HEALTH ASPECTS OF BIOLOGICAL AND CHEMICAL WEAPONS

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PROPOSED TEXT (CHAPTERS ONLY)

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EXECUTIVE SUMMARY

The development, production and use of biological and chemical weapons are prohibited by international treaties to which most states of the world have subscribed: the 1925 Geneva Protocol,[1] the 1972 Biological and Toxin Weapons Convention,[2] and the 1993 Chemical Weapons Convention.[3] Not all states have joined, however, and valid concerns remain that some states may yet resort to the weapons. Moreover, non-state entities may try to gain access to the weapons for purposes of terrorism.

In fact the development, production and use of biological and chemical weapons present significant difficulties. Resort to the weapons, particularly biological weapons, has been rare. Even so, the magnitude of possible impacts on civilian populations of their use or threatened use obliges governments both to seek prevention and to prepare response plans. Such response plans can and should be developed as an integral part of existing national emergency plans.

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

[1] Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare.
[2] Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction.
[3] Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction.

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 prevailing circumstances. Such circumstances include national assessments of the likelihood of attacks using biological or chemical weapons.

The danger should not be disregarded that over-optimistic evaluation of protective preparation will distract attention from the continuing importance of prevention, as by 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 putting practical arrangements into place for such assistance in regard to chemical weapons. As yet, there is no similar organization for biological weapons, but the WHO, among other actors, can provide some assistance to its member states.

Each of these matters is discussed in detail in the main body of the present report. The following practical recommendations emerge:

(1) Public-health authorities, in close co-operation with other parts of government, should have contingency plans prepared in case of a deliberate release of biological or chemical agents against civilian populations. The plans should be consistent or integral with existing plans that address outbreaks of disease, natural disasters, large-scale industrial or transportation accidents, and terrorist incidents. In accordance with resolution WHA54.14, technical support is available from WHO 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.

(2) Standard principles of risk-management should inform preparedness against deliberate releases of biological or chemical agents, starting with an assessment of the relative priority that should be accorded to such releases in comparison with other dangers to public health in the country concerned.

(3) A major contribution to preparedness against deliberate releases of biological or chemical agents in most countries can be achieved by strengthening public-health infrastructure, particularly for public-health surveillance and response.

(4) Managing the consequences of a deliberate release of biological or chemical agents may demand more resources than are available. International assistance could become essential. Channels for such international assistance are available and should be identified.

(5) Attention is drawn to the international assistance and support available to all countries which are Member States of specialized organizations such as OPCW (e.g. in cases of use or threat of use of chemical weapons, and for preparedness planning), and to States Parties to the1972 Biological and Toxin Weapons Convention (e.g. in cases of violation of the Treaty)." It is recommended for countries to actively participate in these multilateral regimes.

(6) With the entry into force of the 1972 and 1993 Conventions and their continuing progress towards universality, there have been great strides 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 moves deeper into the new age of biotechnology, WHO Member States are reminded that every major new technology of the past has come to be exploited, intensively, not only for peaceful purposes, but also for hostile ones. All states are therefore encouraged to implement the two Conventions fully and transparently; to propagate in education and professional training the ethical principles that underlie the Conventions; and to support measures that would build upon their implementation.

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

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CHAPTER 1: INTRODUCTION

1.1 DEVELOPMENTS SINCE THE FIRST EDITION

Thirty years have passed since the World Health Organization published its 1970 report *Health Aspects of Chemical and Biological Weapons* (1.01). During that time there have been significant changes. On the negative side there has been the large-scale use of both mustard gas and nerve gas in the Iran/Iraq war; the use of these agents by the Iraqi government against its own citizens, most conspicuously at Halabja in March 1988;[4] and the use of sarin on two occasions (in 1994 and 1995) by the Aum Shinrikyo religious cult in public places in Japan, including the Tokyo subway (the cult also made preparations, fortunately ineffective, to use biological weapons). On the positive side, the Biological and Toxin Weapons Convention and the Chemical Weapons Convention came into force in 1975 and 1997 respectively, and the Organisation for the Prohibition of Chemical Weapons (OPCW) has started its work of supervising the destruction of chemical weapon stocks, including those of Russia and the United States, and monitoring the world's chemical industry to prevent future misuse. These and other developments, both technical and political, over that period led to a need for a review. This Second Edition is the result.

The technical situation has been one of further development along already identified lines rather than totally new concepts. The most important agents of biological and chemical warfare probably still include ones listed in the 1970 edition. There have been rumours of nerve gases of still greater power than VX or VR, but the main important development in chemical weapons has been the 'binary munition',

[4] Statement by the UN Secretary-General to the 3rd Meeting of the General Assembly of 12 October 1998 (document A/C.1/53/PV.3), 3-5.

which carries out the final stage of synthesis of the agent from precursors 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 additional biological-warfare agents. The accessibility of biological agents on a militarily significant scale has been much enhanced by advances in industrial microbiology and its spreading practice throughout the world.

The year 1970 represented 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 separate its consideration of biological and chemical weapons, which, as in the 1925 Geneva Protocol prohibiting their use, had previously been considered together. 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 action. The resultant Biological and Toxin Weapons Convention (hereinafter '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 to address concerns about compliance. This work is still in progress.

The Geneva disarmament conference intensified its efforts on the problem of chemical weapons in the 1980s and submitted the completed 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 (hereinafter 'CWC') contained elaborate verification provisions to be operated through a new international organization, the OPCW, headquartered in The Hague. The 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 First Edition of this report. It now resides mainly in regions of the world where certain states still hold back from joining the two Conventions. Also, the risk that non-state entities might resort to the weapons remains a possibility in most areas. Vigilance and preparedness to react effectively will 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 co-operate with a group of consultant experts that was then being established to prepare a report for the UN on biological and chemical weapons and the effects of their possible use. The UN report was duly completed and released in July 1969 (1.02). It drew from a submission by the WHO that had been prepared by a group of consultants appointed by the Director-General. Among them were consultants from

two non-governmental organizations engaged in study of the subject, namely Pugwash[5] and the Stockholm International Peace Research Institute (SIPRI).[6] Shortly afterwards, the Twenty-Second World Health Assembly requested the Director-General to continue the work (1.05). The result, which expanded the original submission to the UN, became the First Edition of the present report.

Over the years 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* that had drawn from a study updating parts of the 1970 report (1.06). WHO funds were thereafter provided for a Working Group Meeting to review information on health effects of chemical-warfare agents and the availability of such information. The meeting took place at WHO Headquarters on 7-9 February 1989. (1.07).

Regarding biological weapons and the need to be able to respond under Article 2(d) of the WHO Constitution to emergencies that they might cause, contacts were developed towards the end of 1990 between the Federal Department of Foreign Affairs of Switzerland and the WHO. There was concern then about unpreparedness to respond to the consequences of any attack there might be with weapons of mass destruction, especially bioweapons, upon civilians during military operations in

[5]The Pugwash Conferences on Science and World Affairs is an international organization of scientists, to which the Nobel Peace Prize was awarded in 1995, whose activities have included close attention to matters of biological and chemical warfare since the 1950s (1.03).

[6]SIPRI, funded by the Swedish Parliament, was then working, in consultation with Pugwash, on its six-volume study of the historical, technical, military, legal and political aspects of biological and chemical warfare armament and disarmament (1.04).

Kuwait. This led to a collaboration between the WHO and the Swiss Disaster Relief Unit, from which resulted Task Force Scorpio, an equipped and trained team of specialists that could have been dispatched by ambulance jet at short notice to an afflicted area (1.08). Since that time there has been attention to possible associations between WHO surveillance of emerging infectious diseases and provisions of the projected BWC protocol. More generally, as the public has become more conscious of the possibility of biological or chemical agents being released deliberately, whether as an act of war or of terrorism, WHO has become concerned about the information on the subject available to the public-health authorities of Member States. The Federal Department of Foreign Affairs of Switzerland has continued to support WHO efforts in the biological/chemical field, including the provision of financial support for the present publication.

In May 2001, the Fifty-Fourth World Health Assembly requested the Director-General "to provide technical support to Member States for developing or strengthening preparedness and response activities against risks posed by biological agents, as an integral part of their emergency management programmes" (1.09). This Second Edition of the report is in line with the request of the World Health Assembly. Moreover, in view of the need for WHO to provide a complete scientific assessment on which to base technically sound advice for preparedness and response, both biological and chemical agents are covered as in the First Edition, in order to provide an analysis of their similarities and differences.

The original 1970 report considered biological and chemical weapons at a technical and policy level. It was addressed to public health and medical authorities

as well as to those concerned with emergency reactions to suspected or actual use of the weapons. The present Second Edition is directed at 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 advisors. Not all of the First Edition has been subsumed within the Second, and some parts of it may still be of interest to specialists.

The Second Edition, like the First, presents an analysis of the health aspects of the possible hostile use of biological or chemical agents. It is intended to be applicable to countries at any level of social or economic development in order to define implications for WHO and its Member States. The assessment concentrates on civilian aspects. Little attention is paid to the purely military aspects, some of which were taken up in the First Edition. It remains the case that the great majority of Member States have experienced neither biological nor chemical warfare. For them, unless this historical record becomes violently disrupted, the present report may seem to have little relevance, especially when set against the emergence of new diseases, such as HIV/AIDS and Ebola, and the re-emergence of diseases previously considered under control in much of the world, such as tuberculosis and malaria. The relevance of the report lies, rather, in the context of risks that, historically, have been low but that nevertheless deserve intelligent consideration and various degrees of precautionary planning.

The report also considers the 1972 BWC and the 1993 CWC, to which nearly three quarters of WHO Member States are party.[7] These two treaties and their

[7]The status of individual WHO Member States under the 1925 Geneva Protocol, the 1972 Biological Weapons Convention and the 1993 Chemical Weapons Convention is set out in Annex **INSERT**.

national implementing legislation constitute a form of protection against the weapons, and also a route to international assistance in the event that the weapons are nevertheless used.

1.3 SOME WORKING DEFINITIONS

In the present report, **biological weapons** are ones whose intended target effects are due to the infectivity of disease-causing micro-organisms and other replicative entities, including viruses, infectious nucleic acids and prions.

Some of these biological agents may be ones whose pathogenicity is due to toxic substances that they themselves generate. Such **toxins** can sometimes be isolated and used as weapons. Since they would then be working, not through infectivity, but through toxicity, they would fall within the definition given below of a chemical weapon, even though there would still be grounds for regarding them as biological weapons. The BWC covers toxins, by which it means toxins produced by any living organism, not only by micro-organisms, or by any other means, including synthesis. The present report does the same, while recognising that toxins also fall within the CWC.

Chemical weapons are weapons that work principally through toxicity, which means chemical action on life processes capable of causing death, temporary incapacitation or permanent harm. Weapons exploiting chemicals such as propellants, explosives, incendiaries or obscurants are not regarded as chemical weapons, even though their chemicals may also have toxic effects. Only if those toxic effects are the main ones sought from the weapon is it regarded as a chemical weapon. Some toxic

chemicals, such as phosgene, hydrogen cyanide and tear gas, may be used for civil or peaceful purposes as well as for hostile purposes. In the latter case they, too, are chemical weapons.

1.4 STRUCTURE

The main body of the report is in five chapters. These are supported by a set of annexes that present more detailed technical information.

Chapters 2 and 3 describe how biological and chemical agents may menace public health. They proceed from the historical to the present day, from the general to the particular. Their purpose is to identify what is essential to any planning to avert or at least to mitigate the consequences of biological or chemical agents released deliberately.

Chapter 4 applies standard principles of risk-management in order to outline the steps that Member States may take to prepare themselves for the possibility of biological or chemical agents being deliberately released against their population. The intention here is to provide, not the detailed guidance of an operational manual, but an overview of the components of preparedness plus a guide to sources of more detailed information.

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

Supplements may be issued in due course, for two main purposes. One would be to extend the range of topics addressed in this report, for example on health aspects of biological or chemical agents that might be released deliberately against animals or plants rather than against people. The other purpose would be to update the information presented here, especially in the annex on information resources.

CHAPTER 2: ASSESSING THE THREAT TO PUBLIC HEALTH

Public health faces many challenges, and there is now concern that, among those challenges, the possibility of biological or chemical agents being deliberately released has not been given sufficient attention. Biological warfare, in particular, is being portrayed by some reputable commentators as a dangerously neglected threat. For public health authorities, the matter is one of relative priority. Where should such deliberate releases be ranked -- high or low -- among the many contingencies for which medical preparedness is needed? The present chapter addresses this question by way of introduction to the more detailed threat assessment in Chapter 3.

2.1 CONTEXT

Poisons and pathogenic micro-organisms are among the natural health hazards with which human beings are obliged to co-exist. Difficult to perceive and therefore to avoid, they present a threat that is insidious as well as damaging or deadly. The species has survived by adaptation. In part this has been physiological, as in the development of the immune system far back in vertebrate evolution. In part the adaptation has been social, as in the development of individual and public health practices that serve to limit exposure to the dangers.

The codes of professional behaviour adopted by the military that forbid the use of poison and therefore also disease may be regarded as a part of that same social adaptation. Reaching back to the Manu Laws of India through, for example, the Saracen code of warfare drawn from the Koran, the Lieber Code of 1863 in America

and the 1925 Geneva Protocol (2.01), this taboo seems so widespread, ancient and specific as to require some such explanation (2.02).

International law relating to biological and chemical warfare is described in Chapter 5, which details how the multilateral treaties of 1972 and 1993 on the total prohibition of biological and chemical weapons have extended that law. Promoting the new law-making was a widespread sense that powerful new weapons were on the verge of proliferating and diffusing within a global security system otherwise poorly capable of containing their destabilizing characteristics. The United Nations had, almost from its inception, differentiated *conventional weapons* from *weapons of mass destruction*. It had defined the latter in terms of their operating principles[8] but the concern was with their consequences: their potential for bringing devastation, death and disease to human societies on a scale incompatible with survival. New weapons-technology might, in other words, be generating threats to the species that called for improved forms of protection: a strengthening of social adaptation to present dangers. In unique summit session in January 1992, the Security Council determined that the "proliferation of all weapons of mass destruction constitutes a threat to international peace and security". Moreover, the 15 member states of the Council also committed themselves "to working to prevent the spread of technology related to the research for or production of such weapons and to take appropriate action to that end" (2.04).

[8] In September 1947, weapons of mass destruction were defined in a Security Council document as "atomic explosive weapons, radioactive material weapons, lethal chemical and biological weapons, and any weapons developed in the future which have characteristics comparable in destructive effect to those of the atomic bomb or other weapons mentioned above" (2.03). It was this wording, proposed by the United States, that the UN 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 UN Charter.

Public health infrastructure throughout most of the world 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 the developing countries infectious disease caused one in two deaths (2.05). More than 2 billion people are seriously ill from disease at any given moment, so it is estimated (2.06). Against such a background, the additional menace to public health of disease set loose in a country by biological or chemical warfare might be no more than a slight addition to major challenges already manifest. Yet, conceivably, it might also be on such a scale or of such a nature as to be beyond the capability of the healthcare system to cope. For deliberate releases (or threats of release) of biological or chemical agents, a spectrum of threat can therefore be envisaged that ranges between those two extremes: relative insignificance at one end, mass destruction of life or mass casualties at the other. Where along the spectrum a particular form of biological or chemical menace is situated will be determined by the characteristics of the threat and by the vulnerability of the threatened, vulnerability reflecting such factors as health status and public-health preparedness of the population under threat. Particularly threatening would be the possibility of a pandemic resulting from the intentional unleashing or inadvertent release of infective agents that cause contagious disease, such as smallpox, for which effective prophylaxis or therapy may be unavailable. Towards that mass-destruction end of the spectrum, remedies or countermeasures may be beyond the resources of that country and therefore available, if at all, only in international co-operation.

There is some historical guidance on the likelihood of such catastrophe. Proven resort to biological or chemical weapons by military forces has been rare in recorded history. Unproven instances have been more common, which could be taken

as testimony either to the problem of proof, or to the obscurity of such unverified episodes, or to the readiness with which the emotiveness of anything to do with poison gas or germ warfare lends itself to calumny and disinformation. In unrecorded history, instances of biological or chemical warfare may have recurred sporadically for at least as long as their proscription. Poison is no novelty as a weapon of murder, and the deliberate pollution of, for example, otherwise protected water supplies is an expedient to which retreating forces must often have become attracted in the field. Only in recent times, however, have the weapons moved from the insignificant towards the mass-destruction end of the spectrum. Technological change has brought this about.

2.2 CHANGING TECHNOLOGY

The event that most clearly marked the emergence of this form of warfare from its pre-history 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 large industrial capacity for the liquefaction of chlorine gas, and, as the war progressed, it turned to this comparative advantage as a possible way out both of the trench-warfare that was immobilizing its armies in the field and of the shortage of explosives brought about by enemy naval blockade. These military necessities were accorded precedence, in keeping with the (since disavowed) German legal doctrine of *Kriegsraison*, over the ancient prohibition of poison warfare that had been reaffirmed at The Hague less than a decade previously. Starting on the late afternoon of that day, 180 tonnes of liquid chlorine contained in 5,730 pressure cylinders were released into the breeze that would carry the resultant cloud of asphyxiating vapour towards enemy lines. The available records are sparse, but some say that as many as 15,000 French,

Algerian and Canadian soldiers fell casualty to this onslaught, a third of them dead. The actual numbers may have been different, but, whatever they were, here was the world's first experience of a weapon of mass destruction.

The weapon worked by polluting the air that its targeted population was obliged to breathe, so protection, in the form of air filters, was not impossible to arrange. The first filters worked by chemical reaction with the poison gas. They 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 held in the filter. Improved filters were then introduced that worked by physical adsorption of the pollutant, 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 vapour or aerosol threat. By 1917, the growing efficacy of gas masks had stimulated resort to chemicals that could attack on or through the skin. The paramount example was 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 more agent than does inhalation attack, meaning 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 nowadays.

Another way forward for the weaponeers was to use special agent-dissemination methods capable of surprising target populations before they could don

masks. Such a result could be achieved with crash airborne concentrations of agent delivered by massed artillery or, later, by aerial bombardment. Or 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 presented themselves, some more effective than others, but, taken together, capable today of negating the mass-destructiveness of the weapons at least against military forces. Comparable protection of larger and less disciplined civilian populations would be much harder, but not necessarily impossible, to achieve. The countermeasures include medical ones, in the forms of therapy and, for some agents, prophylaxis; technical countermeasures, in the form of 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 organizational countermeasures, in the forms of specially developed intelligence machinery, standard operating procedures, and training. Latterly, new instruments of international law have taken their place in this array, notably the BWC and the CWC.

