Microsoft SQL Server
Customer Solution Case Study

Birmingham Regional Emergency Medical Services System

Hospitals Reducing Fatalities from Severe Trauma and Stroke using SQL Server 2005

Overview

Country or Region: United States
Industry: Healthcare

Customer Profile

The Birmingham Regional Emergency Medical Services System (BREMSS) oversees pre-hospital care in the six county Birmingham, Alabama metropolitan area.

Business Situation

BREMSS needed a system to provide real-time updates on hospital availability for emergency medical technicians and paramedics to use in deciding the best hospital to take people suffering from severe trauma or stroke.

Solution

BREMSS deployed a real-time hospital availability solution using Microsoft® SQL Server™ 2005 to support a central database and Microsoft SQL Server 2005 Express Edition to support the application on emergency room workstations.

Benefits

- Saving lives
- Faster patient recoveries
- "Immediate" ROI
- Ability to respond to respond to mass-casualty incidents
- Easier maintenance with SQL Server 2005 Express

"We need to export this [LifeTrac system] now to all the other states."

Bob Riley, Governor, Alabama

After a University of Alabama at Birmingham Hospital study found most severe trauma patients weren't taken to the optimal hospital for treatment, the Birmingham Regional Emergency Medical Services System (BREMSS) took action to improve the situation. Working with Microsoft Gold Certified Partner Forté Incorporated, BREMSS created a solution that provides first responders with real-time reports of hospital resources and availability. The LifeTrac solution uses Microsoft® SQL Server™ 2005 on the server side and SQL Server 2005 Express Edition on workstations in the hospitals. Previously only 40 percent of severe trauma patients were taken to an emergency room appropriate to their injuries. Now 98 percent are correctly routed, helping to reduce trauma fatalities by 12 percent. More than 28,000 critical trauma and stroke patients have benefited from the system.

Forté Incorporated™

Microsoft®

BREMSS Fast Facts	
Patients properly routed before deployment	40 percent
Patients properly routed after deployment	98 percent
Reduction in deaths from severe trauma	35 percent
Reduction in deaths from all trauma	12 percent
Critical trauma and stroke patients helped by the system	28,000
ROI	"Immediate"
Server database	SQL Server 2005 Standard Edition
Workstation database	SQL Server 2005 Express Edition

"The fatality rate from injury in the six-county area served by BREMSS has decreased 12 percent since the program's inception ... which is why we are anxious to expand the coverage of BREMSS and LifeTrac."

Dr. Loring Rue III, Chief of Trauma, Burns and Surgical Critical Care, University of Alabama at Birmingham Hospital

Situation

When a person suffers a severe trauma in an automobile accident or other violent incident, he or she must be treated as quickly and as effectively as possible to reduce the chance of death and minimize permanent damage. This means it is critically important for patients to be taken to a hospital that is ready and able to provide appropriate treatment.

Deciding which hospital an injured person should be taken to can be a difficult decision for the paramedics at the scene. Should the patient be taken to the nearest hospital? Should the patient be driven farther to gain the benefits of a Level 1 trauma center? Is it better to go to a Level 2 trauma center that has a team standing by, than to a Level 1 trauma center that is already jammed with other cases? And how do you keep Level 1 hospitals from being overwhelmed with cases that could be handled by other hospitals?

When trauma physicians in Birmingham, Alabama studied these questions they found that the emergency medical technicians (EMTs), paramedics, and other first responders needed help in determining which hospital trauma patients should be taken to.

"We did a study and found that the vast majority of injured patients did not get taken to a hospital with trauma capabilities," says Dr. Loring Rue III, Chief of Trauma, Burns and Surgical Critical Care at the University of Alabama at Birmingham Hospital. The Birmingham Regional Emergency Medical Services System (BREMSS) responded to the study, determined to find a way to provide real-time updates to EMT and paramedic crews to help them route severely injured patients to the optimal hospital based on location, type of injury, and availability of trauma teams.

Trauma is the fourth-leading cause of death in the United States, and kills more people between the ages of 1 and 44 than any other cause. In addition to providing routing information for severe trauma cases, BREMSS also wanted to provide the same information for persons suffering from stroke, the third-leading cause of death and the leading cause of disability in the United States.

