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REVIEW PAPER

Defending Against Biological Attack: Importance of Biotechnology in Preparedness

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ABSTRACT

The danger of biological warfare has rightly received increasing attention during the past decade. Although 143 State Parties have signed the Biological and Toxin Weapons Convention (BTWC), there have been reports of around a dozen states possessing or seeking to possess biological weapons. There is even a view that the potential threat from biological and chemical weapons is greater than that from nuclear weapons. Biological warfare programme are also being considered for counter-insurgency use and tactical applications in the regional conflicts. Even small groups appear to have the means to launch a biological attack, an example of which was the attack with the nerve gas, sarin, in a Tokyo subway, in 1994. Defence against biological attacks has so far received little attention.

This article begins with an assessment of the potential biological threat and considers the vulnerabilities of states facing such threat. It then considers the role of political-military coalitions in meeting the challenges of the aggressor and goes on to evaluate and identify the vulnerabilities of coalition partners. It also addresses the measures necessary to minimise those vulnerabilities, by active and passive defence, and examines the role of biotechnology in such protective measures. It then briefly surveys the biological warfare defence capabilities of different countries. It concludes with a discussion of policy initiatives useful for addressing gaps by promoting cooperation among the interested parties. The key elements of protective measures against biological and toxin weapons attack are hazard assessment, detection, physical protection, identification and diagnosis, and medical countermeasures. Biotechnology is vital for further advances in all these areas for both civil and military requirements.

Keywords: Biotechnology, biological weapons, biological warfare, BTWC, counter-insurgency, biological warfare programme

1. INTRODUCTION

The danger of biological warfare has rightly received increased attention during the past decade[1,2]. Although biological weapons are totally prohibited by the Biological and Toxin Weapons Convention (BTWC), which entered into force in 1975 and currently has 143 State Parties and 18 Signatory States, one of the co-depositary states–the US–at the fourth review conference in 1996 stated that there were now twice as many states possessing or seeking to possess biological weapons as when the Convention entered into force[3]. Reports have

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also appeared with increasing frequency about the proliferation of such weapons for as many as a dozen other countries[4-9]. The international awareness of the danger from biological weapons has been sharpened for several reasons. It is now clear that Iraq had, at the time of the Gulf war in 1990-91, already developed and produced biological weapons[10], which had been deployed with pre-delegated authority for their use had the coalition forces attacked Baghdad with nuclear weapons. The diligent work by the United Nations Special Commission (UNSCOM) on Iraq has uncovered much information about Iraq's significant biological weapons programme[11]. In addition, Russian President Boris Yeltsin in early 1992 acknowledged that the former Soviet Union–despite being a co-depositary of the Convention along with the US and the UK–had continued an offensive biological weapons programme after signing BTWC in 1972.

2. BIOLOGICAL & TOXIN WEAPONS CONVENTION

Despite continued efforts, since then, by the three depositary states (the so-called trilateral process[12]) to deal with lingering concerns, the US Govt in 1996 reported, 'The US and the UK continue in an effort to work with the Russian Govt to ensure complete termination of the illegal biological weapon programme[13] and in 1999 reported that 'with regard to the trilateral process that began in 1992,... the progress[14] has not resolved all US concerns'. The biological warfare danger has been further accentuated by signs of growing interest in biological warfare agents by non-state actors*. Aum Shinrikyo, the Japanese sect made notorious by its attacks with sarin nerve gas in 1994 and 1995, also reportedly produced, tested and conducted attacks with biological** agents[15].

2.1 Web of Deterrence

This heightened concern about biological weapons and warfare has led to an awareness of the importance of a web of deterrence comprising:

(a) Strong international prohibition regime reinforcing the norm that biological weapons are totally prohibited.

(b) Broad international and national controls on the handling, storage, use and transfer of dangerous pathogens.

(c) Preparedness, including both active and passive protective measures and response plans that have been exercised.

(d) Determined national and international response to any use or threat to the use of biological weapons ranging from diplomatic sanctions through to armed intervention,which are together mutually reinforcing and help a would-be possessor to judge that acquisition and use of biological weapon would not be valuable, would be detected and incur an unacceptable penalty.

Such a web applies to both deterrence of states and of non-state actors.

All elements of the web of deterrence need to be strengthened to counter effectively the enhanced danger from biological weapons. It is recognised that the BTWC includes in article VII provisions for each State Party to provide assistance to any Party to the Convention that has been exposed to danger as a result of a violation of the Convention[16]; these provisions have been elaborated in the draft Protocol[17] in article VI 'Assistance and Protection against Biological and Toxin Weapons'–in which the text has been developed by India in its role as Friend of the Chair on National Implementation and Assistance–which defines assistance as meaning 'the coordination and delivery to the State Parties of protection against biological and toxin weapons, including, *inter alia*, detection equipment, alarm equipment, protective equipment, decontamination equipment and decontaminants, prophylactic, diagnostic and/

* Concern rightly embraces both the sub-state and non-state actors. Examples of non-state actors are Aum Shinrikyo and Osama bin Laden.

