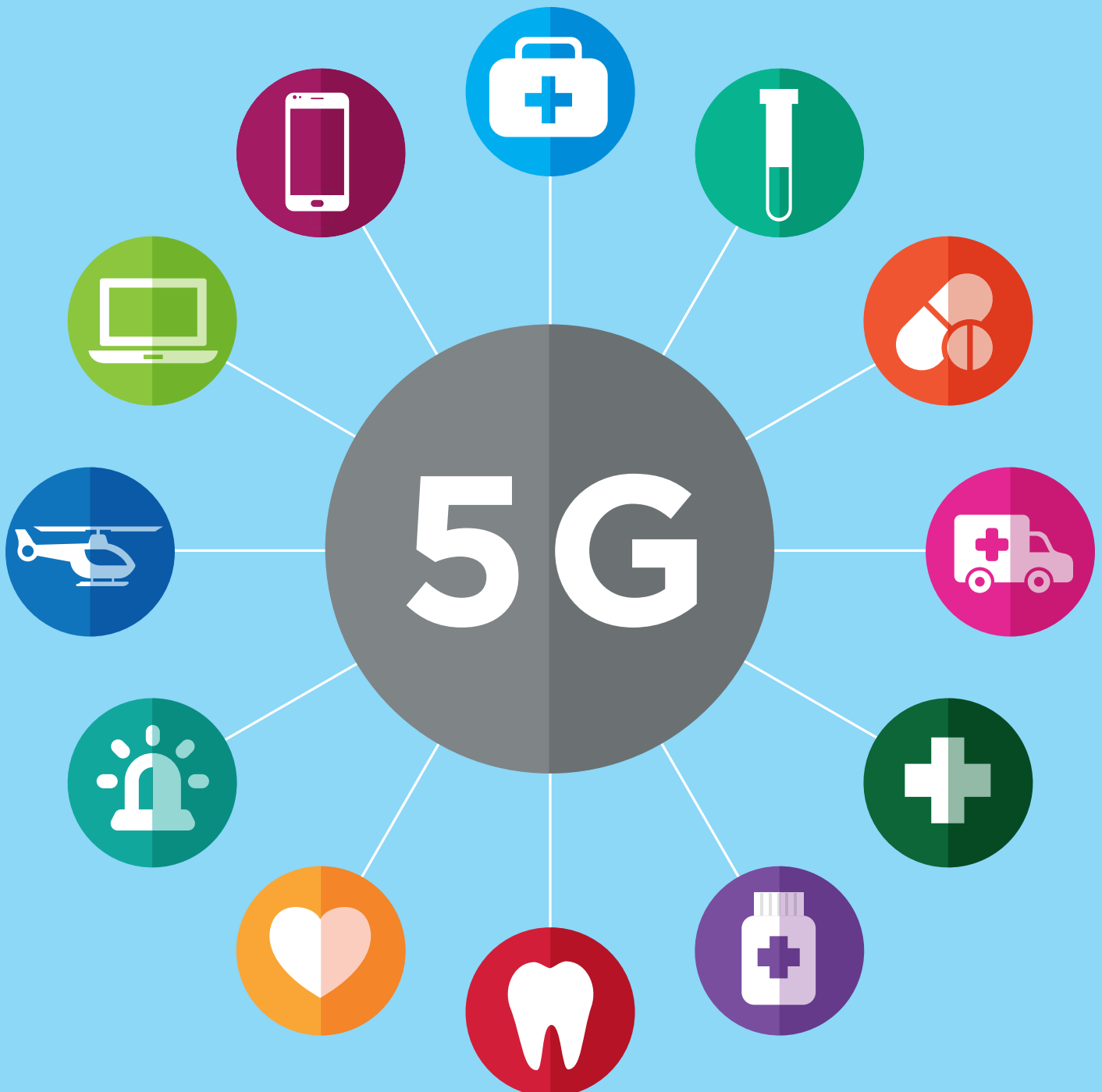# How can 5G support the transformation of health and social care services?

A joint report between techUK and the
Liverpool 5G Testbed | July 2019

Contents

Foreword

5G and the power of transformation

Technology is revolutionising the way we do business, manufacture, educate, feed ourselves, and stay well. 5G has the potential to become the driving force behind new and emerging innovations; sweeping in changes that can improve the way we live.

