Microsoft Customer Solution
Healthcare Industry Case Study

Medical Center Develops Automated Patient Screening and Early Detection Tool

Vanderbilt University Medical Center

Overview

Country or Region: United States
Industry: Healthcare

Customer Profile

Vanderbilt University Medical Center (VUMC) is a leader in innovative patient care, research, and education. Based in Nashville, Tennessee, its hospitals and clinics treat over one million patients each year.

Business Situation

Sepsis is the tenth leading cause of death worldwide and accounts for 40 percent of total ICU costs. VUMC wanted to develop an integrated information system to enhance early detection and treatment.

Solution

VUMC and developer Accent on Integration followed the Microsoft® Connected Health Framework Architecture and Design Blueprint to develop the Patient Safety Screening Tool for Sepsis.

Benefits

- Reduced incidences and severity of sepsis
- Shortened hospitalization, reduced costs
- Improved compliance with practice standards
- Increased efficiency, pre-populated screening data
- Enhanced clinical decision-making

Accent on Integration

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"We can provide the highest quality care and maximize patient safety through early detection, appropriate treatment, and technology-enabled healthcare solutions."

John Barwise, MD, Medical Director, Neuroscience Intensive Care Unit, Division of Critical Care Medicine, Department of Anesthesiology, Vanderbilt University Medical Center

Severe sepsis is the tenth leading cause of death worldwide and costs hospitals over U.S.$16.7 billion each year (Angus, DC et al. *Critical Care Medicine*, 2001; 29:1303-1310). Vanderbilt University Medical Center (VUMC) decided to develop a technology-based patient screening tool to help its clinicians more effectively detect and manage sepsis. Physicians at VUMC collaborated with the healthcare application developers at Accent on Integration to create the Patient Safety Screening Tool (PSST) for Sepsis. The new tool was built using the guidelines in the Microsoft® Connected Health Framework Architecture and Design Blueprint. VUMC anticipates that using the PSST for Sepsis solution will reduce the frequency and severity of sepsis through early detection and improved compliance with treatment standards.

Microsoft®

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Michael Higgins, MD, Chair of the Department of Anesthesiology and Executive Medical Director for Perioperative Services, Vanderbilt University Medical Center

Situation

Throughout its 133-year history, Vanderbilt University Medical Center (VUMC) has been committed to the use of knowledge-based tools that help its clinicians provide exceptional healthcare to patients. This commitment to innovation has earned VUMC a reputation for leadership in research, medical education, and patient care. Vanderbilt University Hospital was one of only two Tennessee hospitals selected by U.S. News and World Report for inclusion in its list of America's Best Hospitals, and 49 of the 76 physicians chosen by the magazine as America's Top Doctors in Tennessee practice at VUMC.

In 2006, over one million patients visited Vanderbilt Clinics, and more than 46,000 patients were admitted to the four Vanderbilt Hospitals. By providing quality care to such an extensive patient population, physicians and clinicians at VUMC have become increasingly familiar with the impact of sepsis. Sepsis is characterized by a systemic inflammatory response to infection which can progress to circulatory system dysfunction, multiple organ failure, and eventually death. Severe sepsis is common, with over 750,000 cases diagnosed in the United States each year. It is the tenth leading cause of death worldwide, killing approximately one person every minute (Angus, DC et al. *Critical Care Medicine*, 2001; 29:1303-1310).

"Sepsis is a complex disease process that results in a high degree of morbidity and mortality," says Michael Higgins, MD, Chair of the Department of Anesthesiology and Executive Medical Director for Perioperative Services at VUMC. "It's a disease that's widespread but difficult to detect and challenging to manage. We do know, however, that if we detect sepsis early enough and apply the right treatment protocols, we can significantly improve the outcome for our patients. Early detection and appropriate intervention are critical."

Not only is sepsis a leading cause of death, it also accounts for nearly 40 percent of all intensive care unit (ICU) costs. In 2001, hospital expenses for patients with severe sepsis totaled over U.S.$16.7 billion (Angus, DC et al. *Critical Care Medicine*, 2001; 29:1303-1310). The burden of these costs to providers could increase substantially due to an August 2007 ruling by the Center for Medicaid and Medicare Services (CMS) which limits payment to hospitals for certain preventable, hospital-acquired infections. Sepsis—along with other acquired infections like pneumonia, urinary tract infections, and methicillin-resistant staphylococcus aureus infections—is slated to be added to the list of conditions covered by this ruling in 2009.

