Hospitals Fight Sepsis with AI

By predicting cases, Sepsis Watch could save lives

In hospitals, doctors and nurses keep vigilant watch over patients’ vital signs and blood tests to catch the first symptoms of sepsis. In this life-threatening condition, the body responds to an infection with widespread inflammation that can lead to organ failure. Cases can progress rapidly to severe sepsis and then to septic shock, which has a mortality rate of almost 50 percent in the United States.

But even the most vigilant humans get tired, make mistakes, and miss subtle patterns. That’s why several hospitals are experimenting with artificially intelligent sepsis detectors. Researchers say these pilot projects are the first real examples of AI being integrated into hospital operations, with data flowing from electronic medical records and alerts being incorporated into physicians’ workflows.

This month, Duke University Hospital, in Durham, N.C., is officially launching Sepsis Watch, an AI-based system that identifies incipient sepsis cases and raises the alarm. The hospital is deploying it initially in the emergency department, and will then extend it to the general hospital floor and the intensive care unit. “The most important thing is to catch cases early, before they get to the ICU,” says Suresh Balu, director of the Duke Institute for Health Innovation and one of the project leads.

Sepsis Watch was trained via deep learning to identify cases based on...
The European XFEL, or EuXFEL—currently the largest X-ray free-electron laser in the world—produced its first light in May 2017. The facility, built in a 3.4-kilometer tunnel near Hamburg, Germany, was commissioned in September of last year. And August 2018 brought another milestone—the publication of the first scientific paper based on experiments with the laser, which the authors used to probe the 3D structures of protein microcrystals.

More results are sure to come as the laser ramps up to full operation. Already, more than 500 researchers from 20 countries have visited the facility to investigate structures of crystalline materials, biomolecules, viruses, and chemical reactions. Two experimental stations are now available to the scientific community, but by 2019, the facility should have six stations supplied with pulses from three X-ray lasers. The cooling requirements of the current design limit it to delivering no more than 27,000 pulses per second, but researchers envisage increasing this to a continuous stream of pulses.

In the EuXFEL, electrons first move through a linear accelerator, mounted in
dozens of variables, including vital signs, lab test results, and medical histories; its training data consisted of 50,000 patient records including more than 32 million data points. In operation, it pulls information from patients’ medical records every 5 minutes to evaluate their conditions, offering intensive real-time analysis that human doctors can’t provide. If the AI system determines that a patient meets its criteria for someone with the early signs of sepsis, it alerts the nurses on the hospital’s rapid response team.

The AI can’t do it all, says Mark Sendak, a physician and data scientist at the Duke Institute. When the rapid-response nurses hurry to a patient’s bedside, it’s their job to decide whether to dismiss the alert, place the patient on a watch list, or speak with the physician about starting treatment. If directed, the Sepsis Watch system will also guide staff through the checklist of treatment steps recommended by a global initiative called the Surviving Sepsis Campaign, including which blood tests and medications to administer within the first 3 hours. “The model detects sepsis,” Sendak says, “but most of the application is focused on completing treatment.”

Sendak says the team carefully considered the system’s user interface and how the alerts would fit into existing workflows. Clinicians were wary of adding disruptions to their rounds: Sendak says a different early warning system that Duke Hospital tried out in 2015 to identify sepsis cases sometimes rang the alarm 100 times a day for a single patient.

The Duke system isn’t the first AI-based sepsis detector to make it to a hospital floor. That honor belongs to an early warning system put into place at the Hospital of the University of Pennsylvania, explains Craig Umscheid, an associate professor of medicine at the hospital. His team launched that system in early 2016—and shut it off for good in 2017. Umscheid says the system simply didn’t improve the quality of care or patient outcomes—in part because it identified probable sepsis patients that the medical staff already had their eyes on. “The opportunity to identify unsuspected cases is lower than you might expect,” Umscheid says.

At the Johns Hopkins Hospital, in Baltimore, a similar system is showing much better results, says Suchi Saria, an assistant professor of computer science at Johns Hopkins University. Saria’s team launched its AI at the end of 2017, and she says it’s working so well that they’re preparing to expand it to four other hospitals. “We’re seeing significant changes in care,” she says, “and fewer cases where a patient suddenly deteriorates.”

The Hopkins sepsis detector is tailored for different patient populations—for example, it assesses patients with compromised immune systems based on different criteria—and also has workflows that are optimized for the hospital’s various units.

If these AI systems do improve care, plenty of hospitals will be eager to adopt the technology, says Duke’s Sendak. Beginning in July 2018, the U.S. government’s Hospital Compare website began publishing data about hospitals’ records on providing early and appropriate treatment for sepsis. “The national average is about 50 percent,” Sendak says. “A lot of places struggle with this problem.”

—Eliza Strickland

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Scientists used the EuXFEL to reveal the structures of the tiniest proteins

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