THE IMPACT OF DIGITAL TECHNOLOGIES ON THE UK HEALTHCARE

A Human-Centered Study

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Digital technology is one form of technology with ubiquitous application, especially with the spread of smart phones and other smart devices.Tools and platforms for Information and Communication such as chat or video calling have become popular since the covid pandemic, becoming a new norm in the workplace.

Similarly, the healthcare sector in the UK has also witnessed since the covid pandemic a notable acceleration in digital applications and digital services. One example is the NHS app, the digital application of the Governmental British National Health Service.

The aim of the study is to determine how digital technologies have impacted the UK healthcare service from the patient's (end-user) perspective.

The thesis project is a human-centered qualitative research that follows the interpretive paradigm and phenomenology. Phenomenology as the focus is to look into a phenomena which is digital technologies in UK healthcare services, and interpretivism as it focuses on interpreting the views of people receiving the service. The metods used in this research are a focus group, an inspirational cards session and finally a future workshop.

The research findings show that although digital technologies were implemented in a number of processes increasing efficiency within the UK healthcare, this has not drastically improved the healthcare service as of yet for patients, as they showed no signs of using the apps as a first option when seeking medical advice or booking an appointment. This is mainly due to the fact that the apps are not used frequently. There is also still a lack of awareness of the app features, and accessibility and trust issues remain especially with sensitive individual health information. However, with further new technology like DNA mapping, the service will potentially become more personal and adapted to the individual, which could be a trigger for the patient to interact more frequently with the app.

The study is of benfit at individual level as it brings their voice to improve the service provided by the NHS app and other digital-based offerings, and at organisational level as businesses would benefit from understanding customers' expectations and work to fulfil that void in the service, and also at governmental level as it paves the way for the government to take necessary decisions and set-up incentives for companies to provide better services to the end-user.

Keywords Digital Technologies, Healthcare services in the UK,
Human-Centred approach, Participatory Design
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1 Introduction

In this chapter the topic of the thesis report is introduced. Starting by defining the thesis title and the research questions, as well as setting the context with a topic background and a statement of purpose, and finally explaining the relevance of the study. This will provide the Empirical setting and set the position of the thesis work, as well as Hypothesis statements predicting technology use with other parameters to be defined.

It is undeniable that we are living in the Digital era where technologies are reshaping our day to day lives.

Indeed, the creation of the world wide web and the Internet has seen a proliferation of technological devices that we rely more and more on, combined with the increasing power of devices such as personal computers in the decade of the 80s, and later on the rise of the smart devices such as phones and tablets has seen an ever-increasing number of applications that are created in order to perform one function or another and that soon enough become indispensable to our lives.

Different technologies have been created simultaneously in the past years and their applications have been in a multitude of domains such as the public sector, the military and other governmental functions, the environment, private businesses, education…etc. In fact, there is no limit to where the technology can be implemented and applied because it brings benefits in terms of performance and functionalities.

The impact of technologies is noted on individual, organisational and societal levels.

Digital technologies are relatively recent and include anything that is digital in nature. This means Information and Communication Technologies, sometimes abbreviated to ICTs, and can include but are not limited to electronic tools, systems, devices and resources that generate, store or process data. Prime examples of digital technology include social media, online games and communication platforms, smart phones and multimedia. Moreover, advancements of digital technologies however now include relatively new and innovative

concepts such as Artificial Intelligence (A.I.), the Internet of Things (IoT), Augmented Reality (AR), and Telemedicine.

When combined with other type of technologies, digital technologies are becoming a powerful tool of information and provide humans, businesses and other organisations as well as society with extra power and functionalities to achieve more and in a faster manner.

As an example, the Global Positioning System, or more commonly known as GPS is a system of geo-localisation that initially was invented for the US army. However, when combined with digital technologies such as a smart phone with a Satellite navigation application such as Google Maps, this has become a powerful tool for the individual to be better informed and find and reach locations faster. Humans now travel to a new city and behave like a local with the knowledge that the digital technology provides to them. Another example is my education example. In education, Digital technologies such as Moodle and other educational platforms have given the opportunity to universities to reach students anywhere in the world, and a similar opportunity for the student to open their horizon from a local University to being able to choose from Universities across the globe. While living in the UK, I was able to follow an educational programme with a University in Finland thanks to Digital Technologies. I also have been able to travel for the very first time to Finland where my University is located and yet surpass all the usual difficulties of being in a new place, disorientated, thanks to the internet, a smart phone and digital technologies such as applications to search for a Hotel to stay, or rent a car to move, or finding good local places to eat, to see, to do…etc.

It is clear that digital technologies is a derived product that is possible in combination with recent technological advancements such as electricity, laser technology, semiconductor chips & quantum computing making computers smaller yet more powerful…etc and their main functionalities are related to information and communication.

This thesis will focus on the study of digital technologies in healthcare as a specific sector, and how this type of technology is impacting the sector from the perspective of humans as ultimate beneficiaries, end-users, the centre of the solution provided.

1.1 Thesis Title

The thesis title is:

The Impact of Digital Technologies on the UK Healthcare: A Human-Centric Study.

1.2 Research Question

This research study is aimed to answer the following Research Question:

From a user perspective, how have digital technologies shaped the healthcare sector and healthcare services in the UK?

In order to answer this question, a number of focus questions are defined:

- From a customer/patient perspective, is the end-user experiencing better healthcare services with digital technologies?
- How does the customer feel about sharing their health information?
- With the application of digital technologies, how can the healthcare services improve in the near/medium term future?

For the purpose of this study, the term customer or patient is defined as a person that benefits from healthcare services offered in the UK, for example a British Citizen living in the UK and registered with the National Health Service (NHS).

Similarly, the term end-user is defined by any person that is at the end spectrum of the healthcare services, for example any person that is registered with the NHS and also registered to use the digital version of the service, either via a mobile device application (App), or a web-based application, and benefiting from these apps as an end-user.

1.3 Hypotheses

While the research question is generally clear and concise, focusing on a question that provides a path for research, the hypothesis in qualitative research on the other hand can be in the form of a statement concerning the problem to be investigated. (Chigbu, 2019)

As such, a number of hypotheses are raised with this study and are defined as below:

- It is predicted new technologies helped to make patients/customers feel closer to their health centres.

- It is predicted new technologies helped patients/customers become more aware, informed and focused on their health and services available to them.

- It is predicted that patients/customers/end-users are more concerned about the free flow of their health data and health-related information.

1.4 Background

There is no deniability that we live in the digital era. Technologies have advanced to a point where they now reshape human behaviour at all levels. Indeed, Walsham (2012) stated that technologies are omnipresent in all aspects of life and while arguing whether the world is better with or without them, it is undeniable that these have transformed people's habits and interactions whether individually, or within Business and other organisations, as well in society at large. Technologies for information and communication purposes, also called ICTs, are one important category of technologies. ICTs are everywhere today. As the name suggests, the main purpose of this type of technology is to help the flow of information and communication. We see them for example in the form of applications (apps) in phones, reporting all sorts of information to the user such as social media, health, food intake, distance, time...etc. On top of individual use, ICTs are present in the work place. Businesses are more and more reliant on Business Information Systems to organise their operations and compete more efficiently. Indeed, both Individuals and Businesses make the use of ICTs in order to adapt to an ever changing environment and overcome their respective challenges (Beynon-Davies, P., 2013).

The Covid-19 crisis has added new and unprecedented challenges to businesses in general, and particularly to the healthcare sector. General private and government businesses had to close their premises and faced unusual physical limitations such as lockdown and other movement and social restrictions, pushing people to change work habits and to take such actions that they would not normally take in normal times. As an example, travelling and representing a business whether locally or internationally, taking part in exhibitions, promoting business brand, facing customers as well as prospecting clients, therefore generating sales and business Income is one of many aspects of Business operations that was directly hindered.

The healthcare services, on the other hand, have experienced a different kind of challenge. With the pandemic and panic within individuals, organisations and governments expanding, the healthcare sector in the UK, and similarly to healthcare services in the world, was facing its biggest challenge yet since its creation over 70 years ago. Not only it had to quickly study, understand and intent to combat a virus unknown to it, but it also had to cope with volumes of people in simultaneous need of the service, volumes only seen in times of war.

The National Health Service is a service created by the British Government with the mission to provide health services to the residents of the United Kingdom. The service is cooperative in nature, similar to an insurance, whereby residents who are able pay a percentage of their wages in order to be covered, or insured, by the National Health Service. In return, The NHS provides 100% Free necessary medical services for all residents.

