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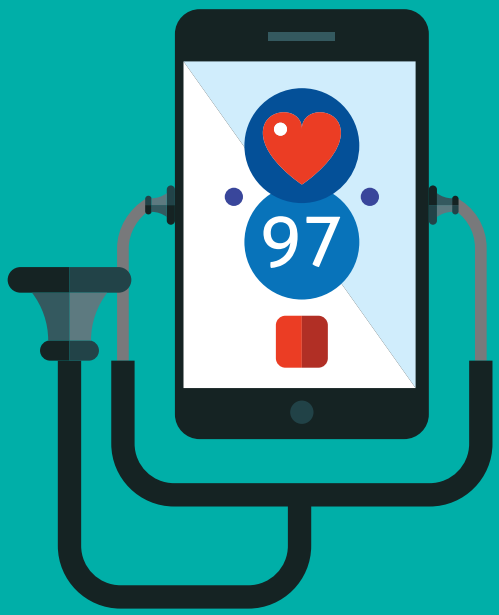
Smart Infrastructure: Improving healthcare

How emerging technologies could transform the management of long-term health conditions, improving patient outcomes whilst relieving the pressure on the NHS



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The Smart Infrastructure series

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Infrastructure is all around us and ever-present in our lives: think of schools, roads, hospitals, power stations, telecommunications networks and sports facilities, to name but a few. Picture these in your mind and they are all quite, shall we say, solid. Made of bricks and concrete and steel and glass. Infrastructure is robust and long-lasting and inflexible. Until now.

In recent years, sectors such as communications and the media have been transformed by digital technologies; now infrastructure is in the foothills of its own technological revolution. And with that revolution comes a transformation in how infrastructure serves us, becoming more agile and responsive and clever

By gathering, analysing and sharing new forms of data, we can improve and adapt decision-making in real time. By embracing the application of new technologies – such as driverless cars, smart electricity grids and adaptable buildings – we can drive up efficiency and realise new opportunities. And by building new data management systems and more flexible assets, we can improve collaboration and responsiveness – providing benefits for customers, managers and public agencies alike.

To help envision and promote that future, KPMG have conducted a series of thought experiments – considering how we could use new technologies in infrastructure development, maintenance and operation to improve our lives, reduce costs, and create economic growth.

We imposed only a handful of rules on these workshops. All of our ideas had to be built around existing and emerging technologies; we've set our scenarios just a few years in the future. They had to have clear benefits for investors and managers as well as customers and public policy goals. And they had to be realistic and deliverable, addressing the potential concerns and challenges around matters such as privacy, security and governance.

Within those constraints, we've tried to step outside conventional thinking and test out new ideas. We want to stretch ourselves, applying new technologies and techniques to solve old problems. We want to think about how the world is changing, and how to stay ahead of that change. And then we want to bring that thinking back into today's world – mapping out the practical steps towards building a truly smart infrastructure.

Smart meters | Medical wearable technology | Ambulance | Real time data | Test = SMART Infrastructure.

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Introduction

Prevention is always better than cure – and smart infrastructure could help predict and avert medical emergencies, reducing the pressure on both patients and health systems

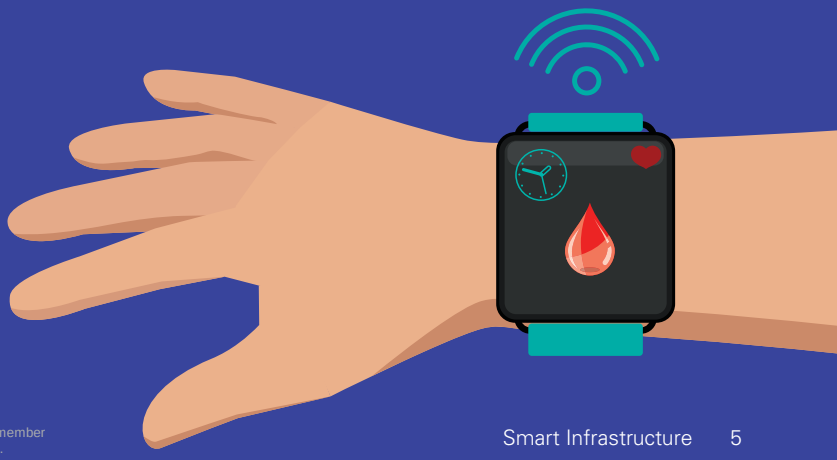
In the modern age, our healthcare systems are advanced and powerful – but they're not always smart.

