Using Big Data to Prevent Infections

A thought paper by Scalable Health

SCALABLE HEALTH

Big Data Analytics Reduces Infections in Hospitals

Healthcare Associated Infections (HAIs) are developed while patients are receiving medical treatment in a healthcare facility. HAIs are a major, yet often preventable, threat to patient safety. Despite strict hygiene protocols within the healthcare setting about 1 in 25 patients will develop an infection.

According to the CDC, more than 2 million patients contract a hospital-related infection annually. The most common HAIs are pneumonia, sepsis, urinary tract infection and surgical site infection. HAIs are extremely dangerous to patients as their existing conditions may have left them with compromised immune systems. HAI detection can become difficult as symptoms often present that are similar to other common ailments. Treatment is often further complicated by drug-resistant strains and/or the patient's already compromised health.

There are numerous conditions contributing to an increased risk of contracting an HAI including longer hospital stays, surgical procedures, inadequate hygiene protocols and overuse of antibiotics. In response, hospitals are combining traditional infection control practices with advanced data technologies to combat this pervasive problem.

Of the various HAIs, sepsis is the most pervasive, deadly and expensive to treat.

Sepsis - Deadly and Expensive

Sepsis is a life-threatening condition that arises when the body's response to infection injures its own tissues and organs. As sepsis worsens, blood flow to vital organs such as the brain, heart, and kidneys becomes impaired. Patients with sepsis are at a higher risk of developing blood clots leading to varying degrees of organ failure and tissue death (gangrene).

Most people recover from mild sepsis, but the mortality rate for septic shock is nearly 50 percent. Patients with a history of sepsis are at higher risk of future infections.

Sepsis frequently arises in hospitals because it commonly stems from another medical condition — an infection in the lungs, urinary tract, skin, appendicitis, or as the result of invasive medical procedures (e.g., the insertion of a vascular catheter that introduces bacteria into the bloodstream).

The signs that a patient has system inflammatory response syndrome (SIRS), a precursor to sepsis, can be difficult to diagnose, even in a hospital setting, because early manifestations often mimic other conditions. Common symptoms include fever, chills, rapid breathing and heart rate, rash, confusion, and disorientation. To diagnose sepsis, physicians must obtain historical, clinical, and laboratory findings indicative of infection and organ dysfunction. Chest x-rays or CT scans can also be used to identify infections.

Over 200,000 patients die from sepsis (systematic inflammation caused by severe infection) annually. Sepsis affects more 750,000 hospitalized patients resulting in longer and increased healthcare costs. The number and rate per 10,000 population of hospitalizations for septicemia or sepsis more than doubled from 2000 through 2008. Seventeen percent of septicemia or sepsis hospitalizations ended in death, whereas only 2% of other hospitalizations did.

Prevent sepsis and improve early recognition

● **Improve health conditions.**

George is a 72-year-old man with diabetes. During his check-up, George's healthcare provider takes the opportunity to strengthen his chronic disease care (glucose control and skin care), provide recommended vaccines, and share information about symptoms that indicate an infection is worsening or sepsis is developing.

Educate patients and there families ●

One month later, George has a cut on his foot that might be infected. He calls his healthcare provider, who tells him how to take care of the cut and signs of infection. Two days later, his foot is worse and he becomes short of breath, has clammy skin, and is more tired than usual. He recognizes symptoms are worsening and it could be sepsis. He seeks medical attention immediately.

● **Think sepsis. Act fast.**

At the hospital, a healthcare provider recognizes the signs and symptoms of sepsis. She immediately orders tests to determine the source of infection and starts appropriate treatment, including antibiotics. She documents the dose, duration, and purpose of antibiotics.

Reassess patient management ●

Healthcare providers closely monitors George's progress and adjust therapy as needed. When George improves, his providers transfer him to a rehabilitation facility to continue his recovery. The hospital care team discusses his treatment plan with the team at the new facility.

One of the most challenging aspects of sepsis is diagnosing it early to prevent further health deterioration. Hospitals have been collecting infection data for decades and this data can offer actionable insights into prevention and care. Empowered with this information, doctors will be better equipped to identify and diagnose infections earlier. This allows for faster intervention before the patient becomes further compromised.
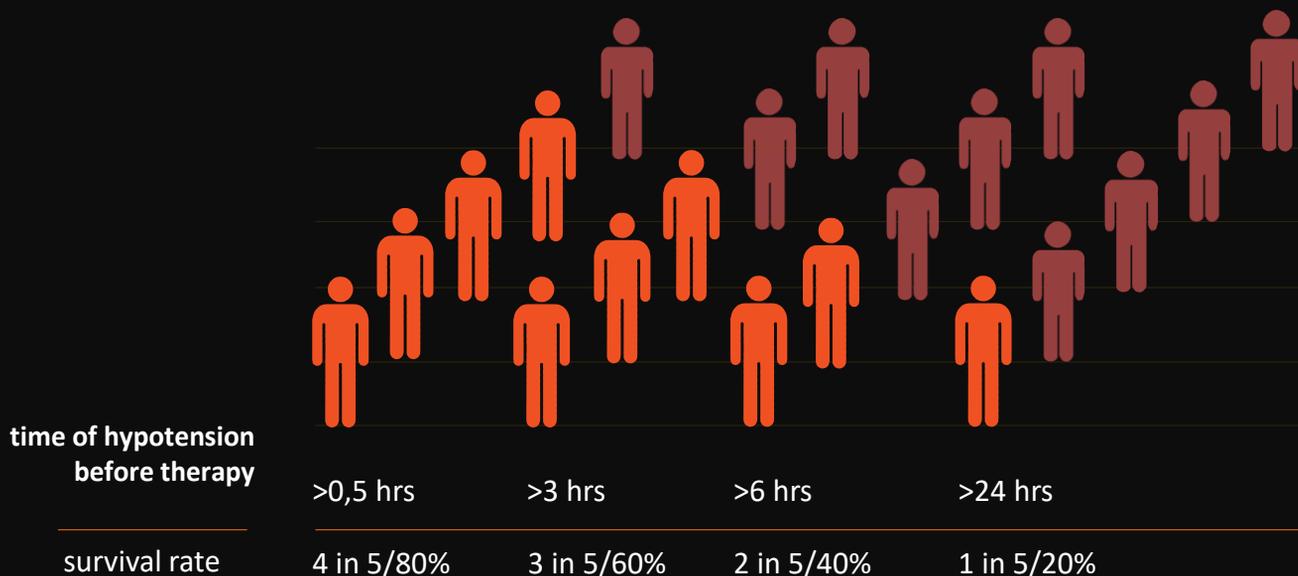
The average length of stay (LOS) of a hospitalized patient with sepsis is 75% longer than for those hospitalized for other ailments. Sepsis is the most expensive inpatient condition with an annual cost of over $20 billion and representing more than 5% of inpatient costs.