New technologies of information and communication were quickly used in order to face this unprecedented crisis. ICT was useful, amongst other things, for keeping track of the issue and reporting, reporting to relevant government bodies and the World Health Organisation (WHO), communicating with the population, managing health centres and partcularly the emergency and intensive care units, defining the symptoms and method of virus propagation, etc.

At organisational and governmental levels, ICTs have played an important role in the healthcare sector and the recent Covid-19 crisis was a clear illustration of the extent of this

role. From an individual perspective, this thesis work aims to study the extent of impact that ICTs have had on individual citizens within the Healthcare sector and also in times of facing a health crisis such as Covid-19.

1.5 Purpose

This thesis research has the purpose to explore whether, and if so, to what extent currentiInformation & communication technologies were helpful for UK individuals receiving healthcare services in normal times as well as in periods of crises.

Also, the aim is to highlight, if any, the limitations of these technologies in such a crisis situation and the future of healthcare practices taking into account this type of crisis. The research focuses on this topic from the perspective of people who are involved in one way or another with healthcare organisations, such as employees, consultants, managers, business owners and so on.

Therefore, this work project is qualitative by nature as it looks to provide an understanding on whether people in the UK, think that using ICTs has made a substantial difference in the way that they receive healthcare and other related services, and also whether they were able to react to the Covid-19 crisis situation more efficiently than without the use of ICTs. And if not, what technology features and properties they wish to add and/or see improved in order to feel that the health service provided is satisfactory, and also feel confident to face another future crisis with the necessary tools in place.

And finally, the topic of study is justified as it can help set the foundations for future design in services, knowing the demand and concerns to cover.

1.6 Topic justification

The study is justified at individual, organisational, governmental and societal levels as the Information & Communication Technology fields are still under constant development and therefore scrutiny. Indeed, at individual level this topic studies the impact of people's knowledge and interaction with technology in a particular sector, namely Healthcare, as a

particular sector because it touches people directly with their health and well-being. The management and handling of a health crisis such as Covid-19 is also part of the study and will help individuals understand how to effectively make use of technology in order to maintain control of information and act accordingly. An individual who is in a particular health condition and relies on the Health service to get medication promptly or set-up a meeting with a healthcare official (medic, Doctor, Professor…etc) will be interested to see whether these services can be improved with the use of ICTs. Similarly, an individual who can feel close to the Health Service and is in full understanding of how it operates and what to do when the service is needed, will also feel a sense of security and assurance.

While there is much research on technology in the organisational & Business context in general, there is still a gap in understanding people's perceptions of use, adaptability, performance, and general end-user requirements. This study comes as a User-Centric approach to look into these perceptions in more detail in order to complement studies on healthcare services process automation and efficiency because efficiency of ICTs and systems are in the most part dependent on the degree of user acceptance.

At organisational level this topic is relevant as businesses are confronted with crucial decisions in ICT acquisition, implementation and application. This study aims to provide viable findings that businesses and organisations can take into account in terms of preparing for future healthcare services and disruptions due to unexpected crisis situations. Also, the study is of interest to other companies that currently supply Information and technology applications and services in taking the end-user perspective and the challenges to overcome in such situations into account and include a participative design of Technology.

It is also an interesting study for governmental bodies at societal level, because it shows the point of view of humans in their behaviour using ICTs and how governments can achieve the provision of satisfactory healthcare services to its citizens.

2 Theory

In this section the theoretical framework is set. This is also simply referred to as the Theory. In this part the work is positioned within a frame of previous research and/or other studies that are relevant to the study work.

The past two decades brought, amongst other things, the proliferation of Biotechnology, or simply Biotech with the possibilities that biotechnologies provided with companies focusing on precise diseases and research for treatments. For example, single layer of cells is now reached by separating blood vessel from the blood stream.

More recently however, technology businesses are shifting their focus on healthcare delivery, also named “Telehealth”. This new concept is expanding virtual healthcare options with the use of social platforms and other new technologies to provide new offerings like virtual doctor appointments, chat service. We have seen a surge in the use of delivery healthcare through digital technologies to individuals, and more specifically during the Covid-19 pandemic.

Additionally, there is a shift in focus from technology for doctors and other healthcare agents to healthcare tech for patients. As an example, we find that Applications (Apps) to check health symptoms and that were designed to be used by doctors mainly are now shifting the tone of voice, language and interface to focus more on symptoms information to patients directly.

The past two decades have seen a shift in healthcare tech becoming much more personal and its use is designed predominantly for care delivery, not only on medical research and medical science advancements. (Madeleine Hillyer, 2020)

2.1 Concepts

Several concepts or ideas are presented below. These concepts are either directly or indirectly related to the topic of research and constitute a parameter to be aware about and to take into account when conducting the research. They also provide sub-topics that make the foundation on which the study will be based and discussed.

2.1.1 Digital Technologies & Digital Inclusion

2.1.1.1 Information & Communication Technologies (ICTs)

As explained above, ICTs have proliferated and this type of technology is now found everywhere. It is indeed one important category in technology because its main purpose of is to facilitate information and communication. The concept remains broad and is in constant evolution as technologies evolve and converge together to form new technologies of Information and communication. As discussed, smart phones apps are a perfect example of ICT as a key functionality is to report all sorts of information to the user such as social media, health, food intake, distance, time, weather...etc. ICTs are of course not limited to individual use only, but are in fact present in the workplace. Businesses and other organisations or institutions are more and more reliant on Business Information Systems to organise their administrative processes and operations, increasing efficiency to have that needed competitive edge compared to the competition. Indeed, both Individuals and Businesses make the use of ICTs in order to adapt to an ever changing environment and overcome their respective challenges (Beynon-Davies, P., 2013).

More specifically, in the healthcare sector, ICTs include Telehealth or Telemedicine, which allows for long-distance contact between the healthcare provider and the patient, opening the possibility of remotely providing and receiving advice, care, clinical notes and reminders, as well as patient monitoring. Telemedicine is supported by another concept: mHealth. mHealth is an abbreviation of mobile health and will be discussed below in a separate section. Also included in ICTs for the healthcare is the use of software for several

functions such as the mitigation of a pandemic similar to the covid situation, or to support healthcare professionals with clinical decisions, or for general administration purposes.

Deloitte's Centre for health solutions looked into the developments in technology and how these enabled care services and healthcare provision. Indeed, the advances and convergence of health technology, digital media and mobile communication technology, combined with the reducing costs of digital technology in general, and also to the increased demand in healthcare has been a catalyst for the use of technology to help deliver safer, more efficient and cost effective healthcare services. (Karen Taylor, 2015)

2.1.1.2 Mobile Healthcare – Your Health services accessible from anywhere

Mobile technology has improved rapidly in the past few years to the point of ubiquity (found everywhere). Almost everyone, including older age groups, has a smartphone, and smarphone usage is increasing amongst all age groups. This together with the proliferation of health-related applications, whether web-based or as an App for mobile devices has led to new opportunities in the healthcare industry.

According to Deloitte, there are four dimensions to an effective mHealth: Single use, Social, Integrated and complex. Single use mHealth fulfills one single purpose for one single user. This is a typical example of a smartphone app or smart watch or other wearable device for diet, wellness or exercising. Social mHealth adds the social networks to the equation. Typical example would be an exercising app with a social competition feature that encourages users to meet goals. Integrated mHealth is a linked system that connects the patient through their mobile device to a network of healthcare system, for example the doctors' system, or the clinic or hospital. And finally, complex mHealth is the technology that draws different analysis from healthcare system with the purpose to support decision-making. An example would be the gathering of information on a specific illness or disease and which group it affects most and decide to screen that specific group from an earlier age to diagnose the disease at an earlier stage and have more chance to treat it. Similarly,

this can analyse trends and help predict the most effective planning and management actions. (Karen Taylor, 2015)

Four providers dominate the mHealth current market: Mobile operators, mobile device vendors, content developers and healthcare providers. This is a dynamic market evolving rapidly with the evolution of technology and new market entrants offering new and innovative products and service propositions, for instance easy to use wearable devices that work in conjunction with mobile apps.

mHealth proliferation is led by the higher demand in health data and information and by the increase of mobile devices and their usage by all user groups, and also by the increasing costs of healthcare hence the appetite to use cost-effective applications to help lower the costs of delivering healthcare in general. mHealth is also an excellent solution for users who are leading busy lifestyles and do not always have the luxury to physically go to the healthcare provider location for a simple piece of information or advice, when this can be delivered within the comfort of the smart phone and at any time, and also in real-time. (Karen Taylor, 2012)

2.1.1.3 Big Data & Data Mining

Big Data refers to the large volume of data that generates from the use and storage of information in the form of data. Big data is characterised by the 3 Vs: greater Variety, arriving in increasing Volumes and with higher Velocity. Big Data usually includes large amounts of data set that are diverse, complex and of a massive scale, which requires sophisticated tools and software to capture, manage and visualise.