** Brad Roberts (Ed). Terrorism with chemical and biological weapons: Calibrating risks and responses Chemical and Biological Arms Control Institute, Alexandria, Va., 1997.

or therapeutic medical measures and materials, and/or advice on any of these protective measures'. This article considers the importance of strong preparedness through both active and passive protective measures, recognises the importance of coalitions of like-minded states in countering biological weapons attack and demonstrates the vital importance of biotechnology in achieving effective preparedness.

3. BIOLOGICAL PREPAREDNESS

The heightened awareness of the potential danger from biological weapons over the past decade has led to greater interest in a number of countries around the world, including particularly the US, the UK, and some other countries, both within and outside of NATO as well as NATO more generally, in improved protection against the biological weapons attack[18,19] and other forms of military preparedness for biological weapon contingencies*.

In 1997, in the US the *Quadrennial Defense Review,* reflected this heightened concern. It stated, 'In particular, the threat or use of chemical or biological weapons (CBW) is a likely condition of future warfare, including the early stages of war to disrupt US operations[20] and logistics'. It goes on to argue, 'Moreover, given that the United States will most likely conduct future operations in coalition with others, we must encourage our friends and allies to train and equip their forces for effective operations in CBW environment'. The Director of Central Intelligence[21] in March 2000 said, "About a dozen states, including several hostile to western democracies–Iran, Iraq, Libya, North Korea and Syria–now either possess or are actively pursuing offensive biological and chemical capabilities for use against their perceived enemies, whether internal or external. Some countries are pursuing an asymmetric warfare capability and see biological and chemical weapons as a viable means to counter overwhelming US conventional military superiority. Other states are pursuing biological weapons programme for counter- insurgency use and tactical applications in regional conflicts, increasing the probability that such conflicts will be deadly and destabilising".

Other US publications, such as Proliferation: Threat and Response[22] in 1997, indicate that the dangers from biological weapons are not limited to the near east but extend to other regions, such as northeast Asia. It is clear that the US is taking steps nationally, bilaterally, and through NATO, to ensure effective military operations despite the presence, threat or use of NBC weapons[23]. In July 1999, the document of UK Govt said, 'The potential threat from biological and chemical agents is now greater than that from nuclear weapons', and went on to state, 'The UK's key policy aim .... is to maintain our political and military freedom of action despite the presence, threat, or use of biological or chemical[23] weapons'.

One particular feature of the problem that has thus far received only scant attention is the vulnerability to biological weapons attack of those engaged in wars against biologically-armed regional aggressors. Although biological weapons may initially be seen as a threat against a single state, because of the nature of biological weapons, the consequences of a biological weapons attack may well extend to neighbouring states and consequently a state facing a potential biological weapons attack is likely to seek assistance from neighbouring states and thus may face a potential biological weapons attack as part of a regional coalition or a coalition of like-minded states. The vulnerability of such a coalition to biological weapons attack is a potential Achilles heel in the effort to deter, and where necessary defeat, such aggressors and their use of biological weapons. A better understanding of this vulnerability–and of the actions necessary to minimise it–is essential if deterrence and defence are to be strengthened.

But defence against biological attack has so far received little attention. Some of the questions raised are:

* A manifestation of this increased interest in biological defence was the change in the names of the lead facilities in both the UK and the US to include biological defence; thus the UK Chemical Defence Establishment became the Chemical and Biological Defence Establishment (CBDE) on 01 April 1991 and the US Army Chemical Research, Development and Engineering Centre at Edgewood became the US Army Chemical and Biological Defence Agency (CBDA) in 1992 and then the US Army Chemical and Biological Defence Command (CBDCOM) in 1993.

(a) What is the biological threat?

(b) What are the vulnerabilities of states facing such a threat either alone or in a coalition?

(c) What are the essential ingredients of biological defence?

(d) What is the role of biotechnology in biological defence?

(e) How well prepared are those who may be attacked by biological weapon-armed aggressors to deal with such contingencies?

(f) How well might biological weapons threats or use be met? What assistance might be available under the BTWC and its Protocol?

(g) What steps have been taken to minimise vulnerabilities? What further steps seem warranted?

To answer these questions, this article begins with an assessment of the potential biological threat and considers the vulnerabilities of states facing such a threat. It also considers the role of political-military coalitions in meeting the challenges of such aggressors and goes on to evaluate and identify the vulnerabilities of coalition partners as a potential Achilles heel. It addresses the measures necessary to minimise or redress those vulnerabilities, by means of active and passive defence, and examines the role of biotechnology in such protective measures. It briefly surveys the biological weapons defence capabilities of a number of countries and offers an assessment of the capacity of prospective coalitions in Europe, the Middle East, and East Asia to cope with biological weapons attack by the regional aggressors. It concludes with a discussion of policy initiatives useful for addressing gaps by promoting cooperation among the interested parties.

