Tackling sepsis

Claire Read

Sepsis is one of the biggest killers in the UK, yet it can be treated relatively simply. The difficulty is spotting a complex condition; and here technology can help.

Cerner's St. John Sepsis Agent, part of its electronic medical record system, aims to help clinicians more accurately and speedily identify those with the condition.

The tool has been developed over a number of years to take account of the latest advice and guidance, and is now being deployed by NHS organisations such as Wirral University Teaching Hospital NHS Foundation Trust.

In 2005, Ron Daniels encountered a patient who was to determine the focus of his career. Jem was 37, a father to two young children, and a victim of sepsis. "I watched him dying," remembers Dr Daniels, "and it was very clear that there had been opportunities to rescue him, both in the community and in my hospital, that hadn't been taken."

The needlessness of the loss struck the newly-qualified consultant in critical care and anaesthesia hard. "I was following Jem's wife Karen down the hospital corridor, knowing I was about to take her into the relatives' room to tell her that her fit, strong husband was going to die.

"She was going to have to go home and tell their two young children that Daddy wasn't coming home. And I just thought this is unfair, this is unjust, and we've got to fix this."

Understanding the condition

As chief executive and co-founder of the UK Sepsis Trust, and chief executive of the Global Sepsis Alliance, Dr Daniels devotes his time to doing just that. He and his colleagues have undoubtedly made great strides in increasing understanding of the condition.

Yet ask most people to name the UK's biggest killers, and sepsis rarely crops up. This despite it claiming more lives than prostate cancer, breast cancer and bowel cancer put together.

"In the UK, we're talking about 150,000 episodes every year, which is more than we see episodes of heart attack or stroke, and an estimated 44,000 deaths annually," explains Dr Daniels, who is a consultant at Heart of England NHS Foundation Trust.

"Globally — and it's very difficult to measure globally because we have to interpret it as a similar incidence and mortality in the resource—poor world as in the resource—rich world, which clearly is going to be a gross underestimate — we conservatively estimate 18 million cases every year, with 8 million deaths annually, of which around 5 million are children and neonates. So it is an absolutely enormous issue."



A significant cause of death and harm

What makes these figures all the more upsetting is that many of these deaths are avoidable. Sepsis – previously known as septicaemia or blood poisoning – occurs when the immune system overreacts to an infection. The body attacks its own organs and tissues, which can rapidly lead to death.

Administered early enough, simple treatment with intravenous antibiotics and fluids can halt the progress of sepsis and allow patients to make a full recovery. When such care is provided, between 80% and 90% of those with sepsis can be saved. Fail to provide speedy treatment, however, and the consequences can be death or serious harm.



"We estimate that at one year after surviving sepsis, around 20% to 30% of survivors have problems either with significant pain in their muscles or their joints, or have significant problems with fatigue," reports Dr Daniels. "We estimate about 2% have more visible physical symptoms, particularly either breathlessness or loss of digits or limbs."

There is a psychological burden too. "We know that 22% of survivors have post-traumatic stress disorder; we know that 17% of survivors have moderate to severe cognitive dysfunction a year after surviving; and an unmeasured number will have panic attacks, nightmares, flashbacks, personality changes," says Dr Daniels.

"These are all figures and numbers, which is all very erudite, but what this means is people's relationships are stressed, people can't return to work at their previous level of function and so on."

That in turn has a significant economic impact. "In the UK, we estimate sepsis accounts for about £2.5 billion of hospital costs a year, but the fiscal burden... goodness knows how much that is.

"Because if you've got a whole cohort of people who are no longer productive in society and have rehabilitation needs, then that's huge. Typically we find people spend a minimum of nine to 12 months before they can return to normal function, and many are left without normal function."

A complex condition to spot

Consider the presence of simple and typically successful treatment for sepsis, and a simple question occurs: just why are so many people harmed? Why is it often not caught quickly enough for treatment to be effective?

Dr Daniels emphasises the condition is one of the most complex facing clinicians. "It can affect people of any age, at any time. Although there are risk factors, it doesn't respect lifestyle choices, so it can affect perfectly fit and healthy people, and it can arise from any number of different infections. So it can arise from infections as diverse as pneumonia and a cut on the finger."