Leland Lancaster, MD, Director of Commercial Development, Department of Anesthesiology, explains that the first step in detecting and treating sepsis is to standardize diagnostic indicators and treatment protocols. "Several critical care associative groups came together to evaluate the available information regarding sepsis and to determine the best ways to treat these patients—both early on in the progression of the disease and when the patients are already septic and in shock," Lancaster says. "They formed consensus statements about the common denominators that would point a physician or clinician to suspect sepsis, then recommended specific treatment processes." Aggressive treatment protocols, also known as bundles, have been shown to lower mortality rates by 30 percent for severely septic patients and by 50 percent for patients who are at risk but have not yet developed the disease (Rivers et al: *New England Journal of Medicine*; 2001; 345:1368-1377).

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enough," says Higgins. "Implementing them and making sure that everybody stays on track with them is the real challenge. This is where we see a huge opportunity for information technology to deliver a real solution."

Solution

For over 12 years, VUMC has used Microsoft® tools to develop in-house information management systems. "One of our strengths has been using Microsoft technologies to develop software that really provides value to our clinicians," says Lancaster. In 1995, the Department of Anesthesiology developed the Vigilant Perioperative Information Management System (VPIMS) to bring electronic charting and data analysis to surgical patient care. Another tool, Vigilance©, monitors patient and systems data in surgical settings and sends alerts and notifications to care providers. VUMC has recently made VPIMS and Vigilance© available to other hospitals as a commercial product through a third-party reseller, Acuitec.

"These tools are very helpful for getting patient information to the clinicians," explains Higgins, "but what we'd like to work towards is creating a tool that helps us detect problems and effectively manage them. When Microsoft suggested we work together to create a patient surveillance tool that would screen for sepsis while also gathering information for the clinician—we saw this as the perfect win-win situation."

Defining the Infrastructure

To optimize development of this new Patient Safety Screening Tool (PSST) for Sepsis, VUMC decided to follow Microsoft guidelines for creating technology-enabled healthcare (e-Health) solutions. These guidelines, known as the Microsoft Connected Health Framework Architecture and Design Blueprint, assist healthcare providers like VUMC in creating a seamless IT infrastructure that simplifies administration and maximizes efficiency. A system implemented according to these guidelines is based on industry best practices and adheres to Service Oriented Architecture design principles. The Connected Health Framework also offers guidance for creating e-Health solutions that takes into consideration the unique needs of the healthcare industry.

VUMC turned to Microsoft and Accent on Integration (AOI), a Microsoft solutions partner, to help it define and develop the PSST solution for managing Sepsis. "We understood the importance of creating a screening tool specifically for sepsis," says Jeff McGeath, CTO, Accent on Integration, "but from a technology point of view, we saw the potential to create a foundational environment for additional disease state management tools. After deploying the PSST for Sepsis solution, we plan to reuse every bit of this infrastructure to create a PSST for other acquired diseases. It will simply be a matter of redefining the screening questions and plugging those new modules into the database. We designed the workflows and built the interface technology stack to make it easy for us to further customize this solution."

To support this flexibility, Microsoft and AOI decided to develop the PSST for Sepsis as a Web-based application. Developers used the enhanced core Web technologies of the Windows Server® 2008 operating system, the Microsoft Visual Studio® Team System 2008 Team Suite development system, and Microsoft SQL Server® 2005 database software (with plans to upgrade to Microsoft SQL Server 2008 once it is formally released to market, to take advantage of the system's new, innovative capabilities). The interface technology stack also included the Microsoft Office SharePoint® Server 2007 and the Microsoft Office InfoPath® 2007 information-gathering program.

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The PSST implementation is also an example of an Office Business Application (OBA) solution built on top of Microsoft technologies using Office SharePoint Server 2007 and the 2007 Office system.

Integrating the Solution

VUMC and Acuitec recently migrated the existing VPIMS solution from Microsoft Office Access™ database software and the Microsoft Visual Basic® development system to SQL Server 2005 and Microsoft Visual Basic.NET. AOI used this foundational architecture to support the integration of the PSST for Sepsis solution and the VPIMS tool. Using SQL Server 2005 and the Windows® Communication Foundation programming interface, developers designed the PSST for Sepsis solution to communicate with VPIMS and pull patient information directly from bedside monitoring equipment and other clinical systems. This information is displayed on an easily accessible Office SharePoint Web site and is available to care providers throughout the hospital. With Office SharePoint Server 2007, this patient data is also dynamically populated directly into InfoPath Forms Services over Microsoft Office Forms Server 2007, reducing the amount of time clinicians spend performing manual assessments and capturing data.