As BREMSS prepared to address the problem locally, they were touching on a problem that is endemic. Studies conducted by other organizations have found that across the United States, emergency trauma and stroke patients are often transported to hospitals based on location, as opposed to how appropriate a hospital is for that patient or the availability of all necessary treatment resources at the hospital. An additional sense of urgency about routing patients to the most appropriate medical facilities has emerged in recent years because of heightened concerns about terrorism and homeland security.

Solution

The University of Alabama at Birmingham (UAB) and BREMSS collaborated with local trauma care physicians and pre-hospital care providers to develop the basic concepts required for a computerized system that would provide real-time status reports on emergency room availability of participating hospitals.

"Prior to the implementation of LifeTrac, only 40 percent of severe trauma patients were transported to an emergency room that was appropriate to their injuries. Our emergency room routing accuracy is now up to 98 percent ..."

Joe Acker, Executive Director, Birmingham Regional Emergency Medical Services System

UAB and BREMSS then worked with Microsoft Gold Certified Partner Forté Incorporated to create the system, which includes a centralized communication center that coordinates availability reports from participating hospitals and relays this information to EMTs to help determine the best hospital to meet each patient's needs. Participating hospitals report their availability using dedicated workstations.

Forté created its LifeTrac solution using Microsoft® Visual FoxPro® and recently upgraded the deployment to Microsoft SQL Server™ 2005 Standard Edition for the operations center database, and Microsoft SQL Server 2005 Express Edition for the desktop database used on dedicated emergency room workstations.

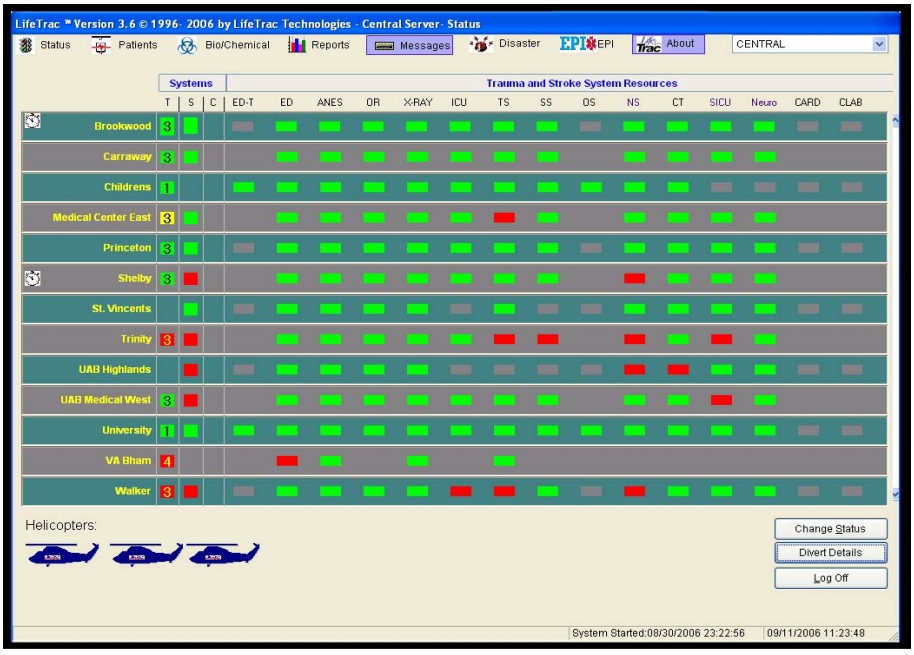
The BREMSS LifeTrac system supports a population of 1.5 million in six counties, including more than 60 different municipalities and the City of Birmingham. The system helps coordinate communication with more than 180 emergency medical service agencies, 19 hospitals, and more than 20 911 centers. About 2,500 paramedics and EMTs use the system. Communicators at the TCC view a screen showing real-time availability of all participating hospitals, using a simple red, yellow, green color coding.

The LifeTrac application includes an algorithm that analyzes hospital emergency room intake data to issue alerts to the TCC in cases where a sudden influx of specific symptoms across multiple hospitals might indicate mass exposure to a biochemical substance or terrorist action.