There are many unique properties that make 5G the perfect technology to usher in change. 5G is the perfect technology to support the plethora of every-day innovations – gadgets, devices and applications, known as the Internet of Things (IoT) – that are driving efficiency and improvement across all industries and sectors.

Our current options appear incapable under the growing weight of IoT innovations. 5G's millimetre wave spectrum offers increased bandwidth for new technologies, lower latency, transfers larger amounts of data, and is nearly 100 per cent reliable.

The Health and Social Care Sector could be one of the first to benefit from 5G technology. In a post analogue world, with an aging population, health and social care professionals increasingly rely on applications that support patients managing long-term illnesses at home.

For those facing more acute illnesses in a hospital setting, 5G supported machine-to-machine devices can also revolutionise techniques like robotic surgery. 5G supported applications already provide pain distraction therapy at The Royal Liverpool and Broadgreen University Hospital Trust.

Other sectors will benefit too. We will see connected trains and smarter road networks that offer drivers information about congestion and air quality, enabling them to choose routes that are less environmentally impactful. Connected emergency vehicles could locate crash sites faster, saving lives.

Manufacturing and agriculture will benefit from targeted innovations using Artificial Intelligence (AI) and machine learning, which will be able to drive productivity whilst reducing waste/environmental impact. This is an exciting time to be involved with emerging technologies and 5G is at the forefront of these possibilities.

How has 5G technology impacted on the work that Liverpool Health and Social Care is able to deliver?

Liverpool 5G Health and Social Care is celebrating a successful first year of innovation, which has been reflected in the announcement of a 12 month project extension and additional £1.48 million in funding (six months funding from the government and an additional six months funded by partners).

By 2022, it is expected that analogue services will be switched off, which means Liverpool City Council must find affordable and future-fit technologies to replace current telehealth services. 5G technology offers tangible solutions that have the potential to exceed the status quo by providing more reliable, agile, responsive, and targeted solutions; digitalised health and social care services that can be scaled up affordably.

Liverpool 5G Health and Social Care's goal is to provide affordable 5G connectivity to digitally deprived communities. This would help keep people healthier for longer, creating opportunities that are available to everyone, regardless of income or location. Liverpool 5G will continue to work towards realising the benefits of these possibilities.

In the past 12 months, we have also learned important lessons about creating a 5G network in a dense urban environment.

Our innovative 'digital twin' of Kensington (an online visualisation of the area), designed by CGA simulation, has enabled us to find the perfect 'lines of sight', needed to place the 5G nodes for our network. We can do this online and can see the exact location of trees, buildings and other obstructions, which means we can avoid them entirely and plan our equipment around them, without disrupting the surrounding environment.

The usability, accessibility and the desirability of any products being used in the project is very important to us and we will continue to assess the usefulness of any products we are using. The creation of the Adoption Readiness Level (ARL) policy has given us a better understanding of how useful and easily adopted our technologies have been for those using them. The policy ensures that we continue to create technologies that respond to a need within the sector.

We look forward to the next 12 months of Liverpool 5G Health and Social Care, to building our 5G network and the eco-system we need to ensure our products are easily adopted and sustainable.

For more information on the Liverpool 5G Testbed visit http://liverpool5g.org.uk/ or on Twitter @Liverpool5G

Rosemary Kay, Project Director, Liverpool 5G Testbed

Background

The adoption of digital tools in the health and social care sector has increased rapidly in recent years, from patient-facing apps, to communication tools for clinicians and social workers. Digital connectivity is an essential, though often overlooked, pre-requisite to realising the full benefits of these tools, and awareness of how improved connectivity can help transform this sector remains low.

Like the health services of all developed countries, the NHS is facing multiple pressures that undermine the sustainability of the service in its current form. In 2019, there are more than three million people aged over 80 years old living in the UK. By 2030, this figure is projected to almost double, and by 2050 reach eight million.[1]

The ageing population is a major factor. We are living longer lives because of medical advances, better drugs, healthier lifestyles, and safer workplaces. A girl born in the UK today has a one in three chance of living to 100, and the chance of living to 100 will double in the next 50 years.[2] This is certainly something to celebrate. Infectious diseases are no longer a significant threat. Heart attacks do not claim the lives of people early in the same numbers. Even cancer is not the death sentence it once was - half of people now survive for a decade or more.