Data mining is the process of extracting and analysing Big data sets in order to draw meaningful information. Techniques of data mining are constantly evolving however there are some common classes such as Detection of changes and/or anomalies, Regression models, Classification & Clustering…etc. (Erl et al., 2016)

2.1.1.4 Machine Learning & A.I. (Artificial Intelligence)

Artificial Intelligence (A.I.) is a broad term that refers to the ability of a digital application, software, program or more generally a computer to seem intelligent. AI can be described as the ability to gather data from its environment and adapt, or learn, in order to reach a specific goal or set of goals. For an AI system to be efficient and reach its objective, an algorithm (set of programming) is created for use on big data, or a large volume of data that are selected and filtered to draw meaningful information for the system to reach the intended goal. As the system is processing these quantities of Data, it is perceived as experiences with the concept of cause and effect and enable the system to store this type of knowledge that it can relate to for making future decisions. (Russell & Norvig, 2021)

A.I. becomes more beneficial if a clear strategy and plan are set on the way data is captured and utilised. This will serve as a basis for improved decisions, greater insight and processes optimisation and efficiency. (Marr & Ward, 2019)

As a metaphor, Data is compared to oil as it goes through the process of refining in order to draw maximum value from it. Similarly, Data must be refined in order to draw meaningful and usable information or knowledge that presents added value. Large amounts of information are generated in the form of financial data, customer data, sales data, product and service data, sensor data, etc. This is usually referred to as raw data that AI methods can use in order to generate insights and decision-making opportunities. (Shaw et al., 2021)

Also, software algorithms are now capable of performing tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and language translation.

2.1.1.5 Smart Technologies such as IoT (Internet of Things)

Internet of Things is described as a network of technology objects such as smart devices or vehicles embedded with sensors, software, network connectivity, and computing capability, that does not only collect but has the ability to exchange data over the Internet. IoT enables devices to be connected and remotely monitored or controlled (Greengard, 2021).

Smart technology is tangible with the example of the recently introduced electricity smart meters. Smart meters are being deployed in homes and their main technological functionality is connectivity. When connected to the internet, or another network such as 4G or 5G, and also directly and wirelessly connected to other devices such as the electricity company's main hub, these devices allow the flow of information between the home and the electricity provider, making the billing process seamlessly simple. Also, these can be connected to a control panel or through an App and the consumer can view their electricity consumption in different times of the day, as well as a number of different reports providing information related to electricity consumption.

Similarly, in the healthcare there has been a growing number of medical smart devices that connect to the internet or another network or communicate with other devices wirelessly. For example, sensors that are wearable can collect information and send it directly to a connected App, making access to data and information an immediate process for the patient. One example of a mobile digital smart sensing device would be the iWatch by Apple, taking the patient's blood pressure or monitoring changes in physiology. This information can be immediately accessed via the Apple Health App, providing the patient with a wide range of reports, graphs, and further information in several formats.

2.1.2 Public Health Policy, e-Government & e-Health Service

Government planning, decisions and actions towards a specific topic are key parameters that affect greatly the consequence of developing a specific service. If we look at the government policy towards public healthcare, we note that for the past years, the UK government has been focusing on strategies to implement digital health nationwide and

provide integrated digital health services through the National Health Services (NHS). As a reminder, the NHS is the national government-owned health system in the UK. The strategy to implement digital health services is mainly driven by the motivation of reaching cost-efficiency. e-Government is an initiative to bring government services to the digital era. All government services and divisions to come closer to citizens through digital services. This includes the Healthcare sector.

e-Health services are particularly important because it is in demand by all parties involved: the patient as a user, the healthcare provider and the government or other regulating body. In medical Insurance companies for instance, e-Health is particularly important and a promising sector for insurers because it will enable insurance companies to come closer to the customer in terms of offering and can also help increase customer engagement and loyalty. Tailored offers is a natural progression to services and this can only be achieved by the use of technologies and e-Health data. Moreover, insurance companies are driven by the competition, like Fintech and biotech companies, in order to provide an offering to customers that would suit their needs.

Another application of e-Health services is the Patient and Service end-user Experience. By providing a good user-experience, this will ensure user engagement and interaction as well as the opportunity to gather big data that can be analysed in order to be closer to the end-user and their specific needs, and provide tailored services.

e-Health records (EHRs):

The advances in Technologies and specifically digital technologies have enabled the storage of medical records digitally and in form of connected health that facilitates remote access to information by the patient or healthcare professionals. EHRs can have several formats, some EHRs include Clinical Notes, Medical Imaging Data, Genetic Data and Other Data type such as patient cognitive behaviour. (Karen Taylor, 2019)

2.1.3 Privacy & Security

One major challenge of the digital era and digital data across all sectors is the issue of privacy and security. This includes issues in relation with Data & Information ownership, sharing & protection. The same issues are layed for the e-healthcare services and are particularly important to address given the sensitive, personal and private nature of the information. Patients do not wish for their sensitive and private health data to be shared with third parties and healthcare providers have the duty to protect this data and gain the patient's trust. (Jose Aleman, 2022)

However, Privacy in general is not always clearly defined and depends on culturally-dependant parameters, and information security and privacy remain major areas of concern. In this sense, the UK government advanced with a legislation with the Data Protection Act (DPA) of 1998 regarding aspects that concern personal data held by others, such as the collection, maintenance, use and disclosure of personal information including names, addresses, Data of birth, medical records and bank details, as well as unique clinical identifiers such as the physiological or biological information of an individual. (Tony Sahama et al., 2013)

Under the General Data Protection Regulation (GDPR), for example, data concerning health is defined as personal data related to the physical or mental health of a natural person, including the provision of health care services, which reveal information about that person's health status (Article 4(15), GDPR). GDPR entered into effect in the UK on 25 May 2018.

2.1.4 Innovation & Implementation

In this section Technological Innovation is discussed and Emerging & Future Technologies that could bring new ways of Healthcare are presented.

Virtual reality (VR) and Augmented Reality (AR) are innovative technologies that allows the user to interact in a computer-simulated recreation of a real environment. AR combines elements of reality and a computer-simulated environment where both are merged. The use of VR and AR technology improves customer experience and contributes to increased quality and speed of processes and service.

While the technology is already being implemented in a number of industries and sectors, for example, car testing for potential customers, or new educational platforms built using VR and AR technology, it is not yet widespread in the Healthcare sector. The application of AR and VR in healthcare could result in a better patient experience, immersing into the body and seeing health in a new form.

Blockchain is another technology that is applied in Financial Services but could make its way in healthcare. Blockchain is defined as a distributed transactional database in which the information about the transactions is similar to all. It is usually not possible to change information in the database. A blockchain therefore provides secure and accurate information that does not need to be verified or validated as it remains unchanged. This establishes a level of trust that could be useful in healthcare with secure transfer of patient medical records, as well as a more efficient management of the medicine supply chain. Blockchain technology enables better data security, transparency and privacy protecting the sensitive nature of medical records.

Robotics and Automation of otherwise manual processes is being applied within several sectors. This means that physical robots and machines are increasingly taking over work duties previously carried out by human employees. Currently, this is mostly used within processes associated with warehousing, logistics and surveillance, but it is also moving into a number of other sectors such as the healthcare with medical robots and robotics.

2.2 Related Studies

2.2.1 Digital transformation and health care

Deloitte Centre for Health Solutions produced a report where it looked into how digital technology is transforming health and social care. Indeed, according to Karen Taylor (2015), digital technology is becoming more pervasive with the smartphone penetration reaching 70% of the population in 2014 and the top Pharma companies producing 63% more Applications for digital devices and mobile devices in 2014 compared to 2013. Also, the number of healh Apps on mobile devices has more than doubled within 2.5 years to reach the milestone of 100,000 Apps by 2014. Also, the need for cost effective healthcare is increasing, with the NHS forecasting a funding gap (lack of funding) in 2020-2021 to reach £30 billion. This forecast does not take into account the Covid-19 or any other crisis. With more and more people, including the aging population, using mobile devices, the mHealth market is growing rapidly. Indeed, global revenues from mHealth was forecasted to reach over $21bn, of which the European market would be the largest with a third of global revenues i.e. over $7bn.

