

*Bioterrorism and Other Public Health Emergencies  
Tools and Models for Planning and Preparedness*

# **National Hospital Available Beds for Emergencies and Disasters (HAvBED) System**

## **Final Report**

### **Prepared for:**

Agency for Healthcare Research and Quality  
U.S. Department of Health and Human Services  
540 Gaither Rd.  
Rockville, MD 20850  
[www.ahrq.gov](http://www.ahrq.gov)

### **Task Order No. 8**

**Contract No. 290-00-0014**

### **Prepared by:**

Denver Health

### **Principal Investigator**

Stephen V. Cantrill, MD

### **Contributing Authors**

Sheri L. Eisert, PhD: Co-Principal Investigator  
Peter T. Pons, MD: Co-Principal Investigator  
Jacob Dye, MS: HAvBED Project Manager  
Camille Marthaler, MS  
Carrie Vinci, ScM: HAvBED Project Manager  
Michael Bates, IT Project Manager  
Scott Daub, IT Developer  
Ben Grafton, IT Developer

**AHRQ Publication No. 05-0103**

**December 2005**

## Suggested Citation

National Hospital Available Beds for Emergencies and Disasters (HAvBED) System: Final Report. AHRQ Publication No. 05-0103, December 2005. Agency for Healthcare Research and Quality, Rockville, MD. Available at <http://www.ahrq.gov/research/havbed/>.

Funding to support the National Hospital Available Beds for Emergencies and Disasters (HAvBED) System: Final Report, was provided by the U.S. Department of Health and Human Services, Agency for Healthcare Research and Quality under Contract No. 290-00-0014.

The authors of this report are responsible for its content. No statement in the report should be construed as an official position of the Agency for Healthcare Research and Quality or the U.S. Department of Health and Human Services.

This document is in the public domain and may be used and reprinted without permission except those copyrighted materials noted, for which further reproduction is prohibited without the specific permission of copyright holders.

## Contents

I.	Executive Summary.....	1
II.	Purpose/Objectives.....	5
III.	Background.....	6
IV.	Methods.....	7
V.	Results.....	10
	A. Review of Hospital Bed Availability Reporting Systems.....	10
	B. Review of Specific Patient Tracking Systems.....	16
	C. Hospital Bed Definitions.....	18
	D. Development of System-to-System Communication Protocol.....	21
	E. Database and Web Development.....	22
	F. Geographic Information System Development.....	23
	G. Interface and Manual Data Entry .....	29
	H. Demonstration of Real Time Hospital Bed Available (HAvBED) System.....	49
	I. HAvBED Test Period Operation.....	49
	J. User Comments.....	53
VI	Recommendations and Discussion.....	54
	A. Conceptual Recommendations.....	54
	B. Technical Recommendations.....	55
	C. Discussion: Patient Tracking.....	56
	D. Discussion: Decisions Concerning Alternate Care Facilities.....	57
	E. Discussion: Testing the System with State, Local and National Command Centers.....	58

## Figures

Figure 1:	HAvBED System Diagram / Data Flow.....	2
Figure 2:	National Disaster Medical System (NDMS) Federal Coordinating Centers.....	11
Figure 3:	States Currently Using or Considering Hospital Bed Reporting Systems.....	15
Figure 4:	St. Louis Metropolitan Medical Response System (MMRS) Tracking Tags.....	17
Figure 5:	The Relationship Between Different Bed Statuses.....	18
Figure 6:	HAvBED Data Elements Screen.....	20
Figure 7:	Sample of HAvBED EDXL Schema.....	21
Figure 8:	HAvBED System Diagram / Data Flow.....	22
Figure 9:	Washington Bed Capacity System Interface.....	24
Figure 10:	EMSystem Interface.....	25
Figure 11:	HERDS Interface.....	26
Figure 12:	HAvBED Hospital Web Manual Data Entry Screen.....	27
Figure 13:	HAvBED Logon Screen.....	29
Figure 14:	HAvBED Main Screen.....	29
Figure 15:	HAvBED Help Screen.....	30
Figure 16:	Individual Hospital Web-based Data Entry Screen.....	31
Figure 17:	Administrative Options Screen.....	31
Figure 18:	Creating an Alternative Care Facility (or New Hospital) Screen.....	32

Figure 19:	Data Entry for an Alternative Care Facility Screen.....	32
Figure 20:	Log-ins Human and Otherwise Screen.....	33
Figure 21:	National Bed Summary Screen.....	34
Figure 22:	Main Screen: Retrieve a Regional Data Report .....	35
Figure 23:	Summary Report Federal Region X Screen.....	36
Figure 24:	Mouse-Over Help.....	37
Figure 25:	Summary Report: Federal Region X Hospital Data.....	38
Figure 26:	Mouse-Over: Bed Types.....	39
Figure 27:	Mouse-Over: Time of Last Data Entry.....	40
Figure 28:	Federal Region X Map.....	41
Figure 29:	Zooming Down to Washington State.....	42
Figure 30:	The Seattle Area.....	43
Figure 31:	Next Level Down.....	44
Figure 32:	Drop-Down State List.....	44
Figure 33:	New York State.....	45
Figure 34:	New York City.....	45
Figure 35:	New York City – Zooming Down.....	46
Figure 36:	New York City – Selecting a Hospital.....	46
Figure 37:	Selected Hospital’s Detail.....	47
Figure 38:	New York City - Street Level.....	48
Figure 39:	Non-Heightened Reporting – Colorado.....	50
Figure 40:	Metro-Denver Tabular Listing.....	51

## Appendixes

- A – Advisory Group Members
- B – Advisory Group meeting minutes
- C – Questionnaire for site visits
- D – Preliminary System Specification Document
- E – Full HAvBED EDXL Communication Schema
- F – HAvBED Bed Definitions
- G – HAvBED EDXL Data Elements
- H – HAvBED Database and Web Services Documentation
- I – Geographic Information System (GIS) Documentation

## I. Executive Summary

**Purpose:** The primary purpose of this study was to develop, implement and evaluate a real-time electronic hospital bed tracking/monitoring system that will serve as a demonstration management tool to assist in a system/region's ability to care for a surge of patients in the event of a mass casualty incident. In addition, existing patient tracking systems were to be reviewed and recommendations made for the future development of a national patient tracking system. The overarching purpose of this project was to develop an exportable model of a hospital bed tracking system for the Department of Health and Human Services Office of the Assistant Secretary for Public Health Emergency Preparedness (OASPHEP) Secretary Command Center (SCC) and other Federal, Regional, State or Local Command Centers to access standardized information across the entire nation.

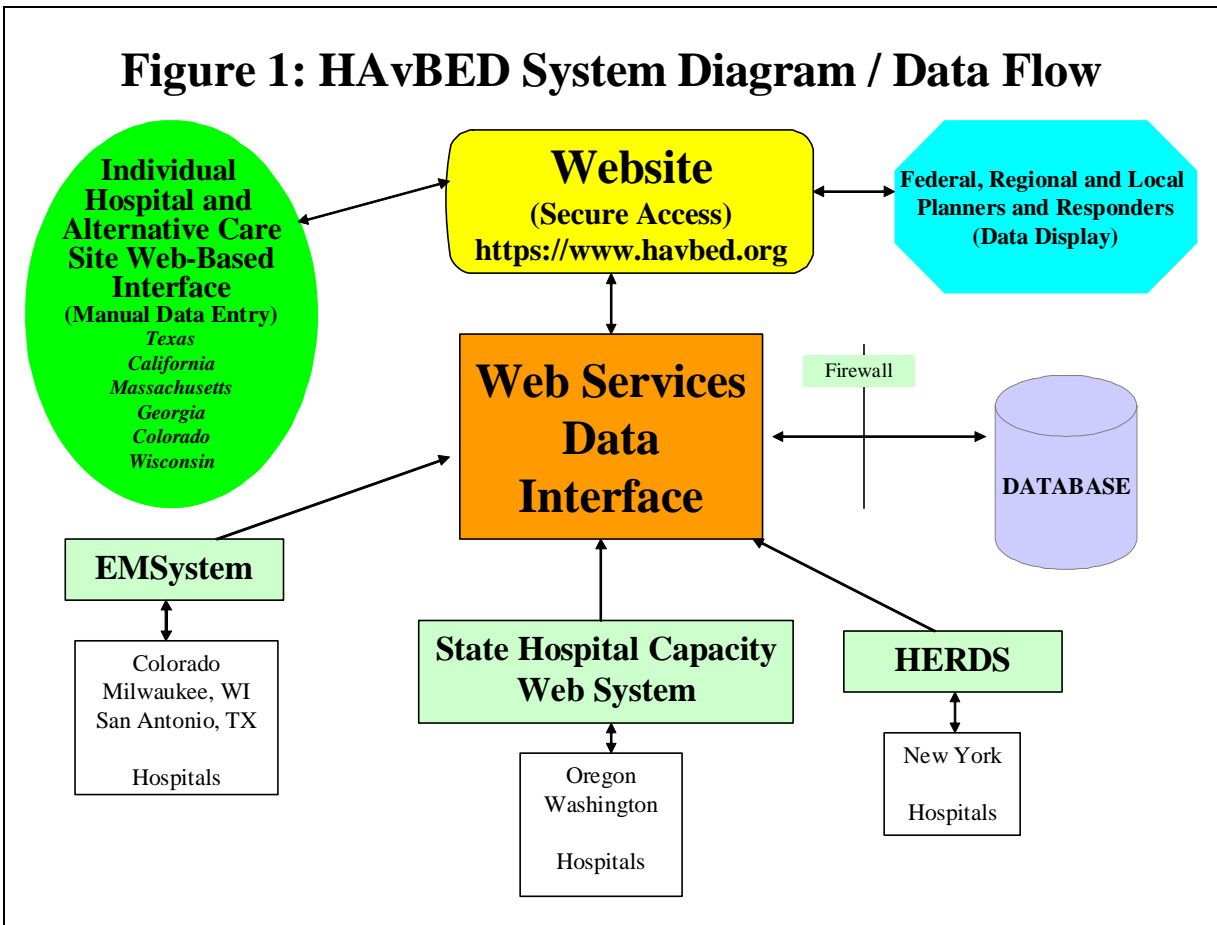
**Background:** Denver Health established Advisory and Working Groups of entities (private sector, hospitals, states and federal government) that have already developed and utilize bed availability and patient tracking systems to design, implement and test a standardized "real-time" national bed availability demonstration system. These pre-existing stand-alone systems were developed to monitor varying objectives including: hospital divert status, the status of hospital resources during a mass casualty incident, and the status of a voluntary network of non-Federal acute care hospitals that have agreed to accept patients in the event of a national emergency. Some of these systems are web-based where as others require the reporting of data in response to a telephone request. Each of these systems collects various data elements, some are as simple as yes/no for bed availability and others record actual bed numbers. The definition of various data points such as "available hospital bed" also varies between these systems and even between hospitals.

**Methodology:** The Advisory Group met four times at the Office of the Assistant Secretary for Public Health Emergency Preparedness (OASPHEP) at the Department of Health and Human Services (DHHS) in Washington, D.C., and once during the National Disaster Medical System (NDMS) Conference in Orlando, Florida. Under the direction of the team at Denver Health, the Development and Implementation Working Group conducted the following activities:

- Review and analysis of pre-existing hospital bed reporting systems including:
  - NDMS
  - OASPHEP Secretary's Command Center (SCC) Hospital Asset Reporting System
  - Hospital Emergency Response Data System (HERDS) (New York Department of Health, Greater NY Hospital Association)
  - EMSsystem® (Milwaukee, Wisconsin)
  - State Hospital Capacity Web System (Seattle, Washington)
  - (other systems were invited to participate but chose to decline)
- Development of a consensus agreement of standardized definitions for bed types and capacity
- Development, implementation and testing of a data interface that receives and reports hospital bed availability data from:
  - Hospitals that participate in existing reporting systems
  - Individual hospitals that do not currently participate in such systems
- Implementation of geo-coding and spatial display of hospital bed availability data from the developed data interface website

- Evaluation of existing systems for transporting, tracking, and reporting patient status and location including TRAC<sup>2</sup>ES and the St. Louis Metropolitan Medical Response System (MMRS) – Raytheon system.

**Results:** The demonstration hospital bed availability reporting system illustrated in Figure 1 was implemented and operated in a demonstration/production mode from June 26 through July 31, 2005. The results of this operational period were presented to the Advisory Group on July 12, 2005 in Washington, D.C.



**Recommendations:**

The HAvBED Project Group, after testing, evaluation and review of the demonstration system, recommends the following:

Conceptual Recommendations:

- The HAvBED demonstration system should be implemented on a national level and expanded to interface with all other existing bed capacity systems currently in operation.
- The HAvBED system should not replace any existing systems, but rather it should acquire and amalgamate data already being gathered by these pre-existing systems

- Hospitals not participating in a multi-institutional bed capacity system should provide necessary data via the HAvBED manual data entry web interface.
- The reporting structure and framework of the HAvBED system was developed by a national representation consensus. If modification is deemed necessary, it should occur only after very careful deliberation.
- The concepts and operation of the expanded HAvBED system should remain simple and user friendly. Major expansion of the scope of the system will put the potential for success at risk.
- Incentives for hospital participation in the HAvBED system should be developed and implemented. This could include such management tools as capacity trend reports for hospitals as well as regions.
- DHHS should work with state and local departments of health, EMS agencies and emergency managers to inform and educate them of the utility of this system. These groups, in turn, will be instrumental in encouraging participation at the local level. This could be done via a series of conferences or meetings. Additional partners in this effort may include the Department of Homeland Security, the American Hospital Association, state hospital associations, emergency management professional organizations and selected medical specialty professional organizations. This approach will offer and provide collaborative efforts at multiple levels as well as the greatest opportunity for acceptance and widespread implementation of such a system.
- DHHS, in concert with potential state, local and national users, should develop a mechanism for testing the utility of the HAvBED system at these different levels of operation.
- Concerns raised regarding the legality of ongoing collection of bed capacity data by the federal government should be investigated and addressed.
- As currently designed, the HAvBED system provides limited utility for use by field personnel in their day-to-day operations as the HAvBED data structure may not include some bed types felt to be of local importance for these operations.
- The implementation of the expanded HAvBED system should be done by an impartial organization or contractee working with DHHS (such as achieved by the Booze Allen Hamilton collaboration with the Department of Defense in the creation of TRAC<sup>2</sup>ES).
- A national patient tracking system may be of help during a time of national emergency but supplying data to such a system may prove too burdensome to make it efficacious. A patient locating system may be easier to successfully implement.

#### Technical Recommendations:

- The HAvBED hospital data base (based upon the AHA hospital data) should be edited and updated to:

1. Remove non-acute care institutions
  2. Correct errors in institutional location (longitude/latitude) and AHA bed numbers
  3. Add institutions that are not AHA members (such as some military installations)
  4. Indicate those institutions that are NDMS and/or TRICARE participants.
- The web interface for data entry and retrieval should be refined to be more intuitive and to be ADA and eGov compliant. Additional specific search and data retrieval modalities should be implemented, such as:
    1. NDMS/TRICARE institutions only
    2. Time specific criteria, i.e. all data that are less than “X” hours old
    3. Geographic specific criteria, i.e. all hospitals within a specified number of miles of a specific location
    4. Data point specific criteria, i.e. all available ventilators or all institutions with available mass decontamination units.
  - The symbology of the GIS maps should be improved and extended, including providing detailed institutional data on mouse-over of the institution’s icon.
  - The system should be reconfigured in a more robust manner to provide improved responsiveness.
  - An extensive acceptance test procedure should be implemented to verify system operation and data reliability.



## II. Purpose/Objectives

Develop, implement and evaluate a demonstration real-time electronic bed tracking/monitoring system that augments a system/region's ability to care for a surge of patients. This will be accomplished by meeting the following objectives:

1. Produce an analysis of available information of systems currently in use and incorporate essential elements of surge capacity data from these systems, taking into consideration security issues.
2. Define, through expert consensus, bed capacity and a standard for consistent counting of available beds.
3. Develop a mechanism to connect and report data to the OASPHEP SCC as well as state and regional emergency management and command centers. Develop a process for integration with emergency medical services.
4. Discuss specific related topic areas including:
  - a. Geo-coding of data and GIS capability for spatial display;
  - b. Whether a mechanism for transporting, tracking, and reporting patient status and location is feasible, beneficial and fiscally sustainable;
  - c. Development of algorithms to assist local, state and national planners in making decisions for use of alternate care facilities capabilities and capacities.
5. Discuss developing a mechanism for testing the use of the system with state, local and national command centers.

The goal of this project was to determine the feasibility of bringing together common data elements (and/or easily adapted data elements) from within each of these systems through an interface, after the specific useful data elements and their definitions were identified (including GIS) and display formats were developed through collaborative input. Once the feasibility was determined and data elements identified, an interface was created that could be accessed and managed by OASPHEP SCC. Through collaborative input and a secure server, relevant data elements could then be made accessible to regional/local emergency management offices. This web accessible interface system was tested by the collaborators during the development and implementation phases.

### III. Background

As an integrated delivery system and a regional Level One Trauma center, Denver Health has experience with the full spectrum of health care service areas such as hospitals, emergency departments, ambulatory care and public health facilities. Denver Health has been operating Denver County's EMS system for over 30 years. As a major participant in Operation TOPOFF 2000 and Nunn-Lugar-Domenici exercises, activities of the Denver Center for Public Health Preparedness (DCPHP), linkages with the Colorado Front Range Metropolitan Medical Response System (MMRS), and previous surge capacity task orders with AHRQ, Denver Health has direct experience in coordinating health care system bioterrorism preparedness with multiple levels of government and numerous agencies and providers, including US Northern Command and the states that comprise Federal Region VIII. Through these strong collaborative efforts and experiences with state and national agencies, Denver Health has learned lessons and gained the insight necessary for planning and developing this national bed reporting mechanism. Moreover, Denver Health has a unique cooperative relationship with city/county and state governments on multiple levels, including the area of preparedness. This experience, expertise and regional recognition has contributed to the development of a standardized "real-time" *National Hospital Available Beds for Emergencies and Disasters (HAvBED)* that addresses complex system needs.

Multiple bed availability systems have been developed around the country to satisfy various needs, such as hospital diversion status and resource availability. It was the goal of this project to demonstrate the feasibility of dynamically amalgamating data from several of these systems as well as allowing manual data entry via a secure web interface by hospitals that do not participate in these systems, into one integrated system called HAvBED. This demonstration HAvBED system is expected to improve the ability of planners, providers and decision makers to understand acute hospital and alternative care site bed availability in "real time" on a regional and national basis.

The creation of this demonstration system also necessitated the development of standardized bed-related definitions and a common communication protocol. It became clear that a common communication protocol based on the EXtensible Markup Language (XML) would facilitate data transfer between the participating systems and the demonstration HAvBED system. It was determined that, if possible, this communication protocol should be consistent with and build upon work already begun in the area of medical and emergency communication. To achieve this, an Emergency Data Exchange Language (EDXL) schema was developed for this project.

## IV. Methods

This project required and involved collaboration and communication among multiple partners. This section describes the process by which this project was completed within the 14 month contract period and the degree to which communication and collaboration were key to its completion and success.

1. This project was conducted by a project team led by Dr. Stephen Cantrill, Associate Director of Emergency Medicine at Denver Health Medical Center. Dr. Cantrill has been involved in medical informatics for 40 years and bed availability reporting issues for 20 years. Co-investigators include Dr. Peter Pons, who has extensive experience in prehospital care and disaster management, and Dr. Sheri Eisert, who has extensive experience in health systems research. Project managers included Carrie Vinci and Jacob Dye.
2. An Advisory Group for the HAvBED Project was identified with representation from the following (Appendix A):
  - Department of Health & Human Services
    - Agency for Healthcare Research and Quality (AHRQ)
    - Office of the Assistant Secretary for Public Health Emergency Preparedness
    - Health Resources and Services Administration
    - Centers for Disease Control and Prevention
  - Department of Defense
    - Office of the Assistant Secretary of Defense for Health Affairs
    - USTRANSCOM
    - USNORTHCOM
  - Department of Homeland Security
    - National Disaster Medical System
    - Federal Emergency Management Agency
  - Office of Veterans' Affairs
  - New York City Office of Emergency Management
  - Uniform Services University of the Health Sciences
  - AHRQ Integrated Delivery System Research Network Partner: Weil Medical College
  - Denver Health Medical Center
3. A project Development and Implementation Working Group was identified and formed with representation and participation by:
  - Denver Health Emergency Medicine
  - Denver Health Information Systems
  - Denver Health Health Services Research
  - HERDS
  - EMSsystem
  - Hospital Capacity Website

4. Five Advisory Group meetings were held during the duration of the project. These meetings were instrumental in guiding the project and achieving consensus on issues such as institutional bed definitions and specification of those data elements to be collected by the system. The results of the project were presented at the final Advisory Group meeting on July 12, 2005. A live demonstration of the HAvBED computer system was presented during that meeting. The minutes of these meetings are presented in Appendix B.
5. Site visits were made to several existing bed/resource availability systems to better understand the capabilities of these systems and to enlist agreement by these systems to provide an up-linked data feed to the HAvBED system during the periods of system testing and operation. The systems visited included EMSSystem® (Milwaukee, Wisconsin), the Hospital Capacity Website (Seattle, Washington) and the New York State Department of Health Hospital Emergency Response Data System (New York City). A system questionnaire was developed prior to these visits to optimize data gathering (Appendix C). Each of these systems agreed to participate in the HAvBED demonstration. Other systems operational in this area were investigated via conference call and web demonstration.
6. Site visits were conducted to two systems involved in patient tracking: the St. Louis Metropolitan Medical Response System (MMRS) and USTRANSCOM/TRAC<sup>2</sup>ES (Scott AFB, Ill) and one system involved with casualty identification (HERDS).
7. A software specification document was prepared to capture initial design elements of the desired HAvBED system (Appendix D).
8. A coalition of interested parties, including HAvBED staff, developed a communication protocol to be used in the communication between our partner systems and the HAvBED system. This protocol utilizes the Extensible Markup Language (XML) and is designed to allow easy expansion. (See Appendix E)
9. The HAvBED Project Working Group then designed and implemented the necessary software to make the HAvBED demonstration operational. This included data base design and implementation, web services and web interface design and implementation and geographic information system (GIS) interface design and implementation.
10. Hospitals that were not using any of our partner systems were solicited to enter their HAvBED data manually, thereby demonstrating the ability to incorporate data from all hospitals (and from potential alternative care sites), whether they are part of another system or not.
11. Three test periods for HAVBed data collection were specified. Test period #1 ran from June 20 through June 26, 2005 and involved a period of “Heightened Reporting”, i.e. hospitals were requested to enter bed availability data a minimum of once per day. This test period allowed initial evaluation of the adequacy of the system-to-system and manual data entry interfaces and the utility of the display of the bed availability data. Test Period #2 ran from June 27 through July 6, 2005 and utilized the data available from our system partners during periods of normal operation. The final test period, #3, ran from July 7 through July 31 and allowed final evaluation of the demonstration system. It, too, was a

period of “Heightened Reporting” with bed data being supplied on a daily basis. During this final test period, the usefulness the system in an EMS field environment was also evaluated.

## V. Results

### A. Review of Current Relevant Bed Availability Reporting Systems

#### Denver Health Medical Center

Denver Health Medical Center (DHMC) administrates all emergency medical service (EMS) 911 activity in the City and County of Denver, Colorado. To facilitate orderly transport of patients from the field to area hospitals, DHMC EMS dispatch must be aware of real-time hospital resource availability. A computer-based system to log and distribute this information has been in place since 1986. These data have also been available on a web-based system since 2002. Denver area hospitals have an interest in reporting to this system since it provides an ability to regulate hospital ED arrivals. Denver area paramedics are key users of this system and have the capability of accessing this system on laptop computers located in the ambulances. These data are summarized by hospital. Each hospital has access to its own data summary.

#### National Disaster Medical System (NDMS)

The NDMS is a section within the U.S. Department of Homeland Security (DHS), Federal Emergency Management Agency (FEMA), Response Division, Operations Branch, and has the responsibility for managing and coordinating the Federal medical response to major emergencies and Federally declared disasters including<sup>1</sup>:

- Natural Disasters
- Technological Disasters
- Major Transportation Accidents
- Acts of Terrorism including Weapons of Mass Destruction (WMD) Events

Working in partnership with the Departments of Health and Human Services (DHHS), Defense (DoD), and Veterans Affairs (VA), the NDMS Section serves as the lead Federal agency for medical response under the National Response Plan (NRP). The three primary objectives of NDMS are<sup>2</sup>:

- To provide health, medical and related social service response to a disaster area in the form of medical response units or teams and medical supplies and equipment.
- To evacuate patients who cannot be cared for in the affected area to designated locations elsewhere in the nation.
- To provide hospitalization in Federal hospitals and a voluntary network of non-Federal acute care hospitals that have agreed to accept patients in the event of a national emergency.

There are currently 1,656 NDMS participating hospitals, which represent about one third of all U.S. acute care hospitals providing a potential capacity of 100,000 beds.<sup>3</sup> NDMS hospital bed availability is currently reported using the following six categories:

---

<sup>1</sup> NDMS website: <http://www.ndms.dhhs.gov/>.

<sup>2</sup> Slide show presentation provided by William Joseph Kormos Jr., Lt Col, USAF, MSC, CHE, Force Health Protection and Readiness, Pentagon, Washington D.C.

<sup>3</sup> Telephone conversation on 3/8/04 with William Joseph Kormos Jr., Lt Col, USAF, MSC, CHE.

1. Medical /Surgical
2. Critical Care-Pediatrics
3. Critical Care-Adult
4. Pediatrics
5. Psychiatric
6. Burn

Participating NDMS hospitals report the current number of available beds (within 12 hours) and the maximum number of beds, by category, that could be made available within 24 and 48 hours. When NDMS is activated, these data are requested by NDMS federal coordinating centers (FCC's) as frequently as once per week. Reporting is via phone, fax or area-wide computerized bed availability systems. Figure 2 depicts the location of the NDMS FCC's throughout the U.S.

**Figure 2: National Disaster Medical System (NDMS) Federal Coordinating Centers (FCC's). (Military installations are squares; Veteran's Administration facilities are triangles.)**



## DHHS OASPHEP

The OASPHEP was established to direct preparation for, protect against, respond to, and recover from all acts of bioterrorism and other public health emergencies that affect the civilian population.<sup>4</sup> OASPHEP serves as the focal point within HHS for these activities, and directs and coordinates the implementation of a comprehensive HHS strategy. A major component of OASPHEP is the Office of Emergency Response (OER), transferred from the Office of Public Health and Science (OPHS), and formerly named the Office of Emergency Preparedness. OER is the primary OASPHEP component for emergency response operations. In carrying out this responsibility, OER utilizes the resources of the NDMS. The OASPHEP has also engaged in the longest continual activation of the NDMS in its history, beginning on September 11, 2001 through the end of August 2002.<sup>5</sup>

<sup>4</sup> U.S. Department of Health and Human Services. *Performance and Accountability Report, Fiscal Year 2002.*

<sup>5</sup> U.S. Department of Health and Human Services. *Performance and Accountability Report, Fiscal Year 2002.*

OASPHEP has established and operated the Secretary's Command Center (SCC) to serve as a single point of emergency contact for DHHS. The SCC has responded to over 8,000 communications and along with HHS emergency operations centers have monitored nearly 600 cases potentially related to terrorism. The OASPHEP SCC has also established the Hospital Asset Reporting System.

### **State of New York Department of Health / Greater NY Hospital Association**

New York's Hospital Emergency Response Data System (HERDS) combines geographic information systems (GIS) technology and a comprehensive, interactive database to provide health officials with online, real time data describing available hospital beds, medical supplies, personnel, numbers, status and immediate care needs of ill or injured persons, along with other urgent information to facilitate a rapid and effective emergency response.

At the direction of Governor Pataki, HERDS was developed by the State Health Department, in conjunction with the Greater New York Hospital Association, following the World Trade Center attacks. The system, which includes highly sophisticated features to ensure its security, is capable of responding to simultaneous emergencies, whether they occur in the same city or many different locations.

Should a health emergency occur, the State Health Department could use HERDS to generate a computer map of the affected area and identify and "activate" nearby hospitals. Once activated, hospitals participate in an online dialogue with health officials to provide real-time data about available beds, medications, equipment, staff and other essential information to address immediate needs and ensure that ill or injured persons are directed to hospitals best able to provide necessary care. This system is not used for daily, non-mass casualty operation.

The system also facilitates transport of patients to hospitals and transfer of assets among hospitals, so that resources can be directed where they are needed most. HERDS also includes a "patient locator" function since in an emergency people often flood hospitals with calls, trying to locate their loved ones who are missing and may require medical care. This function allows authorized persons to conduct searches for specific individuals by name, gender, age range and/or patient type (e.g. civilian, military, etc.). This comprises a patient locator function as opposed to a strict patient tracking function.

### **EMSystem®**

Headquartered in Milwaukee, Wisconsin, EMSystem® was founded in 1998 as a division of Infinity HealthCare, Inc., a multi-hospital emergency medicine physician practice. The company's founders initially designed EMSystem® to assist communities with addressing over-capacity in hospital emergency rooms. The purpose of this system is similar to the Denver Health web-accessible divert system described above.

EMSystem® is an internet based application that tracks the status of various resources within the emergency medical environment. According to the President of EMSystem®, Dr. Christopher Felton, this system is currently being used by nearly 20 percent of the hospitals in the U.S., including Colorado. Missouri, New Mexico, Arizona, Oklahoma, Nevada, Kentucky and Hawaii have already or are in the process of deploying EMSystem® statewide. EMSystem® lists the resources within a geographic region providing real-time resource status to system users. In providing real-time communications and resource management solutions, preparedness and



response to medical emergencies, mass casualty incidents, and public health incidents, including terrorist events are enhanced. All EMSsystem® applications are created with state-of-the-art technology consistent with emerging national data standards and are hosted in secure and redundant data centers to ensure continuous availability of the services and robust data security. Components of the data centers include multiple redundant application and database servers, redundant internet communication services and multiple back-up power sources.

Even though EMSsystem® is currently focused on relaying hospital ambulance divert status information, the system is expected to easily support the reporting of hospital bed availability. In addition, a patient tracking function has recently been introduced.

### **ReddiNet®**

ReddiNet® (Rapid Emergency Digital Data Information Network) is the product of a unique collaborative process that involved a range of healthcare industry end-users, and the not-for-profit organization, Healthcare Association of Southern California (HASC). After years of continuous use, testing and refinement, ReddiNet® provides emergency communications reliability to ensure continuous information sharing between emergency medical professionals during times of disaster.<sup>6</sup>

ReddiNet® provides emergency response professionals with crucial information, including:

- Hospital diversion status and reports
- Day-to-day resource assessment information
- Daily law enforcement bulletins
- Disaster assessment information
- Emergency preparedness information
- Managing incidents of weapons of mass destruction
- Extreme weather and environmental advisories
- Epidemics and other health crisis alerts
- Mass Casualty Incident management
- Metropolitan Medical Response System capabilities (MMRS)
- Victim search capabilities

This information is updated automatically, instantaneously and around the clock. The system not only improves decision-making at every level of emergency response, but also provides many day-to-day benefits and reporting functions. ReddiNet® helps coordinate hospital and paramedic services in the event of a major emergency. In non-emergency situations, ReddiNet® provides hospitals with daily diversion status updates to determine which hospitals can provide appropriate patient care.

### **State Hospital Capacity Web System**

This hospital resource capacity system was developed four years ago by Harborview Medical Center and University of Washington and is currently being used in Washington, Oregon and South Carolina. Additional states that are considering this system are Vermont, New Hampshire, Idaho and Nevada.

---

<sup>6</sup> <http://www.reddinet.com/>

This system includes dedicated, secure web access allowing hospitals to exchange status and other information to support daily and crisis operations. The system incorporates many features to support patient planning assumptions on a regional and statewide basis. The secure, password protected web site is designed to be updated daily by all hospitals, assuring that hospitals will use this critical resource in an emergency situation. This system allows hospitals to update status in real-time and at a time convenient to the hospital. This assures a common tool for all hospitals in a state to collect and disseminate critical information during a significant disaster event. Its use on a daily basis assures that hospitals are familiar with the web page and can access it during the time of crisis<sup>7</sup>.

The Washington State Hospital Capacity Web System collects the following information:

- Emergency Department Status
- Hospital Status
- Bed Census
- Supplies Status
- Support Services Status
- Calendar of Events
- Phonebook
- Radio Test
- Hospital and Support Services Reference Information
- Damage Assessment
- Patient Management
- Incident Log
- Announcements
- Smallpox Reporting
- Stage Announcements
- Compliance QA
- Diversion QA
- Documents
- Web Links
- Drill Site

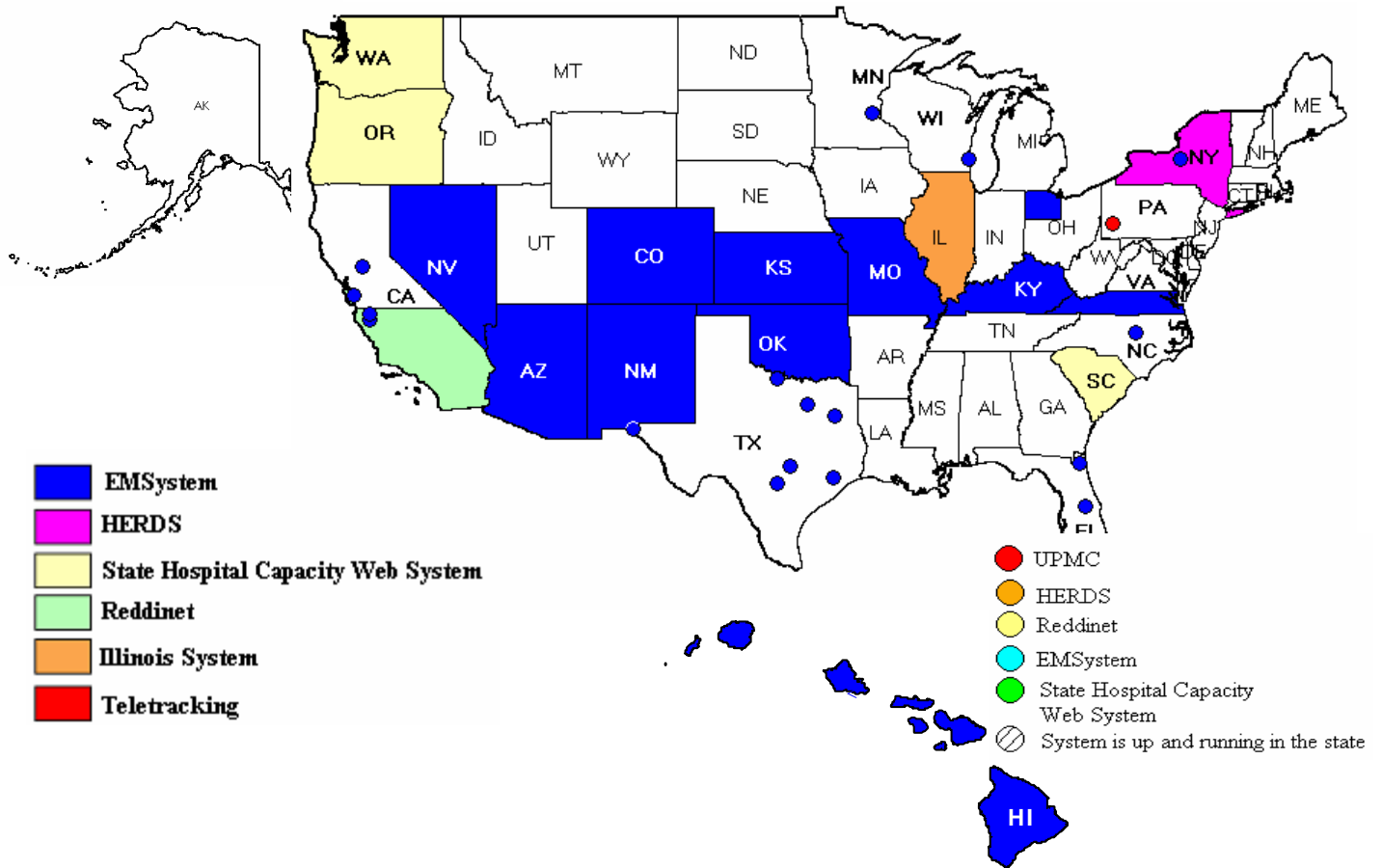
Of note, one component of this hospital inventory system is the hospital bed capacity report where hospitals identify bed availability using the 6 categories of beds defined by NDMS as well as operating room and emergency department beds. Each of the participating hospitals can view the other hospitals' information, assisting in the coordination of the sharing of resources during a disaster or emergency.

---

<sup>7</sup> <https://capacity.medical.washington.edu>.

Figure 3 depicts the states that either have or are considering the hospital divert reporting systems and hospital inventory systems described above.

**Figure 3: States That Have or Are Considering the Implementation of a Hospital Bed Availability and/or Hospital Divert Information System**



## **B. Review of Patient Tracking Systems**

### **TRANSCOM Regulating and Command & Control Evaluation System - TRAC<sup>2</sup>ES**

TRAC<sup>2</sup>ES is a patient tracking/movement/destination-assignment integrated software program developed for the Department of Defense to provide for the world wide transport of ill or injured soldiers. The initial development of TRAC<sup>2</sup>ES was begun by Science Applications International Corporation (SAIC) and completed by Booz Allen Hamilton. TRAC<sup>2</sup>ES is administered by USTRANSCOM, headquartered at Scott AFB, Illinois and utilizes four patient movement requirement centers (three fixed, one mobile). Future expansion of TRAC<sup>2</sup>ES may provide for patient movement, tracking and destination assignment for NDMS. At the present time, there are no other systems that interface with TRAC<sup>2</sup>ES; it operates as an independent system.

From an operational perspective, a request for patient movement is made to a TRAC<sup>2</sup>ES patient movement requirement center after the soldier has received initial medical care at a facility. The coordinators at the center then match the patient to an available military hospital bed as well as available transport modalities and manpower capabilities. Patient information gathered as part of the movement request includes identification number (Social Security number or other), current facility, ready date, reason for regulation (movement), classification (ambulatory, litter, etc), precedence, type of space required and space requirement estimate.

TRAC<sup>2</sup>ES currently supports bed availability from DOD, VA and NDMS hospitals. In normal operating mode, total bed numbers (not available beds) are updated twice a year from these institutions. In contingency mode, available/vacant bed numbers from these institutions may be updated on a daily basis. This contingency mode was last utilized at the beginning of the Iraq ground campaign.

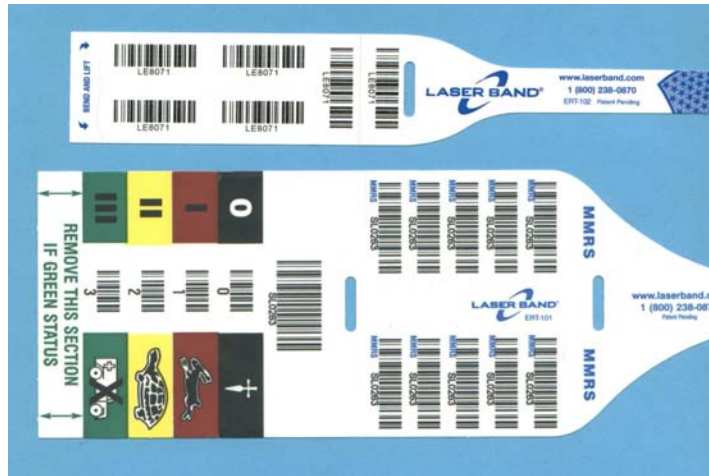
### **St. Louis Metropolitan Medical Response System (MMRS) – Raytheon**

The St. Louis EMS and MMRS utilize a patient tracking system that was developed in conjunction with the Raytheon Corporation. This system utilizes a bar-coded patient tag (Figure 4) which is placed on a patient in the field and is scanned via a wireless device and transmitted to a central computer along with the following data: patient condition; destination hospital; decontamination status and optional information of patient name, age, race, etc. Currently, modified Nextel phones are used for this data gathering and transmission function.

This system is in daily operation for approximately 65-70% of prehospital ambulance runs in the St. Louis metropolitan area. Once the patient has arrived at the destination hospital, their patient tag is scanned and these data transmitted to the central system. Patient location information may then be obtained via a website inquiry of this central database. This system is designed to support any mass casualty event as well.

Recurring costs for this system include telecommunications charges of approximately \$50 per month per ambulance. Patient tags cost \$.40 per tag for routine operation and \$1.00 per tag for the expanded disaster tags. This system is in the process of being deployed in Lansing, Michigan.