Vulnerabilities nevertheless remain, especially for countries where the economic or technological base is not capable of supporting all that is needed. That 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. Regions afflicted include Morocco (1923-26), Libya (1930), Sinkiang (1934), Ethiopia (1935-40), China (1937-42), Viet Nam (1961-75), Yemen (1963-67) and Iran/Iraq (1980-88) [**to insert reference**]. 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 weapons whose effects are more difficult to diminish, and there was no significant strategic or battlefield resort to chemical warfare.

Vulnerabilities are not absent from even the best equipped protective arrays. The struggle for supremacy between offence and defence which characterized the development of chemical warfare during the first world war continued after it. The search for novel agents was one of the forms taken by that competition. It included searches for agents capable of inducing new types of physiological effect from which novel military advantage might be gained: casualty-producing agents of low lethality, for example, which promised to reduce the political costs of resort to armed force, or percutaneous casualty effects of reduced onset-time, which could enable chemical weapons to be used like landmines to deny terrain to unprotected personnel. Above all, there was the search for agents of increased potency that would enable weapon delivery systems to be used more economically and more efficiently. Toxic chemicals whose effective doses were measurable in tens of milligrams per person, as was the case with phosgene and hydrogen cyanide, came to be supplanted in the 1940s and 1950s by organophosphate acetylcholinesterase-inhibitors ("nerve gases") that were active in milligram or submilligram quantities, meaning that an order of magnitude fewer munitions would be needed for the attack of a given target, thereby conferring logistical benefit. The most prominent of these nerve gases and other chemical-warfare agents of our time are identified in Chapter 3 and described in Annex 3.

Beyond the nerve gases on that scale of increasing toxicity lie certain toxins, such as those described in Annex 2, and beyond them, down in the nanogram and

smaller effective-dose range, are pathogenic bacteria and viruses. As understanding of the microbiology and airborne spread of infectious disease accelerated 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 [**to insert reference**].

Other concepts of biological warfare had also been emerging. The vulnerability of draught animals to deliberate infection with diseases such as anthrax or glanders had been 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 infrastructure towards air-raids became increasingly apparent, the idea of setting loose contagious disease by bombardment of public-health facilities (such as water-treatment, sewage-disposal and pest-control structures) attracted attention. This in turn gave rise to investigation of other possible ways of deliberately initiating spread of infectious disease. Establishing foci of contagious disease that would then spread of its own accord to parts of the target population not initially exposed to biological agent was one such concept. Because of uncertainties associated with the epidemic spread of disease, such a concept could not be accommodated at all readily within military doctrine except in the context of certain

types of strategic or clandestine operation. So in their selection of biological agents to weaponize or to take precautions against, military staffs tended to place more emphasis on non-contagious than on contagious diseases. In the context of terrorism, the relative priorities may be different.

During the first half of the cold-war years, arsenals of biological weapons exploiting some of these, and other, concepts were accumulated, alongside nerve gas and other chemical weapons, on both sides of the superpower confrontation. After 1970, biological armament appears to have continued only on one side. The principal biological agents known with reasonable certainty to have been weaponized during that time are identified in Chapter 3 and described in Annex 1. The biological weapons ranged from clandestine devices for special forces up to designs for large guided missiles or heavy bomber aircraft armed with munitions capable of generating extensive clouds of aerosol inhabited by live causative agents of contagious disease for far-distant rear targets, or of non-contagious disease for closer targets. Here were biological weapons that could in principle greatly exceed the mass-casualty effects of the chemical weapons that their progenitors had emulated.

Comparability 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 1964-68, 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 out to several tens of kilometres downwind. It thus appeared that people living within areas on the order of thousands of square kilometres in size could now be threatened with disease by single aircraft. As to

chemical weapons, defence science advisers were at that time anticipating a new generation that could attack targets up to the order of 100,000 square kilometres in area (2.07).

Such large-area weapon concepts for exploiting the damage potential of chemical or biological agents also brought new categories of target into consideration, such as foodcrops and livestock. At the time of the second world war, chemicals had been discovered that were as toxic to plant-life as the new nerve gases were to people. These herbicides, notably derivatives of 2,4-dichloro- and 2,4,5-trichloro-phenoxyacetic acid in formulations such as Trioxone and Agent Orange, came to be used as weapons in several conflict-areas of southeast Asia and Africa during the period 1950-75, sometimes targetted against foodcrops and sometimes against the forest vegetation that could furnish concealment. Certain plant and animal pathogens were also weaponized. Indeed, some of the first wide-area biological and toxin antipersonnel weapons were based on agent delivery systems originally conceived for anti-agriculture purposes.

Since the possible impacts on public health of anti-animal and anti-plant biological agents are indirect, the present report does not address either them or their chemical counterparts in detail. Yet the ability of biological agents in particular to endanger food security should not be disregarded.

2.3 NEW SCIENCE

Technological change in biological and chemical warfare has been driven by inherent factors such as the competition between the weapon and the protection against it and also by new user-requirements stemming from changes in military doctrine. More profoundly, technological change has also been driven by advance of the basic sciences within which the technology is rooted. A current concern is that new understanding in the life sciences is accumulating so rapidly that major change in the nature, accessibility or efficacy of biological and chemical weapons may be happening even now. Exacerbating this concern are certain non-military technologies that are emerging from new science and diffusing around the world, for some of these, notably biotechnology, are potentially dual use, having application also in biological and chemical warfare.

The advent of "genetic engineering" offers opportunities for the advancement of all the activities concerned with human health and nutrition, yet in principle it also offers means of producing novel and perhaps more efficacious biological agents and toxins as compared with those of past weapons programmes. Ability to modify in a programmed way the genetic properties of living organisms could allow the insertion of new heritable properties into micro-organisms that make them more resistant to the available defences, or more virulent or pathogenic (2.08), or easier to produce, or better able to withstand the stresses of an unnatural environment, or more difficult to detect by routine assays. In so doing the chances are high that some other valued characteristic of the micro-organism would no longer be expressed, but, eventually, even this drawback might be overcome.

Still other aggressive possibilities may lie beyond these manipulations. Weapons may be developed that could be used to harm human populations by disrupting cell signalling pathways, for example, or by modifying the action of specific genes.

Given the range and variety of pathogens already present in nature, the advantages of basing a weapons programme on a modified organism are not at once obvious. Nor is it the case that the new biotechnologies necessarily favour the offence over the defence. Vulnerability to biological agents exists chiefly because of present 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 ability to report in a timely manner with exclusion of false positives is not clear. Moreover, the necessity of detecting certain agents at concentrations equivalent to one organism per breathfull of air continues to impose an enormous air-sampling requirement, even when PCR or other amplifying technologies are used. Other new biotechnologies are transforming the development of vaccines, while others still are thought to promise nonspecific alternatives to vaccines. Yet there can be little doubt that the spread of advanced biotechnology and the new accessibility of information about it offer new tools to any country or ill-minded group intending to develop a biological weapon. (2.09, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16)

2.4 A PRELIMINARY THREAT ASSESSMENT

In that spectrum of biological or chemical threat to public health envisaged at the outset of this chapter, the far mass-destruction end may perhaps have been

approached by some of the bacterial or viral aerosol weapons of the cold war. That there should be uncertainty about this lies chiefly in the demonstrable existence of increasingly severe technological constraint as development moves the weapons along the spectrum: the greater and more assured the mass-destructive power sought for the weapon, the greater the practical difficulties of achieving it. There are, in short, inherent technical limitations to take into account.

Consider, for example, some of the problems of conveying an agent to its intended target. Toxic or infective materials can be spread through drinking water or foodstuffs but, as is explained in Annex **INSERT**, their effects would then be expected to remain localized unless the contaminated items were themselves widely spread or unless any biological agent that had been used succeeded in initiating contagious disease. Otherwise, large-scale effects are available 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 much uncertainty. The movement of the vapourized or aerosolized agent towards and across its target would be by atmospheric transport, which would move the agent both laterally and vertically, causing a possibly large fraction to miss the target. As is explained in Annex **INSERT**, 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 on local meteorological conditions and be influenced by the local topography. For aerosol or vapour released inside enclosed spaces rather than in the open, the situation would of course be different. Beyond that there is the fact that some agent materials 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. In addition, for the agent to be retained after inhalation and to exert its intended pathological effects, further technical requirements must be satisfied. In the case of particulate material, for example, larger particles may not be able to penetrate far enough into the respiratory tract, while smaller ones may not be retained there. The optimal size range is, moreover, a narrow one, and the production and maintenance of the optimal size distribution within an aerosol cloud is subject to a variety of difficulties, given, not least, the processes of evaporation or condensation that will be taking place as the cloud travels. These considerations apply to the aerosol dissemination of contagious-disease agents as well as to non-contagious ones, though an attacker might hope to rely on epidemic spread to compensate for poor aerosol presentation. That spread, too, is subject to unpredictabilities and therefore uncontrollabilities, as is described in Annex **INSERT**.

These technical factors operate to render such large-scale forms of attack more demanding in terms of materials and skills than is commonly supposed. Large amounts of agent will need to be disseminated to be sure of a sufficient proportion reaching 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 contagious-disease agents are used.

Nor do these delivery considerations represent the only or even the most demanding technical problems. In the case of biological agents, there are, for example, the difficulties of selecting the appropriate strain in the first place and then

of maintaining its virulence throughout culturing, harvesting, processing, storing, weapon-filling, release and aerosol travel.

The technical considerations just outlined apply to biological or chemical weapons whether used by military forces or by terrorists. Terrorist purposes, it should however be noted, might be served by small-scale localized attack by virtue of its potential panic effects.

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

Technical factors are not the only consideration. Throughout much of the world, the social constraints on resort to biological or chemical weapons, including provisions of national and international law, will act to amplify the practical problems

of acquiring and gaining advantage from the weapons. These constraints will impede access to the requisite materials. They will also obstruct those less tangible forms of assistance otherwise available from international service providers, from consultants or even from academics, whose corporate image, reputation or trading status would stand to suffer once their involvement became apparent. Further, there would be additional legitimation for concerted international action against any weapons programmes. The long and continuing period of non-occurrence of biowarfare suggests that the number of competent groups or states intending actually to use such weapons must be very small, even zero.

Even so, due preparation for such an eventuality, with a response strategy and plan held at the ready, may be judged necessary. Whether in relation to natural disasters such as earthquakes, or in relation 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 in the light of changing circumstances and experience. Principles of risk management for dealing with chemical or biological attacks will overlap with those dealing with natural or human-induced disasters or emergencies. Where deliberate biological or chemical releases present additional risk-management aspects, biological and chemical addenda to an existing disaster/emergency strategy and plan could suffice, in most circumstances, for civil preparedness.

Returning, finally, to that question of relative priority stated at the outset of this chapter, it is clear that there can be no simple answer. Where, for a country's enemies -- internal or external -- the balance of constraint and incentive regarding

resort to biological or chemical weapons may lie at any given moment, and hence the magnitude of the threat inherent in that balance, will surely depend primarily on circumstances peculiar to that country. There can be no general rule: national authorities will need to make their own assessments. The fact that there is vulnerability does not necessarily mean that there is threat.

CHAPTER 3: BIOLOGICAL AND CHEMICAL AGENTS

Preparedness planning for biological and chemical incidents needs to be carefully considered. It is not possible to prepare specifically for all possible biological and chemical threat agents. Nor is it necessary. If a country is seeking to bolster its preparedness to counter biological and chemical threats, then targeting of its preparation and training on a limited but well chosen group of agents will provide the necessary understanding for a capability that will be adequate for a far wider range of possibilities. By understanding the general properties of these representative agents, insights will be gained that are valid for virtually any agent. In addition to being impractical from a preparedness perspective, long and exhaustive lists of agents also produce a misleading presentation of the extent of possible threats. The present chapter sets out an approach to identifying agents of concern. This is followed by a discussion of dissemination methods, 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 SELECTION PRINCIPLES

Biological and chemical weapons have been described as the “poor man’s atom bomb”, but this conveys a misleading impression of their ease of production and their utility. It is not enough that biological and chemical agents be highly infective or highly toxic. In order to be effective as a weapon, an agent needs also 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 against its target. In use, the

agent must be spread in such a way that the necessary infective or effective dosage is delivered to the target population. The agent must be relatively easy to produce from available precursor compounds or from naturally occurring micro-organisms. Once produced, it must be weaponized and, depending on the concept of deployment and use, stored without undue risk to its possessor. The effectiveness with which the weapon is deployed will depend on the extent to which this has been addressed and practised. Technology and concepts for use continue to develop. For example, many biological and chemical agents were selected in the past for a retaliatory capability, which consequently required a long storage life. However, different approaches, such as the binary concept, mean that this is no longer necessarily the case for chemical agents. Precursors can be mixed to generate actual agent either just prior to or during weapon launch, though stability of precursors might then become a factor affecting choice. For biological agents, concepts of use other than retaliation could act to reduce the requisite storage period.

While thousands of toxic chemicals and pathogenic micro-organisms have been investigated for their potential utility as weapons, few have been judged as satisfactory candidates, and even fewer have found their way into weapons and actually been used. The selection principles in these past programmes have been driven primarily by considerations relating to their planned military use. It is not necessary to explore such military considerations here in order to arrive at guidance on the agents that should, or need not, be at the centre of preparedness concern today. Guidance can instead be drawn from activities associated with the international biological and chemical treaties and from the historical record of biological and chemical armament and use, which necessarily reflect the same selection principles. A progressively sharper focus on agents

of concern can be gained, first, from the treaty definitions of biological and chemical weapons; then from the lists of agents that have been negotiated to facilitate treaty implementation; then from such authoritative information as is publicly available about which agents have been weaponized or stockpiled in recent times; and finally from the lists of agents known to have been used as weapons.

3.1.1 Guidance from the international treaties

The intergovernmental negotiations that culminated in the BWC and then the CWC commenced while the first edition of the present study was being prepared. In 1969, in order to set the scope of its study, WHO relied in the first edition 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 ones "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, however, had to make accommodations that required a less technical approach, for they were aiming to control technologies that were often dual-use in character, in other words applicable both to warfare and to peaceful purposes. For example, the negotiators would not be able to prohibit production of the principal killer gas of the first world war, phosgene, without at the same time denying feedstock to manufacturers of certain plastics and of other worthwhile commodities. Nor would they be able to outlaw large-scale fermentation of pathogenic micro-organisms 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 their treaties. Such a general purpose criterion is to be found in those parts of both the Biological and the Chemical Weapons Convention where the scope of the treaty is stated. Thus, the prohibitions set out 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", defining both of these categories of chemical in broad terms. In contrast, the BWC does not seek to define the biological agents and toxins of its scope. The actual language used in the two Conventions to define the weapons to which they apply is set out in the adjacent boxed text [**NOTE**: **The text to be boxed is set out at the end of this chapter]**

In order effectively to implement treaties of such wide-ranging scope, lists of particular agents have had to be drawn up so as to focus the efforts of the implementers. The Chemical Weapons Convention 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*. They list 29 specific chemicals and 14 families of chemicals. Some of the families are very large indeed, running into many millions of specific chemicals, most of which have, however, never actually been made or characterized. For example, the dialkyl alkylphosphonates that represent a small fraction of the chemicals constituting item 4 on Schedule 2 comprise 1,668,964 different chemicals (excluding stereoisomers), of which it seems that only 118 have actually been synthesized (3.01), and even the family of alkyl alkylphosphonofluoridates with which Schedule 1 opens, which is the sarin family of nerve gases, theoretically contains 3,652 members. Large though these numbers are,

the CWC makes it clear that its schedules are not meant as a definitive listing of all chemicals that constitute "risks to the object and purpose of this Convention". The schedules simply exemplify chemicals covered by its general purpose criterion. The Biological Weapons Convention, which is a much shorter and simpler legal instrument, contains no analogous schedules, but such lists have been developed for inclusion in the BWC Protocol now under negotiation,[9] again to exemplify, not to define, the scope of the general purpose criterion. Several authorities, including defence agencies, have compiled such lists of potential biowarfare and bioterrorism agents in recent years. Some are identified in Table 3.1, from which it may be seen just how much variation there can be in different agent assessments.

[9] Ad Hoc Group of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, document BWC/Ad Hoc Group/56 (parts 1 and 2) dated 18 May 2001.

Table 3.1 Biological agents variously cited as possible weapons for use against human beings

Biological agent and WHO numeric code for the disease it can cause	UN (1969)	WHO (1970)	BWC CBM-F (1992)	Australia Group (1992)	NATO (1996)	APHA (2000)	BWC draft Protocol (2001)
BACTERIA (including RICKETTSIA and CHLAMYDIA)							
Bacillus anthracis, A22 (anthrax)	X	X	X	X	X	X	X
Bartonella quintana, A79.0 (trench fever)				X			
Brucella species, A23 (brucellosis)	X	X	X	X	X		X
Burkholderia mallei, A24.0 (glanders)	X	X	X	X			X
Burkholderia pseudomallei, A24 (meliodosis)	X	X	X	X	X		X
Franciscella tularensis, A21 (tularaemia)	X	X	X	X	X	X	X
Salmonella typhi, A01.0 (typhoid fever)	X	X		X	X		
Shigella species, A03 (shigellosis)	X				X		
Vibrio cholerae, A00 (cholera)	X	X		X	X		
Yersinia pestis, A20 (plague)	X	X	X	X	X	X	X
Coxiella burnetii, A78 (Q fever)	X	X	X	X	X		X
Orientia tsutsugamushi, A75.3 (scrub typhus)					X		
Rickettsia prowazeki, A75 (typhus fever)	X	X	X	X	X		X
Rickettsia rickettsii, A77.0 (Rocky Mtn. spot'd fev)	X	X		X	X		X
Chlamydia psittaci, A70 (psittacosis)	X				X		
FUNGI							
Coccidiodes immitis, B38 (coccidioidomycosis)	X	X			X	X	
Histoplasma capsulata, B39.4 (histoplasmosis)							
VIRUSES							

Hantaan/Korean haem. fever, etc, A98.5		X		X	X		
Sin Nombre, J12.8							X
Crimean-Congo haemorrhagic fever, A98.0		X		X	X		X
Rift Valley fever, A92.4		X		X	X		X
Ebola fever, A98.3				X	X		X
Marburg, A98.4		X		X			X
Lymphocytic choriomeningitis, A87.2				X			
Junin, A96.0 (Argentinian haem.fever)				X	X		X
Machupo, A96.1 (Bolivian haem.fever)				X	X		X
Lassa fever, A96.2				X	X		X
Tick-borne encephalitis/Russian spring-summer encephalitis, A84.0/ A84	X	X		X	X		X
Dengue, A90/91	X	X		X	X		
Yellow fever, A95	X	X		X	X		X
Omsk haemorrhagic fever, A98.1					X		
Japanese encephalitis, A83.0		X		X			
Western equine encephalomyelitis, A83.1		X		X			X
Eastern equine encephalomyelitis, A83.2	X	X		X	X		X
Chikungunya, A92.0	X	X		X	X		
O'nyong-nyong, A92.1		X					
Venezuelan equine encephalomyelitis, A92.2	X	X	X	X	X		X
Variola major, B03 (smallpox)	X	X		X	X	X	X
Monkey pox, B04				X			X
White pox (a variant of variola virus)				X			
Influenza, J10,11	X	X			X		
PROTOZOA							
Naeglaeria fowleri, B60.2 (naegleriasis)							X

Toxoplasma gondii, B58 (toxoplasmosis)		X					
Schistosoma species, B65 (bilharziasis)		X					

Notes

- Diseases are identified by the numeric code assigned by the WHO *International Classification of Diseases*, 10th edition.
- UN (1969): United Nations, *Chemical and bacteriological (biological) weapons and the effects of their possible use: Report of the Secretary-General*, New York, 1969.
- WHO (1970): World Health Organization, *Health aspects of chemical and biological weapons: Report of a WHO Group of Consultants*, Geneva, 1970.
- BWC CBM-F (1992): UN Office of Disarmament Affairs, compilation of declarations of information by BWC states parties in accordance with the extended confidence-building measures agreed at the Third Review Conference, DDA/4-92/BW3 plus Add.1, Add.2 and Add.3: data from Section 2, *Past offensive biological R&D programmes*, of the Form F as filed by Canada, France, Russia, the UK and the USA.
- Australia Group (1992): Australia Group document AG/Dec92/BW/Chair/30 dated June 1992.
- NATO (1996): *NATO Handbook on the Medical Aspects of NBC Defensive Operations*, AMedP-6(B), Part II - Biological.
- APHA (2000): J Chin (editor), *Control of Communicable Diseases Manual*, 17th edition, Washington, DC: American Public Health Association, 2000.
- BWC draft Protocol (2001): Ad Hoc Group of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and On Their Destruction, document BWC/AD HOC GROUP/56-2, at pp 465-66, which is in Annex A of the Chairman's Composite Text for the BWC Protocol.

