November 14. Unlike any of the earlier infections, there was no known link to the anthrax letters and no evidence of environmental contamination. In the first of these perplexing cases, an employee at a New York hospital died on 31 October. Although her workplace had housed a temporary mailroom, no contamination was found there. In the second case, a 94-year old woman residing in Connecticut died on 21 November. Whatever the source of the pathogen, these two cases emphasize the possibility that, with very low probability, perhaps depending on the health status and age of the individual, even small numbers of inhaled spores may initiate infection.

No onset of any form of anthrax was recorded among personnel at any site after they were instructed to start antimicrobial prophylaxis. Six patients diagnosed with inhalational anthrax who were admitted to hospital with only prodromal symptoms and were given antimicrobials active against \textit{B. anthracis} survived. These observations are consistent with pre-existing experimental and clinical evidence and indicate that antimicrobial prophylaxis prevented clinical disease in exposed people, limiting the extent and duration of the outbreak, and that antimicrobial therapy, when begun soon after onset, prevented death.

**Public health response**

Most cases were detected through self-reporting and from unsolicited reports from clinical laboratories and clinicians, with the assistance of active surveillance established by local public health authorities.

After laboratory confirmation of cutaneous anthrax in an NBC employee on 12 October, an Emergency Operations Center was established at CDC to organize teams of epidemiologists and laboratory and logistics staff to support local, state and federal health investigations. Investigators responded to reports of possible cases from clinicians, law enforcement officials, and the general public.

Local and federal agencies, including the Office of the Attending Physician, United States Congress, implemented the rapid distribution of antimicrobials (ciprofloxacin and doxycycline) to individuals after an inhalational anthrax risk was officially estimated at specific sites. The United States National Pharmaceutical Stockpile, mandated by the United States Congress in 1999, facilitated the emergency availability of drugs to some 32 000 people who were potentially exposed. Altogether, National Pharmaceutical Stockpile teams distributed some 3.75 million antimicrobial tablets. Those presumed to be at higher risk were advised to remain on a prolonged course of 60 days and were encouraged to participate in a follow-up study conducted by CDC through a private contractor. At that time, they were also given the option of anthrax vaccination. Public health officials were candid about the limited data supporting the efficacy of post-exposure vaccination. Fewer than 100 people, many of them Senate staff, took advantage of the offer.

During the crisis, collection and testing of environmental and clinical samples, as well as materials from suspicious incidents and hoaxes, placed an immense burden on the FBI, Defense Department, CDC, and public health laboratories throughout the United States. The magnitude of the clinical and environmental testing undertaken would have quickly overwhelmed the United States national capacity had a significant investment not already been made in expanding laboratory training and capacity through a system called the Laboratory Response Network. This links state and local public health laboratories with advanced capacity clinical, military, veterinary, agricultural, and water- and food-testing laboratories. Established in 1999, it operates as a network of laboratories with progressively more stringent levels of technical proficiency, safety, and containment necessary to perform the essential rule-out, rule-in, and referral functions required for agent identification. The network consists of 100 core and advanced capacity public health laboratories and two
higher-level laboratories, at USAMRIID and at the CDC National Center for Infectious Diseases.

During the acute phase of the outbreak, Laboratory Response Network laboratories processed and tested more than 120,000 environmental and clinical specimens for *B. anthracis*. This was accomplished chiefly by state and local public health laboratories, USAMRIID, the Naval Medical Research Center and CDC. Forensic tests and analyses of the recovered anthrax-contaminated envelopes and their contents and of control materials were conducted by the FBI, Northern Arizona University, USAMRIID, Lawrence Livermore National Laboratory, Sandia National Laboratories and several other facilities. Epidemiological investigations were performed or coordinated by CDC.

