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How MTSU academic, hospital use data to fight disease

A silent killer lurks in the halls of most hospitals waiting to strike patients.

Commonly called "blood poisoning," sepsis strikes one patient every 20 seconds, totaling 1.6 million patients every year

Even with an increased health care industry focus on diagnosing sepsis early, it remains the third leading cause of death in the U.S. with more than 258,000 people dying annually from the condition. Notable victims of sepsis are Muhammad Ali, Patty Duke and Pope John Paul II.

If they survive, 59 percent patients over age 50 with severe sepsis suffer lasting disabilities and 62 percent of survivors are readmitted within 30 days due to complications from the potentially deadly condition that occurs when the body reacts to a bacterial infection.

In recent years, the health care industry has focused on reducing sepsis and its impact by using big data collected from electronic health records, which led to an opportunity for Middle Tennessee State University's Todd Gary.

Damian Mingle, WPC chief data scientist, and Dr. Todd Gary work at a white board at the Brentwood-based data firm. Gary, who works in MTSU's Office of Research, is WPC Healthcare's first Visiting Scholar

Gary, who works in MTSU's Office of Research, is the first scientist in Middle Tennessee to participate in Brentwood-based WPC Healthcare's Visiting Scholars Program.

"I enjoy working on the kinds of complex problems they strive to solve: saving lives and reducing health care costs," Gary said when he accepted the post at WPC.

Working with WPC Chief Data Scientist Damian Mingle and his team, Gary is providing research support on groundbreaking projects, like the sepsis model, that leverage data science to deliver practical solutions addressing the major clinical, financial and operational concerns of health care organizations.

The program began out of interactions between the company and Gary at the Nashville Entrepreneur Center in fall 2015 where Mingle presented to faculty from MTSU, Tennessee State University and other local universities interested in data science.

"There's not been a lot of interaction, and collaboration between healthcare information technology professionals and academic institutions in our market," said Ray Guzman, WPC's chief executive officer. "The Visiting Scholars Program builds a bridge between data science in our industry and Middle Tennessee universities."

So far, the program is paying dividends.

With Gary's help, the company has developed a model to predict with 95 percent accuracy the likelihood that incoming patients are susceptible to sepsis.

What is sepsis?

Sepsis dates back to Greek time, when it was first described by Hypocrites. The affliction still perplexes many medical professionals, Mingle explained.

The condition is “a complication caused by the body’s overwhelming and life-threatening response to infection, which can lead to tissue damage, organ failure, and death,” according to the Centers for Disease Control.

The signs and symptoms of sepsis include fever, extreme pain or discomfort, clammy or discolored skin, confusion or disorientation, shortness of breath, and high heart rate.

Treatment, called bundles, includes antibiotics and intravenous fluids, explained Dr. Brady Allen, vice chief of hospital staff at Saint Thomas Rutherford Hospital.

“It’s not always easy to identify patients with sepsis, but we have implemented strategies to catch it early and be at the forefront of evidence-based care,” Allen said about a similar program implement at all of Saint Thomas’s hospitals in Middle Tennessee.

Sepsis can cause a cascade of bodily changes that could result in tissue damage, failure of organ systems and, if not caught early, death, according to the Mayo Clinic.

“When we identify those patients and start the bundles early, it can only be a positive thing,” Allen said.

Not only is sepsis potentially deadly, it is also an expensive condition to treat. And the longer it goes untreated, the more costly it becomes and the more likely it is to result in death.

“Only 2 percent of emergency room patients report with sepsis,” Mingle said. But the condition accounts for 5.2 percent of all hospital costs, totaling $20.3 billion annually — with each case costing from $35,000 to in excess of $100,000, depending on how long it is from onset to treatment.

“The timing is critical that it gets diagnosis fast,” Mingle said.

For every hour it goes untreated, mortality rates increased by 7.6 percent. If it isn’t caught within 36 hours, the chance of survival plummets to near zero. Even if it is caught early, patients risk long-term complications.

“If you can catch it early, then you can pretty much get them back to where they were. But if you wait just a few hours the complications and mortality increases,” Mingle said.

Over the holidays, Gary experienced the effects of sepsis first hand.

On Christmas Day, Gary said he spoke with his 82-year-old father, JC Gary who lived in California.

“He seemed healthy, alert and fine. The next day he was rushed to the hospital with stomach pains,” Gary said.

His father was diagnosed with sepsis and placed on life support. Gary flew out to see his father for the last time.

“I witnessed first hand how quickly sepsis took his life. If his sepsis had been detected earlier, he might have survived,” Gary said.

JC Gary passed away Dec. 30.

Predicting sepsis

“This is a multi-thousand-year-old problem and time for a new approach,” Guzman said.

Since 2002, Saint Thomas has worked to reduce the impact of sepsis on its patients. In 2013, the nonprofit hospital chain introduced Optum One, a clinical analytics platform that draws knowledge from clinical and claims data, to help them improve their treatment and management of sepsis cases.

Allen said the program is helpful because the symptoms of sepsis are not always easy to identify and can be confused with other diseases.

“All the Saint Thomas facilities, certainly Saint Thomas Rutherford, we take sepsis seriously,” said Allen, who works in the emergency department.

Using a similar idea, WPC developed an analytical process to help identify which patients are at risk for developing sepsis.

Part of WPC’s TapRoot Platform, it uses big data from hospitals — historical and real-time patient data along with site-specific data trends — to predict a patient’s probability to develop sepsis.

WPC then notifies health care providers they should look for sepsis symptoms so providers can keep a watchful eye on the patients or deploy sepsis treatment bundles.

“What we have found is a combination of tools and clinician means for a better outcome for the patient. We just say this patient has a better chance of sepsis to slow down physician,” he said, calling it “highly accurate and high predictive.”

Optum One takes all the same information — like temperature, white blood cell count, vital signs and other data points — and alerts medical staff.

“At the computer, there will be a camp fire icon,” Allen said. It makes staff aware that a sepsis alert has been triggered.

“They don’t all have sepsis, but it makes them more aware,” Allen said. The alert is particularly helpful for patients who have been admitted to the hospital, he said, so the emergency department can be notified and treatment can start earlier.

Preventing sepsis

Allen said Optum One is helping reduce mortality rates at Saint Thomas hospitals. Data shows that in 2014 the number of sepsis-related deaths fell by 21 percent.

Mingle said there wasn’t any one thing that surprised him about the model, other than finding the results are geographically specific.

This means different data points — vital signs, income level, car ownership, age and others — are used to predict sepsis at different sites. So the data that predicts sepsis susceptibility in Murfreesboro could be different than in Nashville, Mingle said.

“This is important because literature today says ‘there is an average way to deal with an average patent at an average hospital.’ We have found that there is no average hospital,” Mingle said.

Gary added the model also learns as more patient data is entered into TapRoot, making it more effective for individual facilities.

So far the model has been 95 percent accurate in predicting sepsis susceptibility.

Gary’s work has been recognized. He was recently nominated for the Nashville Business Journal’s **2017 Health Care Heroes Awards** for his research.

But the men aren’t working for awards. They are working to save families the heart ache Gary in suffered over Christmas.

“We realize we can’t save everyone, we hope to catch as many people as possible,” Guzman said.

Mingle said many people die annually, but 72 percent survive with long-term complications from organ failure to amputation.

“We can, with early identification, improve the quality of life of those patients,” Mingle said.