3.1.2 Guidance from the historical record

Toxic and infective agents that have in the past been available to the forces of states in weaponized forms are identified in official state papers now open to the scrutiny of historians. This historical record is not complete, because not all past possessor states have yet opened relevant papers, and of those that have the papers rarely extend into the present two or three decades (the declarations received by UNSCOM are an exception in that they include reference to weaponization during the period 1987-91). An extensive listing of the antipersonnel agents can be compiled nevertheless. The listing set out in Table 3.2 covers the period since January 1946 and is drawn from an archive of collected state papers, works of historical scholarship and other documentation at the University of Sussex.[10] It is limited to agents identified in state papers as having been stockpiled or as having otherwise entered the process of weaponization. For convenience, Table 3.2 groups the agents into categories that are explained and used later in this report.

For some of the toxic chemicals in Table 3.2, an indication of relative importance historically in possessor state programmes can be gained by considering the quantities of the different agents that have been declared to the OPCW as part of the obligatory declarations required from states parties to the Chemical Weapons Convention. These declared quantities are set out in Table 3.3.

Table 3.3 shows that an aggregate total of 69,863 tonnes of chemicals have been declared as chemical weapons to the OPCW by its member states. Of that total 5,422 tonnes had been verified as destroyed by 31 December 2000. The table also indicates the breakdown of quantities declared. These declared stockpiles fall under the monitoring

[10] The archive is the Sussex Harvard Information Bank, which is maintained at SPRU, University of

provisions of the Chemical Weapons Convention, and are thus under international control.

Turning, finally, to the historical record of actual use of toxic and infective agents for hostile purposes, it must be observed that the information available may be less complete even 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 are instances of chemical and biological weapons being reported as having been used when in fact they were not used, the reports originating in misperception or other error, or in intention to deceive. Table 3.4 summarises the record of antipersonnel use, drawn from the same archive as used for Table 3.2. Its entries are restricted to those instances since 1919 in which the fact of use can be regarded as indisputable, and in which the toxic or infective agents employed have been sufficiently identified. The use of anti-plant or anti-animal agents is not included. Table 3.4 includes in its last two entries the use of toxic or infective antipersonnel agents by non-state groups, including episodes regarded as act of terrorism, on which the historical record is even sparser than that for the possessor state programmes.

Taken together, Tables 3.2, 3.3 and 3.4 suggest that the number of agents actually weaponized or used is considerably smaller than the number of agents selected for description in the literature on biological and chemical warfare. Nevertheless, for the representative group of agents that is to guide the present report it seems necessary to add only three further agents: Variola major, which is smallpox virus; perfluoroisobutene, which is a toxic agent now occurring as a byproduct in the chemical

Sussex, UK, by the Harvard Sussex Program on CBW Armament and Arms Limitation (see www.sussex.ac.uk/spru/hsp).

industry in tens of kilotons per year; and the chemical psychotomimetic agent lysergide, also known as LSD. Annexes 1, 2 and 3 present further particulars of the representative group of agents.

Table 3.2 Toxic and infective anti-personnel agents stockpiled or otherwise weaponized for state forces since 1946 according to official documents of possessor states

Tear gases and other disabling chemicals:
- 10-chloro-5,10-dihydrophenarsazine (adamsite, or DM)
- 1-chloroacetophenone (CN)
- a-bromophenylacetonitrile (larmine, BBC or CA)
- 2-chlorobenzalmalononitrile (CS)
- dibenzoxazepine (CR)
- oleoresin capsicum (OC)
- 3-quinuclidinyl benzilate (BZ)

Choking agents (lung irritants):
- phosgene
- chloropicrin

Blood gases:
- hydrogen cyanide

Vesicants (blister gases):
- bis(2-chloroethyl) sulphide (mustard gas)
- 2-chlorovinyldichloroarsine (lewisite)
- bis(2-chloroethylthioethyl) ether (agent T)
- tris(2-chloroethyl)amine (a nitrogen mustard)

Nerve gases:
- ethyl NN-dimethylphosphoramidocyanidate (tabun, or GA)
- O-isopropyl methylphosphonofluoridate (sarin, or GB)
- O-1,2,2-trimethylpropyl methylphosphonofluoridate (soman, or GD)
- O-cyclohexyl methylphosphonofluoridate (cyclosarin, or GF)
- O-ethyl S-2-diisopropylaminoethyl methylphosphonothiolate (VX)
- O-ethyl S-2-dimethylaminoethyl methylphosphonothiolate (medemo)
- O-isobutyl S-2-diethylaminoethyl methylphosphonothiolate (VR)

Further toxins
- Ricin
- Saxitoxin
- *Clostridium botulinum* toxin
- Staphylococcal enterotoxin
- Aflatoxin

Bacteria and rickettsiae
- *Bacillus anthracis*
- *Francisella tularensis*
- *Brucella suis*
- *Burkholderia mallei*
- *Burkholderia pseudomallei*
- *Yersinia pestis*
- *Rickettsia prowazeki*
- *Coxiella burnetii*

Viruses

Venezuelan Equine Encephalitis virus

Table 3.3 Aggregate quantities of chemical agents declared to the OPCW by its member states, as of 31 December 2000

Chemical agent	*Total declared (tonnes)*[11]
Category 1 chemical weapons[12]	
• Lewisite	6,745
• Mustard/lewisite mixtures	344
• Mustard gas[13]	13,839
• Runcol (HT)[14]	3,536
• Degraded sulfur mustard (toxic waste)	1
• Tabun (GA)	2
• Sarin (GB)	15,048
• Soman (GD)	9,175
• Medemo	<1
• Agent VX	4,032
• Agent VR	15,558
• Difluor (precursor DF[15])	444
• OPA[16]	731
• EDMP (precursor QL)[17]	46
• Unknown	4
Category 2 chemical weapons[18]	
• Chloroethanol	302
• Thiodiglycol	51
• Phosgene	5

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

Table 3.4 Some verified instances of hostile use of anti-personnel toxic and infective agents since 1919

Period	*Agent*	*Location of use*
1919	Mustard gas	North Russia
1923-26	Mustard gas, &c **EXPAND LATER**	Morocco
1935-40	Mustard gas, &c **EXPAND LATER**	Ethiopia
1937-45	Mustard gas Lewisite Diphenylcyanoarsine *Yersinia pestis*	China
1963-67	Agent CN Mustard gas Phosgene	Yemen
1965-75	Agent CS	Vietnam
1983-88	Agent CS Mustard gas Tabun (Agent GA) Sarin (Agent GB)	Iran/Iraq
1984	*Salmonella enterica* Typhimurium	USA
1994-95	Sarin	Japan

3.2 DISSEMINATION OF BIOLOGICAL AND CHEMICAL AGENTS

For any release of a chemical or biological agent, the nature and degree of hazard will depend on a multitude of factors, including, among other things, the agent and the amount, 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 general types of hazard are usually distinguished -- inhalation hazard and contact hazard -- with different characteristic implications for protection, as is discussed in Chapter 4. Presented here is a brief summary of methods of dissemination for biological and chemical agents that may create an inhalation or contact hazard to unprotected persons. Principles governing the atmospheric dispersion and travel of vapour and particulate clouds are discussed in Annex 4 **CHECK**..

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

For chemical agents, an inhalation hazard may be created by dissemination of the agent as a vapour; as liquid or solid particles sufficiently small to be respirable; as a spray that evaporates to form a vapour while still airborne; or as a spill or spray deposited on surfaces that subsequently evaporates to form a vapour. For some agents, vapours or respirable particles may also present a hazard to sensitive mucous

membranes, especially those of the conjunctivae. 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 likely to come into contact with people. The dissemination of a chemical agent may be done mechanically as by spraying or the rupturing of a container, by using explosives, or by a thermal process in which a pyrotechnic composition is used as the source of heat. Pyrotechnic dissemination is effective only for heat-resistant and non-combustible agents, which may evaporate initially, and then condense as a suspension in air of respirable particles, creating principally an inhalation or conjunctival hazard.

For infective agents, the principal hazard to people would be from inhalation. For many infective agents, the hazard is greatest if the agent reaches the target population in the form of particles within a narrow size range -- small enough to penetrate to the alveoli in the depths of the lungs but not so small that most of the particles fail to be deposited and instead are simply exhaled. In terms of diameter, the corresponding size range is approximately 0.6 to 5 μm. Contact with an infective agent and its entry into the body via a wound or via mucous membranes may also present a hazard, although generally much less than that from inhalation. Infective agents may be disseminated as respirable particles by explosives or by sprayers specially designed to produce particles in the respirable size range.

Particles in the respirable size range and smaller have such low gravitational settling velocities that the movement in the atmosphere of a cloud of such particles is like that of a vapour cloud. A particulate cloud of this type is known as an aerosol, denoting a colloidal suspension of matter in air. For both vapour and aerosol, the rate of

deposition depends not on gravity but rather on chemical and physical forces that might bind the molecules or particles to specific surfaces with which they come into contact, thereby removing them from the cloud. Although wind and other mechanical disturbances may resuspend deposited particles, the amount resuspended is likely to be small and even that would be bound to soil or other particles of diameter too large to be respirable. In consequence, exposures to respirable particles resulting from resuspension would generally be much lower than those caused by an initial cloud.

As a particulate or vapour cloud is carried downwind, 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 with larger 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 downwind of the source.

3.3 ROUTES OF EXPOSURE

3.3.1 Respiratory system

Most biological and chemical agents affect the lungs in some way, even if the respiratory system is not the primary target organ. The body is most vulnerable to this route of exposure because of the large surface area and gas-exchanging function of the lungs; because of the susceptibility of mucous membranes to infection; and because of the presence of phagocytic cells that, if unsuccessful in destroying a pathogenic micro-organism, may instead carry it to the lymph system where it may proliferate and cause

systemic infection. Usually, the onset of symptoms after a respiratory exposure to chemical agents is much earlier than after skin exposure or ingestion. With some biological agents, in contrast, most notably *Bacillus anthracis*, cutaneous infection may be noticeable before infection by other routes.

The inhalation toxicity of a vapour is not only dependent on the concentration of the vapour in air but also the period of time over which exposure occurs. For this reason, respiratory exposure or "dosage" is measured as a function of concentration and time, commonly known as the "Haber product" (W, or Ct-product, with units such as $mg.min.m^{-3}$). With some agents, notably hydrogen cyanide, the formula becomes more complicated for low concentrations or long exposure times, as it needs correction for factors such as the rate of detoxification in the body. With other agents, such as the nerve gases, this dose-rate dependence is less marked. Corrections will also be needed for variation in volume of air being breathed in a given time, partial excretion and incomplete absorption. The eventual effective dose in the body is thus dependent on a variety of internal and external factors. Some are characteristic of the agent, while others depend on the exposed individual and her or his level of activity. Vapours can only be absorbed by the lungs as long as the individual remains in the toxic atmosphere, so, as soon as respiratory protection means are used or the individual is removed from the contaminated atmosphere, breathing of clean air will flush the respiratory system and the exposure level will decrease.

Unlike vapours, aerosol particles of a certain size are accumulated over time in the respiratory system. While particles between 5 and 10µm are largely retained in the nose and throat (and may subsequently be swallowed, adding an ingestion component to

the exposure), particles smaller than 0.6μm in diameter will not deposit in the respiratory system and will simply be exhaled. Volatile chemical agents, however, if inspired in the form of fine particles (< 0.6 μm) may then evaporate due to the higher temperature in the lungs, so adding to the vapour load in the lungs. Particles in the range 1 - 5μm will be deposited in the lungs. The action of aerosolised agents in the lungs will therefore continue even after removal of the individual from the contaminated air or the subsequent use of respiratory protection.

As a cloud of airborne agent, whether in vapour or aerosol form, travels downwind, the integrated dosage it presents at ground level will be diminished by the actions of cloud dilution, including vertical dilution, agent-decay, wash-out and deposition.

3.3.2 Skin and mucous membranes

While many modern chemical agents are designed to penetrate the skin, few biological agents will do so. The presence of injuries, sores or skin rashes might change this significantly and allow even biological agents to enter the body by this route. As a general rule, the thinner, more vascular, and moister the skin, the more prone it is to penetration. High relative humidity promotes skin penetration. Liquid spills and aerosols cause a hazard for skin penetration that can be several orders of magnitude higher than from vapours. Spills will occur mainly around the point of delivery. In case of makeshift devices, a larger fraction of agent will be in the spills and a smaller part will usually be aerosolised. Aerosol particles, in contrast to the much larger particles that will occur in a spray or dust, do not tend to settle on surfaces and might just pass without any harm to the skin (exceptions are hairy areas where aerosol particles might be

trapped). The onset of symptoms after skin exposure to chemical or biological agents is usually delayed compared with respiratory or ingestive exposure. The eyes are particularly sensitive to chemical agents and may develop symptoms of exposure very fast and at relatively low concentrations. Biological pathogens may survive much longer on mucous membranes than on the skin, due to the increased moisture that is present.

3.3.3 Digestive system

Biological and chemical agents can enter the digestive system in contaminated food or drinking water, by hand-mouth contact after touching contaminated surfaces, or by swallowing of respiratory mucus after an 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 the supplies of food and drinking water can reduce the risk of exposure significantly. In case of an ingestion of chemical agents, the delayed onset of symptoms (compared with respiratory exposure) and the increased prevalence of systemic rather than localised effects might appear as a disease or general malaise and, could even be misinterpreted as a biological agent exposure.

Since the particle size is not important after deposition on surfaces, even non-respirable aerosols can contaminate food supplies or drinking water over long distances. The problems presented by direct biological contamination of food, water or other ingestible material are considered in Annex **CHECK**.

3.4 CHARACTERISTICS OF BIOLOGICAL AGENTS

The chief characteristic of biological agents is their ability to multiply in a host over time. Their aggressive potential is rooted in this characteristic. The disease they may cause results from a multi-factorial interaction between the biological agent, the host (including the latter's genetic constitution, nutritional status and the immunological status of its population) and the environment (e.g. sanitation, temperature, water quality, population density). The consequences of employing biological agents to cause disease will reflect these complex interactions.

Biological agents are commonly classified according to their taxonomy, the most salient taxa being fungi, bacteria and viruses. Such classification is important to medical services for its implications regarding detection, identification, prophylaxis and treatment. Biological agents can also be characterised by their intrinsic features, notably infectivity, virulence, lethality, pathogenicity, incubation period, mode of transmission, and stability[19], all of which influence their potential for use as weapons.

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

Virulence is the relative severity of the disease caused by a micro-organism. It can be quantified as the ratio of the number of clinical cases over the number of infected hosts. Different strains of the same micro-organism may cause disease of different severity, e.g. infection due to *Brucella melitensis* is usually more severe than infection due to *B. suis* or to *B. abortus*.

[19] The definition of these terms given below in general follows J M Last, *A Dictionary of Epidemiology*, fourth edition, Oxford University Press, 2001.

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

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

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

For those infections that are contagious, a measure of their **contagiousness** is the number of secondary cases following exposure to a primary case in relation to the total number of the exposed susceptible secondary contacts. The mechanisms of transmission involved may be direct or indirect. The transmission may, for example, result from direct contact between an infected and an uninfected person. Or it may be mediated through inanimate material that has become contaminated with the agent, such as soil, blood, bedding, clothes, surgical instruments, water, food or milk. There may also be airborne or vector-borne secondary transmission. Airborne transmission can occur through coughing or sneezing, which may disseminate microbial aerosol. Vector-borne transmission can occur via biting insects, arthropods, or other invertebrate hosts. The

distinction between types of transmission is important when methods for controlling contagion are being selected. Thus, direct transmission can be interrupted by appropriate handling of infected persons, while indirect transmission requires other approaches, such as adequate ventilation, chlorination of water, or vector control.

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

3.5 CHARACTERISTICS OF CHEMICAL AGENTS

As with biological agents, a given chemical agent 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 chemical agents are grouped and referred to in different commentaries or manuals. The most common characteristics are described below in order to introduce and explain frequently used terminology.

A common form of classification of chemical agents is according to degree of effect, i.e. 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, and usually remain capable of removing themselves from exposure to it unless they are otherwise constrained. Usually they will recover fully in a short time after exposure ends, with no medical treatment required. An **incapacitating agent** also disables, but people exposed may not be aware of their predicament, as with certain psychotropic agents, or may be rendered unable to function or move away from the

exposed environment. The effect may be prolonged, but recovery may be possible without specialised 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 dose received and on the health and other factors determining the susceptibility to adverse affects on the individuals exposed. Tear gas (such as CS or CN), usually a harassing agent, could be lethal if a person were exposed to a large quantity in a small closed space. On the other hand, nerve agents, usually lethal, might only incapacitate if the target were exposed only to 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 pre-treatment and antidotes in a nerve gas victim is unlikely to provide a complete "cure", but it may well reduce what would have been a lethal effect to an incapacitating effect.