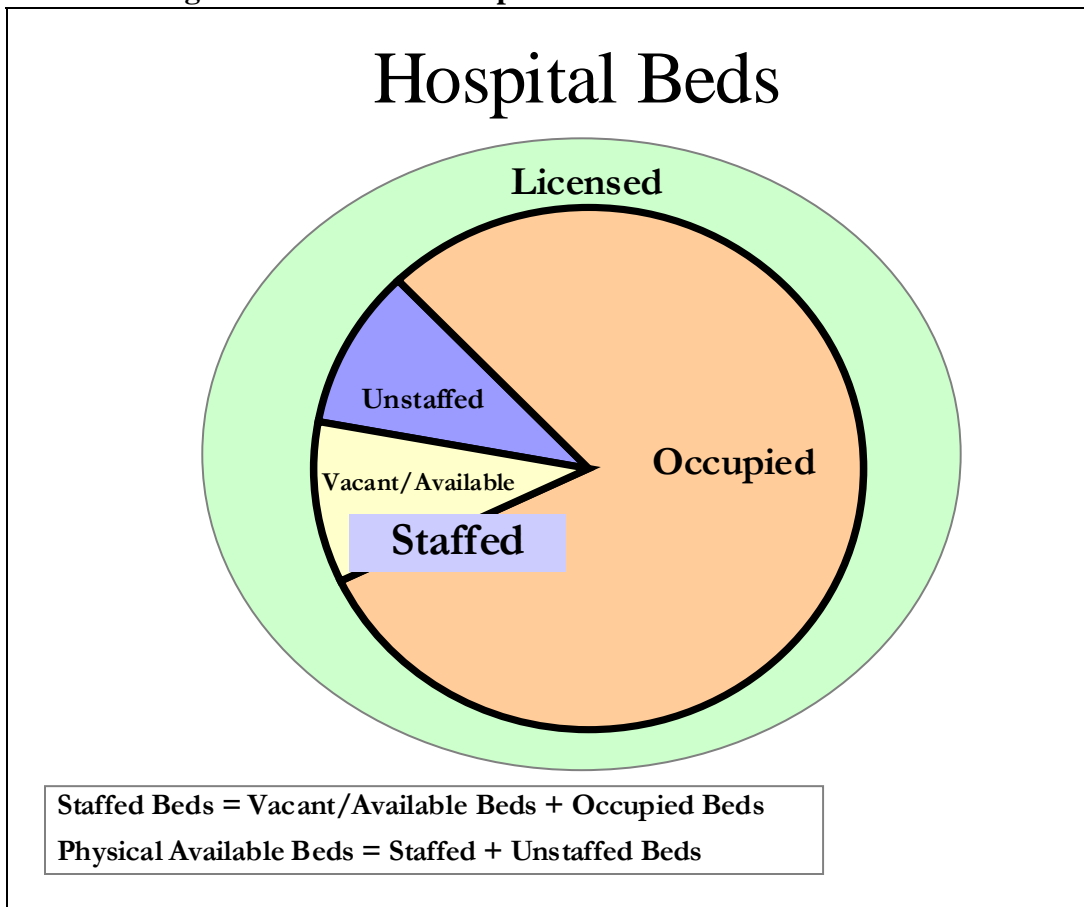
**Figure 4: St. Louis MMRS Patient Tracking Tags:  
Routine (upper) and Disaster (lower)**



## C. Hospital Bed Definitions

Through Advisory Group advice and consensus, definitions were created and agreed upon by all participants for the reporting of different statuses of a hospital bed and the available types of beds to be reported to the HAvBED system (Appendix F). In the HAvBED system, “Vacant/Available Beds” refers to beds that are vacant and to which patients can be immediately transported. These must include supporting space, equipment, medical material, ancillary and support services and staff to operate under normal circumstances. These beds are licensed, physically available and have staff on hand to attend to the patient who occupies the bed. In the HAvBED project, the term “Current Beds Available” refers to “Vacant/Available Beds”. The relationship between the different types of bed statuses is depicted in Figure 5.

**Figure 5: The relationship between different bed statuses.**



A description of the types of beds to be reported to the HAvBED project includes the following:

- **Adult Intensive Care (ICU):** beds that can support critically ill/injured patients, including ventilator support
- **Medical/Surgical:** also thought of as “Ward” beds
- **Burn:** thought of as Burn ICU beds, either approved by the American Burn Association or self-designated. (These beds are NOT to be included in other ICU bed counts.)
- **Pediatric ICU:** as for Adult ICU, but for patients 17 years and younger
- **Pediatrics:** “Ward Medical/Surgical” beds for patients 17 and younger

- **Psychiatric:** “ward” beds on a closed/locked psychiatric unit or ward beds where a patient will be attended by a sitter.
- **Negative Pressure/Isolation:** - Beds provided with negative airflow, providing respiratory isolation. NOTE: This value may represent available beds included in the counts of other types.
- **Operating Rooms:** – An operating room that is equipped and staffed and could be made available for patient care in a short period of time.

The Advisory Group requested, for the purposes of estimating institutional surge capability in dealing with patient disposition during a large mass casualty incident, the following bed availability estimates also be reported for each of the bed types described above:

- **24 hr Beds Available:** This value represents an informed estimate as to how many vacant (staffed, unoccupied) beds for each bed type above the current number that could be made available within 24 hours. This would include created institutional surge beds as well as beds made available by discharging/transferring patients.
- **72 hr Beds Available:** This value represents an informed estimate as to how many vacant (staffed, unoccupied) beds for each bed type above the current number that could be made available within 72 hours. This would include created institutional surge beds as well as beds made available by discharging/transferring patients.

Through use of these standardized definitions of bed statuses, bed types and estimates of future bed availability, there will be greater consistency amongst hospitals in reporting their bed availability information.

The Advisory Group also recommended the following hospital characteristics also be reported as data elements for the HAvBED project:

- **Emergency Department Status:**
  - **Open** – Accepting patients by ambulance
  - **Closed** – Not accepting patients by ambulance
  - **N/A** – Not Applicable (Hospital does not have an ED)
- **Mass Decontamination Facility Availability:**
  - **Available** – The institution has chemical/biological/radiological multiple patient decontamination capability
  - **Not Available** – The institution is unable to provide chemical/biological/radiological patient decontamination
- **Ventilators:**
  - **Available:** The number of ventilators that are present in the institution but are currently not in use and could be supported by currently available staff

Figure 6 summarizes the data elements specified for the HAvBED demonstration system and depicts the HAvBED web form for manual hospital data entry. The “AHA Beds” numbers are preloaded for each institution from their American Hospital Association Annual Hospital Survey. These data can be updated, if necessary.

**Figure 6: HAvBED Data Elements**

**HAvBED**  
Hospital Available Beds for Emergencies and Disasters

**Hospital Data Entry**

**Denver Health Medical Center**      777 Bannock Street      DENVER      CO      AHA: 6840290  
 Phone: (303)436-6000      Last Update: 7/1/2005 1:25:00 PM      Date: 7/5/2005 Time: 12:35 PM MDT

Bed Type	Available Beds			AHA Beds	Remarks
	Current	24 Hour	72 Hour		
Adult ICU	2	10	20	40	
Medical/Surgical	1	20	40	100	
Burn	0	0	0	0	
Pediatric ICU	2	2	2	2	
Pediatrics	5	4	8	15	
Psychiatric	3	6	12	32	
Negative Pressure/Isolation	2	6	12	N/A	
Operating Rooms	4			10	

Emergency Department Status:

Mass Decontamination Status:

Ventilators Available:



## D. Development of System-to-System Communication Protocol

As one of the main tenets of this project was the demonstration of the utility of amalgamating data from multiple existing systems, it was important to develop a standardized protocol for communicating with these systems. The Denver Health Working Group identified and worked with a volunteer non-profit group, the Emergency Interoperability Consortium that was facilitated by the ComCARE Alliance. These groups receive technical support from the Disaster Management eGov Initiative and have worked on the Common Alerting Protocol which is currently being implemented by the Department of Homeland Security, the National Oceanographic and Atmospheric Administrative and the US Department of Justice.

The goal of this affiliation was to attempt to define a National Incident Management System (NIMS)-compliant data exchange specification to provide standardized messages for: incident reporting; resource requesting, reporting, and dispatching; mass care reporting, and intelligence reporting. This specification is based on the EXtensible Markup Language (XML) and is called Emergency Data Exchange Language (EDXL). This specification is being submitted for stakeholder and industry review and formalization. This communication specification (schema) allows straight-forward Web services communication between otherwise incongruent computer systems. The HAvBED data elements, as defined in EDXL, are shown in Appendix G. The full EDXL schema is contained in Appendix E. A sample of the HAvBED EDXL schema is shown in Figure 7:

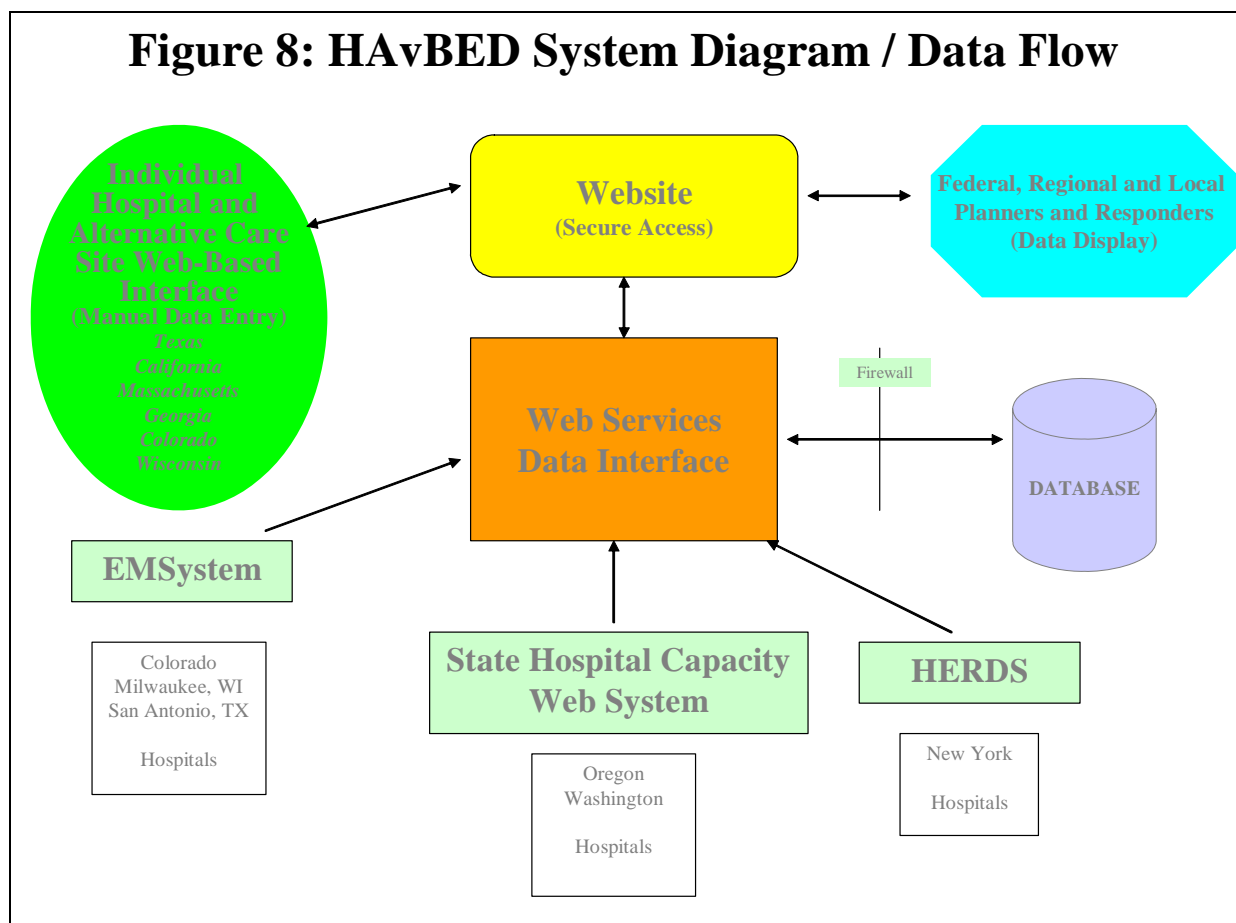
Figure 7: Sample of HAvBED EDXL Schema

```
<xs:element name="bedCapacity" minOccurs="0">
Specify status, availability, baseline and capacity counts for each of the bed types.
  <xs:complexType>
    <xs:element name="adultICU" type="rs:BedCapacity" minOccurs="0">
      <xs:annotation>
        Capacity status for adult ICU beds. These can support critically ill or injured patients,
        including ventilator support.
      </xs:annotation>
    </xs:element>
    <xs:element name="medicalSurgical" type="rs:BedCapacity" minOccurs="0">
      <xs:documentation> Capacity status for medical-surgical beds. These are also
      thought of as ward beds.
    </xs:element>
    <xs:element name="burn" type="rs:BedCapacity" minOccurs="0">
      <xs:annotation>
        <xs:documentation>Capacity status for burn beds.</xs:documentation>
      </xs:annotation>
    </xs:element>
  </xs:complexType>
</xs:element>
```

## E. Database and Web Development

The high level system architecture and data flow are shown in Figure 8. The database is comprised of a SQL (Server Query Language) server. This hospital database was designed to maintain an historical record of bed availability updates and allows the addition of new institutions to support the concept of creation of alternative care sites that could also be tracked by HAvBED. All web access is through a secure internet server: <https://www.HAvBED.org>. All programming in the system was written in Microsoft .NET, ASP.NET and C#.

A detailed description of the database and web services programming is provided in Appendix H. All program code and the HAvBED SQL database are provided in Appendix J (CD only).



The hospital database was preloaded with the following information using data from the American Hospital Association 2003 hospital survey (latest available as of fall, 2004):

- Hospital name
- Hospital street address
- Hospital phone number
- Hospital American Hospital Association (AHA) identification number

- Hospital geographic coordinates (latitude/longitude)
- Total beds in each HAvBED bed category

The database is primarily indexed and accessed by AHA number. For institutions without a designated AHA number (such as new hospitals, non-AHA member hospitals or alternative care sites), a pseudo-AHA number was assigned outside the range of the actual AHA numbers.

## **F. Geographic Information System (GIS) Development**

For improved usability, especially for information retrieval, a GIS component was developed, implemented and included in the HAvBED demonstration system. To provide this support ArcIMS 9.0 (ESRI, Inc) was installed and configured on the applications server and interfaced with the web services software. This configuration is described in detail in Appendix I. This functionality permitted retrieval and graphic display of information that could be viewed at a regional, state, county, city or street map level. Specific color-coding of display elements provided rapid visual information of hospital status with mouse-over links to specific hospital information.

## **G. Interface and Manual Data Entry**

As mentioned above, two mechanisms for hospital data entry were developed:

- 1) “automatic” data streaming from preexisting data collection systems provided by our system partners (HERDS, Washington Hospital Capacity Website, EMSsystem) via the EDXL protocol and
- 2) a web based manual data entry interface for those hospitals that were not part of an existing system.

The web site (for manual data entry and data retrieval) and data streaming web services were available 24 hours/day, 7 days/week during the testing periods. The data streaming system partners and the hospitals for which they provided data were:

- Washington Hospital Capacity Website
  - Washington Hospitals
  - Oregon Hospitals
- EMSsystem
  - Colorado Hospitals
  - Milwaukee, Wisconsin Hospitals
  - San Antonio, Texas Hospitals
- HERDS
  - New York State Hospitals

A sample of each of our system partners’ data entry screens are shown in Figures 9-11.

Figure 9 is a data screen from the Washington Bed Capacity Website. Data entered into this system that are congruent with the HAvBED data elements are captured and transmitted to the HAvBED system.

Figure 9: Washington Bed Capacity System Interface

ED STATUS   BED CENSUS   SUPPLY STATUS   SUPPORT SERVICES STATUS																		
(View Bed Capacity Definition) Trauma Region: Central																		
Bed Census for Central Trauma Region																		
Hospital Status	Bed Census Last Updated	ED Last Updated	ALS/CC Last Updated	New Patients	Why Not? NOTE 1	Activated Disaster Plan	MASS DECON Capacity (TVI, etc.) NOTE 2	Hospital Disaster Capacity Accept NOTE 3	ER CAPACITY NOW (Alpha-I)	ER CAPACITY Within 30 minutes (Alpha-II)	OR CAPACITY Within 30 minutes (Bravo-I)	OR CAPACITY Within 60 minutes (Bravo-II)	MED/SURG CAPACITY Available Beds (Charlie-I)	ICU Available Beds (Charlie-II)	CCU Available Beds (Charlie-III)	PEDS Available Beds (Charlie-IV)	PSYCH Available Beds (Charlie-V)	Hospital Disaster Capacity Received NOTE 4
<b>Autumn Gen.</b>	8/21/05 - 10:05 Inactive	7/6/2005 6:17:07 PM	7/6/2005 6:17:07 PM	0	No	No	A	23 27	7	10	10	15	25	5	5	5	5	1 126
<b>Childrens</b>	8/21/05 - 10:12 Inactive	8/21/2005 10:56:48 AM	8/21/2005 10:56:48 AM	0	No	No	N	0	1	0	0	5	50	4	0	0	0	0
<b>Enumclaw</b>	8/21/05 - 10:12 Inactive	8/21/2005 10:56:48 AM	8/21/2005 10:56:48 AM	0	No	No	N	0	6	8	0	1	4	2	2	2	2	0
<b>Evergreen</b>	8/21/05 - 10:05 Inactive	8/21/2005 10:56:48 AM	8/21/2005 10:56:48 AM	0	No	No	A	0	0	0	4	0	0	3	5	3	5	0
<b>GH - Central</b>	8/21/05 - 10:13 Inactive	8/21/2005 10:56:48 AM	8/21/2005 10:56:48 AM	0	No	No	A	0	8	8	1	2	5	3	1	2	11	0
Bed Census for Central Trauma Region																		
Hospital Status	Bed Census Last Updated	ED Last Updated	ALS/CC Last Updated	New Patients	Why Not? NOTE 1	Activated Disaster Plan	MASS DECON Capacity (TVI, etc.) NOTE 2	Hospital Disaster Capacity Accept NOTE 3	ER CAPACITY NOW (Alpha-I)	ER CAPACITY Within 30 minutes (Alpha-II)	OR CAPACITY Within 30 minutes (Bravo-I)	OR CAPACITY Within 60 minutes (Bravo-II)	MED/SURG CAPACITY Available Beds (Charlie-I)	ICU Available Beds (Charlie-II)	CCU Available Beds (Charlie-III)	PEDS Available Beds (Charlie-IV)	PSYCH Available Beds (Charlie-V)	Hospital Disaster Capacity Received NOTE 4
<b>GH - East</b>	8/21/05 - 10:05 Inactive	8/21/2005 10:56:47 AM	8/21/2005 10:56:47 AM	0	No	No	N	0	7	9	0	2	3	1	5	2	0	0
<b>Harborview</b>	7/6/05 16:11	7/6/2005 4:15:45 PM	7/6/2005 4:15:45 PM	No	E	No	F	5 5 5	10	10	1	7	3	0	0	0	0	2 225 0
<b>Highline</b>	8/21/05 - 10:13 Inactive	8/21/2005 10:56:47 AM	8/21/2005 10:56:47 AM	0	No	No	N	0	13	11	0	0	8	5	2	2	0	0
<b>Northwest</b>	8/21/05 - 10:05 Inactive	8/21/2005 10:56:47 AM	8/21/2005 10:56:47 AM	0	No	No	A	0	15	23	2	4	2	5	3	0	0	0
<b>Overlake</b>	8/21/05 - 10:13 Inactive	8/21/2005 10:56:47 AM	8/21/2005 10:56:47 AM	0	No	No	A	0	5	10	3	1	0	2	1	0	2	0
Bed Census for Central Trauma Region																		
Hospital Status	Bed Census Last Updated	ED Last Updated	ALS/CC Last Updated	New Patients	Why Not? NOTE 1	Activated Disaster Plan	MASS DECON Capacity (TVI, etc.) NOTE 2	Hospital Disaster Capacity Accept NOTE 3	ER CAPACITY NOW (Alpha-I)	ER CAPACITY Within 30 minutes (Alpha-II)	OR CAPACITY Within 30 minutes (Bravo-I)	OR CAPACITY Within 60 minutes (Bravo-II)	MED/SURG CAPACITY Available Beds (Charlie-I)	ICU Available Beds (Charlie-II)	CCU Available Beds (Charlie-III)	PEDS Available Beds (Charlie-IV)	PSYCH Available Beds (Charlie-V)	Hospital Disaster Capacity Received NOTE 4
<b>St. Francis</b>	8/21/05 - 10:05 Inactive	8/21/2005 10:56:48 AM	8/21/2005 10:56:48 AM	0	No	No	A	0	1	2	2	4	1	1	0	0	0	0
<b>Swedish - Ballard</b>	8/21/05 - 10:05 Inactive	8/21/2005 10:56:57 AM	8/21/2005 10:56:57 AM	0	No	No	A	0	7	12	1	2	10	8	2	0	0	0
<b>Swedish - First Hill</b>	8/21/05 - 10:05 Inactive	8/21/2005 10:56:48 AM	8/21/2005 10:56:48 AM	0	No	No	A	0	0	0	0	0	0	0	0	0	0	0

Figure 10 represents an augmented data entry display from EMSsystem. Data entered via this display are transmitted to the HAvBED system.

Figure 10: EMSsystem Interface

The screenshot shows a web-based data entry form titled "Routine Bed Count Data Collection 2". The form is set within a browser window with tabs for "Report", "message", and "Regional Info". The main heading is "Routine Bed Count Data Collection 2" with a sub-heading "Please enter the following information about your facility's staffed beds and resource availability." A red note states "\*\* Indicates the information is required." The form contains the following fields:

- Adult ICU Current:
- Adult ICU Additional 24 hrs.:
- Adult ICU Additional 72 hrs.:
- Medical/Surgical Current:
- Medical/Surgical Additional 24 hrs.:
- Medical Surgical Additional 72 hrs.:
- Burns Current:
- Burns Additional 24 hrs.:
- Burns Additional 72 hrs.:
- Pediatric ICU Current:
- Pediatric ICU Additional 24 hrs.:
- Pediatric ICU Additional 72 hrs.:
- Pediatrics Current:
- Pediatrics Additional 24 hrs.:
- Pediatrics Additional 72 hrs.:
- Psychiatric Current:
- Psychiatric Additional 24 hrs.:
- Psychiatric Additional 72 hrs.:
- Negative Pressure Isolation:
- Operating Rooms Current:
- Operating Rooms Additional 24 hrs.:
- Operating Rooms Additional 72 hrs.:
- Emergency Department Status:
- Mass Decontamination Status:
- Ventilators Available\*\*:
- Reporting Hospital\*\*:
- Comments:

A "Post Message" button is located at the bottom right of the form.

A sample data entry display from the HERDS system is shown in Figure 11. After data entry, those data elements that are also resident in the HAvBED system are captured and transmitted to HAvBED.

**Figure 11: HERDS Interface**

Version: 1.1
Emergency Incident Data
Date: 7/6/2005  
Time: 12:37:55 PM

Main
[Click this tab for Page 2 - Comments](#)

**Weekly Bed Availability Count**  
**(Wednesday, Jul 6 2005 10:00AM)**

**St Peters Hospital**
**Weekly Available Bed Count**

Reporter Contact Information	
*Reporters Name	<input style="width: 100%;" type="text"/>
Reporters Title	<input style="width: 90%;" type="text"/>
*Reporters Phone	<input style="width: 80%;" type="text"/>
Reporters Fax	<input style="width: 80%;" type="text"/>
ED Patients waiting for hospital admission	
*Adults	<input style="width: 40px;" type="text"/>
*Pediatric (<16)	<input style="width: 40px;" type="text"/>
Available Adult Beds	
*General Medical/Surgical	<input style="width: 40px;" type="text"/>
*Critical Care	<input style="width: 40px;" type="text"/>
*How many Airborne Infection Isolation Beds could be available for Airborne Infectious Patients	<input style="width: 40px;" type="text"/>
*Burn Beds	<input style="width: 40px;" type="text"/>
Available Pediatric Beds	
*General Medical/Surgical	<input style="width: 40px;" type="text"/>
*Critical Care	<input style="width: 40px;" type="text"/>
*How many Airborne Infection Isolation Beds could be available for Airborne Infectious Patients	<input style="width: 40px;" type="text"/>

[Print Form](#)

For those hospitals that are not participating in a bed reporting system, a web-based interface was developed to allow entry of data directly into the HA<sub>v</sub>BED system database. This manual data entry screen for a single hospital is shown in Figure 12. The data elements on this screen are identical to the data elements reported by our system partners via the system-to-system interface.

**Figure 12. HA<sub>v</sub>BED Hospital Web Manual Data Entry Screen**

**Denver Health Medical Center**  
 777 Bannock Street DENVER CO AHA: 6840290  
 Phone: (303)436-6000 Last Update: 7/1/2005 1:25:00 PM Date: 7/5/2005 Time: 12:35 PM MDT

Bed Type	Available Beds			AHA Beds	Remarks
	Current	24 Hour	72 Hour		
Adult ICU	2	10	20	40	
Medical/Surgical	1	20	40	100	
Burn	0	0	0	0	
Pediatric ICU	2	2	2	2	
Pediatrics	5	4	8	15	
Psychiatric	3	6	12	32	
Negative Pressure/Isolation	2	6	12	N/A	
Operating Rooms	4			10	

Emergency Department Status: Open  
 Mass Decontamination Status: Available  
 Ventilators Available: 6

Save

For manual data entry, the user entered the requested data on this web form and then mouse-clicked the “Save” button, causing that hospital’s data to be updated in the database. Hospitals using this mechanism for data entry included:

- Safety Net Hospitals:
  - Parkland Medical Center, Dallas, Texas
  - San Francisco General Hospital, San Francisco, California
  - Boston Medical Center, Boston, Massachusetts
  - Grady Health System, Atlanta, Georgia
  - LA County Harbor UCLA, Los Angeles, California
- Madison, Wisconsin Area Hospitals:
  - Divine Savior Healthcare
  - Memorial Hospital of Lafayette County
  - Upland Hills Health
  - Columbus Community Hospital

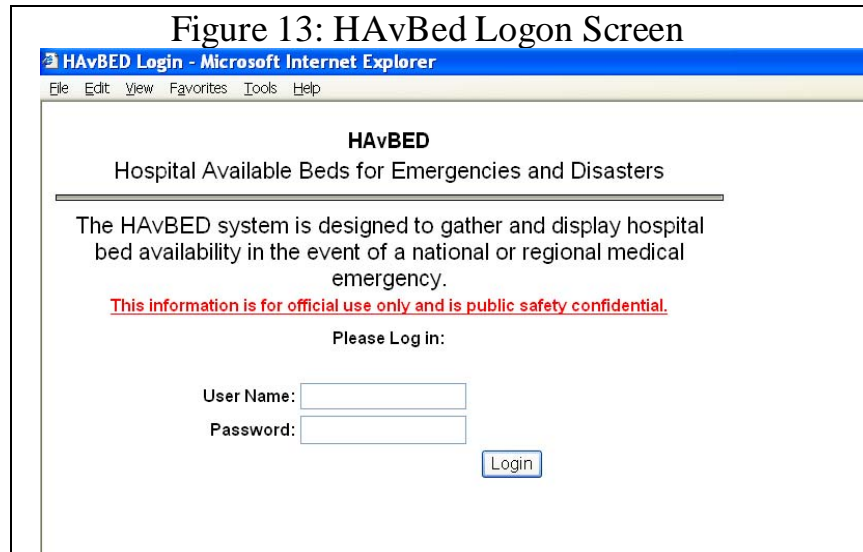
The web site was also used to retrieve and display amalgamated data (see next section).



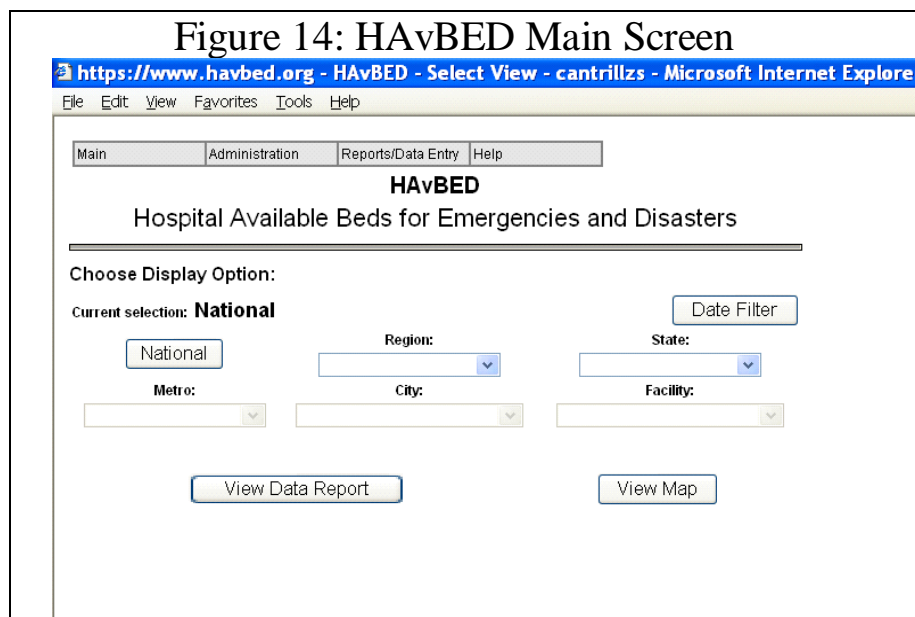
## H. Demonstration of the Real Time Hospital Bed Available (HA<sub>v</sub>BED) System

The most useful approach for education of the reader as to the capabilities of the HA<sub>v</sub>BED demonstration system is to provide a virtual tour of its operation.

Immediately upon accessing the HA<sub>v</sub>BED secure web site, the user is presented with the logon screen depicted in Figure 13.

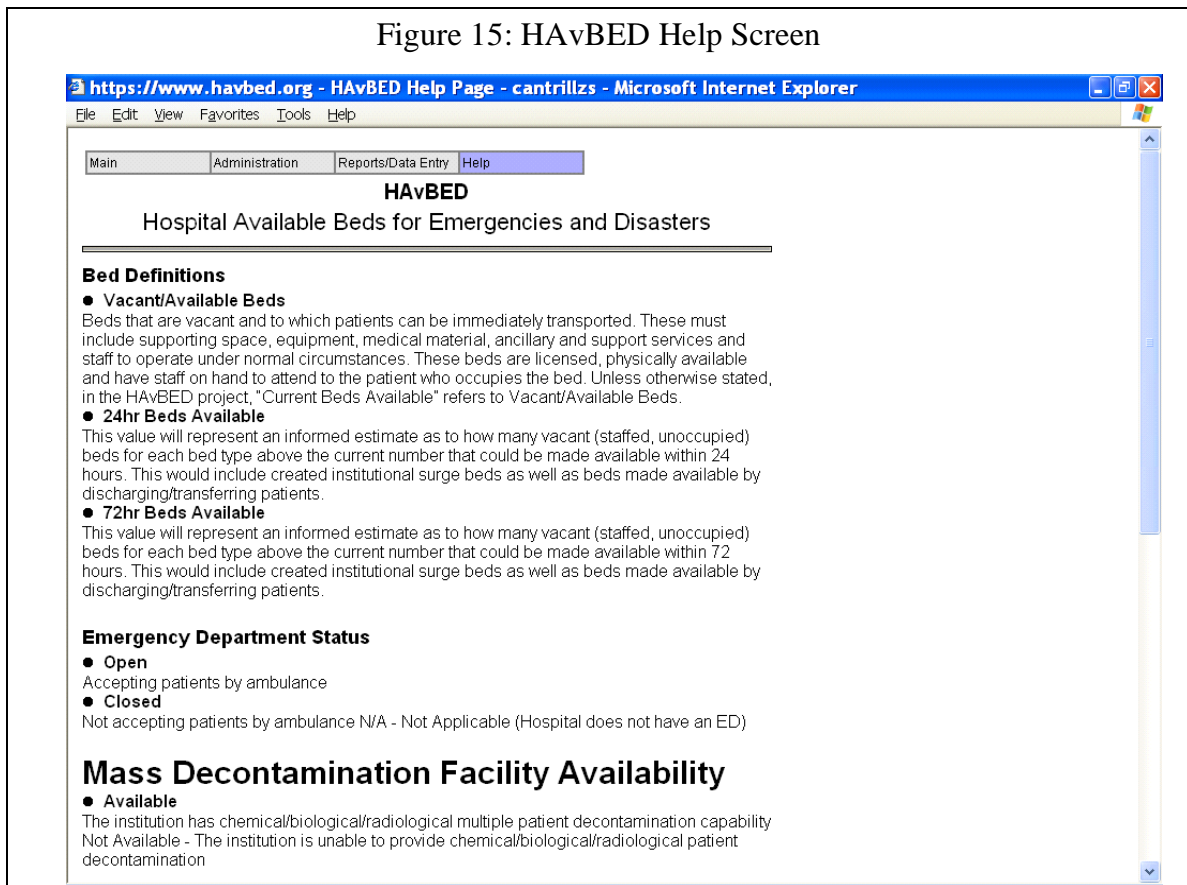


This logon screen allows the system to be password-protected, and, by using predetermined access rights, limits the user to specific sections of the system relevant to their approved access level (e.g. data for a specific hospital, a specific state, a specific region, etc). After signing on, the user then sees the HA<sub>v</sub>BED main screen, shown in Figure 14.

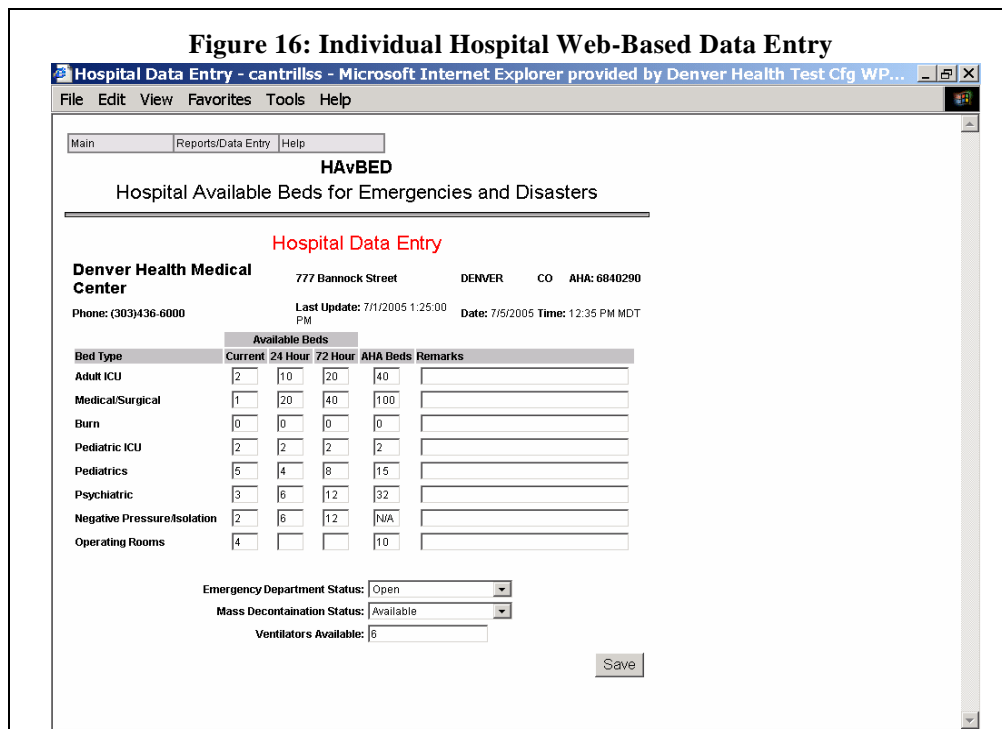


All functions use this screen as the home or starting off point. Clicking the “Help” selection on the gray bar takes the user to the help display, a portion of which is shown in Figure 15. This section deals with the data field definitions as described in Section V-C.

Figure 15: HAvBED Help Screen

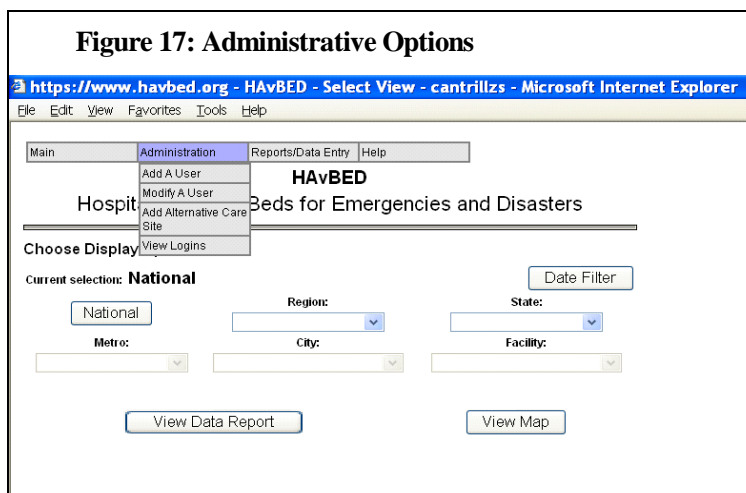


If the user has data entry rights for a specific institution, clicking on the “Reports/Data Entry” selection would result in the data entry form for that specific institution to be presented, as shown in Figure 16.



Data for the specific institution could then be entered for update in the database. Clicking the “Save” button then uploads the entered data into the HAvBED system.

For those users with administrative privileges”, mousing over the “Administration” selection on the gray bar allows selection, via a drop-down list, of any of the administrative functions: “Add a User”; “Modify a User”; “Add Alternative Care Site”, or “View Logins”, as shown in Figure 17.



It is expected that during a surge event it will be necessary to add non-hospital alternative care site facilities to the HAvBED database. The Facility Creation Display Screen in Figure 18 allows users to add alternative care site identifying information to the HAvBED system, such as name and location. Note that this display may be used to enter either a new hospital or an alternative care site. In this example, the user has entered the identifying information necessary to create an alternative care site.

**Figure 18: Creating an Alternative Care Facility (or New Hospital)**

**HavBED**  
Hospital Available Beds for Emergencies and Disasters

**Create Facility**

Type of Facility:  Alternative Care Site  Hospital/Medical Institution

Medical Institution/Alternative Care Site Name: [Lowry AFB Hanger 2]

Name of Chief Administrator or Contact: [Chuck Steaks]

Street Address: [1945 Lowry Blvd]

City: [Denver] State: [Colorado]

Zip Code: [80247] Telephone Number: [303-436-7174]

County: [Denver]

AHA Hospital Identification Number or Alternative Care Identification Number: [8000321]

If Alternative Care Site, Name of Operating Facility: [UCHSC]

Longitude: (###.#####) [-104.90] Latitude: (###.#####) [39.40]

Metropolitan Statistical Area (MSA) Code: [ ]

NDMS Participant:  Yes  No

TRICARE Participant:  Yes  No

[Save]

Once an alternative care facility has been created, authorized users can then access the bed availability/update screen to enter appropriate bed availability information (Figure 19).