**Environmental contamination and decontamination**

FBI, CDC, and USPS personnel and contractors collected surface samples from diverse locations, including offices, postal facilities and private homes. Samples collected from adjacent surfaces by swipes with wet cotton or rayon gauze and by vacuum collection through high-efficiency particulate arresting (HEPA) filters gave reasonably concordant results, but dry swipes consistently gave far less agreement and were judged unacceptable. At some sites, air sampling was also conducted. Contamination was found in at least 23 postal facilities and post offices, nearly all in New Jersey, New York, Washington, and south Florida but also as distant as Kansas City. The risk of disease associated with any level of air or surface contamination remained undefined, though more valid sampling and risk estimates quickly became a high priority for United States public health officials.

USPS mail-processing facilities were the most extensively affected environments. Mechanical agitation and air turbulence produced by high-speed sorting equipment and the use (now discontinued) of compressed air to clean machines undoubtedly contributed to the creation of dangerous aerosols and high levels of surface contamination. The Hart Senate Office Building was decontaminated with gaseous chlorine dioxide and is again in operation. After a year, the Brentwood and Hamilton mail-processing facilities remained closed, pending decontamination. In order to reduce potentially contaminated dust and aerosols from the atmosphere in its facilities, the USPS has introduced some 16,000 HEPA vacuum machines and, as a precaution, routinely sterilizes mail going to federal agencies by electron-beam irradiation. For the two fiscal years 2003–2004, it has budgeted US$ 1.7 billion for additional modifications and improvements in its ability to protect the health of its workers and to prevent pathogens and other hazardous substances from being distributed through the mail.
Table 4.4. **Postal anthrax attacks 2001: demographic, clinical and exposure characteristics of the 22 cases**