Another form of classification is according to route of entry of the agent into the body (see section 3.3 above). **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, causing damage to the skin (e.g. mustard) or gaining access to the body to cause systemic effects (e.g. nerve agents), or both. According to its physical properties or formulation, a single agent may be taken up by either or both routes.

A further classification refers to duration of hazard. **Persistent agents** will remain in the area where they are applied for long periods (sometimes up to a few weeks). They are generally low-volatility substances that contaminate surfaces and have a primary hazard potential of contact with the skin. A secondary danger is inhalation of

vapours that may be released. Persistent agents may consequently be used for creating obstacles, for contaminating strategic places or equipment, for area denial, or, lastly, for causing casualties. Protective footwear and/or dermal protective clothing will often be required in contaminated areas, usually together with respiratory protection. Mustard and VX are persistent agents. **Non-persistent agents** do not stay long in the area of application. Being volatile substances, they evaporate or disperse rapidly, and may consequently be used to cause casualties in an area which needs to be occupied soon after the area has cleared. Surfaces are generally not contaminated, and the primary danger is from inhalation, and secondarily from skin exposure. Respirators will be the main form of protection required. Protective clothing may not be necessary if concentrations are below skin toxicity levels. Hydrogen cyanide and phosgene are typical non-persistent agents.

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

3.6 CONSEQUENCES OF EMPLOYING BIOLOGICAL OR CHEMICAL WEAPONS

3.6.1 Short-term consequences

The most prominent immediate consequence of incidents involving biological or chemical weapons is their ability to cause mass casualties. It is this characteristic that directs most preparedness strategies. The potential for overwhelming medical resources and infrastructure is magnified by the fact that the psychological reaction of a civilian population to biological or chemical attack is likely to be far more severe than that caused by assault with conventional weapons. Chapter 4 describes how psychological support strategies combined with risk communication are an integral addition to the response services that are needed to manage the many exposed and non-exposed casualties that may present at medical facilities. A graphic and instructive illustration of the nature of short-term consequences of urban attack with chemical agents is provided by study of the 1994-95 terrorist attacks in Japan in which the nerve gas sarin was used. This is described on pages **INSERT** below

Details of the short-term injuries that are 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 use of biological or chemical weapons, including delayed, prolonged and environmentally mediated health effects felt far beyond the time and circumstances of employment of the weapons, have generally received less attention in the literature than the more obvious short term consequences discussed above.

Some biological and chemical agents have the potential for causing physical or mental illnesses that either remain evident or only become evident months or years after the weapons have been used. Such effects have long been recognised, and have indeed

been the subject of specific scientific monographs (3.03, 3.04). They may extend the potential for harm of biological or chemical weapons beyond their immediate target area in time as well as space. Users may seek to exploit this characteristic of the weapons for offensive purposes, but for many agents too little is known about long-term effects for reliable predictions to be made.

Such uncertainty also affects the planning of medical countermeasures, and not much more can be done than to outline the various possibilities needing further study. Unanticipated long-term effects of agents may later prove more harmful than the immediate effects. Non-military experience with disease-causing organisms, or 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 generally greater quantities may be involved. Useful pointers to what the consequences might be can, however, be found in knowledge of exposure to chemicals in an occupational setting. Organophosphate insecticides, for example methyl parathion, are hazardous for humans, and the methods of treatment and the likely long-term effects of poisoning may be similar to those for nerve gases such as sarin.

Categories of long-term health consequences of releases of biological or chemical agents may be defined: chronic illness; delayed effects; new infectious diseases becoming endemic; and effects mediated by ecological changes.

The potential for **chronic illness** after exposure to some toxic chemicals is well known. The occurrence of chronic debilitating pulmonary disease in victims of mustard exposure was reported after the First World War (3.05). Such experience is also

recorded in reports describing the current status of Iranian casualties from Iraqi mustard gas during the Gulf War of the 1980s (3.06, 3.07). Follow-up of Iranian victims has revealed debilitating long term disease of the lungs (chronic bronchitis, bronchiectasis, asthmatic bronchitis, pulmonary fibrosis, large airway obstructions), eyes (delayed mustard gas keratitis with blindness), and skin (dry and itchy skin, with multiple secondary complications, pigmentation disorders, structural abnormalities ranging from hypertrophy to atrophy). Deaths from pulmonary complications are still occuring at the time of writing, approximately twelve years after all exposure had ended.[20] Details of long-term effects caused by particular toxic chemicals are provided in Annex 3. Biological agents, too, may cause long lasting illness, including some of the agents of particular concern. *Brucella melitensis* infections, 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 1 provides further information.

As to **delayed effects** in persons directly exposed to biological and chemical agents, the possibilities of carcinogenesis, teratogenesis and mutagenesis cannot be disregarded. Concerning *carcinogenesis*, both viral and chemical agents have been strongly implicated in the causation of cancer in humans. Whether infection by any of the micro-organisms of particular concern in this study can be carcinogenic in humans is not at present known. Only limited information is available on the ability of certain classes of chemicals to induce cancer, mainly in experimental animals. For example,

[20] K Keshavarz (Chief Physician Baghiyat'ollah Hospital, Teheran), personal communication.

many alkylating agents have been found to be carcinogenic. Some compounds of military interest, such as mustard gas, are alkylating agents. While the evidence suggesting carcinogenesis after a single acute exposure to sulfur mustard is equivocal, there is stronger evidence suggesting a significant increase in respiratory-tract cancer amongst workers suffering prolonged low-dose exposure in mustard production factories (3.08). As to *teratogenesis*, certain chemicals and infective agents can cause severe damage to the developing human foetus. Thalidomide and the rubella virus are particularly well known examples. It is not known whether any of the specific chemical or biological agents addressed here would have teratogenic effects at the doses likely to be received by pregnant women in civilian populations that might be exposed during an incident of release. Regarding *mutagenesis*, insufficient attention has been given to the possibility that known chemical and biological agents might cause detrimental alterations in the human genome. Several chemicals are reported to induce such changes in experimental organisms and in cultured human cells.

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

Finally, there is the possibility of **effects mediated by ecological change**. New foci of disease might become established as a result of ecological changes, caused by use of biological agents infective for man and animals, or as a result of the use of anti-plant agents. These could exert profoundly adverse long-term effects on human health via reductions in the quality and quantity of the food supply derived from plants or animals.

The broad conclusion to be drawn from the foregoing analysis is that there are enormous difficulties associated with assessing the long-term health effects of exposure to chemical and biological agents. Confounding variables often affect the results of studies, and it is frequently difficult to distinguish genuine long-term effects of exposure (which by nature are often non-specific) from background occurrence of the same symptoms due to a wide spectrum of other causes. Conflicting data and inconclusive results often lead to an inability to formulate definitive answers.

Examples of the difficulties in determining the existence of long-term effects of chemical exposure have been provided by the ongoing investigations of medical problems apparently caused by the herbicide Agent Orange to people exposed in Vietnam, where the chemical was extensively disseminated in the 1970s during the Vietnam War (3.09). Investigations have paid special attention to the Orange-production contaminant TCDD, a chlorinated dioxin that is persistent in the environment, detectable at elevated levels in sampled blood lipid and body fat, and highly toxic to specific test animals. In a more recent example, and with even less scientific evidence available regarding a cause/effect relationship, chemical exposures of a variety of types were amongst the many factors that have been put forward as potential causes of the so-called Gulf War syndrome. In both cases, a wide range of long-term symptoms and adverse

health effects (including carcinogenesis, teratogenesis, mutagenesis, and a plethora of non-specific somatic and psychological symptoms) have been claimed to have been caused by exposure to chemical agents, amongst other possible causes (3.10). Despite intensive investigation, definitive explanations have not yet been found in either case.

3.6.3 Psychological warfare aspects

Distinct from their ability to cause physical injury and illness, biological or chemical agents are amenable to the waging of psychological warfare because of the horror and dread that they can inspire. Even if the agents are not actually used, the 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 are often to be found in political circles and in the news media. Also, people may be more able to understand and comprehend the wounding effects of conventional weapons than those of toxic or infective materials. These matters are taken up in more detail in Annex **CHECK**

The emergence and spread of long-range ballistic missile delivery systems has increased the sense of vulnerability to biological or chemical attack that can prevail in cities, where the population may seem largely unprotectable, and this in turn has increased the psychological warfare potential. This was demonstrated in Tehran during the 'war of the cities' in the final stage of the Gulf War of the 1980s when the prospect – in fact unfulfilled – of missile-delivered chemical agent reportedly sapped morale to an extent that the actuality of high-explosive warheads had not. There was further demonstration during the Kuwait War of 1990-91, with fears that Scud missiles launched against cities of Israel might be armed with chemical warheads. In addition to military and civil defence personnel, much of the civilian population was issued with anti-

chemical protective equipment and trained in procedures for chemical defence. Considerable disruption occurred as missile strikes were regarded as chemical until proven otherwise, despite the fact that no chemical warheads were actually launched by Iraq.

3.7 ASSESSMENT AND CONCLUSIONS

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

Of the various methods available for release of biological and chemical agents, the major risk emanates from their dissemination as aerosols or, in the case of some chemicals, as vapour. Against these hazards, the primary requirements are for respiratory protective equipment and for means of predicting the potential spread of the airborne agent so that preventive and protective measures can be implemented in areas that could be affected.

Skin exposure hazards primarily result from chemical agents and will mostly occur in the immediate vicinity of a release. Here the mainstay of protection will be protective clothing. Skin protection may be required to protect against both direct liquid exposure, and potential skin damage from high vapour concentrations. If a vapour hazard is involved, respiratory protection using adsorptive carbon filters will also be required. Contaminated areas will need to be located, demarcated, and decontaminated.

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

TEXT FOR THE BOX IN SECTION 3.1.1:

HOW BIOLOGICAL AND CHEMICAL WEAPONS ARE DEFINED IN THE BWC AND THE CWC

Article I of the Biological Weapons Convention is 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.

CHAPTER 4: PUBLIC HEALTH READINESS FOR BIOLOGICAL OR CHEMICAL INCIDENTS

Initial response to a deliberate release of infective or toxic agents against civilian populations is largely a local responsibility in many parts of the world. Local authorities have the greatest opportunity to impact positively on events, and will generally be held accountable should the incident be mishandled. While national and international resources will play an important long-term role, it is the responsibility of local officials to have response systems and plans in place before an incident actually occurs.

This chapter provides a framework that local and national authorities could use to guide the planning of an ability to respond 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 subject-matter involved, or to present a didactic training text. The goal is rather to demonstrate that the standard principles of risk management are applicable to biological or chemical incidents as they are to other hazards, and that these principles can be used to identify areas needing particular attention when biological or chemical agents are involved. It should be considered as an outline of the issues that will need to be addressed. Further resources for detailed information are identified in Annex **Z CHECK**. As far as chemical attacks are concerned, states party to the CWC, who have thereby become members of the OPCW, have access to international aid for their preparedness activities. Assistance in assessing needs, and specific training, can be accessed by contact with the International Cooperation and Assistance Division of the OPCW Technical Secretariat. As to biological attacks, Article VII of the BWC makes some provision

for assistance in the event of a state party becoming exposed to danger as a result of violation of the Convention. For further information on this and other sources of international assistance, including the WHO, see Chapter 6.

Readiness needs also to extend to 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 and concerns as well as to initiate appropriate action to locate and neutralize any suspect device.

There may be a close relationship between the public-health readiness that is to be discussed in this chapter and the preparedness of military forces to protect their capabilities and operations against adversary biological or chemical warfare. Yet, while it may be possible for some countries adequately to warn, encapsulate and otherwise protect the disciplined, centrally commanded, healthy, adult individuals 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 positive danger in holding out a prospect of adequate civil protection that is actually unrealistic, for it may detract from efforts at prevention.

4.1 PLANNING PRINCIPLES

The first responders to an attack with a toxic substance with prompt effects are likely to be police, fire departments and emergency medical personnel on or near the scene. In contrast, the first responders to an initially undetected attack with an infective agent, or with a toxic agent having only delayed effects, are more likely to

be regular healthcare providers, including nurses, physicians and hospital emergency room personnel, who may be located in widely separated places.

While chemical weapons would place a great burden on public safety personnel and biological weapons on public health infrastructure, they both can result in an extraordinary burden on the local healthcare delivery system.

Because victims of a chemical attack could be affected immediately, a rapid response would be required with the primary focus on contamination control and early medical treatment. Emergency personnel would 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 would be more likely to become evident over a longer period of time -- days or even weeks. It would probably manifest as the appearance of cases of infectious disease. Due to movement of victims in the symptom-free incubation period after exposure, cases of the disease might appear in different parts of the country (or world), and the full picture might only become evident after combining information, medical reports, and surveillance data from multiple areas. Biological agents that are transmissible from person-to-person could generate clusters of secondary outbreaks. Depending on the nature of the organism involved, it could initially appear to be a natural outbreak of disease.

These differences need to be borne in mind when planning readiness efforts for biological and chemical incidents. However it must be noted that, in the early phases of an incident, it may not be clear whether the causative agent is biological or

chemical, or possibly even mixed. As a result, first responders may find themselves needing to manage both types of incident before the relevant specialists for biological or chemical incident management become involved.

In order to prepare for biological or chemical attack, authorities should be encouraged to make maximum use of existing emergency response resources, and to adopt an approach that is consistent with the principles of management of any other type of public health emergency. While attacks with biological and chemical agents would have some distinct features, they do not necessarily require the formation of completely new and independent response resources. A well designed public health and emergency response system can provide a significant capacity for responding to a limited biological or chemical attack and can form the basis for developing measures designed specifically to mitigate the effects. A chemical agent attack would share many similarities to a major hazardous materials accident. A community's existing hazardous materials response capability is therefore a critical component of preparedness for such an incident. A biological agent attack would generally have the characteristics of a disease outbreak. Consequently city, state and regional public health programmes must be involved in the response, which will have more to do with the mobilization of infection control strategies (as for any outbreak of disease).

Establishing routine sensitive and near real time disease surveillance systems will serve a dual purpose in natural and deliberate outbreaks. It is important to have such systems in place well in advance of an attack, so that the background disease prevalence in an area is known. The capabilities of a surveillance system regarding outbreak alert and response to naturally occurring outbreak of disease is an indication

of its possible contribution during deliberately caused outbreaks. A national centre may detect a national outbreak not noticed in any one regional locality. It can also maintain economically epidemiological expertise for investigating the cause and source of outbreaks. It could contribute to both biological and chemical defence, as epidemiological techniques that might be used in their investigation are similar (although possibly more frequently important in biological episodes). Establishing mechanisms for routine exchange of information between the public health and veterinary sectors is very important as many biological agents are zoonoses.

A greater role is being played in disseminating information on outbreaks and other health events by the media and interest-groups, notably the Program for Monitoring Emerging Diseases (ProMed) that is now run by the US-based International Society for Infectious Diseases: see http://www.promedmail.org. WHO has established epidemic intelligence capabilities and actively collects, verifies and disseminates information on outbreak of diseases of international public health concern. Information on these outbreaks is available on a restricted basis to WHO partners and member states weekly, and once officially notified they are made public electronically through the World Wide Web and in printed form through the *Weekly Epidemiological Record* (4.01).

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

Identification of the presence of a covert release may be a particularly difficult task. Routine emergency-call monitoring systems (which continually track the frequency, nature, and location of emergency calls) are a valuable emergency service management tool, and may be of considerable benefit in drawing attention to an unusual outbreak of symptoms, possibly indicating a deliberate release of biological or chemical agents.

The danger of fully centralizing biological and chemical incident response onto dedicated specialized response units is that the relative infrequency of call-out could lead to a stagnation of skills. More seriously, excessive centralization would risk lengthening the time of reaction. Mobilization of a specialized biological and chemical unit throughout a region could never match the 24-hour availability and general emergency management experience of existing response and public health groups. It is true, however, that certain activities will need to be conducted by specialists (e.g. sampling and analysis for definitive identification of agent involved). This suggests that a readiness and response strategy should be directed at enabling the local public health, emergency response and other authorities (fire brigade, ambulance services, police force, and civil defence) to respond to and manage the incident scene in its early phases, with specialized functions being added later by a dedicated mobile biological and chemical response unit. The exception might be the pre-positioning of special response units for highly visible events (e.g. the Olympic Games) that might be a target for terrorists.

This approach indicates that planning of a response system should address the needs of two categories of service provider - the standard emergency response personnel who will perform the primary response, and the specialists who will supplement the primary response with specialised functions. A third group that needs to be addressed in planning is the local population itself. A response strategy is not complete unless attention has been given to distribution of the knowledge that the population should have before any incident occurs, and communication/training in what they should do after an attack. A final area of consideration is the medical treatment centres (usually hospitals) that will receive potentially large numbers of casualties (both exposed victims and those who think they may have been exposed).

Development of the ability to respond to biological or chemical incidents should address two distinct areas. In this chapter, these will be referred to as *preparedness* (what needs to be addressed well 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).

A systematic and logical framework is needed to structure the planning process, and to identify the areas that require attention in a logical manner. This can be provided by adopting the principles of risk management:

- Identify the hazards.
- Evaluate the hazards to determine initial risk (probability and severity).
- Introduce risk reduction strategies.
- Quantify the residual risk, and make a risk acceptance decision.

- Monitor the risk-management programme, and repeat the process as required.

These steps can be used to identify areas of activity during both the pre-attack "preparedness" phase, and the post warning or attack "response" phase. While attention to biological/chemical issues may necessitate terminology different to that which is usually found in risk management guides (as well as some hazard-specific technical considerations), the principles of applying these steps remain the same.

4.2 PREPAREDNESS

4.2.1 Identify the hazards

This step, and the hazard evaluation step that follows, is commonly referred to as "threat analysis". It is an activity to be conducted in a multi-disciplinary fashion, with particular inputs from the country's law enforcement, intelligence, and medical/scientific communities. It is aimed at identifying those who may wish to use biological or chemical weapons against the population, the agents that could be used, and the circumstances under which the weapons might 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 local authorities. Precise identification of the threat is likely to be infrequent, and general preparedness measures will usually be required. Judgements will usually need to be made on the basis of a general appraisal of national or local circumstances.

Even if specific biological or chemical hazards cannot be identified, general improvement in public health (and ability to respond to outbreaks of disease) will

automatically improve a population's ability to manage biological incidents. Establishing an ability to manage industrial chemical accidents will provide resources that can be diverted, if needed, to managing a chemical incident.

4.2.2 Evaluate the hazards

If specific potential hazards can be identified, the probability of an incident occurring and its consequences must be evaluated. Justified and well motivated decisions on resource allocation can only be made after these steps are complete.

