Introduction

For this dissertation it was important to look at what technologies are currently being developed in the Medical Technology sector. In an ever-expanding market it is important to look at what is involved with bringing new technologies forward and the difficulties with regulations for newer and emerging technologies. This paper will look at Artificial Intelligence (AI) and Deep Learning Programs, to generate questions and databases and to identify “risk factors” in a persons lifestyle based on information provided by the user. To store this information to a database. To try and gather information such as age, family history, cigarettes smoked, alcohol consumption. activity levels and compare the reported to the recommended

Artificial intelligence as defined in the Collins dictionary

“Artificial intelligence is a type of computer [technology](https://www.collinsdictionary.com/dictionary/english/technology) which is [concerned](https://www.collinsdictionary.com/dictionary/english/concern) with making [machines](https://www.collinsdictionary.com/dictionary/english/machine) work in an [intelligent](https://www.collinsdictionary.com/dictionary/english/intelligent) way, similar to the way that the human [mind](https://www.collinsdictionary.com/dictionary/english/mind) works. The [abbreviation](https://www.collinsdictionary.com/dictionary/english/abbreviation) [AI](https://www.collinsdictionary.com/dictionary/english/ai) is [also](https://www.collinsdictionary.com/dictionary/english/also) used.” (Collins, 2018)

The aim is to write an application using computer software for coding languages Python/Spyder.

To create databases with questions and different variables that a user can interact with.

The programme could be used to look for patterns in family history of disease to try and predict possible health complications in later life. Considering variables such as age, family history, smoker/non-smoker, dietary choices (poor, balanced and extreme/unusual diet like vegetarian and vegan, unusual meaning outside a normal balanced diet), activity levels, alcohol use.

A programme that can look through a person’s medical history for times of doctors’ visits and reasons for the visit. For example, a person suffering from chronic infections can have their data analysed to check for a pattern to see what may be triggering infection. A person with a heart condition can have their data checked against other people who have the same condition, again to look for more patterns and similarities.

AI can be used to help interoperate this kind of data at a much faster level. If done correctly it has the potential to be very useful for gathering and understanding data and information.

Data definition according to the Collins dictionary, in terms of AI;

“Data is information that can be [stored](https://www.collinsdictionary.com/dictionary/english/store) and used by a computer program.” (Collins, 2018)

Information in terms of AI:

“Information consists of the facts and [figures](https://www.collinsdictionary.com/dictionary/english/figure_1) that are [stored](https://www.collinsdictionary.com/dictionary/english/store) and used by a computer [program](https://www.collinsdictionary.com/dictionary/english/program).” (Collins, 2018)

This kind of technology is used very successful within social media and marketing campaigns as they can tailor advertisements based on a user input. An application that could do the same based on health information and history would be very beneficial in terms of saving time when compiling research into disease causes and treatments.

Literary Review

For this dissertation, literature on the following topics were researched and explored.

Starting with search terms such as Artificial Intelligence (AI) & Computer Sciences, Deep learning programs, Data mining, Standards and Accreditation, Electronic Health Records, General Data Protection Regulations (GDPR) and patient privacy (autonomy) and building from there.

One of the main topics is Artificial intelligence and the term Artificial Intelligence belongs to a broad spectrum. Exploring AI from an early concept to present technologies.

Artificial Intelligence

Artificial Intelligence was first spoken about as early as 1967 in a book called “The Shape of Automation for Men and Management”. This book speaks on topics relating to the distribution of work and how automation can help to distribute work more evenly. This paper refers to the fears people had at the time concerning automation. Meaning they feared automation as it would reduce the amount of available work. This however, is not true as automated services in many cases still need an operator to make sure a process will work, and that should any problems occur an operator is able to resolve them. As discussed in the book above it remains the case today that while the nature of work is changing and requiring people to “upskill” or re-train in areas that are becoming more automated.

Machine intelligence refers to smart systems in a computer/machine and includes automation. Robotics is a good example of AI but for this paper information systems and deep/computer learning is the focus. This will help examine the current state of AI.

