

Nobody wants to talk about catheters—our silence could prove fatal

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The ward nurse wanted to be reassuring. "Your mother's got a bit of an infection and we've popped her into intensive care," she told Sarah Wilkins. (Some names have been changed.)

The update on Judy Jones, 68, was unexpected. She was recovering from surgery, having fractured her hip when she tripped on uneven pavement in the summer of 2015. "Mum was recovering slowly but steadily. Then out of the blue I got this phone call from the ward. It frightened the daylights out of me."

Sarah's fears were justified. Her mum, a retired teacher from Greater Manchester, UK, had sepsis, a life-threatening response to an infection that was spreading through her body, despite being given intravenous antibiotics.

Judy is one of hundreds of millions of people worldwide who develop a hospital-acquired infection every year. In her case, the cause, says Sarah, was a urinary catheter, also known as a Foley catheter. This is a hollow flexible tube inserted into the bladder via the urethra and held in

place over time by a small balloon.

Worldwide every year millions of these devices are used to empty the bladder when patients aren't able to do so themselves. One in five hospital patients in the UK and the USA has a catheter in place at any given time (the proportion is much higher in intensive care units). And despite their routine use, they come with risks.

As detailed in NHS guidelines, the most common healthcare-acquired infections are [urinary tract infections](#) (UTIs), half of which are associated with catheters. The risk of infection is linked to a number of things, including how a patient is catheterised and for how long.

Around a third of people catheterised will develop [bacteria](#) in their urine after two to ten days, and a quarter will develop symptoms of a catheter-associated UTI (CAUTI). A small percentage of these patients will go on to develop life-threatening secondary infections, such as sepsis.

There are other possible complications. In older people, for example, CAUTIs can contribute to falls and delirium.

NHS England estimates that CAUTIs have significant associated costs due to the additional bed days and treatments they necessitate, costing the NHS up to £99 million each year, or £1,968 per episode. The NHS's guidance goes on:

"Patients are often catheterised in ways which could have been avoided through good continence care. Nearly one third of urinary catheter-days are inappropriate in medical and surgical inpatients with 26 percent of catheters inserted in Accident and Emergency having no appropriate indication, suggestive that many catheters are inserted unnecessarily."

In an average-sized hospital in the UK, it's

estimated that up to 15 patients die each year from catheter-related sepsis. In Judy's case, the catheter had probably been in place for just five days when the sepsis developed.

"When she got out of surgery, she already had the catheter," Sarah says. "And she blew up when I asked her about it. It was her business and I wasn't to interfere."

"So there it was under the blankets. And I'm afraid it was a case of out of sight and out of mind. The nurse didn't mention it to me and the doctor certainly didn't. There was so much to worry about. It never occurred to me that the biggest risk to her health was the catheter."

My hairdresser was horrified when I told her what I'm writing about. Her head swung round almost full circle – as though her first thought was whether she'd get into trouble for having a client with such unsavoury interests.

It's not an unusual reaction to urinary catheterisation. People express their disgust out loud or make a face that says as much. Judy Jones, it seems, is not alone in wanting to keep her catheter under wraps. This response itself is a major health hazard, according to Milisa Manojlovich, a professor at the University of Michigan's School of Nursing and a researcher specialising in communication between doctors and nurses.

"There's a hierarchy of diseases, and catheter-associated urinary infections are at the bottom," she says. "It's not sexy and it doesn't get followers on Twitter."

"We know that it's a subject that people avoid talking about – not just patients, but doctors and nurses as well. And that's dangerous."

Manojlovich is a member of CatheterOut, a group of clinicians and scientists based at the university and the VA (Veterans Affairs) Ann Arbor Healthcare System who are committed to raising awareness of the risk of using catheters inappropriately.

"The fact is that catheter-associated UTIs are a

common and costly problem but many hospitals are still not routinely using practices that are proven to prevent them," says Sanjay Saint, the University of Michigan's George Dock Professor of Internal Medicine, Chief of Medicine at the VA Ann Arbor Healthcare System and the leader of CatheterOut.

New research shows that the non-infectious complications of urinary catheters are even more common. Overall, Saint says, they are five times as common as infectious complications, with 57 per cent of patients reporting at least one complication due to the device.

These include pain, discomfort, bleeding and bladder spasms during the insertion of the catheter and while it is in place. More than a third of patients reported that their catheter restricted 'daily living.'

There's no question of getting rid of catheters altogether, however. They will always be needed should the bladder be unable to contract and fully empty on its own. That said, a lot of catheter use is avoidable – most commonly when the catheter is used in place of a bedpan or to make incontinence easier for staff to manage, or because it was inserted during an operation and then left in afterwards.

For more than ten years, the CatheterOut group has campaigned to ensure that the use of every indwelling catheter is justified, to prevent painful and potentially life-threatening consequences of UTIs.

"We started by looking at every patient to see if they had a Foley," says Stacy Sivils, now Quality Improvement Coordinator at the VA Ann Arbor Healthcare System, recalling her work as a nurse champion with the CatheterOut campaign back in 2010.

"We literally pulled up the covers. And then spoke with each nurse," she says.