The level of risk that exists is also a function of the potential vulnerability of the community affected. Vulnerability analysis will identify weaknesses in the system that may be exposed to biological or chemical hazards, and will determine the current ability to respond to and manage the emergency (4.02). This further requires a needs-and-capability assessment. With potential scenarios identified in the preceding steps, it is possible to commence with a study of resources required to respond to such incidents. Response requirements must be elucidated in each of the action areas identified below in the respective sections on response to biological and chemical incidents. When identified needs are measured against currently available resources, deficiencies will be identified. This is the standard approach of "gap analysis". It is during this step of needs-and-capability assessment that a country inexperienced in analysis of defence against biological and chemical weapons is most likely to need expert assistance (see Chapter 6 for sources of assistance).

4.2.3 Introduce risk reduction strategies

The details of risk reduction within a specific incident after it has occurred will be discussed in the response sections below. This section refers to risk reduction in the pre-incident phase of preparedness.

4.2.3.1 Pre-emption of an attack

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

Pre-emption of terrorist use of biological or chemical agents presupposes a number of elements. First and foremost, it requires accurate and up-to-date intelligence about terrorist groups and their activities. As the agents may be manufactured using dual-use equipment, and as equipment associated with

manufacture need not be large or particularly distinctive (from a viewpoint external to the facility), technical means of intelligence such as reconnaissance satellites are of little help. Intelligence regarding terrorism relies heavily on human sources. The underlying consideration is that, while national biological and chemical weapons development and production programmes and facilities have been large-scale and of protracted duration, terrorist activities could be much less conspicuous and therefore more difficult to detect.

Another important prerequisite for pre-emption is the existence of national legislation that renders the development, production, possession, transfer or use of biological or chemical weapons a crime, and that empowers law enforcers to act against suspected protagonists before an actual event occurs. Details of how this is addressed in the CWC and BWC, and the implementation thereof, can be found in Chapter 5.

Pre-emptive efforts would also be aided by concerted national and international efforts to control the availability of both tangible and intangible information that could aid proliferation. This could range from “cookbook” type information on the Internet purporting to explain to laymen how to make biological or chemical weapons, through to intergovernmental monitoring and control regimes applied to dual-use technology and equipment. The international norm which has been established by the majority of the world’s nations by their acceptance of the principles of the BWC and the CWC is a strong force to confront, and could be a decisive dissuading factor for would-be users of biological or chemical weapons.

4.2.3.2 Preparation of an ability to respond

Pre-emptive efforts notwithstanding, the risk of a biological or chemical attack can not be eliminated completely, and it could be a high-consequence event should it occur. Accordingly, a programme of preparedness may be judged prudent. The preparedness phase will involve acquisition of equipment and supplies, procedure development, and training. Communities will need to examine their existing hazardous materials protocols, public health plans, and the current training of police, firefighters, emergency medical service personnel, and public health personnel, including epidemiologists, veterinarians and laboratory staff. Those protocols will have to be amended to meet the challenges unique to deliberately released biological or chemical agents.

Most civilian healthcare providers have little experience with illnesses caused by biological and chemical weapons. They may therefore have little expectation that a patient's symptoms may be due to such weapons, especially in the early phases of an incident. There is a need for familiarization training of healthcare workers in the recognition and initial management of both biological and chemical casualties, and availability of a rapid communication system that allows real time sharing of information when suspicion of an unusual incident arises. Education and training must include the general characteristics of biological agents versus chemical agents; clinical presentation, diagnosis, prophylaxis and therapy for the most important biowarfare diseases; sample handling, decontamination, and barrier nursing. Training, planning and drills must prepare physicians and staff for mass-casualty patient management, respiratory support for unusual numbers of patients, distribution of medication, or support of the local government in vaccination programmes. Providing

such education and training is expensive and may be manpower intensive, yet may be the most cost-effective aspect of medical preparation for biological terrorism. Such training will also be the cornerstone of an approach to prevent anxiety and fear in healthcare workers, a phenomenon which could be expected after a bioweapons event, and which could disrupt provision of healthcare services.

Because early diagnosis of both biological and chemical exposure will be an important prerequisite for establishing treatment and response modalities, preparation should include the establishment of reference laboratory capabilities to identify potential agents using molecular technologies as well as classical clinical laboratory methods. Secondary to the need for diagnosis for medical treatment purposes, forensic analysis will be required from samples obtained from a delivery system or the environment, or from patients. Positioning of diagnostic capabilities in regional laboratories, especially in more geographically isolated countries, would be optimal for earlier diagnosis. New molecular diagnostic technologies facilitate definitive identification of biological agents more quickly, and even at the attack site. Such state of the art techniques may not, however, be widely available.

Failure adequately to prepare the healthcare system and its providers for biological attack could result not only in late detection of an outbreak, but could also facilitate the spread of an outbreak caused by a person-to-person transmissible agent. Should the local healthcare facilities and personnel be perceived as inadequate for managing the outbreak and the clinical cases, the population, including potentially infectious patients, may travel long distances to seek treatment, promoting spread of the outbreak.

Where particular utility for equipment, antidotes, antibiotics or vaccines has been identified, pre-attack stockpiling and planning for distribution systems to make them available to the exposed population would be necessary. The financial cost of such stockpiles, depending upon the items chosen and the quantities stockpiled, could be very high indeed. Allocation of such resources exclusively for responding to biological or chemical weapons could only be justified in extremely unusual and very specific threat situations. In high risk situations, the supply to each person or family of protective equipment (e.g., respiratory protection), antidotes (e.g., syringes loaded with antidotes for self-injection) or antibiotics can be considered. The cost and logistical burden of this type of preparation may be prohibitive, however, and it may not be feasible for poor countries or countries with large numbers of people needing protection. In such cases, and dependent on the agent involved, selective protective measures may still be considered for high risk groups (e.g. prophylactic antibiotics for those who have a substantial probability of being or having been exposed).

It is crucial not to make the error of assuming that availability of equipment is synonymous with an ability to respond, or that the community without all the latest equipment is doomed to failure. Furthermore, availability of specialised equipment is generally a more important part of preparation for chemical attack than it is for biological attack. The use of biological and chemical protective equipment requires very specific training, and adaptation of existing procedures for emergency management. Without careful procedure development and intensive training, introduction of such equipment can hamper the ability to respond, and can in fact be

dangerous. Some of the problems associated with the use of protective equipment are described at the end of this chapter, in Appendix 4.2.

4.2.3.3 Preparation of public information and communication packages

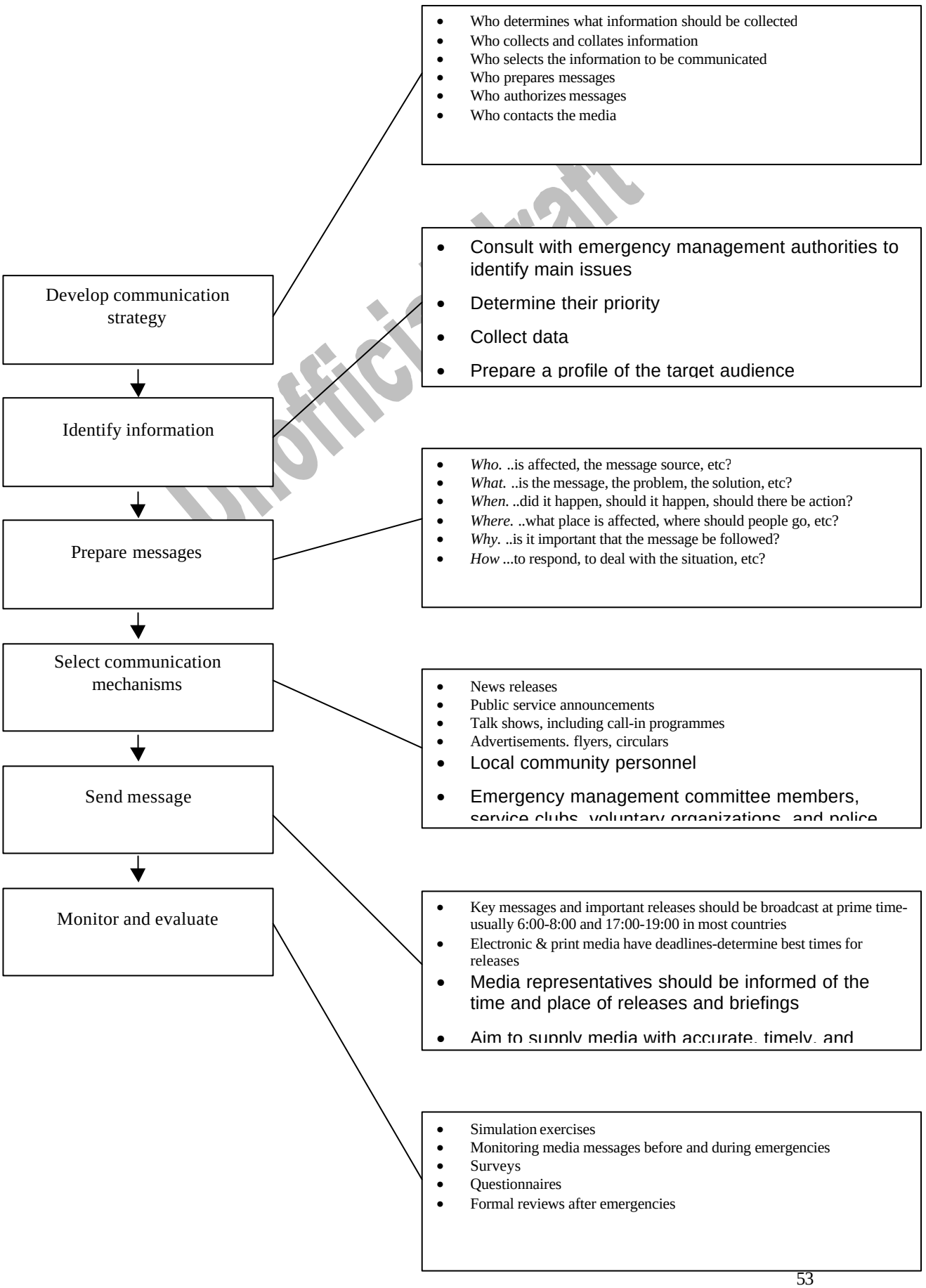
A plan to communicate information to the public and to demystify the subject of biological and chemical weapons needs to be in place well before an incident occurs if it is to have any chance of success. The adjacent **CHECK** box shows how a communication plan might be conceived. If actions are to be effective, the public should know how they will be expected to act in the event of an attack, well before any threat materialises. The communication plan may include radio and television broadcasts, or public distribution of brochures describing the potential threat in plain non-emotive language. Clear instructions should be provided on how the alarm would be raised, and what to do if that should happen. Excellent examples of such communication packages are available (e.g., 4.03, 4.04). A well constructed media plan is essential, both as part of the pre-incident education process, and to avoid sensational reactions 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 against the specific local circumstances, including the possibility that too much information might be counter productive, or even provocative.

4.2.4 Quantify the residual risk, and make a risk acceptance decision

Once the risk reduction measures discussed above have been put into place, it is necessary to reassess the residual risk, and make a decision on whether preventive

and preparedness measures have been effective, and are adequate. The level of residual risk that can be accepted will depend on the circumstances of the region involved. 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 support major resource expenditure, and acceptance of a reduced ability to respond may be justified. Such decisions are clearly extremely difficult, and will be influenced by political factors as well as by practical considerations.

A Six Step Process for Communicating with the Public [a]



[a] Adapted from *Community Emergency Preparedness*, WHO, Geneva, 1999

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

As with all risk management programmes, constant monitoring is required to ensure that adopted strategies are proving to be adequate. This implies continuous attention to the threat analysis process, and constant evaluation of the ability to respond. Critical evaluation of realistic training scenarios is required to identify areas for improvement. Careful analysis of actual biological/chemical-weapons incidents, wherever they may occur, should provide real information to guide the ability of the international community to respond. Lessons from actual incidents or threats need to be incorporated into future planning. Since the publication of the first edition of this report, the first recorded incident of terrorist attack on civilians using chemical weapons occurred in Japan. This incident warrants a careful analysis, as many illustrations and lessons regarding the nature of and response to civilian attacks with chemicals can be learned. For example, the observation that the majority of patients arrived at hospitals on their own initiative, and using their own transport, has important implications for the distribution of triage and decontamination abilities. The movement of mobile units to the incident scene implies that their services will not be available for those who take themselves to hospital. Further discussion of this incident is provided at the end of this chapter, in Appendix 4.1.

The only real-world episode that can be regarded as a successful act of biological terrorism, apparently experimental, occurred in 1984. With a view to influencing a local electoral process, a religious cult known as the Rajneeshees sickened 751 people in a small town in Oregon, USA, by using cultures of *Salmonella*

enterica Typhimurium bacteria to contaminate the salad-bars of ten restaurants over a period of some two months. (4.05, 4.06)

The main point to be extracted from this discussion is that the logic and framework of preparation for response to a biological or chemical attack can be based on the same principles that should be applied when preparing for any disaster or emergency. Those interested in obtaining more details of the process are referred to a WHO publication, *Community Emergency Preparedness: a manual for managers and policy makers* (4.07).

4.3 RESPONSE

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

Should warning of an impending release of biological or chemical agent be received, there are a number of activities that can and should be carried out before the release. The sequence in which these activities are performed will depend on the particular circumstances of the incident. The first indication of an incident could 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 activities may be required:

- **Analysis of the available information.** All the information available needs to be assessed by an appropriate group including the police, intelligence and technical experts who should have trained to work together to analyse such information by means of realistic and credible exercise scenarios. The availability of a small

group of analysts and experts to evaluate threat or suspected incident information will allow advice on appropriate action and mobilization of specialist response, and may go a long way to avoid inappropriate responses to hoaxes.

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

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

- **Hazard reduction and/or neutralization.** If a device or unusual package is found then consideration can be given to reduction or neutralisation of the potential hazard through containment or other mitigation and neutralization approaches[21].

- **Early identification of the nature of the hazard.** It is important to decide as soon as possible whether the impending hazard is chemical or biological in character (or even a mix). This will allow the appropriate specialists to become involved in management of the incident. It will also allow the choice of protective

[21] An internationally marketed system for containment, neutralisation, and decontamination of chemical and/or biological devices has been developed by the Canadian based company Irvin Aerospace – see <www.irvin.co.uk/products/blast.htm>.

equipment appropriate for that hazard. For example, an oro-nasal mask may provide adequate protection against a particulate biological hazard whilst a respirator and full protective clothing may be required to protect against a persistent chemical agent.

4.3.2. Distinguishing features of biological and chemical incidents

In the earliest phases of a release (and particularly if the release is covert), it may be difficult to distinguish between a biological and chemical attack. As a general guide, chemical attacks are more likely to produce simultaneous and similar symptoms in a relatively restricted area near the release point, and relatively soon after release. Biological attacks are more likely to present with the appearance of ill individuals at medical centres and/or doctors over a longer period of time, and far more widely distributed. Of course symptoms resulting from exposure to chemicals with delayed effects may be much more difficult to differentiate from infectious disease. While there are no definitive and invariable distinguishing features, the indicators set out in Table 4.1 below may help to differentiate biological and chemical attacks.

Table 4.1 Differentiation of biological and chemical attack

Indicator	*Chemical attack*	*Biological attack*
Epidemiological features	Large numbers of patients with very similar symptoms seeking care virtually simultaneously (especially respiratory, ocular, cutaneous or neurological symptoms). Could be displaying nausea, headache eye pain or irritation, disorientation, difficulty with breathing, convulsions and even sudden death. Clusters of patients arriving from a single locale. Definite pattern of symptoms clearly evident.	Rapidly increasing disease incidence (over hours or days) in a normally healthy population. Unusual increase of people seeking care, especially with fever, respiratory, or gastrointestinal complaints. Endemic disease rapidly emerging at an uncharacteristic time or in an unusual pattern. Large numbers of rapidly fatal illness (agent dependent). Any patient with relatively uncommon disease that has bioterrorism potential (e.g. pulmonary anthrax, tularaemia, plague).
Animal indicators	Dead or dying animals. Lack of insects that are normally present.	Sick or dying animals or fish. Unusual swarms of insects.
Devices, unusual liquid spray or vapour	Suspicious devices or packages. Droplets, oily film. Unexplained odour. Low clouds/fog unrelated to weather.	Suspicious devices or packages.

Source: Adapted from references 4.08 and 4.09.

4.3.3 Response to biological incidents

Response to an established biological attack is a multidisciplinary and complex task, which will require co-operation between civil defence, emergency response, law enforcement, public health and medical personnel. The normally challenging tasks of dealing with an outbreak will be aggravated by the specific problems relating to the deliberate origin of the incident.

With such an array of issues and questions to address, a logical means of ordering and prioritizing an approach is needed. The requisite response activities, and a logically ordered sequence for their implementation, can be identified by working through the step-by-step principles of the risk management process, as in the following table:

Standard risk management step	*Specific actions for response to biological attack*
Identify the hazards.	Determine that a release has occurred, or an outbreak is underway. • Identify the nature of the agent involved. • Develop a case definition and follow up distribution of cases (time, place and person). • Define the population at risk • Develop an initial hypothesis on the exposure that is causing disease (source of the agent and mode of transmission) • Test the hypothesis with clinical, laboratory or environmental data; conduct field investigation and apply analytic epidemiology tools comparing sub-groups of the population
Evaluate the hazards to determine initial risk (probability and severity).	Evaluate potential outbreak spread, and assess current and delayed case management requirements, having regard to the possibility that the infection may be contagious.
Introduce risk reduction	Implement a risk communication programme for

strategies.	the affected population that conveys information and instructions as needed Order necessary supplies and organise needed personnel. Protect responders and healthcare workers. Introduce infection prevention and control procedures. Conduct case triage. Ensure medical care of infected cases.
Quantify the residual risk, and make a risk acceptance decision.	Decide whether local and national resources are adequate, and whether international resources should be accessed.
Monitor the risk management programme, and repeat the process as required.	Implement active surveillance to monitor the effectiveness of prevention and control procedures, and adjust response activities as needed. Implement follow up activities.

The specific actions identified in the table are expanded in the paragraphs below. Since responses to natural and to intentionally caused outbreaks will follow similar approaches, the descriptions that follow focus specifically on the distinguishing challenges posed by deliberately caused outbreak. Interested readers are referred to other publications for more details on public health response to epidemic emergencies (e.g., 4.10). The intention is to indicate activities that response planners need to address. Sources of more detailed information on these tasks are given in Annex **Z INSERT.**

4.3.3.1 Determination that a release has occurred, or an outbreak is underway

All outbreaks of infectious diseases should be considered natural events unless the contrary can be proved. To initiate a response to intentional outbreak thus

requires a prior realisation that a release has actually occurred, or the suspicion that an outbreak has been intentionally caused. Many factors will influence the decision to initiate such response and particularly on whether the release was overt or covert. A covert release, just as any other outbreak of disease, will only be detected when cases of illness begin to present at medical facilities. The existing surveillance system should be able to detect the outbreak and an epidemiological investigation will be triggered. The results of the investigation, coupled with clinical, laboratory or environmental data, may indicate that the outbreak could be the result of a deliberate release. The importance of routine surveillance and prompt investigations of all outbreaks as a tool to warn that an unusual outbreak may be underway has been discussed in section 4.1 above. A threatened or overt release will generate response requirements more akin to the early stages of a chemical release, described below. While determination that it has indeed happened will most likely come from signs and symptoms in people and animals, it may also require sampling and detection of biological agents in environmental substrates.