Artificial Intelligence had seen large advancements by the 1980’s-2000. A paper written by David Welham explores how AI can benefit training and support. The abstract from his paper Welham states that:

“Since the beginning of the use of technology to support training and learning there has always been the belief that such new technologies would be able to add value either by reducing costs or increasing effectiveness. The 1980s and early 1990s were a period of enormous optimism as to the promise that such technology could bring. The governments of Europe and the US were generous in their funding of research in this area. In Europe research and development program such as ESPRIT, DELTA, RACE, ERASMUS and COMETT, to name only a few, funded a wealth of initiatives aimed at advancing the use of technology. At the margins of the early initiatives was the belief that AI must have a part to play in these developments. This paper reviews the early initiatives and suggests reasons why the potential for the use of AI in education and training has never been truly fulfilled.” (Welham, 2008)

This is a good example of what people may want to be achieve through AI systems versus what has been achieved but this paper is still a few years old. The results found that training can be achieved through AI but was not a cost-effective means to deliver training. The problems faced at the time this paper was published included a lack of memory available to a machine or program as well as computers not being as “mainstream” at the time, meaning computers were not as fast or available compared to the technologies we have today with an explosion in technology and the growth of the internet.

Deep learning & AI

Deep learning, regarding Artificial intelligence systems, refers to a computer’s ability to work with the data we feed it, interpret it and make decisions based off this information.

Papers relating to this topic include one by (OLCZAK et al., 2017) called “Artificial intelligence for analyzing orthopedic trauma radiographs: Deep learning algorithms--are they on par with humans for diagnosing fractures?”

This paper researches diagnoses via the use of deep learning, although this paper is from 2015 it is one of the most recent papers that are available. This paper was written to compare AI against humans for diagnose based on medical images of fractures in patients. They proved that with up to 80-90% accuracy, their code could process images and make a diagnosis.

Their testing was accurate as the only images they report not being usable were due to poor image quality or uncertainties.

They only tested against two Senior Practitioners. Having more senior members being tested against the AI may have altered the data, but for the purpose of their experiment it worked.

They were able to tell their program what to look for and how to categorise the images it was presented.

The term rubbish in rubbish out is true when it comes to AI and machine learning. The paper above showed that when AI is given a purpose and clear set of demands and rules it can function as good as a human.

Another paper focused on the use of data mining to improve customer satisfaction in public transport.

They describe what their program does as:

“Data mining techniques use a broad family of computationally intensive methods that include decision trees, neural networks, rule induction, machine learning and graphic visualization.” (Ma and Capri, 2014)

This paper showed how broad and sophisticated it can be to gather and interpret data. Their study was based on the population of Beijing.

GDPR, Privacy and the use of data

GDPR, General Data Protection Regulation. GDPR was introduced on 14th April 2016 and became enforceable on the 25th May 2018.

The following is the official guideline to GDPR as per their website,

‘One of the requirements of the GDPR is that, by using appropriate technical and organisational measures, personal data shall be processed in a manner to ensure the appropriate security of the personal data, including protection against unauthorised or unlawful processing and against accidental loss, destruction or damage. What is meant by “destruction” of personal data should be quite clear: this is where the data no longer exists, or no longer exists in a form that is of any use to the controller. “Damage” should also be relatively clear: this is where personal data has been altered, corrupted, or is no longer complete. In terms of “loss” of personal data, this should be interpreted as the data may still exist, but the controller has lost control or access to it, or no longer has it in its possession. Finally, unauthorised or unlawful processing may include disclosure of personal data to (or access by) recipients who are not authorised to receive (or access) the data, or any other form of processing which violates the GDPR’ as stated in Article 29 DATA PROTECTION WORKIG PARTY. In the official document they refer to themselves as “This Working Party was set up under Article 29 of Directive 95/46/EC. It is an independent European advisory body on data protection and privacy. Its tasks are described in Article 30 of Directive 95/46/EC and Article 15 of Directive 2002/58/EC. The secretariat is provided by Directorate C (Fundamental Rights and Union Citizenship) of the European Commission, Directorate General Justice, B-1049 Brussels, Belgium, Office No MO-59 03/075” (Data Protection Commission, 2018)

Under the guidelines set out in the GDPR documentation they have clear guidelines on what to do with a person’s data and how data may be shared used.