Prevention and Early Intervention

According to the Mayo Clinic - many doctors view sepsis as a three-stages syndrome starting with sepsis and progressing through severe sepsis to septic shock. The ideal scenario is to treat sepsis during its early stage before it becomes more dangerous.

Detecting sepsis early increases changes for survival

time of hypotension before therapy	>0,5 hrs	>3 hrs	>6 hrs	>24 hrs
survival rate	4 in 5/80%	3 in 5/60%	2 in 5/40%	1 in 5/20%

According to the CDC, The "Surviving Sepsis Campaign" was an international effort organized by physicians that developed and promoted widespread adoption of practice improvement programs grounded in evidence-based guidelines. The goal was to improve diagnosis and treatment of sepsis. Included among the guidelines were sepsis screening for high-risk patients; taking bacterial cultures soon after the patient arrived at the hospital; starting patients on broad-spectrum intravenous antibiotic therapy before the results of the cultures are obtained; identifying the source of infection and taking steps to control it (e.g., abscess drainage); administering intravenous fluids to correct a loss or decrease in blood volume; and maintaining glycemic (blood sugar) control. These and similar guidelines have been tested by a number of hospitals and have shown potential for decreasing hospital mortality due to sepsis.

In addition, data analytics provides actionable insights into the sepsis infection, intervention and its impact on healthcare outcomes. Analytics track various infection patterns that affect patients and offer actionable insights to the communication of diseases, the surveillance of infection patterns and early indicators of infection. With this information care providers can identify when a patient might be at risk for contracting an HAI and implement preventative measures to lessen the risk.

Another powerful area of prevention is simply monitoring cleanliness. In other words, wash your hands. 62% of males and 40% of females don't wash their hands regularly and of those who do 95% are doing it wrong. Yes, according to the CDC, there is a correct way to wash your hands. Tracking personnel and hand washing compliance coupled with tracking when instruments are in need of cleaning reduces the risk of sepsis. On average, staff complies with hand-washing and other hygiene measures approximately 70% of the time in the hospital environment. When care providers know they are being monitored, compliance increases to over 90%.

 The challenge with sepsis is early indicators are similar to many common ailments - fever, chills, respiratory difficulties - thus sepsis may not be diagnosed early. To diagnose sepsis, physicians must obtain historical, clinical, and laboratory findings indicative of infection and organ dysfunction. According to the AAFP - in septic shock, the initiation of antibiotic therapy within one hour increases survival; with each hour antibiotic therapy is delayed, survival decreases by about 8%.

Wearables can help detect early indicators of sepsis. This is especially important when the patient is discharged from the hospital. While convalescing at home has many benefits, many patients won't recognize the early indicators of septic onset. The wearables can transmit real-time vitals to caregivers allowing for early intervention. Early intervention is crucial because as septic progresses organ failure is likely, which is why there is such a high mortality rate from septic shock.

Hospitals are now able to correlate real-time patient data from electronic health records with data indicating emerging environmental conditions to identify who is at risk and what is the best approach to mitigating the risk of infection. This information is added to the knowledge base of where and when an outbreak occurs and which care providers and other patients interacted with the sepsis patient to develop actionable insights into containing the outbreak.

Big Data and Risk Reduction

Steps can be taken to control and prevent HAIs in a variety of settings. Research shows that when healthcare facilities, care teams, and individual doctors and nurses are aware of infection problems and take specific steps to prevent them rates of some targeted HAIs (e.g., CLABSI) can decrease by more than 70 percent. Preventing HAIs is possible, but it takes a conscious effort of everyone–clinicians, healthcare facilities and systems, public health, quality improvement groups, and the federal government–working together toward improving care, protecting patients, and saving lives.

Of all HAIs, sepsis is the most life threatening. By identifying patients at risk through population health analysis, care providers can then determine appropriate preventative care procedures to reduce the risk of sepsis. This is coupled with real-time monitoring of high-risk patients through wearables and aggregating patient data through EHRs and other test results from various departments within the hospital for greater care outcomes.

Sepsis is preventable. And Big Data can help...

Pediatric
RED FLAGS... Think SEPSIS!
Pediatric patients are at higher risk

<36 ^{0C}
≥38.5^{0C}

Core temperature

Increased respiratory rate

Inappropriate tachycardia
see PEWS chart

Altered mental state
Inc., sleepiness, irritability, lethargy, floppiness

Prolonged capillary refill
(reduced skin perfusion)

Have a lower threshold of suspicion for:
Patients younger than 3 months, chronic disease, recent surgery, immunocompromised

Suspect Sepsis. Say Sepsis. Save someone's life today

About Scalable Health

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