4.3.3.2 Identification of the agent involved

Prompt identification of the agent involved is required to direct preventive and medical measures. Because some of these agents may cause an infection that is contagious, it may not be prudent to wait for laboratory confirmation of agent identification. In such circumstances it might be necessary to introduce risk-reduction strategies soon after starting the outbreak investigation.

Detection and identification of biological agents in the environment may not be at all easy. The development of sensitive, timely biological agent detectors for a

broad array of potential threat agents will require significant advances in technology in order to make them widely accessible and may not be available for some time. The problem is particularly acute in regard to those highly infective agents that can create a high probability of disease at doses as low as 1-100 organisms inhaled.

The extent to which laboratory support will be able to aid initial diagnosis and treatment will depend on the level of pre-incident preparation, and availability of a network of diagnostic laboratories. The nature of the biological sample required, and 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 would also be forensically important. Detailed analysis of the organism and its properties may allow tracing to a source laboratory. This is a highly specialised activity. It is distinct from the basic diagnostic procedures needed from an outbreak-management perspective, and often resides beyond the immediate interest and responsibility of the public health sector.

Biological hoaxes may be difficult to evaluate or confirm because of the long incubation periods of the biological agents. One proven method to improve 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 above). The committee should include a biologist and a physician who understand the threat-agent classes, representatives from law enforcement and possibly the military, a forensic psychologist, a representative from the public health

community and on-scene authorities. A group such as this, armed with all information available at the time, could make the best decision possible regarding the way ahead.

4.3.3.3 Evaluation of potential outbreak spread

If the incident involves the release of a biological aerosol, computer-modelling may help predict the spread of the aerosol particles. The first steps will, however, have been to gather information on wind direction and speed and on possible sources. With an ongoing outbreak, a retrospective analysis may indicate that cases originate from specific areas, and may be a valuable indicator of an upwind site of original release.[22]

Most data suggest that re-aerosolization of biological agents will not be a significant problem after biological attack. Respirable particles will either be carried by the wind or lifted into the atmosphere and diluted following release. Larger particles will mostly fall to the ground, and be inactivated by the elements. Continued primary spread of biological agents from the area of deployment of a weapon is therefore of less concern following biological attack than it is for chemical attack.

If the release involves an agent that has potential for human-to-human transmission, an epidemic is likely to spread through secondary outbreaks. Standard epidemiological principles should be applied for prediction of likely spread of the disease, with consequent mobilization and deployment of medical resources.

[22] Investigators of the accidental release of anthrax spores in 1979 from the Soviet military biological facility in Sverdlosk were able to use aerosol spread analysis to show a striking occurrence of cases of pulmonary anthrax in persons who were located within specific isopleths originating from the point of suspected release (4.11, 4.12).

4.3.3.4 Risk communication and information distribution

Due to the potential for widespread fear and panic following a biological incident, clear and accurate communication of the risks to the public is paramount. It must be made known that medical evaluation and treatment is available, and how to access it. If there are preventive measures that could be implemented to minimize the chance of exposure and infection, these must be clearly and rapidly communicated.

If the incident involves a specific release point with a potential airborne agent, and if there is time to deliver an alert, an appropriately prepared room or building might possibly provide some protection for nearby populations from a biological agent cloud. An improvised sealed area could be provided by moving into a single room, and sealing openings with adhesive tape. Wet towels or clothing can 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 dosage of the substance indoors could eventually approach or even equal the dose receivable outdoors. People should therefore leave the shelter as soon as the cloud has passed, which will, however, not be easy to determine without agent detectors. If improvised protection is to be recommended, it needs to be well considered, communicated, understood, and practised before any release actually occurs. Reference sources for further information can be found in Annex **Z CHECK**.

It is unlikely that military-issue or approved industrial masks would be widely available (or indeed, appropriate) for the local population. If respiratory protection

were considered appropriate, oronasal particulate or smog masks, or even improvised multi-layer cloth filters, would provide some level of protection.

4.3.3.5 Protection of responders and healthcare workers

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

During the spread of a biological aerosol, the primary route of exposure would be via the airways and respiratory tract. Respiratory protection would 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 would be needed for filtration of air contaminated with chemical vapour).

Most of the agents of special concern do not cause contagious disease, but some do, in which case, once infections are established in the population, spread of aerosol droplets, contact of infected body fluids with mucous membranes or broken skin, and even ingestion could all be involved in secondary spread of the agent. Therefore, universal precautions for dealing with potentially infective materials should always be applied. The standard principles of barrier nursing and infection

control will be the main elements for protection for responders. Details are readily available in the literature (e.g., 4.09, 4.13, 4.14).

In specific cases (and if time allows), vaccination or prophylactic antibiotic treatment of those involved in response may have to be considered. This is more likely to be useful for the management of any secondary spread there might be of the infection than for the primary manifestations of the attack. In some cases, pre-attack vaccination of healthcare providers might be considered if appropriate vaccines are widely available (e.g. for smallpox, plague and possibly anthrax).

4.3.3.6 Infection control

In the event of transmissible-disease agents being released, basic hygiene and infection control measures could have a crucial impact on limiting secondary spread, for example washing hands after contact, avoiding direct contact with secretions from infected individuals, keeping exposed persons away from public places, or isolating suspected or symptomatic cases. Distribution of such basic information beyond healthcare providers 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 are manifest. Too little specificity in such public advice may result in local health facilities becoming overwhelmed by uninfected patients.

Large-scale evacuation as a preventive measure is not likely to be an element of response to biological incidents. Where contagious disease is involved, it could aggravate the situation by facilitating the spread of infection and the rise of secondary

outbreaks. Movement of patients should be restricted to that which is required to provide treatment and care.

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

Decontamination is not as critical for biological casualties as it is for chemical ones, since biological agents are non-volatile, difficult to re-aerosolize and leave little residue on skin or surfaces. Many pathogens deposited on surfaces would rapidly die, though some may resist for longer (4.15). However it would be prudent to be prepared to perform decontamination both of materials and of 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. The contaminated zone may not be defined until the outbreak has been characterized. At or near the release point of a biological agent, where large particles may have deposited, area decontamination (or whole body decontamination of persons who were in the area) may be appropriate. Decontamination solutions used for chemical decontamination would, in most cases be adequate for biological decontamination of material. Chlorine is the recommended disinfectant for use in outbreak response situations. An all-purpose disinfectant should have a concentration of 0.05% (i.e. 1 g/litre = 1000 ppm) of available chlorine, with a stronger solution of 0.5% (i.e. 10 g/litre = 10,000 ppm) available chlorine used in

situations such as suspected Lassa and Ebola virus outbreaks. The use of 0.5% available chlorine solution is recommended for disinfecting excreta, cadavers, spill of blood and body fluids; and that of 0.05% available chlorine solution for disinfecting gloved or bare hands and skin, floors, clothing, equipment and bedding (4.16). Most experts now agree that water, or soap and water might be adequate, and probably safer, for removal of most biological agents from human skin. Buildings can be decontaminated through the use of chlorine-based liquid spray or formaldehyde vapour produced from the heating of paraformaldehyde. Because of the lack of other definitive tools, there will likely be a psychological benefit component to the decontamination of a building. It may, however, be extremely difficult to certify a building clean after an agent release. Additional to the standard principles of barrier nursing referred to above for highly transmissible agents, disposal of waste materials, safe burial practices, and cleaning/disinfection of patients' clothing should be considered (4.17).

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

In addition, in case of potential international spread of human diseases, consideration should be given to the provision of the International Health Regulations (4.18), currently under revision. The IHR provide an essential global regulatory

framework to prevent the international spread of diseases through permanent preventative measures for travellers, cargo, and at points of entry.

4.3.3.7 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 under local circumstances and the definition of the population at risk of becoming ill are very important for triage (the initial reception, assessment, and prioritisation of casualties). Such information can generally be gathered from the time, place and person description of the outbreak or in some circumstances from more specific survey. Fear and panic can be expected from genuinely symptomatic patients, concerned public, and from involved healthcare providers. Any healthcare facility will need plans in place to deal with overwhelming numbers of people seeking care or advice simultaneously, and to ensure that resources are utilised for those who are most likely to benefit. Psychological support, and active treatment of anxiety will be important support elements in the triage process.

4.3.3.8 Medical care

Specific medical treatment of exposed individuals is absolutely dependant on the nature of the organism involved. Details are provided in Annex 1.

Immunization or prophylactic antibiotic treatment of certain segments of the population (contacts, healthcare personnel and first responders) against potential biological agents may be warranted. This treatment would depend upon availability and effectiveness against the agent involved, for example immunization would be an

important element of control for a smallpox or plague outbreak. This might include all those who enter hospitals where patients are housed and treated.

Because several weeks are required for immunity to develop after vaccination, drugs (antibiotics) and symptomatic care may be the mainstay of management. In specific cases, immune serum may confer advantageous passive immunity.

If stockpiles of antibiotics or vaccines have been prepared, plans for distribution must be activated. In essence the choice is either to take the drug to the potentially exposed person or to have the person come to the drug. The latter option generally requires fewer personnel. It will be necessary to have stocks greater than needed for those exposed, because it may be difficult to distinguish between those who have actually been exposed and those who simply believe themselves to have been exposed. Cases may be much greater in number than the total number of hospital beds available, and alternative care facilities may need to be established.

4.3.3.9 International assistance

The management of a large-scale outbreak (of natural, accidental or intentional origin) is an undertaking that will be beyond the resources of many countries. An early decision to enlist the assistance of international aid (on which see Chapter 6) may save many lives. The WHO is able to offer public health assistance to countries experiencing outbreaks of infectious disease, and this would be available regardless of the source of the outbreak.

4.3.3.10 Monitoring the outbreak

Due to the delay of onset of symptoms, the movement of exposed individuals during the incubation period, and the possibility of a transmissible-disease agent having been used it is possible that outbreaks will be widely distributed. Efficient and co-ordinated collection of national data will be necessary to track the outbreak, and to mobilise resources to areas most in need. Again, good public health and near to real-time surveillance programmes will be the key to monitoring, irrespective of whether the causative agent has arisen naturally or been spread deliberately.

4.3.3.11 Follow up activities

The sequelae of a biological attack could manifest 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 preventative and response measures. Outside the medical field, follow-up activities of a forensic or arms-control nature may also be appropriate.

4.3.3.12 Command, control and communication

The response mechanisms described for biological incidents could involve a large number of different groups. Effective co-ordination and training of such multi-disciplinary response is crucial for successful results. Overall command therefore needs to be pre-identified and allocated to 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 – for example, the law enforcement officers who usually take overall responsibility for the response action in criminal incidents may not have the necessary background and expertise to deal with

biological or chemical incidents. The solution will be to ensure a high-level, authoritative overall command, directly supported by appropriate trained technical and specialist advisors who ensure that the specific features of the incident are given appropriate consideration.

4.3.4 Response to chemical incidents

The activities required for response to chemical attack can be specified by applying, once again, the systematic steps of risk management as has just been done for response to biological attack.

Standard risk management step	*Specific actions for response to chemical Attack*
Identify the hazards	Use rapid chemical detection techniques to determine and/or improve immediate operational response measures Bring in specialists for definitive identification, needed for forensic and legal purposes.
Evaluate the hazards to determine initial risk (probability and severity).	Evaluate the nature and magnitude of the chemical release detected, and how it might affect response. Conduct hazard spread prediction, and assess current and delayed casualty management requirements.
Introduce risk reduction strategies.	Implement a risk communication programme to the affected and surrounding population, conveying information and instructions as required. Protect responders. Control contamination: • Establish “hot-zone” scene control to limit contamination spread. • Conduct immediate operational decontamination on-site, 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.
Quantify the residual risk, and make a risk acceptance decision.	Decide whether local and national resources are adequate, and whether international resources should be accessed.
Monitor the risk management programme, and repeat the process as required.	Continuously monitor the residual hazard level on the site, and adjust response activities as needed. Implement follow up activities (e.g. of long term injuries and rehabilitation).

As in the section on response to biological attack, the actions identified by the risk management process are described further in the following paragraphs:

4.3.4.1 Chemical detection and identification

Detection and identification refers to the processes used to determine the nature of chemical hazard being confronted, if any. It commences with the reasoned and logical application of observation skills, including the analysis of all available information, appearance and function of delivery devices, appearance and odour of the substance itself (if it is an overt release), and the signs and symptoms of persons exposed. It is instructive to note that, after the terrorist chemical attacks in Japan, the first indication that nerve gas had been released was the recognition of characteristic symptoms by emergency medical personnel. This clinical diagnosis guided response activities for some time before analytical results confirmed the nature of the chemical (see Appendix 4.1).

Detection strategies may include the use of a variety of devices that can provide an initial indication of the agent involved. This is needed to guide initial operational response activities. There is a huge range of devices 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 which will be used to activate response (by primary responders, specialist responders, and the population). Decisions are needed on the basic philosophy of response activation. The approach of treating all suspicious incidents as chemical attacks until proved otherwise may be warranted in high-risk scenarios (as exemplified by the Israeli approach to Scud missiles during the Kuwait war). Lower risk scenarios may be more efficiently addressed with an approach calling for further response only if positive chemical detection results are obtained.

Definitive identification of chemicals used will involve a longer term forensically based analytical process, involving the use of sophisticated laboratory facilities. It will be needed as evidence, and to determine strategic response modalities. As with other crimes, chemical attacks require a seamless 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 in an international investigation, or a criminal trial.

Under the provisions of the Chemical Weapons Convention, member states of the 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 utilising a world-wide network of laboratories that have been accredited specifically for this purpose.

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

Further hazard analysis will use the results of detection activities, an evaluation of agent characteristics, and assessments of potential hazard spread, to quantify the expected consequences of the incident. As described in detail in Annex 3, the chemical agents of concern can vary enormously in their environmental persistence, toxicity and effects on victims.

In the case of an overt chemical release, an important component of the risk-assessment is the prediction of spread of the agent cloud. This is the basic first step required for decisions on where to focus protective and incident-management procedures. A variety of computerised prediction models are available to assist with this process. Depending on their sophistication, they take account of agent characteristics, nature of release (point or line source, instantaneous or continuous), initial concentration, wind and weather conditions, and topography to produce predictions of spread. Isopleths indicate the position of expected concentrations over time. These can then be used to decide where effects will be greatest, and to direct the deployment of resources. Further details are provided in Annex 4 **CHECK**

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

4.3.4.3 Risk communication and distribution of information

If there is suspicion that the hazard may spread to affect the downwind population (as predicted in the hazard evaluation step above), a warning and public response system will need to be activated. This may include evacuation instructions, or information on what to do to protect against potential spread of the hazard. Even if the hazard area 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 will be the key to avoiding panic.

Depending on circumstances, it may be considered advisable for the population to stay indoors, and to close all windows and doors. A sealed area might be improvised (as described in 4.3.3.4 regarding shelter from biological agents – and with the same cautionary note).

4.3.4.4 Protection of responders

Individual protective equipment (IPE) must be available to responders, allowing them to conduct a wide range of activities in a contaminated area without becoming casualties themselves. There is again a huge spectrum of choice regarding IPE, ranging from simple aprons and half-mask respiratory protection, to fully

encapsulating self contained impermeable ensembles. The range that is stockpiled, and the choice for individual incidents, is absolutely dependent on the risk assessment and the nature of chemicals involved. In areas where the threat is significant, it may be considered justified to make collective protection facilities available. These are large protected areas with filtered air supplies where people can shelter without the need for individual protective equipment. The outstanding example of this approach can be found in Switzerland, where threat assessments during the Cold War era led to the production of a network of public and private collective protection facilities capable of sheltering the majority of the population in times of need.

4.3.4.5 Contamination control

The most distinctive element of disaster management for chemical incidents is the need for contamination control. Important elements of contamination control are:

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

A principle to be aimed at is to decontaminate patients as soon as possible, and before transport to specialised facilities (to avoid spread of contamination to transport vehicles and overburdened emergency rooms). However the nature of human response to mass casualty incidents is such that many patients are likely to arrive at medical centres via transport routes other than emergency services, bypassing on-site

decontamination facilities. It is important that the triage ability of casualty reception centres also incorporates a decontamination ability.

There are many models for the layout of contamination control centres, and choice will depend on resources and local circumstances.

4.3.4.6 Triage

Triage principles need to be modified to account for casualty reception procedures that have been adapted for contamination control purposes. Conventional triage techniques will be insufficient during a chemical incident. During conventional circumstances, medical personnel separate triage and treatment phases of a response. Due to the rapidity of onset of effects with some chemical agents, responders to a chemical incident will 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 expended for the benefit of 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 emergency department resources and hospital beds to handle the sudden influx. It must be expected that many more individuals will seek treatment than are actually exposed. Psychological support teams should be available to provide crisis intervention assistance, reducing the number of people occupying hospital beds.

4.3.4.7 Medical care and evacuation of casualties

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

There are not many examples of true prophylaxis, but there are certain medications that can improve response to treatment of nerve agents (e.g. pyridostigmine). There are, however, potential negative consequences to the use of such medications, and a case-by-case decision on potential benefit will be needed. Such medications would normally only be used by military personnel in a wartime situation, or emergency responders who must function within a high risk area known to be contaminated with liquid nerve agent.

The employment of specific diagnostic aids may be required for detecting exposure to chemical warfare agents. These could range from established techniques such as observation of typical symptoms, acetylcholinesterase activity measurement (for nerve agent exposure), to newer advanced techniques such as detection of specific DNA adducts (after mustard exposure).

Initial pre-hospital treatment will be aimed at symptomatic and life saving support, to allow decontamination and transport to medical facilities. 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 out of the scope of this publication. Reference sources can be found in Annex 3.

4.3.4.8 Definitive decontamination

The decontamination strategies described above are aimed at immediate operational needs, and to minimise spread of contamination during response activities. Once the immediate manifestations of the incident have been managed, a final decontamination of the site will be required. This is a specialised activity, and will in most cases need to be handled by specialist response units.

4.3.4.9 International assistance

National authorities will have to make an early decision on whether to seek international assistance, either for management of the incident, or for activation of political response. As for many other aspects of chemical incident response, member states of the OPCW have access to a carefully considered package of international assistance measures. Due to the transient nature of some chemicals and their effects, this assistance must be mobilised as quickly as possible. Further details regarding international assistance can be found in Chapter 6.

