

# HEALTH, IOT & WHY SHARING IS CARING



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In January 2019 the NHS released the publication of its long term plan<sup>1</sup> to create a health service for the future. One of the key areas highlighted in the publication indicates the need to make better use of data and digital technology, in fact chapter five of the report is titled “Digitally-enabled care will go mainstream across the NHS”. The Internet of Things (IoT) will without doubt form some of the core services to realise this long term goal, in order to improve the patient experience, reduce costs and maximise efficiencies, thereby allowing health professionals to focus on patient care.

## THE IOT

The IoT is an enabler of digital transformation based on the premise that data collected by “things” can be analysed and shared to provide insight and create more efficient ways of working. This opens up a world of possibilities in the health sector, where connected devices can provide the data to provide insight into symptoms and aid diagnosis, enable remote healthcare, and free up health professionals’ time to focus on primary care and patient contact. This ultimately allows for a more personalised level of care for every patient.

This paper looks at some of the use cases that can be met through adopting IoT technologies across the health sector, some of the key challenges to overcome for the IoT to reach its full potential and deliver the required outcomes, and why data sharing will be vital to creating long term sustainable services.

## PATIENT CARE

The IoT offers a vast array of potential benefits for the healthcare sector. It has the ability to improve patient experience, free up valuable staff time, manage resources and provide the ever-increasing range of services in a timelier, more effective way. The IoT provides the ability to collect data in real time through connected medical devices and share that data with all parties involved in the treatment of any given hospital patient, such as doctors, nurses and family members. This could allow a patient to be constantly monitored during their treatment and keep invested parties continually updated and informed.

However the data collected during the patient treatment process could also provide invaluable insight to those not directly involved with patient care, such as research bodies and regulators. This could better inform the long term understanding of disease, treatments and their effectiveness, and provide a method of continually improving patient care through digital technology.

## REMOTE MONITORING AND DIAGNOSIS

This concept can then be further expanded to provide services such as remote outpatient monitoring. Patients could be continually monitored in real-time during the recovery phase of their treatment without a direct dependency on medical staff, freeing up their time to focus on core services. Allowing patients to return to their homes earlier in the treatment process, reducing the strain on much needed bed spaces and resources. Artificial Intelligence (AI) algorithms could be used to monitor the inputs from the various connected devices and flag any deviations from the norm, for example of any changes to the patient’s status requiring intervention.



1. [www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf](http://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf)

## PREVENTATIVE HEALTH SERVICES

The use of IoT could be further adopted to introduce preventative health services, allowing potentially at-risk patients to be monitored through IoT devices and wearables<sup>[2]</sup>. For example, a patient diagnosed with high blood pressure could be continually monitored by their GP. This would reduce the need to make regular contact and ensure that appointments are only made when required, allowing GPs to focus their efforts on engaging with patients. As these systems and services become more common place, similar technologies could be used to provide social care services<sup>[3]</sup>, allowing elderly and vulnerable people to continue to live independent lives in their own homes and reducing the burden on carers and long-term care establishments.

## ASSET TRACKING, MONITORING AND PREDICTIVE MAINTENANCE

Outside the sphere of patient care, some of the most common use cases for IoT are asset tracking<sup>[4]</sup> and inventory monitoring<sup>[5]</sup>, and these have numerous applications in hospitals and across the health sector. Critical equipment could be location tracked, improving time management and asset allocation efficiencies. Equipment requiring maintenance could be identified in near real-time, and predictive maintenance programmes developed. Inventory systems could continually monitor the supply of pharmaceuticals, track trends, monitor the storage environment and provide predictive ordering services. The list goes on, but needless to say if it's a connected "thing" it can be inventoried, tracked and monitored. We will also likely see the increased adoption of IoT around building and facilities management, environmental control and most significantly energy management as we move to clean renewable energy to meet the government's target of a net zero carbon society by 2050<sup>[6]</sup>.



## DATA SHARING

These systems will co-exist with each other and, as the number of digital services increases in the health sector, it will be vital that data can be shared between them to meet the outcome of creating a seamless patient experience. For example, medical devices collecting patient health data should be combined so that all data regarding an individual patient can be analysed and reported on centrally. This will create a holistic view of a patient's health and progress through the treatment process.

To enable this, a standardised approach to data sharing will be required to allow multiple connected devices, developed by different manufactures and employing different technologies, to operate together to deliver patient outcomes. As the IoT proliferates in other sectors, it may be possible to share data from these systems to provide additional benefits to the health sector. For example, as smart metering continues to rollout across the UK and consumer IoT is increasingly adopted, data collected from these systems could provide new health related services without the need to deploy new hardware. Smart metering could provide insight into a patient's energy usage to build a profile of normal behaviour, this could then be further augmented through consumer IoT such as smart lighting, heating and white goods, to develop a pattern of behaviour, providing an indication of the activity of a patient within the home<sup>[7]</sup>. This data could be continually monitored by AI algorithms and any deviations flagged to care workers or families. This data, combined with health-related services, can provide enough data to non-intrusively monitor the elderly, allowing them to live independent lives for longer.