Furthermore, diagnosis involves careful consideration of a wide range of information. "Observation — so a raise in body temperature or a decrease in body temperature, an increase in the heart rate, an increase in the respiratory rate, an increase or a decrease in the white cell count, which are the cells that are activated at the time of an infection, a change in the blood sugar level — would start to give you a picture," explains Giulio Bognolo, chief medical officer at Cerner Corporation.

"Then the second stage would be a more advanced set of information, another type of blood test, a look at the blood pressure of the patient, at the liver and renal function of the patient, and another look at the composition of the blood to detect a change in the platelets."



Accurately assessing that wealth of information is challenging. "In the midst of a very busy clinical practice, where you as a nurse are looking after more than one patient most of the time, you need to pay attention and put in context a number of pieces of information that as a standalone would not provide you an accurate indication of the patient's risk of sepsis," explains Dr Bognolo.

The lack of a clear, characteristic symptom also means public awareness of the condition is insufficient to increase speedy recognition.

"Unlike meningitis, sepsis doesn't have its characteristic rash, we're not looking for neck stiffness or photo phobia," comments Dr Daniels. "Public awareness is a huge part of it, but what we also need is a healthcare system that's attuned to suspecting sepsis in someone who looks ill."

The role of technology

Dr Bognolo and his Cerner colleagues believe technology could help create that. The company's St. John Sepsis Agent, part of its electronic medical record system, aims to help clinicians more accurately and speedily identify those with the condition.

The creation of the algorithm — which is available free of charge to Cerner customers — was driven by company chairman Neal Patterson. In 2006, his sister—in—law Linda went to her doctor with flu—like symptoms. By Sunday night she was dead, another victim of a failure to speedily diagnosis sepsis.

In thinking of the role of technology in reducing such incidents, Dr Bognolo speaks of another safety-critical industry. "I always compare this to an aeroplane landing.

"The reason we use technology to land an aeroplane — and the reason the landing is a lot softer when it is a computer-generated landing than when it's a manual one — is because you need to take into account the wind direction, the position of the flaps, the speed and so on. It's too complex for somebody that is already concentrating on steering the wheel to keep the aeroplane straight to also do that without the help of technology.

"So in clinical practice, what happens is that either you don't do your maths accurately because you're too busy. And despite having noticed that the temperature is up or down, the heart rate is up or down and so on, you don't put it together to give you the warning signal that the patient may be becoming septic.

"Or you simply don't see the warning signal and you go straight on a bend because you haven't had the time to look at the blood results or the blood pressure and so on."

The St.John's Sepsis Agent

The St. John's Sepsis Agent tool capitalises on technology's ability to constantly monitor information. "The principle behind it is that all this data is routinely stored and acquired in the electronic medical record, and there is an algorithm in the background that continuously looks at these results.



"When the combination of results suggests that the patient is developing the early signs of sepsis, it sends an alert to whoever has been identified within the organisation as being responsible to respond to a septic crisis.

"That alert can be through an e-mail, through a text message, through a pop-up on a terminal, on an iPad, on an iPod, on an iPhone – it depends how you configure the system and what technology you have available.

"So it is the computer of the aeroplane: it allows you to concentrate on other things and does the background work that normally you would have to do yourself continuously, but that naturally is too difficult to do on a continuous basis for every single patient that comes through your system."

The algorithm is constantly refined as guidance on sepsis evolves. "It was developed based on the available evidence from the Surviving Sepsis Campaign, the international guidelines for the management of severe sepsis and septic shock, which was published in Intensive Care Medicine in 2008," explains Dr Bognolo.

"And then there were other references to the work on the international sepsis definition by the American College of Chest Physicians in the Society of Critical Care Medicine in 1992 and 2003.

"We went out and reviewed the current evidence on sepsis and detection of sepsis, and then the algorithm went through a number of iterations to improve its specificity and sensitivity so that its precision increased. We are now on version 14, with version 15 due to be released later this year. It gets continuously refined."

In the United States, Cerner has reported using St. John's Sepsis Agent can lead to a 24% reduction in in-hospital patient mortality; a 21% reduction in length of stay; and \$5,882 medical savings per treated patient. Uptake in the UK is limited but growing, with positive results reported by those who are employing it.

Creating effective workflows

Dr Bognolo admits that, while the product is free, there is always a degree of investment associated with introducing it: not least in overcoming cultural boundaries and potential clinician resistance.

