HCA Healthcare saves lives with early sepsis detection platform

Software and services
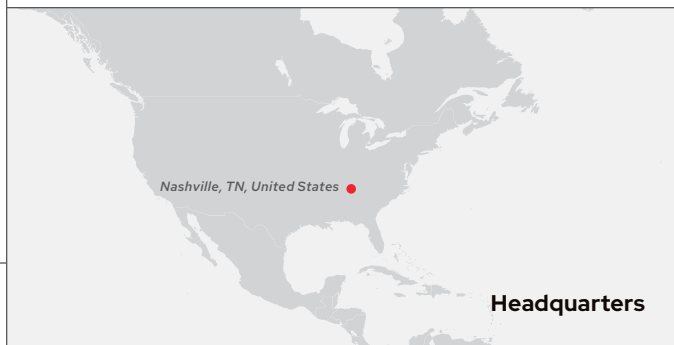
Red Hat® OpenShift®
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HCA Healthcare, a Nashville-based healthcare company, uses its data resources to find innovative solutions to long-standing industry challenges. A cross-functional team of clinicians, data scientists, and technology professionals at HCA Healthcare used Red Hat OpenShift Container Platform and Red Hat Ansible Automation Platform to create a real-time predictive analytics product, SPOT (Sepsis Prediction and Optimization of Therapy). With SPOT, the company can more accurately and rapidly detect sepsis, a potentially life-threatening condition, helping to save lives. SPOT is the first of many initiatives across the organization to use real-time data at scale to improve patient care with new insights.

Nashville, TN, United States ●

Headquarters

Healthcare

273,000 employees
1,800 care sites

"*The products we run affect people's lives deeply, and we need partners who are there to work with us 24x7. Our relationship with Red Hat is critical to ensuring service quality in the clinical environment.*"

Dr. Edmund Jackson
Chief data scientist,
HCA Healthcare

Benefits

- Saving lives by creating big data analysis platform to speed sepsis detection

- Created reliable, highly available container environment for new services and real-time machine learning algorithms

- Established supported yet flexible environment for learning health system

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Using data insights to save lives

With more than 30 million patient interactions each year at 1,800 care sites, HCA Healthcare is one of the largest healthcare service providers in the United States. Founded in 1968, the organization uses its large network of caregivers and resources to offer efficient, effective operations and care. Its Clinical Services Group — a team of nearly 400 physicians, nurses, health professionals, data scientists, and IT experts — works to use data and technology to support modern healthcare.

"We had Electronic Health Records [EHRs] before the industry standardized them. We're as much a technology and data company as we are a healthcare company," said Dr. Jonathan Perlin, chief medical officer at HCA Healthcare. "But the massive volume of data we're collecting is useless if it doesn't help us improve patient care. We want to establish a learning health system, where data from patient care is collected and used to continuously improve patient care and advance healthcare science."

In 2015, HCA Healthcare's leadership identified sepsis rates as a key challenge that data could help solve. Sepsis, a condition where the body's immune system has an overwhelming response to infection, is common in the young, elderly, or anyone with a compromised immune system. It is responsible for 270,000 deaths per year in the United States alone. Traditionally, diagnosis is based on manual review of patient charts during shift changes, but this approach can delay diagnosis of a condition that becomes 4-7% more deadly every hour.

"Our existing data infrastructure was designed for large-scale business intelligence and reporting, but this task is much different. We need to gather, analyze, and share real-time data from all of our facilities so that life-saving action can be taken quickly," said Dr. Edmund Jackson, chief data scientist at HCA Healthcare. "To support our care providers with modern tools like machine learning and cloud computing, we needed a platform that is flexible, scalable, and fast."

Building a scalable foundation for innovative care

HCA Healthcare created the Sepsis Prediction and Optimization of Therapy (SPOT) platform to collect and analyze clinical data — such as patient location, vital signs, pharmacy and laboratory data — and signal caregivers in real time to initiate early sepsis care. To create this platform, HCA Healthcare sought to use proven open source technology.

"SPOT is very reliant on open source technology because sepsis is a complicated problem, and the only way to effectively innovate in such a complex environment is openness," said Jackson. "It's critical for us to be able to experiment and evolve rapidly, and embracing open source has been key to that kind of innovation."

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>
> **Dr. Jonathan Perlin**
> Chief medical officer,
> HCA Healthcare

After evaluating different solutions, HCA Healthcare used Red Hat OpenShift Container Platform and Red Hat Enterprise Linux to create a scalable, container-based Platform-as-a-Service (PaaS) foundation for SPOT. Red Hat Ansible Automation Platform provides broad automation capabilities for data collection, analysis, and proactive notification processes. Red Hat Satellite and Red Hat Insights provide management and analytics for HCA Healthcare's Red Hat environment. The platform is coded using open programming languages, including Clojure, Elixir, and JavaScript.

"Red Hat solutions are a great middle ground between unsupported open source and supported closed source," said Jackson. "In healthcare, we have a duty to protect our patients' data, but having more flexibility in our on-premise environments is critical to innovative services like SPOT and beyond. The products we run affect people's lives deeply, and we need partners who are there to work with us 24x7. Our relationship with Red Hat is critical to ensuring service quality in the clinical environment."