The report shows also that there is growing evidence of health technology benefit to health care providers (Businesses, Health Centres and Ministry of Health). Some of these benefits are namely reducing paperwork and manual processes within the healthcare community by as much as 60%. This allowed extra time to see patients and as a result the patient face time increased by a third. On a daily average, there was an increase of extra patients seen due to Digital technologies. On the other hand, digital technologies used by patients for information about health matters, and also for communicating with health care professionals (Doctors, Nurses…etc) has had a direct link with the noted decrease in Hospital admissions by 35%, and Accidents & Emergency Unit use by over half, and finally a decrease in the number of days of hospital bed by 59%. This shows that digital technologies have helped to minimise service use if it could be avoided, and helped promote patient's independence, and improve care outcomes as well as focusing more on prevention rather than medical treatment and emergency cases. From the patient's perspective, Deloitte's report shows clear evidence of health technology benefit on patients. Indeed, 75% of patients search for health information online through general

websites or health-related Apps for the reliability and accuracy of information and also the simplicity in usage. The primary reasons for a ptient to use health Apps are primarily to obtain information on specific medical conditions and relevant symptoms, followed by communicating with Health Care Professionals, and finally to check their health records and medical test results…etc. (Karen Taylor, 2015)

2.2.2 eHealth vs. Digital Health

It was suggested to differentiate between the concept of eHealth and Digital Health, eHealth being the means to help healthcare providers to perform their work more efficiently and provide a higher quality care with the goal to improve accessibility and care services in the healthcare sector using ICTs. eHealth tools include electronic health records, health information networks, telehealth or telemedecine services and health portals and systems. Digital Health, however, refers to such technologies that directly deliver services to patients and help them manage their personal health and wellness. Examples of such technologies include smart phones and health and wellness related apps. (Khillar, S., 2020)

2.2.3 Digital future of Public Health

The European Commission identified three main aspects on delivering digital health and care within the European Union single market. The first aspect is to secure data access and sharing to facilitate greater access to healthcare cross-border. For this, it defined the need to build an e-Health Digital service infrastructure to enable patient information, including e-prescriptions, to be exchanged between healthcare providers. The first cross border exchange commenced in 2019 with the goal to include all EU countries included by 2025 with a single unified format of electronic health record accessible to health providers and citizens of the EU. The second aspect is to connect and share health information for the purpose of supporting the medical research with the aim of improving prevention, diagnosis, treatments and management of medicine and medical devices. And finally, the third aspect is to empower citizens to take a stronger role and engage through digital services in the management of their personal health by following prevention guidelines and lead a healthier lifestyle. In time, this will help towards the provision of integrated and personalised healthcare systems. (Unknown at European Commission, 2018)

2.2.4 Future trends in Digital Health

Digital technologies are constantly evolving with new applications in the healthcare sector and investment backed healthtech start-up companies continue to emerge to drive the digital transformation and adoption of eHealth and Digital health. The first trend, as explained earlier, is TeleHealth or TeleMedecine. With the covid pandemic situation and social distancing, in-person visits have reduced drastically and visits conducted through digital services have increased sharply. This trend is quickly becoming the new norm in healthcare as it expanded healthcare access to more people, and especially the elderly and other vulnerable patients who have difficulties in terms of mobility and independence, and also reduced the number of patients in healthcare facilities and helped focus on urgent care within the healthcare premises and also with digital service there is a continuity in care with consistent communication and patient monitoring. This trend is no longer seen as an emergency measure to respond to a pandemic situation, but more of an innovative mean that provides an agile and efficient provision of healthcare services. (Reeneta Das, 2019)

IoT is the second trend in medical care as new generations of medical devices are now smart with the capability to connect to one another via a network of internet for things, or devices. This enables the flow of data and is now a growing field with the growth of smart devices such as smart watches and wearable sensors and other monitoring devices. This trend is set to stay as it provides solutions in the healthcare that otherwise were not available, such as remote patient data monitoring in a convenient, non-intrusive and cost-effective manner. (Robbie Richards, 2021)

Another trend is the apps for the purpose of wellness in the workplace. With the changes that the pandemic situation created, employers are starting to be more and more aware of the wellness of their employees, creating a demand for solutions to ensure this aspect. In this sense, there is a growing trend of apps and technology platforms that is taking place, as well as an increase in corporate wellness like the traditional yoga retreats and team-building events, packed in a digital solution or format. This is seen to increase job satisfaction and increase employee retention and productivity, and reduce costs and event coordination issues. This trend will increase in the coming years as healthcare and wellness is generally shifting from treatment to prevention through a healthy lifestyle. (R. Das, 2019)

Additionnally, genetic data innovations and big data driven disease management is another trend that will increase in the future as this was accutely developed recently as a response to the pandemic situation, with innovative ways to understand and tackle the spread of the virus. Technology such as messenger RNA (mRNA) that constituted the basis of the covid vaccine will see an increase in application compared to traditional methods. Similar biological software methodology can be used to provide solutions for further diseases such as Malaria, hepatitis B or in cancer treatments. Big data analytics used in genetic decoding, and AI technology and predictive analytics will be important components in the making of digital solutions that can help combat infectious diseases. (Robbie Richards, 2021)

A.I. technology is another trend that will grow in importance and application. It has the potential to help in productivity and presentation in crucial medical aspects such as scanning imagery analysis and automation in radiology. (Reeneta Das, 2019)

And finally, Virtual Reality (VR) and Augmented Reality (AR) are also becoming a trend in the healthcare industry. First applications of VR and AR have been in the video gaming and entertainment industries. But recently these technologies are being applied in the healthcare sector, helping with surgical training for both healthcare providers and patients getting more comfortable with surgical procedures. (Robbie Richards, 2021)

2.2.5 Digital Health in the UK

According to a recent study conducted by Deloitte Life Sciences & Healthcare, the UK is specifically well-positionned in the context of the global market to take advantage of the opportunity that digital health presents. This is mainly due to the agility of the country and its NHS to take decisions and implement them fast to address most forecasted challenges related to digtal health, such as the skills shortage in health analytics, and set up managerial processese to assess and react to the potential value of digital health solutions, as well as improve the healthcare data access & management and increase the use of digital health solutions by improving reimbursement policies, and finally, to build capabilities to help companies in the UK digital market scale rapidly and efficiently. (Standing & Hampson, 2022)

3 Research Strategy

The research strategy follows a dogma, or paradigm that is defined by the Human-Centric interpretation of a particular issue, or Phenomena. It also follows a specific methodology, also defined as an approach or design. In this case the study is a Qualitative Research and follows the Phenomenological Approach.

3.1 Paradigm

The paradigm is the set of concepts & practices that are defined and accepted within a given discipline, This is defined as the common beliefs between scientists about how problems should be understood and addressed.

The project focuses on interpretive phenomenological Human-centred design (Walsham, 2006), therefore the paradigm followed is interpretivism. This is also referred to as anti-positivism. Rather than being rigid in structural frameworks such as positivist research, interpretivism takes a more personal and flexible approcah that captures meanings of human nature and focuses on the perception of reality.

It is therefore an approach of Qualitatitve nature with the aim to understand a phenomena by looking at meanings people assign to it.

3.2 Methodology

The methodology followed in this study will be Phemonology because the Research aims to study a phenomena from the participants' perspective. According to Guest et alt. (2012), Phenomenology started in humanistic psychology as an approach to data collection and analysis. In this type of approach, the participants' perceptions, feelings and experiences are the main object of study.

The key point of this humanistic anthropology is to give a voice to the participant. Indeed, people have the opportunity to free expression with their own words, without the limitations that pre-set questions with fixed answers can make. The researcher can also interact with the participants in order to deepen a notion or understand the point of view that the participant is making. This type of human-centric research allows the researcher to grasp the problem with a hollistic approach and to answer the research questions with detail including the human perspective of the participants. (Carson et alt., 2001)

3.3 Methods

Since this is a Qualitative Research with the aim to study a topic from the user perspective, the methods and techniques to use will be of Qualitative nature, as opposed to Quantitative.

In qualitative research, rather than one single method, the researcher uses a proliferating family of methods and techniques that constitute their toolbox. These available tools are ideally to be combined together and adapted to the study. Different methods are suitable for different purposes. The researcher will choose, depending on the purpose of the research, from a list of qualitative methods such as storyboards, walking through or card sessions, prototyping, cartographic mapping, as well as several purpose workshops.

