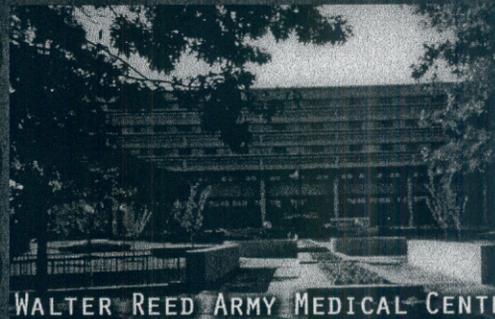




# LEADERS

Lightweight Epidemiology Advanced  
Detection and Emergency Response System



WALTER REED ARMY MEDICAL CENTER

Technical Maturity

Assessment Report

January 2002

---

**LIGHTWEIGHT EPIDEMIOLOGY ADVANCED DETECTION  
AND EMERGENCY RESPONSE SYSTEM**

**TECHNICAL MATURITY ASSESSMENT REPORT**

**January 2002**

**Disclaimer** – The use of trade names in this document does not constitute an official endorsement or approval of the use of such commercial hardware or software. This document may not be cited for purposes of advertisement.

---

*This page is intentionally blank.*

---

# TABLE OF CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>1</b>
Introduction .....	1
Methodology.....	2
Conclusions .....	2
Recommendations .....	3
<b>PURPOSE.....</b>	<b>5</b>
<b>BACKGROUND .....</b>	<b>7</b>
Introduction .....	7
System Description.....	8
MedSurv Module.....	9
RAPID.....	10
IM Module.....	10
CCT Module.....	11
SA Module .....	11
Assessment Limitations.....	12
<b>ASSESSMENT METHODOLOGY.....</b>	<b>13</b>
Assessment Approach .....	13
Assessment Measures.....	16
Assessment Execution.....	19
Training.....	19
IM Module.....	19
CCT Module.....	20
MedSurv Module.....	21
Post-Assessment Debriefings .....	23
<b>RESULTS .....</b>	<b>25</b>
Overview .....	25
Assessment Results .....	27
Training .....	27
IM Module.....	29
CCT Module.....	30
MedSurv Module.....	33
<b>CONCLUSIONS .....</b>	<b>39</b>
<b>RECOMMENDATIONS.....</b>	<b>41</b>
<b>ANNEX A: Acronyms.....</b>	<b>A-1</b>
<b>ANNEX B: Suggested Software and Technical Improvements to the ViewPort and IM Modules.....</b>	<b>B-1</b>
<b>ANNEX C: Suggested Software and Technical Improvements to the MedSurv Module .....</b>	<b>C-1</b>

---

## **List of Figures**

Figure 1. Air Force Surgeon General.....	7
Figure 2. LEADERS Screenshot.....	8
Figure 3. RAPID .....	10
Figure 4. LEADERS MedView .....	11
Figure 5. Assessment Sites .....	13
Figure 6. CCT Locations.....	15
Figure 7. Interview Assessment Sites .....	21
Figure 8. LEADERS Training .....	28
Figure 9. IM Module Instruction .....	29
Figure 10. Fairfax County Hospital .....	30
Figure 11. Computer-aided Dispatch.....	31
Figure 12. MedSurv Module.....	33

## **List of Tables**

Table 1. COI 1.....	17
Table 2. COI 2.....	18
Table 3. COI 1 Outcome Assessment.....	26
Table 4. COI 2 Outcome Assessment.....	27

---

# EXECUTIVE SUMMARY

## *Introduction*

This report provides the results of a technical maturity assessment (TMA) of the Lightweight Epidemiology Advanced Detection and Emergency Response System (LEADERS). Detachment 1 of the Air Force Operational Test and Evaluation Center (Det 1 AFOTEC) conducted this assessment in two parts, from 29 October through 9 November 2001 and 15-16 November 2001. The assessment venues included various locations in northern Virginia and one location in San Antonio, Texas.

The goal of Headquarters, United States Air Force Surgeon General's Office for Medical Readiness, Science and Technology (HQ USAF/SGXY) was to demonstrate the technical maturity of LEADERS when deployed and operated by designated users and subject matter experts (SME) in a simulated operational environment. The assessment objectives were to identify and document critical operational and technical system issues, and to make a determination regarding the feasibility and utility of follow-up spiral development of the system.

LEADERS is web-based, centrally hosted, and modular. It provides a comprehensive set of integrated software tools and data storage capabilities to support the collection, storage, analysis, and distribution of critical medical data and emergency response information. LEADERS is designed to enable rapid, effective, and coordinated responses to natural disease outbreaks and covert biological attacks. The system includes a complete set of command and control (C<sup>2</sup>) tools and functions in both event-based and continuous surveillance modes.

The main components of the system are the Medical Surveillance (MedSurv), the Incident Management (IM), and the System Administrator (SA) modules. Additional modules or components include the Ruggedized Advanced Pathogen Identification Device (RAPID) and the Critical Care Tracking (CCT) module. LEADERS uses a hosted Application Service Provider (ASP) and is designed to provide 24-hour per day, seven day per week web-based medical surveillance capability. This allows participating organizations to exchange critical incident and pertinent medical information using browser-based technology.

Four salient areas of interest were identified for technical review and evaluation during the TMA. These were the training protocol, the IM module, the CCT module, and the MedSurv module. Interoperability issues, although considered important, were left to follow-up development and assessment during a subsequent military utility assessment (MUA) and were not directly assessed during the TMA. Some interoperability issues were, nevertheless, identified during the TMA process.

---

The LEADERS TMA was planned to take place in three phases over the period of 29 October through 9 November 2001. However, the complexity of the MedSurv module, the workload demands required to effectively assess MedSurv, and the numerous, significant technical issues related to MedSurv that were identified required that the MedSurv portion of the assessment be extended into the following week. As a consequence, two additional days, 15-16 November, were used to complete the assessment.

## **Methodology**

Det 1 AFOTEC conducted the TMA. An assessment plan was developed that included critical operational issues (COI), measures of effectiveness (MOE), and measures of performance (MOP). These measures were developed in conjunction with representatives of HQ USAF/SGXY, the United States Air Force Surgeon General's Office for Infection Control (USAF/SGT), Air Force Medical Evaluation Support Activity (AFMESA), and Det 1 AFOTEC.

- Subjective data were collected for all system modules, to include training, via SME and operator/user surveys, questionnaires, and direct interviews that were conducted by the assessors.
- On-site observations by assigned assessor personnel provided additional feedback regarding technical maturity and utility.
- Recommendations were obtained from SMEs and users/operators regarding the maturity and utility of the modules tested.

## **Conclusions**

Overall, user/operator feedback regarding the utility of LEADERS was positive, although the system is considered to be technically immature at the current time and will require additional development and testing prior to fielding. The technical maturity of the system varies, however, with each module.

Two COIs were identified for LEADERS. The COIs address the operational effectiveness and suitability of LEADERS, and each is supported by MOEs and MOPs established as parameters to measure the capability of the system to successfully perform the defined mission.

The COIs for LEADERS are listed in Tables 3 and 4 of this document.

Since the critical technical and performance MOEs and MOPs for each COI were not successfully demonstrated during the LEADERS TMA, neither COI was considered to have been favorably resolved.

The assessment results related to the supporting measures are summarized below.

---

Training was considered inadequate. The training was neither sufficient nor comprehensive, and the “manuals,” such as they were, will require a substantial re-write to be effective and useful. The consortium representatives did not integrate the training presentation protocol.

It should be noted that there was no representative of Idaho Technology, Inc. (the vendor of RAPID) present at the training session or during the rest of the TMA. As a result, none of the TMA participants completely understood the interoperability issues between RAPID and LEADERS, and an assessment of the potential technical maturity of the system interface could not be completed effectively.

The IM module was considered relatively mature, although numerous technical, design, and human factors issues were noted. Like CCT and RAPID, the IM module has the potential to be used independently of LEADERS, particularly in event-based incident management applications.

The utility of MedSurv is limited by the general technical immaturity of the module, as well as other operational issues. The MedSurv module, which is the least mature module of LEADERS, is the most integral to the functionality of the system. MedSurv will require extensive additional development and refinement if LEADERS is to be considered an effective and efficient alternative to currently available technologies.

CCT and the RAPID are commercially available at the present time and each has been deployed at a variety of locations independent of LEADERS. Primarily, though not exclusively, these deployments have been in support of event-based management situations. Both modules are considered mature and require only limited adaptations and development to effectively support LEADERS.

System reliability and sustainability were not assessed and could not be determined, although Internet connectivity failures were numerous and were significant enough to be considered problematic throughout the assessment.

### ***Recommendations***

LEADERS has significant potential utility. Identified problems should be corrected appropriately, and the system should then be assessed in a realistic operational venue to provide a comprehensive determination regarding overall military utility and technical maturity.

A revised, comprehensive concept of operations (CONOPS) with well-defined performance measures should be developed prior to going forward with system development.

Technical results will be provided, as appropriate, to the emerging doctrinal Directorate at USAF Doctrine Center, Maxwell AFB to ensure

---

that pertinent and potential issues relevant to currently evolving homeland defense doctrine are addressed in a timely manner.

LEADERS is a very complex system that requires systematic, integrated, well-organized, and well-presented training to facilitate effective use of the system by designated users, particularly in crisis management situations. A comprehensive training plan should be developed in conjunction with a revised CONOPS.

The MedSurv module is clearly the most immature part of LEADERS, yet it is the most important part of the system. Any follow-on development program for this technology should address the current, significant technical limitations of MedSurv and the need to develop better, effective, and efficient integration with the various other system components.

The overall assessment team recommendation is to identify and correct system problems and technical shortcomings and, in accordance with a revised system CONOPS, conduct a follow-up, comprehensive MUA with emphasis on interoperability and technical maturity.

---

## PURPOSE

The purpose of this assessment was to demonstrate and evaluate the technical maturity of LEADERS system components in a simulated operational environment. The goal of this assessment was to determine the feasibility and utility of the system for follow-up spiral development and testing. This report sets forth the findings, conclusions, and recommendations of the LEADERS TMA.

Det 1 AFOTEC conducted this assessment for HQ USAF/SGXY and AFMESA. The TMA was conducted in two parts, from 29 October through 9 November 2001 and 15-16 November 2001. The assessment venues included various medical treatment facilities (MTF) located in northern Virginia, the Walter Reed Army Medical Center (WRAMC), and the Surgeon General's Office, Bolling Air Force Base (AFB), Washington, D.C.

The TMA was preceded by a series of assessment planning meetings and a limited utility assessment (LUA) that was conducted 27-30 August 2001 at Wilford Hall Medical Center (WHMC), Lackland AFB, San Antonio, Texas. The meeting participants, who included representatives from the consortium developers, HQ USAF/SGXY, AFMESA, USAF/SGT, and assessors from Det 1 AFOTEC, met to determine whether LEADERS was sufficiently mature to conduct an MUA.

Following these meetings, HQ USAF/SGXY, USAF/SGT, and AFMESA representatives recommended that a preliminary TMA of LEADERS be conducted to determine the current level of system maturity and whether LEADERS was, in fact, ready to move forward to an MUA. Technical and interoperability issues were identified during the LUA, and these issues were considered essential to the utility of the system.