But the prospect of longer lives will create new demands for new care technologies, products and services. People are living with a growing number of long-term chronic conditions such as diabetes, heart disease and dementia. These are more about care than cure - what patients usually need is support. By the age of 65, most people will have at least one of these illnesses. By 75 they will have two and therefore the demand for health services will increase to help patients with the care of these conditions.

However, a revolution is underway - one which will fundamentally change how citizens' well-being is managed and the sense of control they have over outcomes. This must happen without breaking budgets.

Technology is the catalyst in the rebalancing of investment from cure to prevention; from health to social care; and from professional locations to wherever is convenient for the public. The healthcare technology revolution comprises both medical grade devices, supplied to the public by medical professionals, and consumer products. The former is tested and approved by regulators, but the latter is usually not.

In this revolution, data will be key: getting a consistent series of trustworthy data from patient to professional. Connectivity will be crucial, where 5G will be the latest tool in the box alongside Wi-Fi and previous generations of mobile technology. What 5G offers is fast, secure, reliable, low latency (delay) connectivity, and (for in-home use) removes a reliance on the patient to have broadband (which many with chronic conditions may not have).

techUK, alongside the Liverpool 5G Testbed, convened a roundtable discussion bringing together a mix of innovators, NHS stakeholders, regulators and academics to explore how 5G technology can play a role in transforming the health and social care sector. This roundtable helped to inform this report.
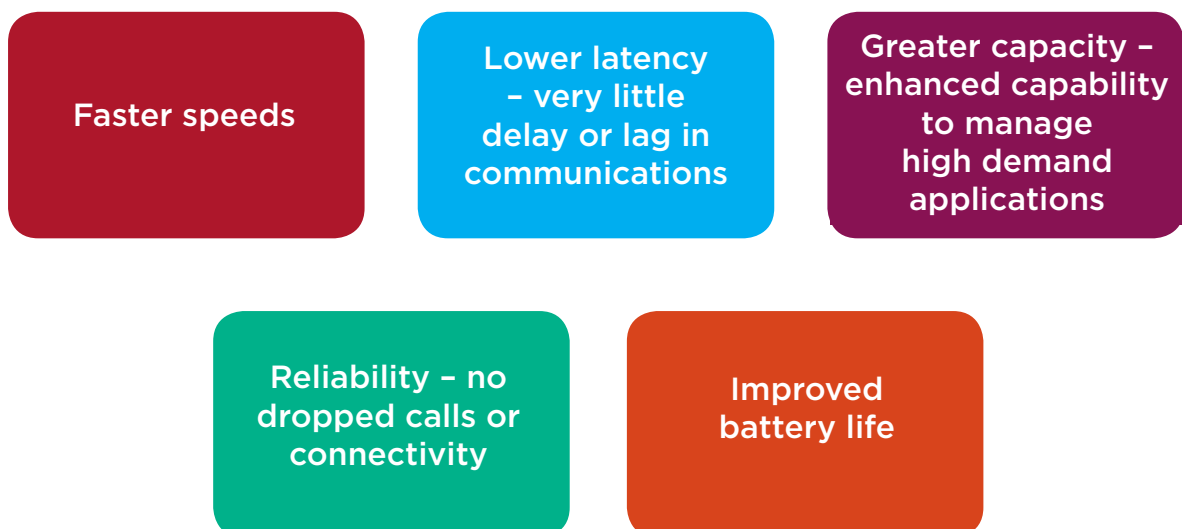
What is 5G?

5G is the term used to refer to the next generation of mobile technology. Previous generations of mobile communications offered video calling, High Definition (HD) streaming services and fast mobile broadband. This technology will offer new capabilities over existing mobile technologies, including higher data rates, lower latency, higher energy efficiency and improved performance.

5G will support multiple applications including mobile broadband to entertainment services and industrial applications such as robotics and logistics. This is with software dynamically changing the characteristics of networks to meet demand; the first type of mobile technology to do so.