In order for the researcher to respond to the Research Questions, three complimetary methods were chosen. These are Unstructured interview (Focus Group), Inspirational Cards, and Future Workshop. The methods are explained in further detail below

The participants

A total of 12 people participated in the study. In each sessions there was 4 participants. People were not selected for their specific knowledge in the topic or involvment in any way, or by age group, gender, social status or other situation. The selection was random and the only criteria is that they have dealt with the NHS at least once in their life, so they can be familiar with the healthcare services provided by the NHS in the UK. Additionnally, since there are 3 methods in use in this study, the participants were divided into 3 separate groups. For each group one session was used. Ensuring that no participant takes part into more than one session is important for the data collection in this study, because the main purpose of 3 separate groups was to ensure a higher reliability in the data. If one person took part in the first session and then into a second session, they could use the same thoughts and answers given by other participants in the first session and repeat them in the second session without necessarily thinking of it for themselves, which could be detrimental to the quality of data collected. Keeping the three groups and three sessions separate increases the reliability and quality of the findings by ensuring data triangulation, i.e. data from separate sources. The interest is to be able for the researcher to capture the data that is validated from different sources, for example different people expressing similar ideas and creating a trend to report in the findings.

In the pool of participants there was a number of participants that works directly or indirectly with the NHS, as well as others who work in a biotech start-up company who has a close relationship with the NHS (Suppliers of biotechnology products), and finally others who are only users of the NHS service as well as private healthcare services. This creates a good sample that represents the different stakeholders in this study.

Also, it is worth mentioning that all three sessions were held via digital social media platforms such as MS Teams, simply for the ease of organising and gathering 4 people in one meeting at one particular time.

3.3.1 Qualitative Method 1: Focus Group

The Focus group was held on Wednesday 13-April-2022 with four participants via a social media digital platform (Microsoft Teams). The session took approximately 30 minutes. The session was deliberately and purposefully to remain without a structure in order to help generate information on collective views, and the meanings that lie behind those views. It also provided the researcher with a rich understanding of participants' experiences and beliefs. Participants were therefore free to express their views and choose their topics and themes, as well as the way they decide to answer and use their own choice of words and structure. The researcher was able to interact at a certain capacity for the purpose of triggering the participants to become expressive but did not direct the session with specific topics to discuss or an agenda to follow during the session, and rather let participants direct themselves in that sense.

This method is particularly useful when the researcher seeks to introduce the subject of the research and explain the aim of the study, and then see how the discussion will go without interfering with pre-set ideas that the researcher may have prior to the participants' involvement.

As this method is unstructured, it is expected that it won't be sufficient and self-standing to have a full view of the study issue and complementary methods were needed in order to identify needs and desires that this previous session may not have helped to identify.

3.3.2 Qualitative Method 2: Inspiration Cards

A second session took place with a different group of 4 participants, also via MS Teams. The session was held on the morning of Thursday 14-April-2022 and the duration was approximately 35 minutes. The Inspiration card session is also an informal type of meeting where cards were shown by the researcher to the participants. Each card showed a topic or idea that the researcher wishes to inspire participants with and to discuss. According to Halskov and Dalsgård (2006) it is an excellent collaborative method that is used to inspire, explore key topics and ideas, and for participants to be expressive about their beliefs, emotions, and values. The Cards session is usually conducted in a relaxed manner which

makes participants at ease. Although informal in nature, the inspirational cards session is somewhat more structured than the previous method. While the unstructured focus group is used to gather information about participants' topics expressed freely without any intervention by the researcher, the card session follows a pre-set path as the topics are defined within the cards before the session takes place. This method is complementary to the first one as it helps the researcher collect ideas and views from participants about specific topics that are relevant to the research and which may or may not have been discussed in the previous method.

One example of a card could be a drawing of a smart phone. This may inspire the participant for instance to express how the phone was considered a tool or a lifeline to performing their work during the covid-19 situation. Also, some particular phone Applications may be discussed.

To conclude, the informal way and minimal structure in which this method is generally conducted, including sources of inspiration, makes it a highly effective method for many purposes and especially for idea generation, engagement, communication and empathy (Wölfel & Merrit, 2013).

For the purpose of this study, some inspiration cards included for example icons of social media apps such as Facebook, Twitter, Instagram. Another card showed an app with a doctor's cross and a hospital as an icon, another card showed a representation of 2 scenarios: one on the left showing a doctor sitting with the patient and explaining something on a board, and on the right side the same doctor in front of the laptop with the patient in the screen. This triggered the discussion on the topic going to the doctor's versus having a virtual consultation, and what benefits and disadvantages each of the methods comes with.

3.3.3 Qualitative Method 3: Future Workshop

The third and last session was held on the afternoon of Thursday 14-Apr-2022 and the duration was approximately 40 minutes. While the focus group is unstructured, and the inspirational card session is minimally to semi-structured, the Future Workshop is a highly

structured process with defined phases which are conducted within a frame of certain rules and restrictions.

This method, however, is relevant for the study as it focuses on to discuss future events and processes.

Jungk and Müllert (1981) argued that the method includes processes such as planning and enacting possible future outcomes, as well as involving participants to work through a joint proposal for change.

The future workshop is usually an appropriate method to use for a researcher when the research involves technology, simply because it is fast paced environment and the future filled with new technologies will evolve rapidly.

The future workshop is generally composed with 5 main phases:

- Preparation Phase: The space is prepared to provide the participants with a welcoming atmosphere to ensure they can think freely, with both critique and imaginative thinking

- Critique Phase: In this phase current issues are discussed and criticised.

- Fantasy Phase: In this phase imaginative thinking takes place, of an imaginary and perfect world, process, or set of events without taking any costs or other limitations into consideration. Participants are encouraged to let their imagination run free.

- Realisation Phase: This is an analysis phase where ideas are codified by themes or other criteria. Reality being the opposite of Fantasy, in this phase realistic factors are taken into account such as costs.

- Follow-Up Phase: In this phase conclusions are shared with participants.

The first two methods relate to time in the past and present. This method helped make a vision into the future and understand future processes and other action that could result crucial in similar situations.

The future workshop was also conducted virtually via MS teams and included 4 participants. No previous preparation was necessary from the participants side. The session started by the researcher giving a clear introduction of the topic and the impact of Digital technologies in the healthcare sector in the UK, and explaining the purpose, after which a constructive discussion started with the issues and problematics that the participants currently encounter while dealing with the NHS or a private clinic/hospital. At this stage a number of critique ideas were expressed and gathered together and added to a white sheet on the left side/ column. From this point we moved to prioritising the critique points to see which one is most important and least important to make changes and ameliorate. This was followed by the fantasy phase where creative ideas were encouraged and to respond to the question: how would you imagine a perfect healthcare service system to be? This was put down on the same paper in one separate column to the right of the critique column. From there, we moved to the realisation phase where we looked at some creative and idealistic ideas and asked the question: How can we reach this idea and concretly materialise it with the tools, technology and taking into account any other current limitations?

By the end of the session, we had a virtual board sheet divided into 3 main categories: The current issues & problematics on one side, the Ideal ideas in the middle, and finally the achievable solutions on the other side.

3.4 Data Collection

Steps were followed during the study period to ensure that the data is accurately and unbiasely collected, codified and analysed. The first step of the process is by conducting a literature review and checking what type of research and publications have already taken place by other researchers. This is an important step to anchor this research within the framework. The second step in data collection is to select participants that have the potential to contribute to the study, and arrange the different sessions. In the focus group session, the focus would be on preparing the presentation of the topic in order to trigger the group to start a discussion and share thoughts around the topic in hand. For the inspiration cards session, the inspiration cards are to be prepared by selecting specific themes that the researcher sees fit to discuss during the session. And similar to the inspiration cards, the future workshop was prepared by selecting the new technologies that are most likely to affect the future shape of digital technologies and the healthcare services.

During the sessions and workshop, concepts, themes and ideas would be introduced and shared with the participants, and their thoughts would be collected in the form of notes and meeting minutes. Silences and body language is also part of the data that was collected for analysis. The data collected would then be classified, or codified, and analysed to produce results.

Ethical considerations are to be taken into account during the entire process in order to ensure that trust between researcher and with participants is maintained, as well as the protection of privacy and security of the data collected.

And the final stage is the presentation of the data analysis in the form of a report or findings. To summarise the data collection and analysis process, the steps are listed below:

- Literature review
- Participants
- Sessions preparation
- Data Collection
- Data coding (classification)
- Data Analysis
- Consider ethical issues
- Present findings

3.5 Ethical Issues

Ethical issues to be considered are issues that are specific to the application of new technologies in general, and digital technologies in particular.