Our medical services respond rapidly to emergencies, deal with complex clinical problems, and efficiently manage individual illnesses. But as our population ages and the incidence of chronic disease grows, demand rises inexorably and costs follow, putting strain on our health and care systems.

In the long term, the solution will be a healthier population with fewer chronic conditions; and recent years have seen growing emphasis on improving public health. But the same dynamic applies to each individual diagnosed with a chronic disease: if we can closely monitor people's conditions and intervene before a decline turns into a collapse, we can minimise the need for emergency hospital care – producing benefits for patients, health providers and the taxpayer alike. And one way to produce such smart healthcare is to realise the potential of smart infrastructure.

By gathering new streams of real-time data, building connections between asset owners and service providers, and applying digital analytics techniques, we can create a far more sensitive and responsive infrastructure. This would enable us to identify latent deteriorations, heading them off before they turn into emergencies. And when that fails and an ambulance is required, then the same data-streams and organisational connections would support a faster and more effective response – improving patient outcomes and saving medics' time.

The picture is an attractive one – but set out in general terms, it sounds unavoidably woolly. So let's consider how this kind of an approach might work in a specific situation: let's say an elderly gentleman with Type 2 diabetes, living alone at home and at some distance from close family. We'll call him Mr Jones.



Looking after Mr Jones: A Smart Infrastructure scenario

How digital technologies can help avert medical emergencies – and improve the response when they do occur

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1 With a smart meter installed in his home, Mr Jones's electricity and gas usage can be monitored in real time. And over weeks and months, analytics software can 'learn' his usual patterns of energy use – then alert friends and family if a change suggests that he may be at risk.