This technology will provide huge opportunities to boost productivity, the economy, and enable more innovative uses in both the private and public sectors, such as within healthcare.

5G is currently being launched in a few cities with the expectation of a widespread rollout of 5G systems in the UK from the end of 2019. 5G handsets from a range of manufacturers are just starting to reach consumers.

What will 5G do?

| Faster speeds | Lower latency – very little delay or lag in communications | Greater capacity – enhanced capability to manage high demand applications |

| Reliability – no dropped calls or connectivity | Improved battery life |

Why is 5G so important?

The Government's ambitions for digital connectivity highlight the determination for the UK to be a world leader in 5G. This fifth-generation network will help transform the communications industry, leading new business innovation and opportunities; and allow people and things to interact and connect like never before.

The Government's 5G Strategy sets out the framework and steps to ensure that the UK is a world leader in the development of 5G mobile networks and services and how this network can be applied to different sectors. The Department for Digital, Culture, Media and Sport (DCMS) introduced the 5G Testbeds and Trials Programme in the 5G Strategy as part of over £1 billion of funding announced to boost the UK's digital infrastructure.[4]

The programme aims to stimulate trials involving different potential 5G cases that can address some of society's largest challenges. It will explore the benefits and challenges of deploying 5G technologies in line with the following key objectives:

• To stimulate market development and deployment of 5G technology and infrastructure in the UK

• Create new opportunities for businesses, developing capability and skills, and encouraging inward investment

• Ensure the UK secures an 'early mover advantage' in the investment and development of capability and skills as future 5G products, services and applications evolve

The Government selected six projects in March 2018 which initially were part funded over a 12 month period to test 5G across a range of applications, including in health and social care. These six trials have now secured an extra year of additional funding. The Liverpool 5G Testbed in particular (which has secure an additional £1.48 million funding), has started to use 5G enabled technology to reduce the digital divide, while to measure the impact on patient monitoring and support, and observe the management of loneliness in older adults by using real-time data with faster speeds and lower latency. The technology will also help older people to live independently in their own homes for longer and improve communication between hospitals and the community.

Overall, the health and social care sector is generally seen as a laggard industry in terms of its digital maturity. A large group of Britons do everything from booking a holiday to managing their finances online but their interactions with the health and social care system remain largely analogue. Simultaneously, demand for health and social care services are increasing as our population ages, whilst expectations of what the system can deliver have also grown. This leaves us with a government struggling to meet these demands and an NHS with finite financial and human resources.

This is where digital technology can have a transformational effect.

5G's impact on health and social care services

Personal use

5G is a disruptive technology. It provides a timely opportunity for the health and social care sector to explore innovative new models of service provision that improve quality of life for patients, reduce care costs and create opportunities for digital content and device designers.

5G and the health and social care applications it facilitates have the potential to create capacity within stretched services. For patients this could mean public services that are more responsive. However, to avoid a postcode lottery of provision, connectivity must be made available as widely as possible.

That is why the Liverpool 5G Health and Social Care Testbed, funded as part of DCMS's 5G Testbeds and Trials programme, is providing free 5G connectivity to homes in one of Liverpool's most deprived areas - for people taking part in the 5G pilot and using its health and social care applications. The aim is to see whether this provision of affordable and reliable 5G has a measurably positive impact on the delivery of health and social care services as part of the trial.

Liverpool 5G Health and Social Care Consortium is led by Sensor City and supported by companies which include: Blu Wireless Technology, Safe House, AIMES, Inventya, DefProc, CGA Simulation, eHealth Cluster, Sensor City, Liverpool City Council, Royal Liverpool and Broadgreen University Hospitals NHS Trust, Liverpool University, and Liverpool John Moores University (supported by Liverpool City Region eHealth Cluster). Together they are focusing on how the technologies being trialed are adopted and integrated into health and social care services during the pilot. Technology alone cannot drive change, especially where human health and social care interaction is concerned.

Liverpool 5G has used existing relationships between those developing the technologies and care providers to embed new health and social care technologies more seamlessly. These relationships have been forged through membership of the city's unique Liverpool City Region e-Health Cluster, which was set up to broker relations between health tech developers and public sector organisations using health and social care technologies. This way of working has ensured a better understanding of where the benefits lie for Small and Medium Sized Enterprises (SMEs), patients, professionals, and public sector in adopting and integrating digital technology into services.