"You can't say, 'I am an expert.' You have to be very eloquent. 'Let me show you. Let's talk,'" she says. "That's how you get buy-in. Then I can have those critical conversations."

According to Lona Mody, Amanda Sanford Hickey Professor of Internal Medicine at the University of Michigan and VA Ann Arbor Healthcare System, it's a matter of changing others' beliefs. "People think, "Oh it's just a catheter." You have got to change that," she says.

And change is happening, albeit slowly. National policies have been somewhat effective. In 2008, Medicare, the US national health insurance programme for over-65s and disabled people, stopped reimbursing hospitals for any treatment that was needed as a result of a CAUTI and seven other hospital-acquired infections.

But further research suggests that such measures work best when they reinforce a local initiative to introduce preventive practices, such as the University of Michigan's CatheterOut campaign. A study found a 25 per cent reduction in CAUTIs in Michigan hospitals in the year 2009/10 – compared to a 6 per cent reduction in the rest of the USA.

In the UK, progress has been slower, but things are going in the right direction. Central to this success are people like Gill Davey, Continence Service Manager at the Dudley Group NHS Foundation Trust in the West Midlands, who has been helping people use catheters safely for 21 years.

"I understand why people shy away from urinary catheters," she says. "My job is to allay their fears so that they can live independent lives, not always have to think around the toilet."

She says that of the 1,200 people with catheters living in the Dudley area, a large number had the devices put in place while they were in hospital.

"When people are discharged," Davey says, "no one knows how long the catheter should stay in – not the GP, community nurse, district nurse, continence adviser. It's been the same all over the country, with hundreds – perhaps thousands – of people living at home with catheters that are not actually needed."

It's a factor that may have contributed to the high rate of patients requiring emergency admission to hospital with a CAUTI.

A game-changer in the last few years has been a growing number of trusts introducing patient-held "catheter passports," to give patients help managing their catheters and healthcare professionals a means to monitor their use, ultimately to reduce CAUTIs.

"It's a small book but should have a major impact on reducing overuse of catheters and catheter-associated UTIs," says Davey. Despite it being around a topic that many of us would rather ignore, Davey tells me that she loves her job. "It makes such a difference to people's lives."

"The surface [of a catheter] is a perfect breeding ground for microbes," says consultant microbiologist David Partridge, Research Lead for the Directorate of Laboratory Medicine at Sheffield Teaching Hospitals NHS Foundation Trust. Bacteria can gather on the surface and form tight-knit communities known as biofilms – "slime cities" that help protect them from the immune system and antibiotics.

Biofilms can be harmless. We're all covered in them. But they do provide a reservoir from which bacteria can escape and cause infection elsewhere. For example, if bacteria from biofilms on a catheter pass into a person's urine and then enter the bladder or kidneys, this can lead to a UTI.

For CAUTIs, doctors tend to administer antibiotics. Sometimes, though, these antibiotics just don't work. This is because, over the decades, the bacteria that cause UTIs have evolved increasing resistance to medications that used to be effective.

This resistance could prove to be deadly. The 2014 O'Neill Review estimated that a continued rise would lead to 10 million people dying from drug-resistant infections per year by 2050.

"Diagnosis is more difficult with a catheter," says Partridge. This is because you don't get the main symptoms of a urinary infection – burning when you pee and urinating frequently.

Doctors sometimes err on the side of caution, assuming, for instance, that when urine samples from a catheter grow bacteria that there is an

infection, even though the culture result may simply represent bacterial colonisation of the catheter. "There's an awful lot of unnecessary use of antibiotics," says Partridge.

Every time bacteria are exposed to antibiotics, they have the opportunity to develop resistance. An analysis of more than a million UTI samples by Public Health England, carried out in 2016, showed that one in three infections is caused by bacteria that are resistant to at least one major antibiotic.

Some infections are caused by bacteria that have acquired resistance to almost all available antibiotics. When these occur they are very difficult to treat.

"In Sheffield, we've been able to manage every case either by cobbling together several different antibiotics or using older types of medication that have fallen out of favour because of unwanted side-effects," says Partridge.

However, the problem is growing. "We've massively underestimated the flexibility and evolutionary intelligence of bacteria and the way that they can share the resistance mechanisms, especially in hospitals," he says.

Certainly, new antibiotics are hard to come by. The latest addition, plazomicin (brand name ZEMDRI), was approved in June 2018 by the US Food and Drug Administration.

The use of the drug will be deliberately limited so that bacteria don't develop resistance to it. It will be held back as a last-resort treatment for patients with complicated and life-threatening UTIs.

"Unfortunately, the current business model for the pharmaceutical industry makes it very difficult to finance new antibiotics, which are designed to be used as rarely as possible for as short a time as possible," says Partridge.

"It makes more financial sense to develop new drugs that will be widely used for decades, for instance heart or diabetes drugs – even though the need for new antibiotics is huge."

But do non-specialists appreciate the seriousness – and urgency – of the problems caused by antibiotic resistance? Does the average patient, relative or carer know that it could make routine surgery, cancer treatment or even catheter use more and more risky?