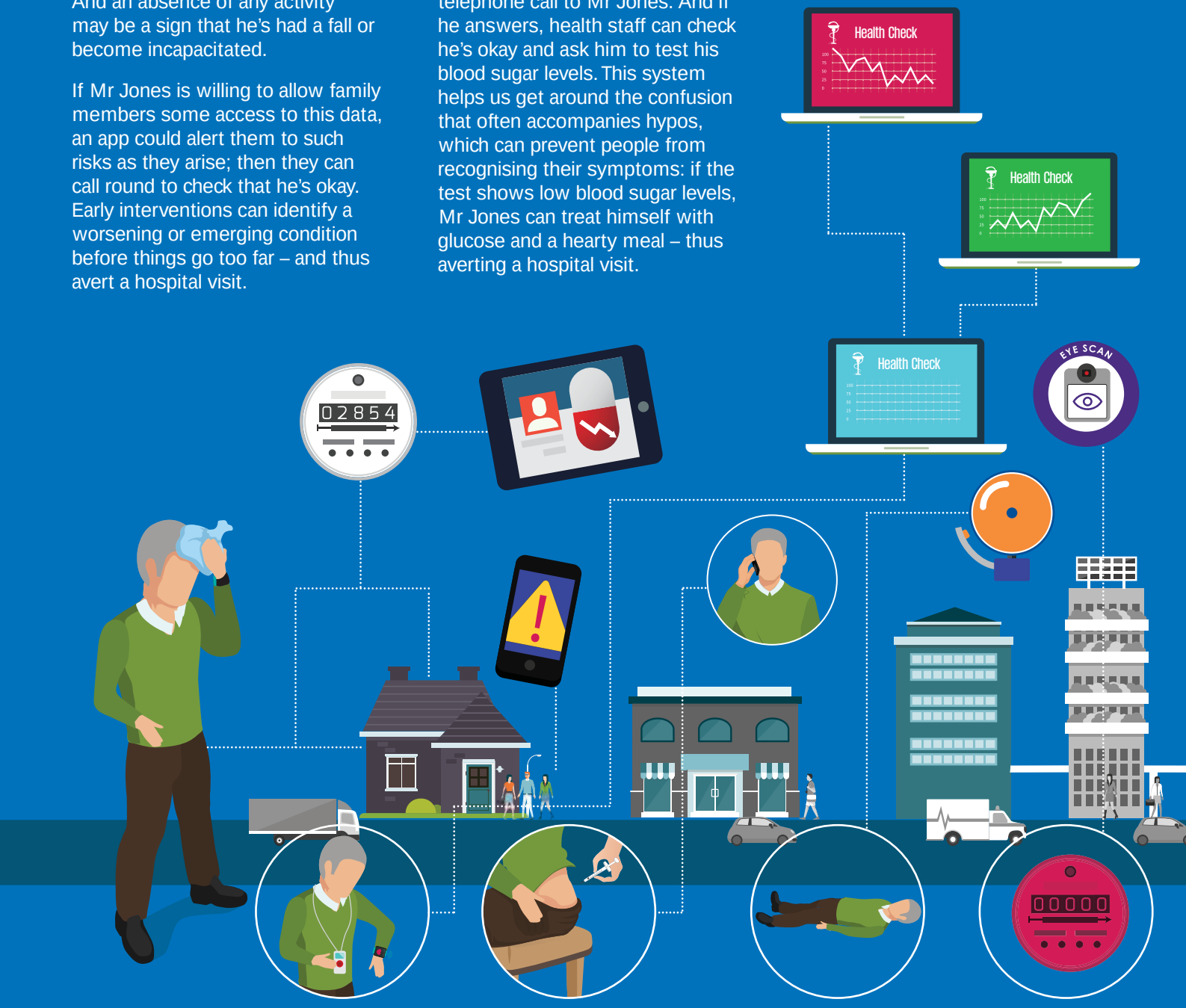
For example, a gradual rise in power use – and consistent use of power throughout the day and evening – could suggest that he's getting out less, raising the possibility that he's losing mobility or becoming depressed; a reduction in his movement around the house might be another sign of low energy or motivation. Alternatively, spikes in power use in the middle of the night may indicate insomnia or discomfort. And an absence of any activity may be a sign that he's had a fall or become incapacitated.

If Mr Jones is willing to allow family members some access to this data, an app could alert them to such risks as they arise; then they can call round to check that he's okay. Early interventions can identify a worsening or emerging condition before things go too far – and thus avert a hospital visit.

2 The greatest short-term risk facing diabetes patients is the threat of hypoglycaemia – low blood sugar levels – which, untreated, can lead to impaired judgement, seizures and even coma. Mr Jones carries a pendant alarm linked to a 24-hour monitoring line; but hypoglycaemia can leave people too disorientated to trigger an alarm. So his house has been fitted with pressure and motion sensors, and he wears a medical device that monitors his position, temperature and movement: bringing together the data from these sources, Mr Jones's health software can detect a fall, a stagger, or even changes in his gait that signify an oncoming 'hypo'.

An alert is then sent to the monitoring line, prompting a telephone call to Mr Jones. And if he answers, health staff can check he's okay and ask him to test his blood sugar levels. This system helps us get around the confusion that often accompanies hypos, which can prevent people from recognising their symptoms: if the test shows low blood sugar levels, Mr Jones can treat himself with glucose and a hearty meal – thus averting a hospital visit.

3 If Mr Jones doesn't answer the phone, however, someone will need to check on him; and asking a neighbour to do so may produce the fastest response time – whilst saving NHS resources for known emergencies. So the monitoring staff alerts the neighbour and, five minutes later, they ring the doorbell: maybe Mr Jones simply didn't hear the phone. If he answers the door, the neighbour can find out whether it's a false alert, help him test his blood sugar and, if required, supply him with some glucose.