4. BIOLOGICAL THREATS

A good case can be made that currently, of all weapons of mass destruction, biological and toxin weapons present the greatest danger[23]. This is because the quantities of agent required for an effective attack are small, yet the effects of an attack can be comparable to those of nuclear weapons and the prohibition regime is the weakest. Biotechnology has made it easier to produce the quantities of biological and toxin weapon agents necessary to carry out an attack and has also offered the prospect of modifying biological and toxin agents to increase their effectiveness. Whilst genetically modified agents can be produced, it seems probable that the unmodified traditional biological and toxin weapon agents will continue to present the greatest danger as it is these agents that have been proved by all means short of actual use in past offensive biological weapons programmes. Genetically modified agents have not been subjected to such extensive trials and there will thus be less confidence that they will be effective, if used in weapons. It is recommended that counters to biological and toxin weapons be focussed primarily on the traditional unmodified agents although the danger from genetically modified agents cannot be ignored[24].

Biological weapons may well be seen as the weapons of choice for regional aggressors facing either a single state or a regional or other coalition partnership. The potential effectiveness of biological weapons is now much better appreciated than before. Several analyses have demonstrated that biological weapons can result in strategic effects comparable to nuclear weapons[7,25]. The very threat of biological weapons attack could weaken the political will of both individual states and of like-minded states contemplating joining a coalition partnership. Actual attacks with biological attacks against ports of debarkation, against lead elements of larger deploying forces, and against local military powers could cripple an individual state or a state which has joined a coalition partnership. Are the risks after all worth it? Threats of use of biological weapons might induce states to refrain from joining a coalition, from opening their bases to use by a coalition, or from seeking unconditional surrender of the aggressor regime.

For these purposes, neither conventional nor chemical weapons would likely be seen by the aggressor as sufficiently certain to have the desired effects. Nuclear weapons might well promise them, but an aggressor would likely also believe that nuclear attack would result in nuclear retaliation. Biological weapons might have a higher risk of provoking nuclear retaliation than conventional or even chemical weapons, but this would probably

be a lower risk than that arising from use of nuclear weapons. Moreover, any aggressor regime at the brink of war with a coalition–especially if it was one including the US–would be running huge risks, not least of a possible overwhelming reprisal by the coalition. In this circumstance, it will have to choose its risks carefully. Biological attacks may be seen as less risky than the alternatives–especially if they cannot definitively be tracked back to the attacking state. A biological weapons attack may be made to look like a normal outbreak of an infectious disease, thus making retaliation politically very difficult. The point of conducting such an attack would be to generate fear and to manipulate that fear politically so as to persuade the targeted country to accept a settlement without going to war.

Whether biological weapon threats or attacks will have the effect intended by the aggressor is by no means certain. Such threats may be intended to weaken the resolve of those who resist aggression, but they may have the opposite effect of galvanising and strengthening such resolve. Or the intent may be to defeat military forces, but biological weapons attacks may have the effect of changing the terms of battle, freeing the coalition to use even greater force and to seek war aims that include removal of the offending regime. Indeed, the use of biological weapons could be highly counterproductive for a regional aggressor–even the threat of their use could well strengthen the resolve of the international community, not just to defend an interest but also to remove the threat to that interest.

5. REGIONAL COALITIONS

Coalitions are valuable, and are likely to become even more so, in dealing with regional aggressors. The reasons are numerous. They ensure that all capable countries are able to share the responsibility of keeping peace. They promote the active involvement of the larger international community in preserving the norms and interests (such as the principle of non-aggression), which have brought it into being as a community. They give the regional victims of aggression a hand in their own self-defence, in achieving a just settlement of local disputes, and in achieving and preserving a peaceful regional order. Militarily, they facilitate a sharing of operational tasks–especially critical when such coalitions depend upon the projection into a region of large numbers of external forces.

Coalitions have a particular importance especially in dealing with regional aggressors armed with weapons of mass destruction. They demonstrate the international opprobrium against possible use of weapons of mass destruction. They underline the isolation of a state willing to use banned weapons for the purposes of aggression. And they facilitate a sharing of the political burdens associated with the consequences of such wars as well as the strategic decisions made in meeting the aggression[26].

Such coalitions are inevitably ad hoc arrangements depending on the specific location and mode of aggression. But they typically have foundations in existing forms of cooperation, whether in international institutions, such as the United Nations or the Arab League or in formal alliances, such as NATO.

