

## Strategy Considerations

Based on the operational requirements for deployed forces, DoD's current strategy is designed to (1) detect, monitor, and avoid exposures to incapacitating or life-threatening concentrations of CB and other harmful agents; and (2) provide enough warning time for troops to take protective action (e.g., don masks and suits) if exposure is necessary or inevitable. For the most part, DoD's strategy, doctrine, equipment, and training are focused on conventional chemical agents (e.g., blister and nerve agents).

DoD has dramatically expanded its biological defense programs since Desert Storm, but new technologies and doctrine are still under development. Currently, DoD has only a limited capability to detect concentrations of biological agents. Current detectors are only sensitive to life-threatening exposures and cannot provide results in real time. Although the strategy is to avoid known concentrations of biological agents, that is not a realistic option with current technology. Therefore, DoD vaccinates troops in advance against anthrax and other biological agents (although they provide only partial protection) and continues to research methods of detection and more effective vaccines.

DoD has made only limited progress in terms of strategies, doctrine, equipment, and training in detecting, monitoring, and tracking of low levels of chemical agents. Low-level exposures, either from single or multiple chemical agents, could cause health effects well after a deployment is ended. Congress has now directed that DoD policies and doctrine be modified to protect personnel from low levels of agents in combination with other exposures and that a research program be focused on the effects of low-level exposures (1999 Defense Authorization [P.L. 105-261] Section 247).

## RECOMMENDED ADJUSTMENTS IN STRATEGY

Based on the results of this study, DoD should consider adjusting its overall strategy for detecting, monitoring, and tracking harmful CB agents in two respects:

1. More emphasis should be put on developing and fielding practical methods of detecting and monitoring concentrations of biological agents in conjunction with troop deployments.
2. The detecting and monitoring of a broader range of CB agents, TICs, and endemic-disease organisms and tracking low-level exposures to them should be addressed comprehensively.<sup>1</sup>

These adjustments require (1) better integration of data from various sensors deployed on the ground, in the air, or on the troops themselves during deployments; (2) monitoring concentrations of agents by stand-off means and tracking troop movements; and (3) maintaining accurate and accessible databases on exposures of troops to different agents that might, singly or in combination, cause long-term health effects. As these capabilities indicate, DoD will need a comprehensive communications and information processing, storage, and retrieval capability to accompany its strategic decisions.

DoD could benefit from civilian sources of data on TICs, environmental and occupational contaminants, and endemic biological organisms. Civilian groups preparing for terrorist attacks would benefit from DoD's data on CB agents. Of course, security considerations (national and personal) would have to be satisfied. DoD is investigating the possibility of establishing a national chemical biological data center, which would exchange appropriate data with the civilian community.

For DoD to improve its detection, monitoring, and comprehensive assessments of low-level exposures to biological agents, the following actions will be necessary:

- the development and procurement of technical means of assessing potential and actual exposures (e.g., real-time, field-usable detectors for biological agents and better detectors for low levels of chemical agents)
- the development of doctrine and training protocols for conducting military operations (based on better information about exposures) that would still accomplish the military mission

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<sup>1</sup> For some biological agents, any exposure could potentially result in severe health effects.

- the collection of information on the health of troops who were deployed, regardless of whether they remain in the military or return to civilian status

## TECHNICAL ASPECTS

Current biological detection equipment is not as advanced as chemical detection equipment in terms of sensitivity, speed, and portability. DoD is pursuing research on new techniques for the real-time detection of very small amounts of biological agent by small, rugged (hence, field-usable) devices. These devices will probably not be developed for at least five years, although stronger support for R&D could hasten their availability.

Assessing potential exposures of deployed troops to low levels of harmful agents is difficult, especially because an array of CB agents and TICs might be encountered during typical deployments. Currently, very little information relates low-dose exposures and long-term health effects to single agents or combinations of agents. Technologies for detecting and estimating concentrations of agents have been focused mostly on high concentration levels. Current equipment that can function at low levels is cumbersome, complex, and often too delicate for use during deployments.