LifeTrac has proven so efficient that in 2006 Mitretek Systems and the Ash Institute for Democratic Governance and Innovation at Harvard's prestigious JFK School announced that the Birmingham LifeTrac system was the winner of the Mitretek Innovations Award in Homeland Security. The award seeks to identify, disseminate, and encourage the replication of exemplary government and public/private sector partnership initiatives, and highlight the leaders responsible for them. BREMSS and its LifeTrac solution were cited as providing an effective model of an inter-jurisdictional integration effort that has the potential to increase our homeland security at the local, state, and federal levels.

Alabama Governor Bob Riley has called for statewide dissemination of the BREMSS LifeTrac model, which would bring the population served to more than 4.4 million. He also suggested the system could help beyond Alabama. "We need to export this now to all the other states. We're going to do everything we can to develop a system that will be the gold standard for the rest of the country."

LifeTrac displays detailed hospital availability at the TCC.

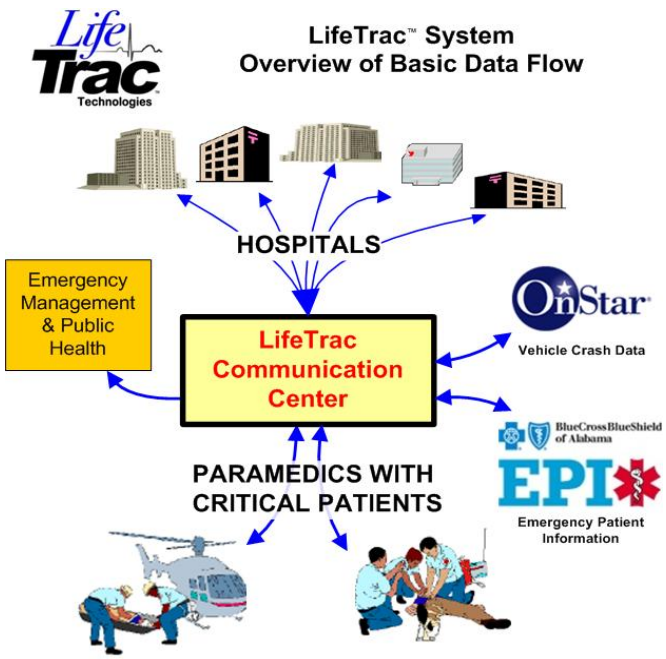


Architecture

Forté used a client-server architecture to create LifeTrac. The server is located in the BREMSS Trauma Communications Center (TCC). The TCC is manned 24 hours a day by paramedics called "Communicators," who are in radio contact with EMTs in the field. The TCC hosts the LifeTrac database using SQL Server 2005 running on the Microsoft Windows Server® 2003 Standard Edition operating system. The server runs on a Dell PowerEdge 850 server with 1 gigabyte (GB) of RAM.

The CommServer application, written using Visual FoxPro version 9.0, continually contacts the LifeTrac client at each of 14 hospitals, across a wide area network of emergency room workstations, to collect and exchange status information. The CommServer application is hosted on a Dell PowerEdge 750 computer with 1 GB of RAM.

Functional overview of the BREMSS LifeTrac system.



The LifeTrac client runs on the Microsoft Windows® XP Professional operating system and uses SQL Server 2005 Express Edition, which replaces SQL Server 2000 Desktop Engine (MSDE 2000). SQL Server 2005 Express provides an easy-to-use, lightweight, and embeddable version of SQL Server 2005 that enables the hospitals to host a version of the database which enables them to see the real-time status of other hospitals in the program, and which supports custom reporting. Dell Optiplex GX520 computers (with modems and packet-data radios as backups to LAN connectivity) are used as workstations at the TCC and at the hospitals.

The hospital staff uses a LifeTrac workstation to note their hospital's availability of resources and diversion status. For example, a hospital can change its status, removing itself from the availability list if its emergency room resources are currently unable to handle additional cases. The interface requires only a few mouse clicks to make any status change and is very easy to use. This is important, as hospital emergency department staffing frequently changes and repeated training of a complex system would be costly. Since healthcare providers are busy, a system that requires significant effort probably will not be used properly.

When a paramedic in the field determines they have a severe trauma or stroke patient, they contact the TCC via normal voice systems (radio, cell, telephone). No computer equipment is required by the paramedics, as a paramedic with a critical patient would have little time for data entry.