---

*This page is intentionally blank.*

## BACKGROUND

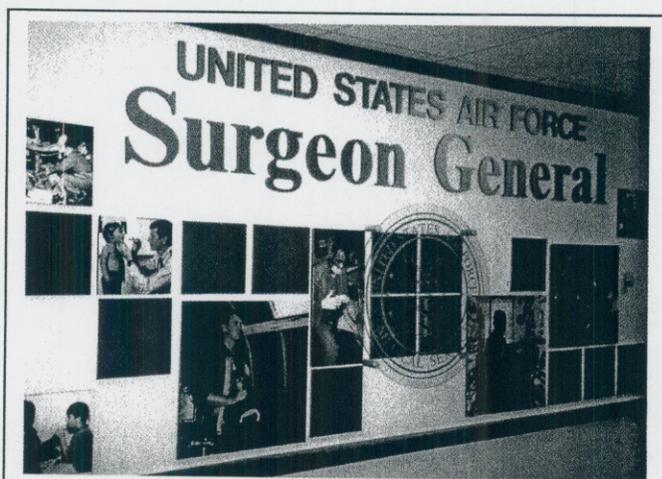
### *Introduction*

The potential consequences of a covert biological attack or the hazards attendant to a serious, large-scale outbreak of natural disease continue to pose a serious threat to warfighter and civilian populations located in the United States and abroad. These types of events have the potential to devastate the ability of the commander to maintain effective C<sup>2</sup> or achieve mission success. In addition, a biological attack or significant disease outbreak can impact the ability of medical treatment personnel to effectively treat a large number of casualties in a timely and efficient manner.

LEADERS is designed to provide military and civilian medical personnel and critical incident commanders with an enhanced ability to mitigate the consequences associated with a biological terrorism/warfare event or the onset of a significant natural disease. Rapid, timely identification of the medical threat and effective, ongoing communication between medical facilities and command personnel are essential elements in minimizing loss of life and the potential for disaster.

LEADERS is designed to provide the following.

- An integrated collection of medical surveillance capabilities, to include real-time, easy-to-use technologies for collection, storage, analysis, and review of critical medical data
- An incident and event management capability to facilitate rapid, timely, and effective responses to biological attack or significant outbreaks of natural disease



**Figure 1. Air Force Surgeon General:** The Air Force Surgeon General Sponsored the LEADERS TMA.

LEADERS is sponsored by HQ USAF/SGXY (Figure 1) and is supported by USAF/SGT and AFMESA.

A five-member consortium using commercial off-the-shelf technologies is developing LEADERS. The consortium includes Oracle Service Industries, Reston, Virginia; EYT (formerly Ernst & Young Technologies, Inc.), Chantilly, Virginia; ScenPro, Inc., Richardson, Texas; SRA International, Inc., Fairfax, Virginia; and Idaho Technology, Inc., Salt Lake City, Utah. The primary contractor is EYT.

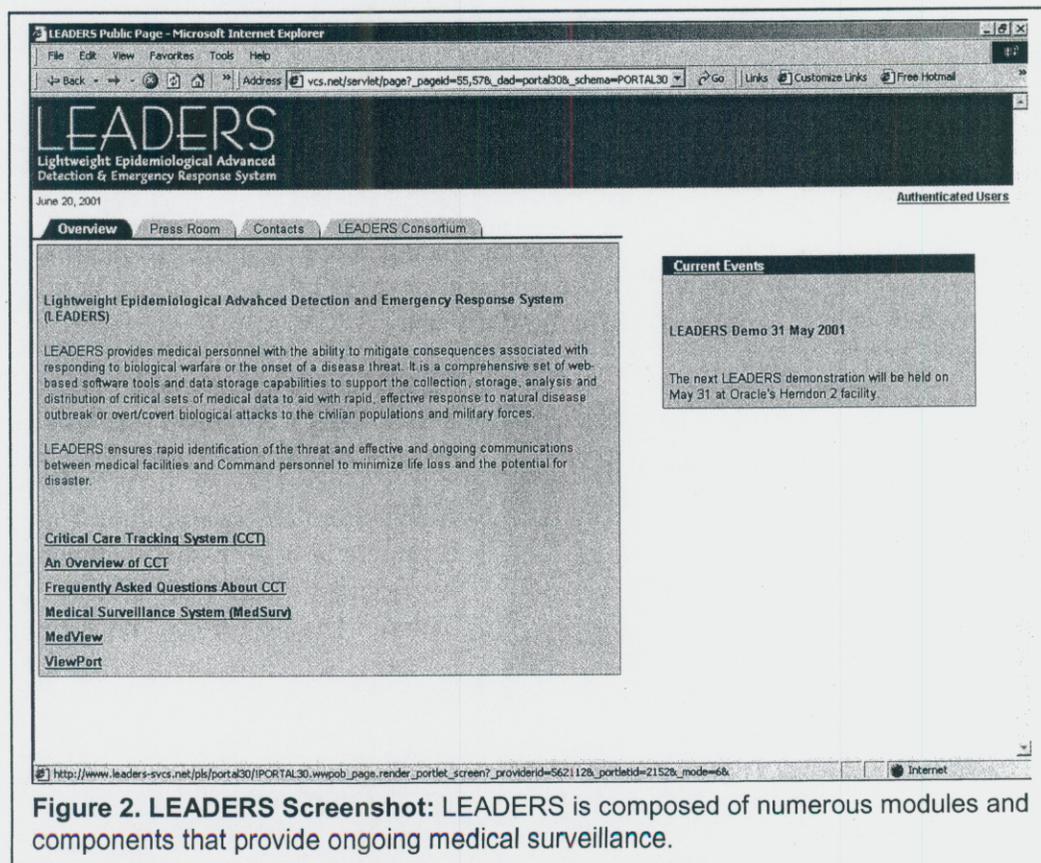
The initial development phase of LEADERS was funded by an AF Commercial Operations and Support Savings Initiative grant.

An LUA of LEADERS was conducted from 27-30 August 2001 at WHMC. The results of that assessment were previously provided in a Det 1 AFOTEC report.

## System Description

LEADERS is web-based, centrally hosted, and modular (Figure 2). It has a comprehensive set of integrated software tools and data storage capabilities to support the collection, storage, analysis, and distribution of critical medical data and emergency response information. LEADERS is designed to enable rapid, effective, and coordinated responses to natural disease outbreaks and covert biological attacks.

The main components of the system are the MedSurv, IM, and SA modules. The CCT module is a sub-component of LEADERS, as is RAPID. LEADERS uses a hosted ASP, and is designed to enable 24-hour per day, seven day per week web-based medical surveillance capability to exchange critical incident and medical information among participating organizations using browser-based technology.



**Figure 2. LEADERS Screenshot:** LEADERS is composed of numerous modules and components that provide ongoing medical surveillance.

---

The LEADERS medical surveillance modules are designed to function as the primary detection and identification mechanisms of the system. Medical surveillance is accomplished by using various modules or components in combination, to include the MedSurv, MedView, IM, and SA modules. LEADERS can be used in both event-based and continuous-surveillance modes. Event-based surveillance is used to support major event management. Continuous surveillance enables the detection and identification of disease outbreak and propagation using medical data stored in a relational database. LEADERS has been used to support events such as the 2001 Presidential Inauguration, the World Series, the 11 September 2001 terrorist events in New York City, and at a variety of hospitals in Florida. The Center for Disease Control (CDC) has been the primary initiator of these surveillance deployments of the system.

In the continuous data feed mode, LEADERS relies on an automated extract of data from source systems at selected sites and at designated times, and an automated transfer and load of this information into the ASP. In the event-based employment of LEADERS, data loaders enter pertinent data directly into the LEADERS database.

LEADERS extracts data into an extended mark-up language (XML) file. An extraction routine captures designated data elements. The file is stored in a specified directory on a local server. The XML software is programmed to search local directories at given intervals for the existence of a data extract file, which is uploaded via secure communications over the Internet to the LEADERS ASP. LEADERS currently supports data extracts from Composite Health Care System (CHCS) through the Integrated Clinical Database (ICDB). CHCS contains data subsets such as information contained in the Ambulatory Data System.

### **MedSurv Module**

The MedSurv module is the key system component, which serves to support overall system functionality. MedSurv enables the detection and identification of disease outbreaks and biological attacks using patient care and treatment information extracted from designated relational databases, such as the CHCS and the ICDB. This function is supported by several software components, which provide enhanced data capture, event analysis, disease symptom pattern detection, alert generation, map-based temporal analysis, and pathogen detection and identification.

When used in the continuous-surveillance mode, MedSurv automatically extracts data from subscriber sites, and based upon predetermined incident thresholds, identifies disease outbreaks and bioterrorism events of note, which then trigger a response from designated MTF personnel. LEADERS facilitates initiation and placement of disease prevention and control measures.

---

MedSurv is the primary detection and identification mechanism of LEADERS. A system alert is generated, predicated on established disease pattern recognition algorithms, and the appropriate MTFs and authorized users are notified. MTF personnel then review the underlying documentation that supports the alert and, if an incident is confirmed, follow-up notifications are effected.

The goal of MedSurv is to provide detailed data analysis of spatial and temporal anomalies, which are tailored to algorithms for known and defined disease syndromic patterns. The data stored in CHCS/ICDB are used for pattern analysis and include general medical data; patient background information; symptoms; International Classification of Disease (ICD)-9 codes; laboratory, radiology and pharmacy (labs/rads/meds) data; and other identifiers.

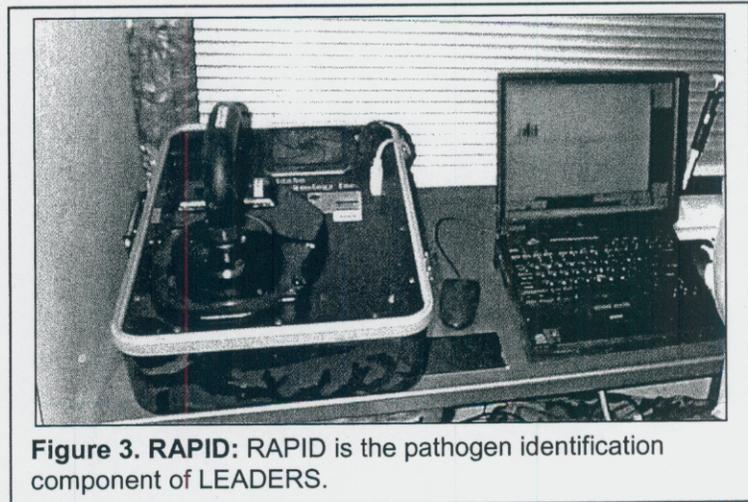
### **RAPID**

RAPID (Figure 3) is the pathogen identification component of LEADERS. It is used to confirm the identification of an agent/pathogen, and to provide confirmation of the presence of the agent/pathogen at a given site. The time required to provide pathogen/agent identification varies with the agent/pathogen.

The goal of LEADERS is to use RAPID to test and expedite verification of the presence of a pathogen to support timely medical and C<sup>2</sup> responses. Although the detection effectiveness of RAPID varies with the agents/pathogens being tested, a 30 minute detection/validation measure has been established for LEADERS to serve as a benchmark. The purpose of this benchmark is to serve as a vehicle to generate data points to determine the ultimate viability and military utility of RAPID as part of the LEADERS package. However, it should be noted that this capability was not tested during the TMA.

### **IM Module**

The IM module is designed to enable coordinated responses to disease or covert biological attack through the use of a suite of C<sup>2</sup> tools for situation assessment and critical incident response management. These include checklist management, casualty tracking, MTF status, and map-based, temporal analysis. The IM module is initiated at the discretion of the designated command element and is used to respond to a confirmed alert, whether as a result of continuous surveillance or to support special event management.



**Figure 3. RAPID:** RAPID is the pathogen identification component of LEADERS.

Key components of IM are ViewPort and MedView, which provide customized map views to support C<sup>2</sup> (Figure 4). MedView and ViewPort are map visualization tools that provide identification and management of possible disease and incident sites. These applications provide rapid situation awareness and response oversight, identification of resource requirements, multi-agency checklist development, map-based visualizations, and real-time reporting.