4.3.4.10 Monitor 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 to determine when the area can be re-opened to the public without further risk. Monitoring must continue until the “all clear” is sounded, which can only occur after definitive decontamination and certification of removal of all residual hazard. This will be a function for specialists in hazardous materials incident management.

4.3.4.11 Follow up.

While the immediate problem after a chemical attack will be management of the acute effects of exposure, it must also be recognised that some chemical agents have long-term effects that could manifest over a period of many years (see section 3.6.2). Well-organised and well-administered follow-up programmes are required, not only for the benefit of the patients, but also for the advancement of medical knowledge 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 initial exposure of individuals to chemical weapons during the Gulf War of the 1980s (4.19, 4.20).

4.3.4.12 Command, control, and communication

The response mechanisms described above could involve a large number of different groups. Effective co-ordination of the multidisciplinary response is crucial for successful results. As referred to in the preceding discussion, response is likely to involve the usual primary responders (ambulance teams, fire fighters, police, etc), specialist responders (such as military chemical defence units) and the public. Overall site command needs to be allocated to an authority that will be able to exert the control required for limitation of the hazard, and to achieve the required co-ordination between all groups.

APPENDIX 4.1: THE SARIN INCIDENTS IN JAPAN

On 20 March 1995, a terrorist group launched a co-ordinated attack using sarin nerve-gas against commuters on the Tokyo subway system. The highly publicised attack killed twelve people and caused over 5000 to seek care. If it were not for the prompt and massive emergency response effort launched by the Japanese authorities, and some fortunate mistakes by the terrorist group, the incident could have been much more devastating. Whilst this was the most publicised incident, it was not the first incidence of nerve-gas attack in Japan. In June 1994, seven people were killed and over 300 injured in an attack by the same group on a residential apartment building in Matsumoto. In December 1994, an opponent of the group was murdered by skin application of VX.

This Appendix provides a brief summary of the background, features, and lessons learned from these incidents. It draws heavily on a number of excellent and comprehensive reviews that have appeared in the international literature. The interested reader is referred to these source texts for more details (4.1.1 – 4.1.6).

Background

The Aum Shinrikyo sect was the brainchild of Chizuo Matsumoto, whose childhood aspirations apparently included 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, increasingly bizarre teachings and rituals for devotees, and ultimately subversion with the aim of achieving supremacy for his followers in Japan. The group

attracted a surprisingly large international membership numbering in the tens of thousands, and actively recruited graduate scientists and technicians to develop armament programmes, which were highly ambitious in their scope. Plans included the development and use of biological and chemical weapons.

Aum Shinrikyo's chemical weapons abilities made world-wide news after the Tokyo subway attack in 1995, but the quest for a biological weapons capability actually predated the chemical programme. Despite intensive expenditure and effort to acquire the means to develop and disseminate biological agents, actual distribution attempts (of 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 involved expenditure of around $30 million. After experimenting with VX, tabun, soman, mustard, hydrogen cyanide and phosgene, the final focus and main effort was on the nerve-gas sarin. A plan was developed for the production of about 70 tons of sarin at the Aum Shinrikyo's facilities in Kamikuisiki, at the foot of Mount Fuji.

The Matsumoto incident

During 1994, Aum Shinrikyo was involved in a legal process concerning the legality of a land purchase. A gas attack on the overnight premises of three involved judges was planned for 27 June of that year, apparently to pre-empt an unfavourable ruling. An improvised sarin dissemination system was employed, involving a heater, fan and drip system, venting sarin vapour from the window of a disguised delivery

truck. After a twenty minute release period, the gas spread over an elliptical area measuring about 800 by 570 meters (with most effects occurring within a smaller area of 400 by 300 meters). While the judges survived, 7 unfortunate residents died as a result of the attack, with 54 other hospital admissions, and 253 persons seeking 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 – 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 mounting evidence suggestive of Aum Shinrikyo's activities regarding chemical weapons. Ironically, they had been unable to act against suspected development or possession of chemical weapons, as no provisions of national legislation at the time had been transgressed. The pretext for a raid on the suspected development facility was provided when evidence linked an Aum member to a suspected kidnapping. Cult members within the authorities informed Asahara of the imminent raid (for which chemical defence training of police officers was being conducted). In an apparent attempt to dissuade 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 consisted 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, due to its hasty production for the specific attack. Five subway lines converging on the station of Kasumigaseki had been selected (where many Japanese government buildings and the Tokyo Metropolitan Police Department are located). At around 0800 hrs, during peak commuting time, the five assailants placed their sarin-filled bags on the train floor, pierced them with sharpened umbrella tips,[23] and disembarked from the trains several stations away from Kasumigaseki.

The first emergency call was received by the Tokyo fire department at 0809 hrs, and before long, emergency public-health authorities were inundated with calls for aid from multiple subway stations, where affected passengers were disembarking and seeking medical help. 131 ambulances and 1,364 Emergency Medical Technicians were despatched. 688 people were transported to hospital by emergency medical and fire department authorities. More than 4,000 people found their own way to hospitals and doctors using taxis, private cars, or on foot. The lack of emergency decontamination facilities and protective equipment resulted in a further 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 they encountered, supported by results of tests indicating depressed acetylcholinesterase activity in symptomatic victims (see

[23] Of the eleven bags, only eight were actually ruptured – three were subsequently recovered intact. It is estimated that around 4.5 kilograms of sarin were released.

Annex 3). An official announcement by the police that sarin had been identified came to the hospitals via television news, about 3 hours after the release.

Overall, 12 heavily exposed commuters died, and around 980 were mildly to moderately affected (with about 500 requiring hospital admission). More than 5000 people sought medical assistance.

Observations

There is much that can be learned via analysis of these attacks, on both a general (international threat oriented), and specific (immediate effect and response) level. Important general observations are as follows:

Magnitude of the event. While the human consequences of the event should not be diminished, 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 were (understandably) worried that they might have been exposed, many with psychogenic symptoms. This conveys an important lesson for the potential utility of rapid information dissemination via the media to reassure and inform a concerned public. It also illustrates the importance of effective triage at receiving centres, to ensure that medical resources are reserved for those that really have been exposed. Before being presented as evidence of the utility of toxic chemicals for terrorism, the casualty figure of 12 dead should be compared to the death tolls of recent terrorist attacks using conventional explosives, such as the bombings of the US embassies in Nairobi

and Dar es Salaam (257), the federal building in Oklahama City, USA (168), and the US Marine barracks in Lebanon (241). Equally, it should be realised that casualty figures might have been considerably worse.

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

Ease of acquisition and use of biological and chemical weapons. Despite ample budgetary, equipment and expertise resources, and years in which to develop their weapons programmes, Aum Shinrikyo failed to use biological agents effectively, and achieved relatively limited success with their chemical programme. Aspirant terrorists may well find these results a deterrent, not an encouragement to seek biological or chemical weapons.

The importance of national legislation against chemical weapons. Despite compelling evidence of the cult's growing chemical activities, initiated well before the Tokyo subway attack, no Japanese laws prohibited these activities at the time, and pre-emptive actions could not be launched. Since entry into force of the Chemical

Weapons Convention in 1997, all member states (including Japan) have been able to share experiences and models to achieve their obligatory implementation of legislation forbidding persons on their territory, or under their jurisdiction, from undertaking any activities that are prohibited to the state party itself.[24] With such legislation in place, pre-emptive action against terrorist groups with chemical-weapons aspirations is enabled. Likewise, the entry into force of the BWC in 1975 has obliged all its states parties (including Japan) to take the measures necessary for implementation

On a more specific and response-orientated level, key observations are:

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. The availability of portable detection apparatus to emergency response personnel would have facilitated earlier identification of the nature of the event. The follow-up forensic and legal process was considerably aided by the laboratory identification of sarin using sophisticated GC-MS techniques available to the police forensic toxicologists (4.1.7). In an interesting development of new biomedical testing methods, scientists in the Netherlands were later able to retrieve sarin from the stored blood samples of 10 out of 11 victims from the Tokyo incident, and 2 out of 7 samples from the Matsumoto incident – unequivocal evidence of exposure to sarin (4.1.8).

[24] See, further, Appendix 2 to Chapter 5, pp **INSERT**

Importance of decontamination abilities and protection. About 10% of responding ambulance staff reported symptoms of exposure, as did 110 staff at the major receiving hospital (although these symptoms were generally mild in nature). This was due to the lack of decontamination abilities on site, and the lack of protective equipment for initial responders and hospital staff. Before jumping to the conclusion that high level protection is always required, it should be considered that 10% mildly affected also means that 90% were not affected at all. A reasonable conclusion is that availability of protective equipment would be of considerable benefit to responders. However an approach based on graded protection appropriate to the level of contamination is required to prevent unnecessary immobilisation of helpers due to the ergonomic problems of wearing protective clothing (see Appendix 4.2 below). Rapidly deployable decontamination abilities are required on site (to avoid secondary contamination of emergency transport means), as well as at receiving facilities. Regarding the latter requirement, it is important to note that the majority of people seeking medical help arrived on their own volition, and using their own transport. This would effectively negate much of the utility of on-site decontamination systems, even had they been available, as they would usually be used for victims being treated within the official evacuation channel.

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. Overload prevented effective communications between on-site and mobile Emergency Medical Technicians with their supervising hospital based doctors (for 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. Timely provision of accurate information to responders is crucial to their own safety, and to their ability to provide appropriate assistance. Pre-planned systems to access the expert inputs of experienced toxicologists, poison information centres, and chemical warfare specialists would have been of major assistance to receiving medical facilities. A single responsible local authority with the ability to communicate with and co-ordinate the activities of the various response elements would have been a considerable advantage. Complicated formalities and high level approval channels prevented the rapid mobilisation of the full abilities of specialist chemical defence abilities within the Japanese military.

Readiness of medical personnel to handle chemical casualties. The majority of the Tokyo hospital staff, as for medical personnel in most parts of the world, were not trained in the principles of chemical casualty care, and had no immediate access to treatment protocols for chemical-weapon victims. This is not an ability that can be reserved for military specialists, as it is the local hospitals that will receive the immediate casualty load. Dissemination of such knowledge and training into the standard medical curricula, and down to first responder and local hospital casualty reception level is an essential component of medical preparedness for chemical incident response.

Conclusion

The release of sarin by a terrorist group in Japan resulted in a highly publicised mass casualty situation. 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. Despite many difficulties, emergency units and local hospitals were able to achieve a remarkably rapid response, without which the casualty figures may 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 and limitations of toxic chemicals as a tool for terrorism.

APPENDIX 4.2: PROBLEMS RELATED TO PROTECTION

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

The key to successful use of protective equipment, whether by civil incident response teams or military forces, is familiarity through repeated training using the equipment. If extended operations using protection are required, the following factors need to be carefully considered and accommodated:

Heat stress. When biological and chemical protective clothing is worn,

insulation is increased, evaporation of sweat from body surfaces is reduced, and the body consequently loses a significant proportion of its natural ability to lose heat. The problem can be so severe, especially if impermeable protective clothing is being worn, that fatal heat stroke can be reached in less than one hour. Supervisors of personnel or emergency services must pay strict attention to monitoring of this problem and to methods of avoiding it as by planned work/rest cycles, or specialised cooling equipment (4.2.1). A further problem associated with wearing a respirator is the effort required to breathe against the resistance of the filter canister. This can severely limit the work rate possible, and is also a significant factor adding to the psychological stress experienced.

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

Ergonomic difficulties. The nature of chemical protective clothing creates many ergonomic problems which may interfere with performance of even

simple tasks. Thick rubber gloves create problems with any task requiring fine touch abilities (computer operation, medical examination, etc.), and bulky clothes hamper movement in restricted spaces (e.g. ambulances). The lenses of the masks may be incompatible with optical equipment, and medical personnel may experience extreme difficulty with even basic procedures of patient management (cardio-pulmonary resuscitation, airway management, etc.).

Medication side effects. Certain medications that are standard in biological and chemical defence can create problems of their own. Pyridostigmine is a commonly used pre-treatment drug for nerve-gas poisoning. It is intended to be taken before exposure, in order to improve the chances of survival if a nerve-gas attack actually materialises. Pyridostigmine can, however, have side effects of its own, such as diarrhoea, intestinal cramps and visual problems. The most common item of medical equipment used in chemical defence world-wide is the auto-injector. Although there are variations in the contents of different types, a medication usually present is atropine, being the basic antidote required after nerve-gas exposure. However if atropine is injected in the absence of nerve-gas poisoning, it can have significant side effects such as increased heart rate, heart-rhythm disturbances, dry mouth and decreased sweating (causing more severe heat stress), and blurred vision.

Civil incident response teams may be less compromised by such factors as they are likely to need shorter deployment periods, and are more able to provide personnel with rest periods outside of the contaminated area without losing efficiency.

An important element of preparedness for any authority facing a biological and chemical threat is the logistics associated with the issuing of protective equipment to the necessary personnel. Some equipment, once removed from sealed packaging or contaminated, may not be reused or readily decontaminated, and consequently is unsuitable for reuse. If large numbers of personnel require protective equipment, this can be extremely costly.

Conclusion

Some of the problems outlined above associated with use of protective equipment for extended periods could become manifest in a military situation even without actual use of biological or chemical weapons. They could become evident in standby conditions, when preparations have been commenced in anticipation of an attack. Such consequences may be in themselves a significant disadvantage for the defending party, and could even be the objective towards which the threat was introduced by the aggressor. However, a state that elects not to introduce biological and chemical defensive and protective abilities could be vulnerable to the full mass casualty producing potential of biological or chemical weapons. It is instructive to note that no major use of biological or chemical weapons has yet been initiated against forces that are well equipped and trained for conditions of biological or chemical warfare.

Successful preparedness involving biological and chemical threat assessment, contingency planning and preparation for a biological/chemical incident lies in balancing these issues and producing a strategy which is justified by and relevant to the potential threat. Over-reaction to a threat could be the very effect sought by a

biological or chemical aggressor.

CHAPTER 5: LEGAL CONTEXT

National and international law were identified in Chapter 2 as a key part of the array of measures serving to protect against hostile release of biological or chemical agents, and to help mitigate the consequences should such release nevertheless happen. 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 co-operation in order to prevent the use of chemical and biological weapons, and for assistance and co-operation in cases where breaches of these treaties are suspected, especially in cases when use of such weapons has occurred. The chapter opens 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, with information in each case about the international obligations they establish and about the national measures required to implement those obligations.

5.1 THE 1925 GENEVA PROTOCOL

At least since the early 1600s, international law has condemned what would nowadays be regarded as biological or chemical warfare, instances of which have been reported since antiquity. Subsequent development of that law (5.01) could be seen in the Brussels Declaration of 1874, which outlawed, *inter alia*, the use of poison or poisoned weapons. It could be seen again at the Hague Peace Conference of 1899, which adopted a declaration recording agreement to "abstain from the use of projectiles the sole object of which is the diffusion of asphyxiating or deleterious

gases". Further, the 1899 Conference adopted a convention that enunciated in treaty form the Brussels prohibition of use of poison or poisoned weapons in land warfare, a condemnation that was carried forward into 1907 Hague Convention IV concerning the laws and customs of war on land. Then, following the extensive use of chemical weapons such as chlorine and mustard gas during the First World War I, the international community agreed to strengthen the existing legislation in regard to these weapons so as to prevent their future use. This led member states of the League of Nations to sign the *Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases and of Bacteriological Methods of Warfare* on 17 June 1925, during the Conference for the Supervision of the International Trade in Arms and Ammunition and in Implements of War. This treaty, which is usually referred to as the Geneva Protocol of 1925, entered into force on 8 February 1928. France is its depositary. By the beginning of 2001, it had 132 states parties, including the five permanent members of the United Nations Security Council but not including 59 **CHECK AGAIN LATER** of the WHO member states.[25]

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 upon states that are not parties to it. However, the Geneva Protocol prohibits only the use of the weapons, not their possession. Moreover, since many states parties at the time reserved a right to use the weapons in retaliation against an attack with such weapons, the treaty was in effect a no-first-use agreement.

[25] See Annex **INSERT**

There were also states parties that reserved a right to use the weapons against states not party the protocol. Therefore a comprehensive prohibition of the weapons themselves came to be considered necessary.

5.2 THE 1972 BIOLOGICAL WEAPONS CONVENTION

When discussion of biological and chemical weapons at the Geneva disarmament conference began in the late 1960s, at the time when the first edition of the present report was being prepared, there was much debate on whether a comprehensive prohibition of the weapons covered by the Geneva Protocol should be sought or, initially, a 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*. Opened for signature on 10 April 1972 and entering into force on 26 March 1975, the BWC had 143 states parties as of June 2001, including the five permanent members of the United Nations Security Council but not including 48 **CHECK AGAIN LATER** of the WHO member states.[26] The United Kingdom, the USA 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

[26] See Annex **INSERT**

otherwise acquire or retain". As has already been noted (in Chapter 3), the 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 new science that might find use as weapons. The treaty does not define either the "biological agents" or the "toxins" to which it refers, but it is clear from the proceedings both of its negotiation and of its subsequent review conferences that these terms are not restricted to human pathogens but extend to other animal and plant pathogens, and that, in addition, the toxins are not limited to microbial products but extend to all toxic substances produced by living organisms even when they are actually produced by synthesis.

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 has to 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, Russia, the United Kingdom and the United States. The periods of activity declared for the offensive programmes all terminated prior to 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 is expected to report to the Fifth Review Conference in November 2001.

5.2.2 National implementation

The BWC stipulates that each state party is obliged to take any necessary measures to implement the provisions of the Convention within its territory or any territory under its control anywhere (Article IV). Besides the basic obligations mentioned above, there are other areas where national measures are necessary if there is to be full implementation of the BWC. States have long taken measures to implement the obligation under Article III not to transfer to anyone agents, toxins or other items specified in Article I. In contrast, the implementation of Article X on measures for promoting technical co-operation 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 for it, France 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 for annual returns of information about "legislation, regulations or other measures" on three different topics, namely activities prohibited under BWC Article I, 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 the legislative measures are given at the end of this chapter, in Appendix 5.1.