**Figure 19: Data Entry For an Alternative Care Facility**

**HavBED**  
Hospital Available Beds for Emergencies and Disasters

**Alternative Care Site Data Entry**

**Lowry AFB Hanger 2** 1945 Lowry Blvd DENVER CO  
Phone: (303)436-7174 Last Update: 7/6/2005 3:28:00 PM Date: 7/7/2005 Time: 7:06 AM MDT

Bed Type	Available Beds			Remarks
	Current	24 Hour	72 Hour	
Beds	[15]	[30]	[30]	[No peds capability]

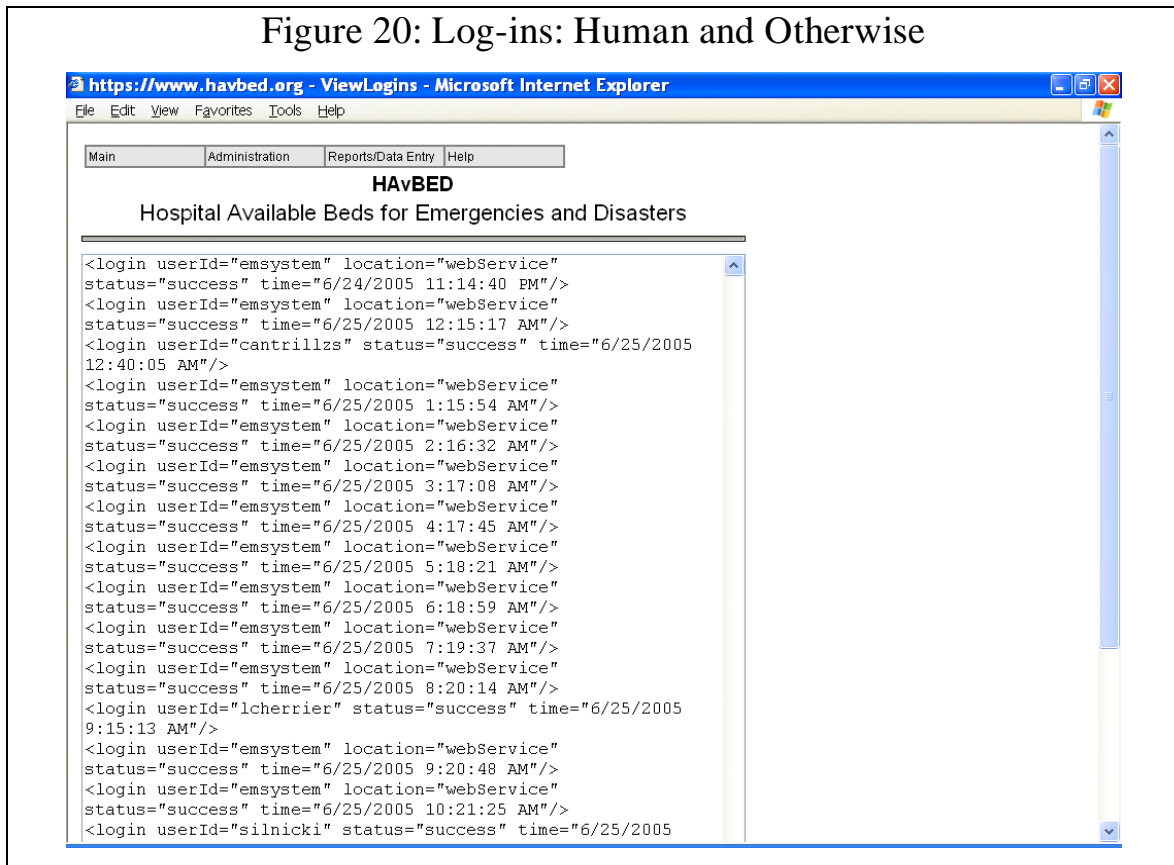
Mass Decontamination Status: [Unavailable]

Ventilator Capable: [No]

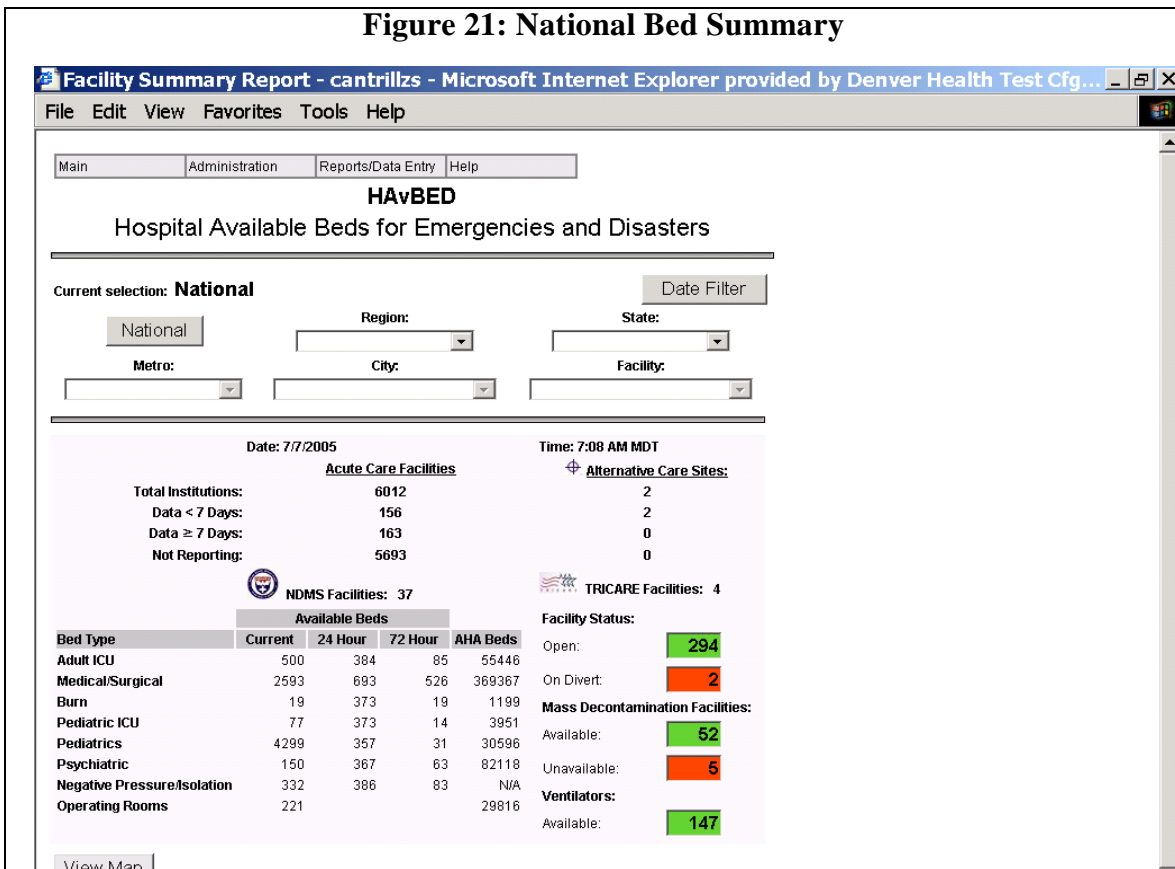
[Save]

If the user with “Administrative Rights” selects the “View Logins” option on the main screen, the screen as shown by Figure 20 would be presented. All log-ins to the HAvBED system, whether from human users or systems-to-system communication are recorded and reported. This allows monitoring of system activity and the detection of potential communication problems.

Figure 20: Log-ins: Human and Otherwise

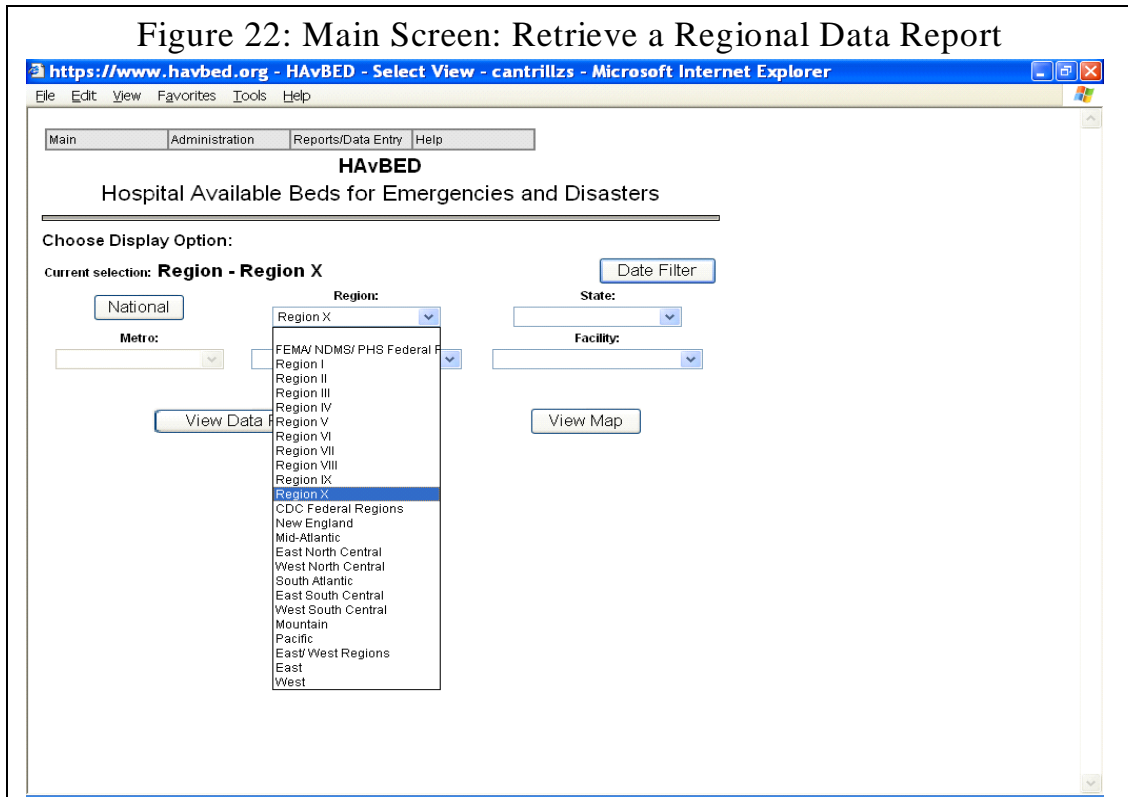


On the main display (Figure 14), selecting the “National” button and then the “View Data Report” selection, the user would then see the national summary of available resources (Figure 21). This summary report would only be accessible to those users granted viewing rights to obtain data on a national level.



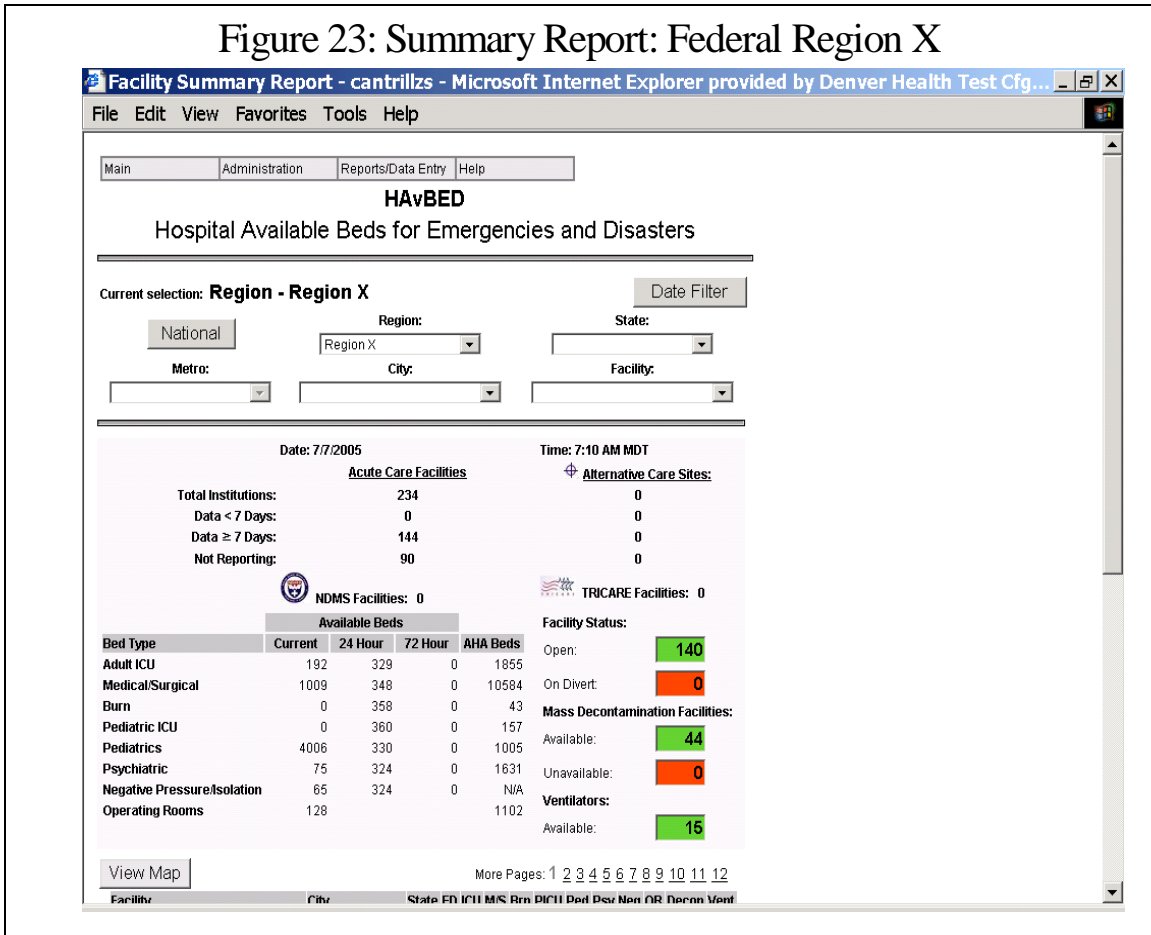
Note that both acute care and alternative care facilities are summarized as well as NDMS and TRICARE facilities. (These last two data sets were simulated for purposes of this project.) Data are also summarized concerning availability of mass decontamination facilities and ventilators.

Returning to the main display and selecting “Region” provides a drop-down list that allows the user to view data for any of the specified regions (Figure 22). This summary report would only be accessible to those users granted viewing rights for regional data.



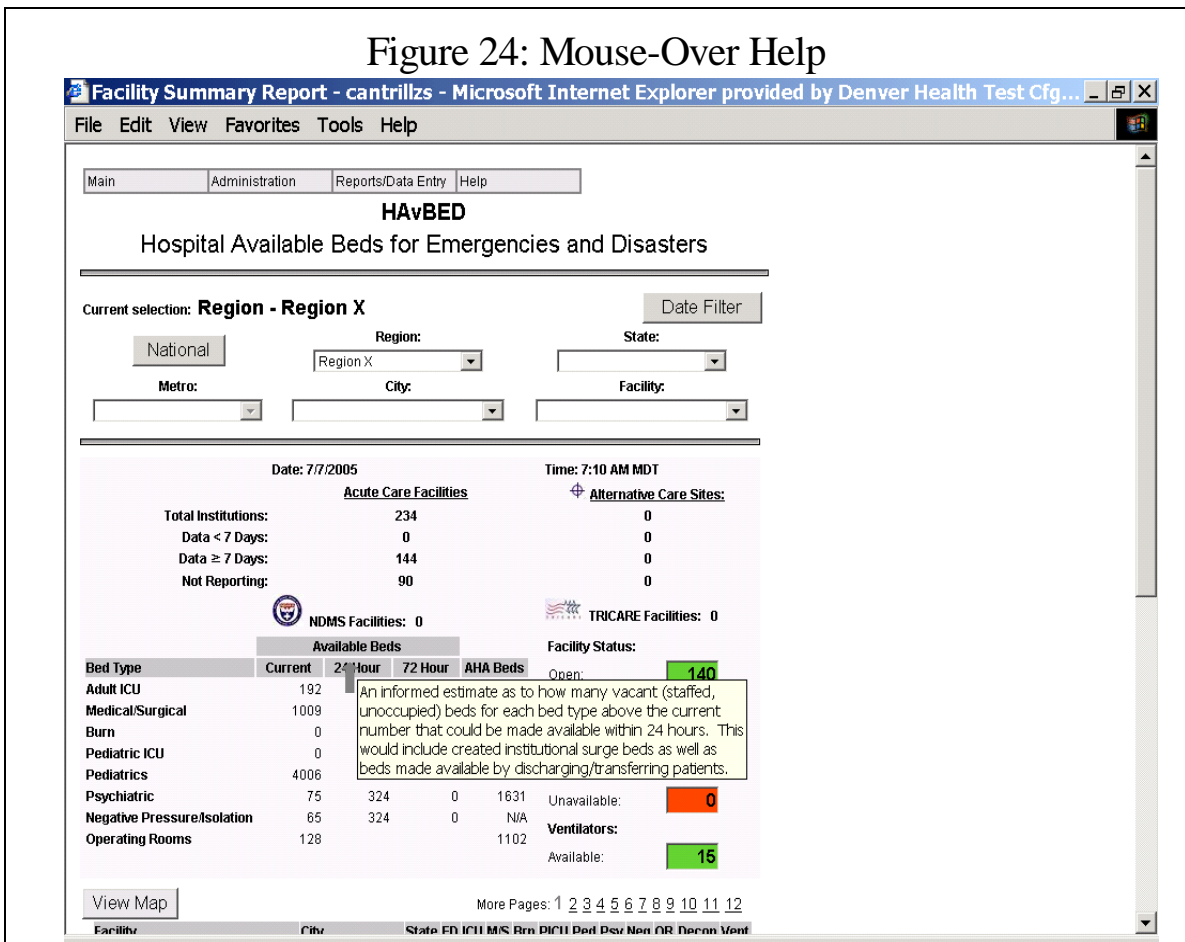
In this case, the user selects “Region X” and then “View Data Report.” The report shown in Figure 23 is then displayed, providing data for all hospitals in Federal Region X.

Figure 23: Summary Report: Federal Region X



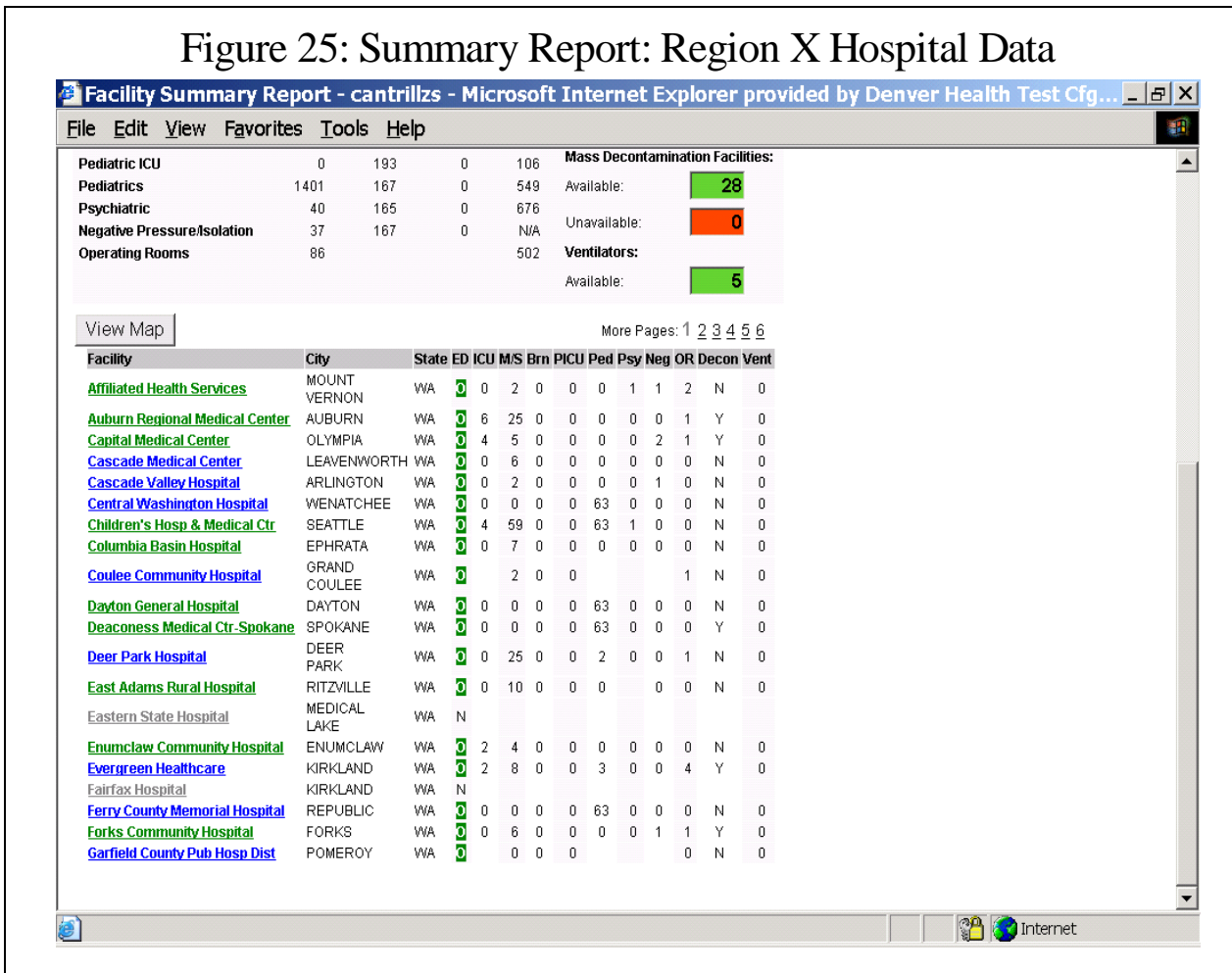


If the user mouses over the titles of the various data fields, an expanded definition of each field is displayed. In Figure 24, the user mouses over the “24 Hour” column header (marked with an arrow), causing the complete definition for this field to appear.



Note that there are additional data on this frame as indicated by the scroll bar on the right. Specifically, all hospitals in this region are listed alphabetically with their respective summary data reports. Quick access to hospitals further down the list is provided by clicking on the “Page” number provided at the bottom of the screen.

Scrolling down on this same display shows the first of several pages of individual hospital summary data, as shown in Figure 25.



Note that the facility names are displayed in different colors:

- Green – Data received within past 7 days
- Blue – Data received more than 7 days ago
- Gray – No data received for this hospital

Note also that the data for the different bed types are displayed in columnar form.

**PLEASE NOTE: FOR PURPOSES OF INSTITUTIONAL PRIVACY, IN THIS REPORT, ALL INDIVIDUAL HOSPITAL DATA HAVE BEEN ALTERED AND DO NOT REPRESENT ACTUAL HOSPITAL CONDITIONS.**

Figure 26 illustrates how mousing over any of the column titles reveals an expanded column title as shown here for the “ICU” column.

Figure 26: Mouse-Over - Bed Types

The screenshot shows a web browser window titled "Facility Summary Report - cantrillz - Microsoft Internet Explorer provided by Denver Health Test Cfg...". The browser's menu bar includes "File", "Edit", "View", "Favorites", "Tools", and "Help".

At the top, there is a summary table with columns: "Bed Type", "Current", "Closed", "Total", and "Inn Beds". The rows include:
 

- Adult ICU: 114, 165, 0, 867
- Medical/Surgical: 713, 184, 0, 5022
- Burn: 0, 185, 0, 26
- Pediatric ICU: 0, 187, 0, 106
- Pediatrics: 1393, 165, 0, 549
- Psychiatric: 40, 163, 0, 676
- Negative Pressure/Isolation: 33, 165, 0, N/A
- Operating Rooms: 83, 0, 0, 502

To the right of this table are statistics:
 

- Open: 82 (green bar)
- On Divert: 0 (red bar)
- Mass Decontamination Facilities: Available: 28 (green bar), Unavailable: 0 (red bar)
- Ventilators: Available: 5 (green bar)

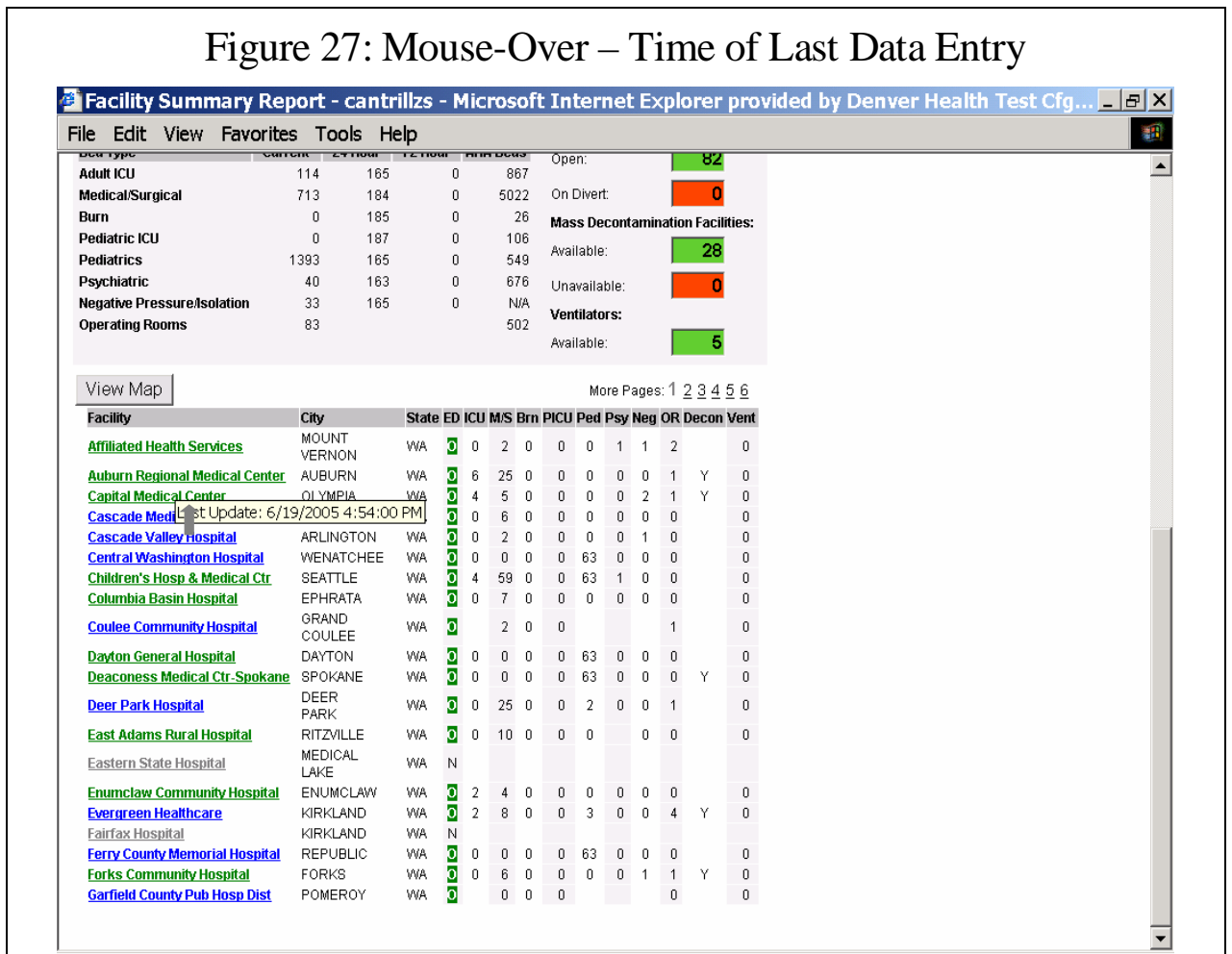
Below the summary table is a "View Map" button and a pagination control "More Pages: 1 2 3 4 5 6".

The main data table has the following columns: "Facility", "City", "State", "ED", "ICU", "M/S", "Brn", "PICU", "Ped", "Psy", "Neg", "OR", "Decon", and "Vent". A mouse-over tooltip is displayed over the "ICU" column header, showing the text "Adult ICU beds available".

The data rows include various hospitals such as "Affiliated Health Services", "Auburn Regional Medical Center", "Capital Medical Center", "Cascade Medical Center", "Cascade Valley Hospital", "Central Washington Hospital", "Children's Hosp & Medical Ctr", "Columbia Basin Hospital", "Coulee Community Hospital", "Dayton General Hospital", "Deaconess Medical Ctr - Spokane", "Deer Park Hospital", "East Adams Rural Hospital", "Eastern State Hospital", "Enumclaw Community Hospital", "Evergreen Healthcare", "Fairfax Hospital", "Ferry County Memorial Hospital", "Forks Community Hospital", and "Garfield County Pub Hosp Dist".

Mousing over the facility name reveals the last date/time that data for that facility were updated. Figure 27 demonstrates how mousing over “Cascade Valley Hospital” causes the display of the last time that data were updated for that hospital.

Figure 27: Mouse-Over – Time of Last Data Entry

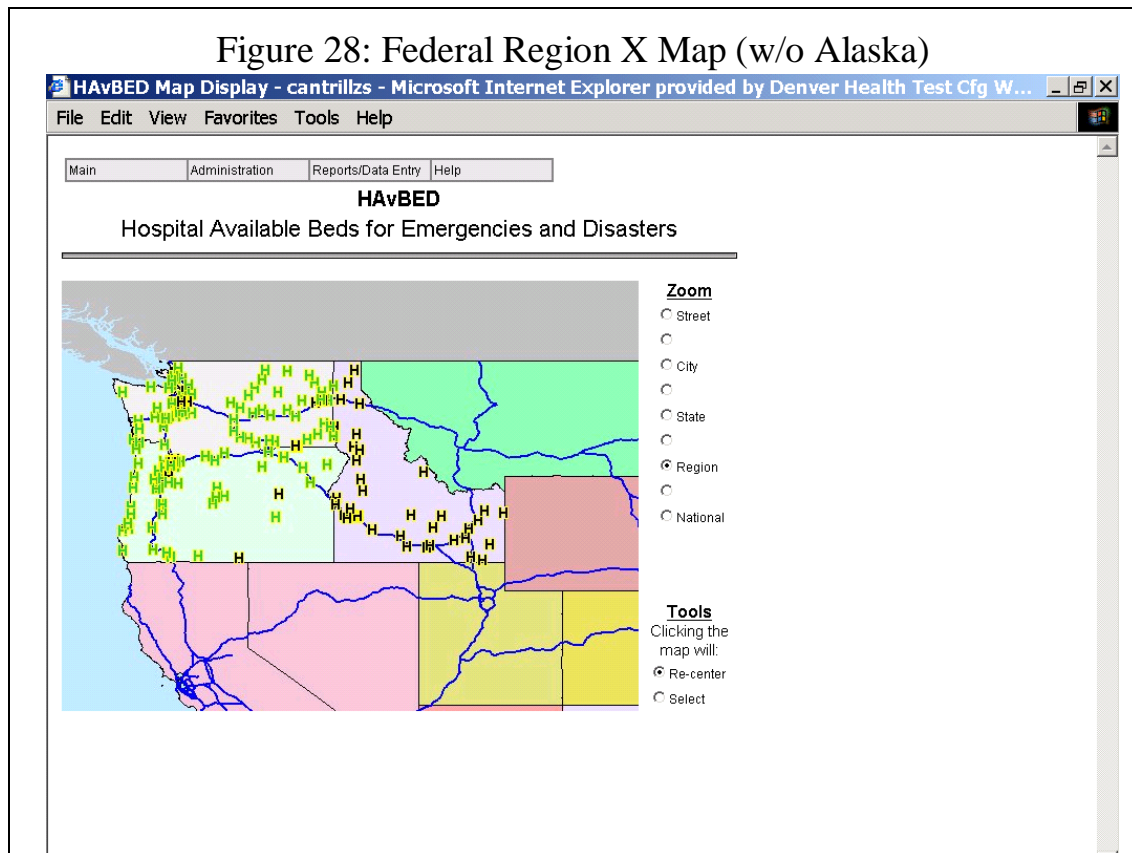


Selecting the “View Map” option on this screen (Figure 27) invokes the GIS display for these data (from Federal Region X) as shown in Figure 28. (For reasons of clarity of demonstration, we have removed Alaska from the display.)

On this display, the hospital indicator (“H”) has been color-coded to provide a rapid visual assessment of capabilities:

- Green “H” – ED open to receive patients
- Red “H” – ED closed to ambulance patients (on “divert”)
- Black “H” – No data received for this hospital.

Alternative care sites, if present, would be similarly represented, but with an appropriately colored “A” indicator.



By using the “Zoom” column on the right side of the map display, the user can then zoom down to the state level as shown in Figure 29.

Figure 29: Zooming Down to Washington State

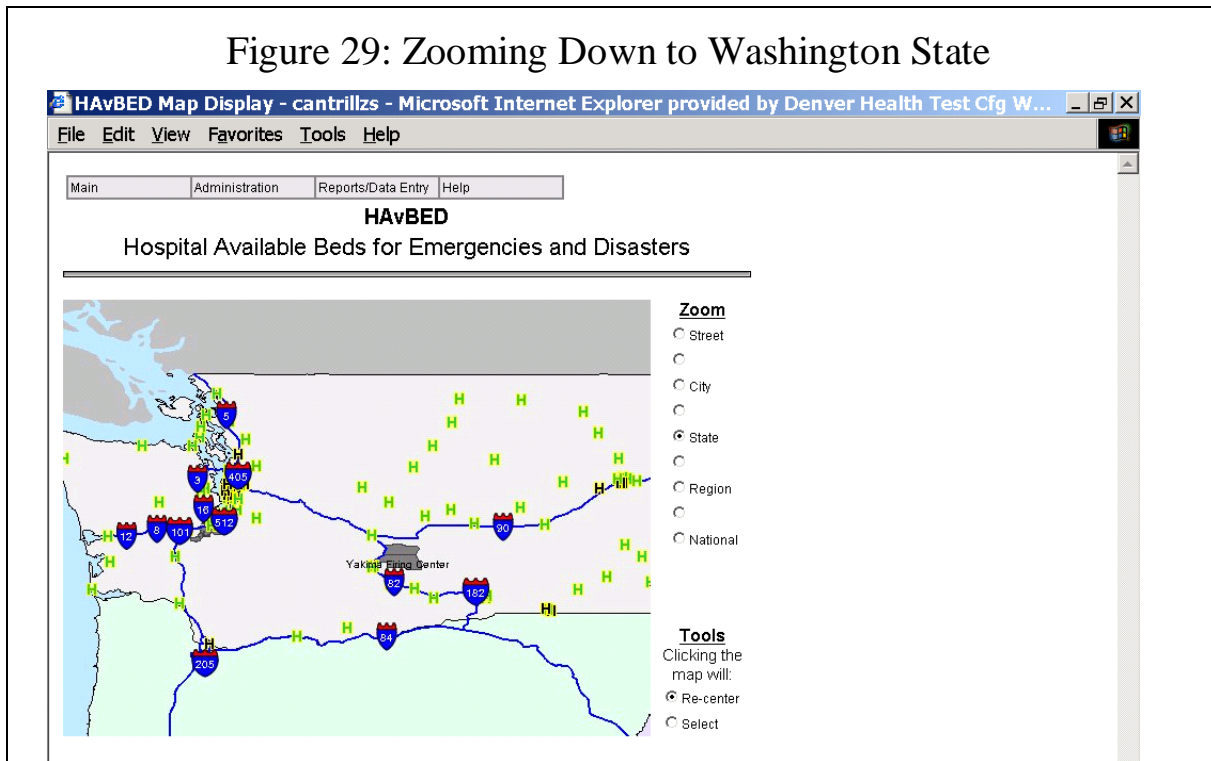
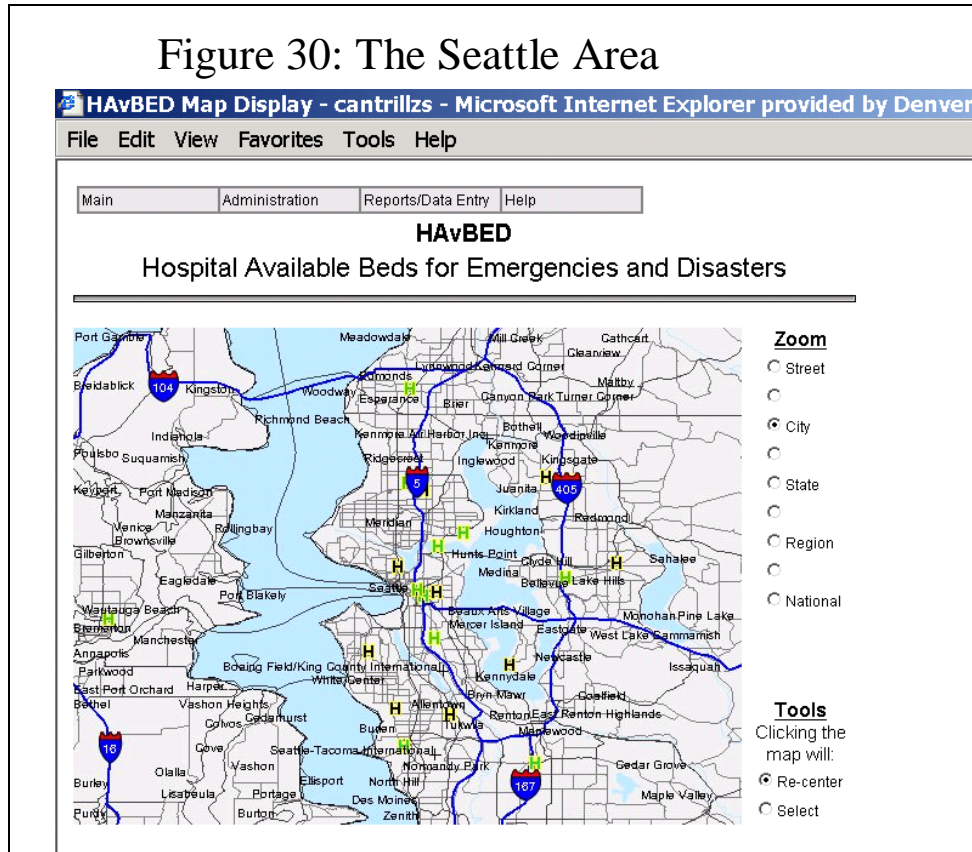
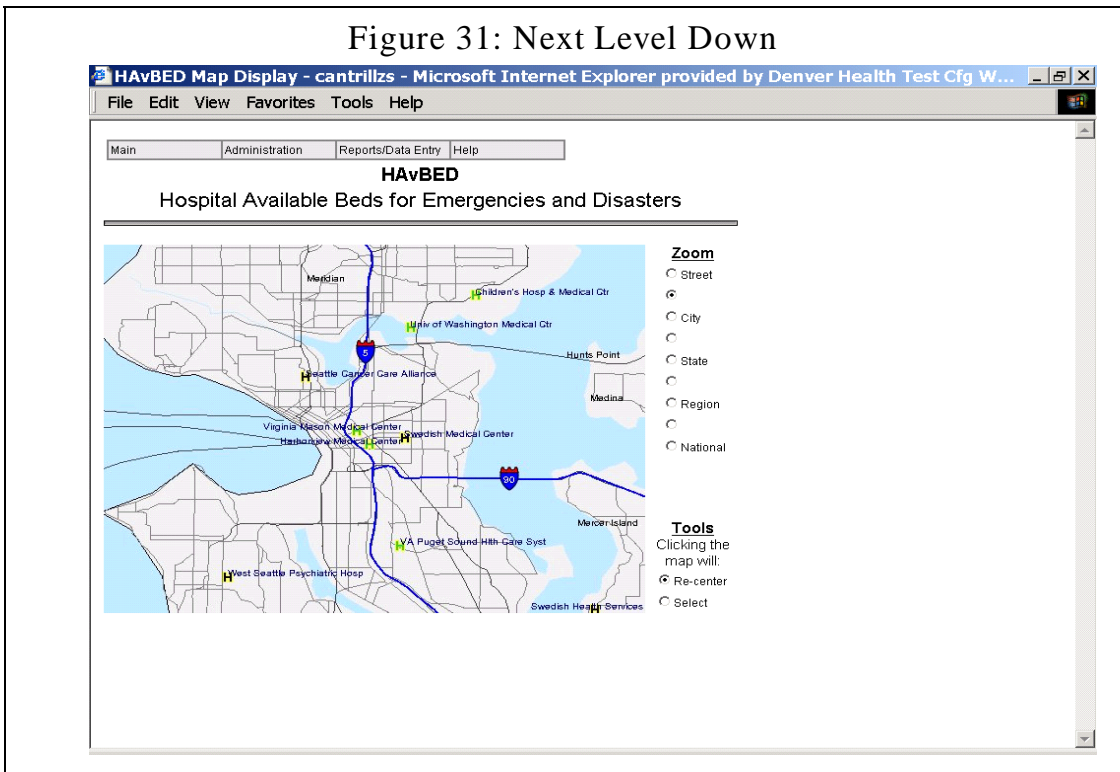


Figure 30 demonstrates the ability to zoom down further to the city level.



Further detail is available by zooming down below the city level, as shown in Figure 31.

Figure 31: Next Level Down



Returning to the main screen, the user then selects “New York” from the drop-down state list (as shown in Figure 32) and then selects the “View Map” option. Figure 33 represents the graphic display of the status of hospitals in the state of New York.