"There are several factors that may come into play," he argues. "One is that clinicians are not used to the support of technology to aid their clinical diagnosis, and that as a result they are really either not familiar with the potential benefit of technology in supporting their work, or they are reluctant to use the technology because it's perceived as 'the machines are taking over from what is my clinical judgement'."

With the sepsis tool, there is also the issue of potential false positives. "The precision of the algorithm is not 100 per cent, so there are a number of false alarms. But that again is a cultural barrier because usually when the sepsis alert goes off, even if the patient is not becoming septic, it's just like an early warning score — the patient is unwell for another reason."

He continues: "What we need to do with technology is always remember it is a tool, an aid to what we do, but every technology you introduce in a healthcare system has to be as part of a transformation programme rather than a technical deployment.



"Hence you need to have the right framework to get people to change their behaviour and embrace and use technology once they see the value of it rather than impose it upon them.

"That is what the true problem of any transformation programme in healthcare is: it's the inability to lead change or the challenges in leading change and the ability to use the right strategy to change behaviour and get people on board with the transformation. And that's where I think we fail."

Making best practice routine practice

While there is no doubt there are challenges involved, Dr Daniels points out improving performance on sepsis does not involve expensive drugs or expensive facilities. "This is about communication; systems talking to each other; and robust escalation."

He adds: "It's archaic that we have nurses charged with taking observations recording them on pieces of paper, and responding by manually calculating risk scores. The public have a right to expect that this process will have redundancies, automation and automated prompts. And that's where electronic systems come in."

CASE STUDY

Wirral University Teaching Hospital NHS Foundation Trust

Mark Hughes says Wirral University Teaching Hospital NHS Foundation Trust has prided itself on being a frontrunner when it comes to improving services through technology.

The identification and care of those with sepsis is no exception. Since August 2015, the trust has used Cerner's St. John's Sepsis Agent tool as part of its electronic medical record.

"Sepsis can be very easy to spot, but it can also be very difficult to spot," explains Dr Hughes, consultant in intensive care medicine and anaesthesia and also the trust's sepsis lead.

"Sepsis can cause lots of other conditions, or can co-exist with lots of other conditions, so it's very easily missed at times. When it's straightforward, it's easy; when it's not it's difficult, and potentially fatal as well."



 $He says the trust uses the {\it Cerner system as a safety net, complementing existing pathways and screening systems.}\\$

"As the nurses take various physiological measures, they [electronically] enter those in and then as they stack up with abnormal measures, it will send an alert out once they hit the trigger criteria. It can also look at lab data, so it has the ability to look through recent culture results, or recent blood results.





"It is based on systemic inflammatory response syndrome [SIRS], so it identifies people who are meeting the SIRS criteria, and who are developing organ failure. So it's like an early warning score system — it's warning that these patients are getting worse.

"Now, hopefully what's happened is that they've already been recognised. But where they might not have been recognised, it will flag up to say 'this patient is sick', or 'this patient is getting sicker', and has hit these criteria now. So it flags up alerts.

"We've introduced a screen into it so that if the system alerts to say your patient is sick, we're then asking people to consider whether infection could be a cause." The alert appears on any device the clinician is using to access the system: at Wirral, this includes desktop computers, computers on wheels and iPads.

A work in progress

Dr Hughes emphasises he and his colleagues worked closely with Cerner to tailor the solution to the trust. "When they first showed it to us, there were a few things which didn't work with the way we were running things. But we sat down and hammered a lot of those things out, and changed it to something that would work for us — we had several build sessions."

That work continues. While Dr Hughes argues SIRS remains a valuable way of screening for potential cases, "sepsis is a lot more complicated than just a SIRS response".

This is reflected by updated definitions published earlier this year by The Society of Critical Care Medicine (SCCM) and the European Society of Intensive Care Medicine (ESICM), which do not include SIRS.

Instead, the focus is placed on a 'quick' version of the Sequential Organ Failure Assessment (qSOFA). There have already been conversations about adding this to Wirral's version of St. John's Sepsis Agent.

"We currently have an early warning alerting system based on SIRS, but we're looking to develop some additional arms as we develop the system.

"We should be able to add qSOFA alongside SIRS and our MEWS [modified early warning score] and NEWS [national early warning score]. And the UK Sepsis Trust also have 'red flags' which are now outside the international definitions but which I think are a very useful to screening potential sepsis patients."

"I can see the benefits, and I think this could be a really, really good system" says Dr Hughes. "We're still developing it, driving this forward."