5.3 THE 1993 CHEMICAL WEAPONS CONVENTION

The CWC was negotiated over a period of more than two decades. It was a period during which related agreements were also concluded, notably the restrictions on warfare conducted with chemicals toxic to plant-life set out in the 1977 *Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques*, and the reaffirmation of the Geneva Protocol by the 149 states represented at the Paris Conference of 1989 on the Prohibition of Chemical Weapons. The *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction* (5.02) was opened for signature on 13 January 1993, entered into force on 29 April 1997 and, as of June 2001, had 143 states parties,[27] including the five permanent members of the UN Security Council but not including 52 **CHECK AGAIN LATER** of the WHO

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

member states.[28] The CWC creates an elaborated regime to ensure compliance. It specifies in detail how its obligations are to be implemented, and it establishes an international organization (the 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 purpose criterion to define its scope,[29] 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 that are located on their territory or under its jurisdiction or control within ten or, under certain conditions, fifteen 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 technique and method that

[28] See Annex **INSERT**
[29] The language that the CWC uses to specify the weapons that it covers is quoted, and discussed further in Chapter 3.

allow for protection of national security interests. This verification machinery, which includes declarations by the states parties, routine inspection as well as means to investigate allegations of violation of the treaty, is run by the OPCW. The main element of the system is factual information obtained through verification procedures in accordance with the Convention that are independently conducted by the OPCW Technical Secretariat, sufficiency of such information being essential for successful operation. (5.03)

While less than forty percent 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 use and threat of use of chemical weapons. This is described further in Chapter 6. Such international co-operation is agreed upon between the OPCW and the UN and will be extended to other international oranisations. Co-operative measures in accordance with the CWC extend also to advice on implementation of the Convention and advice in those areas in which the Technical Secretariat of the OPCW has considerable expertise (5.04).

5.3.2 National implementation

The CWC requires its states parties to promulgate implementing legislation. Under Article VII, paragraph 4, states parties are required to establish a National Authority. The twin pillars of the Convention's verification regime are thus (1) the OPCW Technical Secretariat (through which compliance is verified) and (2) the National Authority (through which compliance is demonstrated, including compliance with those obligations not overseen by the Secretariat). The National

Authority is intrinsic to the success of the verification regime. As the national focal point for liaison with the OPCW and other states parties, the national collection point of data and the facilitator of national implementation, effective National Authorities are key to the effectiveness of the Convention itself. To meet its basic obligations as a state party, the state must be in a position to carry out the following eight fundamental functions, all of which involve its National Authority to a greater or lesser extent: (a) submit all the required declarations; (b) communicate with the OPCW; (c) co-operate with other states parties; (d) facilitate OPCW inspections; (e) respond to OPCW requests for assistance; (f) protect the confidentiality of classified information; (g) monitor and enforce national compliance; and (h) co-operate 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 four years of implementation has shown that comprehensive implementing legislation is key 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 found it necessary to enact legislation in 14 other areas (legal assistance; definition of chemical weapons; declaration

obligations; the regime for scheduled chemicals (regulation of Schedule 1 production/use; criteria for Schedule 2 and 3 declarations; import/export controls); licensing of industry; access to facilities; inspection equipment; application of inspectors' privileges and immunities; confidentiality; liability; mandate of the National Authority; enforcement powers of the National Authority; samples; and primacy of the Convention). (5.05, 5.06)

Four years after entry into force of the CWC, 38 percent of states parties have met their obligation to inform the 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 other states parties in their efforts to fulfil their obligations under Article VII. (5.07).

5.4 CONCLUSION

Through its contribution both to preventing the release of biological or chemical agents for hostile purposes and to consequence-mitigation should such release nevertheless occur, the legal regime just described stands alongside the measures of protective preparation set out in the 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 built upon. Clearly prevention and protection can be no substitute for one another. They can instead be mutually reinforcing. The conclusion has to 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 diminish the value seen in preventive

preparation. Full and complete implementation of the 1972 and 1993 Conventions is therefore an objective that needs continual affirmation and national investment.

APPENDIX 5.1: BWC IMPLEMENTING LEGISLATION

Examples of legislation concerning activities prohibited under BWC Article I, external application of such legislation, and definition of "biological weapons"

Australia: *Crimes (Biological Weapons) Act 1976*

> The Act makes it unlawful for Australians to develop, produce stockpile or otherwise acquire or retain microbial or other biological agents or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes; or weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.
>
> The Act extends to the acts of Australian citizens outside Australia.
>
> Contravention of the Act is an indictable offence.

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

> Section 8 of the Act states:

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

'Biological weapon' is defined as "any agent, toxin, weapon, equipment or means of delivery referred to in Article I of the Convention".

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

Paragraph 175. Prohibitions with respect to biological weapons

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

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

Examples of legislation regulating exports of agents and toxins

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

"Article. I. This Law regulates the operations concerning the exports of sensitive goods and services directly linked to such goods...

Article II. The goods mentioned in Art. 1 will be recorded in Lists of Sensitive Goods periodically brought up-to-date and published in the *Diario Oficial* [...]

Article III. According to the regulation established and published in the *Diario Oficial*, previous formal authorization from the competent federal organs will be required for the export of:

i. goods contained in the List of Sensitive Goods; and

ii. services directly linked with goods contained in the List of Sensitive Goods...

Article IV. Within the Presidency of the Republic is established the Interministerial Commission for Export-Control of Sensitive Goods, composed of representatives from federal organs involved in the process of export of goods covered by the present Law. [...]

Article VI. The export of sensitive goods and directly linked services in violation of the provisions of this Law and its regulating norms will subject the offender to the following penalties:

i. admonition

ii. fine of up to twice the equivalent value of the operation;

iii. confiscation of the good involved in the operation;

iv. suspension of the right to export for a period of six month to five years;

v. cancelling of the license to carry out foreign trade operations in the event of a non-primary perpetrator.[...]

Article VII. The natural persons that, directly or indirectly, by act or omission, are engaged in the infringement of this Law will be committing a crime. Penalty: imprisonment from 1 to 4 years."

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 micro-organisms 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 would only be permitted under the most stringent high security conditions. Very few imports are approved and generally those would be 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 would include pathogenic micro-organisms where these are included in vaccines for human use.

APPENDIX 5.2: CWC IMPLEMENTING LEGISLATION

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

Article VII of the Chemical Weapons Convention provides that specific legislation must be in place prohibiting actions which 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 would encompass criminal as well as 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 co-operate to prosecute offenders of the CW prohibition world wide. The implementation of these obligations would add significantly to the object and purpose of the Convention to prevent using 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 includes the penalty of life imprisonment for the most serious violations.

States may find it complex to comply with their obligation under Article VII, paragraph 2, to respond to requests from other states parties for co-operation and legal assistance. The modalities of such co-operation and legal assistance could range from: (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 co-operation 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 Chemical Weapons Convention 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 co-operation in this regard. If a state party seeks mutual legal assistance and meets obstacles, certain other non-judicial coercive techniques may be available based on comity or co-operation through organisations such as Interpol. (5.2.1)

Regulating and monitoring 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 are able to meet their obligation under the Convention to submit a full and accurate declarations to the OPCW on national activities related to chemicals listed in the schedules of the CWC. In order to maintain a nation-wide overview of activities regulated by the CWC and ensure complete declarations some states parties promulgated legislation subjecting chemical producers to licensing.

From entry into force of the Convention, states parties were required to notify the 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 shall also ensure that Schedule 3 chemicals transferred to states not party to the Convention shall only be used for purposes not prohibited. Each state party's National Authority has to negotiate and conclude facility agreements with the OPCW governing the procedures for the implementation of verification activities of the Technical Secretariat in certain declared facilities. In order to fulfil those tasks, the National Authority has to identify sites, both public and private, that have to be declared and which have to provide data for inclusion in the state's initial and annual declarations. Contacts with chemical industry associations and searches of commercial databases, universities and hospitals are normally necessary to get an overview of the national activities which might be relevant for the Convention.

Among the initiatives that have been advanced to ease the problem, the OPCW Technical Secretariat and the Secretariat of the Organisation of Eastern Caribbean States 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 has a fourfold value: (i) it allows the parliaments concerned to consider the regulations for pesticides and toxic chemicals in one single step; (ii) ratification of and accession to the CWC will be facilitated; (iii) a single interministerial agency in each country will be responsible for pesticides and toxic chemicals and serve as the National Authority under the Convention (iv) the CWC will be enforceable in the sub-region. (5.2.2)

CHAPTER 6: INTERNATIONAL SOURCES OF ASSISTANCE

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

(a) application of international low;

(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 handle potentially massive damage to the population attacked by such weapons.

The principal organisation for political support is the **United Nations**. In the case of chemical attack the **Organisation for the Prohibition of Chemical Weapons** (OPCW) would also be important for its members. If in the future an organisation is established under the Biological Weapons Convention, this too would play a role in the case of biological attack.

Practical assistance in providing protection against chemical weapons can be provided by OPCW (see section 6.4 below). The Biological Weapons Convention also requires its States Parties to come to each others assistance in certain circumstances (see section 6.5 below)

General assistance of a medical nature could be provided in either case by the **World Health Organization** (WHO). The **Food and Agriculture Organization** of the United Nations (FAO) and the **Office International des Epizooties** (OIE) could be asked to provide assistance where an attack was focused on plant (FAO) or animal (FAO and/or OIE), rather than human targets. Where local resources are insufficient to cope with humanitarian aspects of the situation it could be appropriate to call on the **United Nations Office for Coordination of Humanitarian Affairs** or the major **non-governmental organizations.**

Each of these agencies shown in **bold** is addressed briefly below.

A chemical or biological attack may overwhelm available medical resources and pose serious logistical and organisational challenges. In these circumstances it may 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), armed forces have supported relief effort on an invitational basis under the United Nations umbrella.

6.1 UNITED NATIONS

The use or threat of use of chemical or biological weapons by one state against another would clearly constitute a threat to international peace and security and, accordingly fall within the responsibility of the **UN Security Council**, to which the facts should be promptly reported. Both the BWC and the CWC make provision for the involvement of the Security Council when there are allegations of use of these weapons and arrangements are in place for investigation of the facts (see below).

6.1.1 Investigation of alleged use

The United Nations General Assembly under its resolution 42/37C of November 1988 mandated the Secretary General to investigate "reports that may be brought to his attention by any Member State concerning the possible use of chemical and bacteriological (biological) or toxin weapons […] in order to ascertain the facts of the matter…". Under the terms of the resolution the Secretary General has established a panel of experts available to investigate on-site. A group of qualified experts, appointed pursuant to the resolution, has provided in its report A/44/561, dated 4 October 1989, guidance as to how such investigations might be carried out.

The above procedure retains its relevance for investigations of alleged use of biological weapons. The Chemical Weapons Convention (CWC), which entered into force on 29 April 1997, obliges OPCW (see below) to investigate alleged use of chemical weapons against a state party. In the case of investigations relating to allegations of chemical-weapons use brought to the Secretary General by a state not party to the CWC, the OPCW is obliged to cooperate with the Secretary General in accordance with Article II.2(c) of the Relationship Agreement between the UN and OPCW signed on 17 October 2000.

The UN investigations of alleged use of chemical weapons conducted up to the end of 2000 can be summarised as follows:

1981-82: **Asia**. Investigations took place long after the alleged attacks, on-site visits were not possible; results were inconclusive. (6.1)

1984-88: **Iran.** Investigations took place within days of the alleged attacks, on-site visits were made and samples-taken; Iraq was identified as the perpetrator. (6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9)

1987-88: **Iraq**. Chemical injuries among Iraqi soldiers were verified by the investigators (6.5, 6.6, 6.8), who reported finding no conclusive evidence of how the injuries had been caused (6.10).

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

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

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

In the period reported, the Secretary General was not asked to conduct any investigations of alleged use of biological weapons. (However there was one consultation concerning an alleged use carried out under the BWC, see below.)

From the UN experience it is clear that it is essential for the request to be made to the Secretary General immediately after the incident has taken place to minimise the likelihood of degradation of evidence.

6.1.2 Humanitarian assistance

If an attack were on a large scale with serious consequences for the population, humanitarian assistance could be sought from the United Nations. The **Emergency Relief Coordinator** of the UN 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 UN emergency relief operations. That person is also the Under Secretary General for Humanitarian Affairs and supported by the UN **Office for the Coordination of Humanitarian Affairs** (OCHA).

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

In cases of humanitarian emergency, OCHA can do the following:

- process requests for assistance from member states;
- organise in consultation with the government of the affected country a joint inter-agency assessment mission;

- serve as the central coordinating entity with governments, intergovernmental organisations, non-governmental organisations and concerned UN agencies for all emergency relief operations;
- provide consolidated information on all humanitarian emergencies; and
- actively promote, in close collaboration with concerned organisations, the smooth transition from relief to rehabilitation.
- In addition, OCHA has a Military and Civil Defence Unit (MCDU), which is the focal point in the UN humanitarian system for the mobilization and coordination of military and civil-defence assets whenever utilized 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 coordination of all international emergency humanitarian assistance.

In addition, OCHA is the focal point in the UN system for the mobilization and co-ordination of military and civil defence assets whenever utilised in response to humanitarian emergencies.

Countries can address requests for information and/or international assistance in cases of natural disasters or environmental emergencies directly to the OCHA office in Geneva, or through the United Nations Resident Coordinator in the affected country.

6.2 ORGANISATION FOR THE PROHIBITION OF CHEMICAL WEAPONS

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

- *chemical weapons have been used against it*[30]*;*
- *riot control agents have been used against it as a method of warfare; or*
- *it is threatened by actions or activities of any State that are prohibited for States Parties by Article I.*

Article X, paragraphs 9, 10 and 11 require the Director General of OPCW to take immediate action on receipt of a request. He shall, within 24 hours, initiate an investigation and 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 has to be submitted after each such period. The Executive Council is required to meet within 24 hours after receiving an investigation report to consider further action, including supplementary assistance. At the first Conference of the States Parties to the CWC in May 1997 the Organisation established a voluntary fund for action under Article X and invited states parties to inform the Technical Secretariat of the assistance they may elect to provide in accordance with Article X, paragraph 7. To 31 December 2000, the voluntary fund has received around Euros 600,000 in contributions and approximately 40 states parties have made more or less

[30] This provision does not specify the source of the attack, which could be another state or a non-state actor such as a terrorist group.

specific offers of assistance-in-kind, ranging from protective equipment to putting battalion-sized assistance teams at the disposal of the OPCW.

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

Hardware offered by member states consists to a large extent 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 will have to distribute the equipment within the country.

The use of personal protective equipment requires training. In order to facilitate the conduct of such training, a series of courses has been arranged for chief instructors by the government of Switzerland in collaboration with the OPCW. The purpose is that such chief instructors should 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 the OPCW, in cooperation with various member states. These include, for example, courses for medical personnel, training in the use of analytical equipment, and conduct of emergency assistance and rescue operations.

Information about such courses, and how to apply to attend them, is available on the OPCW web site.

Offers from member states of assistance teams that could be made available to assist in the 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 capacity has also been offered; however, it is expected that the costs for transporting the teams might to a certain extent have to be covered by the Voluntary Fund for assistance.

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

Article X, paragraph 5 further requires the Technical Secretariat to provide expert advice on how a state party can improve its protective capacity against chemical weapons. This provision affords a low-key opportunity to ask for assistance without having to accuse any state of using chemical weapons. In order to implement this provision, a protection network has been established. The network currently consists of approximately 40 specialists on various aspects of chemical protection,

coming from some 20 member states. A state party can request help from the protection network without any costs: the salaries will be paid by the member states putting the experts at the disposal of the OPCW, and the travel costs will be covered by the OPCW.

Within the framework of Article X, paragraph 5, the Secretariat can also upon request arrange national or regional protection courses, workshops, etc.

6.3 BIOLOGICAL WEAPONS CONVENTION

Article VI of the Biological Weapons Convention reads:

(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.

In regard to the provision of assistance, this is also provided for under Article VII of the Convention which reads:

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

These obligations are not elaborated further in the Convention. A negotiation that could establish implementing procedures for them through a protocol to the Convention is currently proceeding within an ad hoc group of states parties (see 5.2.1 above).

Also, a consultation provision is set out 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 set up a procedure for convening a formal consultative meeting to facilitate any such cooperation and thus improve implementation of this article. A meeting of this type was convened in 1997 to resolve a dispute in which Cuba had alleged that the United States had been waging biological warfare against it by means of phytophagous insects.

6.4 WORLD HEALTH ORGANIZATION

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

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

The use of chemical or biological weapons could result in extensive public health and medical emergencies, including a sudden 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 such an eventuality.

WHO first became officially involved in the control of biological and chemical weapons in 1969, in response to a request from the Secretary-General of the United Nations to cooperate with the United Nations Group of Consultant Experts on Chemical and Bacteriological (Biological) Weapons in the preparation of a report on this subject.[31]

[31] See section 1.2 above.

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

WHO contributes to global health security in the specific field of outbreak alert and response by strengthening national capacity for surveillance, particularly epidemiology and laboratory capabilities; by disseminating verified information on outbreaks of diseases and, whenever needed, following up by providing technical support for response; as well as by collecting, analysing and disseminating information on epidemic-prone diseases of global importance. Several epidemic diseases 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 being 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. Taking account of global developments during the last 30 years of the 20th century, a revised version of the IHR is under preparation.

The International Programme on Chemical Safety (IPCS), a joint venture of WHO, the International Labour Organization (ILO) and the United Nations Environment Programme (UNEP), which was set up to promote the sound management of chemicals and the protection of human health and the environment, produces guidelines and training material relevant in the preparedness for and response to chemical incidents of technological origin, which would also be applicable in the event of deliberate release of chemical agents. 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 would 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, as well as the European Union as a member organisation. Its constitution requires, *inter alia*, that the 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 FAO constitution.

With regard to biological and chemical weapons, FAO has not been formally involved in the control of these weapons. FAO 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 and floods, earthquakes and hurricanes, locust swarms and livestock plagues, war and civil strife, and natural and man-made disasters have caused immense suffering to populations concerned.

6.6 OFFICE INTERNATIONAL DES EPIZOOTIES

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

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

The OIE has established an information system to collect and disseminate information on outbreaks of animal diseases that are the most serious from animal and public health viewpoints. The urgency of dispatching information varies according to an internationally agreed classification of the disease: i.e. List A and List B diseases.[32]

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

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

6.7 NON-GOVERNMENTAL ORGANIZATIONS

Non-governmental organisations (NGOs) are non-profit, voluntary citizens' groups organised on local, national or international levels, including scientific bodies and professional associations. Task-orientated and driven by people with a common interest, NGOs perform a variety of services and humanitarian functions, bring citizens' concerns to governments, monitor policies, and encourage political participation at the community level. They provide analysis and expertise, serve as early warning mechanisms and help monitor and implement international agreements.

[32] *List A Diseases* are transmissible diseases which have the potential for very serious and rapid spread, irrespective of national borders, which are of serious socio-economic or public health consequence and which are of major importance in the international trade of animals and animal products. *List B Diseases* are transmissible diseases which are considered to be of socio-economic and/or public health importance within countries and which are significant in the international trade of animals and animal

Some are organised around specific issues, such as human rights, the environment or health. Their possible involvement in the prevention and control of health consequences caused by CBW differs depending on their goals, their venue and their mandate.

In the case of accident or incident involving chemical/biological agents, it is very likely that, in addition to the local administrations, NGOs would be actively involved in providing care to the affected populations.

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