The existence of such coalitions will present aggressors with special challenges. Those aggressors will have an interest in breaking those coalitions and so rendering them impotent, especially through attack of bases or other military assets on the territory of individual members that are essential to the operational success of the coalition. They will have an interest in generating fear among the most powerful members of the coalition, so giving them reason to seek negotiated settlement short of war. If war begins, they will have an interest in denying to the coalition territory essential to its military strategy and in preventing the most powerful members from being able to bring the full brunt of their military power to bear, by limiting their abilities to control the skies, assemble overwhelming armoured forces on land, or navigate freely at sea. The *Quadrennial Defence Review* emphasises that the US dominance in the conventional military arena may encourage adversaries to use such asymmetric means, such as NBC weapons to attack the US forces and interests overseas and the Americans at home and to deter allies and potential coalition partners from supporting US intervention.

This line of argument raises many questions about how best to prepare for possible future regional wars in which an aggressor employs biological threat or weapons:

(a) Might it be deterred?

(b) Are the overwhelming nuclear reprisal capabilities of any such coalition likely to be sufficient to deter the use of biological weapons?

(c) What unexpected interests are created for the international community by an aggressor who tries to use biological weapons to secure aggression?

Although the actual impact of biological threats and attacks cannot be predicted with certainty, it is reasonable to assume that their impact would have much to do with the degree to which prospective coalition members are, or are perceived to be, vulnerable. If the aggressor's threat can credibly be carried out and would result in huge numbers of casualties, the pressure on coalition members to compromise will increase, as will the need to restructure military options to be able to survive such attacks. But, if the threat can be countered, the coercive value of those threats, as well as the operational value, can be sharply constrained and reduced. Thus, there is considerable strategic value in minimising the vulnerability of potential coalition partners to attack from biological weapons.

6. BIOLOGICAL DEFENCE

Biological defence is an integrated set of measures designed to maintain the operational effectiveness of an armed force should it be subjected to a biological weapons attack. The armed force needs to be able to survive and maintain its ability to fight. There are two main components to biological defence: Active defence, and passive defence. Among the capabilities that must be integrated to effectively withstand an adversary armed with biological weapons are: (i) active defences and counterforce attack capabilities, and (ii) passive defences the doctrine and planning to exploit them effectively, as well as some measure of civilian protection.

Active defence comprises measures aimed at preventing the biological attack from reaching the target area. These include various techniques for intercepting and destroying enemy missiles.

Counterforce is also regarded as a component of biological weapons defence. Counterforce measures are those aimed at destroying an opponent's biological weapons and associated delivery capabilities before they can be brought to bear in battle. Because counterforce is a generic capability relevant to the full range of an aggressor's conventional and unconventional weaponry, it is not addressed here as a defence measure aimed specifically at minimising biological weapons vulnerabilities.

Passive defence also comprises a variety of measures. It includes hazard assessment, in which the potential danger to the target forces is evaluated, thus enabling operational deployments that minimise the danger. It includes detection measures aimed at detecting a biological attack, thus enabling warning to be given to the armed forces in the hazard area to don physical protection. This physical protection is an additional element, consisting of respirators, or nasal masks, or collective protection, such as facilities or vehicles fitted with filtration systems. Such protection aims at preventing inhalation of the biological agents. It should be noted here that the biological danger differs from the chemical danger in at least one important respect: Body protection is not necessary against a biological attack as biological agents, unlike some chemical agents, typically do not attack through the skin*. Passive defence also includes medical countermeasures both to enhance the body's protection, such as by vaccination, prior to an attack, and by treatment,

* There is another important difference between CW and BW in respect of their passive defence relating to the secondary hazard subsequent to an attack. In the case of chemical agents, there is a persistent hazard resulting from the vaporisation of the agent, or from contact with contaminated surfaces. In the case of biological agent, this risk is very substantially minimised as there is no contact hazard and biological agents do not vaporise. The only danger arises from re-aerosolisation of the agent, which does not occur readily. Typically, about one per cent of the agent cloud is deposited on a surface and of this only about a further one per cent is re-aerosolised. Consequently, the secondary re-aerosolisation hazard is about 0.01 per cent of the original hazard.

such as by antibiotics, after an attack.

In addition, biological defence needs to be addressed as an integral element in developing strategy, doctrine and operational planning. Training in biological defence is also essential if active and passive measures are to be effective.

An often overlooked facet of biological defence for countries in regions of proliferation concern is protection of the civilian population. Minimising civil vulnerabilities is essential for a variety of reasons. If cities can credibly be threatened with mass casualty attacks, an aggressor's political leverage could be considérable. If the population can be panicked into mass migration during the early phases of a conflict, military forces may be denied movement on public transit nets. If civilian dock workers and airfield personnel can be driven out from those facilities at times of high risk, the flow of military material and personnel into the theatre of operations could be restricted.