<table>
<thead>
<tr>
<th>Case number</th>
<th>Date of onset of symptoms</th>
<th>Date of anthrax diagnosis by laboratory testing</th>
<th>Age (yrs)</th>
<th>Sex</th>
<th>Race</th>
<th>Occupation</th>
<th>Case status</th>
<th>Anthrax presentation</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>22 September</td>
<td>19 October</td>
<td>NY 31</td>
<td>F</td>
<td>W</td>
<td>New York Post employee</td>
<td>Suspect</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>2</td>
<td>25 September</td>
<td>12 October</td>
<td>NY 38</td>
<td>F</td>
<td>W</td>
<td>NBC anchor assistant</td>
<td>Confirmed</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>3</td>
<td>26 September</td>
<td>18 October</td>
<td>NJ 39</td>
<td>M</td>
<td>W</td>
<td>USPS machine mechanic</td>
<td>Suspect</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>4</td>
<td>28 September</td>
<td>15 October</td>
<td>FL 73</td>
<td>M</td>
<td>W, H</td>
<td>AMI mailroom worker</td>
<td>Confirmed</td>
<td>Inhalational</td>
<td>Alive</td>
</tr>
<tr>
<td>5</td>
<td>28 September</td>
<td>18 October</td>
<td>NJ 45</td>
<td>F</td>
<td>W</td>
<td>USPS mail carrier</td>
<td>Confirmed</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>6</td>
<td>28 September</td>
<td>12 October</td>
<td>NY 23</td>
<td>F</td>
<td>W</td>
<td>NBC television news intern</td>
<td>Suspect</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>7</td>
<td>29 September</td>
<td>15 October</td>
<td>NY 0.6</td>
<td>M</td>
<td>W</td>
<td>Child of ABC employee</td>
<td>Confirmed</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>8</td>
<td>30 September</td>
<td>04 October</td>
<td>FL 63</td>
<td>M</td>
<td>W</td>
<td>AMI photo editor</td>
<td>Confirmed</td>
<td>Inhalational</td>
<td>Dead (5 October)</td>
</tr>
<tr>
<td>9</td>
<td>01 October</td>
<td>18 October</td>
<td>NY 27</td>
<td>F</td>
<td>W</td>
<td>CBS anchor assistant</td>
<td>Confirmed</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>10</td>
<td>14 October</td>
<td>19 October</td>
<td>PA 35</td>
<td>M</td>
<td>W</td>
<td>USPS mail processor</td>
<td>Confirmed</td>
<td>Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>No.</td>
<td>Date of Onset</td>
<td>Date of Offsets</td>
<td>State/City</td>
<td>Age</td>
<td>Sex</td>
<td>Race/Ethnicity</td>
<td>Occupation</td>
<td>Disease Category</td>
<td>Condition at Time of Data Collection</td>
</tr>
<tr>
<td>-----</td>
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<td>-------------------------------------</td>
</tr>
<tr>
<td>11</td>
<td>14 October</td>
<td>28 October</td>
<td>NJ</td>
<td>56</td>
<td>F</td>
<td>B</td>
<td>USPS mail processor</td>
<td>Confirmed Inhalational</td>
<td>Alive</td>
</tr>
<tr>
<td>12</td>
<td>15 October</td>
<td>29 October</td>
<td>NJ</td>
<td>43</td>
<td>F</td>
<td>A</td>
<td>USPS mail processor</td>
<td>Confirmed Inhalational</td>
<td>Alive</td>
</tr>
<tr>
<td>13</td>
<td>16 October</td>
<td>21 October</td>
<td>DC</td>
<td>56</td>
<td>M</td>
<td>B</td>
<td>USPS mail worker</td>
<td>Confirmed Inhalational</td>
<td>Alive</td>
</tr>
<tr>
<td>14</td>
<td>16 October</td>
<td>23 October</td>
<td>DC</td>
<td>55</td>
<td>M</td>
<td>B</td>
<td>USPS mail worker</td>
<td>Confirmed Inhalational</td>
<td>Dead (21 October)</td>
</tr>
<tr>
<td>15</td>
<td>16 October</td>
<td>26 October</td>
<td>DC</td>
<td>47</td>
<td>M</td>
<td>B</td>
<td>USPS mail worker</td>
<td>Confirmed Inhalational</td>
<td>Dead (22 October)</td>
</tr>
<tr>
<td>16</td>
<td>16 October</td>
<td>22 October</td>
<td>DC</td>
<td>56</td>
<td>M</td>
<td>B</td>
<td>USPS mail worker</td>
<td>Confirmed Inhalational</td>
<td>Alive</td>
</tr>
<tr>
<td>17</td>
<td>17 October</td>
<td>29 October</td>
<td>NJ</td>
<td>51</td>
<td>F</td>
<td>W</td>
<td>Bookkeeper</td>
<td>Confirmed Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>18</td>
<td>19 October</td>
<td>22 October</td>
<td>NY</td>
<td>34</td>
<td>M</td>
<td>W, H</td>
<td>New York Post mail handler</td>
<td>Suspect Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>19</td>
<td>22 October</td>
<td>25 October</td>
<td>DC</td>
<td>59</td>
<td>M</td>
<td>W</td>
<td>Government mail processor</td>
<td>Confirmed Inhalational</td>
<td>Alive</td>
</tr>
<tr>
<td>20</td>
<td>23 October</td>
<td>28 October</td>
<td>NY</td>
<td>38</td>
<td>M</td>
<td>W</td>
<td>New York Post employee</td>
<td>Confirmed Cutaneous</td>
<td>Alive</td>
</tr>
<tr>
<td>21</td>
<td>25 October</td>
<td>30 October</td>
<td>NY</td>
<td>61</td>
<td>F</td>
<td>A</td>
<td>Hospital supply worker</td>
<td>Confirmed Inhalational</td>
<td>Dead (31 October)</td>
</tr>
<tr>
<td>22</td>
<td>14 November</td>
<td>21 November</td>
<td>CT</td>
<td>94</td>
<td>F</td>
<td>W</td>
<td>Retired at home</td>
<td>Confirmed Inhalational</td>
<td>Dead (21 November)</td>
</tr>
</tbody>
</table>

NY, New York; FL, Florida; NJ, New Jersey; DC, District of Columbia; CT, Connecticut; F, female; M, male; W, white; B, black; A, Asian; W/H, white with Hispanic ethnicity; NY, New York; NBC, National Broadcasting Company; AMI, American Media Inc.; USPS, United States Postal Service; CBS, Columbia Broadcasting System.