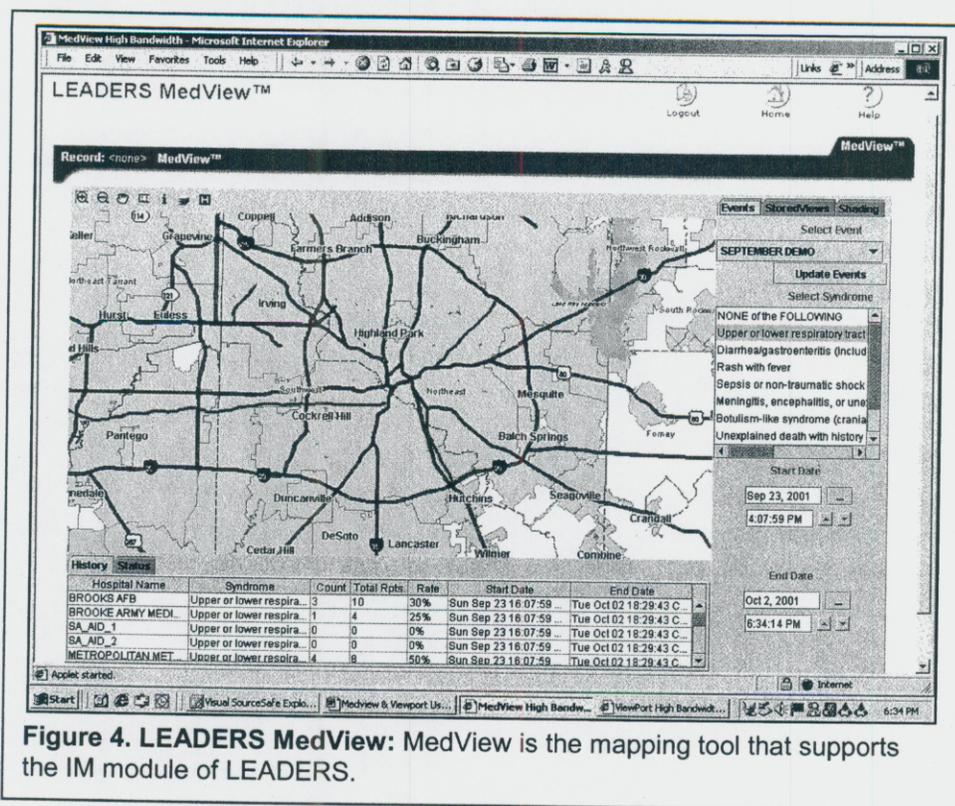


Figure 4. LEADERS MedView: MedView is the mapping tool that supports the IM module of LEADERS.

### CCT Module

The CCT module of LEADERS facilitates incident management through improved communications between hospital emergency departments (ED) and emergency response agencies, such as emergency medical service (EMS) operations centers, for more efficient management of patient transportation resources. CCT provides department status (e.g., open, closed, divert/re-route, and bed count status). Each time the status of an ED or critical care unit changes, the CCT provides an alarm or notification of the change in status to each participating MTF.

### SA Module

SA enables users to address administration, management, customization, and maintenance of system software components via an integrated tool. SA supports adjustments to the system to address a variety of variables that may impact on the viability of the data, as well as to ensure that the

---

system conforms to local standard operating and emergency response procedures.

LEADERS is designed to be a subscription-based system. Each facility, whether civilian or military, subscribes to the entire system or a suite of services of their choice. All data exchanged between the users and stored in the ASP are encrypted to safeguard patient treatment and health record information. System access at all sites is limited to authorized users who are provided with an access code via the SA.

### ***Assessment Limitations***

- System functionality during the TMA was adversely affected by a series of Internet connectivity failures at both primary sites. Although the loss of connectivity at Bolling AFB was intermittent and of limited duration, the flow of SME and user assessment activities at the USAF/SGT assessment location was interrupted and assessment play was delayed.
- Effective participation by the SME at WRAMC was terminated following the second day of the MedSurv portion of the assessment, when a complete and prolonged connectivity failure took place. As a result of this situation, the WRAMC site was unable to participate as planned in the bulk of the TMA.
- The loss of Internet connectivity, also experienced during the LUA at the WHMC assessment site, appears to be a recurring factor, which may portend significant, long-term reliability and suitability issues for the system.
- The lack of a comprehensive CONOPS and the absence of well-articulated tactics, techniques, and procedures (TTP) made it difficult to clearly identify key performance parameters (KPP) of the system.
- The number of users/operators and SMEs dedicated to the TMA at the assessment sites was limited.

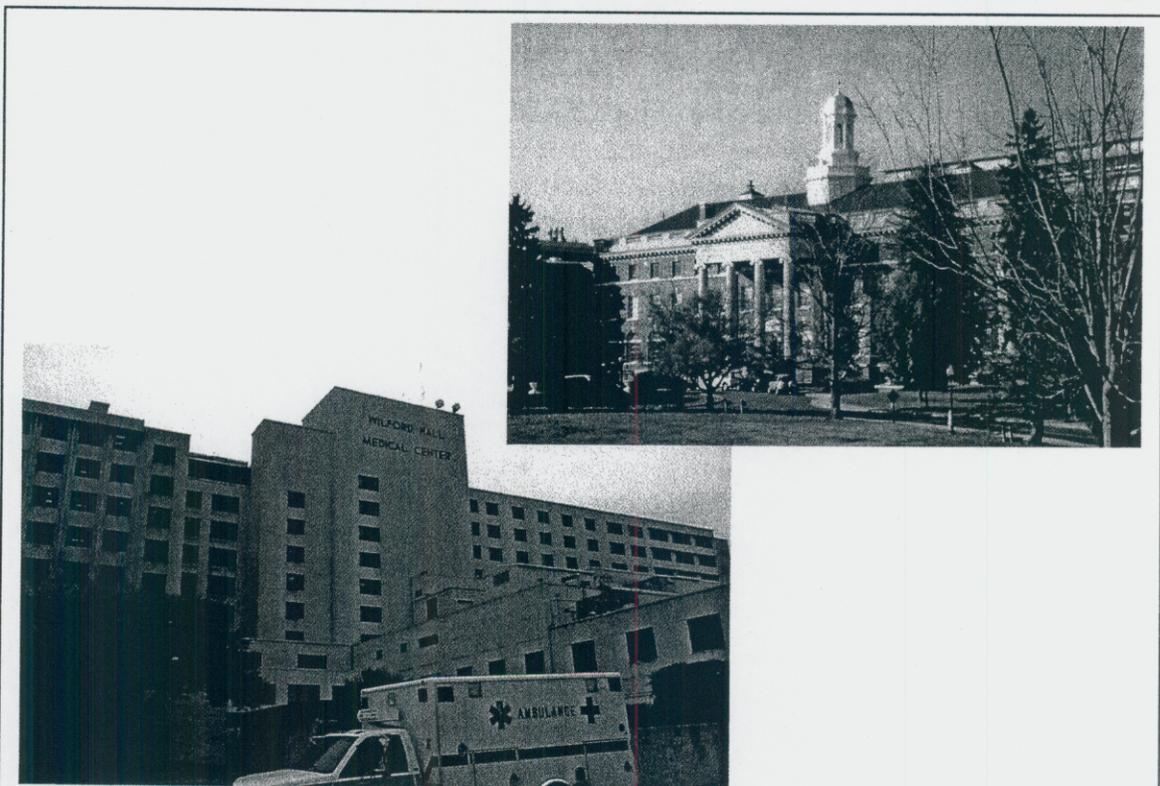
---

# ASSESSMENT METHODOLOGY

## *Assessment Approach*

The LEADERS TMA was conducted in two parts, from 29 October through 9 November 2001 and 15-16 November 2001. Det 1 AFOTEC personnel planned and conducted the assessment in support of AFMESA and HQ USAF/SGXY.

The TMA was conducted at various locations (Figure 5). The primary assessment sites included the office of Oracle Service Industries (one of the LEADERS developer consortium members), Herndon, Virginia; WRAMC and USAF/SGT office, Bolling AFB, Washington, DC; WHMC, Lackland AFB, San Antonio, Texas; and the Advanced Technology Innovation Center (ATIC), Falls Church, Virginia. In addition, part of the assessment involved interviews of civilian medical treatment facility and emergency medical service personnel located at various hospitals and emergency operations facilities in northern Virginia.



**Figure 5. Assessment Sites:** Wilford Hall Medical Center (left) and Walter Reed Army Medical Center were primary assessment sites for the LEADERS TMA.

The goal of the TMA was to demonstrate and evaluate the technical maturity of LEADERS in a simulated operational environment to determine whether the system meets user requirements and technical

---

maturity expectations for the initial phase of the development plan. The TMA was the first opportunity to exercise the system using actual and notional patient treatment data, and to include participation by SMEs and users/operators. Secondary goals of the assessment were to identify potential functional and military utility issues, to provide input for the articulation of LEADERS goals and objectives for the next phase of development, and to lay the groundwork for a follow-on full MUA of the system.

This TMA focused on training and three of the primary modules that compose the system: IM, CCT, and MedSurv modules. Part I of the TMA was divided into three phases (see below), each of which focused on one of the three modules, as well as a separate training module or protocol. The assessment did not specifically address module integration. The three modules that were assessed are at differing levels of maturity. The first two modules, the IM and CCT, are more mature, and currently are being used by various medical treatment and critical incident response management organizations. However, deployment of these modules appears to have been customized to meet the needs of the respective customers. Data have not yet been made available to Det 1 AFOTEC personnel to review the nature and scope of these deployments.

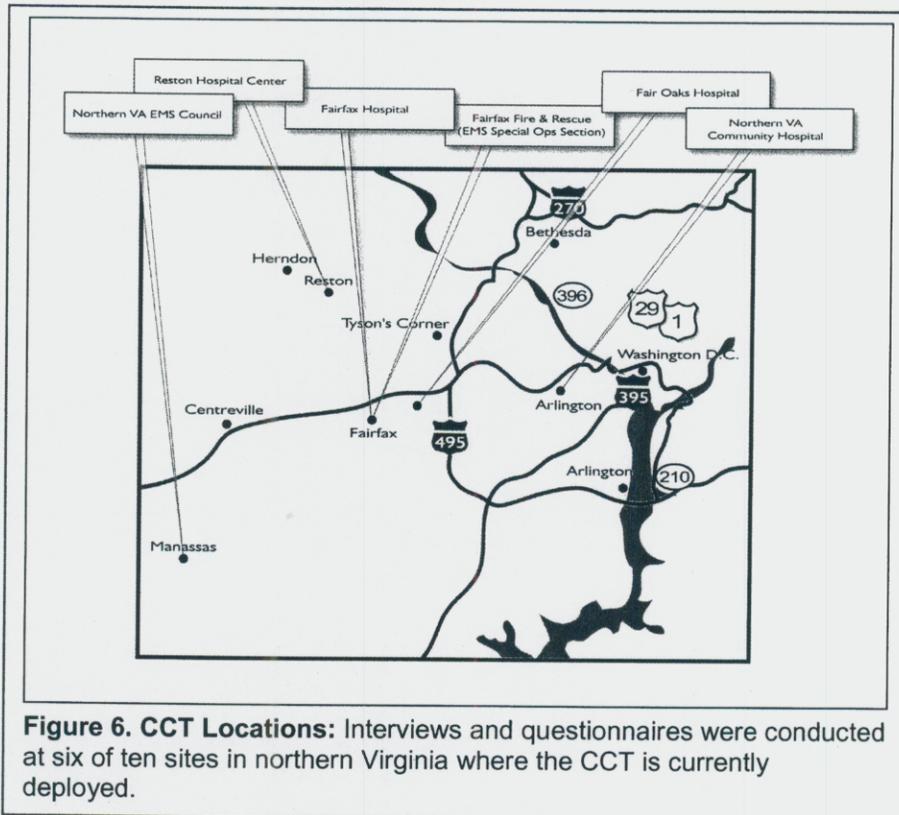
The MedSurv module, which is the core of the LEADERS system, is not considered as mature as the other two modules. The RAPID, which supports LEADERS, is considered mature and is currently available commercially to support chemical and biological agent identification requirements in support of critical incident management needs. The purpose of the assessment of RAPID is to review the viability of the interface with LEADERS.