To minimise those civil vulnerabilities, the active and passive measures outlined above are relevant. Protection of population centres from attack is generally a problem of antimissile and antiaircraft defence but there is also a danger from covert attacks by special forces. This points to the conclusion that a comprehensive biological weapons defence capability must include the means to mask, particularly vulnerable population, the warning systems necessary to make their masking useful, and the associated medical measures. In the absence of such integral civil defence measures, it may not be politically feasible, even when it is militarily feasible, to counter an aggressor assessed to possess biological weapons and the associated delivery means.

6.1 Biotechnology in Bio-defence

The key elements of protective measures against biological and toxin weapons attacks are:

(a) *Hazard assessment*: An evaluation of the likely agents and the concentrations that may be encountered at various distances downwind from the point of attack

(b) *Detection*: The rapid and accurate detection of a biological and toxin weapon agents concentration in the atmosphere to enable warning and alerting of those at risk

(c) *Physical protection*: The adoption of measures to prevent inhaling a harmful concentration of the biological or toxin weapon agent

(d) *Identification and diagnosis*: Rapid identification and diagnosis so that appropriate medical countermeasures can be taken

(e) *Medical countermeasures*: These may be taken prior to an attack–prophylaxis–or after exposure–treatment. There is a particular requirement for products licensed for both safety and efficacy

Biotechnology has been vital for the development of detection techniques, for identification and diagnosis, and for medical countermeasures. Indeed, it would be accurate to say that detection, identification and diagnosis, and medical countermeasures would be impossible without biotechnology.

It consequently follows that the recent advances in biotechnology offer a real opportunity for effective counters to biological and toxin weapon agents to be developed. As biological and toxin weapon agents occur in natural outbreaks of disease or intoxinations, there are both civil and military requirements for counters to biological and toxin weapon agents.

It is useful to consider what the requirements are for warning/alerting, identification, diagnosis and medical countermeasures in a number of different scenarios:

(a) Battlefield/attacks on military targets

(b) Terrorism incidents

(c) Inspection environment

(d) Civil outbreaks of disease

The requirements are summarised in the Table1.

In considering attacks on military targets,

Table 1. Requirements for the warning/alerting, identification, diagnosis and medical countermeasures in different scenarios

Scenario	Warning/alerting	Identification	Diagnosis	Medical countermeasures
Attacks on military targets	Particularly important	Rapid identification	Required	Required
Bioterrorism	—	Required	Particularly important	Required
Inspection environment	—	Required	—	—
Civil outbreaks	—	Required	Particularly important	Required

warning/alerting is of particular importance because the detection of the attack followed by warning for military resources that may be subject to the attack is a central element of the protective stance. Identification needs to be rapid as the danger posed by the attack on a military target depends on the particular agent used. Diagnosis is required to devise the most effective medical countermeasures to the attack on military personnel.

In the case of bioterrorism, much depends on the particular terrorist incident. If a terrorist biological device has been functioned without warning, thereby releasing biological agents, then diagnosis is particularly important as the first manifestation is likely to be the symptoms of those exposed. If such a device has not been functioned, then identification of the nature of the agent is required. Medical countermeasures are also required.

In the inspection environment, there should be no situation in which the inspection team is subjected to an unexpected attack. The safety of the inspection team should be guaranteed and the principal requirement will then be for identification of the nature of any material found. Finally, for civil outbreaks of disease, the first manifestation is again likely to be the symptoms of those exposed. The agent needs to be identified and medical countermeasures will be required.

7. SURVEY OF CAPABILITIES

How substantial are the vulnerabilities of individual states whether facing a biological attack or as a prospective coalition member? What action is being taken to minimise these vulnerabilities?

To answer these questions, the authors have undertaken a survey of available journal literature, media reports, and other unclassified information on biological defence, as well as interviews with analysts in various countries. This survey points to the following conclusions:

- Biological weapons vulnerability is a problem of growing concern to many states and prospective coalition partners.
- This concern has led to an increased investment in the biological warfare defence programmes of many countries.
- By and large, however, these investments are modest and appear vulnerable to cutbacks, if defence budgets continue to shrink.

This interest in biological defence seems to have different sources. Rising international concerns about the proliferation of weapons of mass destruction in general, were magnified by the near-brush in the Persian Gulf war. These concerns were reflected in a significant political statement by the UN Security Council which, in a first-ever meeting at the Heads of States and Govts level, declared on 31 January 1992, 'The proliferation of all weapons of mass destruction constitute a threat to international peace and security. The members of the Council commit themselves to working to prevent the spread of technology related to the research for or production of such weapons and to take appropriate action[27] to that end'. Heightened concern about emerging infectious diseases in the wake of the Ebola outbreaks added to the

interest of many countries in diminishing vulnerability, both military and civil, to infectious agents. After all, biological weapons is the use of disease as a weapon[1,28] of war*.