However, detection capabilities are improving, as are modeling and simulation capabilities and the analysis of weather effects on agent "clouds." Miniature GPS receivers could help track the movements of individuals or groups at much higher space and time resolutions. DoD could take advantage of rapid advances in communications and information technologies, fueled principally by commercial developments, to improve its processing, storage, and retrieval of data (1) for synthesizing information from various detectors and monitors; (2) tracking the locations of troops relative to these concentrations; and (3) assessing the potential exposures of troops before, during, and after deployments. Coupled with retrospective epidemiological studies, these data could be used for diagnosing and treating troops after deployments.

## RECOMMENDATIONS

### Defining Needs

**Recommendation.** The Department of Defense should formulate an integrated approach to assessing the threats of chemical and/or biological agents. The approach should include: (1) a near-term and long-term perspective; (2) data collection; (3) estimates of the relative importance of various threats (e.g., biological threats, chemical threats, and chemical

toxins derived from organisms) in a variety of overseas theaters; and (4) data on the effects of low-level doses of a broad range of agents.

### Determining Exposure

**Recommendation.** The Department of Defense (DoD) should proceed with a robust program to develop chemical detectors and biological detectors that can detect and measure low-level as well as high-level concentrations. The first priority should be the development of improved passive sampling devices based on existing technologies that could be fielded quickly. The DoD should also develop a support structure for using the devices and for archiving the data.

**Recommendation.** The Department of Defense should expeditiously develop the capability of identifying and archiving continuous data on the operational location of each small unit—and, if practical, each individual—as well as the unit or individual's proximity to actual or suspected releases of potentially harmful agents. Technical assessments and cost-benefit analyses should be used to determine the best ways to accomplish these functions in the near term (e.g., supplementing the miniature global positioning system receiver to achieve the desired result).

**Recommendation.** The Department of Defense should establish a long-term goal to develop very small devices that could be deployed with each individual to measure and record automatically exposures to one or more of the most threatening agents, the location of the individual, the activity of the individual, the microenvironment, and the time.

**Recommendation.** The Department of Defense should develop and field improved meteorological measuring and archiving systems to provide finer data grids of wind, temperature, and atmospheric stability in the theater of operations. These data will be necessary for improved transport modeling and for after-action analyses of data on the movements of chemical and biological "clouds."

**Recommendation.** The Department of Defense should support research to clarify how chemical and biological processes affect the rate of transformation of agents in different environmental media under a variety of conditions.

### Handling Data

**Recommendation.** The Department of Defense should develop a

representative activity-location database for different types of units, major military duty categories, and high-risk subpopulations of personnel likely to be deployed. This database, along with models and simulations, should be used to predict and evaluate potential exposures associated with specific deployments.

**Recommendation.** The Department of Defense should develop its data-handling capability to track the locations of all individuals (or, at least, the smallest units) during future deployments and compare them to the locations of actual or potential agent concentrations at the same point in time. The data-storage capacity should be increased simultaneously so that these locations can be recalled and analyzed after each deployment (e.g., data could be recalled from a high-capacity personal information carrier).

**Recommendation.** In the future, the Department of Defense should characterize the variations in exposures of members of groups believed to have been exposed during their deployment. To help accomplish this, location data and agent-concentration data for individuals or small units should be analyzed thoroughly, using statistical methods where applicable.

**Recommendation.** The Department of Defense should study the ramifications of establishing a national chemical and biological hazardous agent data center.

### **Doctrine, Training, and Administration**

**Recommendation.** Doctrine and training for taking protective action should be reviewed to ensure a proper balance between military necessities and the risks of harmful exposures. The Department of Defense should reevaluate its doctrine and training for handling and reporting alarm activations and false alarms and revise them, if necessary.

**Recommendation.** Doctrine and training should take account of predeployment exposures that might put some individuals at greater risk during deployment. This information, along with data gathered on actual or suspected exposures or on the locations of individuals or units and the locations of concentrations of agents, should be used to assess the risk to individuals.

**Recommendation.** The Department of Defense should review its doctrine and training protocols governing the interactions of offensive operations and protective measures. If an offensive operation may cause exposure to troops nearby, this information should be factored into the decision.