Part I of the TMA was conducted in the following three phases.

- Phase I included the development and presentation of a comprehensive training protocol. Representatives of the development consortium provided training on the first day of the TMA for identified users/operators of the system who subsequently participated in the TMA, and selected representatives of AFMESA, USAF/SGT, and HQ USAF/SGXY. Det 1 AFOTEC data collectors observed this training presentation.

This phase also involved a two-day, limited exercise of the IM module of LEADERS. Identified users/operators and SMEs exercised the system. In planning for this phase of the TMA, limited participation or input from the consortium representatives (who were present during this portion of the assessment) was anticipated, and then only when technical issues or training-related shortfalls were identified. Phase I was conducted at the Oracle office site in Herndon, Virginia.

- Phase II was an assessment of the CCT module of LEADERS, which has been deployed for approximately 90 to 180 days in a limited manner at MTFs and the EMS operations center in the northern Virginia area. This part of the assessment involved numerous interviews with users/operators of the CCT module and the Executive Director of the Northern Virginia EMS Council. These interviews took place at four medical treatment facilities, the Northern Virginia EMS Council office, and the Fairfax Fire and Rescue Operations Center (Figure 6).



- Phase III assessed the maturity and interoperability of the MedSurv module. The goal of this portion of the assessment was to determine whether MedSurv could effectively provide both continuous and event-based surveillance. Technical uncertainties were identified, to include the utility and effectiveness of RAPID to support the MedSurv module of the LEADERS system.

This part of the assessment was conducted at WRAMC, USAF/SGT office at Bolling AFB, WHMC, and at the ATIC. In addition, related meetings and discussions, debriefings, and system performance summary hot washes were conducted with AFMESA personnel at the Expeditionary Medical Support facility at Fort Detrick, Maryland.

---

Part II of the LEADERS TMA was conducted on 15-16 November 2001. During the initial part of the TMA, several factors were identified, which required that the MedSurv portion of the assessment be extended. These factors included the general complexity of the MedSurv module, the related TMA equipment and personnel requirements necessary to effectively assess MedSurv, and the numerous, significant technical issues encountered during the course of the TMA.

Follow-up interviews of the primary users/operators of the LEADERS MedSurv module during Part I of the TMA were conducted at both WRAMC and the USAF/SGT at Bolling AFB on 15 November 2001. On 16 November, a general, post-assessment hot wash was conducted. This meeting was held at the ATIC. In addition to the users/operators and SMEs who participated in the interviews on the previous day, attendees included the newly assigned LEADERS Systems Program Office (SPO) representative, the LEADERS project manager (PM), the LEADERS operations manager, three Det 1 AFOTEC data collectors, and a representative of the AF Surgeon General's office, who functioned in the capacity of observer during the TMA. Prior to the hot wash, the newly assigned SPO representative was provided with a LEADERS briefing by the Det 1 AFOTEC representatives.

### ***Assessment Measures***

Tables 1 and 2 present the COIs, MOEs, and MOPs for the LEADERS TMA. These measures reflect the performance standards for evaluating the various components and modules of LEADERS.

**Table 1: COI 1: COI 1 supporting MOEs and MOPs are presented.**

**COI 1. Does LEADERS enhance the ability of military commanders and medical personnel to mitigate the consequences associated with the onset of a significant natural disease or a biological warfare attack?**

MOE 1.1: Is LEADERS interoperable with designated relational databases?

MOP 1.1.1: \*Ability to automatically and continuously extract data from ICDB.

MOP 1.1.2: \*Accuracy of data in MedSurv compared with actual data entries.

MOP 1.1.3: Accuracy of data stored in ASP.

MOP 1.1.4: \*Ability to automatically extract labs/rads/meds and inpatient and outpatient encounter data from ICDB.

MOE 1.2: Is LEADERS able to detect and identify event-based disease outbreaks and propagation and provide appropriate system alert notification in a timely manner?

MOP 1.2.1: \*Accurately identifies symptom-based disease patterns compared with the actual number of data forms entered.

MOP 1.2.2: \*Generates an alert via pager to designated point of contact (POC) when established threshold is exceeded.

MOP 1.2.3: \*Detects and validates biological agent presence within 30 minutes using RAPID.

MOE 1.3: Is LEADERS able to detect and identify significant disease outbreaks and propagation, using continuous feed data, and provide appropriate system alarm notification in a timely manner?

MOP 1.3.1: \*Detects and identifies significant disease patterns and propagation.

MOP 1.3.2: \*Generates an alert via pager to designated POC when established threshold exceeded.

MOP 1.3.3: Accuracy of ICD-9 code diagnosis data.

MOE 1.4: Do the interactive C<sup>2</sup> tools enhance situational awareness for the commander to support effective critical incident and event management responses?

MOP 1.4.1: Validates the alert generated by LEADERS through an analysis of MedSurv data contained in the relational database.

MOP 1.4.2: Reliability of CCT to provide accurate hospital status (open/closed) and MTF bed count capacity.

MOP 1.4.3: \*Reliability of CCT accuracy for MTF bed availability.

MOP 1.4.4: Accuracy of summary status reports (e.g., numbers presenting with identified symptoms).

MOP 1.4.5: \*Ability of ViewPort to provide accurate map-based displays of information.

An asterisk (\*) next to a measure indicates that it is a KPP.

**Table 2. COI 2: COI 2 supporting MOEs and MOPs are presented.**

**COI 2. Is LEADERS suitable for deployment and sustained operations in the operational environment?**

**MOE 2.1: Is LEADERS reliable?**

MOP 2.1.1: The number of operational system failures by type, amount of time the system was inoperable, and the impact on operations.

MOP 2.1.2: The number of false alerts.

MOP 2.1.3: The number of ASP interface failures.

**MOE 2.2: Is LEADERS logistically supportable?**

MOP 2.2.1: Maintenance and technical support requirements to maintain system functionality.

MOP 2.2.2: Additional personnel required to operate, maintain, and support the system.

**MOE 2.3: Does the training program effectively train system operator and maintenance personnel?**

MOP 2.3.1: Ease of training for RAPIDS.

MOP 2.3.2: The adequacy of training manuals.

MOP 2.3.3: The adequacy of LEADERS system training program.

**MOE 2.4: Does LEADERS provide adequate information security?**

MOP 2.4.1: The ability to limit screen access to designated users.

MOP 2.4.2: The adequacy of system encryption to maintain the confidentiality of treatment records.

**MOE 2.5: Are the LEADERS operator and technical manuals adequate to support operation and maintenance?**

MOP 2.5.1: The effectiveness of operators using LEADERS technical manuals to successfully troubleshoot the system, identify operational problems, and effect timely corrections and solutions with no input from system developers.

**MOE 2.6: How does the LEADERS system design impact effective operation and maintenance?**

MOP 2.6.1: Effectiveness and suitability of system operator displays.

MOP 2.6.2: Ease of use and navigation of LEADERS.

MOP 2.6.3: Timeliness of system displays during both power up and in refresh mode.

The TMA was primarily focused on the technical maturity of LEADERS; however, some of the measures reflect issues such as sustainability, human factors, and suitability. These latter were considered to be secondary goals of the assessment, and data regarding these measures were generated as a general by-product of the TMA. Care was taken to appropriately document user/operator and SME input to support conclusions regarding these measures.

---

## **Assessment Execution**

### **Training**

The TMA dedicated training day was 29 October 2001. Training was conducted at the Oracle office site in Herndon, Virginia. Det 1 AFOTEC evaluators and SMEs from various organizations received training on the LEADERS system and its component modules. Trainers provided all attendees with user manuals for the primary system modules, exclusive of RAPID.

The LEADERS PM had directed the consortium members to develop a comprehensive, integrated training program, which would adequately prepare prospective users to effectively operate the system. This was the first attempt to develop a comprehensive, integrated training protocol. The training was prepared and presented by representatives of the LEADERS consortium.

Five SMEs attended the training session. Each participant completed Det 1 AFOTEC questionnaires about the effectiveness of the training and adequacy of training documentation. These questionnaires were augmented by direct observation by all of the Det 1 AFOTEC assessors.

Additional, detailed, hands-on IM module training was conducted on 30 October 2001, which focused on user/operator familiarization with the IM module. All users/operators and SMEs who were to be involved with the IM module assessment received this training. The training plan for both sessions included ample opportunity for question-and-answer sessions and appropriate feedback from the consortium trainers.

### **IM Module**

The assessment of the IM module was conducted on 30-31 October 2001. This event took place at the Oracle office site in Herndon, Virginia. This portion of the TMA consisted of a tabletop simulation exercise and included seven incident management SMEs. The SMEs included representatives from the SGX, USAF/SGT, WRAMC Force Protection Office, Air Force Medical Operations Center, Defense Threat Reduction Agency, and WHMC. After receiving additional hands-on training and familiarization provided by the consortium representatives regarding both the MedView and the ViewPort components, participants were given an IM scenario. Individual participants assumed exercise roles, such as the incident commander and the incident manager. Designated SMEs, consortium representatives, and the LEADERS PM developed the scenario event stream. The utility and technical performance of the IM module and its components, such as MedView and ViewPort, were examined using this scenario. Performance issues included system ability to declare an incident in a timely manner, to support effective management of the incident, and to provide effective C<sup>2</sup> of associated resources.

---

Det 1 AFOTEC observers recorded detailed observations during user/operator discussions and throughout the tabletop exercise. Although the TMA plan was to limit participation by the members of the consortium who provided the training and were present during the IM module assessment, this proved to be impossible. Technical issues and system operation uncertainties required that the consortium representatives be actively involved throughout the tabletop exercise. In fact, consortium representatives actively directed and controlled the entire tabletop exercise event flow. The original plan to allow the users and SMEs to function as independent operators and to exercise the system on their own could not be realized. Lacking an effective CONOPS or well-defined TTPs, roles and responsibilities were unclear to the participants, and additional guidance from the developers regarding the general IM module process was required.