The interest of NATO member countries was driven by proliferation trends in areas around its periphery and by the Persian Gulf war following the Security Council's statement of 31 January 1992. NATO's interest led to the creation of the Senior Defence Group on Proliferation (DGP**). The DGP led to the recognition that 'NBC weapons are quite different from one another as are their characteristics and their potential military effects'. In other words, biological weapons must be regarded as different from chemical weapons and nuclear weapons. This consideration led the DGP to draw particular attention to the importance of protection for deployed forces, given NATO's new roles and missions and the regional nature of the risk. The DGP study[29,30] has resulted in the definition of a series of overarching principles to guide NATO's defence response to proliferation. These include:

(a) Maintain freedom of action and demonstrate to any potential adversary that the Alliance will not be coerced by the threat or use of NBC weapons.

(b) Reassure both Allies and coalition partners of the Alliance's ability effectively to respond to, or protect against, NBC threats or attacks

(c) Complement non-proliferation efforts with a mix of military capabilities that devalue NBC weapons, by reducing the incentives for, and raising the cost of acquisition

(d) Emphasise system mobility, given that NBC proliferation risks are expected to be primarily regional in character and that NATO forces may be called upon to operate beyond NATO's borders.

The report then set out a number of priorities. To counter proliferation risks, NATO most needs capabilities for the detection (both point and stand-off) of biological (and chemical) agents, as well as attack identification and warning, plus NBC individual protective equipment for deployed forces.

Reflecting the political importance attached to proliferation issues, the defence ministers of NATO directed that an accelerated process be used to address any shortfalls in capability within a shorter timeframe. This was the first time in 12 years that NATO has used this accelerated process. Implementation of the DGP agenda is being taken forward by a comprehensive program of 39 separate action plans, which will be monitored by the DGP and reported to NATO ministers.

In June 1997, the meeting of the North Atlantic Council reaffirmed its commitment to address proliferation risks as an integral part of the Alliance's ongoing response to the new security environment. Its final communique stated, 'While prevention remains our primary aim, we recognise that proliferation of nuclear, chemical and biological (NBC) weapons and their means of delivery...can pose a direct threat[31] to the Alliance'. The Council also specifically welcomed the emphasis being put on 'improving protection against biological weapons'. The danger from NBC weapon proliferation was reaffirmed in the Washington Summit Communique which stated, 'The proliferation of nuclear, chemical and biological (NBC) weapons and their means of delivery can pose a direct threat to Allies' population, territories, and forces and therefore continues to be a matter of serious concern[32] for the Alliance'. This went on to announce the weapons of mass

* Pearson, Graham S. Preventing deliberate disease. *Medicine Conflict Survival*, 2000, **16**, 42-59.

** The NATO Senior Group on Proliferation (DGP) was established following the decision of the NATO Heads of State and Government meeting of the North Atlantic Council held at NATO Headquarters, Brussels, on 10-11 January 1994 to intensify and expand NATO's political and defence efforts against proliferation (see Press Communique M-1(94)3, 11 January 1994). Six months later, NATO issued the Alliance Policy Framework on Proliferation of Weapons of Mass Destruction at the Ministerial Meeting of the North Atlantic Council held in Istanbul, Turkey on 9 June 1994 [see Press Release M-NAC-1(94)45,9 June 1994]. This framework set out various aspects of the defence dimension stating "As a defencing Alliance, NATO must therefore address the military capabilities needed to discourage WMD proliferation and use, and if necessary, to protect NATO territory, population and forces".

destruction (WMD) policy initiative with objectives including 'enhance existing Allied programme which increase military readiness to operate in a WMD environment and counter WMD threats'; and 'enhance the possibilities for Allies to assist one another in the protection of their civil population against WMD risks'.

However, prior to the Aum Shinrikyo attack in Tokyo, very few countries in Europe or elsewhere had addressed the potential vulnerability of civilians to terrorist attack with biological agents. The sole exceptions were countries, such as Sweden and Switzerland (and, outside Europe, Israel), which have long sought to protect their civilian population from weapons of mass destruction. Since the Aum Shinrikyo attack, considerable attention has been paid, particularly in the United States, during the past few years to the dangers from bioterrorism with recent emphasis being placed on the necessity for comprehensive threat and risk assessments[33-36].

Although there has been a growing interest in biological defence, this is still matched by great uncertainty about the precise nature and magnitude of the biological weapons problem. This is particularly true within regions where biological weapons are of specific concern. Many analysts in countries that may become partners in a coalition are of the view that the military implications of the threat remain poorly understood and ill-defined. Many are receptive to arguments that the biological weapons threat is growing, but few believe that it has been well enough calibrated to allow a reasoned allocation of resources. Few officials are willing to publicly delineate clear national priorities in their biological weapons defence programmes; indeed, some programmes are typically described as useful for getting up to speed or 'following the US lead'.