In addition, the eHealth Cluster has developed an ARL protocol, to sit alongside Liverpool 5G's Technology Readiness Level policy. ARL is being trialed on the 5G project and adds five new dimensions against which user cases are assessed, prior to being accepted onto the testbed. The five dimensions are market, human, systems and integration, finance and procurement, motivation.

The current use cases explore: the use of sensor technology as a replacement for existing analogue telecare systems; how technology can address loneliness, and remote digital monitoring as a support for existing health and social care services.

Some of the applications, devices and digital content created as part of the Liverpool 5G Health and Social Care Testbed include:

- A pharmacy assistant that helps people take medication safely at home using a live video link to a qualified pharmacist
- Safehouse Sensors that monitor falls and changes in the behaviour of vulnerable people
- A digital loneliness device called 'Push-to-Talk', which connects people to chat by the push of a button and a social gaming app with quizzes, games and chat for people who are isolated

These applications all rely on 5G's durability, speed and increased data transfer to provide a consistent service for patients.

The technologies developed through Liverpool 5G's project reflect a growing trend for telehealth, apps and wearables in health and social care. Our ageing population means more people than ever are living longer with more than one illness that needs treating, placing greater strain on health and social care services and GPs. Home-based digital healthcare products (similar to those mentioned above) can begin to shoulder some of the strain, alongside real-world support.

Downloadable gaming solutions on virtual reality platforms are used as distraction therapy for people with burns or in palliative care wards. Meanwhile, sensor technology can detect falls or unusual behaviours in patients preparing to move back home, whilst at hospital rehabilitation units.

Commercially, the 'worried well' market in personal wearables is growing rapidly too, with over a third of Britons (33 per cent) using a device to monitor their health or exercise.[5]

Wearable devices can combine readings of movement, temperature, pressure, and electric field sensors to monitor the heart rate, brain activity, respiratory rate, and skin temperature. The introduction of 5G to these devices will begin to benefit those with health-monitoring and clinical wearables by facilitating continuous monitoring of patients. 5G will have a greater capacity to gather patient specific data and provides the ability to process, examine and quickly send processed information and recommended courses of action to the patient meaning patients. This means patients will have the capability to manage conditions on their own.

58% agree that wearable devices with feedback and alerts will provide personalised care

62% agree that wearable devices will put people in control of their own health

60% agree that wearable devices will lead to a healthier lifestyle

Source: Ericsson ConsumerLab, from Healthcare to homecare, 2017

Healthcare use

Remote monitoring

5G networks enable new pathways for the delivery of health care. Over 42 per cent of cross-industry decision makers expect 5G to enable devices to consume less power which is key in remote monitoring situations within healthcare.[7] Digital health and social care services, supported by 5G, would bring efficiency and choice for patients and staff. 39 per cent of patients managing multiple conditions say online consultations with doctors would be a welcome choice.[8]

Ofcom states 5G has the capacity to deliver peak speeds of 10 to 20 gigabits per second and the ability to connect one million devices per square kilometre.[9] By being linked with the Internet of Medical Things, a 5G network supporting online consultations could help reduce in-person visits to doctors, whilst also giving staff quicker access to patients data (through cloud based, sharable patient information), emergency helplines, and the ability to transfer patients data to hospitals quickly. Doctors can then rely on connected devices to continually capture, collect, and electronically receive patients medical data (such as vital signs, physical activity, and prescribed medication) that will then be available to them at any time.

Connecting more medical devices with a faster network such as 5G will enable doctors to remotely monitor patients without the need for costly in-patient care. Research shows that this technology could also free up 1.1 million hours for GPs by facilitating telehealth video conferencing and real-time health monitoring.[10]

Remote procedures

Hospitals are seeing the benefits of emerging technologies. Robotic and remote surgeries rely on robust supportive connectivity like 5G to ensure information is received in real-time and connections are not lost at a crucial point. This is whilst using greater bandwidth and prioritising mission-critical functions, such as machine communication which is required for the surgery.