Figure 32: Drop-Down State List

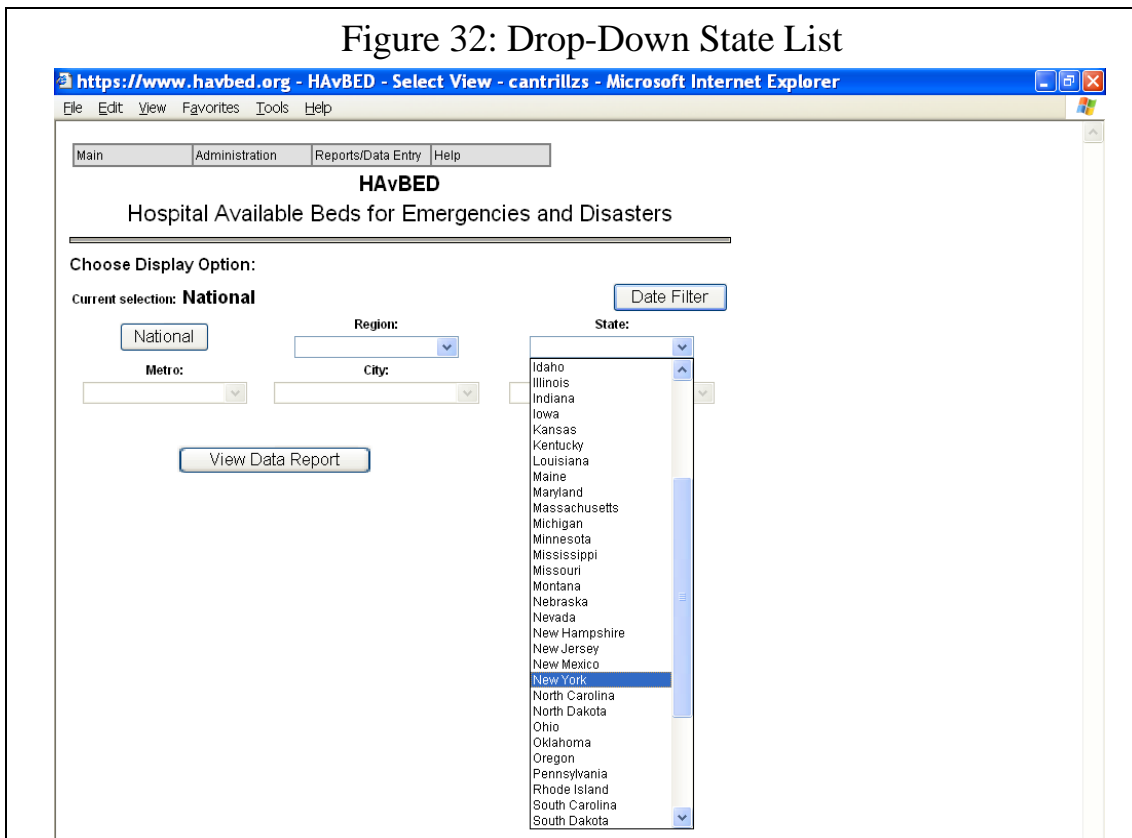
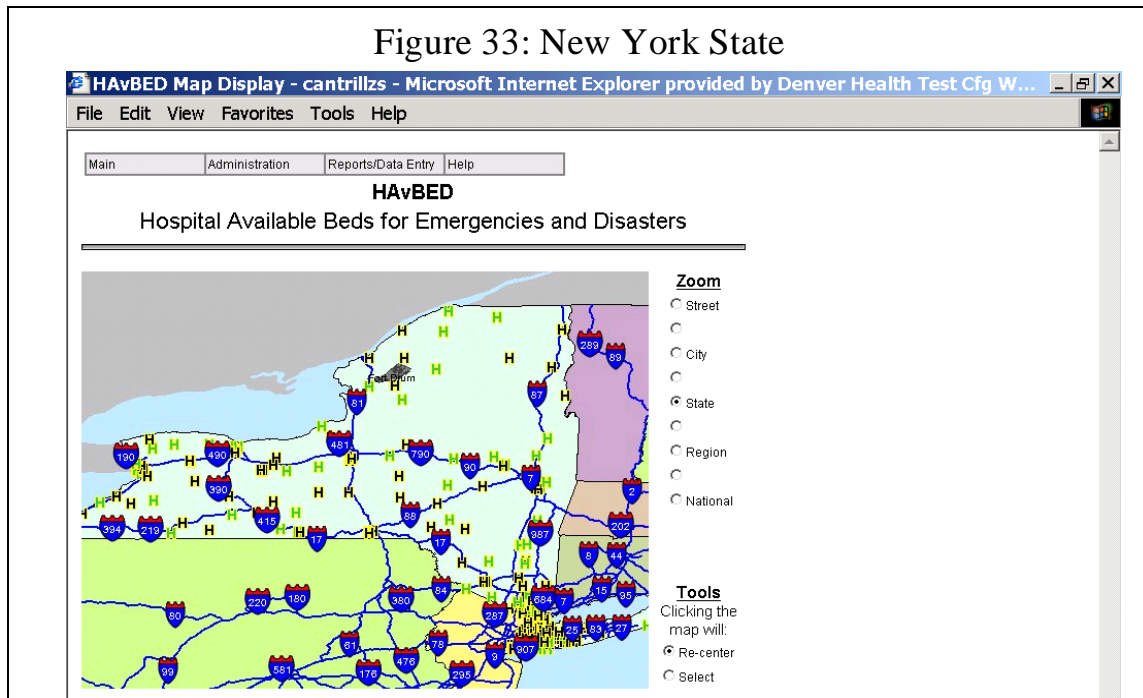


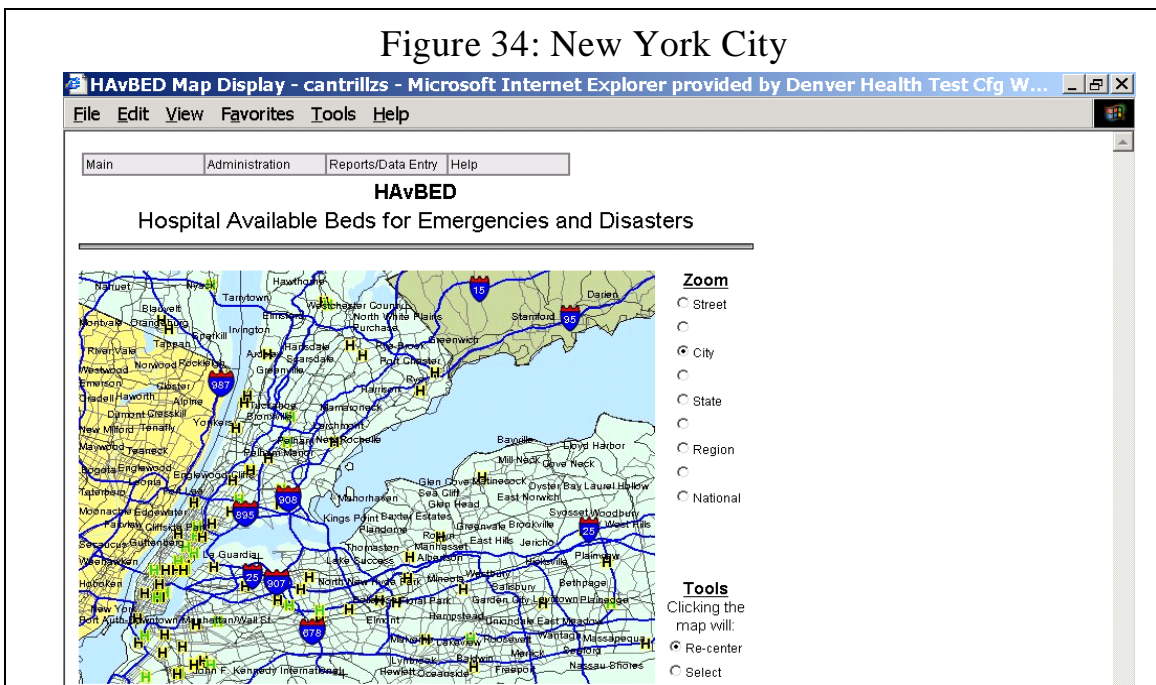


Figure 33: New York State



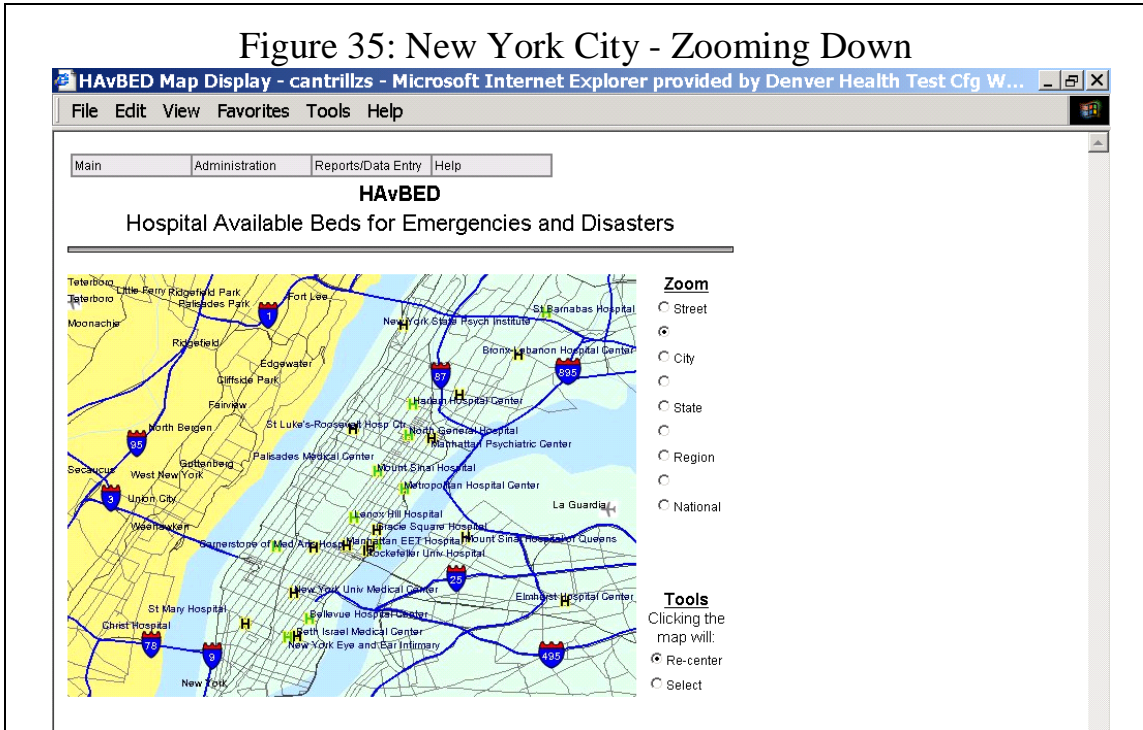
Zooming down to the city level would produce the display in Figure 34. Were HAvBED implemented nationally, it would be possible to view the status of hospitals in neighboring states as well.

Figure 34: New York City



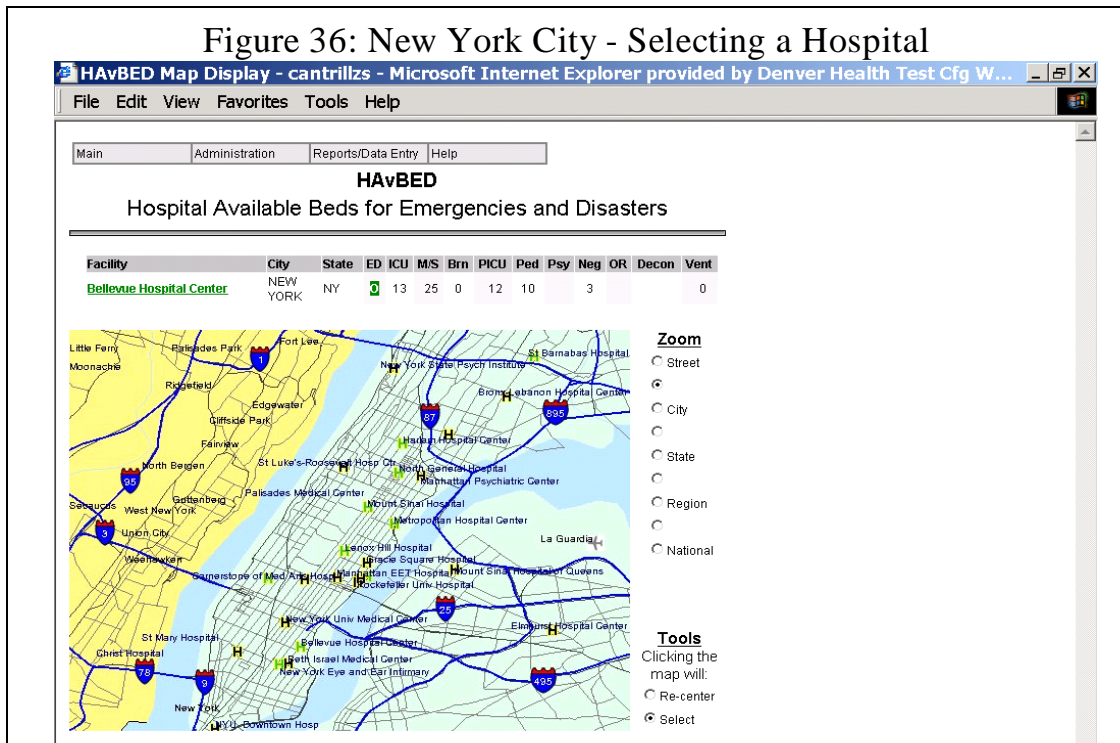
Zooming to the next level down, Figure 35 would be shown. Note that at this level (and lower) individual hospitals are labeled with their name.

Figure 35: New York City - Zooming Down



Summary data for a specific hospital are available by clicking on that institution as demonstrated in Figure 36. Note the summary data below the double line near the top of the display:

Figure 36: New York City - Selecting a Hospital



Clicking on the underlined hospital name in Figure 36 causes that hospital's detailed information to be displayed as shown in Figure 37.

**Figure 37: Selected Hospital's Detail**

Hospital Data Display - cantrillz - Microsoft Internet Explorer provided by Denver Health Test Cfg W...

File Edit View Favorites Tools Help

Main Administration Reports/Data Entry Help

**HAvBED**  
Hospital Available Beds for Emergencies and Disasters

---

Hospital Data Display

**Bellevue Hospital Center** 462 First Avenue NEW YORK NY AHA: 6212630  
 Phone: (212)562-4141 Last Update: 7/6/2005 3:42:00 AM Date: 7/7/2005 Time: 7:32 AM MDT

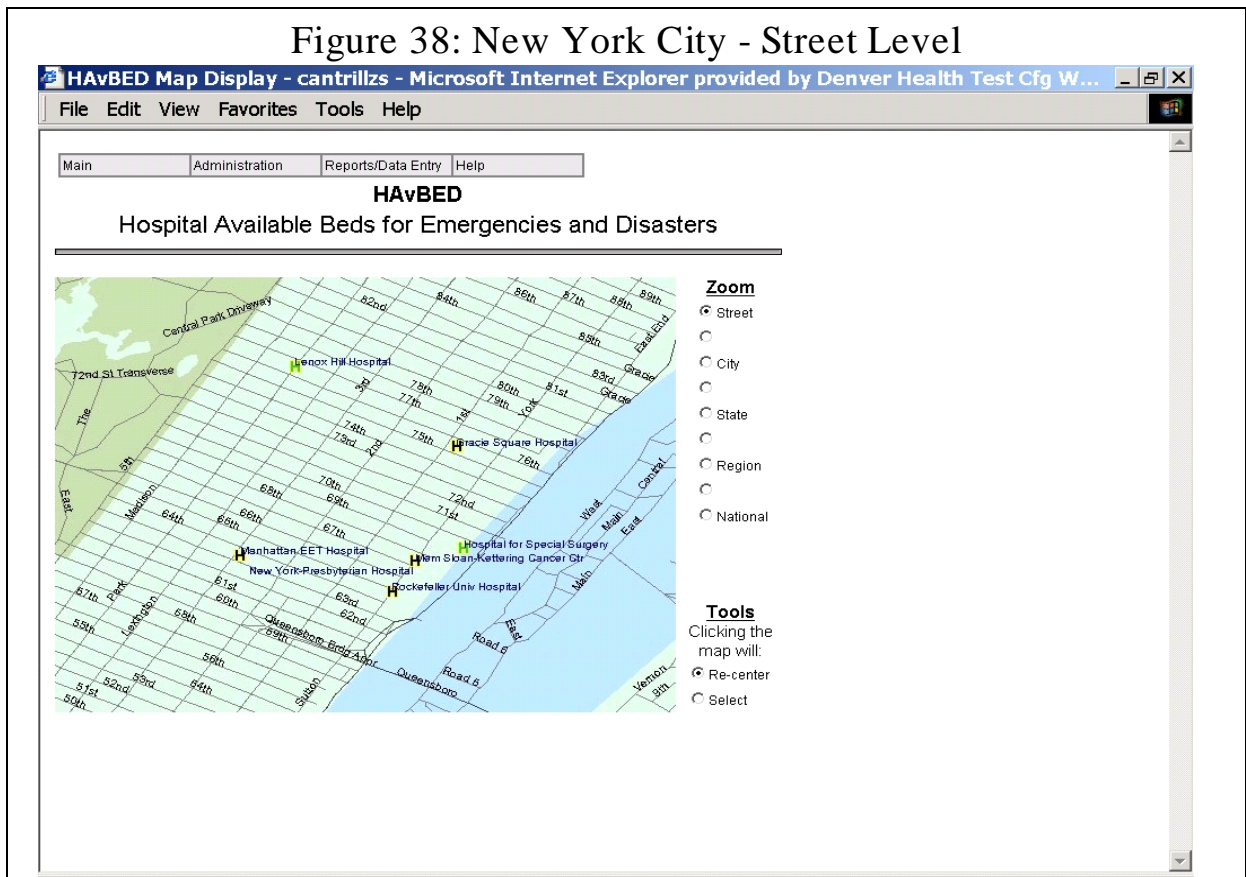
Bed Type	Available Beds			AHA Beds	Remarks
	Current	24 Hour	72 Hour		
Adult ICU	13	N/A	N/A	0	
Medical/Surgical	25	N/A	N/A	768	
Burn	0	N/A	N/A	0	
Pediatric ICU	12	N/A	N/A	0	
Pediatrics	10	N/A	N/A	0	
Psychiatric	N/A	N/A	N/A	0	
Negative Pressure/Isolation	3	N/A	N/A	N/A	
Operating Rooms	N/A			15	

Emergency Department Status:

Mass Decontamination Status:

Ventilators Available:

Figure 38 illustrates that at the highest level of resolution, individual street names as well as hospital names are visible.



Additional functionality built into the HAvBED system permits directed viewing options. Selection of a particular state activates and provides a “City” drop-down menu permitting direct access to and viewing of city-specific hospital information. In addition, selection of a particular city within a specified state then activates a “Facility” drop-down menu permitting access to, selection of, and viewing of data from specific healthcare facilities.

## **I. HAvBED Test Period Operation**

The HAvBED demonstration system was fully operational from June 20, 2005 through July 31, 2005. Several issues became clear even before system operation:

- We encountered some resistance in enlisting individual hospitals for manual data entry. In some cases, this was due to concerns about sharing bed availability data; in others, it represented difficulties with institutional bureaucracy and decision making.
- Shortcomings were identified with the AHA data. Since these data were from 2003 (the latest available at the beginning of our project), hospitals opened since that time were not in the database. Several of these were manually added. Many institutions opted not to include their overall bed counts, limiting the usefulness of their entries. In many cases, the institutional latitude/longitude were incorrect, causing obvious problems with the GIS displays.
- We were unable to obtain a listing of NDMS and TRICARE member hospitals, precluding having them so indicated on the tabular retrievals of available beds. For purposes of the demonstration, several institutions were arbitrarily designated as such to illustrate this feature.

The operation interval was divided into three test periods. Test Period #1 commenced June 20 and ran through June 26, 2005. This was designated a period of “Heightened Reporting” with hospitals (and systems) being requested to enter bed availability data on a daily basis. During the test period, several issues were identified:

- Some of our data streaming partners were unable to provide daily updates, often because their systems were not gathering data with that high a frequency.
- Some of the HAvBED data elements were not being transmitted (e.g. 72 hour bed count) because those data were not being solicited.
- Daily compliance by our manual data institutions was a minor issue.
- Some isolated errors in the syntax of the data transmission were discovered and repaired.

Test Period #2 ran from June 27 through July 6, 2005. This was designated a period of “Non-Heightened Reporting,” utilizing the data available from our system partners during their normal operation. This demonstrated the utility of data gathered as part of day-to-day healthcare system operation with no requirement for additional data entry. The GIS retrieval of Colorado data during this period (Figure 39) demonstrates this usefulness.

Figure 39: Non-Heightened Reporting - Colorado

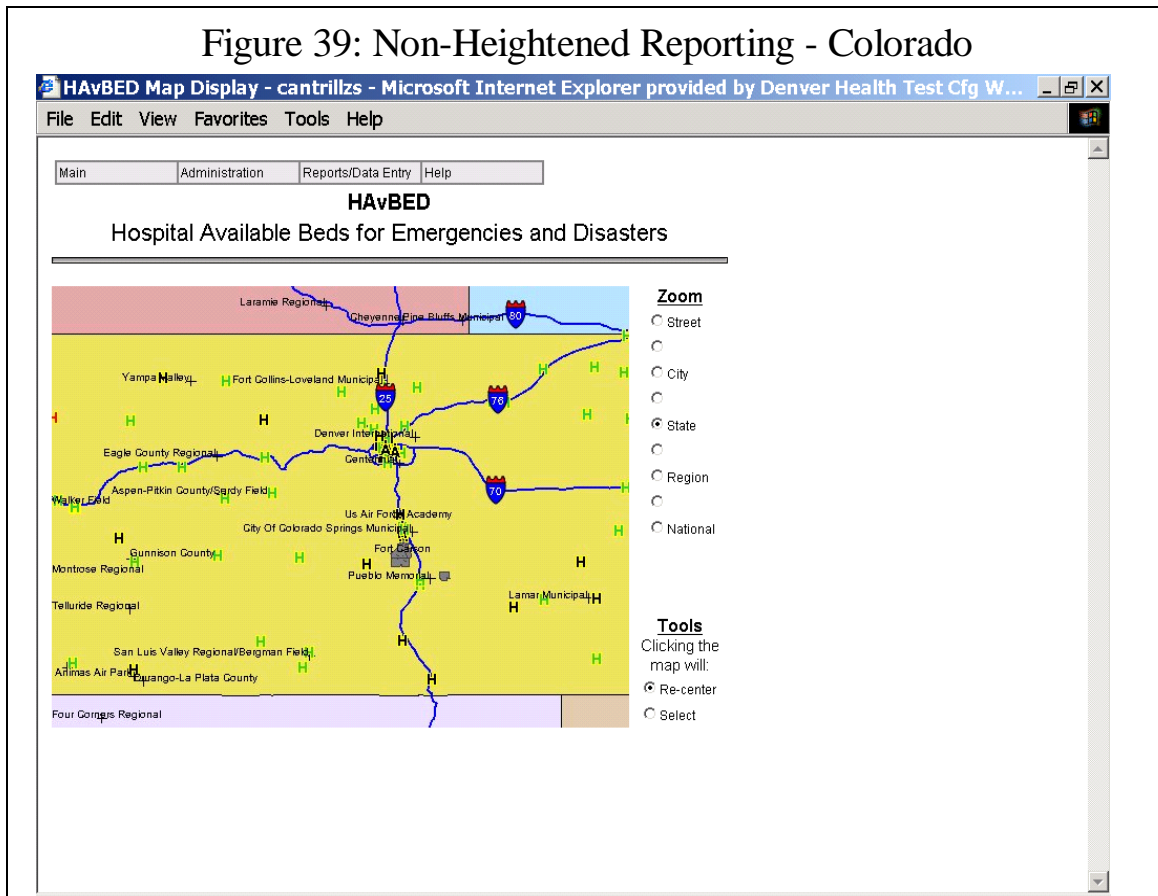


Figure 40 shows a tabular listing of metropolitan Denver data during this time.

Of interest:

- Notice the (demonstration) graphical symbols indicating those institutions that are NDMS or TRICARE members
- Note that data are not available in all HAvBED categories, as this is not routinely collected during normal operations.
- Note that the bed counts in certain categories show “ $\geq 1$ ”. This indicates that the institution, while not providing an actual count of available beds of that type, it is taking patients in that category. Thus, the institution has at least one bed of that type available.

Figure 40: Metro-Denver Tabular Listing

Facility	City	State	ED	ICU	M/S	Brn	PICU	Ped	Psy	Neg	OR	Decon	Vent
<a href="#">Children's Hospital</a>	DENVER	CO	0										
<a href="#">Colorado Acute Specialty Hosp</a>	DENVER	CO	N										
<a href="#">Colorado Mental HRh Institute</a>	DENVER	CO	N										
<a href="#">Colorado Psychiatric Hospital</a>	DENVER	CO	N										11
<a href="#">Crain Hospital</a>	ENGLEWOOD	CO	0	≥1	≥1				≥1	≥1			
<a href="#">Denver Health Medical Center</a>	DENVER	CO	0	2	1	0	2	5	3	2	4	Y	6
<a href="#">Exempla Lutheran Med Center</a>	WHEAT RIDGE	CO	N										
<a href="#">Exempla Saint Joseph Hospital</a>	DENVER	CO	0	≥1	≥1				≥1	≥1			
<a href="#">Kindred Hospital-Denver</a>	DENVER	CO	N										
<a href="#">Lowry AFB Hangar 2</a>	DENVER	CO	N		15						N		0
<a href="#">Medical Center of Aurora</a>	AURORA	CO	0										
<a href="#">Natl Jewish Med &amp; Res Ctr</a>	DENVER	CO	N										
<a href="#">Porter Adventist Hospital</a>	DENVER	CO	0	≥1	≥1				≥1	≥1			
<a href="#">Presbyterian-St Luke's Med Ctr</a>	DENVER	CO	0	≥1	≥1				≥1	≥1			
<a href="#">Rose Medical Center</a>	DENVER	CO	0										
<a href="#">Spalding Rehabilitation Hosp</a>	AURORA	CO	N										
<a href="#">St Anthony Central Hospital</a>	DENVER	CO	0										
<a href="#">Swedish Medical Center</a>	ENGLEWOOD	CO	0										
<a href="#">Univ of Colorado Fitzsimons Campus</a>	AURORA	CO	N										
<a href="#">Univ of Colorado Hospital</a>	DENVER	CO	0										

The final test period, #3, ran from July 7 through July 31, 2005. This allowed for a final evaluation of the demonstration system and was a period of “Heightened Reporting” with daily bed availability updates being requested. Some of the same limitations were encountered during this test period as during Test Period #1, especially with some of the partner systems being unable to provide daily data. During this test period, members of our Advisory Group were given data retrieval access to the system.

Also during this period, we tested the utility of the HAvBED system as a field tool to assist in the assignment of patient destinations by actually accessing the HAvBED website via wireless internet access from an ambulance in the field responding to 911 calls. Our findings:

- Overall, system operation was smoother with improvements in the tabular and GIS data display.
- The utility of the system in the field was somewhat limited for the following reasons:
  - In day-to-day patient transports, bed availability is a second-by-second issue. Having data entered once a day is not timely enough for this application.
  - In situations where there is not complete congruence between the data gathered by HAvBED and those data elements deemed regionally important to facilitate normal hospital traffic, strategic data (as determined by that locale) may be lacking, making the system’s overall operation somewhat problematic and of limited utility.

Review of HAvBED system usage data during the test periods revealed the following:

- Total number of hospitals entering data into HAvBED: 325 hospitals
  - Via web services EDXL Communication: 316 hospitals
    - Hospital Capacity Website: 144 hospitals
    - HERDS: 90 hospitals
    - EMSystem®: 82 hospitals
  - Via Manual Website Data Entry: 9 hospitals
- Number of States Represented: 9 states
- Number of System Logons to Provide Bed Updates: 1586 logons



## **J. User Comments**

Several comments were received from our system partners and individual data entry users of the HAvBED demonstration system:

- Our system partners commented on the lack of congruence between the data sets that they routinely capture and data requested by the HAvBED system. Given the time-limited aspect of this demonstration project, they were unable to modify their systems to include all of our data elements.
- Our use of the American Hospital Association institution number as the means of access to specific hospital information required several of our system partners to generate a cross-walk table to be able to convert from their proprietary indexing schemes.
- There was also some initial concern voiced about the complexity of the EDXL schema designed by HAvBED as opposed to other XML schema, but it was concluded that the HAvBED approach allowed for a more flexible and powerful approach.
- The use of automated web services to automatically transmit system updates to HAvBED caused some security concerns and firewall issues.
- There were also issues in implementing daily updates to the HAvBED system.

These problems were all felt to be solvable over the long run. Some users entering data via our system partners voiced concern that they did not have easy access to the definitions of some of the data fields specific to the HAvBED project.

The web-based hospital data entry partners had no difficulties with technical aspects of data entry. Some institutions had minor compliance issues in supplying updated values on a daily basis. There were also some concerns that the institutions had no specific approach to estimate the values for the “24 hr Beds Available” and the “72 hr Beds Available” fields. It was felt, that in addition to the supplied definitions, that an algorithm be developed to assist them in these calculations for supplying these data.

## **VI. Recommendations and Discussion**

The HAvBED project has demonstrated the feasibility and utility of a system that captures and integrates currently accessible bed availability data from divergent systems in use across the country and coupling those data with data from hospitals that do not currently participate in these systems to produce a large-scale picture of patient bed availability across the country. These amalgamated data would be of assistance at a local, regional or national level in dispositioning patients from one (or more) large-scale multi-casualty events from either natural causes or from the use of weapons of mass destruction.

The HAvBED Project Group, after testing, evaluation and review of the demonstration system, recommends the following:

### **A. Conceptual Recommendations**

- The HAvBED demonstration system should be implemented on a national level and expanded to interface with all other existing bed capacity systems currently in operation. This will require developmental effort on the part of the many systems not currently included in the HAvBED demonstration, but will be facilitated by the EDXL communication schema developed as part of this project.
- The HAvBED system should not replace any existing systems, but rather it should acquire and amalgamate data already being gathered by these pre-existing systems. The imposition of an additional bed capacity system that does not use preexisting system data would be viewed as an unacceptable imposition by the public and private sectors.
- Hospitals not participating in a multi-institutional bed capacity system should provide necessary data via the HAvBED manual data entry web interface. Although many institutions do participate in such systems, an incomplete picture of bed availability would result if allowances were not made for these “unaffiliated” hospitals to supply their data.
- The reporting structure and framework of the HAvBED system was developed by a national representation consensus. If modification is deemed necessary, it should occur only after very careful deliberation.
- The concepts and operation of the expanded HAvBED system should remain simple and user friendly. Major expansion of the scope of the system will put the potential for success at risk.
- Incentives for hospital participation in the HAvBED system should be developed and implemented. This could include such management tools as capacity trend reports for hospitals as well as regions. Hospitals would be more inclined to participate if they received some value for their efforts.

- DHHS should work with state and local departments of health, EMS agencies and emergency managers to inform and educate them of the utility of this system. These groups, in turn, will be instrumental in encouraging participation at the local level. This could be done via a series of conferences or meetings. Additional partners in this effort may include the Department of Homeland Security, the American Hospital Association, state hospital associations, emergency management professional organizations and selected medical specialty professional organizations. This approach will offer and provide collaborative efforts at multiple levels as well as the greatest opportunity for acceptance and widespread implementation of such a system.
- DHHS, in concert with potential state, local and national users, should develop a mechanism for testing the utility of the HAvBED system at these different levels of operation.
- Concerns raised regarding the legality of ongoing collection of bed capacity data by the federal government should be investigated and addressed.
- As currently designed, the HAvBED system provides limited utility for use by field personnel in their day-to-day operations as the HAvBED data structure may not include some bed types felt to be of local importance for these operations.
- The implementation of the expanded HAvBED system should be done by an impartial organization or contractee working with DHHS (such as achieved by the Booze Allen Hamilton collaboration with the Department of Defense in the creation of TRAC<sup>2</sup>ES).
- A national patient tracking system may be of help during a time of national emergency but supplying data to such a system may prove too burdensome to make it efficacious. A patient locating system may be easier to successfully implement.

## **B. Technical Recommendations**

- The HAvBED hospital data base (based upon the AHA hospital data) should be edited and updated to:
  1. Remove non-acute care institutions
  2. Correct errors in institutional location (longitude/latitude) and AHA bed numbers
  3. Add institutions that are not AHA members (such as some military installations)
  4. Indicate those institutions that are NDMS and/or TRICARE participants.
- The web interface for data entry and retrieval should be refined to be more intuitive and to be ADA and eGov compliant. Additional specific search and data retrieval modalities should be implemented, such as:
  1. NDMS/TRICARE institutions only
  2. Time specific criteria, i.e. all data that are less than “X” hours old
  3. Geographic specific criteria, i.e. all hospitals within a specified number of miles of a specific location
  4. Data point specific criteria, i.e. all available ventilators or all institutions with available mass decontamination units

- The symbology of the GIS maps should be improved and extended, including providing detailed institutional data on mouse-over of the institution's icon. A multiple, expanded icon set could be utilized to easily convey additional information on the graphical displays.
- The system should be reconfigured in a more robust manner to provide improved responsiveness. Efforts could include increased multi-processing, refinement of the database design and moving the GIS functions to their own dedicated processor(s).
- An extensive acceptance test procedure should be implemented to verify system operation and data reliability. The limited time frame of this demonstration project precluded methodical validation of all aspects of system operation. Systems that transmit data should note and deal with any errors in the reception of their data. Any data reception errors should be immediately brought to the attention of system administrator for corrective action.

### **C. Discussion: Patient Tracking**

The identification and tracking of patients from a mass casualty incident pose significant challenges and difficulties. The first question which must be answered is to determine at what point the identification and tracking processes begin. The ideal answer is for this activity to be initiated at the actual incident site. Unfortunately, past experiences clearly indicate that casualties do not necessarily remain at a disaster scene. If they are capable of ambulating, most victims will not await the arrival of public safety agencies, including EMS, but rather will seek alternative transport modalities to obtain medical care. In fact, prior incidents suggest as many as 80% of casualties will make their own way to the hospital. Therefore, any patient identification and tracking system must be flexible and be capable of permitting data entry about recognized victims at various points in the medical treatment point-of-entry chain. This includes such locations as the incident scene, receiving hospitals (both near and distant) and points in-between, as patients who attempt to get to a hospital, but are unable to do so, enter the EMS or healthcare delivery system at locations remote from the actual disaster scene.

To date, all patient identification and tracking systems are associated with significant cost, both financial and in manpower, for data entry. Systems such as the Raytheon Patient Tracking System partially automate the initial data entry process and provide for FedEx-style patient (package) tracking using scannable bar coded armbands. This system has significant financial cost associated with it and ultimately still requires manpower costs to acquire and enter personal identifying data for each patient. New York State includes a less robust patient identification and status system in HERDS for purposes of being able to track what victim is being treated at a particular hospital. This functions more as a patient locator system and also requires an expenditure in manpower for data entry.

In the development of any patient tracking system, decisions will also need to be made about the definition of a victim, the time frame in which they present for care and other similar issues. A consensus will need to be reached about who should be included and

identified as a victim as well as how open-ended the time period will be for including victims in such a database.

In addition, for any patient identification and tracking system to work effectively, it must either be extremely easy and intuitive to use or it must be used on a routine basis. If routinely used, once again on-going costs associated with such a system become an issue.

In summary, a “patient tracking” system is currently technologically feasible, however, the implementation, sustainability and manpower costs present significant fiscal challenges.

#### **D. Discussion: Decisions Concerning Alternate Care Facilities**

The development of specific algorithms to assist local, state and national planners in making decisions for the use of alternate care facilities is a complex process that involves the analysis and integration of many factors that are beyond the scope of data collection for the current project. However, prior experiences both actual (Fairfax, Virginia, on September 11, 2001<sup>8</sup>) and simulated (Denver Health surge capacity exercise, January 2005) provide for general recommendations. Evidence suggests that as many as 25% of the beds in a hospital could be made available for casualties from a catastrophic event by early discharge of currently admitted patients. Thus, a preliminary guideline for implementation of alternative care sites appears to be that such sites should be considered if the number of victims from an incident will likely exceed 25% of the local or regional hospital bed capacity. This is, of course, a general recommendation based upon a small sample size and warrants additional investigation to identify and include the various factors which affect the decision to open an alternative care site and thus better refine the recommendation.

#### **E. Discussion: Testing the System with State, Local and National Command Centers**

The HAvBED demonstration system interfaced with several pre-existing hospital bed reporting systems that are currently in use in a variety of local and state command centers and emergency operations centers. While not a direct test of the HAvBED system in these command centers, the ability of the HAvBED system to integrate with and amalgamate data from these other systems demonstrates the interoperability responsiveness of HAvBED.

As mentioned in our recommendations, we believe that in order to achieve widespread acceptance and implementation of the HAvBED system, numerous meetings and conferences with local, state and regional departments of health, EMS agencies and emergency managers should be held to inform and educate them about the system. Once this has been accomplished, formal testing of the HAvBED system in local, state and national command centers can proceed. This should include using this system in local, regional, state and national drills and exercises.

---

<sup>8</sup> Hick JL, et al: Health care facility and community strategies for patient care surge capacity. *Ann Emerg Med.* 2004;44:253-261.

*Bioterrorism and Other Public Health Emergencies  
Tools and Models for Planning and Preparedness*

# **National Hospital Available Beds for Emergencies and Disasters (HAvBED) System**

**Appendixes**

**APPENDIX A**

**HA<sub>v</sub>BED Advisory Group**

<b>U.S. Department of Health and Human Services AHRQ</b>	
<p><b>Sally Phillips, RN, PhD</b>                      Director, BT Preparedness Research Program                      DHHS-AHRQ                      Rockville, MD 20850                      Ph: 301-427-1571                      Fax: 301-427-1595                      Email: <a href="mailto:sphillip@AHRQ.gov">sphillip@AHRQ.gov</a></p>	<p><b>Daniel Salazar</b>                      Technical Advisor                      Bioterrorism Preparedness Research Program                      AHRQ                      540 Gaither Rd                      Rockville, MD 20850                      Ph: 301-427-1248                      Email: <a href="mailto:DSalazar@ahrq.gov">DSalazar@ahrq.gov</a></p>
<p><b>Padmini Jagadish</b>                      DHHS-AHRQ                      Ph: 301-427-1927                      Email: <a href="mailto:pjagdis@AHRQ.gov">pjagdis@AHRQ.gov</a></p>	
<b>U.S. Department of Health and Human Services Office of the Assistant Secretary for Public Health Emergency Preparedness</b>	
<p><b>Robert Blitzer</b>                      Deputy Assistant Secretary                      200 Independence Ave.,                      S.W., Room 633-F,                      Washington, DC 20201                      Ph: 202-205-0872                      Email: <a href="mailto:Robert.Blitzer@hhs.gov">Robert.Blitzer@hhs.gov</a></p>	<p><b>Josefine (Chris) Keenan</b>                      Staff Assistant/Dr. Claypool                      Email: <a href="mailto:Josefine.Keenan@hhs.gov">Josefine.Keenan@hhs.gov</a></p>
<p><b>Shayne Brannman, MS, MA</b>                      Special Assistant, OASPHEP {CNAC IPA}                      U.S. Department of Health and Human Services                      200 Independence Ave. SW, Suite 635F                      Washington, DC 20201                      Ph: 202-205-4246                      Email: <a href="mailto:Shayne.Branman@HHS.GOV">Shayne.Branman@HHS.GOV</a></p>	<p><b>Capt Ann Knebel, RN, DNSc</b>                      Sr. Program Management Officer                      Consultant                      200 Independence Ave.                      Washington, DC 20201                      Ph: 202-205-5129                      Email: <a href="mailto:Ann.Knebel@hhs.gov">Ann.Knebel@hhs.gov</a></p>
<p><b>Robert G. Claypool, MD</b>                      Deputy Chief Medical Officer                      OASPHEP/USDHHS                      Ph: 202-401-2281 or 202-205-2882                      Email: <a href="mailto:Robert.Claypool@hhs.gov">Robert.Claypool@hhs.gov</a></p>	<p><b>Matthew Payne, MPA</b>                      Ph: 202-205-4862 or 202-205-1002                      Email: <a href="mailto:matthew.payne@hhs.gov">matthew.payne@hhs.gov</a></p>

Appendix A – HAvBED Advisory Group Members

<p><b>Rhonda Earls, MSN, CNM</b>          Army War College Fellow          Email: <a href="mailto:Rhonda.Earls@hhs.gov">Rhonda.Earls@hhs.gov</a></p>	<p><b>Dean Ross</b>          Director, Secretary's Command Center          200 Independence Ave          Washington, DC 20201          Ph: 202-619-7879          Fax: 202-619-7870          Email: <a href="mailto:Dean.Ross@hhs.gov">Dean.Ross@hhs.gov</a></p>
<p><b>Patricia Y. Johnson</b>          Staff Assistant/Mr. Blitzer          OASPHEP          Hubert Humphrey Bldg.          200 Independence Ave., Suite 638-G          Washington, D.C. 20201          Ph: 202-205-2882          Fax: 202-690-6512          Email: <a href="mailto:patricia.johnson@hhs.gov">patricia.johnson@hhs.gov</a></p>	<p><b>Elaine C. Wolff, MHS</b>          LTJG, USPHS          PHEP Predictive Services Officer          Secretary's Command Center          200 Independence Avenue, SW          Room 636G          Washington, DC 20201          Ph: 202-619-7808          Fax: 202-619-7870          Email: <a href="mailto:Elaine.wolff@hhs.gov">Elaine.wolff@hhs.gov</a></p>
<p><b>Frank DeSando</b>          HHS/OSEO          Ph: 202-619-0125          Email: <a href="mailto:Frank.DeSando@hhs.gov">Frank.DeSando@hhs.gov</a></p>	
<p><b>U.S. Department of Health and Human Services          Health Resources and Services Administration</b></p>	
<p><b>Sumner L. Bossler Jr.</b>          Senior Public Health Analyst          Lieutenant Commander, United States Public Health Service          Division of Health Care Emergency Preparedness          Special Programs Bureau          Health Resources and Services Administration          5600 Fishers Lane,          Rockville, MD RM GC 25          Ph: 301-443-1095          Fax: 301-480-0334          Email: <a href="mailto:sbossler@hrsa.gov">sbossler@hrsa.gov</a></p>	<p><b>CDR Melissa Sanders</b>          Branch Chief          HRSA, National Bioterrorism Hospital Preparedness Program          Ph: 301-443-0924          Fax: 301-480-0334          Email: <a href="mailto:msanders@hrsa.gov">msanders@hrsa.gov</a></p>



Appendix A – HA vBED Advisory Group Members

<b>U.S. Department of Health and Human Services Centers for Disease Control and Prevention</b>	
<b>Daniel A. Pollock, MD</b> Health Outcomes Branch Chief Division of Healthcare Quality and Promotion National Center for Infectious Diseases Centers for Disease Control and Prevention Mail Stop E55 Atlanta, GA 30333 Ph: 404-498-1124 Fax: 404-498-1101 Email: <a href="mailto:dpollock@cdc.gov">dpollock@cdc.gov</a>	
<b>Department of Defense-Office of the Assistant Secretary of Defense for Health Affairs</b>	
<b>Lt Col William J. Kormos, Jr., USAF, MSC, CHE</b> Force Health Protection and Readiness Room 3E281 Pentagon Washington D.C. Ph: 703-614-4158 Email: <a href="mailto:william.kormos@ha.osd.mil">william.kormos@ha.osd.mil</a>	<b>CAPT F. Christy Music, MSC, USN</b> Director, Homeland Security and National Medical Contingency Planning OASD/HA Force Health Protection & Readiness Office of the Assistant Secretary of Defense for Homeland Defense Department of Defense Room 5D337 2600 Defense The Pentagon Washington, D. C. 20301-2600 Ph: 703-697-5839 or 703-614-4159 Email: <a href="mailto:Francesca.music@osd.mil">Francesca.music@osd.mil</a>
<b>Tony DeNicola</b> Ph: 703-578-8544 Email: <a href="mailto:Tony.DeNicola@deploymenthealth.org">Tony.DeNicola@deploymenthealth.org</a>	<b>Sam Stange</b> LMI Email: <a href="mailto:ssange@lmi.org">sstange@lmi.org</a>
<b>DOD-USNORTHCOM</b>	
<b>Lt Col James Baxter</b> USNORTHCOM, Liaison to the USTRANSCOM SG USTRANSCOM USTCJ6-PC Scott AFB IL 62225 Ph: 618-229-1391 Email: <a href="mailto:James.Baxter@hq.transcom.mil">James.Baxter@hq.transcom.mil</a>	<b>Col Anthony M. Rizzo, MC, SFS</b> Director of Operations, Northern Command Surgeon's Office Peterson, AFB CO 80914 Ph: 719-554-0937 Email: <a href="mailto:Anthony.Rizzo@northcom.mil">Anthony.Rizzo@northcom.mil</a>
<b>Lt Col Thomas Berry, MS, MA</b> Ph: 719-554-4980 <b>Email:</b> <a href="mailto:Thomas.Berry@northcom.mil">Thomas.Berry@northcom.mil</a>	