4 And if he doesn't answer the door? Health staff are getting worried now: they remotely trigger an alarm in the house, just in case he's simply sleeping, and shut off the gas supply via the smart meter – eliminating any risk from abandoned cooking pans. Then the neighbour permits a retina-scanner to verify their identity, and the front door is unlocked. Entering the house, they can find out whether this is a false alarm, a hypo that's left Mr Jones conscious but incapacitated, or a real medical emergency. Once again, in the first two cases, the need for hospital treatment can be averted: he'll need help from a family member or social care provider to get over a nasty hypo, but there's no requirement for a race to A&E and an admission.

5 So we've had four chances to take the pressure off hospital emergency services. But if Mr Jones is found unconscious, we need professional medics on-site quickly – and smart infrastructure can help here, too.

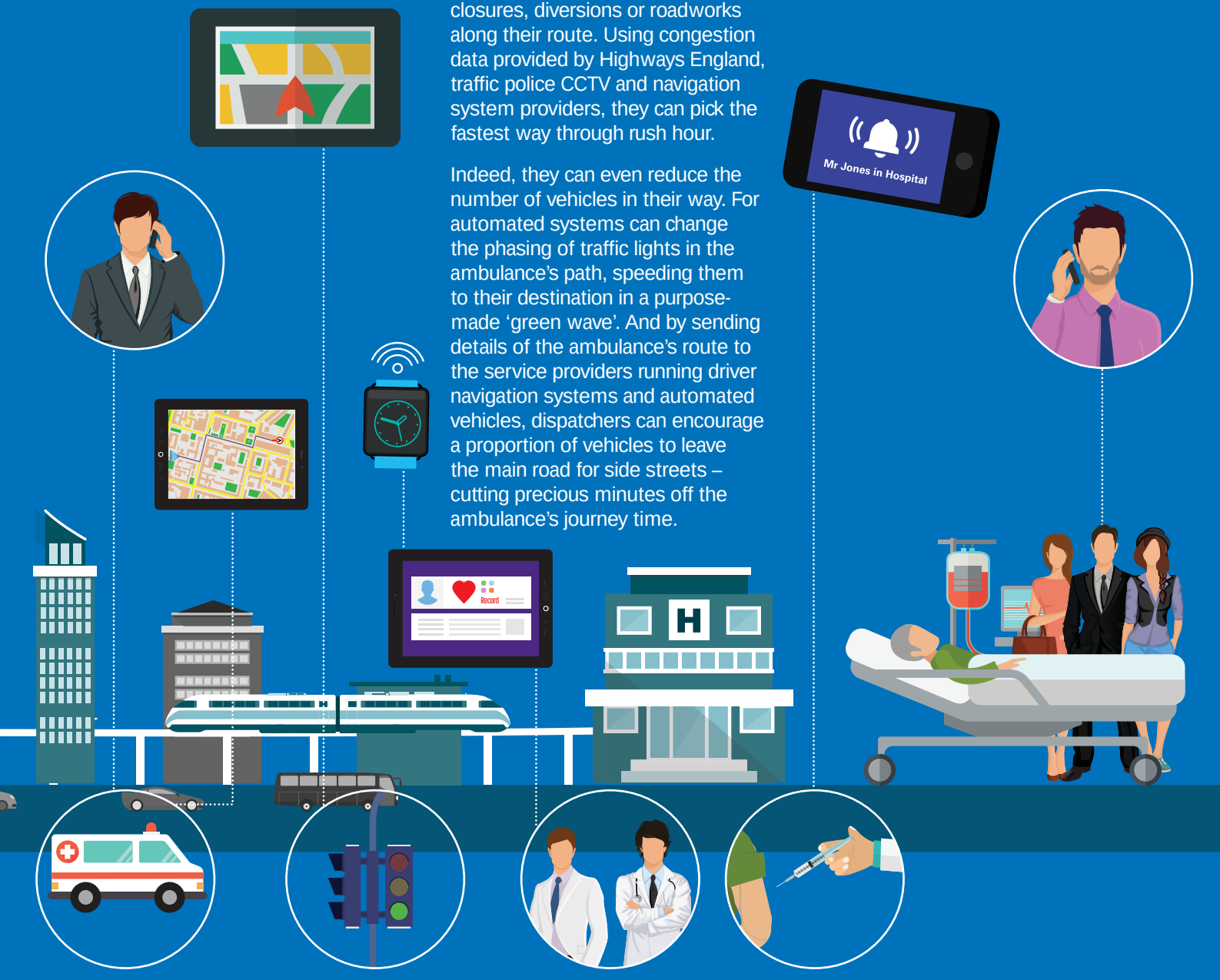
Brought up to speed by the neighbour, the monitoring staff call for an ambulance. Now the priority is to get through traffic to the correct address as fast as possible; so the ambulance team call on another set of infrastructure data streams and connections.