Sarah Wilkins does – now. "You'd never in a million years have guessed that there was any risk at all," she says. "OK, my mum needed a catheter after the operation. The only problem was that it almost certainly gave her sepsis and that nearly killed her."

It was 2004 and materials scientist Professor Morgan Alexander was in the first year of his dream job, researching materials for healthcare applications at the University of Nottingham.

Using a system developed by researchers from the Massachusetts Institute of Technology, Alexander and his team were testing large libraries of combinations of monomers (the constituent units of plastics, which are polymers) to look for materials that stem cells would stick to.

"We'd found a polymer that did the job," says Alexander, who then began to wonder how else this discovery could be put to use.

He recalls having a eureka moment as he walked back to his laboratory with a colleague after lunch. "I was racking my brains to find another use for the materials discovery system. I said, "Instead of identifying materials that things stick to, what if we could find a biomaterial to which things don't stick...?"

This is where the concept of controlling bacterial biofilms came from. Then, his colleague made a suggestion that cemented the change of course of Alexander's work. "He said, "Well, if you need a microbiologist, Paul Williams is working right here.""

For many years, in the very building next door to Alexander, microbiologist Professor Paul Williams had been working on how bacteria communicate. His team's breakthrough discovery came in the late 1980s, while working on the development of [new antibiotics](#). They found that bacteria can talk to each other using signal molecules, synchronising

themselves and behaving as a group rather than as single cells – something now called 'quorum sensing.'

Subsequently, they discovered that quorum sensing is also used by pathogenic bacteria to cause infection, opening up an intriguing idea: what if it was possible to stop infections by blocking bacteria's ability to communicate, rather than by killing them with antibiotics?

Knowing that quorum sensing is also involved in the building of biofilms, the pair met, and Alexander soon convinced Williams to get involved in hunting for biofilm-resistant polymers that bacteria could not stick to. They decided to focus on coatings for [urinary catheters](#).

Antimicrobial coatings for catheters, including those containing silver, were already on the market. However, not all of the claims made about their cost-effectiveness and efficacy have stood up to scrutiny.

A 2014 Cochrane Review of 26 trials involving over 40,000 patients found that silver alloy-coated [catheters](#) "were not associated with a statistically significant reduction in symptomatic catheter-associated urinary tract infections (CAUTIs), and are considerably more expensive."

Catheters coated with antimicrobial chemicals didn't fare much better. The review says that these may "reduce both the number of bacteria in the urine as well as the number of people having CAUTIs caused by the presence of the catheter. However, the evidence is relatively weak, and any benefit is likely to be small and hence unlikely to be meaningful to either patients or clinicians."

What's more, antimicrobial chemicals – including antibiotics – can make the situation worse. "When you try to kill bacteria, you force them to evolve," says Williams. "The way bacteria become resistant is that they either mutate or acquire new genes, and excessive use of antibiotics leads to resistance."

It's here that the new coating would have a massive advantage: it wouldn't attempt to kill the bacteria,

but instead would stop biofilms forming in the first place.

And the plan appears to be working. Over a period of four years, the researchers tested more than 20,000 combinations of polymers and bacterial pathogens.

The breakthrough came when they found that bacteria could distinguish between different surfaces. They then discovered materials that showed up to a 30-fold (96.7 per cent) reduction in the surface area covered by bacteria compared to a commercial silver-containing surface.

They conclude that there is something about the closely related chemistry of these materials that means the bacteria can't or won't attach to them.

The next step was to investigate what it is about the bacteria that means they don't stick to and form biofilms on certain polymers. One method they're using to explore this is to try and make the bacteria evolve over time so that they become able to make biofilms on the polymers they previously rejected.

"Antimicrobial coatings often work well for a limited time until the bacteria develop resistance," says Williams. "We hoped to show that this does not occur with our new polymers. The good news is that it hasn't happened yet."

A urinary catheter coating made from one of these polymers now has a CE (Conformité Européenne) marking from the European Commission, which means that it is a marketable healthcare product. The entire development process cost around £3 million, a "ridiculously small sum compared to the billions needed to produce a new drug," says Williams. And miniscule compared to the worldwide cost of treating CAUTIs.

A trial, set to involve six hospitals and around 250 patients, is currently testing the ability of the coating to prevent infections in the human body. Preliminary findings indicate that the coating does, in fact, suppress biofilm formation.

Once this trial is complete, a larger one will be needed to demonstrate the impact on infection and

hospital costs.

While Judy Jones survived sepsis, with antimicrobial resistance on the rise, not everyone will be that lucky. "It's quite plausible that within decades the majority of [patients](#) with sepsis will be very difficult to treat," says Ron Daniels, a consultant in critical care at the Heart of England NHS Foundation Trust in Birmingham and Chief Executive of the Sepsis Trust.

The infection, on top of the surgery, has taken its toll on Judy. She is now virtually bed-bound and has a catheter permanently in place. "We made the decision that she would go into a nursing home to get proper care," says Sarah.

Sarah's biggest regret is not challenging her mother or the medical team about the catheter. "I look at my mum sometimes and just wish I'd said something."

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