Appendix A – HAvBED Advisory Group Members

<b>DOD-USTRANSCOM</b>	
<p><b>Major Wayne Surratt</b> TRAC2ES Functional Program Manager USTCJ6-PC Scott AFB, IL 62225 Email: <a href="mailto:Wayne.Surratt@hq.transcom.mil">Wayne.Surratt@hq.transcom.mil</a></p>	<p><b>Mark Barnes</b> Lead Contractor TRAC2ES Functional Management Office Scott AFB, IL 62225 Email: <a href="mailto:Mark.Barnes@hq.transcom.mil">Mark.Barnes@hq.transcom.mil</a></p>
<p><b>Lt Cipriano Pineda</b> Medical Planner Email: <a href="mailto:Cipriano.Pineda@hq.transcom.mil">Cipriano.Pineda@hq.transcom.mil</a></p>	<p><b>Mark Mahar</b> Senior Operations Officer GPMRC Email: <a href="mailto:Mark.Mahar@hq.transcom.mil">Mark.Mahar@hq.transcom.mil</a></p>
<p><b>MWO Christopher Moffatt</b> GPMRC Email: <a href="mailto:Christopher.Moffatt@hq.transcom.mil">Christopher.Moffatt@hq.transcom.mil</a></p>	
<b>Department of Veterans Affairs</b>	
<p><b>Michael Feeser</b> VA PPP, Room GD-114 VA Medical Center Martinsburg, WV 25401 Ph: 304-264-4803 Fax: 304-579-2510 Email: <a href="mailto:Michael.Feeser@med.va.gov">Michael.Feeser@med.va.gov</a></p>	<p><b>R. Tom Sizemore, III, MD</b> Department of Veterans Affairs Director of Operations &amp; Readiness Office of the Assistant Secretary for Policy, Plans, and Preparedness 810 Vermont Ave, NW Washington, DC 20420 Ph: 202-273-5287 Fax: 240-220-0680 Email: <a href="mailto:Tom.Sizemore@mail.va.gov">Tom.Sizemore@mail.va.gov</a></p>
<b>Department of Homeland Security</b>	
<p><b>Bob Jevic</b> Ph: 202-646-2439 Email: <a href="mailto:Robert.Jevic@dhs.gov">Robert.Jevic@dhs.gov</a></p>	<p><b>Teresa Lustig</b> Chemical Biological Countermeasures Office Science and Technology Directorate Department of Homeland Security Ph: (202) 254-5766 Email: <a href="mailto:Teresa.Lustig@dhs.gov">Teresa.Lustig@dhs.gov</a></p>
<p><b>Harry Koerner</b> Program Specialist FEMA/RS-OP-MS-SD Ph: 301-443-2467 Email: <a href="mailto:harry.koerner@dhs.gov">harry.koerner@dhs.gov</a></p>	<p><b>Dawn M. Myscofski, PhD</b> Advisor, Biological Countermeasures US Department of Homeland Security Washington, DC 20528 Ph: 202-254-6032 Email: <a href="mailto:dawn.myscofski@dhs.gov">dawn.myscofski@dhs.gov</a></p>
<p><b>Jeffrey Lowell, MD</b> Senior Medical Advisor to Secretary Ridge Email: <a href="mailto:Jeffrey.Lowell@dhs.gov">Jeffrey.Lowell@dhs.gov</a></p>	<p><b>Gary Sirmons</b> Email: <a href="mailto:gary.sirmons@dhs.gov">gary.sirmons@dhs.gov</a></p>

Appendix A – HA vBED Advisory Group Members

<b>Denver Health</b>	
<p><b>Stephen V. Cantrill, MD</b> Associate Director, Emergency Medical Services Denver Health 777 Bannock, MC 0108 Denver, CO 80204 Ph: 303-436-7174 Fax: 303-436-7541 Email: <a href="mailto:Stephen.Cantrill@dhha.org">Stephen.Cantrill@dhha.org</a></p>	<p><b>Peter T. Pons, MD</b> Emergency Medical Services Denver Health 777 Bannock, MC 0108 Denver, CO 80204 Ph: 303-436-6970 Fax: 303-436-7541 Email: <a href="mailto:Peter.Pons@dhha.org">Peter.Pons@dhha.org</a></p>
<p><b>Sheri L. Eisert, PhD</b> Director, Health Services Research Denver Health 777 Bannock, MC 8701 Denver, CO 80204 Ph: 303-436-4072 Fax: 303-436-4035 Email: <a href="mailto:Sheri.Eisert@dhha.org">Sheri.Eisert@dhha.org</a></p>	<p><b>Carrie Vinci</b> Project Manager Denver Health 777 Bannock, MC 8701 Denver, CO 80204 Ph: 303-436-5973 Email: <a href="mailto:cvinci@dhha.org">cvinci@dhha.org</a></p>
	<p><b>Jacob Dye</b> Project Manager Denver Health 777 Bannock, MC 8701 Denver, CO 80204 Ph: 303-436-7789 Email: <a href="mailto:Jacob.Dye@dhha.org">Jacob.Dye@dhha.org</a></p>
<b>Other</b>	
<p><b>James Bentley</b> American Hospital Association Email: <a href="mailto:James.Bentley@aha.org">James.Bentley@aha.org</a></p>	<p><b>Robin K. Koons, PhD</b> Director, Hospital Preparedness Program Colorado Department of Public Health and Environment Denver, CO 80246 Ph: 303-692-2719 Email: <a href="mailto:robin.koons@state.co.us">robin.koons@state.co.us</a></p>
<p><b>Nathaniel Hupert, MD, MPH</b> Assistant Professor, Public Health and Medicine Division of Outcomes and Effectiveness Research Department of Public Health Weill Medical College New York, NY 10021 Ph: 212-746-3049 Email: <a href="mailto:nah2005@med.cornell.edu">nah2005@med.cornell.edu</a></p>	<p><b>Kevin Yeskey, MD</b> Deputy Director Center for Disaster and Humanitarian Assistance Medicine (CDHAM) Uniform Services University of the Health Sciences (USUHS) 4301 Jones Bridge Rd. Bethesda, MD 20814 Ph: 301-295-0780 Fax: 301-295-1038 Email: <a href="mailto:kyeskey@cdham.org">kyeskey@cdham.org</a> or <a href="mailto:kyeskey@usuhs.mil">kyeskey@usuhs.mil</a></p>

Appendix A – HAvBED Advisory Group Members

<p><b>Edward J. Gabriel, MPA, EMT-P, CEM</b>                  Deputy Commissioner                  Planning and Preparedness                  New York City                  Office of Emergency Management                  11 Water Street                  Brooklyn, NY 11201                  Ph: 718-4220-4614                  Fax: 718 --422-4662                  Email: <a href="mailto:EGABRIEL@OEM.NYC.GOV">EGABRIEL@OEM.NYC.GOV</a></p>	
<p><b>Hospital Bed and Patient Tracking Systems</b></p>	
<p><b>EMSystem®</b></p>	
<p><b>Christopher W. Felton, MD, FACEP</b>                  President                  1035 W. Glen Oaks Lane, Ste. 104                  Mequon, WI 53092                  Ph: 414-350-8090                  Email: <a href="mailto:cfelton@emSystem.com">cfelton@emSystem.com</a></p>	<p><b>Andy Nunemaker</b>                  Chief Executive Officer                  1035 W. Glen Oaks Lane, Ste. 104                  Mequon, WI 53092                  Ph: 414-475-4502                  Fax: 414-290-6781                  Email: <a href="mailto:anunemaker@emsystem.com">anunemaker@emsystem.com</a></p>
<p><b>Dave Colwell</b>                  Senior Programmer                  1035 W. Glen Oaks Lane, Ste. 104                  Mequon, WI 53092                  Ph: 414-475-4507                  Cell: 262-442-6321                  Email: <a href="mailto:dcolwell@emsystem.com">dcolwell@emsystem.com</a></p>	
<p><b>HERDS</b></p>	
<p><b>Susan S. Stuard</b>                  Director, Regulatory Affairs                  Greater New York Hospital Association                  555 West 57th Street                  New York, NY 10019                  Ph: 212-259-0727                  Email: <a href="mailto:stuard@gnyha.org">stuard@gnyha.org</a></p>	<p><b>Mary Ellen Hennessy, RN</b>                  Assistant Director                  Hospital BT Preparedness Program                  Office of Health Systems Management                  New York Dept. of Health                  Hedley Park Place                  433 River Street                  Troy, NY 12180-2299                  Ph: 518-408-5163                  Fax: 518-402-8659                  Email: <a href="mailto:meh08@health.state.ny.us">meh08@health.state.ny.us</a></p>
<p><b>Ivan Gotham</b>                  New York Dept. of Health                  Hedley Park Place                  433 River Street                  Troy, NY 12180-2299                  Email: <a href="mailto:4@health.state.ny.us">4@health.state.ny.us</a></p>	<p><b>Debra Sottolano, PhD</b>                  Informatics Group Manager                  New York Dept. of Health                  433 River Street                  Troy, NY 12180-2299                  Email: <a href="mailto:dls20@health.state.ny.us">dls20@health.state.ny.us</a>                  (518)473-1809</p>

Appendix A – HA vBED Advisory Group Members

<p><b>Susan Waltman</b>          General Council          Greater New York Hospital Association          555 West 57th Street          New York, NY 10019          Email: <a href="mailto:waltman@gnyha.org">waltman@gnyha.org</a></p>	
<p><b>Illinois Bed Tracking System</b></p>	
<p><b>Leslie Stein Spencer, RN, MS</b>          Chief, Div of Emergency Medical Services and          Highway Safety          Illinois Dept. of Public Health          100 W. Randolph St., Suite 6-60          Chicago, IL 60601          Ph: 217-785-2080          Fax: 217-524-0966          Email: <a href="mailto:lstein@idph.state.il.us">lstein@idph.state.il.us</a></p>	
<p><b>Reddinet</b></p>	
<p><b>Cathy Winans</b>          Senior Vice President, Member Support          Services          Hospital Association of Southern California          515 South Figueroa Street, Suite 1300          Los Angeles, CA 90071-3300          Ph: 213-538-0719          Fax: 213-629-4272          Email: <a href="mailto:cwinans@hasc.org">cwinans@hasc.org</a></p>	
<p><b>State Hospital Capacity Website</b></p>	
<p><b>Duane Mariotti, BSEE, CHFM</b>          Director, Clinical Engineering          Emergency Preparedness Liaison          Harborview Medical Center          Box 359980          Seattle, WA 98104-2499          Ph: 206-731-3496          Fax: 206-731-3829          Email: <a href="mailto:duanem@u.washington.edu">duanem@u.washington.edu</a></p>	

Appendix A – HA vBED Advisory Group Members

<b>Teletracking</b>	
<p><b>Anthony Sanzo</b>                      President and CEO, Tele-Tracking Technologies, Inc.                      336 Fourth Avenue                      The Times Building                      Pittsburgh, PA 15222                      www.teletracking.com                      Ph: 412-638-1657                      Fax : 412-391-5148                      Email: <a href="mailto:asanzo@teletracking.com">asanzo@teletracking.com</a></p>	
<b>Emergency Patient Tracking System (EPTS)</b>	
<p><b>David Gellen</b>                      Raytheon Systems                      Director of Marketing                      St. Louis Operations                      1843 Sherman Drive                      St. Charles, MO 63303                      Ph: 636-449-3213                      Fax: 636-449-3239                      Cell: 314-280-6280                      Email: <a href="mailto:gellend@raystl.com">gellend@raystl.com</a></p>	<p><b>Richard Smith</b>                      Director of Operations                      SLMMRS/STARRS                      Ph: 314-268-7850                      Email: <a href="mailto:smithr@slmmrs.org">smithr@slmmrs.org</a></p>
<p><b>Mike Thomas, MPH</b>                      Associate Director                      Heartland Center for Public Health Preparedness                      Ph: 314-977-4350                      Email: <a href="mailto:Thomasmw@slu.edu">Thomasmw@slu.edu</a></p>	
<b>Booz Allen Hamilton-TRAC2ES</b>	
<p><b>John D. Power</b>                      Associate                      1728 Corporate Crossing, Suite 2                      O'Fallon, IL 62269                      Ph: 618-622-2332                      Fax: 618-632-6605                      Cell: 618-560-9810                      Email: <a href="mailto:Power_John@BAH.com">Power_John@BAH.com</a></p>	

Appendix A – HAxBED Advisory Group Members

<b>Wisconsin Division of Public Health</b>	
<b>Dennis Tomczyk</b> Director Hospital Bioterrorism Preparedness Program Wisconsin Division of Public Health PO Box 2659 Madison, WI 53701-2659 Ph: 608-266-3128 Cell: 608-220-6503 <a href="mailto:tomczdj@dhfs.state.wi.us">tomczdj@dhfs.state.wi.us</a>	<b>Ann Marie Gates</b> Program Assistant Hospital Bioterrorism Preparedness Program Ph: 608-264-6060

Appendix A – HA vBED Advisory Group Members

<b>Denver Health Development Group</b>	
<p><b>Stephen V. Cantrill, MD</b>                      Associate Director                      Emergency Medical Services                      Denver Health                      777 Bannock, MC 0108                      Denver, CO 80204                      Ph: 303-436-7174                      Fax: 303-436-7541                      Email: <a href="mailto:Stephen.Cantrill@dhha.org">Stephen.Cantrill@dhha.org</a></p>	<p><b>Peter T. Pons, MD</b>                      Emergency Medical Services                      Denver Health                      777 Bannock, MC 0108                      Denver, CO 80204                      Ph: 303-436-6970                      Fax: 303-436-7541                      Email: <a href="mailto:Peter.Pons@dhha.org">Peter.Pons@dhha.org</a></p>
<p><b>Michael Bates</b>                      Data Systems Administrator                      Information Services                      Denver Health                      777 Bannock                      Denver, CO 80204                      Ph: 303-436-8040                      Email: <a href="mailto:Michael.Bates@dhha.org">Michael.Bates@dhha.org</a></p>	<p><b>Sheri L. Eisert, PhD</b>                      Director, Health Services Research                      Denver Health                      777 Bannock, MC 8701                      Denver, CO 80204                      Ph: 303-436-4072                      Fax: 303-436-4035                      Email: <a href="mailto:Sheri.Eisert@dhha.org">Sheri.Eisert@dhha.org</a></p>
<p><b>Ben Grafton</b>                      Web Developer                      Denver Health                      Email: <a href="mailto:Ben.Grafton@dhha.org">Ben.Grafton@dhha.org</a></p>	<p><b>Scott Daub</b>                      Web Developer                      Denver Health                      Email: <a href="mailto:Scott.Daub@dhha.org">Scott.Daub@dhha.org</a></p>
<p><b>Carrie Vinci</b>                      Project Manager                      Denver Health                      777 Bannock, MC 8701                      Denver, CO 80204                      Ph: 303-436-5973                      Email: <a href="mailto:cvinci@dhha.org">cvinci@dhha.org</a></p>	<p><b>Jacob Dye</b>                      Project Manager                      Denver Health                      777 Bannock, MC 8701                      Denver, CO 80204                      Ph: 303-436-7789                      Email: <a href="mailto:Jacob.Dye@dhha.org">Jacob.Dye@dhha.org</a></p>
<p><b>Camille Marthaler</b>                      CDSS Project Manager                      Health Services Research                      Denver Health Medical Center                      303.436.4066  <a href="mailto:camille.marthaler@dhha.org">camille.marthaler@dhha.org</a></p>	



**APPENDIX B  
HA<sub>v</sub>BED Advisory Group Meetings  
MEETING MINUTES**

**Thursday, July 15, 2004**

**Secretary's Conference Room**

**Office of the Assistant Secretary for Public Health Emergency Preparedness  
Hubert Humphrey Bldg., 200 Independence Ave., Washington, D.C. 20201**

**ATTENDEES:**

Lt Col James Baxter	Rhonda Earls, MSN, CNM	Matthew Payne, MPA
Robert Blitzer	Capt Ann Knebel, RN, DNSc	Sally Phillips, RN, PhD
LCDR Sumner Bossler	Lt Col William Kormos	Peter T. Pons, MD
Shayne Brannman, MS, MA	Sheri Eisert, PhD	Dean Ross
Stephen Cantrill, MD	CAPT F. Christy Music, MSc, USN	Kevin Yeskey, MD
Robert Claypool, MD	Michael Nugent	

**OASPHEP CONSIDERATIONS**

**Mr. Blitzer**

Attributes Mr. Blitzer would like this effort to include are:

**1. Utilize existing systems**

Capitalize on existing systems that are currently in use and working. Should not be intrusive.

**2. Inter-operability**

Should be interoperable with existing systems such as HARTS and NDMS.

**3. Adaptable**

Data should be made available by Region and have the ability to reconfigure information to meet the event at hand.

**4. Real Time**

Timely, accurate data should be available within 2-4 hours of an event.

**5. Bed Definition**

Not just bed count; need number of available staffed beds, specialty beds (ie. burn, neonatal, CCU, ICU), ventilators while not being intrusive. Want all beds to be accounted for, including public, private, VA and DOD beds. Divide into pre-hospital assets, hospital assets and alternative care sites. Build on HARTs.

**6. Utility to HHS**

This system needs to help HHS make sound and timely decisions on how the Federal government can best help local and State resources respond to an emergency, based

## Appendix B – HAvBED Advisory Group Meeting Minutes

on verifiable sound data. This data will drive policy decisions like redirecting resources (staff, equipment, supplies) to a region in need from other regions, pre-positioned resources, NDMS, etc. Data from this system could drive aero-medical evacuations from one region to another.

### **Mr. Ross**

System needs to be dynamic, bi-directional, scalable, relational and spatial. Attributes to address include:

#### **1. Legislation**

Mr. Ross mentioned that the federal government is currently prohibited from collecting “routine data” from local agencies. This prohibition is outlined in existing OMB legislation. The question was posed as to how NDMS is allowed to receive data from locals. Two conditions allow NDMS to collect such data 1) The NDMS has a signed memorandum of understanding with each participating hospital giving permission for such collection 2) The NDMS collection of data is not considered “routine” (we were not provided a definition of what OMB defines as routine). Dean also mentioned that he has had several conversations with hospital executives in which he discussed their willingness to provide bed availability data. He stated that they seemed to be resistant because of competitive concerns.

#### **2. Scalability**

All meeting participants agreed that the HAvBED system must be scalable. Hospitals should be able to determine bed availability in close proximity to their institution and move out from there as capacities are exceeded.

#### **3. “Disaster EGOV” Compliance**

DHHS and DHS initiative; compliance will be developing uniform data standards.

#### **4. Geospatial Elements**

Mr. Ross commented that GIS and geospatial analysis capabilities should be an essential component of the HAvBED system.

#### **5. Erroneous Inputs**

During the design phase of HARTS, Mr. Ross visited several of the existing bed tracking systems including HERDS and the Washington system. During these visits, he encountered instances in which erroneous data had been entered into a system. Need to identify by analyzing variation in trends and putting reasonable limits using capacity numbers. This could be an objective of the HAvBED exercise, to validate via site visit or internal confirmation that data entered has been accurately entered. Dr. Phillips also suggested validating the numbers through the testing component of this task order.

#### **6. Scope of Hospitals**

#### **7. Data Dictionaries**

### **8. Diversity of Data Locations**

Mr. Ross described the DHHS’ “Hug the Box” policy. In order for DHHS to integrate a technology system into their operations they must own and operate the server. Existing systems used by DHHS contain redundant and secure data centers located in 5 different sites around the country. In the next two weeks, OMB legislation will be approved requiring federal systems to demonstrate this type of “diversity”.

### **9. Cannot be totally web dependent**

Both Dr. Cantrill and Mr. Ross cautioned the group about our increased dependence on web-based and IP systems and tools. This infrastructure could be damaged during a natural or manmade disaster; Mr. Ross suggested the HAvBED system should consider telephonic inputs. Data entry considerations include the use of telephone data entry using automated prompts and the use of stand alone alert equipment in EDs that prompts hospitals to enter data. Ideally will have single device system-no email or phone calls.

### **10. Data-Field Flexibility**

Must include flexibility to add or delete fields.

### **11. Permissions**

Who should have access to what?

## **DEFINITIONS: BEDS**

### **Available Beds: Licensed, Staffed and Equipped**

Using number of licensed beds in defining capacity is dangerous; hospitals may have entire wings shut down and still have those beds on record. DAS Blitzer prefers to have beds distinguished by staffed beds and other non-staffed beds.

Dr. Yeskey is concerned that bed definition/categories do not reflect the services needed (ie. food, isolation etc). The definition needs to reflect more than just staffed and licensed. It is important to understand service capability or what type of care can be provided and how the beds will be used. The HAvBED system may not be able to define standardized definitions for bed classifications. Ideally, the tool would enable a facility to respond to services needed. Defining beds based on level of care needed by the patient will help limit the variance in reporting definitions amongst clinicians and facilities. A ventilated bed category might be more explicit than a critical care category such as NDMS uses, again terminology should reflect patient need.

CAPT Music wants to follow patients through the continuum of care and therefore prefers categories that include rehabilitation, nursing home, etc. She also feels the categories should include civilian and Federal (DOD, VA, military).

## Appendix B – HAvBED Advisory Group Meeting Minutes

The HAvBED system should include what an institution's adjusted bed capacity could be if augmentation was provided. E.g. Staff, equipment and external support.

### **Current NDMS Categories**

Mr. Ross mentioned the need to look at psych beds since there is a need based on expected hysteria of population. Dr. Yeskey does not believe that lumping medical and surgical beds is a good idea and they should be separated. There is a need to add isolation beds.

Dr. Yeskey also thought it was important to include a hospital evacuation category so that we know when a bed is about to be available. Civilian clinicians need to think about the concept of evacuation upon entry to the medical facility. In a military context, the term evacuation is used to describe patient movement out of a medical facility to another environment such as specialty services or rehabilitation. Dr. Yeskey believes that civilian clinicians currently consider this concept upon discharging patients; however given a rapid influx of acutely ill or injured patients some decisions will have to be made early as to whether the hospital can provide the continuum of care required by the patient. Dr. Cantrill questioned whether civilian health care providers could make such decisions.

Comments were presented regarding medical disaster management, specifically as to whether it is more effective to evacuate patients in a disaster area or to deploy medical resources to the affected area. In the cases of specialty care, it may be more beneficial to move these patients to a site with this capability. However, in a large-scale medical disaster, patient movement out of the affected area is too resource intensive. There was consensus amongst the participants that the NDMS patient evacuation resources would be quickly diminished in a medical disaster scenario.

There seemed to be a consensus among the Advisory Board that the project should not limit its data elements to those currently used by NDMS and that these are not meeting the DHHS regions' needs. This is another reason why it is important to look at the others systems that have been developed, since other people have been looking at these same issues for a while.

### **HAvBED Data Elements**

LCDR Bossler stressed the need for simplicity and proposed focus on a few categories of beds. This project should review the other systems to see what they collect and interface with what they currently collect to the best of our ability. Most of the project effort should be spent on creating data and reporting uniformity among the already existing system. Then we could develop categories/definitions and data elements that would be most appropriate and provide them in the form of recommendations in the final report. Adding additional data elements could decrease the utility of the HAvBED concept.

Dr. Yeskey thought we should develop the ideal list of categories and augment the systems to the best of our ability to capture this data, particularly since this is a national

## Appendix B – HAvBED Advisory Group Meeting Minutes

system. This project should identify an all-encompassing, best-practice data set that would be used in the ideal bed tracking system. It would be disappointing if the threat of “pushback” from private industry vendors or current system participants limited identification of these data elements. These ideal elements should be based on federal, state and local needs.

### **Total Number of Data Elements**

Originally, the NDMS tracked 16 different bed categories; this number was decreased to 6 and increased reporting compliance. HARTS collects 10 different bed categories including the number of isolation rooms available. TRAC<sup>2</sup>ES collects bed information based on snapshot.

### **Other**

Some discussion on defining capacity as what you can do with your current resources with minimal augmentation.

### **DEFINITIONS: TIME**

#### **“Real-Time”: Data Input Frequency**

“Real time” data entry and display was not really defined in this meeting. Most in the meeting agreed that a snapshot of data such as that collected by NDMS is insufficient and limited. Bed and resource availability is too dynamic.

Comments were made about the frequency of data input in an ideal system. HARTS data can be updated every four hours. The question was posed regarding whether day to day data input is necessary; instead, could an effective bed tracking system only include data entry during a large-scale emergency? The group favored the ability to obtain data at a variable rate based on the type and scale of an event. The system would have to be extremely simple and intuitive for a user.

DHHS has developed system that uses satellite band for medical warnings like the weather service.

#### **Maximum: Available in 72 Hours**

The NDMS system provides a data collection field called “maximum beds”. This is defined as the number of potentially available beds within a 72 hours time period. Most users agree that this number is a “best guess”, but Dr. Claypool believes that the current threat climate necessitates some similar attribute in the HAvBED system. The existing snapshots of bed availability provided by many of the systems are helpful, however prolonged incidents spanning weeks or months will require projections of bed availability.

## **PATIENT TRACKING**

Capt Music emphasized the need for patient tracking. Capt Knebel cautioned with the need to either focus on the tracking of assets or the tracking of patients. Lt Col Baxter explained that TRAC<sup>2</sup>ES tracks the patient while in transit. Once they are discharged, other systems capture the data. As part of this task order, Dr. Phillips explained that patient tracking can be part of the asset bed tracking component such as developing the fields, while not necessarily collecting actual data. FEMA is expected to have 10 emergency coordinators among the 10 regions to assist with patient movement.

The only existing system that seems to track from time of injury to hospital destination is the St. Louis system with involves a cooperative relationship between Raytheon and EMsystems. Patients are bar coded for patient tracking and destination is provided using EMsystems.

The Advisory Board approved of the concept of when moving patients, priority should be to move them to local area hospitals, even if this requires minimal hospital augmentation. It would be preferable to move the assets to where the patients are located rather than move the patient to the part of the country where there are assets. This is particularly applicable to a communicable event.

## **HARTS SYSTEM OVERVIEW**

Mr. Ross presented an overview of the HARTS system and gave a handout that Dr. Eisert collected. He described HARTS as a comprehensive system that tracks numerous different attributes including blood, equipment, etc. Can add fields, GIS component, has event log that can be used by participating hospitals. Once hospitals are “opened up” (those medical centers that are affected by an event) they are given an opportunity to enter data. If hospital is a hub for both blood distribution and medical care, the facility can have access to both HARTS components. HARTS has a chat function and derives its facility data from the American Hospital Association. During events, HARTS can specify the frequency in which users must enter data and then track hospital compliance via colorimetric scales such as red, yellow, and green. Looking at TRAC<sup>2</sup>ES system to incorporate patient movement. HARTS activates hospitals and other medical facilities by placing a phone call and deploying emergency response teams to the affected area. HARTS can be updated every four hours. HARTS has admin section, hospital section and blood section.

## **National Health Alert and Warning System**

Mr. Ross provided a brief description of the National Health Alert and Warning System. This non-terrestrial system is currently in testing and production; in summary, it includes an inexpensive alert device that can be placed in a public health center or hospital and has the capability to transmit voice, text, and data when activated by DHHS. Staff will receive an audible tone to alert them of an incoming message.

## Appendix B – HAvBED Advisory Group Meeting Minutes

### **CHOICE OF TRACKING SYSTEMS TO REVIEW**

- Illinois- HHAN system
- St. Louis- hybrid system with Raytheon patient tracking function and EMSystems patient destination
- FREDs Pennsylvania State?
- California- Capt Music refers to Jeff Rubin (Reddinet?)
- North Carolina?

### **ADDITIONAL PARTICIPANTS**

- DHS/NDMS- Contact Bob Jevic
- American Red Cross- should have representative although Capt Knebel stated that Dr. Claypool could represent this group
- American Hospital Association representative

### **NEXT MEETING DATE**

The group agreed on the week of October 11. HAvBED project team is looking at October 14 or 15 for the next meeting and will solicit votes.

**HA<sub>v</sub>BED ADVISORY GROUP  
MEETING MINUTES**

**Thursday, October 14, 2004  
Deputy Secretary's Conference Room  
Office of the Assistant Secretary for Public Health Emergency Preparedness  
Hubert Humphrey Building, 200 Independence Ave.  
Washington, D.C. 20201**

**ATTENDEES:**

Lt Col James Baxter	Ivan Gotham	Sally Phillips, RN, PhD
LCDR Sumner Bossler	Nathaniel Hupert, MD, MPH	Peter Pons, MD
Shayne Brannman, MS, MA	Jeffrey Lowell, MD	Dean Ross
Stephen Cantrill, MD	Duane Mariotti	Daniel Salazar
Robert Claypool, MD	CAPT F. Christy Music, MSc, USN	Maj Wayne Surratt
Rhonda Earls, MSN, CNM	Dawn Myscofski, PhD	Carrie Vinci, ScM
Sheri Eisert, PhD	Andrew Nunemaker	Elaine Wolff, MHS
Michael Feeser		

**HOSPITAL BEDS DEFINITION**

**Staffed and Unstaffed Beds**

The project team proposed that unstaffed bed count is a useful data element reflecting an open bed that a patient could be regulated to if staff were supplied as an asset. The advisory group felt that contractual pools of staff may allow quick staffing of unstaffed beds. The question becomes whether these beds are “staffed” or not and what is the time frame? Other members noted that many new staff may not be familiar with the hospital equipment and procedures and need orientation.

**Vacant Beds**

The term “vacant” beds may not be as intuitive to users as “available” beds used by NDMS. Most hospitals are familiar with the term “available”, but may not understand “vacant”.

**DATA ELEMENTS: CURRENT CAPACITY**

We must collect information that is actionable, not just collect for collecting sake. This project needs to separate things that are “nice” to know versus things that are “need” to know. This project should also beware of mission creep and this first look through should be concise as to what we “need” to know.



## Appendix B – HAvBED Advisory Group Meeting Minutes

This system should contain the bare essentials but other data besides bed count is crucial. Dr. Claypool is very interested in other data elements and suggests tailoring data collection to nature of events. Beginning with bed availability for simplicity sake to demonstrate the proof of concept may lead to a more refined dataset once the feasibility has been proven. This project should also be aware of looking at things at an academic level but not necessarily paying attention to what assets could actually be moved based on this information. This project needs to address the daily trip wires and attributes.

### ***Bed Types***

If the hospitals are given no definitions they can make different beds into different types and the counting is inconsistent. Suggestions include making sure burn beds are ABA certified. ED diversion status is a more useful data element than number of ED beds since these beds can be turned over quickly.

### ***Ventilators and ICU Beds***

The Washington system collects ventilator status but not blood supply information. Ventilator status is located on the resource page and every two months requests a total number of ventilators from each hospital. Most of these ventilators are attached to a patient and are not available. This project may want to differentiate between “vacant” and “used” ventilators.

A concern from the last meeting referred to throughput and that additional resources beyond beds will be necessary to count. Counting ventilators addresses the issue of bed functionality because utilizing ventilators available and ICU bed count provides the necessary information for encompassing services needed for critical care. If other resource data elements are included this will address the issue of noting bed service capability.

Since there is a lack of respiratory therapists, some suggested including the staff in the ventilator definition. Another note of caution arose in that an ICU bed count may identify ICU beds that meet all other ancillary needs such as nurses, but do not include a ventilator. Implicit in that idea is that every ICU has to have the capability to do everything to every patient, which does not hold true for most hospitals. A new frontier is going to be using ventilators in non-traditional settings. Oxygen is also important to address.

### ***Operating Rooms***

This project should look at defining what an available OR is (ie. canceling elective surgeries) including requiring staffing with a surgeon, anesthesiologist, and nurses. The reporting of available operating rooms may be more meaningful in binary form such as “capable” and “not capable”.

### ***Federal Assets***

Federal beds are a community resource. There are DOD memorandums of understanding that will provide mutual support. The VA will be told that they can make beds available to the public. DOD and VA resources should be listed but flagged until authorized to

## Appendix B – HAvBED Advisory Group Meeting Minutes

participate and accept civilian casualties. NDMS and Tricare hospitals should be tagged in this system as well.

For civilian facilities, there are no formal agreements and sharing of assets will be up to the locals. With NDMS, the DOD coordinates the patient transportation component. The largest issues arise from reimbursement.

### **DATA ELEMENTS: SURGE CAPACITY**

The question was posed: should this system forecast data or is it beyond the scope of this project? The committee agrees this project should use NDMS bed availability type surge counts, instead of the proposed “unstaffed” beds category. When discussing surge, we should address not only what will become available but also what you may need in the 1-3 day range. There are two types of surge capacity and capability that should be counted: Hospital and Alternative Care Facility (ACF).

#### ***Hospital Bed Capacity***

There are many different suggested hourly projections necessary for planning and responding to an MCI such as 8-, 24-, 48-, 72-hour estimates. Each different stakeholder requires a different length projection and this group agrees that a lowest common denominator minimizes the burden on the hospital, for example 12-18 hour shifts. NDMS surge bed counts (or deliberate planning beds) are requested at minimum (24 hour) and maximum (72 hour) projections, which are a guess for the civilian hospitals reporting. The 24-hour estimate becomes a 48-hour projection when done every 24 hours.

Local and regional planners rely on and value the smaller hour projection where as multi-state regional and federal planners find the longer projections helpful. The focus of your view is based on who you are and what you need. The hospitals may not know what they need and DHS will just start sending assets. The hospitals need to get better at knowing how many of what they need. They also need to think about sustainment. The 24-hour estimate becomes what from a planning perspective could be asked for in a 72-hour window.

Providing a 24-hour NDMS type bed capacity projection will be very useful in the buffer zone of the event, but not the cross hairs. The incident will move out to overwhelm the next hospital. It provides an increased depth of information to the areas that haven't been affected. State or county managers could also use this information to decide where to place casualties in the next 24 hours. The 72-hour projection gives a regional idea of where to place casualties.

The Washington System notes that multiple hour projections are too intuitively difficult and cumbersome for hospitals to provide before an incident occurs. From their experience, they feel most hospitals can and would be willing to supply a 24 hour estimate. These estimates should be at minimum provided daily, during an event, every 24 hours.

## Appendix B – HAvBED Advisory Group Meeting Minutes

In conclusion, the board advised a 24-hour forecast with a definition if you cancel elective surgeries and discharge patients what is best guess of how many beds could be opened in 24 hours. The project will need to address in detail defining hospital surge capacity beds in a standardized way. For example, cancel elective surgeries and discharging patients. For a CBRNE incident, there is a need to decide the requirements for acceptable standards of care. The question that the hospitals need to ask themselves is: What do we have over and above what we are running right now? What could we make available to accept an active case? Surge capacity requires a common understandable definition; potential capacity can change every ten minutes and depends on how frequently the polling occurs. The number of operating rooms and recovery beds will change with every operation therefore a binary capability may be more relevant.

### ***Alternate Care Facility (ACF) Bed Capacity***

The project should contain a placeholder for ACFs so that ACF bed counts do not commingle with the current hospital capacity information. These surge beds off-site could be entered early if known, before an incident, minimizing data entry burden and assisting in planning. For this system, a bimonthly or quarterly question of what could be made available may suffice. This information should be shared locally, to address how quickly you could move the patient between facilities locally. This would also require local memorandums of understanding and EMS integration. In addition, this project could graph capability to project needs and capabilities out or graph availability of beds over time to follow trends.

ACF bed count should be built in to this system, but would require ownership of this feature. The committee agrees there are two main organizational levels that deal with ACFs and could report capabilities: hospitals and State (regional) planners. Hospitals could track and count according to their mandated JCAHO hospital plan for an alternative care site (ACS). This is the planning phase number associated with each hospital ACS or planned capacity.

Alternatively, States have been forced to look at the regionalization of off-site care and have allocated certain areas as an ACF. These are pre-designated in areas like New Hampshire and New York stadiums according to *The Concept of Operations for the Acute Care Center*, U.S. Army Soldier and Biological Chemical Command (SBCCOM), 2003. Colorado has equipment but has not pre-designated ACFs yet. In order to obtain this type of planning data, the state commissioners may be. In addition, most regions have benchmarks. The regional plans are based on certain projections such as the ability to handle 500 victims per million population or to accommodate a 20% surge. This information could aid in estimating what the ACFs in area can provide.

EMSystem has already added ACFs such as shelters during incidents like the hurricanes in Florida. With this feature they can track availability of shelters for DHS, HHS and the Red Cross.

## Appendix B – HA vBED Advisory Group Meeting Minutes

In conclusion, hospitals should enter 24-hour projections daily and an ACS planning projection quarterly. Regional/State planning information should be entered for an area's ACF planning projection quarterly. The data enterer is still unidentified and may be a long-term goal.

### **SYSTEMS INTERFACE**

The interface will be with each distributed hospital resource tracking system, not centralized. For the regions of the country that are not covered by each of the existing systems, the project will develop an individual hospital interface.

HRSA suggested that operational test cases for the individual hospital interface represent a diverse group of health facilities across the country. For example, these could include a health care *system* in a mid-level city such as Intermountain healthcare or a smaller metropolitan area that does not utilize one of the existing systems.

#### ***Crossing National Borders***

Regarding crossing borders and sharing resources with Canada, Detroit and Ontario have been doing this for many years. 3,000 nurses move every week from Canada to the US (? or vice versa) for better pay and have apartments in Detroit. They work for 3 days and then cross the border back to Canada. One third of nurses are "border crossers" in that area. We lose care providers this way. Sharing of resources with Canada has already begun. The ministry of health runs the Ontario bed tracking system and Dr. Claypool may be able to provide a link to the person he has been working with related to cross border issues. Dr. Claypool suggests pursuing the Ontario system. LCDR Bossler questions if the Ontario system is a provincial system vs. Health Canada.

#### ***Redundancy***

Mr. Ross mentioned 50% of hospitals had no data capability after the earthquakes in Japan. The network and internet NCS experienced T1 shutdown. Redundancy issues, although a valid concern, will not be addressed in this study.

### **DATA COLLECTION: ROUTINE AND INCIDENT DEPENDENT**

The data should be able to communicate "I am becoming saturated, these are my needs". The Federal government cannot poll the hospitals regularly. This project should not only collect what hospitals are normally gathering and reporting, but should be able to be expanded during an event to address incident dependent data collection. EMSsystem® collects this information as an event. HERDS activates certain data fields based on the event type. Routine data must be separated from an open and closed event, not a day-to-day usage. This project may want to think about scalable data entry based on nature of event and if there is an event.

#### ***HARTS System***

Mr. Ross brought up HARTS which collects real time data during an incident. Each hospital has been given a log in and a password. Illinois has a similar system. A portal

## Appendix B – HAvBED Advisory Group Meeting Minutes

sends information to HARTS and sub populates additional fields. This system will port data one way but may want to look at porting data the other way. HARTS was created Federally and is not proprietary.

HARTS has been used real time, for example during the hurricanes in Florida. The project team requested an offline discussion of exactly which data has been collected at what time. The granularity of the data is of concern. For example, during the hurricanes HARTS collected information on hospital structural damage, power sources either commercial or generator and information was sent to the states and power companies.

### **SYSTEM USERS**

The end-users of this system need to be clearly defined. It is important to look at how this system will be used and in what time frame. Different levels of planning and response require different data sets. The required datasets vary for ED, regional and state needs. A concept of operations for this product should also need to be developed for all the anticipated users. This type of operational discussion is larger than the technical discussion. This system is collecting data for the local EMS responders all the way to Federal planners.

Some of the issues regarding the users of this system include operational versus planning usage. Responders utilize different information than planners. In addition, the complexity of each of these users is also an issue. Both operational and planning users may service the local, regional or national level. There are different data elements and time sensitivities required for local or regional planners and responders. Operational users may use this tool to aid in regulating staff from another community *to an event* or to regulate patients *from an event* to another area.

The staff movement concept of sending staffing resources to an event, instead of moving patients away, was proposed to aid in containment for a biological incident. Eric Tolbert of DHS is working on some of these issues including volunteer credentialing.

The Trac2es team noted that they have a synopsis of patient regulating procedures as part of the Global Patient Movement Requirement Center (GPMRC) that they will review with the project team during the site visit.

In terms of usage incentives, this project may want to provide links to other disaster response information and systems such as HAN. This tie adds every day value to have extra information available for users. Common practices augment information and minimize additional data entry. You can ask people to populate the fields but they won't do it unless it benefits them.

### **NEXT MEETING DATE**

The next HAvBED Advisory Group meeting will be January 27, 2004 in Washington, DC.