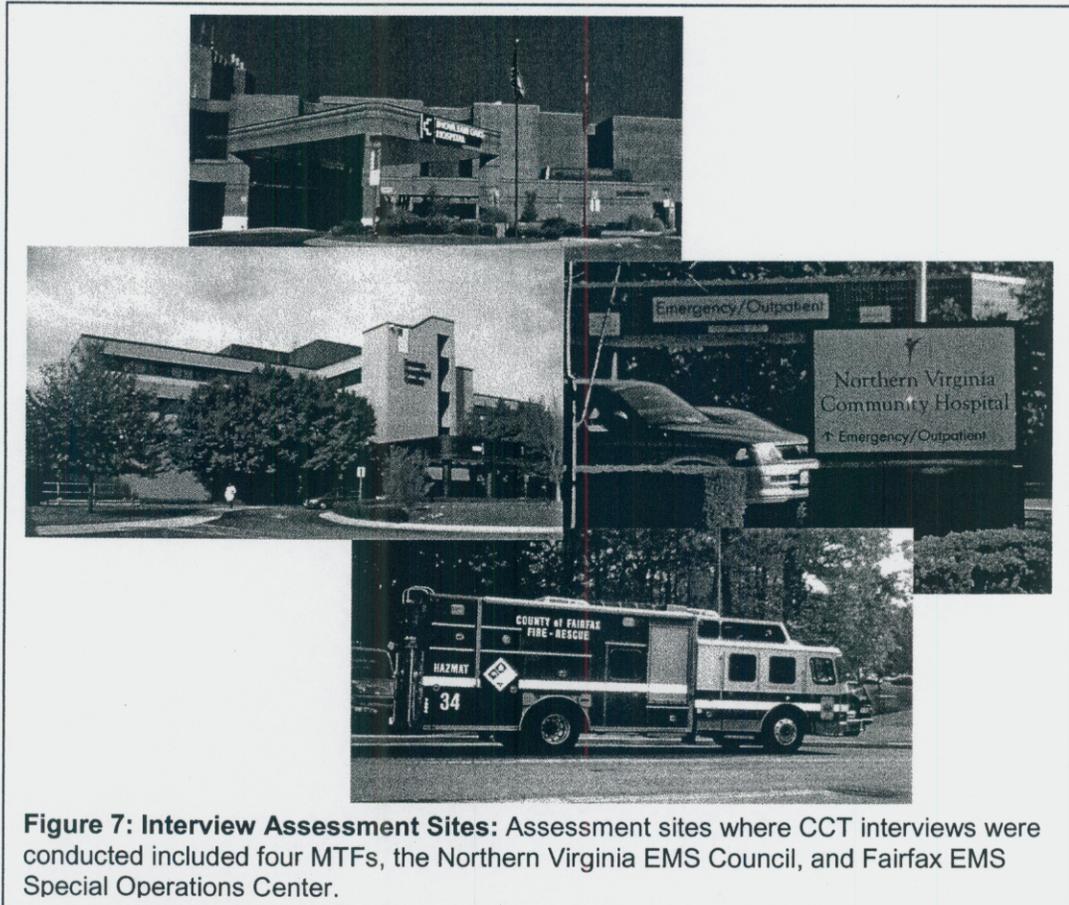
The exercise proved to be an extremely valuable tool to identify potential shortfalls and prospective system upgrades to support future enhanced capabilities of the system. Following the tabletop exercise, a debriefing session was held by the Det 1 AFOTEC assessors where the SMEs discussed and identified desired future enhancements and improved capabilities for the LEADERS IM module. Many of the recommended improvements were specific technical upgrades. At the end of the IM tabletop exercise, SMEs completed questionnaires regarding system technical maturity, functionality, utility, and usability. Det 1 AFOTEC assessors individually interviewed three of the users/SMEs.

### **CCT Module**

Det 1 AFOTEC personnel interviewed seven previously identified civilian users/operators of the CCT module on 1-2 November 2001. The Northern Virginia EMS Council has overseen the deployment of the LEADERS CCT module in 10 hospitals, three urgent centers, and three EMS operations centers, where the CCT module has been in use for approximately three to six months. This deployment of the system is limited in nature and was initially funded by a Defense Advance Research Projects Agency (DARPA) grant as a beta test project. DARPA covered the start-up costs. The individual medical treatment facilities have been paying a monthly fee to support continued operation of the CCT module.

The current deployment of CCT in northern Virginia is limited to tracking ED status, i.e., whether the facility is open or in reroute status. Reroute status is defined as a condition in which the ED of a pertinent MTF has no current bed availability to support additional patient inflow from the EMS. Bed counts or triage tracking status capabilities of CCT, which are key capabilities for incident management, currently are not being utilized. As presently deployed in northern Virginia, the CCT module has undergone several permutations. In short, the representatives of the user hospitals consider it a work in progress.

Det 1 AFOTEC assessors interviewed seven users, ranging from the Nurse Manager for the ED of the smallest hospital in the region, the Patient Care Director for the largest hospital/trauma center/air ambulance/command hospital in the region, and the Chief of Fairfax EMS Special Operations (Figure 7). The Northern Virginia EMS Council and associated hospitals and EMS departments are using only a very limited subset of CCT capabilities, but the feedback received from the users was positive. Det 1 AFOTEC data collectors used a uniform, pre-scripted interview format to conduct individual, structured interviews of each user and to record data from each of the respondents.



### MedSurv Module

The MedSurv module is the core of LEADERS. The week of 5-9 November 2001 was dedicated to assessing the technical maturity of the MedSurv module, associated database analysis capabilities, and the alerting software. The consortium provided designated users/operators and SMEs with LEADERS access accounts to support this part of the assessment. The activities of the participants took place at their respective work areas. The designated observer, a representative from the Surgeon

---

General's office who was located at the ATIC, was also able to log on to LEADERS and supported the users/operators during the assessment.

This portion of the assessment included extraction of both event-based patient data and continuous-feed patient data from WRAMC (an Army MTF) and WHMC (an Air Force MTF). The continuous-feed data was analyzed, including patient encounter information entered into CHCS and stored in the ICDB. This information included labs/rads/meds, i.e., laboratory, radiology, and pharmacy data from the ICDB.

Rise of patient treatment information and personal data will be accomplished in accordance with privacy act limitations.

Additional event data was directly entered using MedSurv data entry forms. SMEs from the USAF/SGT office at Bolling AFB and the Infection Control Office at WRAMC examined alerts received. These were compared with data extracted from the database and with raw data input at WHMC and WRAMC. The SMEs requested changes to alerting algorithms during the TMA to adjust the sensitivity and utility of the alerting system, as well as other basic upgrades or alterations to improve or enhance system performance during the TMA.

The event-based data forms were developed as previously noted. They were used at both sites, WRAMC and the USAF/SGT office. In order to facilitate the exercise flow, 60 patient visit records were created for WHMC and 40 patient records were created for WRAMC. These records were completed prior to the start of this part of the assessment. The patient visit forms, sometimes referred to as "surveillance" forms, are created using the LEADERS SA module.

During previous assessments of LEADERS conducted by Det 1 AFOTEC, most notably the LUA, which took place 27-30 August 2001 at WHMC, a loss of Internet connectivity impacted the overall reliability of the system. LEADERS functionality was again interrupted by losses of Internet connectivity at both the USAF/SGT office location at Bolling AFB and at WRAMC. The connectivity interruptions at Bolling AFB were intermittent and did not appear to have a significant impact on the operation of the system. The cause of the problem is not known at this time.

On the second day of this part of the assessment, the WRAMC site lost Internet connectivity. The loss of connectivity continued for the entire week and the following week as well. This factor contributed to the need to extend the TMA. Active TMA participation by the only user at that site was effectively terminated for the duration of the assessment and precluded any effective participation by WRAMC in the MedSurv part of the exercise. The issue at WRAMC appeared to be both technical and procedural.

---

In support of the MedSurv part of the assessment, a RAPID test was conducted on 7 November 2001 at WHMC. Pertinent user/operator personnel uploaded the results of the RAPID test into the LEADERS MedSurv module for review. Although SMEs were able to verify that limited accurate data was available from the test, actual test results were not accessible, and technical issues were identified that negatively impacted the suitability of RAPID to successfully support the LEADERS concept.

During the week of 5-9 November 2001, Det 1 AFOTEC data collectors observed and individually interviewed SMEs who participated in the MedSurv/RAPID assessment. Data entry personnel and SMEs completed questionnaires and provided verbal feedback regarding the technical maturity and utility of the MedSurv module.

### **Post-Assessment Debriefings**

Det 1 AFOTEC data collectors met with LEADERS TMA users/operators and SMEs to conduct individual interviews and debriefings on 15 November 2001. Each participant was provided with additional questions and directions regarding the completion of the questionnaires and supporting documentation for the MedServ module. The debriefings also included input from the assessors regarding preparation for the exercise hot wash scheduled for the following day. The two key SMEs agreed to prepare a narrative summary report based upon their individual participation in the assessment, to include their observations about the military utility, technical maturity, human factors, and suitability of LEADERS when deployed in its designated operational environment.

An assessment hot wash was conducted on 16 November at the ATIC. This was a group debriefing of key users and SMEs and consisted of extensive, comprehensive discussions of the assessment. Participants identified problems encountered and suggested system upgrades, changes, and technical improvements. Also, each participant in the discussion was provided time to extensively comment on their individual experiences with the LEADERS MedSurv module. The PM led this discussion.

---

*This page is intentionally blank.*

---

# RESULTS

## *Overview*

Although some operational limitations were experienced during the LEADERS TMA, which impacted the ability to complete a comprehensive assessment, the TMA was, nevertheless, considered a qualified success.

Most importantly, for the first time the system was exercised in a simulated operational environment. Extensive, hands-on user/operator and SME participation was the vehicle used to assess the system. These users/operators and SMEs identified notable technical, interoperability, suitability, reliability, and training issues, and provided valuable input regarding the overall technical maturity of LEADERS at the end of the initial phase of development. The fact that a sufficient amount of data were collected to support conclusions regarding interoperability, suitability, and reliability is reflective of the success of this assessment.

Briefly stated, the primary results of the assessment of the four modules or components of LEADERS are as follows.

- Training was considered inadequate, ineffective, and poorly organized.
- The IM module was considered relatively mature; however, additional development will be required to address identified technical uncertainties and to improve system suitability.
- The CCT module is mature and has potential utility in support of critical incident command and control and daily patient triage management.
- The MedSurv module is very immature and will require extensive development and refinement to be suitable and effective and to have sufficient utility.
- The role of the RAPID as a component of LEADERS is poorly defined and not adequately supported by a CONOPS or TTPs.
- The CONOPS for LEADERS is not considered adequate to support its employment or deployment.
- System reliability and technical maturity are significantly impacted by inconsistent, unreliable Internet connectivity at the MTF sites.

- Although conclusions regarding system interoperability were not planned as part of this TMA, enough anecdotal data were generated to indicate that this issue is significant and should be addressed in any follow-up assessment of LEADERS.

Tables 3 and 4 provide a summary subjective assessment of MOEs and MOPs that were used to support the LEADERS TMA. The outcome column reflects whether a particular measure was successfully demonstrated (green), not successfully demonstrated (red), or was partially demonstrated (yellow). Each MOE is supported by more than one MOP. A “not assessed” (N/A) designation indicates that the measure could not be assessed during the TMA.