In order to use Data that would be protected under these guidelines data can be anonymised. According to the Data Protection Commissioner. "Anonymisation" of data means processing it with the aim of irreversibly preventing the identification of the individual to whom it relates. Data can be considered anonymised when it does not allow identification of the individuals to whom it relates, and it is not possible that any individual could be identified from the data by any further processing of that data or by processing it together with other information which is available or likely to be available.

“There is a lot of research currently underway in the area of anonymisation, and knowledge about the effectiveness of various anonymisation techniques is constantly changing. It is therefore impossible to say that a particular technique will be 100% effective in protecting the identity of data subjects, but this document is intended to give guidance on identifying and minimising the risks to data subjects when anonymising data. In the case of anonymisation, by 'identification' we mean the possibility of retrieving a person's name and/or address, but also the potential identifiability by singling out, linkability and inference.” (Data Protection Commission, 2018)

To bypass this a person would have to give consent for their data to be used, be able to enter their own details if they wish (or the GP to do so with written consent) into a database that could be linked up with the Electronic Health Records, that could all be stored in one place, where medical information can only be accessible by an account number, as well as GP details (GP name and address of GP office) to protect personal data but still be able to enter medical data. This also ensures that the data will be relevant/accurate as if it is entered in a GP office it can be verified as it is entered.

Data intended for the use of study and analysis would have to be anonymised to protect a person’s right to confidentiality and for the benefit of studies as data such as name and address might not be useful.

Health Level 7

One of the biggest contributors to health informatics relating interoperability and informatics is Health Level 7 (HL7). HL7 sets the standards for the interoperability and transfer of information between healthcare systems. On their website they state that they focus on the 7th tier of Open Systems Interconnection (OSI).

"Level Seven" refers to the seventh level of the International Organization for Standardization (ISO) seven-layer communications model for Open Systems Interconnection (OSI) - the application level. The application level interfaces directly to and performs common application services for the application processes. Although other protocols have largely superseded it, the OSI model remains valuable as a place to begin the study of network architecture.” (Health Level 7 International, 2018)

Interoperability is an ongoing problem within healthcare as many different types of machines can generate and store data.

An ECG machine for example can take and monitor a person’s hearth rate and vital signs while electronically storing this information.

If this information could be sent to a different server/database that relates to a patient, it could prove useful in the future for checking previous vitals against current to see if overall health has changed much. If a person’s heart rate is higher or lower than their previous reading it could be stored in the database and be attached to the patient profile for future analysis.

Clinicians could look for different heart rates and patterns to keep an overall profile on the condition of a person’s heart, the same could be done for blood pressure lung capacity, glucose levels.

This idea ties in with the Electronic Health Record but in a bigger scope. If every detail of a person’s life is recorded and stored in one central location It could prove useful in providing diagnoses and looking for causation into diagnoses as a bigger profile can be built electronically.

The biggest problem is interoperability. The application I want to use could be developed in the future to have different extensions added in so that no matter the source of the information the application will be able to sort through it and convert it into a useable function.

For this dissertation the focus is to have an application that can ask questions of a user and store that information to give out a reading of risk factors.

The idea is to use the following:

* Flow/State Diagram
* UML Class Diagram
* DataBase Diagram

IF YES

While

“Finished” == False

**Start**

Finished =True

Write Patient to database

If No

If Yes

If there are any questions left

Update Field in “Patient” Class

Answer Valid

Validate Answer

Not Valid

“Print not valid Try Again”

Enter Answer

Print Question [i]

IF NO