Indeed, one major issue is privacy & security. With the growing number of devices used and technologies applied such as big data, machine learning, the Internet of Things and Artificial Intelligence, so is the volume of data produced and sometimes as data flows from several sources the line of privacy and security can become difficult to maintain. Respecting the right of individuals to privacy is a major ethical consideration. In this sense, the participants were clearly informed of the nature and purpose of the study, and the level of participation and amount of time that is required of them, and also on how the data collected would be used and how their privacy would be respected.

For this purpose, a participant consent form was issued and shared with every participant. The form is enclosed as appendix A and explains the study process and involvement of the participants. It also esures that the researcher is aware of data privacy and security issues and provides guarantees for confidentiality and anonymity. The views expressed in the sessions will be kept separate from the identity of the participants. In terms of data storage, data collected would be secured and not stored for a longer period than needed for the purpose of conducting this study.

The consent form was prepared to address these issues and guarantee that these are taken into consideration during the study and correct action followed to ensure privacy and security, and maintain validity and reliability of the study.

4 Research Findings

In this section the research findings are presented, starting with a general overview of the participants views and perspectives. Data is also analysed and codified or classed into a number of categories or themes, this process is also called thematic classification.

4.1 Findings summary

The first finding is that everyone uses digital technologies and smart devices regardless of age, gender, social status, income or education level. Digital inclusion seems to be total as this has gradually been related to the introduction and development of smart phones in the market for the past 25 years. One participant made this apparent as they replied to the question “who uses a smart phone?” with “who doesn’t?”.

Digital technology is well introduced and applied through apps within the smart phone that everyone carries everywhere with them. The idea that each app has a specific functionality was developed through the card inspiration session, and the idea seems to be well established with all the participants and some examples were discussed, for example: “what is the use of Google Maps and what utility do you use it for?”. It was expressed that Google Maps for example, together with restaurants and food reviews has helped ease the travelling experience by making people act as a local in a town that they first visit. In the same theme of travelling, many examples were discussed, for instance the ease of which travel plans can be arranged with a simple application from the comfort of home, for example Skyscanner, trivago…etc, and all participants but one seemed to agree that there was no longer a need to physically go to a travel agent in order to organise a trip. Flights, hotels, car hire, experiences and days out can all be booked from one smart phone or a laptop connected to internet. Generally, this all indicated that digital technologies have helped reshape and improve many processes in several industries such as travelling, mobility, accessibility…etc.

From this theme, the trend was moved by method of analogy, or comparison, to the medical sector in both the focus group where participants shifted to it by their own initiative, and in the inspiration cards by showing a card including a picture of medical apps on the phone. In both cases the notes were similar, participants were hesitant, they could not remember or distinguish names of apps on the smart phone for medical purposes.

One participant expressed that the extent of using his smart device for medical purposes was to use Google Maps if he needs to see the location of a particular clinic to go to for an appointment, or to find out their phone number and call to arrange for an appointment.

Another participant naratted that they started to use web searches to find more information about specific symptoms and try to see what the issue is before deciding whether to approach a medical practice for a check-up. However, the majority of the participants concurred in dropping this method soon after the first searches as often times simple symptoms can show as dangerous life threathening illnesses on a web search, creating more concern and panic than normal.

Knowing that these are functions found in the NHS app, I proceeded to show a card that included the NHS app. The absolute majority of participants linked the app to covid. This is mainly because they reported having downloaded the app only to be able to get the vaccination certification in order to travel or enter public gatherings where this is required.

Participants reported no knowledge of further functions in the app apart of the covid specific information. Other participants reported trying to use it but the interface being difficult to use with links to websites rather than within the app and lots of reading material, which is not intuitive like most popular apps.

When asked to associate the main functionality that they think the app provides apart of covid certificates, the majority of participants were unable to find one definitive answer, and remained confused to what function the NHS app mainly provides.

This led the discussion to recognising that the app was only downloaded during the covid pandemic period and not in relation to any medical need or to perform administration

functions such as booking an appointment or requesting a virtual consultation or a prescription.

Moreover, most participants would link healthcare and medical apps to healthy lifestyle apps. All participants but one reported having used a healthy lifestyle app before at least once. However, just like with the gym, the motivation is there for the first few weeks and then the interest is reduced to a minimum and the app deleted shortly after for no specific and recurrent use.

Only one participant seemed to be aware of the array of possibilities and options offered by the apps linked to healthcare. For instance, this participant is suscribed to a private medical insurance, and the insurance company provides an intuitive app that includes functions such as request a virtual appointment. This function was used by the participant on one occasion to go through screening questions with a nurse before being able to obtain a prescription for puffer medicine for Asthma condition (Ventoline).

One interesting analysis that was reported in both the group focus and the inspirational cards session was that there is a sense of urgency when someone is sick and needs to see a doctor, and the first thought to seek help still is via calling the practice where registered in order to secure an appointment. The NHS app is not a choice when thinking to seek medical help. When asking about further thoughts of the NHS app, reports included difficulty to register and access information, difficulty to use the app generally compared to other apps, no clarity on the services provided via the app, and finally not feeling confident to achieve the function needed at the right time, for example booking a same-day appointment.

Through the inspirational cards, when showed apps of different healthcare providers in the UK, such as boots, participants were not aware of it and most reported that they did not have the app installed in their devices.

When shown cards representing travel vaccinations or other vaccinations such as vaccination for Meningitis B, Pneumonia, Chicken pox or HPV, all participants reported that they would arrange for an appointment by phone to check with their doctor in a face-to-face consultation prior to taking any of these vaccinations.

In the future workshop, and especially during the actual and critique phases, similar reports were echoed, highlighting the lack of clarity with app functionality and not being an automatic start point to be thought of when in need of medical advice, consultation or booking appointments. Also, during the pandemic lockdown, when needing medical attention the first action was to call the medical facility where the person is registered and request a call back by a medical practitioner or consultant for advice.

4.2 Data Analysis

The method followed in this research to analyse the data is thematic analysis. This proves to be an effective method in qualitative research because it provides an easy way to look at patterns and trends that emerge within the data collected.

In the thematic analysis 6 steps were followed as below:

- Data Familiarising: In this phase the focus is to ensure that the researcher is familiar with the data collected. Notes are read and re-read, recordings are reviewed.
- Data initial coding: In this phase several classes will emerge from the data collected and can be classified together with specific codes
- Detecting themes: In this phase the researcher will investigate the patterns to detect more apparent categories, or themes
- Thematic review: A review to ensure themes emerging are self-standing and independent from eachother.
- Defining the themes: In this phase themes are given a name and definition
- Reporting: Finally the researcher can move to the final phase and produce a report showing the main themes identified. (Braun & Clarke, 2006)

Following the thematic analysis process, the following themes were apparent:

User Awareness:

with participants of this study who are also users of apps, smart devices with digital technologies and applied to Healthcare services, it became apparent that user awareness is not as high for healthcare digital applications as it is for other applications such as travel, mobility, food…etc. Indeed, although the app is available and functions are there, people do not seem to be aware of it and do not necessarily think of this route when seeking medical assistance, consultation or advice.

Accessibility and ease of use:

This theme relates to accessibility issues that most participants reported. Using the NHS app to access services is not intuitive and there is too much material to read and the app keeps sending to NHS websites which are not designed to fit smaller devices such as smart phone displays. It was also reported that availability for same day appointments was not included in the NHS app which makes it harder to access the same service as via other means such as phone call or walk-in to the clinic.

Trust issues:

Another theme emerged to show that there are some trust issues related to the use of digital technologies by participants, mainly because the NHS app seems to be at national scale and people have become used to dealing with one medical practice. Trust issues relating to individual and private information, often sensitive information, being streamed through the NHS app. With the medical office, there is a perception that your data is secured within the boundaries of the facility rather than widely crossing multiple digital platforms and systems, increasing the risk of being misused or leaking to the wrong place.

Medical healthcare vs healthy lifestyle:

It seems that lifestyle apps have been gaining more interest than the NHS app. This is mainly due to the private nature of companies behind these lifestyle apps, and filling a void for a healthy lifestyle that could be interpreted as a healthcare service.

However, it was reported that the interest for these apps soon wears off and the app is deleted shortly after by the user as there is no consistent engagement on a daily basis and interaction between the app and the user.

Covid as a catalyser for increased digital use:

Many studies have shown the link between the covid situation with the lockdown period, and the increased use of digital technologies in the workplace for instance.