**Table 3: COI 1 Outcome Assessment:** Outcome assessments for COI 1 are presented.

<i>COI 1: Does LEADERS enhance the ability of military commanders and medical personnel to mitigate the consequences associated with the onset of a significant natural disease or a biological warfare attack?</i>	
Assessment Measure	Outcome
MOE 1.1: Is LEADERS interoperable with designated relational databases?	
MOP 1.1.1: *Ability to automatically and continuously extract data from ICDB.	
MOP 1.1.2: *Accuracy of data in MedSurv compared with actual data entries.	
MOP 1.1.3: Accuracy of data stored in ASP.	
MOP 1.1.4: *Ability to automatically extract labs/rads/meds and inpatient and outpatient encounter data from ICDB.	
MOE 1.2: Is LEADERS able to detect and identify event-based disease outbreaks and propagation and provide appropriate system alert notification in a timely manner?	
MOP 1.2.1: *Accurately identifies symptom-based disease patterns compared with the actual number of data forms entered.	
MOP 1.2.2: *Generates an alert via pager to designated POC when established threshold is exceeded.	
MOP 1.2.3: *Detects and validates biological agent presence within 30 minutes using RAPID.	
MOE 1.3: Is LEADERS able to detect and identify significant disease outbreaks and propagation, using continuous feed data, and provide appropriate system alarm notification in a timely manner?	
MOP 1.3.1: *Detects and identifies significant disease patterns and propagation.	
MOP 1.3.2: *Generates an alert via pager to designated point of contact (POC) when established threshold exceeded.	
MOP 1.3.3: Accuracy of ICD-9 code diagnosis data.	
MOE 1.4: Do the interactive C <sup>2</sup> tools enhance situational awareness for the commander to support effective critical incident and event management responses?	
MOP 1.4.1: Validates the alert generated by LEADERS through an analysis of MedSurv data contained in the relational database.	
MOP 1.4.2: Reliability of CCT to provide accurate hospital status (open/closed) and MTF bed count capacity.	
MOP 1.4.3: *Reliability of CCT accuracy for MTF bed availability.	
MOP 1.4.4: Accuracy of summary status reports (e.g., numbers presenting with identified symptoms).	
MOP 1.4.5: *Ability of ViewPort to provide accurate map-based displays of information.	

An asterisk (\*) next to a measure indicates that it is a KPP.

**Table 4: COI 2 Outcome Assessment:** Outcome assessments for COI 1 are presented.

<b>COI 2. Is LEADERS suitable for deployment and sustained operations in the operational environment?</b>	
<b>Assessment Measure</b>	<b>Outcome</b>
MOE 2.1: Is LEADERS reliable?	
MOP 2.1.1: The number of operational system failures by type, amount of time the system was inoperable, and the impact on operations.	
MOP 2.1.2: The number of false alerts.	
MOP 2.1.3: The number of ASP interface failures.	N/A
MOE 2.2: Is LEADERS logistically supportable?	N/A
MOP 2.2.1: Maintenance and technical support requirements to maintain system functionality.	N/A
MOP 2.2.2: Additional personnel required to operate, maintain, and support the system.	N/A
MOE 2.3: Does the training program effectively train system operator and maintenance personnel?	
MOP 2.3.1: Ease of training for RAPIDS.	N/A
MOP 2.3.2: The adequacy of training manuals.	
MOP 2.3.3: The adequacy of LEADERS system training program.	
MOE 2.4: Does LEADERS provide adequate information security?	
MOP 2.4.1: The ability to limit screen access to designated users.	
MOP 2.4.2: The adequacy of system encryption to maintain the confidentiality of treatment records.	N/A
MOE 2.5: Are the LEADERS operator and technical manuals adequate to support operation and maintenance?	
MOP 2.5.1: The effectiveness of operators using LEADERS technical manuals to successfully troubleshoot the system, identify operational problems, and effect timely corrections and solutions with no input from system developers.	N/A
MOE 2.6: How does the LEADERS system design impact effective operation and maintenance?	
MOP 2.6.1: Effectiveness and suitability of system operator displays.	
MOP 2.6.2: Ease of use and navigation of LEADERS.	
MOP 2.6.3: Timeliness of system displays during both power up and in refresh mode.	N/A

The overall assessment results for the training and each of the three system modules, as well as comments related to other system components, are discussed sequentially in the individual module assessment sections of this report.

## **Assessment Results**

### **Training**

The training presentation was considered inadequate. Training was neither sufficient nor comprehensive, and the “manuals,” such as they were, will require substantial re-write in order for them to be effective for independent use by potential users/operators (Figure 8).

The insufficiency and lack of integrated training were evident during the subsequent assessment of the IM module where confusion was endemic among the users/operators and SMEs. The IM module tabletop exercise assessment could not have continued without substantial participation and input from consortium representatives.

It should be noted, too, that there was no representative of Idaho Technology, Inc. present at the training session. As a result, none of the TMA participants

completely understood the integrated operational role of RAPID for LEADERS, and the LEADERS/RAPID interface was not clearly defined. Subsequently, during the assessment of the MedSurv module, this became evident when none of the participants were able to completely understand or interpret the RAPID test result feeds to the LEADERS database.

One hundred percent of the questionnaire respondents stated that the training was not well organized or clearly presented. One respondent commented, "There was a distinct lack of organization in the presentation of the material." She added that, "Had the course been better organized...confusion would have been minimized." Another added, "Need a bit more structure." One respondent suggested that a "plan of instruction" be developed to facilitate the training.

The quality of the training manuals or "hand-outs," as one user described the documents, was only "OK," although two of four respondents indicated that the documents used to support the training were clear and easy to understand.

Following the training, users and SMEs were asked whether each understood the specific components or sub-sets of LEADERS, such as ViewPort, MedView, the alerting protocol, and the RAPID. Three of four respondents indicated that they were "not sure," or specifically stated that they did not understand the operational concept for these components. One respondent stated, "Incident Management, map view, and CCT are fairly straight forward. (Although) "The Event Module was too large to digest from...(the) type of training presented."

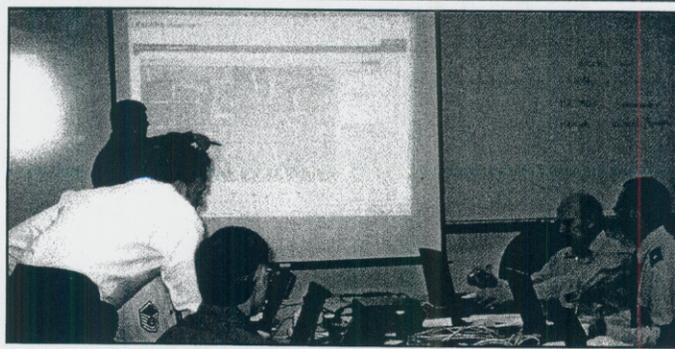
Two of four respondents commented that the use of checklists for LEADERS would require additional training and familiarization for the user to be sufficiently comfortable with this feature of the system.

An important peripheral issue raised by the training participants is whether LEADERS will require additional personnel to effectively use the system in the continuous-surveillance operational environment. Three of four



**Figure 8: LEADERS Training:** SMEs and users participated in LEADERS training.

participants indicated that additional personnel will be required to effectively support operation and management of the system.



**Figure 9. IM Module Instruction:** A ScenPro representative provided instruction for IM module operations.

### IM Module

The tabletop exercise was a very effective vehicle to identify technical and system uncertainties and to generate user input to improve the potential medical and incident management utility of the system (Figure 9).

User/SME and developer discussions and interaction during the tabletop exercise were extensive. Issues identified by the users and SMEs were

presented directly to the developers for consideration and action. Many of the user/SME suggested changes and upgrades to the IM module were considered at the time by the consortium representatives as viable and easily accomplished technical or program fixes. Some user suggested upgrades or “fixes” were noted by the consortium representatives for follow-up action.

Three of five (60 percent) of questionnaire respondents rated the overall functionality of the IM module as poor or acceptable, while only 40 percent rated it good. The overall usability of the IM module was rated as acceptable or good by all of the respondents; however, the usability ratings for ViewPort were less well defined, with three of five respondents rating this component acceptable or good, and one each as poor or excellent.

Essential functionality of the IM module was considered low by three of five respondents (60 percent). Primary shortcomings were related to integration of this module with CCT. Also, syndromic pattern analysis issues were considered extremely important. One respondent stated, “A focused effort on CCT and symptom flagging will bring a tremendous capability to (the) consequence assessment/consequence management community.” Another stated, “Put more \$\$\$ into this (the IM module) and integrate into existing capabilities.”

The checklist feature is a system function that received some limited criticism, particularly for its lack of flexibility. The inability to highlight items, the absence of multiple incident screens, limited user-friendliness of the checklist function, and the lack of a “click-and-drag” capability were cited as examples of this limited flexibility. Another respondent cited the lack of “nested checklists” as significant. Two respondents added that, in the checklist mode, a checklist default override function to allow user comment entries would be useful.

Another important system shortcoming, which was identified by three of five user and SME questionnaire respondents, is the lack of sufficient interoperability or integration between the IM module and ViewPort. In addition, one respondent identified functional shortcomings, again citing lack of system integration. The ViewPort function was described as “slow.”

Generally, the IM module was given high marks for potential utility. It was considered a relatively mature module of LEADERS, but will require additional development. Most of the feedback consisted of minor technical “tweaks” of the module, although some significant module improvements were identified. Identified system upgrades are presented in Annex B.

### **CCT Module**

Although the CCT module is currently deployed in a very limited role supporting the northern Virginia EMS system, some valid conclusions can be made.

The CCT module is a mature technology that is potentially effective in support of critical incident C<sup>2</sup> and in daily patient triage management. While the CONOPS for the CCT, when used as a component of LEADERS, will require some additional refinement and definition, this module is very flexible, user friendly, and suitable for operational deployment.

The CCT module received generally positive feedback from the MTF interviewees. CCT was highly praised by EMS Operations Center personnel as a significant improvement over the currently employed system for emergency patient routing. The Executive Director of the Northern Virginia EMS Council considered CCT to be potentially effective, although as yet it has not been fully deployed as designed. She believed that a valid determination regarding the overall, long-term suitability and effectiveness of this module will require expanded deployment of the system and follow-up assessment.

Under the administrative oversight of the Northern Virginia EMS Council, the CCT has been deployed at approximately 10 northern Virginia area hospitals, three sentinel MTFs, and the EMS Operations Center, which is “dispatch central” for emergency responders. The EMS Council functions as an oversight entity for all emergency medical service activity in the region and monitors all local hospital and emergency service transportation coordination protocols (Figure 10).



**Figure 10. Fairfax County Hospital:** Fairfax County Hospital is the largest regional trauma center to have participated in the CCT assessment.

The primary function of CCT during its 90- to 180-day trial has been to facilitate coordination between EMS and MTFs in the area for general EMS patient routing and rerouting coordination activities. To support this part of the assessment, interviews were conducted at six of the northern Virginia sites, to include four MTFs and the EMS Operations Center. Areas of assessment were overall functionality, utility, suitability, and human factors issues, as well as the technical maturity of the system.

Three of four MTF personnel interviewed commented favorably regarding use of the system to monitor the flow of patients to the MTFs via the EMS, although the EMS Council Executive Director suggested that adding triage tracking capabilities to the CCT would be helpful.



**Figure 11. Computer-aided Dispatch:** EMS personnel use computer-aided dispatch to monitor the CCT and plan their routes more effectively.

CCT use is based on information exchanged between the participating MTFs and the EMS Operations Center. MTF interviewees agreed the CCT is an effective communication and monitoring tool (Figure 11). As CCT is currently configured, none of the interviewees believed it is necessary or feasible at the present time to dedicate a full-time staff member to track ED status and update the CCT. Monitoring and updating of the CCT is handled in all the MTFs as an ancillary duty.

Personnel at less active hospitals admitted that the CCT is generally updated only two or three times each day, but all participants agreed the CCT is more consistent and an “overwhelming improvement” over the

prior method of ED tracking. Previously, ED personnel and EMS responders relied on faxes and phone calls sent to/from the EMS Operations Center throughout the day. This system was paperwork intensive and did not necessarily provide timely, up-to-date information.

ED personnel who use the CCT regularly suggested that it is “helpful as an overall system of knowing,” and a good data-organizing tool. It was considered, however, a “narrow application” that requires additional refinement such as real-time, continuous updated patient tracking data, and more detailed information about individual facilities to be more useful, timely, and effective.

EMS personnel, particularly the shift commander at the EMS Operations Center, were very pleased with CCT. He commented that it has generally freed their communications personnel from the burdensome responsibility of sending and monitoring the flow of faxes to individual MTFs hospitals, and has reduced confusion with regard to patient transport coordination.