In addition to gathering information, the system performs a real-time assessment of patient vital statistics every five minutes. As soon as a condition is met that indicates a patient is developing sepsis, a variance alert is automatically created and transmitted to care providers so that they can immediately begin early and aggressive treatment protocols.

Deploying the Pilot

VUMC chose a Dell PowerEdge 2950 III server computer with a Quad-Core Intel Xeon processor to run the PSST solution.

Nimesh Patel, Director of Perioperative Informatics for VUMC, adds, "Through our partnership with AOI and the work we're doing on the PSST project, we have been able to see some of the unique benefits that come from using the latest MS Web development technologies, including Windows Server 2008, Visual Studio 2008, as well as SQL Server 2008."

John Barwise, MD, Medical Director, Neuroscience Intensive Care Unit, VUMC, and Physician Lead for the PSST solution, recommended the Neuroscience Intensive Care Unit (NICU) as the pilot location. The NICU is a 22-bed unit specializing in the care of critically ill adults, a patient demographic with a high risk of developing severe sepsis. "In critical illness, it's very important to monitor all of a patient's vital signs continuously so that we can keep them as healthy as possible while they recover from their primary injury," says Barwise. "Just looking at an individual a few times a day isn't going to be nearly as effective as monitoring them continuously, and we felt that the IT solution we're developing might be excellent for this purpose."

Lancaster adds, "The early alerts generated by the PSST for Sepsis solution will help us to intervene more quickly and aggressively when a patient shows signs of becoming pre-septic or severely septic."

During the initial phase of the testing, the VUMC team will work with Microsoft and AOI to capture as much patient screening information as possible. After the initial test, the pilot will continue in the form of a research study—over the course of a year, the VUMC team will capture, qualify, and quantify information obtained by using the PSST for Sepsis. As a result of being studied in this formal research environment within Vanderbilt, the return on investment for the

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PSST for Sepsis solution will be based on actual, non-subjective data. "Documented research is very important to the credibility of the PSST for Sepsis solution," says Lancaster. "As physicians, we want to see peer reviewed data around evidence-based medicine."

Benefits

VUMC anticipates that its clinicians will use the PSST for Sepsis solution to reduce the frequency and severity of sepsis through early detection and improved compliance with treatment standards. This, in turn, will reduce healthcare costs by shortening the length of hospital stays for at-risk patients. VUMC also expects to use the real-time bedside monitoring, automated patient screening tools, and pre-populated patient screening forms to increase efficiency and enhance clinical decision-making. The solution is also designed to be easy for clinicians to use, simple to implement with minimal configuration, and customizable to track and manage other acquired diseases.

Anticipated Reduced Mortality and Morbidity

VUMC anticipates that the PSST for Sepsis solution will help its physicians and clinicians significantly reduce the occurrence of sepsis in at-risk patients through early detection and aggressive treatment. "If the PSST for Sepsis solution were placed near any hospital bed, early detection of sepsis and early treatment of sepsis would probably prevent these patients from needing to go to the ICU at all," says Barwise. "This would shorten their length of stay and absolutely save lives."

Higgins notes that hospital teams can use the PSST for Sepsis solution to dramatically improve compliance with the treatment bundles recommended by the critical care associative groups. "I expect the PSST for Sepsis solution will help our teams work together more efficiently so we can provide our patients the right treatment at the right time based on established treatment standards," he says. "The PSST for Sepsis solution will also help us track whether our efforts are working by giving us instant feedback. These are important first steps in reducing the severity of sepsis."

Enhanced Efficiency and Decision-Making

VUMC plans to use the PSST for Sepsis solution to reduce the amount of time it takes its clinicians to perform patient screening assessments. Rather than manually searching for information on patient charts or looking at bedside monitors, clinicians can use the PSST for Sepsis solution to view lab results and vital sign values in the dynamically pre-populated patient screening forms. Then clinicians can complete the necessary subjective assessments and quickly evaluate whether a patient is suspected of having sepsis.

"The PSST for Sepsis solution is an enhancement of the patient-provider experience, not the replacement of it," Higgins explains. "Technology cannot replace a physician's skill to detect, examine, diagnose, and make complex decisions. The clinicians, physicians, and nurses will never be replaced by an information system. But information systems can help us by delivering information more quickly.