The tendency is that the healthcare services would have a similar trend. However, given the low frequency of healthcare service need (as opposed to working on a daily basis), and the lack of easy to use healthcare app, as well as the sensitive and private nature of the data involved, this has led to covid not being a catalyser to increasing the use of healthcare services via digital technologies.

New technologies for future services:

Services through digital technologies are best when used with high frequency, such as chatting and video calls platforms for work. In the future, all participants agreed to the idea that new technologies such as DNA mapping and DNA analysing will help bring a new offering in healthcare services that will be bringing value to the user on a daily basis and would complement the traditional healthcare services such as booking an appointment or accessing advice. Services such as DNA analysis and customised advice about food intake

and food products and their suitability with one's DNA profile would become popular as people are looking for ways to stay healthy and gain awareness and knowledge of what intake is good for them and what isn't.

4.3 Discussion

The validity and reliability of the study can be a topic of discussion, especially when a study involves one researcher, a recurrent item of concern is the level of objectivity or subjectivity of the researcher, as the reliability of a work can become compromised if the researcher adopts a subjective approach while conducting his work. (Ritchie et.al, 2003)

To address this concern, the choice of 3 different methods to apply in the research, as well as the choice of 3 separate groups of participants, is designed to ensure that data is collected objectively from 3 separate sources of information. The data collected from 3 pool samples and methods gives a high level of objectivity as the data is not all sourced from one single source of information but from three different ones. This method is referred to as triangulation. Similar to the triangulation method in locating a mobile device by determining the exact distance from 3 different sensors. Triangulation methodology in qualitative research will provide reliable and accurate information as it provides 3 sets of perspectives or angles on the same issue or topic of study. (Wilson, 2010)

Another method followed by the researcher in order to increase objectivity is the use of detailed, rich & thick descriptions. The more detailed the notes are taken, the higher the reliability of the data collected and the information drawn from it. The detailed description method was also followed in this research to ensure validity & reliability. (Creswell, 2008)

5 Conclusion

This thesis study looks into the healthcare sector in the United Kingdom (UK) and more specifically on the impact that digital technologies are having on this sector. Digital technologies are being deployed and implemented in all sectors and in most cases these have added some value, change, and improvements to the initial service offerings, making processes more efficient and timely.

The study develops an understanding, from the user perspective, of the impact of using digital technologies such as smart phones and apps like the NHS app. It also provides a basis of principle on the future digital services that users want to see included in the healthcare sector.

The empirical work is based on interpretive phenomenological Human-centred qualitative research in order to understand customers' experiences using digital technology such as smart phones and apps, and their expectations of additional new technologies that they wish to see in the context of healthcare services.

The research question is formulated as below:

From a user perspective, how have digital technologies shaped the healthcare sector and healthcare services in the UK?

The focal questions answered by this study are as follows:

- From a customer/patient perspective, is the end-user experiencing better healthcare services with digital technologies?

- How does the customer feel about sharing their health information?

- With the application of digital technologies, how can the healthcare services improve in the near/medium term future?

The methods and techniques applied in this research are a focus group, inspiration cards session, and a Future workshop. A total number of 12 participants were divided into the 3 different methods.

Data collected was analysed following the thematic analysis process and findings presented in a separate section showing 6 themes:

- User awareness
- Accessibility and ease of use
- Trust Issues
- Healthcare service vs. Healthy lifestyle
- New technologies and opportunities for new services

The study shows that although digital technologies have been deployed and implemented in a wide range of industries and sectors, improving traditional processes and increasing efficiency, reliability and traceability, in the healthcare sector, however, it seems to be lacking behind in term of positive implementation and use. Indeed, users did not show clear signs of using the apps as a first option when seeking medical advice, consultation or treatment. The traditional method of calling by phone to arrange an appointment is still currently prevailing. Although advances in technologies such as Big Data and Data mining techniques, machine learning and Artificial Intelligence have seen a clear advance in understanding and help early diagnosis, these are advances in the healthcare sector at organisational level. However, at individual level, there is still room for improvement to link the user to the service improvements due to digital technologies in the Healthcare sector.

The study also showed that there is a lack of awareness from the user mainly due to not using the service on a constant basis, as is the case for chat and video calls features in the workplace. Additionnally, trust issues remain apparent as the information is sensitive and private by nature, leading people to still trust the physical limits of a medical practice, clinic or hospital.

In the future, as the technologies continue to advance, especially in the field of nanotechnology and biotechnology, new digital apps will emerge with new offerings such as individual DNA analysis and advice based on unique genetic map. These offerings will be more engaging as users would use them on a daily basis when food shopping, or eating in general, and this would likely trigger a higher level of awareness and trust compared to today's levels.

This study paves the way to further research in the field. One interesting research point would be to know whether users are ready and welcoming to the idea of sharing their personal health data as well as data generated from their behaviour with private companies who would be in a position to present a revolutionary digital offering in relation to healthcare.

Another interesting point to investigate would be the interface and functionalities of the NHS app compared with other European states national health service app, and whether this affects the interaction and engagement of the user with an app that presents a supposedly easier accessibility.

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Appendix 1: Participant Informed Consent Form

Title of the Thesis

THE IMPACT OF DIGITAL TECHNOLOGIES ON THE UK HEALTHCARE: A Human-Centered Study

Researcher
Erika Kukoryte

Purpose of the Research
The purpose of this research is to assess whether, from your perspective as the participant, digital technologies are making a substantial differences in your life, as well as explore your expectations from current and newer digital technologies aimed at providing support to your needs and desires for faster and more reliable healthcare services.

The Benefits of the Research
The research focus is on new digital technologies and their ability to provide a tangible change and improvement in the healthcare services in the United Kingdom.

As mentioned in the title, the research is Human Centric by nature. This means that the study relates mainly to the perceptions, personal experiences and point of view of the participants who are assumed to have used at least once in one way or another digital technology and technological devices such as The Internet, smart phones, Apps…etc and looks into their needs and desires within the topic. A study of the people's views and experiences, to finding principles of viable solutions for the people using the technology.

There is no specific eligibility criteria to participate. However, it would be benficial to this study if participants have used at least one of the technologies when seeking and/or receiving healthcare services. This could be for instance using your smartphone or a personal computer to book a medical appointment, or have registered with a medical facility (Doctor's practice or a clinic/ hospital) via internet, or have had a medical consultation on video call instead of physically going and seeing a Nurse/Doctor, or have been able to request a prescription digitally rather than physically, or simply used the internet for information regarding particular medical issues.

This research aims in general to give a voice to the users of smart devices and digital technologies and represent their perspective as a full stakeholder in Healthcare services within the UK.

Your contribution will help shape your future in the way you interact with your healthcare provider and also the way you receive Healthcare services.

Participant Contribution

To participate in this research, you will be assigned by the researcher to take part in one of the virtual meetings below:

- Workshop with the researcher and around 3 further participants. Duration: Approx. 30mins;
- Session with the researcher and 3 further participants. Duration: Approx. 30mins;
- Group discussion with the researcher and further 3 participants. Duration: Open.

Participant Rights

Please note that your participation is on a voluntary basis and you have the right to withdraw it at any time if you no longer wish to participate and without the need to provide any type of explanation or justification.

The analysis of the research will be provided as research findings and will be shared with the participants showing general trends only. Commentaries, views, and direct quotes will not be linked to specific names of one or another participant, but rather reported anonymously.

Data and Confidentiality

Please note that pictures, screenshots and video recordings may be used in order to help the researcher with this study. Notes and other data gathered may be used for the sole purpose of this study and will not be shared with any third party.

Informed Consent Declaration

- **I have read and understood the above** **Yes☐** **No☐**
- **I am participating voluntarily** **Yes☐** **No☐**
- **I wish to participate in this research and give my consent to the researcher to make use of the information provided for the purpose of this study** **Yes☐** **No☐**

Participant Full Name_____

Date & Place _____

Participant Signature _____

Appendix 2: Focus Group presentation

Title of the Thesis

THE IMPACT OF DIGITAL TECHNOLOGIES ON THE UK HEALTHCARE: A Human-Centered Study

Researcher
Erika Kukoryte

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The Benefits of the Research
The research focus is on new digital technologies and their ability to provide a tangible change and improvement in the healthcare services in the United Kingdom.

As mentioned in the title, the research is Human Centric by nature. This means that the study relates mainly to the perceptions, personal experiences and point of view of the participants who are assumed to have used at least once in one way or another digital technology and technological devices such as The Internet, smart phones, Apps…etc and looks into their needs and desires within the topic. A study of the people's views and experiences, to finding principles of viable solutions for the people using the technology.