Precise details on the nature of the biological weapons defence programme pursued by these countries are difficult to acquire, for reasons discussed below.

The single best source of data is the collection of declarations made as confidence-building measures (CBMs) by states parties to the Biological Weapon Convention. Four such measures were agreed at the second review conference[37] in 1986 and they were extended and enhanced at the third review conference[38] in 1991. One measure in particular [A Part (ii)] requires an exchange of information on national biological defence research and development programme. Another measure (F) requires a declaration of past biological offensive and/or defensive research and development programmes. But thus far only about one-half of the Parties to the Convention have made any declaration at all and only 11 have made the required annual declarations. Many of the most important ones from the point of view of this study have made several declarations. However, the declarations vary widely in their contents and are only required to address 'research and development' programme.

One review of this data summarises the key findings as

- Respondents declared a total of 43 facilities involved in research and development for biological defence (nearly half of those were in the US)
- Maximum 70 containment facilities (about 10 per cent of which were funded by ministries of defence)
- Another 106 facilities equipped with containment units other than maximum containment (about 20 per cent of which were funded by ministries of defence)
- A total of 163 facilities engaged in the production of human and animal vaccines (88 of them in industrialised countries[39]).
- Later data, based on the responses in 1997, produced:
- A total of similar figures: 43 facilities involved in research and development for biological defence (nearly half of those were in the US)
- A total of 49 maximum containment (BL-4) facilities, and a total of 163 facilities engaged in the production of human and animal vaccines[40,41]

Four conclusions may be derived from this analysis of CBM information and other available information.

(a) There is a fair amount of industrial infrastructure

and associated scientific expertise available among the community of nations most likely to find themselves in a coalition against a regional aggressor armed with biological weapons. They should have it within their means to provide adequate protection. The key issue is whether they will have sufficient time to do so.

(b) Limited self-protection capabilities are already widely available from large number of nations producing protective equipment for chemical and biological defence. For example, gas masks (which are effective but unnecessarily cumbersome for protection against biological weapons threats) are produced[42] in nearly two dozen countries*. Moreover, oronasal masks capable of providing 100 to 1000 times better protection than no mask (which may thus be valuable for providing protection to civil population) are generally available in the commercial market for public health and for manufacturing uses. In fact, many of the countries surveyed, especially the developed ones, have infrastructure in the public health and commercial sectors that could be drawn upon in time of crisis to provide both medical countermeasures and treatments as well as some limited self-protection capability.

(c) Biological weapons detectors are not broadly available. Although at least 19 countries produce chemical detectors, very few produce even basic biological weapons detectors[44-46]. However, some biological detectors were deployed during Desert Storm. Moreover, concepts of deployment are being developed that recognise that point biological weapons detectors located some distance upwind of deployed forces can give warning of attack, enabling timely countermeasures by downwind forces, such as the donning of masks.

(d) There is little evidence to suggest that national programmes have actually reached the point where a systems approach to the problem substantially redresses military vulnerabilities to biological weapons attack. Some countries are stronger on medical readiness than on fielded systems. Others are stronger on hardware than training and doctrine. With the exception of the US, the UK and Canada, none appears to have put in place an integrated programme that matches a comprehensive set of capabilities to realistically-defined threats. There is insufficient visibility of the Russian biological defence programme to know whether an integrated capability has been established; it should be expected, however, that such a capability would exist in Russia.

A caveat to these conclusions deserves mention. Virtually all countries surveyed in preparing this article were reluctant to make information publicly available on their bio-defence capabilities. In our judgment, this reticence has a variety of sources. Some countries are reluctant to do anything to suggest or illuminate vulnerabilities–this is especially true of countries in the Middle East and East Asia, where there are specific and immediate concerns about the biological threat posed by neighbouring states. Others are fearful of magnifying the potential interest of terrorists or proliferants in biological weapons by doing anything to suggest that the problem is being given sustained attention in national capitals. Despite this caveat, it is believed that the following assessments are valid:

8. ASSESSMENTS

The past decade has seen a clear recognition –and rightly so–that biological weapons pose a significant threat to states, either from other states or from terrorist groups. It is therefore timely and right that states should evaluate their vulnerabilities and initiate national programmes to enhance their protective measures against such threats.

Whilst genetically modified biological weapons are certainly feasible, it is important to recognise that it is the traditional biological warfare agents, such as anthrax and tularemia, which have been the subject of development and production programmes in countries that had offensive biological

* This includes countries in Western, Central, and Eastern Europe as well as Israel and Iraq in the Middle East and China and the Republic of Korea in East Asia. The number of countries producing masks may well be larger, as the provision of data to the CBIAC handbook was voluntary.

weapons programmes prior to the entry into force in 1975 of the BTWC. These traditional agents have been proven by all means short of actual use in war and present a greater risk than do genetically modified agents which have not been subject to comparable development, test or evaluation. Nevertheless, whilst concentrating on protective measures against the traditional agents, it would be prudent also to be aware of and pay attention to the potential risks from genetically modified biological agents and other new developments.