Robotic surgery is already happening today in operating theatres. However, surgeons are predominately in attendance rather than operating remotely. Nearly half (48 per cent) of consumers feel that remote robotic surgery would be acceptable, yet 61 per cent believe such procedures are risky as they rely on the internet.[11]

Such procedures are conducted using tactile feedback and high definition image streaming demanding low-latency, secure, and high throughput communication. Kings College London have also researched and tested in remote robotic surgery that uses 5G technology, demonstrating how the technology allowed a surgeon wearing a haptic glove to operate in real-time with a robotic arm.[12]

The world's first remote robotic surgery using 5G has also been performed. A surgeon in the south-eastern province of Fujian, China performed a successful surgery on a laboratory animal roughly 30 miles away.[13] The link was created using a 5G network, with the latency around 100 milliseconds (0.1 second). The 5G technology allowed the doctor to see a clear, real-time image of the operation, as well as communicate with his assistants, and the short delay between the surgeon's movements and the robot in the theatre, was quick enough to avoid potentially dangerous mistakes.

5G networks are essential to the provision of remote services, bringing unique performance and latency characteristics for critical tasks such as mobility and security. However, demands from the evolving healthcare sector on technology are still high.
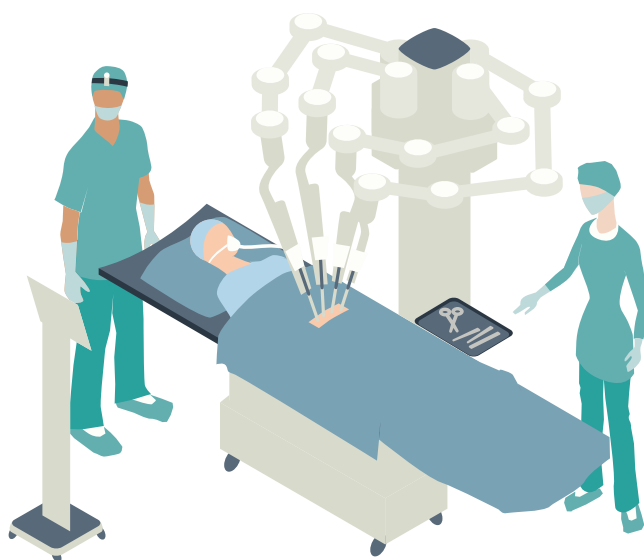
Case study
West Midlands 5G Trial:
the connected ambulance

In September 2018, the West Midlands was selected to become the first multi-city 5G testbed as part of the Government's Urban Connected Community Project. The project developed a large-scale 5G pilot across the region, with hubs in Birmingham, Coventry and Wolverhampton. Through this competition, the West Midlands Combined Authority (WMCA) was selected with their bid that focuses on the health, construction and automotive sectors, with its overarching ambition to help drive economic growth and benefit people's lives through participation in new digital technologies and digitally transformed public services.

Most recently, the authority partnered with the University Hospital Birmingham NHS Foundation Trust (UHB) to demonstrate the benefits of a 5G connected ambulance. The demonstration, which is designed to serve as a real case study, has shown ways in which 5G connectivity can facilitate the work of public and emergency services, saw paramedics conduct an ultrasound scan on a patient with real-time remote guidance from a clinician viewing the ambulance through a 5G connection.

This has been done using a joystick operated remotely by the clinician which sends control signals over the live 5G network to a robotic glove worn by the paramedic. Cameras are also installed in the ambulance which transmits a high definition view of the overall scene inside of the ambulance covering the patient and paramedic to a second screen located to the clinician's workstation.

Enabling ultrasound scans to be performed by paramedics on-the-go and reviewed remotely by an expert clinician through a 5G network has the potential to speed up diagnoses for patients, as well as reduce the number of ambulance journeys and emergency department visits. techUK's report on 'How can 5G technology support the emergency services' elaborates on why 5G matters to the UK emergency services, along with use cases of the network within different places, such as in the control room, on the frontline and at the device level.