---

Two hospital interviewees commented independently that despite the enhancements provided by CCT, EMS personnel continue to transport patients to the nearest MTF versus one that is, based on CCT bed availability status, more suitable. EMS Council personnel attribute this ongoing issue, in part, to a loose and “not agreed upon” definition of reroute or divert status.

The users interviewed during the TMA indicated that there also are residual issues concerning CCT, which were identified during this limited deployment of the system. These issues include logistic/infrastructure compatibility of the CCT with existing EMS policies, procedures, and personnel responsibilities. Also, given the significantly larger footprint involved with bed count tracking and patient status in critical incident management situations, such as additional manpower requirements and increased administrative responsibilities, users expressed reservations about the ability to fully integrate CCT into the existing patient management system.

All personnel interviewed at the MTFs and the EMS agreed that maintaining bed count and availability on a regular basis, to include type and location within a particular MTF, is generally unnecessary and potentially expensive in terms of manpower. To do this effectively, even with a fully dedicated staff member, would be extremely difficult to achieve given the fluid nature of bed turnover in the ED. Users did comment that bed count/status information would be extremely useful in emergency/crisis situations, such as those following the 11 September 2001 terrorist attacks. A Fairfax County interviewee observed that, because maintaining bed count/status is not generally feasible and therefore not exercised, the function was of no use in the hours after the attack (on the Pentagon). Instead, CCT was shut down altogether and MTF and EMS personnel reverted to the “pen-and-paper” method with which they were most familiar and comfortable.

Despite its limited use, all personnel interviewed rated *overall functionality* and *overall utility* of CCT as “good.” When asked about *usability* and *user interface*, operators responded that the CCT is easy to use and provides easy access stored data, which operators assessed as being accurate and up to date.

Operators agreed that the CCT module requires full participation by regional MTFs to be of any real benefit. This is an issue, inasmuch as personnel at one facility admitted to updating the CCT system only two or three times each day, usually at the beginning/end of each shift. As an ancillary issue, operators at the Reston Hospital Center stressed that not all departments have Internet access. Those that do may encounter corporate firewall restrictions, as is the case at Reston, which greatly complicates access to the system or limits access altogether. System timeouts, limited CCT-dedicated computers, and user access (permission) are additional areas of concern.

## MedSurv Module

User feedback was generally positive with regard to the overall potential utility of MedSurv to support early detection and identification of disease outbreaks and propagation (Figure 12). Overall, however, both primary SMEs and all of the users who were involved in this part of the LEADERS TMA stated that significant follow-on development to increase the technical maturity of the system is required before MedSurv and, by logical extension, LEADERS can be considered an effective tool with which to support the medical surveillance mission.

The screenshot shows a Netscape browser window titled "LEADERS Medical Surveillance - Report Page - Netscape". The browser's address bar is empty, and the main content area displays a table titled "Patient Visit with Primary Syndrome Report". The table has 16 columns: Record ID, Patient Visit Date/Time, Hospital Name, Hospital ID, Patient Age, Patient Birthdate, Patient Gender, Patient Race, Home Zip Code, STREET\_1, STREET\_2, CITY, COUNTY, Patient Disposition, Disposition ID, Patient Syndrome, and S. The table contains 12 rows of data, each representing a patient visit with associated details and a reported syndrome.

Record ID	Patient Visit Date/Time	Hospital Name	Hospital ID	Patient Age	Patient Birthdate	Patient Gender	Patient Race	Home Zip Code	STREET_1	STREET_2	CITY	COUNTY	Patient Disposition	Disposition ID	Patient Syndrome	S
119371	24-SEP-2001 00:00:00	BROOKE ARMY MEDICAL CENTER		6	34			34442							Upper or lower respiratory tract infection with fever	
119374	24-SEP-2001 00:00:00	BROOKE ARMY MEDICAL CENTER		6	56			34444							Diarhea/gastroenteritis (including vomiting, abdominal pain, or any other GI distress)	
119375	24-SEP-2001 00:00:00	BROOKE ARMY MEDICAL CENTER		6	25			32233							Diarhea/gastroenteritis (including vomiting, abdominal pain, or any other GI distress)	
119382	25-SEP-2001 00:00:00	BROOKE ARMY MEDICAL CENTER		6	45			32456							Upper or lower respiratory tract infection with fever	
119376	24-SEP-2001 00:00:00	BROOKS AFB		5	46			32456							Rash with fever	
119377	24-SEP-2001 00:00:00	BROOKS AFB		5	52			32234							Upper or lower respiratory tract infection with fever	
119378	24-SEP-2001 00:00:00	BROOKS AFB		5	34			23323							Botulism	
119383	25-SEP-2001 12:30:00	BROOKS AFB		5	34			32099							Diarhea/gastroenteritis (including vomiting, abdominal pain, or any other GI distress)	
119384	25-SEP-2001 00:00:00	BROOKS AFB		5	34			34567							Diarhea/gastroenteritis (including vomiting, abdominal pain, or any other GI distress)	

Key: ID = Identification

**Figure 12. MedSurv Module:** MedSurv provides both event-based and continuous surveillance of disease outbreaks and biological agents.

The MedSurv assessments were conducted at WHMC, WRAMC, and the USAF/SGT office; however, effective participation by the WRAMC user was precluded by a complete failure of Internet connectivity after the second day of this part of the exercise. While connectivity at the USAF/SGT site also was lost, the disconnect was intermittent and had limited, minimal impact on effective participation by the site users. Loss of Internet connectivity appears to be a recurring factor that may have significant impact on the long-term utility and reliability of LEADERS.

---

The complexity of the MedSurv module is reflected in the current high level of system immaturity, as well as the large number of significant issues articulated by the users/operators and SMEs. Numerous operational shortcomings, design flaws, and system inconsistencies were noted (see Annex B). The number of issues was magnified since this was the first opportunity for actual users in a limited operational environment to interact with the system and exercise it with actual data feeds from multiple MTF sites. Some of the issues were as simple as a redesign of the system to permit editing of the patient visit form; some, such as the lack of sufficient, comprehensive sets of disease pattern-matching algorithms used to support continuous surveillance, require better-defined performance requirements and technical development. Some of the identified problems involved human factors/usability issues, such as ease of use of the tab functions, clarity of the screens, and general ease of use.

Event-based surveillance is used to support a planned event. In this mode, MedSurv data collection is supported by customized patient encounter forms tailored to include specific data collection requirements specified by the C<sup>2</sup> element. The forms are customized using the SA module. The data are input by designated personnel at the MTF or in other identified, pre-planned locations.

All of the SMEs and users stated that the patient data entry forms were “relatively easy to create.” The majority of the SME/user suggested improvements to this part of the MedSurv module were related to ease of use within the computer screens and the need for a capability to alter forms after the initiation of the event, a capability not currently available.

After an initial assessment protocol misunderstanding between the USAF/SGT SME and the SRA/Oracle developers, the LEADERS alerting system “alerted” via both e-mail and pager. The alert trigger level or threshold was arbitrarily set by the consortium and SMEs to ensure system alerting occurred during the exercise. One SME suggested a review of the whole alert protocol be conducted to ensure that only pertinent and useful alerts are received in a manner that is timely, appropriate, and narrowly focused. Updating alerts without having to create a new alert number was also a very important system upgrade that should be considered.

Significant considerations for system upgrades include improvements in and expansion of patient identifiers on the patient treatment form. Patient identity is considered extremely important to facilitate timely and appropriate healthcare response, to implement effective infection control, and to ensure safety of public health workers.

Patient counts and MedSurv reports were compared with data entry information to ensure accuracy and ease of use of the system. SMEs and user observations underscored the reliability of the system in this regard. Patient-count data and report data were considered accurate.

---

The MedView mapping tool was generally found to be unacceptable. The maps displayed at the USAF/SGT site were of poor quality, were considered to be very “grainy,” and concurrent functionality, such as listing syndrome numbers, could not be used.

The system was unable to alert based on lab results when employed in the continuous surveillance mode, which is critical to effectively support infectious disease surveillance. A notable shortcoming of the system is the lack of the ability to conduct simple statistical analysis of the data.

Overall, SME/user observations of the event-based surveillance mode of operation of LEADERS during the TMA can be summarized as follows.

- It is an effective “quick look” at populations and syndromes.
- Event creation is very easy.
- Training to use LEADERS in this mode is also “easy;” however, the need for more comprehensive training and more adequate training manuals to support training was highlighted.
- System access and data entry is “easy.”
- Alerts are timely and accurate.
- Map views, although poor in quality, accurately reflect the data in each alert and provide a good “quick-look epidemiology.”
- Reports are accurate for the event data entered.

Flaws or shortcomings in the data entry protocols were noted, including excessive time required to enter the data, the lack of timeliness of the data entries, lack of sufficient patient identifiers, and screen integration limitations. In addition, statistical analysis functionality was suggested as a valuable upgrade to be considered for this part of LEADERS.

The MedView help screens were noted as being “good” by the SMEs. In addition, the SMEs suggested that the help screens should be used as templates for other help screen protocols in LEADERS, and the use of help screens should be incorporated into the training program.

When LEADERS is being operated in the continuous-feed based surveillance mode, the salient issue noted is the lack of validity of the data extracted from the ICDB to the LEADERS ASP. These data form the backbone of the alerting system. Lack of timeliness, insufficiency of data elements, erroneous data entry, and other issues regarding the ICDB data have a potential impact on the overall validity and utility of LEADERS. This is one of the most significant impediments to fielding an effective and efficient system to address disease outbreaks and bioterrorism attacks.

The primary SME noted, “Prior to the TMA, Air Force and consortium members considered a variety of ways to perform...surveillance on data available in the ICDB in order to identify disease outbreaks more quickly. ...Use of ICD-9 codes is not effective...due to the delay of data entry. ...laboratory and radiology results are the ultimate in surveillance and disease detection.”

---

The SMEs suggested that the most effective way to identify disease outbreaks in a timely manner is "...provider activities, to include ordering labs and rads, and prescribing medications. A second round of surveillance would include the results of these labs and rads. The third round may be related to ICD-9 code(s)...to provide a back-up or redundancy in the surveillance...." This perspective is fundamental to the utility of MedSurv and should be considered to determine the utility of the entire process. Currently, the technical maturity of LEADERS is limited by the validity of the data used to drive the system. These databases, such as CHCS and ICDB, are database management tools employed in a variety of MTFs that are effectively independent of LEADERS.

Throughout the assessment, the transfer of data was considered to be inadequate and, as a result of technical problems, incomplete. During this part of the assessment, however, the quality of the data feed was not evaluated to ensure the accuracy of the data transfer to or from the server or the ASP.

Data feeds from WHMC were problematic at best, and the SMEs were never able to validate that LEADERS could identify the established pathogens used to support this assessment. The WHMC and WRAMC data feeds were interrupted, as previously noted, with the former not reestablished in a timely manner. Consequently, this capability could not be evaluated at that site. This was also true of the RAPID test result data.

In the event management mode, manually collected, date-based alerts were accurate in number and content. The continuous-surveillance alerting system did not function as designed. Pages and e-mails were not sent/received, there were multiple alerts for the same data sets, the ease of use of the alert viewing system was considered only fair, and the lab query function was poorly designed. Alerting based on lab results was not demonstrated.

The ICD-9 related alerts were considered accurate; however, all of the alerts were related to patients who had been seen approximately a week previously, and this part of the assessment was highly scripted and narrow in both scope and focus. In terms of effective, timely continuous surveillance, this is an unacceptable characteristic of the LEADERS extraction protocol. Coding and data entry delays are reflected in lack of timeliness of these entries.