5. LEGAL ASPECTS

National and international law was 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. The status of individual WHO Member States under the three treaties is set out in Annex 7.

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 (1) 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 (2) 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. At the time of writing, it has 130 States Parties, including the five permanent members of the United Nations Security Council but not including 64 WHO Member States.1

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. Some States Parties also 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, 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 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 (3). Opened for signature on 10 April 1972 and entering into force on 26 March 1975, the BWC now has 146 States Parties, including the five permanent members of the United Nations Security Council but not including 48 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. It is clear from the proceedings both of its negotiation and of its subsequent review conferences that the term “toxins” is not limited to microbial products but includes all toxic substances produced by living organisms even when they are actually produced synthetically. There is a description of toxins in Annex 2.

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 nine 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 five or six 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 five States Parties affirmed that they had had such programmes, disclosing particulars. The five 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 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 worked from 1995 to 2001 without reaching consensus on such an instrument.

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1 See Annex 7.
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* (4) was opened for signature on 13 January 1993, entered into force on 29 April 1997 and, as of October 2002, had 147 States Parties, including the five permanent members of the United Nations Security Council but not including 47 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.

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

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1 This means that 147 states had deposited their instruments either of ratification of the CWC or of accession to it. An additional 27 states, all of which are members of WHO, had signed the treaty, but not yet ratified their signature.

2 See Annex 7.
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).

While fewer 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 (6).

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.

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 five 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 15 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; mixtures); 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; environmental measures; and primacy of the Convention) (7–8).

Five years after the entry into force of the CWC, 43% 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 fulfill their obligations under Article VII (9). In December 2001, the OPCW Executive Council identified full implementation of the legislative measures required by Article VII as one of the five priority areas to be focused upon in OPCW’s contribution to global antiterrorist efforts.

5.4 Conclusions

Through its contribution both to preventing the release of biological or chemical agents for hostile purposes and to mitigating the consequences 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.

References


3. The text of the Biological Weapons Convention is available in reference 1 and also at www.opbw.org.


APPENDIX 5.1: BWC IMPLEMENTING LEGISLATION

Legislation to enforce the prohibitions of Article I

Article IV of the BWC provides that each State Party shall take any necessary measures to prohibit and prevent the development, production, stockpiling, acquisition or retention of the agents, toxins, weapons, equipment and means of delivery specified within Article I of the Convention. It further requires that these measures apply within the territory of the State, under its jurisdiction or under its control anywhere. At subsequent Review Conferences, States Parties have been invited to consider the application of such measures also to actions taken anywhere by natural persons possessing its nationality. For consistency with the Convention, the national legislation or measures should incorporate the definition of biological weapons as contained in the Convention. 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 biological and toxin weapons as a means of warfare or as a terrorist threat.

Examples are provided below of the relevant language in the legislation enacted by three of the States Parties.

**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.”

Legislation regulating exports of agents and toxins

Article III of the BWC provides that each State Party undertakes not to transfer to any recipient whatsoever, directly or indirectly, and not in any way to assist, encourage or induce any State, group of States or international organizations to manufacture or otherwise acquire any of the agents, toxins, weapons, equipment and means of delivery specified within Article I of the Convention. At subsequent Review Conferences, it has been stated that States Parties should also consider ways and means to ensure that individuals or subnational groups are
effectively prevented from acquiring, through transfers, biological agents and toxins for other than peaceful purposes.

Examples are provided below of the relevant language in the legislation adopted by two States Parties.

**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 offences.

...  
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

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 (1).

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.

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) facilitates ratification of, and
accession to, the CWC; (iii) makes a single interministerial agency in each country
responsible for pesticides and toxic chemicals and serve as the National Authority under the
Convention; and (iv) enables the CWC to be enforceable in the subregion (2).