The TCC Communicator collects patient information and ensures that the patient is routed to an emergency department that is both appropriate for the patient and that all necessary treatment resources are immediately available. Although the EMT

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makes the final determination on where a patient is taken, the LifeTrac CommServer application has a branching decision support system that helps the Communicator and EMT determine the needs of the injured person. (In the state of Alabama, the patient, and/or family have final say on where a patient is transported. However, in most instances this decision id deferred to the EMT.)

Collected patient information is also transmitted to the hospital's LifeTrac workstation, where it automatically sets off an Inbound Patient alarm and prints a report with patient information.

Information from the TCC LifeTrac database is backed up to an offsite location using the Log Shipping feature of SQL Server 2005.

Integrating Additional Data Sources

Looking for more ways to enhance the information available for EMT and paramedics, in 2004 BREMSS began a collaborative project with General Motors to integrate into LifeTrac data generated by the company's OnStar automotive alert system. In 2005, LifeTrac was updated to interact with databases containing live Automatic Crash Notification (ACN) and Advanced ACN (AACN) data from motor vehicle collisions. Crash information from General Motors' OnStar systems activated in Alabama is delivered via XML to LifeTrac. This data, which includes impact measurements and whether the car rolled over, as well as location data for dispatching rescue units, can help Communicators at the TCC better gauge the potential severity of injuries. LifeTrac processes the data and forwards information on to the receiving hospital. This system is believed to be the first of its type to allow true collision-to-hospital-to-release tracking of patients for studies.

In 2005 LifeTrac was enhanced with an additional data source—from Blue Cross and Blue Shield of Alabama's Emergency Patient Information (EPI) system. The EPI system, available free of charge for all Alabamians, provides individuals a secure, Web-based means of storing information that may be needed by healthcare providers in an emergency, including medical history, medications, and emergency contact information.

Forté used Microsoft Visual Basic® .NET and the Microsoft .NET Framework version 1.1 to create a Web-services driven data broker system for external XML communications to integrate OnStar and EPI data into the SQL Server database. The data broker is hosted on a Dell PowerEdge 2850 computer with 2 GB of RAM. Developers at Forté plan to use the Common Language Runtime (CLR) feature of SQL Server 2005 as new functionalities are added to LifeTrac in the future.

Benefits

The LifeTrac system has already assisted in the timely and appropriate routing of over 28,000 critical trauma and stroke patients. BREMSS has enjoyed a number of benefits since the deployment, including saving lives, faster recoveries and shorter hospital stays, "immediate" ROI, ability to respond to mass casualty incidents, and easier maintenance with SQL Server 2005 Express.

Saving Lives

The biggest benefit to emerge from the deployment of LifeTrac has been the ability to save more lives through better routing severe trauma and stroke patients. "The fatality rate from injury in the six-county area served by BREMSS has decreased 12 percent since the program's inception," says Dr. Rue. "We haven't seen only a fraction of that reduction in fatalities for the state's remaining 61

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counties, which is why we are anxious to expand the coverage of BREMSS and LifeTrac."

Looking at severe trauma cases, the life-saving statistics are even greater. A study published by UAB researchers in the healthcare journal "The American Surgeon" reviewed the impact of BREMSS and the LifeTrac system, and found that the system reduced mortality of severe trauma by approximately 35 percent.

"Prior to the implementation of LifeTrac, only 40 percent of severe trauma patients were transported to an emergency room that was appropriate to their injuries," says Joe Acker, Executive Director of the Birmingham Regional Emergency Medical Services System. "Our emergency room routing accuracy is now up to 98 percent since deployment of our LifeTrac system."

Faster Patient Recoveries and Shorter Hospital Stays

The same study also found that more accurate routing of severe trauma patients led to a reduction of three days in the average hospital stay, saving money for the hospital, the patients and insurers.

"There is a period, referred to as the Golden Hour in trauma cases because a patient who is significantly injured and doesn't die in the initial crash, frequently begins to go into shock," says Acker. "When a patient is in shock, they're not getting adequate circulation to the central organs of the body, and the longer that those central organs of the body do not receive adequate circulation, the more debt a patient begins to build that has to be repaid because they don't have adequate oxygenation. They also aren't getting adequate sugar to the cells, and they don't have a way to extract the waste product from those cells. If you can get a patient in the first hour and begin to reduce their potential of going into shock, or begin to treat those who have already gone into shock, you can generally save about a third of those who would otherwise die. You'll also help ensure a faster and more complete recovery."