**HAvBED ADVISORY GROUP  
MEETING MINUTES**

**Thursday, January 27, 2005  
Deputy Secretary's Conference Room  
Office of the Assistant Secretary for Public Health Emergency Preparedness  
Hubert Humphrey Building, 200 Independence Ave.  
Washington, D.C. 20201**

**ATTENDEES:**

Lt Col James Baxter  
LCDR Sumner Bossler  
Shayne Brannman, MS, MA

Michael Feeser  
Nathaniel Hupert, MD, MPH  
Jeffrey Lowell, MD

Sally Phillips, RN, PhD  
Peter Pons, MD  
Col Anthony Rizzo, MC,  
SFS

Stephen Cantrill, MD  
Robert Claypool, MD  
Rhonda Earls, MSN, CNM  
Sheri Eisert, PhD  
Deborah Levy, PhD

Duane Mariotti  
CAPT F. Christy Music, MSc, USN  
Andrew Nunemaker  
Kevin Yeskey, MD

Daniel Salazar  
Christopher Felton, MD  
Jacob Dye, MS  
Padmini Jagadish

**Introduction**

Dr. Cantrill

**AHRQ Bioterrorism Research Overview**

Sally Phillips

- Project interface
  - Surge capacity requirements for tracking
  - Mass causality movement of patients
  - Strategic national stockpile.
  - Cross training
  - Interface with other projects like HAvBED

**Software Specifications Summary / Definitions / Screen Shots – Frames**

Dr. Cantrill

- ABA Certified is limited, not including the 43 ABA verified, there are 132 ABA certified hospitals nationwide. Change to "Burn Unit Bed in a Burn Center" or "Burn ICU beds in Burn Centers"
- Overstating capabilities

## Appendix B – HA<sub>v</sub>BED Advisory Group Meeting Minutes

- If not ABA certified, pulling from same certified critical care nurses for ICU beds
- Add comment that staff for beds should not draw each other individual hospitals
- Negative air flow??
- Beds must be mutually exclusive
- Need to have a dialog with ABA to potentially expand the burn bed data field.

### Claypool

- What is it meant by “currently not in use”?
- Change to “can be made available in 2 hours”

### Rizzo

- Virtually every operating room available for immediate receipt of patients
- 
- Change to "available for prompt receipt of patients". or "Staffed ORs"
- Ventilators- total #
- Delete ventilators – “not in use”
- Change “Decontamination” to "Mass Decontamination"
- Emergent Department Status – change to:
  - Open
  - Closed
  - N/A

### **EDXL Group Discussions**

- XML schema EDXL
- XML: Data tagged and organized allowing the receiving system to know where to place the data. Snapshot of the data available and how often does it change.

### **Presidential Inauguration Bed Tracking Report**

Lt Colonel Baxter

#### **Discussion**

- NDMS does not include all hospitals, but includes the majority
- Show NDMS to another level – go to other system
- "Throughput" is the limiting factor for the ultimate number of available beds.
- Tracking hospital resources to calculate throughput.
- HA<sub>v</sub>BED does not have throughput capabilities; hospitals do not have technology to make this judgement.

### Feeser

- Need to have hospitals regulate operations during tests of HA<sub>v</sub>BED
- Set conference call for the April meeting.
- Change the date for the April meeting? NDMS conference

## Appendix B – HAvBED Advisory Group Meeting Minutes

### **NEXT MEETING DATE**

HAvBED project team will have a phone conference sometime in April for the next meeting and will solicit votes.



**HA**v**BED ADVISORY GROUP  
MEETING MINUTES**

**Monday, May 2, 2005  
Hotel Caribe Royale  
Orlando, Florida**

**ATTENDEES:**

Lt Col James Baxter  
Stephen Cantrill, MD  
LCDR Cipriano Pineda  
Chris Felton

Mark Roupas  
Duane Mariotti  
CAPT F. Christy Music, MSc, USN  
Andrew Nunemaker

Sally Phillips, RN, PhD  
Jacob Dye  
Shayne Brannman

**PowerPoint Presentation**

Dr. Cantrill presented the HA**v**BED project progress leading up to data delivery by system partners and hospitals using the manual data entry web interface.

- Secured Server on-line
- Database ready to receive data
- System partners testing web services interface
- GIS interface progress
- Requested matrices for final report

**Data Points**

EMSystem®, represented by Andy Nunemaker and Chris Felton, explained how data is requested from participating hospitals it covers. A data entry screen is dispersed to the data entry person at each participating hospital as a HTML page. Data is entered and sent to an EMSystem® database and on to the HA**v**BED database. Hospitals participating through EMSystem® will include all the public and private hospitals in the State of Colorado, and potentially hospitals in Southeast Wisconsin and Virginia. State Hospital Capacity System, represented by Duane Mariotti, explained that a subset of data already being requested from participating hospitals in Washington, Oregon, and South Carolina will be sent to the HA**v**BED database. Hospital data will include public, private, and military hospitals.

**Matrices for Final Report**

Dr. Cantrill requested the advisory group discuss the final report documentation and the project findings in the form of matrices.

- The one suggestion that dominated the discussion was the need for a follow-up survey to determine the success of the HA**v**BED project from the user's perspective. Many of the obstacles the HA**v**BED project has met were not technological but administrative. Interfacing with hospital data, which is

## Appendix B – HAvBED Advisory Group Meeting Minutes

considered proprietary to the individual hospital, presents many challenges. To ensure the continuance of the HAvBED project requires the documentation of the process to construct the hospital database, GIS and web interface. In addition, the process each individual hospital went through administratively to approve or disapprove the participation in the HAvBED pilot project will assist in a full-scale national implementation. The survey would document both the technological and administrative issues involved with participating in the HAvBED project.

- It was suggested that HAvBED staff file for an extension through AHRQ for the follow-up survey and documentation.

**HAvBED ADVISORY GROUP  
DRAFT MEETING MINUTES**

**Tuesday, July 12, 2005**

**Office of the Assistant Secretary for Public Health Emergency Preparedness  
Hubert Humphrey Building, 200 Independence Ave. Rm. 305A  
Washington, D.C. 20201**

**ATTENDEES:**

Sally Phillips, RN, PhD  
Stephen Cantrill, MD  
Jacob Dye, MS  
Sheri Eisert, PhD  
Kevin Yeskey, MD

Robert Claypool, MD  
Nathaniel Hupert, MD, MPH  
Duane Mariotti  
Andrew Nunemaker  
CAPT F. Christy Music, MSc, USN

Padmini Jagadish  
Peter Pons, MD  
Daniel Salazar  
Michael Feeser

**Introductions**

**HAvBED Presentation: Dr. Stephen Cantrill**

Dr. Cantrill reviewed the steps involved in the development of the HAvBED project including the development of bed definitions, the designation of desired data elements and the development of the operational HAvBED system including the specification of XML interface, the Emergency Data Exchange Language. A review of the three testing periods was presented. The functionality of the HAvBED system was demonstrated via an internet connection to the HAvBED system. Operational issues and limitations were presented. Recommendations for next steps were discussed. Advisory group members were provided with a logon and password for the HAvBED system. They were encouraged to review the system and provide any comments to Dr. Cantrill.

**Discussion:**

- In general, the Advisory Group thought the HavBed System is a good tool that could be used by regional and local emergency planners and responders.
- Edward Gabriel expressed that the HavBed system would be good tool for emergency planners, especially when dealing with interstate issues of bed availability.
- There were discussions of next steps concerning ownership and sustainability of the HAvBED system. Dr. Claypool and Phillips expressed the need to have a follow-up meeting regarding how to proceed once the Final Report is completed and recommendations finalized.

## **Appendix C Questionnaire for Site Visits**

### **System Overview**

1. Provide an overview of your system including ALL data elements collected, key staff, and approximate cost.

### **Information Technology**

2. Is your system web-dependent? Telephone?
3. Explain your system's data management.

### **Beds**

4. Is your bed availability data element binary (yes/no) or count?
5. What *types* of beds do you offer data fields for?
6. Are these specified as staffed or un-staffed?

### **Patient Tracking**

7. Does your system include a patient tracking feature?

### **Real Time**

8. How often is the data updated?

### **GIS**

9. Does your system incorporate geospatial elements?
10. If so, where do you get the data?

### **Data Reliability**

11. What do you have in place to prevent data entry errors (ie. trend analysis, caps on entry fields)?
12. Do you include data dictionaries to describe the data entry field to the user?

### **Hospitals**

13. Where and how many states use your system? Regions? Hospitals?
14. What is the incentive for hospitals to participate?

### **Security**

15. Does your system operate on a secure server?

**Appendix D**  
**Preliminary System Specification Document**

**HAvBED**  
**Hospital Available Beds for Emergencies and Disasters**

**Preliminary Software Requirements Specifications**

**2004 - 2005**

**Version: January 21, 2005**

## Document Purpose

The purpose of the software requirements specifications (SRS) document is to detail the functional and nonfunctional requirements of the HAvBED system. This document will be used as a guideline for the development of the system.

## 1. Introduction

### 1.1 Purpose

HavBED (Hospital Available Beds for Emergencies and Disasters) is an information technology proof-of-concept project funded by AHRQ (The Agency for Healthcare Quality and Research). The purpose of the HAvBED project is to demonstrate a standardized “real-time” hospital bed and resource availability information system that can be used by decision makers, planners and emergency personnel at the local, state, regional and federal levels.

### 1.2 Intended Audience

This Software Requirements Specifications (SRS) document is written for the HAvBED software development team and AHRQ. This document will outline the detail of the HAvBED system as derived from several sources including: the HAvBED Advisory Board, the HAvBED Project Team, review of various medical resource tracking systems, the AHRQ Task Order: *Health Care System Preparedness and Surge Capacity for Bioterrorism and Public Health Emergencies* Requirements, and the HAvBED Technical and Cost Proposal.

### 1.3 Project Scope

The HAvBED demonstration system, when fully developed and implemented, will collect and display sample national hospital bed and resource availability information to be utilized for planning and response to a medical disaster. The information HAvBED will collect and display is considered highly confidential; security is a high priority.

HavBED will gather data via two mechanisms: 1) a data interface which monitors and receives data from existing local, state and regional hospital status of reporting systems, which may require minor modifications to ensure standardization reporting and 2) a web-based data entry system allowing manual data entry for hospitals that do not participate in any other bed reporting system.

The HAvBED system will offer the ability to display levels of data from the national level to individual hospital information. The system will display data in two formats: a report format available for printing and a Geographic Information Systems (GIS) map display.

The HAvBED system is a 12-month information technology proof-of-concept project. The project development will run from October 2004 – May 2005; the testing phase will begin early in development and end in May 2005. This will be an iterative IT development project due to time constraints. The final demonstration of the HAvBED system to the HAvBED Advisory Board will be in June 2005. The final report is due

## Appendix D – HAvBED Preliminary System Specification Document

following completion of this task order. At that time, the HAvBED demonstration system will become the property of AHRQ.

### 1.4 References

Other HAvBED development documentation referenced in this document include the Use Cases, the Data Flow Diagram and the Wireframes.



## 2. Overall Description

### 2.1 Product Perspective

The HAvBED system is a stand-alone demonstration that will be interfaced with three hospital resource data monitoring systems that have been developed for state, local and regional use and an internet-based product to provide and data entry for hospitals that do not participate in such data monitoring systems. The three hospital resource data monitoring systems, EMSystem®, HERDS and the Washington state system, will send relevant data to the HAvBED demonstration system for data storage and display. This national system is a new product; there is no knowledge of a previous development attempt of this type of system which interfaces with existing systems.

### 2.2 Product Features

The proposed major features of this product include:

1. Display of timely, accurate and standardized bed availability data.
2. A secure login assuring confidentiality of data.
3. Displaying data in a report format with the ability to print.
4. Displaying data in a map format (GIS), with the ability to print.
5. Displaying data with the ability to drill-down (to federal, regional, state and local information) based upon predetermined access needs.
6. Manual data entry for medical facilities to enter relevant data.
7. Internet access to this system for data entry and display.
8. Contact information for each participating medical facility across the nation.
9. AHA data accessibility.
10. Forecasted surge bed capacity for facilities 24 and 72 hours in the future.

### 2.3 User Classes and Characteristics

The pathway the user will be allowed to take is determined at log-in, based upon the predetermined access permissions specified for that individual user. The user classes and characteristics are identified as follows:

#### 1. **Manual Data Entry (MDE) Pathway User**

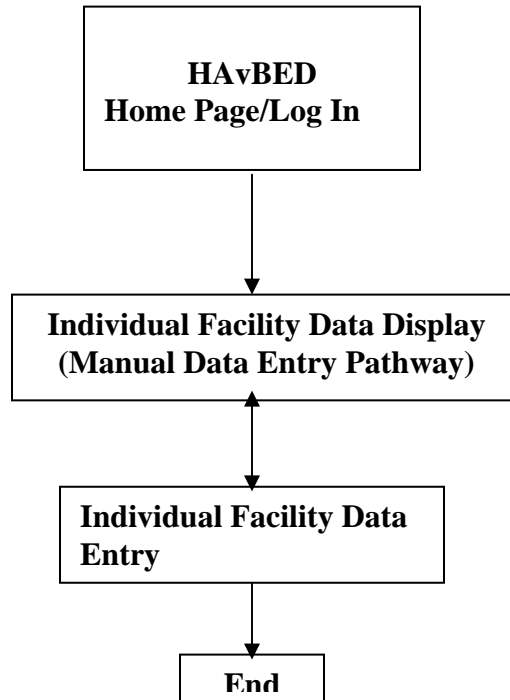
There are two types of MDE users:

1. Hospital or medical facility personnel who are entering data into the web-based HAvBED system because their hospital does not participate in one of the already interfacing systems.
2. Hospital or medical facility personnel *from an already interfacing system* who are manually editing or adding data (such as surge capacity beds).

## Appendix D – HAvBED Preliminary System Specification Document

These users will have access to only their facility's data, both in the data display and data entry modes. When this user is finished viewing or entering data, the user will then log out and the system will return to the homepage.

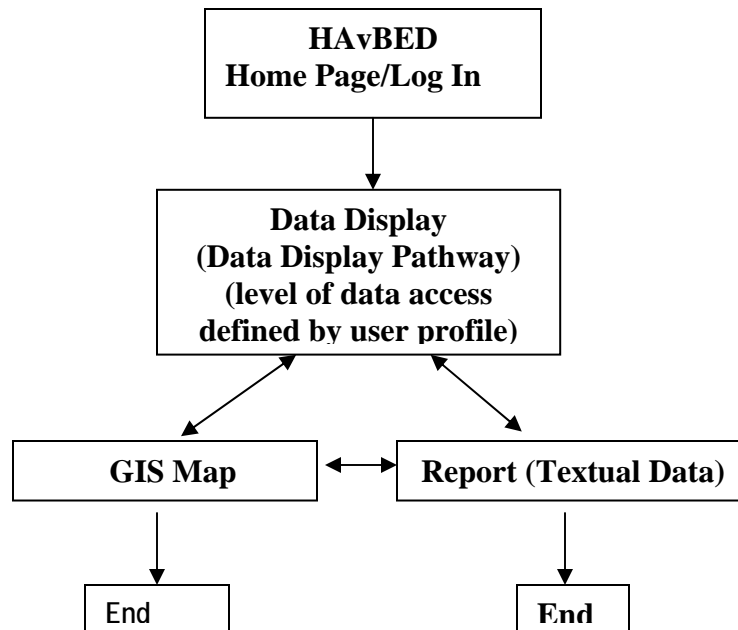
Schematically, this is shown here:



### 2. Data Display (DD) Pathway User

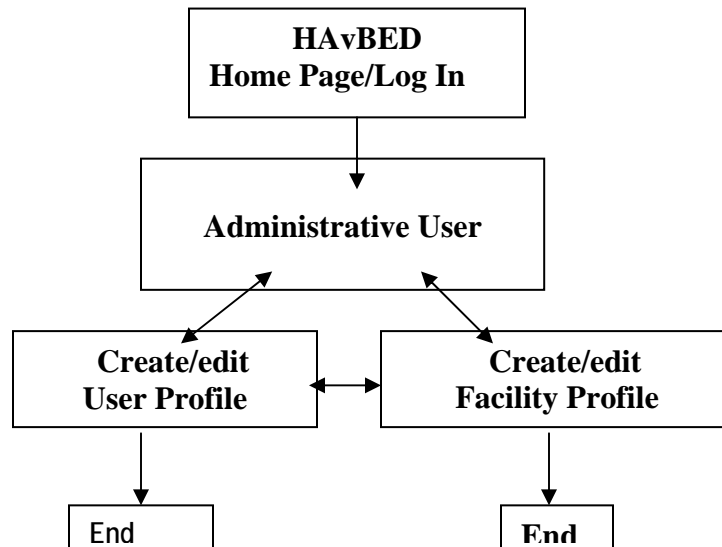
There are many types of data display users based upon the permission level they are granted to view data in the HAvBED system. This user can be generally defined as medical emergency planners and responders at multiple levels including National, Regional, State, Metropolitan Area, and City. This user will be able to view the data in two formats: report or map; the system will open separate windows for viewing each format. The login provided to this user will only allow DD, not MDE. For purposes of this demonstration, display of data via this pathway will be predetermined by the user's level of display access and will be limited to National (including individual states) or State (multiple states may be allowed).

Schematically, this is shown here:



### 3. Administrative User

This class of user will be allowed to full access to the Manual Data Entry and Data Display pathways as well as being able to create/edit user and facility profiles.



Note:

1. Each user profile will contain user name, user pass code and level of access allowed. If access for that user is limited to a single facility, that facility identification number will also be in the profile. (See Section 3.6, below, for further details.)

## 2.4 Operating Environment

The HAvBED system will use a web server and a database server. The system will utilize the internet, allowing user accessibility from virtually any location within the nation.

For this project, the team ordered two PowerEdge 1850 Servers. These servers have:

- Intel Xeon Processors at 2.8GHz/ 1 MB Cache
- 1GB DDR2 400MHz Memory
- 36GB, Ultra 320 SCSI Hard Drives

The code, servers and databases will all be housed and maintained within the Denver Health IT department during the entire development process. Although this product will encompass some GIS maps, there are no other software or applications with which this system will need to collaborate within its physical operating environment, although the system will be configured across the Denver Health IT firewall.

HAvBED will interface with three other systems in order to receive data (one-way); those systems are located in New York, Milwaukee and Seattle.

## 2.5 Design and Implementation Constraints

1. The most important constraint on the development process is the time limitation. This development will have a very quick turn-around. Development is slated to begin in October 2004 and end in June 2005, encompassing early testing during development. This will limit the product to the highest priority features, with recognition of some identified features as useful future functionality.
2. The development of the project will use a SQL database, Webservices and eXtensible Markup Language (XML) as a data interchange format. The project team reviewed the HL7 format for use in this development, but identified problems utilizing HL7, mainly due to a lack of richness in specifying the type of data elements to be transmitted from the participating systems. The HL7 format could possibly be incorporated into future development of this product if additions are made to the types of data elements allowed.
3. The project team investigated incorporating GIS software into this product. HAvBED is designed to utilize map-based information, and will most likely use static ESRI ARCInfo maps for this demonstration. The team originally reviewed ESRI ARC software products identifying ARCIMS as the software package most compatible functionally with the HAvBED system. However, at this point, the amount of .net coding and hardware and system support necessary to make the GIS display component internet compatible is felt to be prohibitive, making the use of truly dynamic mapping problematic. Unless future research identifies a more efficient way to incorporate GIS into HAvBED, static ARCInfo maps will

## Appendix D – HA**v**BED Preliminary System Specification Document

be included in late development after HA**v**BED has received data from the partnering systems. These static maps will be programmed to be interactive for drill-down functionality for the final demonstration.

### 2.6 User Assistance/Help

HA**v**BED will have a user help component built into the system. Every screen available to the any level user will have a help function available providing an explanation of the screen and a “how to” explanation of the task the user is currently working with in HA**v**BED. For example, if a user is in the data entry screen, the Help function will display an explanation of the data entry process.

The user Help function will also describe the color-coding built into the data report screen.

The help function of HA**v**BED will also include contact information for the system administrator.

Another feature of the system will allow the user to mouse over column titles and have a pop-up window show the definitions. For example, mousing over a column named “Current Beds Available” will show the definition of that title for user clarification.

### 2.7 Assumptions and Dependencies

External factors that this project are dependent upon are the development of communication interfaces with the partnering systems. There are many factors involved in developing the interface including recognition of important data elements and a timeline for completion and ongoing communication with the partnering systems. These will all be important to the completion of the interfaces.

### 3. System Features

#### 3.1 User Login

The user will open the HAvBED homepage/login and enter a username and password, then press “enter” on the computer keyboard. Both the username and the password fields are open text, allowing a maximum 10 digit alphanumeric entry. The minimum entry for these fields is 5 alphanumeric digits. If the user enters a username and/or password with too many or too few characters, HAvBED will ask the user to re-enter the login. If the user tries to re-enter three times and is unsuccessful, HAvBED will ask the user to contact the HAvBED system administration for assistance (offering contact information).

#### *User Permissions*

When the login is successful and the user presses enter, the system will do a check to determine what level of access this user has, and if so, for what health facility. If this user is allowed manual data entry access, the system will take the user to the data display screen for the facility for which the user is allowed to enter data. If this user is allowed data display access (more than a single institution), the system will take the user to the Data Area Selection Display (see 3.3, below).

#### 3.2 Manual Data Entry (MDE)

##### 3.MDE.1 Description and Priority

The manual data entry feature is a high priority for this system. It allows a user with appropriate permission to review and edit information for his/her institution in the HAvBED database.

##### 3.MDE.2 Stimulus/Response Sequences

Upon entry to the MDE pathway, the user will be presented with the current HAvBED data for his facility as shown below. Note that the “24 hour beds” and “72 hour beds” may be made available for data entry and display based upon an option set by a system administrator. An example of these data for the user’s institution are shown below.

Appendix D – HAvBED Preliminary System Specification Document

**Official use only. Public safety confidential.**

**HAvBED**  
Hospital Available Beds for Emergencies and Disasters

“Edit” is a link to the data entry page. Edit | Print **Hospital Data Display** Help Log Out

St. Sisters of Currency, 123 Main Street, Anytown, CO 303-555-1212 Date: 1/15/05  
Last Update: 1/15/05 13:00:00 Time: 13:45:02

Bed Type	Current Beds Available	24hr Beds Available	72 hr Beds Available	Current Beds Remarks
Adult ICU	<input type="text" value="3"/>	<input type="text" value="8"/>	<input type="text" value="10"/>	<input type="text" value="Step-down unit closed; PACU open"/>
Medical/Surgical	<input type="text" value="1"/>	<input type="text" value="5"/>	<input type="text" value="20"/>	<input type="text"/>
Burn	<input type="text" value="4"/>	<input type="text" value="6"/>	<input type="text" value="9"/>	<input type="text"/>
Pediatric ICU	<input type="text" value="3"/>	<input type="text" value="6"/>	<input type="text" value="6"/>	<input type="text"/>
Pediatrics	<input type="text" value="8"/>	<input type="text" value="10"/>	<input type="text" value="12"/>	<input type="text"/>
Psychiatric	<input type="text" value="2"/>	<input type="text" value="5"/>	<input type="text" value="5"/>	<input type="text"/>
Negative Pressure/ Isolation Rooms	<input type="text" value="2"/>	<input type="text" value="6"/>	<input type="text" value="8"/>	<input type="text"/>
Operating Rooms	<input type="text" value="2"/>			<input type="text"/>

Emergency Department Status:

Decontamination Facility Availability:

Ventilators Available:  In Use:  10

If “Edit” is selected on this page, the user will be taken to a similar display that will allow the updating of any of the data items.

Functionality of the data entry window includes:

1. The “Current Beds Available” column is “softly” capped by the AHA bed data already in the HAvBED database. This is due to the fact that the facility may create additional surge beds, greater than the static AHA number for that category. If a user enters a number larger than the AHA bed number for that facility, HAvBED will show a warning message: “The number you have entered is greater than expected. Please confirm this number.” The user will click “Confirm” or “Re-enter” on the message. “Confirm” will result in the system accepting the data. All of these fields should allow a null or zero entry without a resulting error message.
2. The remarks field will have a fifty alphanumeric character limit. The remarks entered in this window will show in the Report detail window as a notation (or symbol) with each hospital bed type (under “Current Beds Available”). When the user mouses over this notation in the Report window, a pop-up window will show the remarks that were entered in the Data Entry window. These remarks will remain until the next manual data entry user removes them.

## Appendix D – HAvBED Preliminary System Specification Document

3. After the data is entered, the user will press the “Submit” button on the window. These data will then be used to update the database, and replace the Data Entry window with Hospital Data Display window. This window allows the user to view the data that have just been updated.

4. The print function in the Data Entry Feedback window will simply print what is displayed in the window. This print menu feature is not available in the Data Entry window (the functionality is not needed in this window).

5. Mousing over the columns “Current Beds Available”, “24hr Beds Available”, and “72hr Beds Available” will show a pop-up definition of those terms. (All other terminology definition and explanation of window functionality will be listed in the ‘Help’ menu option.)

### *Alternative Care Facility (“Care Station”) Data Entry*

If the user is entering data for the Alternative Care Facility type of facility, the only fields available in the Facility Data Entry window are:

1. Surge Beds Available (includes Current, 24 hr and 72hr beds)
2. Current Beds Remarks
3. Decontamination Facility Availability
4. Ventilator Capable (Y/N)
5. Ventilators Available
6. Ventilators In Use

### 3.3 Data Report Display (DRD)

#### 3.DRD.1 Description and Priority

The data report display window allows the user to view the data for whatever level of information the user chooses from the data display window, based upon the predetermined level of data access allowed for each specific user. This functionality is a high priority for this system, allowing the data for a nation, region, state, metro area, or hospital to be formatted in a report that can be printed.

#### 3.DRD.2 Stimulus/Response Sequences

The user will open the homepage/login window, enter a username and password and press “Enter” on the keyboard. The system will run a check to determine what access this user has. When the system determines this user has access to only the data display process, the window is immediately changed to the Data Display window.

In this window, the user has the ability to choose the level of data from drop-down menus, based upon predetermined permissions. The menu offers:



**1. National**

**2. Regional:**

a. FEMA/ NDMS/ PHS Federal Regions:

1. Region I
2. Region II
3. Region III
4. Region IV
5. Region V
6. Region VI
7. Region VII
8. Region VIII
9. Region IX
10. Region X

b. CDC Federal Regions:

1. New England
2. Mid-Atlantic
3. East North Central
4. West North Central
5. South Atlantic
6. East South Central
7. West South Central
8. Mountain
9. Pacific

c. East/ West Regions:

1. East
2. West

**2. State:**

- a. A listing of all fifty states in the U.S., including Washington D.C.

**3. County: [Future enhancement]**

- a. A listing of AHA data hospitals by county (the state abbreviation will be included with the county name listing for clarification)

**4. Metro Area: [Future enhancement]**

- a. Metropolitan Statistical Areas (from the AHA data)

**5. City:**

- a. City listings from the AHA data.

**6. Hospital:**

- a. Hospital name.

**7. Other:**

- a. User-defined criteria (at this time zip code defined search)

\* See Appendix A for definitions of the menu options.

The data display will contain many layers of information from which to choose. The National, Regional and State menus are designed as a separate drop-down search from the County, Metro Area, City and Hospital menus.

The drop-down menu must highlight the choice the user makes, and when highlighted, the choice (eg Region) will open an appropriate sub-menu, allowing the user to make a desired selection (FEMA regions, CDC regions, etc) which, in turn will cause an additional sub-menu to open, displaying the types of regions. The user will then select the specific region and then select “Map” or “Text Report” to retrieve the desired data.

**3.4 Report Text Display (RTD)**

**3.RTD.1 Description and Priority**

The report window allows the user to view textual data by the level of display chosen in the Data Display window. This window will have several features allow the user to filter, print and define the data display.

**3.RTD.2 Stimulus/Response Sequences**

Once the user makes a choice in the Data Display window and presses “Report”, the system opens a new window showing the user-defined data in a report format. The user will be able to see a summary first, followed by detailed information listing by hospital. The detailed information will be viewed by scrolling down in the window. This window will have three print options: print summary, print detail and print summary and detail. These options will be available to the user from a fly-over menu when the user presses the “Print” button. The fly-over menu will also highlight the choice the user makes with a mouse click, then immediately will disappear and begin the print job.

At this point, the user will have the ability to go back to the Data Display window and choose another user-defined data report opening a new window. The user will also have the ability to map this same user-defined data in the report window when the “Map Display” button is pressed in the report window. Using “Map Display” from the report window will open a new window.

When the user is done viewing the information in the report window, they can choose to click on the “Log-out” button. The HA<sub>v</sub>BED system will log the user out of that window and move that window back to the home page/log in; and time out of all other windows open.

The Report window will list “Current Beds Available”, “Surge Beds Available” (two columns of “24 hours” and “72 hours”), “AHA Survey Beds”, “Acute Care Facility

## Appendix D – HAvBED Preliminary System Specification Document

Emergency Department Status” (Open or On Divert), “Decontamination Facility Availability” (Available or Unavailable) and “Hospitals with Ventilators” (Available or In Use).

The detail of the report (individual hospital listings) will include the number of patients waiting in the Emergency Department.

One important function in the detail of the report window is the ability to view by page 1,2,3,4,5,etc., listing twenty hospitals per page. The detail of the report window can list thousands of individual institutions and without this functionality, loading this page could bring down the system.

An important feature in this report is an asterisk symbol indicating that the actual number of available beds may be equal to or greater than the number shown (for all the current bed types, not including “Alternative Care Beds”). The detail of the report will indicate a  $\geq 1$  for bed numbers greater than one; otherwise zero will be listed. EMSsystem®, under normal operating conditions, would not send any actual bed number for a category, only that the institution is not on divert for that category of bed (and thus, having one or more beds of this class available). Including this symbol after the bed number allows the user to see there is equal to or more than the number of beds available. During the test period, EMSsystem® will activate a bed poll page for their users asking them to fill in actual bed numbers for the “Current Beds Available” by bed type listed in the HAvBED system. The user will be able to click on the help file to determine what the asterisk represents in the report.

The report window will have several features listed below by priority. These will be included as development time allows:

1. The detail list will have contact information with each hospital and symbols to represent: NDMS:



TRICARE:



or Alternative Care Site (Care Station):



## Appendix D – HAvBED Preliminary System Specification Document

This information will default to the information from the AHA database, but will be updated with the information from the partnering systems. The following systems will be updating the contact information as needed:

- Washington: hospital name, street address, city, zip code, area code, local telephone number, NDMS facility, TRICARE facility, county.
- EMSSystem®: hospital name, local telephone number
- HERDS: n/a

The AHA data will contain: hospital name, name of chief administrator, street address, city, state two digit abbreviation, zip code, area code and local telephone number.

2. The detail list will differentiate between Acute Care Facilities and Alternative Care Sites by using a symbol indicating an Alternative Care Site. The detail list will also use symbols to differentiate between NDMS and TRICARE facilities. HAvBED will use NDMS and TRICARE entities' symbols for this purpose.
3. Color-coding in the display of the information. In the detail of the report window listed by hospital, the current beds vacant and the last update time information will have the font change to a blue color after 24 hours have passed without an update.
4. The detail list will default to listing individual hospital information by alphabetized state, then alphabetized by hospital within the states. The detail list will also allow the user to order the information by hospital, city and state by clicking on the headers of these columns if this implementation detail is easily achievable.
5. The ED divert status, ventilator availability and decontamination availability will be color coded both in the summary and detail area of the report page. The detail area will show the ED open status, decon available and ventilator available number will show the font as green. ED on divert, decon unavailable and ventilator in use will show the font as red. The summary area will show the text background (not font) as red or green to the corresponding information.
6. The open date field will default to the current day, but allow the user to input a past date for historical data. For example, if the user puts in a historical date of 1/13/04, the system will display data up through that date (if easily achievable – this feature may be a future enhancement).
7. The report window will also allow the user to open up a window showing the detail hospital information by clicking on the hospital name. In order to view

## Appendix D – HAvBED Preliminary System Specification Document

the summary again, the user will be able to press a “Go back to summary” link that will appear in this detail window.

8. The summary list will allow displaying information by State, Region, County, Metro Area or City within the level of information specified by the user in the Data Display window (based upon the user’s allowed level of access).

If the user is viewing National information, Regional and State options for data will be available. For Regions, State, Metro Area and County options will be available. For State, County, Metro Area and City options will be available. For Metro Area: a City options will be available.

9. The detail list will allow the user to re-order the detail hospital data by the column headings: Hospital, County, City and State.

### 3.RTD.3 Functional Requirements

1. The system must be able to interpret the login as a data display level user and bring that user to the Data Display window.
2. The HAvBED system must be able to present data by the level of viewing information chosen in the data display window.
3. HAvBED must have the ability to print by summary, detail, and summary with detail in the report window.

### 3.5 Map Data Display (MDD)

#### 3.MDD.1 Description and Priority

The map data display window allows the user to view bed availability data by geographic location. This function is a high priority within the HAvBED system. The HAvBED system will incorporate GIS functionality (through static GIS maps, as feasible) for this feature.

#### **3.MDD.2 Stimulus/Response Sequences**

After the user chooses the scope of data to view from the Data Display window, the user presses the “Map Display” button. The system will open a new window display a GIS map with the same scope of information (i.e. national, regional, etc.) the user had chosen in the Data Display window. From this point, the user is able to “drill-down” in the GIS maps to lower levels of information. For example, if the user chose Region VIII in the data display window, and the map display window appeared with a GIS map of Region VIII, then the user would be able to drill down by state, metro area, city and hospital.

1. Through the map display window, the user will also be able to view the same level of information in the report window by pressing the “Report” button.

## Appendix D – HAvBED Preliminary System Specification Document

This will open a new window with the same level of information, but in a report format (see 3.3 RTD for report window functionality).

2. The user will also be able to view the Report data through the Map Display window in a simple format. This Map Display window will have a “Data” button that will show a fly-over data summary by “Current Beds Available”, “24 hr Beds Available”, “72 hr Beds Available” and “AHA Survey Beds”.
3. The GIS map will have various symbols representing important information such as airports; hospitals and alternative care sites. These symbol options will include:
  - A. The hospital symbols may be color-coded; green indicating the emergency department is available and red indicating the emergency department is on divert status.
  - B. The symbols will also include the NDMS, TRICARE and alternative care facility symbols featured in the Report window.

These symbols will be displayed in a symbol key located at the lower right side of the window. The user will be able to move this key with the mouse.

When finished, the user will log-out. HAvBED will go back to the home page/log in window, and time out of the other open windows.

The GIS map component will be integrated in one of three ways:

### 1. Static Maps:

The map display button in HAvBED will link to .jpgs. This option will allow data fly-over from the Report window. This will also use static bed number pulls from the HAvBED database.

### 2. Interactive Maps:

The map display button in HAvBED will open the desktop ArcVIEW GIS software. This desktop software will allow user-defined graphs and regions for the summary data display. This option will use static bed number pulls from the HAvBED database.

### 3. Server-based GIS and ArcIMS:

This option is the most development-intensive, in terms of time constraint, programming, and expense. If achievable, this is the most desirable solution.

## 3.MDD.3 Functional Requirements

1. The Map Data Display window will have a print option; HAvBED must be able to print out the GIS map.
2. The Map Data Display window will have a “Data” button with a fly-over menu containing the same data as the report window – this data must be on the same level (national, regional, etc.) as the GIS map in the window.

3. The system must be able to open a report window with the same level of data displayed in the map data display window.

### 3.6 Administrative Functions

#### **Create Facility Option**

Administrative users will have the ability to create new facilities in the database. HAvBED will allow two options: Hospital or Alternative Care Site (Care Station) facility creation. This window will have radio buttons for the user to choose between these types of facilities. It will also contain text fields for:

1. Institution or Facility Name
2. Name of Chief Administrator (or Contact Person for Alternative Care Facilities)
3. Street Address
4. City
5. State
6. Zip Code
7. Area Code
8. Local Telephone Number
9. County
10. AHA Hospital Identification Number (or ID number for Alternative Care Facility)
11. Hospital (or Care Site) Latitude/Longitude
12. Metropolitan Statistical Area (MSA) Code
13. NDMS Participant (user will enter yes or no)
14. TRICARE Participant (user will enter yes or no)

The required fields are the facility name, AHA number or ID number, complete address, chief administrator or contact person, and local telephone number. There will be a ‘Save’ button at the bottom of this window.

Most of these types of information (except for TRICARE and NDMS participants) are already within the AHA data for facilities within the HAvBED database, and whatever information the user updates will change the defaulted AHA information.

#### *User Profile Creation*

Administrative users will be able to create and maintain user profiles. User profile data fields for this demonstrations system will include:

1. User Name
2. User email
3. User phone number
4. Facility code for which the user may enter data (AHA number)

5. Level of data retrieval access allowed (National, State, None)
6. If State level of data retrieval, which states that user may view.

## 4. Interface Requirements

### 4.1 User Interface

The HAvBED user interface will be developed with the XML/C# programming language. The user interface standards will include:

1. A true-type Arial 12 pt font. A true-type font will ensure that all printers have the capacity to print out the information from the system.
2. Buttons will have a consistent appearance throughout the system:

**Submit**

3. Fly-over menus and fly-over data will have a consistent appearance. These menus will have a grey background; highlighting each option background in white as the user mouses through the options.
4. The main menu will have the following appearance:

**Map Display | Print**

**Help | Log Out**

This menu will change according to the functionality of the window, but will have this consistent appearance. As the user mouses over the menu options, the words will highlight blue indicating to the user that this is an active link.

5. The HAvBED banner will appear on the Homepage/Login window, the Data Display window and the Data Entry Window:

## **HAvBED**

### **Hospital Available Beds for Emergencies and Disasters**

---

The other windows will display only the solid line, leaving more room for the Report and Map Display information:

---



## Appendix D – HAvBED Preliminary System Specification Document

6. Standard buttons on every screen (except the login window) will include “Help” and “Log Out”.
7. Scroll bars will appear if necessary to the right of the window. This feature will more than likely be used in the report window, the data entry window and the data entry edit/feedback window. This might also be necessary in some of the GIS map windows.

### 4.2 Hardware Interfaces

HAvBED will be interfaced with other systems through an internet/webservices network. This network will utilize XML as the data interchange format. Each partnering system will create an interface to forward the data into the HAvBED system. HAvBED will act as the receiver of information, and will not send information out to a partnering system.

### 4.3 Software Interfaces

The partnering systems are EMSystems based in Milwaukee, WI; the Washington state system based in Seattle, Washington and the HERDS system based in New York, New York. The partnering systems’ databases will share data with the HAvBED system. A partnering system refresh will also trigger a refresh in the HAvBED system; specifically an individual hospital refresh in a partnering system will trigger that hospital data refresh in the HAvBED system. Avoiding unnecessary data refresh in a batch format will allow the system to work more efficiently.

Although EMSystem does not generally require bed type available data in their system, they have already designed a “bed poll” specialized page for some of their users and will utilize this bed poll page during the several weeks of testing HAvBED. This bed poll page will include the interface data required by the HAvBED system, and allow EMSystem to update the HAvBED database.

Any translation of terms used by the partnering systems to terms used by HAvBED will be done by the partnering system prior to transmission.

#### 4.3.1 Partnering Systems Interface:

The interface will contain data elements:

1. The AHA hospital identification number
2. Current Beds Vacant numbers:
  1. Intensive Care Unit (ICU)
  2. Medical and Surgical (Med/Surg)
  3. Burn Unit
  4. Pediatrics Intensive Care Unit (Peds ICU)
  5. Pediatrics (Peds)

## Appendix D – HAxBED Preliminary System Specification Document

6. Psychiatric (Psych)
  7. Negative Pressure Isolation Beds
  8. Operating Rooms
- 
3. Emergency Department Divert Status
  4. Decontamination Facility Available
  5. Ventilators Available (Unused)
  6. Ventilators In Use
  7. Data Entry Date/Time
- 
8. Surge Capacity Beds for 24 hours (these are the additional beds that can be made available for patients in that amount of time):
    1. Medical and Surgical (Med/Surg)
    2. Intensive Care Unit (ICU)
    3. Pediatrics (Peds)
    4. Pediatric Intensive Care Unit (Peds ICU)
    5. Psychiatric (Psych)
    6. Burn Unit
    7. Negative Pressure Isolation Beds
- 
9. Surge Capacity Beds for 72 hours (these are the additional beds that can be made available for patients in that amount of time):
    1. Medical and Surgical (Med/Surg)
    2. Intensive Care Unit (ICU)
    3. Pediatrics (Peds)
    4. Pediatric Intensive Care Unit (Peds ICU)
    5. Psychiatric (Psych)
    6. Burn Unit
    7. Negative Pressure Isolation Beds

\*Data received that is older than two weeks will not be displayed in the HAxBED user interface.

### 4.3.2 American Hospital Association Static Data

The HAxBED database will contain an excerpt of American Hospital Association (AHA) data. This will contain static data for each hospital:

1. Staffed Beds:
  1. Intensive Care Unit (ICU)
  2. Medical and Surgical (Med/Surg)
  3. Burn Care
  4. Pediatrics Intensive Care Unit (Peds ICU)
  5. Pediatric (Peds)
  6. Psychiatric (Psych)
  7. Operating Rooms

## Appendix D – HAvBED Preliminary System Specification Document

2. Total Staffed Beds
3. Hospital Identification Information:
  1. Hospital Name
  2. Name of Chief Administrator
  3. Street Address
  4. City
  5. Zip Code
  6. Area Code
  7. Local Telephone Number
  8. County
  9. AHA Hospital Identification Number
  10. Hospital Latitude/Longitude
  11. Metropolitan Statistical Area (MSA) Code
  12. MSA Names (MSA cities)
  13. NDMS Participant

\*Note that the hospital address (including City, Zip Code), phone number and chief administrator are defaulted as contact information for the HAvBED data. If the system interface does not update these data elements, then the AHA contact information will show in the interface.

\*Note also that the ability to add alternative care sites in a real time fashion will necessitate that these site be given a (bogus) AHA number for identification that will be beyond the range of normal AHA hospital numbers.

## 5. Other Non-Functional Requirements

### 5.1 Performance Requirements

A high priority of this system is to show accurate and timely data. The goal is to achieve real-time bed availability information from the partnering systems. Each system updates data at different times, and HAvBED would need to have the most current data available. A data refresh in a partnering system will trigger a refresh in HAvBED.

### 5.2 Security Requirements

Security of information is a high priority in this system. User logins for the system will dictate whether the user is permitted to enter data into the system or view displayed data through the report window or the GIS map component. The administrator of the system will maintain these logins.