A list of MedSurv system functionality improvements is provided in Annex C.

Although the user-suggested improvements for the MedSurv module are both numerous and significant, many were considered by representatives of the consortium to be relatively easy fixes. However, others will require significant technical evolution. It should be noted that the lack of technical maturity of the MedSurv module, as demonstrated during the

---

TMA, was not considered predictive of the overall potential military utility or reliability of the system. All users and SMEs were consistently enthusiastic about the potential of this system.

The role of RAPID in support of MedSurv was ill defined, the CONOPS for integration of RAPID was vague and poorly articulated, and connectivity with the LEADERS database was not clearly understood.

---

*This page is intentionally blank.*

---

## CONCLUSIONS

The general consensus of all the SMEs and users who were involved with the LEADERS TMA was that the system has significant potential utility, but will require a substantial number of upgrades and additional system development in order to be ready to undergo an MUA.

Two COIs were identified for LEADERS. The COIs address the operational effectiveness and suitability of LEADERS, and each is supported by MOEs and MOPs established as parameters to measure the capability of the system to successfully perform the defined mission.

Since the critical technical and performance MOEs and MOPs for each COI were not successfully demonstrated during the LEADERS TMA, neither COI was considered to have been favorably resolved.

The assessment results related to the supporting measures are summarized below.

The training program developed to support the LEADERS TMA was inadequate. The training was neither comprehensive nor well presented. The trainers did not integrate the training presentation, and there was no representative of Idaho Technology, Inc., the RAPID vendor, present at any time during the TMA. As a result, none of the TMA participants completely understood the interoperability issues that exist between RAPID and LEADERS, and an assessment of the potential technical maturity of the system interface could not be completed.

The IM module is a relatively mature technology that will require minor, though numerous, upgrades to the current module in order for it to be an effective part of the LEADERS system.

CCT is mature and has been fielded already at various locations. The module is very malleable and can be customized to meet the needs of prospective user(s). At the present time, CCT is not well integrated into LEADERS, and there was some disagreement on the part of users and SMEs regarding the utility, compatibility, and interoperability of the CCT module with the rest of the LEADERS mosaic.

The modules and components of LEADERS are at different stages of technical maturity, but the primary, most integral module of LEADERS, MedSurv, is clearly the most immature. Modular integration and effective system operation will be impossible without a fully mature MedSurv module.

MedSurv was actually too immature at the time of the TMA to permit an adequate assessment of system utility. During the TMA, the MedSurv did not demonstrate that LEADERS would, in fact, be a more efficient and

---

effective vehicle to support timely epidemiological surveillance when compared with currently available technologies.

Interoperability was not directly assessed during the TMA. Separate assessments of the various components of LEADERS, however, reinforced the already extant concerns that attention should be given to ensure that each of the components are compatible and that interface issues are resolved at the earliest possible time in the development process.

The MedView mapping feature was unacceptable. The clarity of the screens was very poor, and the resolution and contrast should be reviewed to identify what can be done to address these significant issues.

System reliability issues are reflected in the failure of Internet connectivity at both primary assessment sites. Internet connectivity problems and concerns should be identified and factored into any determination of system utility and maturity. The critical importance of this issue is increased significantly when viewed through the prism of normal technical problems attendant to critical incident management command and control situations.

---

## RECOMMENDATIONS

In order to be effective, a comprehensive training protocol must be developed and presented. This training program should focus on the LEADERS MedSurv module and its components, although adequate training on all components and modules is required for system operation to be efficient and effective.

Training for use of the RAPID should be included as an integral part of the training program. In addition, the operational concept supporting the use of the RAPID in the LEADERS construct should be revisited to identify suitability and sustainability issues related to the deployment of this technology.

Additional IM module development should be conducted by the consortium, incorporating user/SME suggested changes as noted in Annex C. The IM module should be incorporated in a subsequent, integrated MUA with a focus on interoperability, suitability, and human factors issues.

The CCT module is very malleable and can be customized to meet the needs of prospective user(s). Previous and current deployments of the CCT module should be reviewed for a determination of overall technical maturity and compatibility with LEADERS.

The CCT module should be deployed and assessed in a follow-up, integrated MUA to identify suitability, interoperability, and sustainability issues when used in tandem with LEADERS. A review of projected increases in manpower required to effectively operate the CCT module also should be considered. A follow-up assessment of the CCT module should be accomplished as part of an integrated piece of LEADERS.

The follow-on development program for LEADERS should address the current, significant technical and functionality limitations of MedSurv, and the need to develop better, more effective system integration with the various other components.

The next phase of development for the MedSurv module should focus on the following.

- Refine the event-based and continuous surveillance components of LEADERS with emphasis on the development of sufficient, viable algorithms to support effective surveillance.
- Implement identified web page changes and upgrades.
- Validate the quality of the data feeds from ICDB and other relational databases.

- 
- Implement data mining capabilities and assess as part of an integrated medical surveillance tool.
  - Refine and upgrade the alerting system for both disease and bioterrorism agents identified by CDC.
  - Determine appropriate alerting thresholds.

Revise and update the CONOPS and develop adequate TTPs.

Technical results will be provided, as appropriate, to the emerging doctrinal Directorate at USAF Doctrine Center, Maxwell AFB to ensure that pertinent and potential issues relevant to currently evolving homeland defense doctrine are addressed in a timely manner.

In summary, the Det 1 AFOTEC recommendation is to identify and correct system problems and technical shortcomings and, in accordance with a revised system CONOPS, consider conducting a comprehensive MUA with emphasis on interoperability and technical maturity.

---

## ANNEX A: ACRONYMS

AF	Air Force
AFB	Air Force Base
AFMESA	Air Force Medical Evaluation Support Activity
ASP	Application Service Provider
ATIC	Advanced Technology Innovation Center
C <sup>2</sup>	command and control
CCT	Critical Care Tracking
CDC	Center for Disease Control
CHCS	Composite Health Care System
COI	critical operational issue
CONOPS	concept of operations
DARPA	Defense Advanced Research Projects Agency
Det 1 AFOTEC	Detachment 1 of the Air Force Operational Test and Evaluation Center
ED	emergency department
EMS	emergency medical service
GSA	General Services Administration
HQ USAF/SGXY	Headquarters United States Air Force Surgeon General's Office for Medical Readiness, Science, and Technology
ICD	International Classification of Disease
ICDB	Integrated Clinical Database
ID	Identification
IM	Incident Management
KPP	key performance parameter
labs/rads/meds	laboratory, radiology, and pharmacy
LEADERS	Lightweight Epidemiology Advanced Detection and Emergency Response System
LUA	limited utility assessment
MedSurv	Medical Surveillance
MOE	measure of effectiveness
MOP	measure of performance
MTF	medical treatment facility
MUA	military utility assessment
N/A	not assessed
PM	project manager
POC	point of contact
RAPID	Ruggedized Advanced Pathogen Identification Device

---

SA	System Administrator
SPO	Special Projects Office
SME	subject matter expert
TMA	technical maturity assessment
TTP	tactics, techniques and procedures
USAF/SGT	United States Air Force Surgeon General's Office for Infection Control
WHMC	Wilford Hall Medical Center
WRAMC	Walter Reed Army Medical Center
XML	extended mark-up language

---

## ANNEX B: SUGGESTED SOFTWARE AND TECHNICAL IMPROVEMENTS TO THE VIEWPORT AND IM MODULES

This annex contains a list of user/SME/assessor-suggested software and technical improvements to ViewPort and the IM module. This list was compiled using input from users, SMEs, and assessors who participated in this part of the TMA. Most of these recommendations have been previously provided to the module developer for review and appropriate action.

1. Include a split screen capability to simultaneously view both IM and ViewPort.
2. Develop ability to view multiple checklists in separate windows more easily.
3. Provide the ability to drag and drop multiple icons.
4. Indicate time zones on ViewPort maps.
5. Integrate incident creation into ViewPort.
6. Provide capability to print maps.
7. Integrate asset accounting capability.
8. Provide ability to associate patient encounters (e.g., neighbor-to-neighbor, parent-to-parent, and child-to-parent).
9. Provide the capability to request supporting documentation within user-defined boundaries highlighted on the map (e.g., numbers of casualties, assets, or resources).
10. Integrate a cut-and-paste capability to create new checklists using existing checklists and Word files.
11. Be able to show incident location and related area topography on the ViewPort maps.
12. Allow users to define ad-hoc Discoverer reports.
13. Consider adding the capability to move between multiple incidents, as well as moving between multiple checklists within a single incident or event.
14. Make terminology and format consistent.
15. Include a glossary of terms used in this and related modules.
16. Add additional capability to track deceased patients/victims.
17. Provide the ability to access General Services Administration (GSA) building and base facility maps.

- 
18. Provide the user with the capability to choose or create a list of favorite sites.
  19. Review the CCT-IM module interface to address improvements in patient-casualty tracking and other CCT-IM module processes.
  20. Develop a single user's manual.
  21. Include 'flag' ability to annotate a particular trend.

---

## ANNEX C: SUGGESTED SOFTWARE AND TECHNICAL IMPROVEMENTS TO THE MEDSURV MODULE

This annex contains a list of user/SME/assessor suggested software and technical improvements to the MedSurv module. Most of these recommendations have been previously provided to the module developer for review and appropriate action.

1. Reformat the patient visit form/screen to enable edit, delete, and alteration functions.
2. Institute an electronic log of form changes to facilitate recall of this information to view who made the change, what changes have been made, and when the changes have been made during the course of an exercise.
3. Include drop-down boxes and pick lists to standardize data capture during an event.
4. Improve the quality and completeness of the text boxes to enable more than one question to be used.
5. Redesign the 'primary condition' box to improve the format and reduce potential errors caused by the closeness of the lines.
6. Improve the alert viewing system to allow for alert updates with new information without creating a new alert number and, consequently, a new alert.
7. Provide more clearly worded, detailed alert descriptors.
8. Obtain a legal opinion to determine the limitations imposed on the collection and use of personal data on the patient forms in the event-based operation of LEADERS.
9. Improve pattern recognition to ensure that patient disease patterns potentially relevant to public health or infectious control personnel are identified.
10. Conduct additional testing and development for the pager/e-mail notification function in order for it to become an effective LEADERS tool.
11. Refine and develop 'Alert details' (e.g., identification of managing authorities, clustering of related facility groups, and 'top level' management oversight access).
12. Review the function of 'Data Files' and the quality of user visibility of this function for pertinence.
13. Review the MedView map function to identify the cause of the poor quality of the screens experienced at the HQ USAF/SGXY office, the inability to print syndrome numbers, and the alert function on this page. **Make appropriate fixes for this problem.**

- 
14. Improve the web page colors/shading for better contrast.
  15. Provide 'help screens' for all user components of the system. Model this on the MedView help screen and include the 'help screens' in the training module.
  16. Develop the ability to perform statistical analysis to support epidemiology.
  17. Improve the integration and interface among the LEADERS screens.
  18. Improve print screen capability to ensure that the entire document can be printed.
  19. Consolidate all alert-related management functions in one screen, but transfer the ability to close or change an alert from the alert management screen to the alert details page.
  21. If possible, revise the Discoverer reports to have a mechanism to identify who the patient is for the Infection Control Officer, the Public Health Officer, or patient care provider.
  22. Establish an objective measure or mechanism to ensure that all data elements have been appropriately transferred.
  23. Review the lab query process to determine the most productive manner to address the alerting mechanism (i.e., group versus individual lab alerting).
  24. Review the ICD-9 code alerting mechanism to determine the suitability for use as a function of the alerting tool.



WALTER REED CENTRAL HOSPITAL