"Immediate" ROI

The LifeTrac system, with SQL Server 2005 on the server side and SQL Server 2005 Express on the client side, saves participating hospitals significant sums each time an incorrect routing decision is avoided. The "American Surgeon" study found that the system had enabled savings in the hospital studied of $1 million over one year.

"BREMSS is funded by the participating hospitals, and it is all on a volunteer basis," says Acker. "When a hospital, or any other entity, will put their own money on the line to pay for a service that's not legislatively mandated, you know they are benefiting. This system [with SQL Server 2005 on the server side and SQL Server Express on the client side] had an immediate return on investment because it pays for itself again every time a bad routing decision is avoided. For example, if a head trauma patient were to be brought to a hospital that wasn't equipped to immediately attend to the patient, the cost of bringing in extra resources, and the additional length of time the patient may stay because of the delay in treatment could exceed $1 million."

Hospitals also benefit because the LifeTrac application makes it so easy for a hospital to go to a divert status—indicating it can't currently accept severe trauma or stroke cases. "The system makes it easy for a hospital to accept patients when it is fully staffed, and divert if it is temporarily without a CAT scan team, neurosurgeon, or other key staff." Acker says. "Without the flexibility that we get from this application, I don't think it could have been successfully deployed. We

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John Huddleston, Senior Consultant, Forté International

give them the ability to decide minute-by-minute what services they are offering."

Ability to Respond to Mass Casualty Incidents

While the LifeTrac system helps to save lives and improve outcomes on a daily basis, it also provides the infrastructure required to better respond to mass casualty incidents such as multiple-car accidents, tornados, hurricanes, or any other incident.

An early version of the solution proved its capabilities when Birmingham was struck by an F5 tornado. LifeTrac assisted in this mass casualty incident and helped distribute the most critical patients among several hospitals, reducing the risk that these patients would all be rushed to the closest hospitals only to have to wait for appropriate care. This positive impact of the system was reported by UAB researchers in the April 2000 edition of the "Journal of Trauma-Injury Infection & Critical Care."

"The tornado killed about 32 people, and we had 169 patients triaged through the system in about two and a half hours," says Acker. "We had about another 80 injured that made it to the hospital on their own, which occurs in any disaster. Using LifeTrac we never had a hospital that got so overloaded that they could not continue to take patients. We were able to route those who were critically injured to Level 1 trauma centers, while sending those less severely injured to Level II, Level III, and community hospitals."

Easier Maintenance with SQL Server 2005 Express

Forté developers have found that it is easier to maintain the emergency room LifeTrac workstations since upgrading to SQL Server 2005 Express from MSDE 2000. Developers access the remote workstations and then use the Management Studio Express on the remote workstation. "The combination of SQL Server Express and SQL Server 2005 Management Studio has enabled us to do system maintenance remotely," says John Huddleston, Senior Consultant at Forté. "With MSDE we had to do everything by hand, which meant traveling to each hospital with a laptop, connecting to the LAN, mapping to the database, and then using Enterprise Manager from the laptop. Now I do it all remotely from Management Studio."

For More Information

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For more information about Forté Incorporated products and services, call (205) 620-0500 or visit the Web site at: www.forteonline.com

For more information about Birmingham Regional Emergency Medical Services System products and services, call (205) 934-2595 or visit the Web site at: www.bremss.org

Microsoft Server Product Portfolio

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Microsoft SQL Server 2005

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Software and Services

- Products
  - Microsoft Windows Server 2003 Standard Edition
  - Microsoft SQL Server 2005 Standard Edition
  - Microsoft SQL Server 2005 Express Edition
- Microsoft Windows XP Professional
- Microsoft Visual Basic .NET
- Microsoft Visual FoxPro 9.0
- Technologies
  - Microsoft .NET Framework version 1.1

Hardware

- Dell PowerEdge 850 with 1 GB RAM for the TCC LifeTrac database server
- Dell PowerEdge 750 with 1 GB of RAM for the CommServer application server
- Dell PowerEdge 2850 computer with 2 GB of RAM for the data broker server
- Dell Optiplex GX520 workstations at the TCC and hospitals

Partners

- Forté Incorporated

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