Rather than using address and postcode data – which can be misleading – the ambulance team use Ordnance Survey map data, which is more accurate and updated in real time to recognise new buildings, road layout alterations and other changes. Through an overlaid data feed, they're alerted to any road closures, diversions or roadworks along their route. Using congestion data provided by Highways England, traffic police CCTV and navigation system providers, they can pick the fastest way through rush hour.

Indeed, they can even reduce the number of vehicles in their way. For automated systems can change the phasing of traffic lights in the ambulance's path, speeding them to their destination in a purpose-made 'green wave'. And by sending details of the ambulance's route to the service providers running driver navigation systems and automated vehicles, dispatchers can encourage a proportion of vehicles to leave the main road for side streets – cutting precious minutes off the ambulance's journey time.

6 By the time the ambulance crew arrive, they're fully briefed on Mr Jones's condition: they've just read his digital health records, shared with them by central managers. The hospital have also been informed of their anticipated arrival time, the patient's existing conditions and his various prescriptions.

The crew test Mr Jones's blood sugar and give him a glucagon injection, but they want to get him into hospital for further tests. As they update his notes during the drive, the hospital receives the information in real time; meanwhile an alert goes out to his GP, his social care manager, and key family members. One of his sons calls the hospital – and by the time Mr Jones has been treated and moved to a ward, his son is there to reassure and comfort him.



Final thoughts

In our scenario, smart infrastructure greatly improves Mr Jones's hospital visit – speeding his ambulance journeys, and informing and preparing his medical teams. But the greatest power of these technologies lies in minimising the need for hospital visits in the first place. In the early steps of this scenario, digital technologies and inter-organisational linkages provide ways to prevent threats turning into emergencies; to emphasise checks, rather than reactions; to preserve hard-pressed medics and hospital wards for those most in need. And everyone benefits from this approach; for when Mr Jones really does need emergency treatment, he'll find that systems have the capacity to cope.

None of these technologies are science fiction. In Britain, 'telecare' systems already monitor patients' health in the home. In Singapore, smart traffic lights turn green when ambulances approach. Self-driving cars are coming down the road. And, of course, around the world people keep an eye on their elderly neighbours. Our scenario simply illustrates how connecting together new and emerging data systems, building links between organisations, and applying analytics techniques could combine the power of many different changes – vastly amplifying the potential benefits.

This is clever stuff. In fact, it's something better still – for clever systems can lead to ever-bigger challenges, as we've seen in health. So it's clever; but more importantly, it's smart.

We think the technology is ready; we think the benefits are huge; we think it's time to act. Let's create a smart infrastructure.

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Thishi is a qualified doctor with 4 years clinical experience working in a variety of health care settings including acute care, general medicine, surgery, general practice and rehabilitation.

He joined KPMG in November 2012 and has since completed a number of projects including cost improvement projects, quality and clinical governance due diligence and an international project on service design.

Prior to joining KPMG, Thishi worked on a consultancy project for Beacon UK, a mental health company focused on patient pathway integration.

He has also gained experience in Business Intelligence at Guy's and St.Thomas' NHS Foundation Trust, a large (£1bn) trust in London.

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