"This being the case," Higgins continues, "I'm optimistic that using the PSST for Sepsis solution will actually help our clinicians feel a greater sense of satisfaction in their work. I'm hopeful that they'll be happier because they'll have the information they need to make better clinical decisions, they'll get the information quickly so they can be proactive in caring for patients, and they'll get immediate feedback so they'll know how well the treatment is working."

Easy to Use

From an end-user perspective, the PSST for Sepsis solution is a SharePoint Web site that

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is easy to access and simple to navigate. AOI designed the solution to integrate seamlessly with the existing VPIMS solution so that real-time patient data is available to clinicians with the click of a mouse.

"We designed the PSST for Sepsis solution to bring all of the patient screening information together on the Web in one place at one time," says Whiteside. "Clinicians won't be doing anything that they don't already do, it'll just be a lot easier for them. It's a very simple application—it's basically a SharePoint Web site—so it's just a matter of clicking on the tabs and navigating to the appropriate queue. Training will be minimal because it's a very intuitive program."

Anticipated Reduced ICU Costs

As healthcare costs associated with the treatment of sepsis continue to rise, VUMC is interested in studying what kind of impact the PSST for Sepsis solution will have on these expenses. "Once the PSST for Sepsis solution is in place, we'll track the costs associated with sepsis care and compare them to previous data," says Higgins. "We anticipate that early detection of sepsis will shorten hospitalization time and reduce other resources required for treating severe sepsis. This should result in lower ICU costs." VUMC is also exploring ways to use the PSST for Sepsis solution to manage costs associated with the new CMS ruling regarding preventable, hospital-acquired infections.

Modular, Customizable Infrastructure

Microsoft architects and AOI developers designed the PSST for Sepsis to be a modular solution. The infrastructure can easily be reconfigured to screen for and manage other types of acquired diseases. Architects adhered to Microsoft best practices by creating a multitier architecture with separate presentation, application, and data tiers so that any of the three layers could be modified to meet the requirements of additional disease management modules.

VUMC deployed the pilot PSST for Sepsis as a Web-based software solution, but the architecture will also support a software-plus-services model. In the future, hospitals can choose a traditional software solution by physically installing the software onsite; or they can choose a software-plus-services strategy that weaves together the best of software and internet services. Hospitals will have the added flexibility of installing a subpart of the software onsite and then running the actual business intelligence, as well as the configuration of forms and services, through offsite data centers.

Developers also created the solution as a Web-based application to further enhance its flexibility. "Using the enhanced integration between MOSS [Microsoft Office SharePoint Server] 2007 and SQL Server 2005, we have zero footprint on client machines at VUMC," says McGeath. "We're using SQL Server 2005 as the application server to host all of our workflow components and WCF [Windows Communication Foundation] services, and we're using MOSS 2007 to deliver InfoPath Forms over Office Forms Server 2007. This means we're able to deliver our solution as a SharePoint Web site with the added functionality of Office InfoPath 2007 without having to install InfoPath clients on all of the hospital's machines."

"As physicians, we want to be as proactive as we can to prevent and treat diseases like sepsis," concludes Lancaster. "The seamless integration of the PSST for Sepsis solution with our existing infrastructure plays an important role. Minutes can mean the difference between life and death for our patients, so the faster we get information the sooner we can intercede."

For More Information

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For more information about Acuitec products and services, call (205) 266-0848 or visit the Web site at: www.acuitec.com

Barwise adds, "At the end of the day, we can provide the highest quality care and maximize patient safety through early detection, appropriate treatment, and technology-enabled healthcare solutions."

Microsoft Solutions for the Healthcare Industry

Healthcare and life sciences organizations are under tremendous pressure to meet regulatory requirements, improve patient care, and reduce the time it takes to develop drugs and take them to market. To meet this challenge, Microsoft and its partners have developed cost-effective solutions that enable healthcare organizations to streamline and automate daily processes that improve productivity and deliver information whenever and wherever it is needed. The result is enhanced productivity, safety, and quality.

For more information about Microsoft solutions for the healthcare industry, go to: www.microsoft.com/healthcare

Software and Services

- 2007 Microsoft Office system
  - Microsoft Office InfoPath 2007
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- Microsoft Visual Studio
  - Microsoft Visual Studio Team System 2008 Team Suite
- Microsoft Silverlight™
- Services
  - Windows Activation Service
- Technologies
  - Active Directory®
  - Internet Information Services 7.0
  - Microsoft .NET Framework 3.5
  - Windows Communication Foundation
  - Windows Workflow Foundation

Hardware

- Dell PowerEdge 2950 III server computer
- Quad-Core Intel Xeon processor

Partners

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- Acuitec
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