Whilst IoT has the potential to provide numerous benefits to the health sector (and beyond), there are still a number of challenges present that need to be considered before widespread adoption can proliferate and data sharing systems are created.

2. <https://ieeexplore.ieee.org/document/8644514>
3. [www.spectator.co.uk/2019/09/how-smart-technologies-can-alleviate-our-social-care-crisis/](http://www.spectator.co.uk/2019/09/how-smart-technologies-can-alleviate-our-social-care-crisis/)
4. [www.internationaljournalssrg.org/uploads/specialissuepdf/ICFTESH/2019/CSE/IJCSE-ICFTESH-P107.pdf](http://www.internationaljournalssrg.org/uploads/specialissuepdf/ICFTESH/2019/CSE/IJCSE-ICFTESH-P107.pdf)
5. [www.unleashedsoftware.com/blog/iot-mean-inventory-management](http://www.unleashedsoftware.com/blog/iot-mean-inventory-management)
6. [www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law](http://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law)
7. [www.smartenergygb.org/en/smart-living/how-smart-meters-could-transform-health-and-social-care](http://www.smartenergygb.org/en/smart-living/how-smart-meters-could-transform-health-and-social-care)

## DATA PRIVACY

The first consideration is data privacy. Understanding what data can be shared between services will be vital and therefore data should be categorised in a standardised manner to understand what can be shared and what cannot. Some data will be open, allowing it to be shared with any system, some data will be restricted to identified parties and some data will not be able to be shared at all.

Personal data will require consent, and with the sheer amount of data potentially being collected from a vast array of systems, a consent management service will likely be required to effectively manage this. The Data Protection Act 2018 (GDPR)<sup>8</sup> is a step in the right direction in informing data controllers and processors of their obligations to protect the rights of the individual. Furthermore, the recently released ETSI specification for consumer IoT security<sup>9</sup> makes it clear that IoT devices collecting personal data are subject to GDPR.

## DATA INTEROPERABILITY

As the IoT further proliferates, data interoperability between IoT services will need to be considered to allow data collected by one service to be correctly interpreted by another, and this is not an easy task.

Imagine sending an email from a smart phone via 4G. The email can be read by the recipient using a PC connected over WIFI and interoperability is achieved through standards regarding email to allow this to happen. However, if the email is written in French and the recipient only speaks English, the data interoperability fails. With the vast array of protocols currently supported by IoT services, it will be important to agree a method for sharing data between them.

This concept is applicable to all sectors and ultimately, if a standardised method of data sharing can be established, it will help to accelerate the creation of truly smart cities. These cities will be able to combine data from a multitude of digital services to make decisions at a city level, incorporating data collected from smart buildings (including hospitals), energy management systems, transport and environmental monitoring to name but a few. Whilst numerous initiatives are being funded to map the data applicable to a given sector, it is vital to the long term stability of digital services to understand how this data could be shared across sectors.

## SECURITY

Security is a well-documented challenge for the IoT, as manufacturers move to create connected products without full appreciation of the risks. As we move into an increasingly more connected world, where IoT systems from multiple manufacturers, utilising multiple technologies, will co-exist with each other, it is vital that the risks are understood. We will likely see health, energy and consumer IoT converge in the domestic space and therefore a minimum standard for IoT security should be considered. Secure-by-design practices must become the norm to ensure data privacy and security are addressed across the system development lifecycle, and the obligations applicable to all stakeholders made clear. The Network and Information Systems (NIS) directive<sup>10</sup> aims to improve security practices across essential sectors such as energy and health, and this will be used to inform impacted services of their security requirements in order to plan the journey from the current baseline to the desired outcome.

8. [www.gdpr-info.eu/](http://www.gdpr-info.eu/)

9. [www.etsi.org/deliver/etsi\\_ts/103600\\_103699/103645/01.01.01\\_60/ts\\_103645v010101p.pdf](http://www.etsi.org/deliver/etsi_ts/103600_103699/103645/01.01.01_60/ts_103645v010101p.pdf)

10. [ec.europa.eu/digital-single-market/en/network-and-information-security-nis-directive](http://ec.europa.eu/digital-single-market/en/network-and-information-security-nis-directive)



## IN SUMMARY

The IoT offers numerous benefits across all sectors, however it is important to consider how these systems should interact in order to protect the privacy of individuals, share data in a standardised consistent manner and ensure security and data privacy is a risk based consideration from the start. In this way we will start to see the development of interoperable systems able to share data securely across multiple digital systems and services. This is no easy feat and will require all stakeholders to be involved in developing standards, not only at the specific sector level but across sectors. Only then will we enable a truly open digital market place, able to support the development of innovative digital services.



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