HAvBED will also log any user off, defaulting back to the homepage/login when the system is unused for a period of 5 minutes.

### 5.3 Software Quality Attributes

The HAvBED system is designed for emergency personnel use, accessing the data easily is of primary importance. The system must be simple, straight-forward and intuitive. Ease of use is especially important in the data display process of HAvBED.

Appendix A: Data Display Window Definitions

**1. FEMA/ NDMS/ PHS Federal Regions:**

**Region I:** MA, ME, NH, CT, RI, VT (Massachusetts, Maine, New Hampshire, Rhode Island, Vermont, Connecticut)

**Region II:** NY, NJ, (New Jersey, New York)

**Region III:** DC, DE, MD, PA, VA, WV (Washington DC, Delaware, Maryland, Pennsylvania, Virginia, West Virginia)

**Region IV:** AL, FL, GA, KY, MS, NC, SC, TN (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee)

**Region V:** IL, IN, MN, WI, MI, OH (Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin)

**Region VI:** AR, LA, OK, NM, TX (Arkansas, Louisiana, New Mexico, Oklahoma and Texas)

**Region VII:** IA, KS, MO, NE (Iowa, Kansas, Missouri, Nebraska)

**Region VIII:** CO, MT, UT, WY, ND, SD (Colorado, Montana, Utah, Wyoming, North Dakota, South Dakota)

**Region IX:** AZ, CA, HI, NV (Arizona, California, Hawaii and Nevada)

**Region X:** AK, WA, OR, ID (Alaska, Idaho, Oregon, Washington)

**2. CDC Federal Regions:**

**New England:** Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont

**Mid-Atlantic:** New Jersey, New York, Pennsylvania

**East North Central:** Wisconsin, Michigan, Illinois, Indiana, Ohio

**West North Central:** Minnesota, North Dakota, South Dakota, Iowa, Missouri, Nebraska, Kansas

**South Atlantic:** Florida, Georgia, North Carolina, South Carolina, Virginia, West Virginia, Maryland, Delaware, District of Columbia

**East South Central:** Tennessee, Alabama, Mississippi, Kentucky

**West South Central:** Texas, Louisiana, Oklahoma, Arkansas

**Mountain:** Montana, Idaho, Wyoming, Colorado, Utah, Nevada, Arizona, New Mexico

**Pacific:** Washington, Oregon, California, Alaska, Hawaii

**3. East/ West Regions:**

**East:** All states east of the Mississippi River:

Wisconsin, Illinois, Michigan, Indiana, Ohio, Kentucky, Tennessee, Alabama, Mississippi, Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia, Maryland, Delaware, New Jersey, New York, Pennsylvania, New Hampshire, Rhode Island, Massachusetts, Vermont, Maine, Connecticut, District of Columbia

**West:** All states west of the Mississippi River:

Minnesota, Iowa, Missouri, Arkansas, Louisiana, Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii

**5. States:**

A listing of all fifty states plus the District of Columbia:

Wisconsin, Illinois, Michigan, Indiana, Ohio, Kentucky, Tennessee, Alabama, Mississippi, Florida, Georgia, South Carolina, North Carolina, Virginia, West Virginia, Maryland, Delaware, New Jersey, New York, Pennsylvania, New Hampshire, Rhode Island, Massachusetts, Vermont, Maine, Connecticut, Minnesota, Iowa, Missouri, Arkansas, Louisiana, Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii, District of Columbia

**6. Counties:**

Located in the AHA data. This data will not list all the counties in the nation, but only the counties where the AHA hospitals reside.

**7. Metro Area:**

Metropolitan Statistical Area: A core-based statistical area associated with an urban area of at least 50,000 populations. The MSAs are assigned a code, which correspond to the hospital information in the AHA data.

**8. City:**

City Proper: Located in the AHA data. This data will list the city of every AHA hospital in the database.

**9. Hospital Name:**

This information is located in the AHA data. HAxBED will only use AHA hospital names.

**10. Other:**

This option will allow user-defined information display. At this time, the user can choose to view by zip code.

## APPENDIX E HA vBED EDXL Communication Schema

```

<?xml version="1.0" ?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
targetNamespace="http://www.statusmessage.org/ns/hospital/v1.0"
xmlns:rs="http://www.statusmessage.org/ns/hospital/v1.0"
xmlns:core="http://www.statusmessage.org/ns/coredomain/v1.0">
  <xs:import namespace="http://www.statusmessage.org/ns/coredomain/v1.0"
  schemaLocation="CoreDomain.xsd"/>
  <xs:element name="hospitalStatus">
    <xs:annotation>
      <xs:documentation>Communicate the status of one or more
hospitals.</xs:documentation>
    </xs:annotation>
    <xs:complexType>
      <xs:sequence>
        <xs:element name="hospital" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="id" type="xs:string">
                <xs:annotation>
                  <xs:documentation>Unique identifier for this
hospital.</xs:documentation>
                </xs:annotation>
              </xs:element>
              <xs:element name="hospitalName" type="xs:string" minOccurs="0"/>
              <xs:element name="location" type="xs:string" minOccurs="0"/>
              <xs:element name="emergencyDepartment"
type="rs:EmergencyDepartment" minOccurs="0"/>
              <xs:element name="hospitalBedCapacity"
type="rs:HospitalBedCapacity" minOccurs="0"/>
              <xs:element name="physicianCoverage" type="rs:PhysicianCoverage"
minOccurs="0"/>
              <xs:element name="hospitalEOC" type="rs:HospitalEOC"
minOccurs="0"/>
              <xs:element name="ventilators" type="rs:Ventilators"
minOccurs="0"/>
              <xs:element name="comments" type="xs:string" minOccurs="0"/>
              <xs:element name="updateTime" type="xs:dateTime"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>

```

## Appendix E – HAvBED EDXL Communication Schema

```
</xs:element>

<xs:complexType name="EmergencyDepartment">
  <xs:annotation>
    <xs:documentation>Ability of this emergency department to treat
patients.</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="emsTraffic" minOccurs="0">
      <xs:annotation>
        <xs:documentation>Ability of this emergency department to receive patients
via emergency medical services. </xs:documentation>
      </xs:annotation>
      <xs:complexType>
        <xs:sequence>
          <xs:element name="status">
            <xs:simpleType>
              <xs:restriction base="xs:string">
                <xs:enumeration value="Normal">
                  <xs:annotation>
                    <xs:documentation>Accepting all EMS
traffic.</xs:documentation>
                  </xs:annotation>
                </xs:enumeration>
                <xs:enumeration value="Advisory">
                  <xs:annotation>
                    <xs:documentation>Experiencing specific resource
limitations which may affect transport of some EMS traffic.</xs:documentation>
                  </xs:annotation>
                </xs:enumeration>
                <xs:enumeration value="Closed">
                  <xs:annotation>
                    <xs:documentation>Requesting re-route of EMS traffic to
other facilities. </xs:documentation>
                  </xs:annotation>
                </xs:enumeration>
                <xs:enumeration value="Disaster">
                  <xs:annotation>
                    <xs:documentation>Experiencing physical plant failure or
other situation that completely precludes EMS transport.</xs:documentation>
                  </xs:annotation>
                </xs:enumeration>
                <xs:enumeration value="N/A">
                  <xs:annotation>
                    <xs:documentation>Not Applicable. This hospital does not
have an emergency department.</xs:documentation>
                  </xs:annotation>
                </xs:enumeration>
              </xs:restriction>
            </xs:simpleType>
          </xs:element>
        </xs:sequence>
      </xs:complexType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
```



## Appendix E – HAvBED EDXL Communication Schema

```

        </xs:annotation>
        </xs:enumeration>
    </xs:restriction>
</xs:simpleType>
</xs:element>
<xs:element name="reason" type="xs:string" minOccurs="0">
    <xs:annotation>
        <xs:documentation>Reported contributing factor to a EMS Traffic
Status.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="comments" type="xs:string" minOccurs="0"/>
</xs:sequence>
</xs:complexType>
</xs:element>
<xs:element name="capacity" type="rs:TriageCount" minOccurs="0">
    <xs:annotation>
        <xs:documentation>The number of each triage patient type
the hospital can accept.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="census" type="rs:TriageCount" minOccurs="0">
    <xs:annotation>
        <xs:documentation>The number of each triage patient type
the hospital currently has.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="emsOffload" minOccurs="0">
    <xs:complexType>
        <xs:sequence>
            <xs:annotation>
                <xs:documentation>How long it takes an ambulance to offload a
patient.

                Select from either Normal or Delayed and/or specify the average
                offload time in minutes.</xs:documentation>
            </xs:annotation>
            <xs:element name="status" minOccurs="0">
                <xs:simpleType>
                    <xs:restriction base="xs:string">
                        <xs:enumeration value="Normal">
                            <xs:annotation>
                                <xs:documentation>The time required to offload a patient is
typical.</xs:documentation>
                            </xs:annotation>
                        </xs:enumeration>
                        <xs:enumeration value="Delayed">

```

## Appendix E – HAvBED EDXL Communication Schema

```

        <xs:annotation>
            <xs:documentation>The time required to offload a patient is
longer than typical. </xs:documentation>
        </xs:annotation>
    </xs:enumeration>
</xs:restriction>
</xs:simpleType>
</xs:element>
<xs:element name="minutes" type="xs:integer" minOccurs="0">
    <xs:annotation>
        <xs:documentation>Average offload time in
minutes.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="comments" type="xs:string" minOccurs="0"/>
</xs:sequence>
</xs:complexType>
</xs:element>
</xs:sequence>
</xs:complexType>

<xs:complexType name="HospitalBedCapacity">
    <xs:annotation>
        <xs:documentation>Specify status, availability, baseline and capacity counts
for each of the bed types.</xs:documentation>
    </xs:annotation>
    <xs:sequence>
        <xs:element name="adultICU" type="rs:BedCapacity" minOccurs="0">
            <xs:annotation>
                <xs:documentation>Capacity status for adult ICU beds. These can
support critically ill or injured patients, including ventilator
support.</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="medicalSurgical" type="rs:BedCapacity" minOccurs="0">
            <xs:annotation>
                <xs:documentation>Capacity status for medical-surgical beds.
These are also thought of as ward beds.</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="burn" type="rs:BedCapacity" minOccurs="0">
            <xs:annotation>
                <xs:documentation>Capacity status for burn beds. These are
thought of as burn ICU beds, either approved by the American
Burn Association or self-designated. These beds are NOT to
be included in other ICU bed counts.</xs:documentation>
            </xs:annotation>
        </xs:element>
    </xs:sequence>
</xs:complexType>

```

## Appendix E – HA vBED EDXL Communication Schema

```
</xs:annotation>
</xs:element>
<xs:element name="pediatricICU" type="rs:BedCapacity" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Capacity status for pediatric ICU beds. Similar
      to adult ICU beds, but for patients 17-years-old and younger.
    </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="pediatrics" type="rs:BedCapacity" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Capacity status for pediatrics beds. These are
      ward medical/surgical beds for patients 17-years-old and younger.
    </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="psychiatric" type="rs:BedCapacity" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Capacity status for psychiatric beds. These are ward
      beds on a closed/locked psychiatric unit or ward beds where a patient
      will be attended by a sitter.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="negativeFlowIsolation" type="rs:BedCapacity"
minOccurs="0">
  <xs:annotation>
    <xs:documentation>Capacity status for negative airflow isolation beds.
These
    provide respiratory isolation. NOTE: This value may represent available
beds
    included in the counts of other types.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="otherIsolation" type="rs:BedCapacity" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Capacity status for other isolation beds. These
      provide isolation where airflow is not a concern. NOTE: This value
      may represent available beds included in the counts of other types.
    </xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="operatingRooms" type="rs:BedCapacity" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Capacity status for operating rooms which are
      equipped, staffed and could be made available for patient care
      in a short period of time.</xs:documentation>
  </xs:annotation>
</xs:element>
```

## Appendix E – HAvBED EDXL Communication Schema

```
</xs:annotation>
</xs:element>
<xs:element name="comments" type="xs:string" minOccurs="0"/>
</xs:sequence>
</xs:complexType>
<xs:complexType name="PhysicianCoverage">
  <xs:annotation>
    <xs:documentation>Availability of specialty physician
coverage.</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="cardiology" type="core:AvailabilityStatus" minOccurs="0"/>
    <xs:element name="neonatology" type="core:AvailabilityStatus"
minOccurs="0"/>
    <xs:element name="neurosurgery" type="core:AvailabilityStatus"
minOccurs="0"/>
    <xs:element name="neurology" type="core:AvailabilityStatus" minOccurs="0"/>
    <xs:element name="obgyn" type="core:AvailabilityStatus" minOccurs="0"/>
    <xs:element name="facialSurgery" type="core:AvailabilityStatus"
minOccurs="0"/>
    <xs:element name="orthopedic" type="core:AvailabilityStatus" minOccurs="0"/>
    <xs:element name="psychiatric" type="core:AvailabilityStatus"
minOccurs="0"/>
    <xs:element name="generalSurgery" type="core:AvailabilityStatus"
minOccurs="0"/>
    <xs:element name="comments" type="xs:string" minOccurs="0"/>
  </xs:sequence>
</xs:complexType>

<xs:complexType name="HospitalEOC">
  <xs:annotation>
    <xs:documentation>Specify the status of the hospital emergency
operations center's resources.</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="eocStatus">
      <xs:annotation>
        <xs:documentation>Whether the EOC is currently
operating.</xs:documentation>
      </xs:annotation>
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:enumeration value="Active"/>
          <xs:enumeration value="Inactive"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
  </xs:sequence>
</xs:complexType>
```

## Appendix E – HA vBED EDXL Communication Schema

```
</xs:element>
<xs:element name="clinicalStatus" minOccurs="0">
  <xs:annotation>
    <xs:documentation/>
  </xs:annotation>
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:enumeration value="Normal">
        <xs:annotation>
          <xs:documentation>Hospital clinical resources are operating within
normal conditions.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="Level-1">
        <xs:annotation>
          <xs:documentation>Hospital clinical resources are operating at
Level-1 surge conditions.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="Level-2">
        <xs:annotation>
          <xs:documentation>Hospital clinical resources are operating at
Level-2 surge conditions.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="FullInactive">
        <xs:annotation>
          <xs:documentation>Hospital clinical resources are exceeded and
acceptable care cannot be
          provided to additional patients. Diversion or community surge
response is required.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
    </xs:restriction>
  </xs:simpleType>
</xs:element>
<xs:element name="deconCapacity" minOccurs="0">
  <xs:annotation>
    <xs:documentation>The capacity for chemical/biological/radiological patient
decontamination.</xs:documentation>
  </xs:annotation>
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:enumeration value="Inactive">
        <xs:annotation>
          <xs:documentation>Not being used, but available if
```

## Appendix E – HA vBED EDXL Communication Schema

```
needed.</xs:documentation>
    </xs:annotation>
  </xs:enumeration>
  <xs:enumeration value="Open">
    <xs:annotation>
      <xs:documentation>In use and able to accept additional
patients.</xs:documentation>
    </xs:annotation>
  </xs:enumeration>
  <xs:enumeration value="Full">
    <xs:annotation>
      <xs:documentation>In use at maximum
capacity.</xs:documentation>
    </xs:annotation>
  </xs:enumeration>
  <xs:enumeration value="Exceeded">
    <xs:annotation>
      <xs:documentation>Storage needs exceed available
space.</xs:documentation>
    </xs:annotation>
  </xs:enumeration>
</xs:restriction>
</xs:simpleType>
</xs:element>
<xs:element name="morgueCapacity" minOccurs="0">
  <xs:annotation>
    <xs:documentation>The morgue capacity.</xs:documentation>
  </xs:annotation>
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:enumeration value="Open">
        <xs:annotation>
          <xs:documentation>Space is available.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="Full">
        <xs:annotation>
          <xs:documentation>All normal space is in use.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="Exceeded">
        <xs:annotation>
          <xs:documentation>Storage needs exceed available
space.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
    </xs:restriction>
  </xs:simpleType>

```

## Appendix E – HAvBED EDXL Communication Schema

```
</xs:restriction>
</xs:simpleType>
</xs:element>
<xs:element name="facilityStatus" minOccurs="0">
  <xs:annotation>
    <xs:documentation>The facility status.</xs:documentation>
  </xs:annotation>
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:enumeration value="Normal">
        <xs:annotation>
          <xs:documentation>No conditions exist that adversely affect
            the general operations of the facility.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="Compromised">
        <xs:annotation>
          <xs:documentation>General operations of the facility have been
            affected due to damage, operating on emergency backup systems,
            or facility contamination.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="Evacuating">
        <xs:annotation>
          <xs:documentation>Indicates that a hospital is in the process
            of a partial or full evacuation.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
      <xs:enumeration value="Closed">
        <xs:annotation>
          <xs:documentation>Indicates that a hospital is no longer capable
            of providing services and only emergency services/restoration
            personnel remain in the facility.</xs:documentation>
        </xs:annotation>
      </xs:enumeration>
    </xs:restriction>
  </xs:simpleType>
</xs:element>
<xs:element name="securityStatus" minOccurs="0">
  <xs:annotation>
    <xs:documentation>The status of security procedures in the
hospital.</xs:documentation>
  </xs:annotation>
  <xs:simpleType>
    <xs:restriction base="xs:string">
      <xs:enumeration value="Normal">
```

## Appendix E – HAvBED EDXL Communication Schema

```
<xs:annotation>
  <xs:documentation>The hospital is operating under routine security
  procedures.</xs:documentation>
</xs:annotation>
</xs:enumeration>
<xs:enumeration value="Elevated">
  <xs:annotation>
    <xs:documentation>The hospital has activated increased security
    procedures (awareness, surveillance) due to a potential threat,
    or specific security related event i.e. increase in local threat
    level, VIP, bomb threat.</xs:documentation>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="RestrictedAccess">
  <xs:annotation>
    <xs:documentation>Based on security needs, the hospital has
    activated procedures to allow access to the facility through
    a reduced number of controlled entrances.</xs:documentation>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="Lockdown">
  <xs:annotation>
    <xs:documentation>Based on security needs, the hospital has
    activated procedures to control entry to the facility to
    authorized persons only.</xs:documentation>
  </xs:annotation>
</xs:enumeration>
<xs:enumeration value="Quarantine">
  <xs:annotation>
    <xs:documentation>Based on a public health emergency, the
    entry and exit of the facility is controlled by public
    health officials.</xs:documentation>
  </xs:annotation>
</xs:enumeration>
</xs:restriction>
</xs:simpleType>
</xs:element>
  <xs:element name="staffing" minOccurs="0">
    <xs:annotation>
      <xs:documentation>The status of staffing
resources.</xs:documentation>
    </xs:annotation>
    <xs:simpleType>
      <xs:restriction base="xs:string">
        <xs:enumeration value="Adequate">
          <xs:annotation>
```



## Appendix E – HA<sub>v</sub>BED EDXL Communication Schema

```

the current needs.</xs:documentation>
                                <xs:documentation>Meets
                                </xs:annotation>
                                </xs:enumeration>
                                <xs:enumeration value="Insufficient">
                                <xs:annotation>
                                <xs:documentation>Current
needs not being met.</xs:documentation>
                                </xs:annotation>
                                </xs:enumeration>
                                </xs:restriction>
                                </xs:simpleType>
                                </xs:element>
                                <xs:element name="facilityOps" minOccurs="0">
                                <xs:annotation>
                                <xs:documentation>The status of the facility
operations supplies.</xs:documentation>
                                </xs:annotation>
                                <xs:simpleType>
                                <xs:restriction base="xs:string">
                                <xs:enumeration value="Adequate">
                                <xs:annotation>
                                <xs:documentation>Meets
the current needs.</xs:documentation>
                                </xs:annotation>
                                </xs:enumeration>
                                <xs:enumeration value="Insufficient">
                                <xs:annotation>
                                <xs:documentation>Current
needs not being met.</xs:documentation>
                                </xs:annotation>
                                </xs:enumeration>
                                </xs:restriction>
                                </xs:simpleType>
                                </xs:element>
                                <xs:element name="clinicalOps" minOccurs="0">
                                <xs:annotation>
                                <xs:documentation>The status of the clinical
operations supplies.</xs:documentation>
                                </xs:annotation>
                                <xs:simpleType>
                                <xs:restriction base="xs:string">
                                <xs:enumeration value="Adequate">
                                <xs:annotation>
                                <xs:documentation>Meets
the current needs.</xs:documentation>

```

## Appendix E – HAvBED EDXL Communication Schema

```

        </xs:annotation>
    </xs:enumeration>
    <xs:enumeration value="Insufficient">
        <xs:annotation>
            <xs:documentation>Current
needs not being met.</xs:documentation>
        </xs:annotation>
    </xs:enumeration>
</xs:restriction>
</xs:simpleType>
</xs:element>
    <xs:element name="comments" type="xs:string" minOccurs="0"/>
</xs:sequence>
</xs:complexType>
<xs:complexType name="Ventilators">
    <xs:annotation>
        <xs:documentation>Provides information about
the availability of ventilators at this facility.
        </xs:documentation>
    </xs:annotation>
    <xs:sequence>
        <xs:element name="availableCount" type="xs:integer">
            <xs:annotation>
                <xs:documentation>The number of ventilators that
are present in the institution but are currently
not in use and could be supported by currently
available staff.</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="comments" type="xs:string" minOccurs="0"/>
    </xs:sequence>
</xs:complexType>

<xs:complexType name="TriageCount">
    <xs:annotation>
        <xs:documentation>Top level complex schema type defining triage
counts.</xs:documentation>
    </xs:annotation>
    <xs:sequence>
        <xs:element name="triageRed" type="xs:integer" minOccurs="0">
            <xs:annotation>
                <xs:documentation>Number of victims with immediate
needs.</xs:documentation>
            </xs:annotation>
        </xs:element>
    </xs:sequence>
</xs:complexType>

```

## Appendix E – HAvBED EDXL Communication Schema

```
<xs:element name="triageYellow" type="xs:integer" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Number of victims with delayed
needs.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="triageGreen" type="xs:integer" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Number of victims with minor
needs.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="triageBlack" type="xs:integer" minOccurs="0">
  <xs:annotation>
    <xs:documentation>Number of deceased victims.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="comments" type="xs:string" minOccurs="0"/>
</xs:sequence>
</xs:complexType>

<xs:complexType name="BedCapacity">
  <xs:annotation>
    <xs:documentation>Top level complex schema type defining bed capacity counts
given a specific type of bed.</xs:documentation>
  </xs:annotation>
  <xs:sequence>
    <xs:element name="status" minOccurs="0">
      <xs:annotation>
        <xs:documentation>Whether any beds are available.</xs:documentation>
      </xs:annotation>
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:enumeration value="Vacant/Available"/>
          <xs:enumeration value="NotAvailable"/>
        </xs:restriction>
      </xs:simpleType>
    </xs:element>
    <xs:element name="availableCount" type="xs:integer" minOccurs="0">
      <xs:annotation>
        <xs:documentation>The number of vacant/available beds to which patients
can be immediately transported. These must include supporting
space, equipment, medical material, ancillary and support
services and staff to operate under normal circumstances.
These beds are licensed, physically available and have staff
on hand to attend to the patient who occupies the bed.</xs:documentation>
      </xs:annotation>
    </xs:element>
  </xs:sequence>
</xs:complexType>
```

## Appendix E – HAvBED EDXL Communication Schema

```
</xs:annotation>
</xs:element>
<xs:element name="baselineCount" type="xs:integer" minOccurs="0">
  <xs:annotation>
    <xs:documentation>The standard number of available
beds.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="additionalCapacityCount24Hr" type="xs:integer"
minOccurs="0">
  <xs:annotation>
    <xs:documentation>Estimate how many beds above the current
number could be made vacant/available within 24 hours. This includes
institutional surge beds as well as beds made available by
discharging/transferring patients.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="additionalCapacityCount72Hr" type="xs:integer"
minOccurs="0">
  <xs:annotation>
    <xs:documentation>Estimate how many beds above the current
number could be made vacant/available within 72 hours. This includes
institutional surge beds as well as beds made available by
discharging/transferring patients.</xs:documentation>
  </xs:annotation>
</xs:element>
<xs:element name="comments" type="xs:string" minOccurs="0"/>
</xs:sequence>
</xs:complexType>
</xs:schema>
```

**Appendix F**  
**HAvBED Bed Definitions**

**DEFINING A HOSPITAL BED**

**Licensed Beds:** This refers to the maximum number of beds for which a hospital holds a license to operate. Many hospitals do not operate all of the beds for which they are licensed.

**Physical Available Beds:** This refers to beds that are licensed, physically set-up and available for use. These are beds regularly maintained in the hospital for the use of patients, which furnish accommodations with supporting services (such as food, laundry, and housekeeping). These beds may or may not be staffed but are physically available.

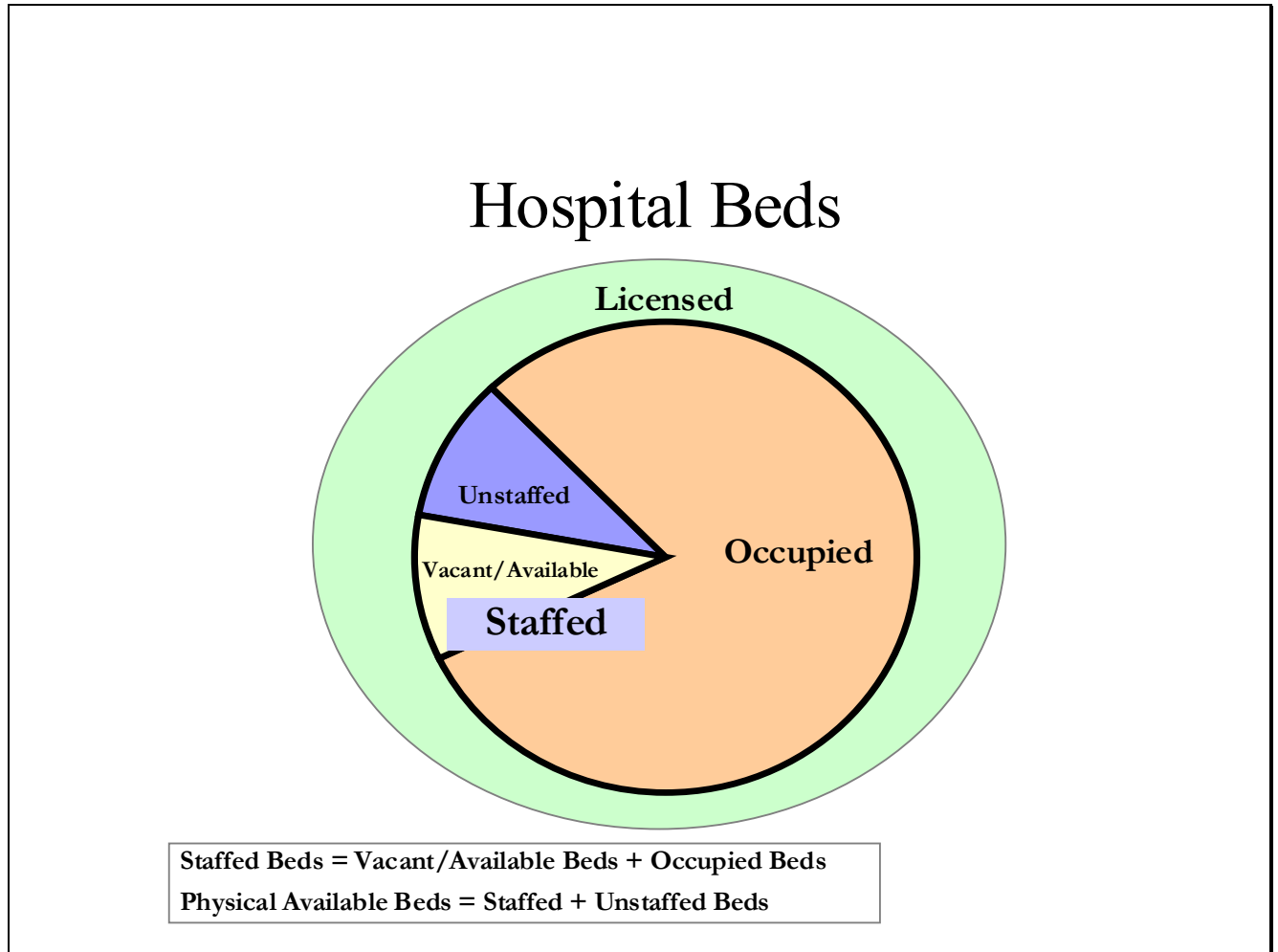
**Staffed Beds:** This refers to beds that are licensed and physically available for which there is staff on hand to attend to the patient who occupies the bed. Staffed beds include those that are occupied and those that are vacant.

**Unstaffed Beds:** This refers to beds that are licensed and physically available that have no current staff on hand to attend to a patient who would occupy the bed.

**Occupied Beds:** This refers to beds that are licensed, physically available, staffed and occupied by a patient.

**Vacant/Available Beds:** Beds that are vacant and to which patients can be immediately transported. These must include supporting space, equipment, medical material, ancillary and support services and staff to operate under normal circumstances. These beds are licensed, physically available and have staff on hand to attend to the patient who occupies the bed. Unless otherwise stated, in the HAvBED project, “**Current Beds Available**” refers to **Vacant/Available Beds**.

A graphical representation of this is shown below:



### Bed Types:

The types of beds to be reported to the HAvBED Project include:

- Adult Intensive Care (ICU): beds that can support critically ill/injured patients, including ventilator support
- Medical/Surgical : also thought of as “Ward” beds
- Burn: thought of as Burn ICU beds, either approved by the American Burn Association or self-designated. (These beds are NOT to be included in other ICU bed counts.)
- Pediatric ICU: as for Adult ICU, but for patients 17 years and younger
- Pediatrics: “Ward Medical/Surgical” beds for patients 17 and younger
- Psychiatric: “ward” beds on a closed/locked psychiatric unit or ward beds where a patient will be attended by a sitter.
- Negative Pressure/Isolation - Beds provided with negative airflow, providing respiratory isolation. NOTE: This value may represent available beds included in the counts of other types.
- Operating Rooms – An operating room that is equipped, staffed and could be made available for patient care in a short period of time.

## Appendix F – HAvBED Bed Definitions

Note that these definitions for “Bed Type” are recommendations, only. Each institution may wish to make minor adjustments based on unique aspects of their institution.

### **24hr Beds Available:**

This value will represent an informed estimate as to how many vacant (staffed, unoccupied) beds for each bed type above the current number that could be made available within 24 hours. This would include created institutional surge beds as well as beds made available by discharging/transferring patients.

### **72hr Beds Available:**

This value will represent an informed estimate as to how many vacant (staffed, unoccupied) beds for each bed type above the current number that could be made available within 72 hours. This would include created institutional surge beds as well as beds made available by discharging/transferring patients.

### **Emergency Department Status:**

**Open** – Accepting patients by ambulance

**Closed** – Not accepting patients by ambulance

**N/A** – Not Applicable (Hospital does not have an ED)

### **Mass Decontamination Facility Availability:**

**Available** – The institution has chemical/biological/radiological multiple patient decontamination capability

**Not Available** – The institution is unable to provide chemical/biological/radiological patient decontamination

### **Ventilators:**

**Available:** The number of ventilators that are present in the institution but are currently not in use and could be supported by currently available staff

**APPENDIX G  
HAvBED EDXL Data Elements**

**HAvBED Data Elements**

This is a listing of the data elements that will be transmitted by web services communication in an XML schema for the HAvBED project. Each class, such as emergencyDepartment and hospitalBedCapacity, is detailed below.

<b>FIELD</b>	<b>DESCRIPTION</b>
OrganizationID	Unique identifier (AHA Number) for this hospital.
OrganizationName	The name of the organization (hospital).
EmergencyDepartment	The hospital's emergency department status.
HospitalBedCapacity	The hospital's bed capacity.
Ventilators	The hospital's ventilator status.
MassDecon	Whether the organization's mass decontamination resources are currently operating.
commentText	One or more comments.

**Emergency Department**

The following data points describe the ability of an emergency department to treat patients.

<b>FIELD</b>	<b>CHILD FIELD</b>	<b>VALID VALUES</b>	<b>DESCRIPTION</b>
emsTraffic	status ( <i>string</i> )	Normal	Accepting all EMS traffic.
		Closed	Requesting re-route of EMS traffic to other facilities.
		N/A	Not Applicable. This hospital does not have an emergency department.
		comments	



### Hospital Bed Capacity

The schema is structured so that a message specifies **Bed Capacity** information for each of the **Bed Types**. This is displayed in two tables rather than expand the bed capacity fields for each bed type.

#### Bed Types

FIELD	DESCRIPTION
adultICU	Capacity status for adult ICU beds. These can support critically ill or injured patients, including ventilator support.
medicalSurgical	Capacity status for medical-surgical beds. These are also thought of as ward beds.
burn	Capacity status for burn beds. These are thought of as burn ICU beds, either approved by the American Burn Association or self-designated. These beds are NOT to be included in other ICU bed counts.
pediatricICU	Capacity status for pediatric ICU beds. Similar to adult ICU beds, but for patients 17-years-old and younger.
pediatrics	Capacity status for pediatrics beds. These are ward medical/surgical beds for patients 17-years-old and younger.
psychiatric	Capacity status for psychiatric beds. These are ward beds on a closed/locked psychiatric unit or ward beds where a patient will be attended by a sitter.
negativeFlowIsolation	Capacity status for negative airflow isolation beds. These provide respiratory isolation. NOTE: This value may represent available beds included in the counts of other types.
operatingRooms	Capacity status for operating rooms which are equipped, staffed and could be made available for patient care in a short period of time.

#### Bed Capacity

The following information is specified for each of the bed types. Top level complex schema type defining bed capacity counts given a specific type of bed.

FIELD	VALID VALUE	DESCRIPTION
status ( <i>string</i> )	Vacant/Available	The type of bed is available.
	NotAvailable	The type of bed is not available.
availableCount ( <i>numerical</i> )		The number of vacant/available beds to which patients can be immediately transported. These must include supporting space, equipment, medical material,

Appendix G – HAvBED EDXL Data Elements

		ancillary and support services and staff to operate under normal circumstances. These beds are licensed, physically available and have staff on hand to attend to the patient who occupies the bed.
additionalCapacityCount24Hr ( <i>numerical</i> )		Estimate how many beds above the current number could be made vacant/available within 24 hours. This includes institutional surge beds as well as beds made available by discharging/transferring patients.
additionalCapacityCount72Hr ( <i>numerical</i> )		Estimate how many beds above the current number could be made vacant/available within 72 hours. This includes institutional surge beds as well as beds made available by discharging/transferring patients.
commentText ( <i>string</i> )		

**Ventilators**

Provide information about the availability of ventilators at this facility.

<b>FIELD</b>	<b>DESCRIPTION</b>
availableCount ( <i>numerical</i> )	The numbers of ventilators that are present in the institution but are currently not in use and could be supported by currently available staff.
commentText ( <i>string</i> )	

**Mass Decontamination Facility Status**

Provide information about the availability of mass patient decontamination at this facility.

<b>FIELD</b>	<b>VALID VALUE</b>	<b>DESCRIPTION</b>
status ( <i>string</i> )	Available	Mass decontamination is available.
	NotAvailable	Mass decontamination is not available
commentText ( <i>string</i> )		

**Appendix H**  
**HAvBED Database and Web Services Documentation**

**Table of Contents**

1. Introduction .....	79
1.1 Objectives.....	79
1.2 Scope .....	79
2. Application .....	79
2.1 Application Narrative/Overview .....	79
2.3 Schematic Diagram of the application .....	81
2.4 Application Profile .....	81
2.4.1 DNS Requirements .....	81
2.4.2 SSL Requirements .....	81
2.4.3 Firewall Ports Requirements.....	82
2.4.7 Hardware.....	82
3. Operations Guide.....	82
3.1 Application Components.....	82
3.6 Error Codes & Messages.....	84
3.8 Logging .....	84
4. System Administration Guide .....	85
4.2 Database Administration.....	85
4.2.1 Database Details.....	85

## **Purpose of this document:**

---

The purpose of this document is to provide necessary information required to properly document, deploy, and host an application created within the Denver Health Information Services Department. It is limited to hardware and database specifications.

## **1. Introduction**

### **1.1 Objectives**

This document describes database architecture and hardware configuration for the HAvBED Web application.

### **1.2 Scope**

This document is focused on the HAvBED database details.

## **2. Application**

### **2.1 Application Narrative/Overview**

The HAvBED system is a national hospital bed-tracking tool which is an internet-based system available for secure website viewing by federal, regional and local offices of emergency management. This is a AHRQ grant-funded research effort to develop a national hospital bed-tracking system in the event of a medical emergency such as a bioterrorist attack.

This system is comprised of a database, web services and a website. The database stores the secure information that is pushed via XML from disparate hospital systems located around the U.S.

The web services will ensure a secure system-to-system transfer of bed availability information into the HAvBED database. The website will allow a secure information display as well as a secure log-in for bed availability data entry from other participating hospitals which do not have a computer system interface with HAvBED.

This is a proof of concept project, and all hardware specifications have been designed to meet this limited functionality.

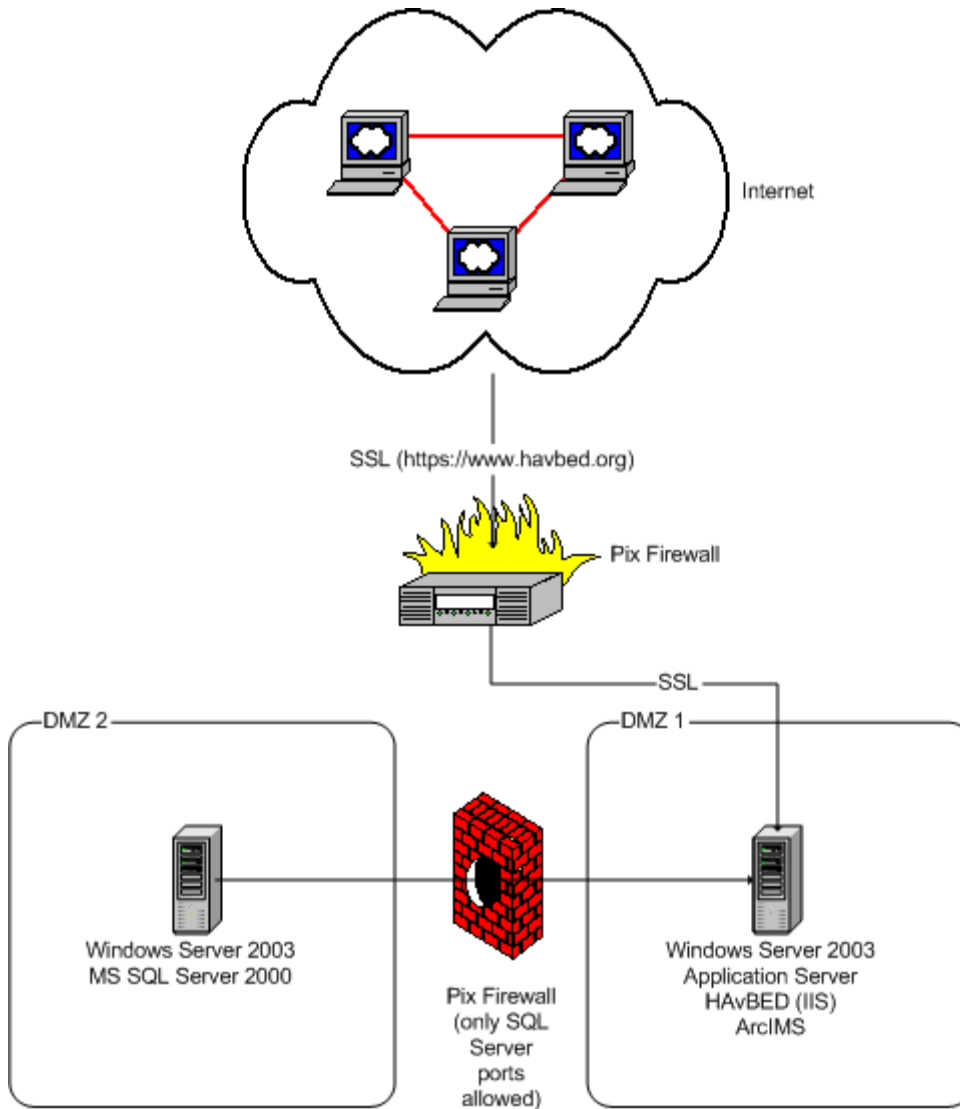
### **High Level Application Architecture**

1. Data is passed via SSL to a web service on the application server, where it is validated and inserted into the SQL Server 2000 database.
  - a. The application server is located in a secure DMZ (demilitarized zone), only allowing HTTPS traffic on port 443.
  - b. The SQL Server database is located in a second DMZ, and accessible only via port 1433 from the application server IP.

## Appendix H – Database and Web Services Documentation

- c. Challenge and response authentication is managed via the web application for both XML stream data feeds and manual web data entry.
  2. Data can then be reported via a web page report or as points on a map, utilizing ArcIMS.
    - a. Users must log on with individualized usernames and passwords.
    - b. ArcIMS (ESRI) must be installed on the application server.
  3. All code for the HAvBED project's web site and web service were written using Microsoft's .NET framework, ASP.NET and C#.