There is no specific eligibility criteria to participate. However, it would be benficial to this study if participants have used at least one of the technologies when seeking and/or receiving healthcare services. This could be for instance using your smartphone or a personal computer to book a medical appointment, or have registered with a medical facility (Doctor's practice or a clinic/ hospital) via internet, or have had a medical consultation on video call instead of physically going and seeing a Nurse/Doctor, or have been able to request a prescription digitally rather than physically, or simply used the internet for information regarding particular medical issues.

This research aims in general to give a voice to the users of smart devices and digital technologies and represent their perspective as a full stakeholder in Healthcare services within the UK.

Your contribution will help shape your future in the way you interact with your healthcare provider and also the way you receive Healthcare services.

Participant Contribution

You will take part in an informal 30 minute session with 3 other participants and with the researcher. The discussion will be unstructured and open, and will revolve around your experience with digital technologies in the healthcare sector. You do not have to prepare for the session or do any particular research on the topic, because the aim is to collect your own ideas and experience. You are welcome to share your thoughts and ideas as they come to you during the session, truthfully. You can also agree or disagree with other ideas shared by others during the session.

During the session

During the session the researcher presented the topic and the purpose of the study and explained how the data shared will be collected and used, ensuring participants' privacy.

General questions were asked to open the discussion such as:

- Who amongst you has used a smart phone, app, the internet or any other type of digital technology to seek healthcare services?
- What kind of healthcare services do you usually need?
- How do you normally seek medical advice, or book a doctor's appointment?
- Are there any benefits that you got from the NHS app or another compared to contacting your healthcare provider directly?
- What else can you add to this topic: using digital technology in the healthcare?

Appendix 3: Inspiration Cards Session | presentation

Title of the Thesis

THE IMPACT OF DIGITAL TECHNOLOGIES ON THE UK HEALTHCARE: A Human-Centered Study

Researcher
Erika Kukoryte

Purpose of the Research
The purpose of this research is to assess whether, from your perspective as the participant, digital technologies are making a substantial differences in your life, as well as explore your expectations from current and newer digital technologies aimed at providing support to your needs and desires for faster and more reliable healthcare services.

The Benefits of the Research
The research focus is on new digital technologies and their ability to provide a tangible change and improvement in the healthcare services in the United Kingdom.

As mentioned in the title, the research is Human Centric by nature. This means that the study relates mainly to the perceptions, personal experiences and point of view of the participants who are assumed to have used at least once in one way or another digital technology and technological devices such as The Internet, smart phones, Apps…etc and looks into their needs and desires within the topic. A study of the people's views and experiences, to finding principles of viable solutions for the people using the technology.

There is no specific eligibility criteria to participate. However, it would be benficial to this study if participants have used at least one of the technologies when seeking and/or receiving healthcare services. This could be for instance using your smartphone or a personal computer to book a medical appointment, or have registered with a medical facility (Doctor's practice or a clinic/ hospital) via internet, or have had a medical consultation on video call instead of physically going and seeing a Nurse/Doctor, or have been able to request a prescription digitally rather than physically, or simply used the internet for information regarding particular medical issues.

This research aims in general to give a voice to the users of smart devices and digital technologies and represent their perspective as a full stakeholder in Healthcare services within the UK.

Your contribution will help shape your future in the way you interact with your healthcare provider and also the way you receive Healthcare services.

Participant Contribution

You will take part in an informal 30-35 minute session with 3 other participants and with the researcher. The session will focus on your thoughts and experience with digital technologies in the healthcare sector. You do not have to prepare for the session or do any particular research on the topic, because the aim is to collect your own ideas and experience. You are welcome to share your thoughts and ideas as they come to you during the session, truthfully. You can also agree or disagree with other ideas shared by others during the session.

During the session, images will be shown to you one by one. Each image will refer to a specific topic that you can link to the topic of digital technology in the healthcare, and share the first thoughts that come to your mind. A discussion can take place from there where you are welcome to share any idea or experience.

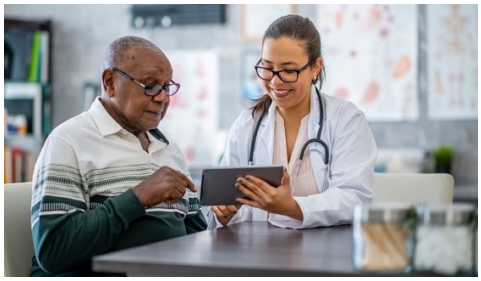
During the session

During the session the researcher presented the topic and the purpose of the study and explained how the data shared will be collected and used, ensuring participants' privacy.

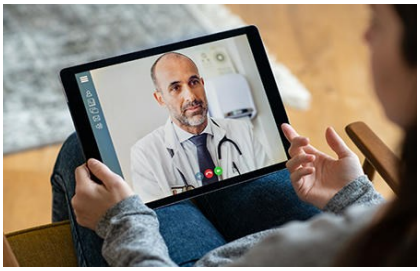
Images of several topics were shared, some of these images/ topics are as below:

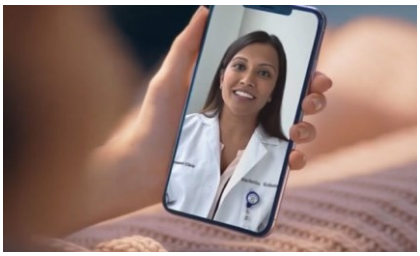
- Smart phones
- NHS App
- Going to the Doctor (Scenario A) vs. Doctor Online (Scenario B)

Scenario A



Scenario B





Appendix 4: Future Workshop | presentation

Title of the Thesis

THE IMPACT OF DIGITAL TECHNOLOGIES ON THE UK HEALTHCARE: A Human-Centered Study

Researcher
Erika Kukoryte

Purpose of the Research
The purpose of this research is to assess whether, from your perspective as the participant, digital technologies are making a substantial differences in your life, as well as explore your expectations from current and newer digital technologies aimed at providing support to your needs and desires for faster and more reliable healthcare services.

The Benefits of the Research
The research focus is on new digital technologies and their ability to provide a tangible change and improvement in the healthcare services in the United Kingdom.

As mentioned in the title, the research is Human Centric by nature. This means that the study relates mainly to the perceptions, personal experiences and point of view of the participants who are assumed to have used at least once in one way or another digital technology and technological devices such as The Internet, smart phones, Apps…etc and looks into their needs and desires within the topic. A study of the people's views and experiences, to finding principles of viable solutions for the people using the technology.

There is no specific eligibility criteria to participate. However, it would be benficial to this study if participants have used at least one of the technologies when seeking and/or receiving healthcare services. This could be for instance using your smartphone or a personal computer to book a medical appointment, or have registered with a medical facility (Doctor's practice or a clinic/ hospital) via internet, or have had a medical consultation on video call instead of physically going and seeing a Nurse/Doctor, or have been able to request a prescription digitally rather than physically, or simply used the internet for information regarding particular medical issues.

This research aims in general to give a voice to the users of smart devices and digital technologies and represent their perspective as a full stakeholder in Healthcare services within the UK.

Your contribution will help shape your future in the way you interact with your healthcare provider and also the way you receive Healthcare services.

Participant Contribution

You will take part in a 40-45 minute session with 3 other participants and with the researcher. The session will focus on your thoughts and past/ current experience with digital technologies in the healthcare sector, as well as future healthcare services that you ideally wish to see offered to you. You do not have to prepare for the session or do any particular research on the topic, because the aim is to collect your own ideas and experience. You are welcome to share your thoughts and ideas as they come to you during the session, truthfully. You can also agree or disagree with other ideas shared by others during the session.

During the session

During the session the researcher presented the topic and the purpose of the study and explained how the data shared will be collected and used, ensuring participants' privacy. Once the participants are at ease and seem ready, the researcher asked a few questions and collected answers and notes on discussions, some of which are listed below:

- What are the current services that you have benefited from when using healthcare apps like the NHS app?
- Are these less, equal or higher than the experience of going to the doctor or a clinic?
- What are the features and functionalities that you feel are currently limited in terms of services?
- What are the difficulties you have faced while trying to use the service digitally?
- What needs to be improved and how?
- If we imagined a world with no limitations whatsoever, how would you imagine the healthcare service to be for you through digital technology?
- If we could build a healthcare system from scratch with technology at its core to service the patient, how would we build it?
- Now thinking of the existing limitations, which idea can we realistically introduce and which idea would be hard to implement and why?