Social care

In the past 15 years the number of 55 to 64-year-olds living alone has increased by 50 per cent. Already over 50 million people in Europe are classified as socially isolated.[14]

Using 5G technology to connect people socially will help benefit those in isolation. The digital loneliness device 'Push-to-Talk', uses a wireless communication to allow IoT devices to communicate over a large distance with minimal battery usage.[15] The system works by placing a button in the home of elderly people who may struggle to get out and socialise. This device, supported by the Liverpool Testbed and Trial Programme, can help users connect to software through a free application or button to communicate to another person who has similar interests to the user.

The connectivity for 'Push-to-Talk' is being enabled by 5G which gives always on coverage using a Long-Range Wide Area Network (LoRaWAN) that will transmit the request to communicate with others. The bandwidth, low latency and steady signal provided by 5G ensures that the system is always on and readily available, even where the participant does not already have fixed broadband.

There are estimations that 35 to 60 per cent of people do not take their medication as prescribed.[16] There could be many reasons behind this, such as forgetfulness or the inability to do so safely. However, these medications could be vital for a patient and must be taken to ensure the patient can manage their conditions in an efficient and safe manner, therefore reminders and notifications could be highly important.

PAMAN is a medication monitoring service which enables service users to take their medication independently and consistently in their own homes, helping them stay safe and well.[17] The service user can connect from their own home via a mobile network to a pharmacist, who calls when medication is due and talks through and observes the medication to be taken. The system also benefits individuals as it provides greater independence, and therefore is not time dependent on carers arriving for a check-up. This service will rely on 5G's durability, speed and increased data transfer to provide a consistent service for patients.

Being able to monitor the elderly or vulnerable using 5G-enabled sensors and devices will not only benefit these people, but 5G-enabled telecare will help reduce social care budgets by around five per cent, saving £890 million to reinvest in other services.[18]

Recommendations for Government regarding 5G in health and social care

Digitising the NHS has been a key priority for the Government for much of the 21st Century but the success of consecutive initiatives has been mixed. Most recently, the Secretary of State for Health and Social Care announced that the Government is launching a new body to align and accelerate health and care digitisation projects in England. The new unit, named NHSX, will take forward digital transformation in the NHS, allowing patients and staff to benefit from the latest digital systems and technology.

NHSX aims to combine the best talent from government, the NHS and industry to create the most advanced health and care service in the world to:

• Diagnose diseases earlier
• Free up staff time and
• Empower patients to take greater control of their own healthcare[19]

This is certainly an encouraging step and should better prepare the sector to harness new technologies such as 5G. To ensure that these benefits are realised, techUK has developed these key recommendations to Government on how to effectively harness 5G in health and social care:

1. Accelerate the deployment of 5G to the majority of the country, enabling UK consumers and businesses to take early advantage of the benefits.

2. Support the uptake of digital health tools to the general public by
a) utilising government data and communication channels to promote the benefits of digital health tools and
b) reviewing how the personal budgets programme could better support the uptake of personal digital technology.

3. Foster knowledge exchange between DCMS and the Department of Health and Social Care to embed knowledge, experience and expertise on the potential of 5G into the newly formed NHSX.

4. Ensure that the new NHS England app allows the public to access data beyond that held in primary care – and promote the ability to do so.

5. Provide health and social care professionals in the community with 5G technology, particularly in rural areas with limited health and social care provision, where consumer options for getting online are also limited.

6. Ensure the NHS can capitalise on developments in AI, Genomics, 5G, and Blockchain technology.

Conclusion

techUK is ready to support the Government in establishing effective development and deployment of the 5G network to ensure a digital enabled economy. So far in 2019, we have already seen positive use cases formed through the 5G Testbeds and Trials programme, along with successful deployments of 5G through multiple Mobile Network Operators, with more to come. The recommendations outlined in this report are to assist Government on how to affectively harness a 5G network specifically in the health and social care sector.

techUK will continue to work with Government to highlight the importance of digital technology and the opportunities that can arise from them. This will help ensure the UK is a world leader in 5G.

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Health and Social Care Programme

The Health and Social Care Programme provides a forum for our industry to meet the key influencers and customers in the sector, and to shape the policies that will decide the future of a digitised health and care industry. It creates a structured environment to enable frank and open discussions about the challenges the industry and health and social care stakeholders face, with the objective of driving innovation and growth.