### 2.3 Schematic Diagram of the Application



### 2.4 Application Profile

#### 2.4.1 DNS Requirements

- <https://www.havbed.org>

#### 2.4.2 SSL Requirements

- [https:// www.havbed.org](https://www.havbed.org)

### 2.4.3 Firewall Ports Requirements

- HTTPS port 443 for access from Internet user to web servers.
- SQL port 1433 for access from web server to SQL Server.
- ArcSDE port 5151 for access from ArcIMS to ArcSDE.
- Using ArcSDE on a Secure Server requires that Port 137 be opened. Due to security concerns Port 137 was not open and subsequently data residing in ArcSDE was placed on the Application Server.

### 2.4.7 Hardware

- For web server, require 1 GB RAM and 2 Processors with 40 GB hard disk space.
- For SQL server, require 1 GB RAM and 2 Processors with 40 GB hard disk space.

## 3. Operations Guide

### 3.1 Application Components

#### Web Services

The HAvBED project utilizes a web service in order to gather data from partner's automated systems via the internet. The project group collaborated to design an XML Schema which would effectively communicate all of the information required for HAvBED. The goal of this schema was to allow for any amount of data to be transmitted, from a single bed count to an entire update for multiple facilities. The decision to accept updates to HAvBED via an XML web service was driven largely by the platform independence of web services. Partners used both .NET, and Java clients to transmit updates to the web service. In fact, many other languages could have also been used if desired.

The HAvBED web service API was rather simple. The publicly exposed methods were:

- **HelloWorld** – Returns “Hello World”. This method was provided so that partners could validate the communication between their client application and the web service. No authentication is performed in this method.
- **SubmitFacilityUpdate** – This method updates the HAvBED database. This method validates the submitted user credentials against the HAvBED database. The string parameter is parsed as an XML document and validated against the schema. If authenticated and the document is valid the document is parsed to update values in the database and an acknowledgement is returned.
- **ValidateHospitalUpdate** – This method validates the string parameter against the HAvBED schema. Partners were able to use this method to ensure that the

## Appendix H – Database and Web Services Documentation

document they are submitting to SubmitFacilityUpdate is in a valid format. This method uses the same validation logic as the SubmitFacilityUpdate method. No authentication is performed by this method.

### Web Application

HAvBED's primary interface is through an ASP.NET web application which is publicly facing on a server using SSL encryption. Users are granted access to this application by an administrator of the system. Due to the public facing system, it was necessary to provide a basic authentication mechanism (username and password). SSL was incorporated to prevent unencrypted passwords from being sent across the internet. SSL also protects sensitive data about facilities from being intercepted by malicious users on the internet.

The web application defines 4 types of roles for users:

- **Administrator** – has complete access to the system. This role can create new facilities, add or modify users, and update information about any facility.
- **Data Entry** – can view/edit facilities for the scale associated with the login.
- **Data Display** – can view facilities for the scale associated with the login.
- **Web Service User** – the only role which is allowed to update the system via the web service. This role has no permission to view the web site.

Authorization to view facilities is dictated by “Scales”. A scale is the geographic area which a user is allowed to view. The scale can range from national level to a specific city, to an individual hospital. A filter control is used to allow a user to navigate through the data. This control will not allow the user to navigate to any scale for which they are not authorized. Additional controls have been built into the ASP.NET data entry pages to only render editable fields if the current user has privileges to update a facility.

### Security

HAvBED user credentials are stored in the database. The user name is stored in plain text. The password is encrypted an SHA1 encryption algorithm. This hashed password is stored in the database instead of the plain text password. To authenticate a user, the password entered when a user logs in is hashed using the same algorithm and compared to the value in the database. If the values match, the correct password was presented. This hashing mechanism is used to prevent a hacker from discovering the passwords of users in the event that the database is compromised.



### **3.6 Error Codes & Messages**

#### **Web Site Errors**

If an error occurs in the HAvBED web application the user will be redirected to an error page. This page provides a generic error message indicating that a problem occurred and the error has been logged. This high-level message is used for security purposes to prevent a possible hacker gaining insight into the structure of the application. In addition, many users are confused by a detailed error message which provides little value to anyone other than a developer.

#### **Web Service Errors**

Errors that occur when updating the HAvBED system via the web service receive notification via SoapExceptions returned to the client. All documents submitted are validated against a published XML schema. For documents that fail validation all validation messages are returned to the client. For application exceptions the error message returned is the Message property of the Exception which was thrown.

### **3.8 Logging**

#### **User Login Attempts**

The system logs all attempted logins from both the web site and the web service. The success status of each login, the time, and source (web site/web service) are logged. This data has been utilized to report on activity levels in the system and to monitor for possible attempts to hack into the site.

#### **Web Service Updates**

The web service keeps a log of all submitted xml updates for requests that from a user that has been validated successfully. The logged files have been useful in debugging errors in submitted documents, both for invalid schemas and errors in the data which need to be reconciled. In a high capacity environment consideration must be made for archiving files and monitoring storage capacity.

#### **Error Logging**

All database updates and ASP.NET code behinds have been wrapped by Microsoft's Enterprise Library for logging errors in the system. In production mode errors will be logged to include the location of the error, error message, timestamp, along with additional data. When an error occurs the user is redirected to a generic error message indicating that a problem was encountered and the error logged.

## 4. System Administration Guide

### 4.2 Database Administration

#### 4.2.1 Database Details

##### Databases

- Database Name = havbed
- Object owners = dbo
- Sort order/Collation = Latin1-General, case-insensitive, accent-sensitive, katype-insensitive, width-insensitive for Unicode Data, SQL Server Sort Order 52 on Code Page 1252 for non-Unicode Data

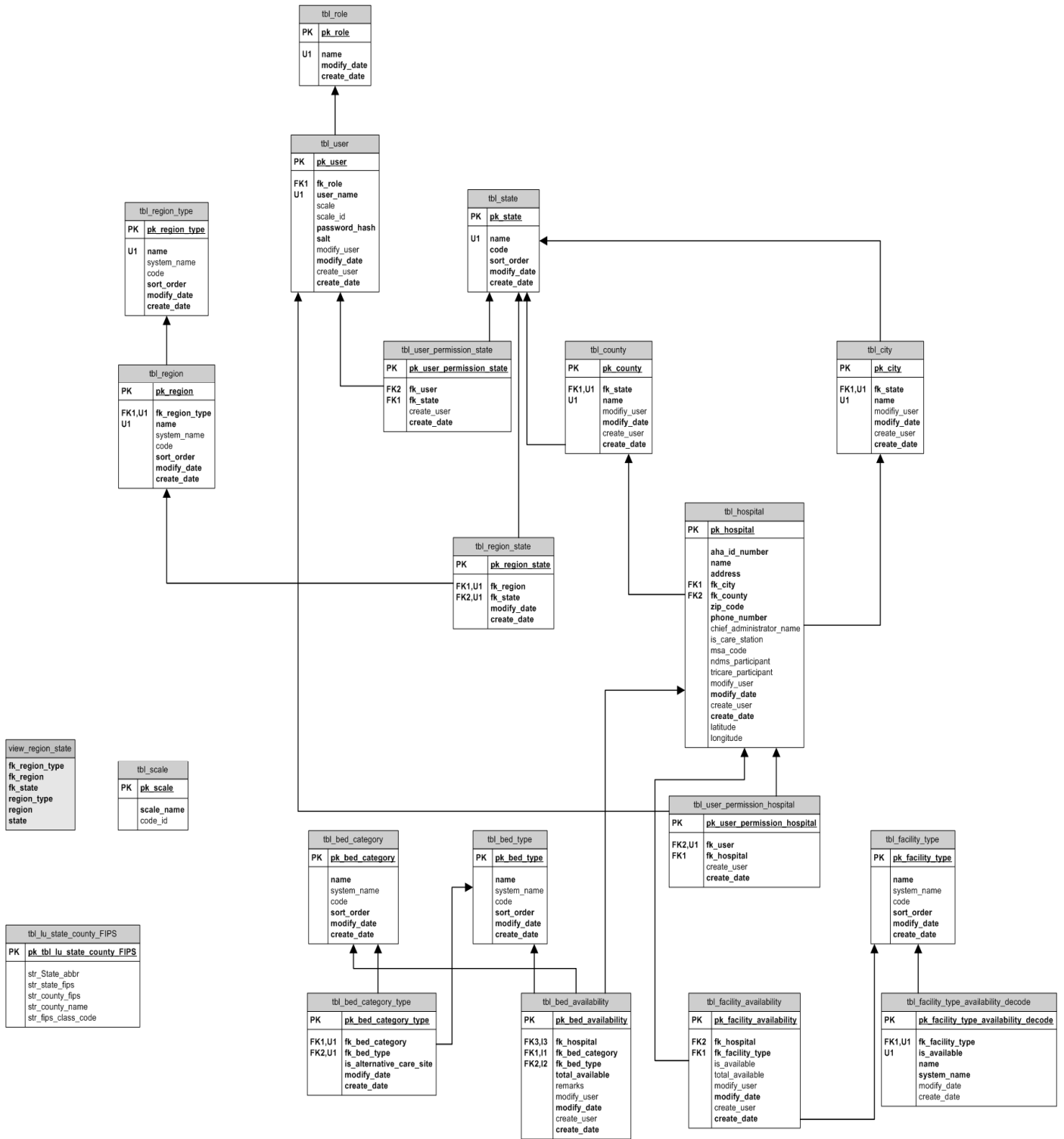
##### Tables

- **tbl\_bed\_availability**
  - insert only table containing all new bed count data.
- **tbl\_bed\_category**
  - lookup table containing bed categories (e.g. current, surge, AHA survey, etc).
- **tbl\_bed\_category\_type**
  - join table for tbl\_bed\_category and tbl\_bed\_type.
- **tbl\_bed\_type**
  - lookup table containing bed types (e.g. Adult ICU, Burn, Pediatric ICU, etc.).
- **tbl\_city**
  - City lookup table initially populated with cities associated with the 2003 AHA data.
- **tbl\_county**
  - County lookup table initially populated with counties associated with the 2003 AHA data. AHA data contained a FIPS lookup for county/state (<http://www.itl.nist.gov/fipspubs/>).
- **tbl\_facility\_availability**
  - insert only table containing divert and availability data (Boolean values).
- **tbl\_facility\_type**

## Appendix H – Database and Web Services Documentation

- description of facility (service, e.g. Emergency Department Status, Decontamination Facility Availability, etc).
- **tbl\_facility\_type\_availability\_decode**
  - description of facility type status (e.g. On divert, open, etc).
- **tbl\_hospital**
  - Hospital demographics, contact information, geographic location, etc.
- **tbl\_lu\_state\_county\_FIPS**
  - lookup table containing FIPS county/state data (<http://www.itl.nist.gov/fipspubs/>).
- **tbl\_region**
  - description of regions
- **tbl\_region\_state**
  - join table for states to regions to region types
- **tbl\_region\_type**
  - description of region types (e.g. FEMA/ NDMS/ PHS Federal Regions, CDC Federal Regions, etc).
- **tbl\_role**
  - Security table describing user roles.
- **tbl\_scale**
  - table used with ArcIMS to determine which mapping layer to display.
- **tbl\_state**
  - state lookup table.
- **tbl\_user**
  - security table containing user credentials.

# Appendix H – Database and Web Services Documentation



**Stored Procedures (name includes the description)**

- stp\_bed\_availability\_get\_by\_aha
- stp\_bed\_availability\_get\_by\_city
- stp\_bed\_availability\_get\_by\_county
- stp\_bed\_availability\_get\_by\_hospital
- stp\_bed\_availability\_get\_by\_metro
- stp\_bed\_availability\_get\_by\_region
- stp\_bed\_availability\_get\_by\_state
- stp\_bed\_availability\_get\_national
- stp\_bed\_category\_get
- stp\_city\_get\_by\_city
- stp\_city\_get\_by\_region
- stp\_city\_get\_by\_state
- stp\_create\_new\_user
- stp\_delete\_user
- stp\_facility\_availability\_get\_by\_aha
- stp\_facility\_availability\_get\_by\_city
- stp\_facility\_availability\_get\_by\_hospital
- stp\_facility\_availability\_get\_by\_metro
- stp\_facility\_availability\_get\_by\_region
- stp\_facility\_availability\_get\_by\_state
- stp\_facility\_availability\_get\_national
- stp\_facility\_create
- stp\_hospital\_get\_by\_city
- stp\_hospital\_get\_by\_hospital
- stp\_hospital\_get\_by\_metro
- stp\_hospital\_get\_by\_page
- stp\_hospital\_get\_by\_region
- stp\_hospital\_get\_by\_state
- stp\_hospital\_get\_national
- stp\_insert\_bed\_availability
- stp\_insert\_facility\_availability
- stp\_modify\_password\_for\_user
- stp\_region\_get\_nested\_list
- stp\_retrieve\_authentication\_credentials
- stp\_retrieve\_role\_names
- stp\_retrieve\_roles\_for\_user
- stp\_retrieve\_users
- stp\_state\_get\_by\_region
- stp\_state\_get\_national
- stp\_update\_user

**User Defined Functions**

- udf\_bed\_availability

## Appendix H – Database and Web Services Documentation

- returns available bed table by date
- udf\_bed\_availability\_by\_hospital\_remarks
  - returns current bed count remarks by hospital
- udf\_bed\_availability\_get\_by\_city
  - returns available bed table by date and city
- udf\_bed\_availability\_get\_by\_county
  - returns available bed table by date and county
- udf\_bed\_availability\_get\_by\_hospital
  - returns available bed table by date and hospital
- udf\_bed\_availability\_get\_by\_metro
  - returns available bed table by date and MSA
- udf\_bed\_availability\_get\_by\_region
  - returns available bed table by date and region
- udf\_bed\_availability\_get\_by\_state
  - returns available bed table by date and state
- udf\_bed\_availability\_get\_national
  - returns available bed table by date
- udf\_bed\_category\_type\_pivot
  - returns bed category pivot table
- udf\_facility\_availability
  - returns facility status table by date
- udf\_facility\_availability\_get\_by\_city
  - returns facility status table by date and city
- udf\_facility\_availability\_get\_by\_hospital
  - returns facility status table by date and hospital
- udf\_facility\_availability\_get\_by\_metro
  - returns facility status table by date and MSA
- udf\_facility\_availability\_get\_by\_region
  - returns facility status table by date and region
- udf\_facility\_availability\_get\_by\_state

## Appendix H – Database and Web Services Documentation

- returns facility status table by date and state
- `udf_facility_availability_get_national`
  - returns facility status table by date

### User Accounts

- One SQL Server Authentication account is needed for the application.
  - `db_datareader`
  - `db_datawriter`
  - execute on all stored procedures

### NOTES:

#### Performance

The HAvBED database was designed to maintain a historical record of bed availability updates. All records are stored in a single table. Each update to a bed count created a new row in the table rather than update an existing row for the related facility and bed type. This approach enabled data to be queried based on the date of the record so that bed availability could be retrieved for a given point in time. The drawback to this approach is that the bed availability table will get quite large as electronic systems provide frequent updates to changed bed counts. Ultimately the size of this table will impact the performance of the system. Since this system is primarily focused on current bed counts, a better approach would be to store outdated records in a separate table where the data could be accessed for reporting on time-based queries. The bed availability table would simply contain the current bed counts for each facility. The subsequent reduction in size of that table will likely yield a significant improvement in performance. Stored procedures that are used to query bed availability data from the database should also be reviewed for optimizing performance in a production system.

#### Additional User Interface Enhancements

A production system for HAvBED would benefit from additional features in the user interface such as:

- A mechanism to delete, or expire an alternate care site. These sites are not permanent and need to have a way to remove them from the system when they have been decommissioned.
- Improve features of GIS mapping. The map page of the user interface does not contain a legend to describe the icons displayed on the map. A user does not have the ability to “rubber band” around a collection of facilities on the map to identify each facility in an area,

## Appendix H – Database and Web Services Documentation

- The ability to modify facility properties. The existing system enables an administrator to create new facilities but not to edit the existing properties after it is created.



**APPENDIX I**  
**Geographic Information System (GIS) Documentation**

**Table of Contents**

1.	Introduction .....	93
1.1	Objectives .....	93
1.2	Scope.....	93
1.4	References/Attachments .....	93
2.	Application Name.....	93
2.1	Application Narrative/Overview.....	93
2.2	High Level Application Architecture.....	95
2.3	Schematic Diagram of the Application.....	95
2.4	Application Profile.....	96
2.4.1	DNS Requirements .....	96
2.4.2	SSL Requirements .....	96
2.4.3	Firewall Ports Requirements.....	97
2.4.4	Hardware.....	97
2.5	Contacts.....	97
2.5.1	Technical Contacts.....	97
3.	Operations Guide.....	98
3.1	Application Components .....	98
3.2	Backup/Restore Requirements.....	99
4.	System Administration Guide .....	99
4.1	Configuration Parameters .....	99
4.2	GIS Data.....	99
4.2.1	GIS Data Details .....	99
5.1	Future Recommendations Narrative/Overview .....	101

## **Purpose of this document:**

---

The purpose of this document is to provide necessary information required to properly document, deploy, and host a Geographic Information System (GIS) created as part of the operating of the National Available Beds for Emergencies and Disasters (HAvBED) system as implemented at Denver Health and Hospital Authority. It is limited to hardware, software, and database specifications.

## **1. Introduction**

### **1.1 Objectives**

This document describes software, database architecture, and hardware configuration for the HAvBED GIS application.

### **1.2 Scope**

This document is focused on the HAvBED GIS details.

### **1.4 References/Attachments**

- ArcIMS9 Architecture and Functionality, ESRI, <http://www.esri.com/library/whitepapers/pdfs/arcims9-architecture.pdf>
- Install IIS 6.0 with Tomcat 4.1.29 using J2SDK 1.4.2 for ArcIMS 9.0 on Windows 2003, ESRI, <http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=25867>
- Identifying Firewall TCP Server Ports In a Enterprise ArcIMS Configuration, ESRI, [http://www.esri.com/systemsint/kbase/docs/arcims\\_tcp\\_port\\_tb\\_rev2.pdf](http://www.esri.com/systemsint/kbase/docs/arcims_tcp_port_tb_rev2.pdf)
- Configure ArcIMS to work with HTTPS, ESRI, <http://support.esri.com/index.cfm?fa=knowledgebase.techArticles.articleShow&d=21669>
- Customizing ArcIMS – Using the ActiveX Connector, ESRI, Software Documentation Library for ArcGIS 9.
- Managing ArcSDE Application Servers, ESRI, Redlands, CA, 2004.
- ArcSDE Developer Help, <http://edndoc.esri.com/arcSDE/9.1>

## **2. Application**

### **2.1 Application Narrative/Overview**

The HAvBED system is a national hospital bed-tracking tool which was implemented as an internet-based system available for secure website viewing by federal, regional and local offices of emergency management and others. This is a Department of Health and Human Services (DHHS) Agency for Healthcare Research and Quality (AHRQ) grant-funded research effort to develop a national

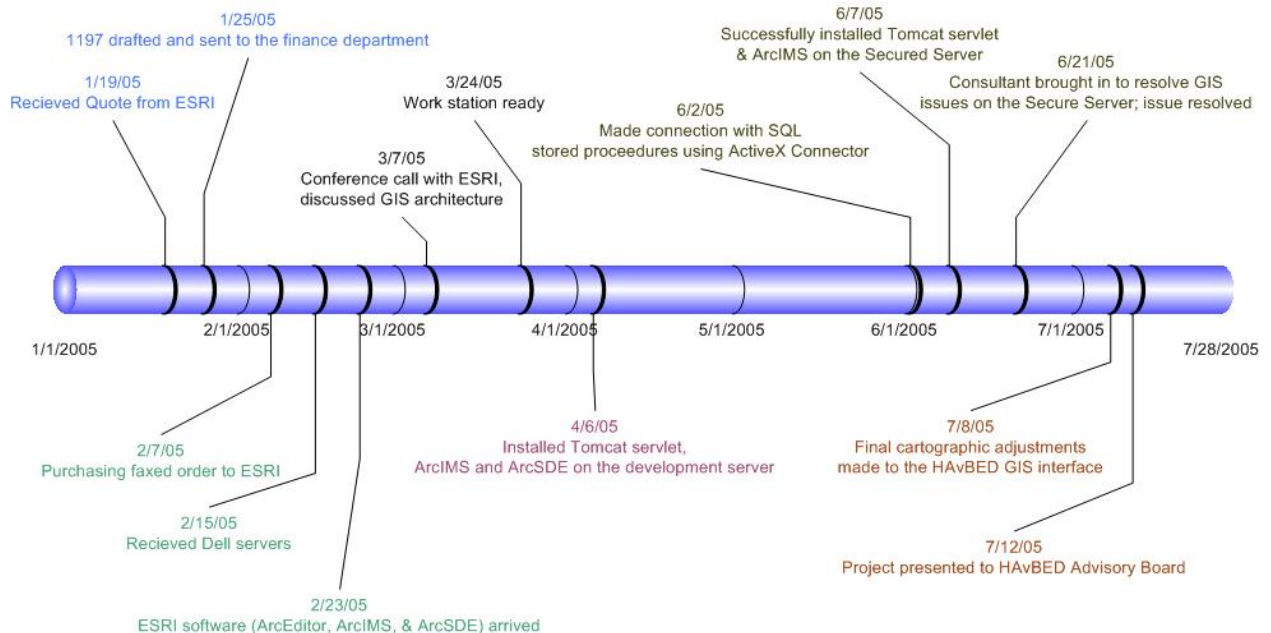
## Appendix I – Geographic Information System (GIS) Documentation

hospital bed-tracking system in the event of a medical emergency such as a bioterrorist attack.

The Geographic Information System (GIS) is comprised of a database, web services and a website. The database is store the secure information that is queried via an eXtensible Markup Language (XML) from disparate hospital systems located around the U.S.

The web service is a secure system-to-system transfer of bed availability information into the HAvBED database. The website allows a secure information display as well as a secure log-in for bed availability data entry from other participating hospitals which do not have a computer system interface with HAvBED. This is a proof of concept project, and all hardware specifications have been designed to meet this limited functionality.

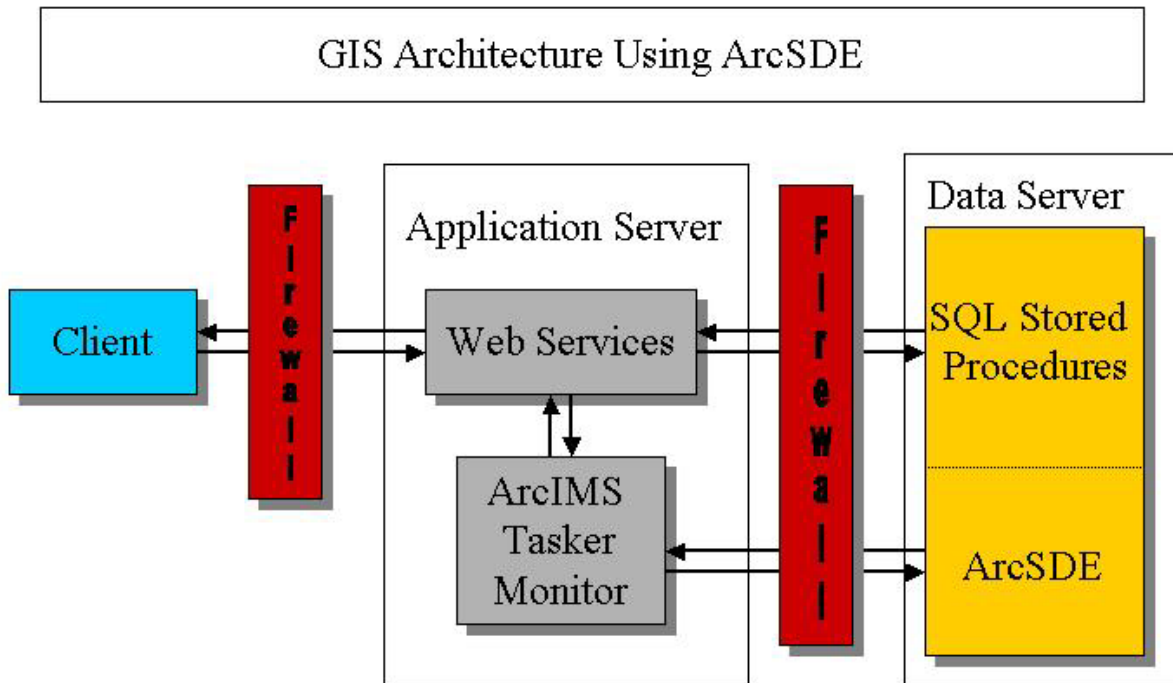
The decision to purchase Environmental Systems Research Institute, Inc. (ESRI) software, ArcEditor, ArcIMS, and ArcSDE, was determined by the need of the project to present a graphical displayed in large geographic databases stored in Microsoft Structure Query Language (SQL) Server 2000. The Internet GIS system would go through development environment, where application components configured to interact with web services and spatial engines to generate maps across the Web. The final production was transferred to the Secured Server where several issues arose. Security features would intermittently allow the display of map images within the web application. The issue was resolved by discontinuing to use the ArcSDE connection and place the ESRI shapefiles directly on the Application Server.



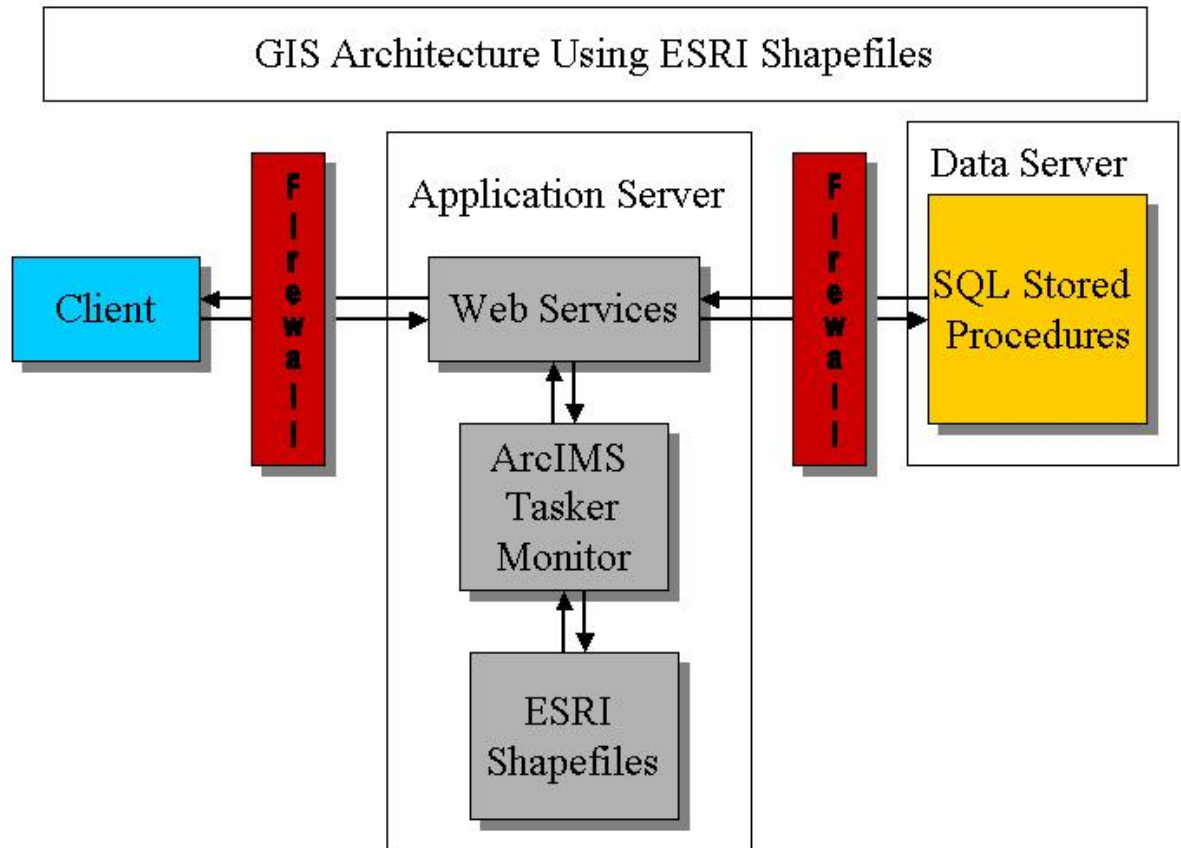
## 2.2 High Level Application Architecture

4. The user-defined query generated by the web application passing stored procedures on Microsoft SQL Server 2000 database to the ArcIMS tasker and monitor, running on the application server, which returns a .jpg map to the web application using a set of Microsoft Common Object Model (COM) objects that expose interfaces to the Application Server, or an ActiveX Connector.
  - d. The Application Server is located in a secure environment, only allowing Secure Hyper Text Transfer Protocol (S-HTTP) traffic on port 443 from the World Wide Web (WWW).
  - e. The Microsoft SQL Server database is located in a second secure environment, and accessible only via port 1433 from the Application Server Internet Protocol (IP).

## 2.3 Schematic Diagram of the Application



The initial configuration involved the use of ESRI ArcSDE connecting to ArcIMS on the Application Server. Once the need to open Port 137 was determined by Farrugut System Consultants, the configuration was determined to be a security threat the use of ArcSDE was discontinued.



The final configuration involved the use of ESRI shapefiles directly on the Application Server to bypass the need to open Port 137.

## 2.4 Application Profile

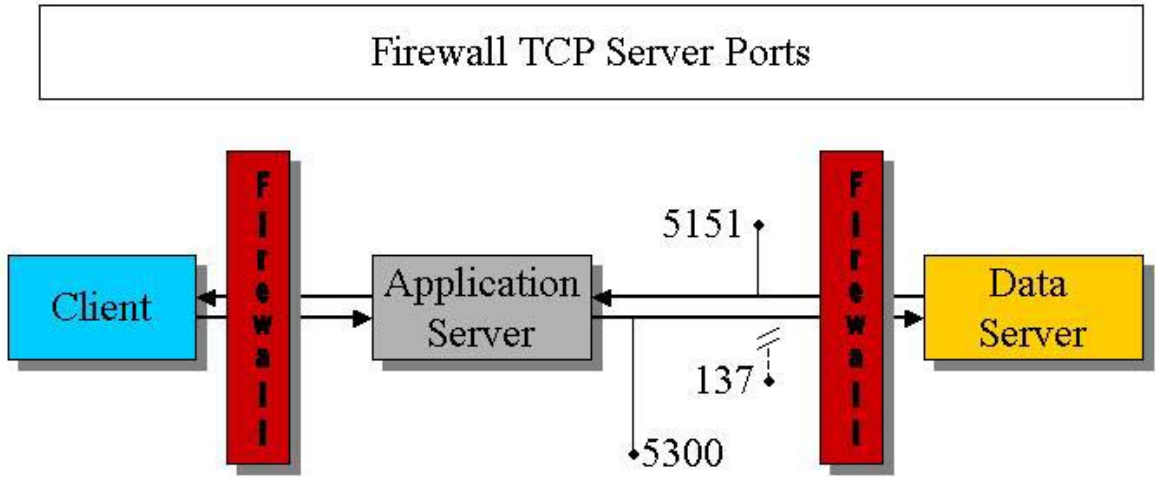
### 2.4.1 DNS Requirements

- <https://www.havbed.org>

### 2.4.2 SSL Requirements

- [https:// www.havbed.org](https://www.havbed.org)

### 2.4.3 Firewall Ports Requirements



S-HTTP port 443 allows access from Internet user (client) to web servers. ArcSDE port 5151 allows access from ArcIMS to ArcSDE. Port 5300 was opened so the ActiveX connector can call the appropriate data derived a user defined query. Using ArcSDE on a Secure Server requires that Port 137 be opened. Due to security concerns Port 137 was not open and subsequently data residing in ArcSDE was placed on the Application Server.

### 2.4.4 Hardware

- For Application Server, require 1 GB RAM and 2 Processors with 40 GB hard disk space.
- For Microsoft SQL Server, require 1 GB RAM and 2 Processors with 40 GB hard disk space.

## 2.5 Contacts

### 2.5.1 Technical Contacts

*The responsibilities of these technical contacts for the application include providing technical support.*

Name	Title	Role / Responsibility	Phone	Email	Pager/Cell
Gerald Pattyn	Senior Consultant	ArcIMS	(303) 666-9133 x112	pattyn@farragut.com	(720) 840-4699

### 3. Operations Guide

#### 3.1 Application Components

1. ArcEditor 9.0
  - a. ArcEditor is the complete GIS desktop system for editing and managing geographic data. ArcEditor was used primarily to move spatial data to Microsoft SQL Server 2000.
  
2. ArcIMS 9.0
  - a. ArcIMS is the solution for delivering dynamic maps and GIS data and services via the Web. It provides a highly scalable framework for GIS Web publishing that meets the needs of corporate Intranets and demands of worldwide Internet access. Using ArcIMS, city and local governments, businesses, and other organizations worldwide publish, discover, and share geospatial information.
  
3. ArcSDE 9.0
  - a. ArcSDE is a server software product used to access large geographic databases stored in relational database management systems (RDBMSs). It is an integrated part of ArcGIS and a core element of any enterprise GIS solution. Its primary role is to act as the GIS gateway to spatial data stored in a RDBMS. ArcSDE provides a suite of services that enhance data management performance, extend the range of data types that can be stored in a RDBMS, enable schema portability between RDBMSs, and offer configuration flexibility.
  
4. Tomcat 4.1.29 using J2SDK 1.4.2
  - a. ArcIMS components are Java components and require a JavaVirtual Machine (VM), which provides the basic application programming interface (API) for running these applications. The JavaVM is included in the Java Developer Kit (JDK). ArcIMS requires a JRE, which is installed if it is not already on the machine. It is possible to have more than one JavaVM on a machine, and ArcIMS can be made to use an existing JavaVM as long as it is compatible. Servlet engine, or small program running on the Server. ArcIMS requires a servlet engine. A servlet engine is an extension to the JavaVM and provides support for servlets through a servlet API.<sup>1</sup>

---

<sup>1</sup> ArcIMS 9 Architecture and Functionality, ESRI, <http://www.esri.com/library/whitepapers/pdfs/arcims9-architecture.pdf>

### 3.2 Backup/Restore Requirements

- ArcSDE Configuration and Tuning Guide for Microsoft SQL Server, Backup and Recovery, ESRI, Software Documentation Library for ArcGIS 9: page 73-89.

## 4. System Administration Guide

### 4.1 Configuration Parameters

Installation Process:

Install Java Servlet → Install ArcIMS → Install ArcSDE.

Servlet Installation

Using the document: Install Internet Information Server (IIS) 6.0 with Tomcat 4.1.29 using J2SDK 1.4.2 for ArcIMS 9.0 on Windows 2003<sup>2</sup>, the servlet was installed on both the Development Server and the Secured Server to allow ArcIMS to communicate with web services. The installation is very particular and if not the the installation steps are not followed precisely the results include a non-responsive Internet GIS system.

The article, Configure ArcIMS to work with HTTPS<sup>3</sup>, is necessary for ArcIMS to work on a Secure Server. A security certificate must be exported out of the Trusted Root Certification Authority and import certificate into the JAVA installation.

### 4.2 GIS Data

#### 4.2.1 GIS Data Details

##### GIS Shapefiles

- **lines\_freeways**
  - National coverage ESRI shapefile.
- **lines\_highways**
  - National coverage ESRI shapefile.
- **lines\_rivers**

---

<sup>2</sup> <http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=25867>

<sup>3</sup> <http://support.esri.com/index.cfm?fa=knowledgebase.techarticles.articleShow&d=21669>



## Appendix I – Geographic Information System (GIS) Documentation

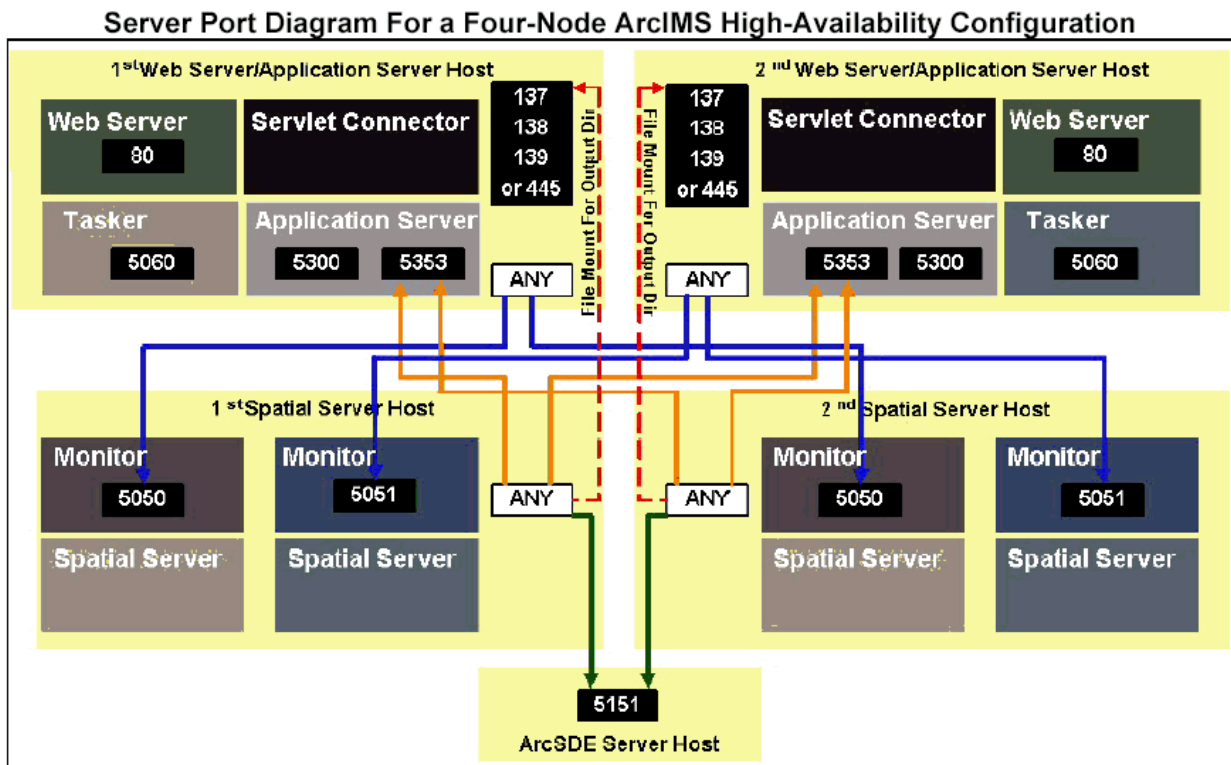
National coverage ESRI shapefile.

- **lines\_roads**
  - National coverage ESRI shapefile.
- **points\_airports**
  - National coverage ESRI shapefile.
- **points\_hospitals\_name**
  - American Hospital Association latitude and longitude data converted to feature points using ESRI's ArcGIS.
- **points\_landmarks**
  - National coverage ESRI shapefile.
- **points\_schools**
  - National coverage ESRI shapefile.
- **polygons\_airports**
  - National coverage ESRI shapefile.
- **polygons\_cdc**
  - National coverage ESRI shapefile.
- **polygons\_counties**
  - National coverage ESRI shapefile.
- **polygons\_countries**
  - National coverage ESRI shapefile.
- **polygons\_lakes**
  - National coverage ESRI shapefile.
- **polygons\_parks**
  - National coverage ESRI shapefile.
- **polygons\_fema**
  - National coverage ESRI shapefile.
- **polygons\_msa**
  - National coverage ESRI shapefile.
- **polygons\_ocean**
  - National coverage ESRI shapefile.

- **polygons\_states**
  - National coverage ESRI shapefile.

**Future Recommendations**

The HA vBED GIS component operation could be improved. The initial architecture included the use of the spatial database engine ArcSDE, a GIS component that works with multiple users editing and using the GIS data without compromising the performance. The use of ArcSDE will also allow the dispersion of GIS components away from a single machine setup which burdens the processing power of a single server. Individual components of the ArcIMS system can be broken out and distributed among several server and thus balancing the work load and increasing the performance significantly. The diagram below shows the outgoing and incoming server port traffic in a typical four-node ArcIMS High-Availability Configuration. All the outgoing TCP



connections on an ArcIMS component are consolidated onto a single “any” port. Listening ports are illustrated with black boxes and white numbers.<sup>4</sup>

<sup>4</sup> [http://www.esri.com/systemsint/kbase/docs/arcims\\_tcp\\_port\\_tb\\_rev2.pdf](http://www.esri.com/systemsint/kbase/docs/arcims_tcp_port_tb_rev2.pdf)

## Appendix J – HAvBED Database and Program Code

### **Index of Directories on the HAvBED CD:**

- .\HAVBED Final Report.pdf - Project final report
- .\HAVBED Appendices.pdf - Project final report appendices
- .\ReadMe.txt – A copy of this index
  
- .\Database Backups\
  - SQL Server 2000 backup file of the HAvBED database prior to any data entry.
  
- .\HAVBed\HAVBED\_DB\
  - Source code to create the HAvBED\_DB.DLL, which is used by the application and web service to make calls to the database.
  
- .\HAVBed\HAVBED\_Web\
  - Source code for the Front End Web Application.
  
- .\HAVBed\HavBed\_WebService\
  - .NET Source Code related to the Web Service.
  
- .\HAVBed\HavBed\_WebService\_Test\
  - A testing .NET application for both the web application and the database connection DLL.
  
- .\HAVBed\HAVBEDValidator\
  - XML validator program (Windows application).
  
- .\HAVBed\HAVBed\menus\
  - Free menu creation DLL that is referenced by the application. Includes the DLL and usage examples.
  
- .\HAVBed\xml\
  - Working directory for XML schema development.
  
- .\HAVBED\_Misc\_Stuff\
  - Supporting documents and 'scratch pad' files.
  
- .\wwwroot\
  - Compiled application and support files as they existed in the virtual directory on the live web server.