The lifesaving SPOT platform has now been deployed to more than 160 hospitals to monitor more than 2.5 million patients to date. HCA Healthcare is also using its open source, Red Hat-based foundation to develop a new algorithm for other conditions and care settings. Its successful application of open source technology and collaborative cultural shift earned HCA Healthcare a 2019 Red Hat Innovation Award.

Collaborating to improve patient outcomes

Improved early detection of sepsis with predictive big data analysis

SPOT gives HCA Healthcare the ability to detect and identify initial indicators of sepsis up to 20 hours earlier than traditional screening methods. As part of the Surviving Sepsis Campaign, a global initiative to reduce sepsis mortality, HCA Healthcare has saved lives from sepsis due to combined sepsis prevention efforts since 2013.

"SPOT is aware of every new piece of data, the relationships between data, and its meaning. Instead of reacting, we get a 20-hour early warning. When every hour counts in decreasing the risk of death, the ability to have an algorithm run in the background in real time, without downtime, to detect those signals is absolutely game-changing," said Perlin.

The container-based, on-premise, and automated cloud environment provided by OpenShift Container Platform and Ansible Tower provide a reliable, reusable infrastructure to collect, analyze, and act on patient data. "Although technology isn't the central aspect of SPOT, it couldn't happen without things like containers, cloud, automation, and approaches like DevOps and SRE [site reliability engineering]," said Jackson. "The technologies that Red Hat provided were critical to our success."

By analyzing the volumes of patient data it collects and quickly alerting caregivers, SPOT has brought new best practices to a deadly condition. In fact, the innovative platform helped save the life of a relative of one of HCA Healthcare's employees.

"In November 2018, my mother-in-law became ill and was taken to the emergency room," said Hal Schultheis, director of IT at Hendersonville Medical Center, part of HCA Healthcare. "About an hour after her admission, a bunch of nurses came into her room, concerned about a test result, and started her on IV antibiotics. After 45 days in the hospital battling sepsis, she was released. I personally believe that she would not be with us today had the SPOT protocol not picked up that she was in a state of severe sepsis."

Increased caregiver accuracy with new tools and technology capabilities

Supported by centralized, scalable Red Hat technology, HCA Healthcare is undergoing a cultural shift to quickly, confidently use digital capabilities and establish best practices for patient care–even across hundreds of systems and applications at each facility, from fetal monitoring to accounting to supply chain management.

OpenShift Container Platform provides a reliable, highly available container environment to support the organization's patient- and business-facing work. HCA Healthcare has used OpenShift Container Platform and process automation through Ansible Tower to increase its service launches from two to 10 per year.

"About 80% of a patient chart is not computable," said Perlin. "Working with great colleagues at Red Hat means we can use new tools like natural language processing and machine learning to develop new insights from that unstructured data that transform healthcare. As the pilot project, SPOT has been an important tool for building clinicians' trust in the computer to see associations that they cannot see and act on those predictions. As a return for the time spent on creating patient EHRs, we create value for them from that data."

Built learning health system to decrease risk and cost of innovation

Its enterprise open source technology foundation has helped HCA Healthcare unite its care and business professionals to form a learning healthcare system, a collaborative, transparent model approach that uses data from each interaction as a source for continuous learning and improvement–similar to continuous integration and delivery (CI/CD).

"We're committed to the care and improvement of human life. That mission is what draws IT and the care team together. That culture drives this organization, and it allows us to work together to always try to do things better," said Schultheis.

Sharing discoveries with colleagues worldwide

HCA Healthcare will continue to use its Red Hat infrastructure as the foundation for its machine learning and data science services. Since launching SPOT, the organization has successfully deployed several other algorithms on OpenShift Container Platform to improve its clinical practice and operations.

"HCA Healthcare and healthcare in general are at the beginning of a digital transformation journey," said Jackson. "The platform that we're building lets us gather data from all of our sites in real time, run any algorithm on it, and apply results to bedside care. This is a journey of thinking differently about the clinical setting and how technology can support it. SPOT is just the beginning."

About HCA Healthcare

Nashville-based HCA Healthcare is one of the nation's leading providers of healthcare services, comprising 185 hospitals and approximately 1,800 sites of care, including surgery centers, freestanding ERs, urgent care centers, and physician clinics, in 21 states and the United Kingdom. With its founding in 1968, HCA Healthcare created a new model for hospital care in the United States, using combined resources to strengthen hospitals, deliver patient-focused care and improve the practice of medicine. HCA Healthcare is a learning healthcare system that uses its more than 31 million annual patient encounters to advance science, improve patient care and save lives.

About Red Hat

Red Hat is the world's leading provider of enterprise open source software solutions, using a community-powered approach to deliver reliable and high-performing Linux, hybrid cloud, container, and Kubernetes technologies. Red Hat helps customers integrate new and existing IT applications, develop cloud-native applications, standardize on our industry-leading operating system, and automate, secure, and manage complex environments. Award-winning support, training, and consulting services make Red Hat a trusted adviser to the Fortune 500. As a strategic partner to cloud providers, system integrators, application vendors, customers, and open source communities, Red Hat can help organizations prepare for the digital future.

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