References

1. Yepes-Enríquez R, Tabassi L, eds. *Treaty enforcement and international cooperation
in criminal matters with special reference to the Chemical Weapons Convention*. The

2. An integrated approach to national implementing legislation/model act developed by
the secretariat of the Organisation of Eastern Caribbean States. OPCW document
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 below, pages INSERT). In the case of chemical attack the Organisation for the Prohibition of Chemical Weapons (OPCW) (see section 6.2 below, pages INSERT) 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 below, pages INSERT). The BWC also requires its States Parties to come to each other’s assistance in certain circumstances (see section 6.3 below, pages INSERT).

General medical assistance can be provided in either case by the World Health Organization (WHO) (see section 6.4 below, pages INSERT). The Food and Agriculture Organization of the United Nations (FAO) (see section 6.5 below, pages INSERT) and the Office International des Epizooties (OIE) (see section 6.6 below, pages INSERT) 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 below, pages INSERT) 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 logistic 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 below, pages INSERT).

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 1987, 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 (1).
The CWC, which entered into force on 29 April 1997, obliges OPCW 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 Part XI, paragraph 27, of the CWC Verification Annex and with Article II.2(c) of the Relationship Agreement between the United Nations and OPCW that entered into force on 11 October 2001.

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 occurred so that on-site visits were not possible; the results were inconclusive (2).

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 (3–10).

1987–1988: **Iraq.** Chemical injuries to Iraqi soldiers were verified by the investigators (6–7, 9), who reported finding no conclusive evidence of how the injuries had been caused (11).

1992: **Mozambique.** Investigations were made more than a month after the alleged attack; no proof was found of the use of chemical weapons (12).

1992: **Azerbaijan.** The investigation was requested by the state accused of resorting to chemical warfare in order to demonstrate its innocence; a timely on-site visit did not reveal any proof of use of chemical weapons (13).

1993: **Iraq.** Investigation of the alleged internal use of chemical weapons did not reveal any proof of such use (14).

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 section 6.3 below, pages INSERT.)

It is highly desirable 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
evaluation 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 recovery, and development needs.

WFP could provide, consistent with its policies and when given resources by donors,
emergency food and associated logistic 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;\(^1\)
b) riot control agents have been used against it as a method of warfare; or
\(c) \text{it is threatened by actions or activities of any State that are prohibited for States}
\text{Parties by Article I.}\)

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 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

\(^1\) 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.
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 May 2002, the voluntary fund had received about one million Euros in contributions, and 33 States Parties had 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 databank 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 databank 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 databank 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.

Although this provision has so far not been invoked, the States Parties at their Review Conferences have reaffirmed their undertaking to provide or support assistance. They have also said that, should this Article be invoked, they consider that the United Nations, with the help of appropriate international organizations such as WHO, could play a coordinating role.

Provision for consultation is 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. At their third Review Conference, in 1991, they expanded the procedure. A consultative meeting of this type was convened in 1997 to address a problem in which Cuba had alleged that, in October 1996, phytophagous insects had been released over Cuba by the United States (15).

6.4 World Health Organization

WHO is a specialized agency of the United Nations with 192 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 became officially engaged with the subject 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.1

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1 See section 1.2.
A number of WHO programmes provide technical assistance on various relevant aspects of public health, such as: preparedness for, and response to, natural and man-made disasters, earthquakes being an example of the former; chemical or radiological accidents; complex humanitarian emergencies; 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 twentieth century.

The International Programme on Chemical Safety (IPCS), a joint venture of the United Nations Environment Programme (UNEP), the International Labour Organization (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.

6.6 Office International des Epizooties

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 ongoing 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.¹

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.

6.7 Nongovernmental organizations

Nongovernmental organizations are non-profit-making, voluntary citizens’ groups at the local, national or international level, 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, their mandate and their resources. 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.

6.8 Contact information

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¹ *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 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 that are significant in the international trade of animals and animal products.
Outside official working hours, the Duty Officer of the OCHA office in Geneva can be reached at any time through the emergency telephone number +41 22 917 2010.

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