Although there has been considerable hype–especially in the US–about the possible use of biological weapons by terrorists, it is worth noting that the Aum Shinrikyo failed to launch an effective biological attack[47]. The recent US Govt Accounting Office (USGAO) studies of the threat of chemical and biological terrorism has noted, 'Terrorists face serious technical and operational challenges at different stages of the process of producing and delivering most chemical and all biological agents' and quoted a CIA statement to a House Committee, the preparation and effective use of biological weapons by both potentially hostil states and by non-state actors, including terrorists, is harder than some popular literature[34] seems to suggest'.

The US GAO concluded that a national assessment of the risk of biological terrorism, based on analyses of both foreign and domestic origin threats, would help to determine the requirements and priorities for combating terrorism and would target resources where they are needed. A later GAO report noted that Canada, France, Germany, Israel and the UK generally try to maximise their existing capabilities to respond to chemical and biological terrorism threats, rather than creating new programmes or capabilities[36]. Consequently, existing capabilities to respond to a fire, an industrial explosion or a chemical spill would be utilised and built upon to counter a terrorist incident, using chemical or biological agents.

The counter to the danger of biological weapons, whether possessed by states or by non-state actors, is through a web of deterrence made up of a series of strands:

- Comprehensive prohibition through international treaties and national legislation establishing the clear norm that development, production, storage, acquisition or use of biological weapons are totally prohibited
- Broad monitoring and controls ensuring that materials or equipment are used only for permitted purposes, thus increasing the difficulty of acquiring materials or equipment for prohibited purposes
- Broadband protective measures, both active and passive, thereby reducing the effectiveness of biological weapons
- Determined national and international responses to non-compliance with the prohibition ranging from diplomatic actions, sanctions through to armed intervention, making it clear that acquisition of biological weapons will not be tolerated.

These strands are mutually reinforcing and lead a would-be proliferator to judge that acquisition of biological weapons is not worthwhile. A single strand alone will not suffice, yet, together, they make the benefits of chemical and bilogical warfare (CBW) acquisition minimal. It is, however, vital to ensure that all the strands are strong.

Although biotechnology offers the prospects of novel and modified agents, the advantages from biotechnology in enhanced protective measures far outweigh the potential for increased risk. It is apparent that biotechnology is vital for effective biological detection and identification as well as for effective prophylaxis and therapeutic treatment.

There are significant provisions for assistance and protection under article VI of the Protocol to the BTWC nearing completion in the negotiations in Geneva. States Parties to the Protocol will be able to call upon the future organisation for the prohibition of biological weapons as well as other States Parties to provide advice and assistance in respect of bio-defence capabilities.

Further benefits will also come from the Protocol to the BTWC which will, over time, increase transparency and increase confidence in compliance with the Convention between States Parties. If a

State Party believes that it has been subjected to attack by biological weapons, it can both seek assistance and invite the future organisation to carry out a field investigation.

States Parties to the Convention are likely to be like-minded states that will wish to ensure that the prohibitions of the Convention are indeed implemented and to join forces against any state that is in breach of the Convention. Such states may also be willing to become partners in coalitions to counter the threat of biological aggression.

9. CONCLUSIONS

A great deal of work has to be done by states that are the potential victims of biological attack by regional aggressors. In many cases, a modest investment of resources and institutional commitment will go a long way toward strengthening biological defence capabilities and thereby deterring aggression. It is believed that the proliferation of biological weapons in recent years has had a pernicious effect on those who hope to be more secure in the future. Our future vulnerability may well be determined not so much by the actions of aggressors as by the inaction of potential victims. Strong defences will help to mitigate against the use of biological weapons in future wars, as well as the effect of their threatened or actual use. Failure to redress deficiencies could encourage aggression and lead to biological weapon attacks that set precedents of an altogether negative kind. Biological weapon threats successfully used to break a coalition, or biological weapon attacks successfully employed to defeat a coalition, could call into question all future coalition efforts to police global norms–and thus the world order upon which they are based.

Thus, it is urgent that deficiencies in biological weapon defence are redressed now, before an aggressor brings them into sharp focus by exploiting them ruthlessly. As David Davis, the British Minister of State at the Foreign and Commonwealth Office, said at the end of his statement to the fourth review conference, Biological Weapons Convention (BWC) held on November 26, 1996: "We can count ourselves extremely fortunate that the Biological Weapons programmes which were developed in violation of this Convention have not been used. Time for trusting to luck has run out. The responsibility[48] is ours".

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