Literature Summary for MSci Project

There is ongoing research into using software such as apps to improve the healthcare received by patients and reduce the workload for doctors. The idea of having a chatbot to answer common patient questions, allow patients to enter data, etc. has the potential to do this within certain areas of healthcare. By reading the papers, I have been able to gather an understanding of the research that has been done into this area already, as well as some of the successes that the researchers are already starting to see. This shows the feasibility of this idea and the positive results that it can produce.

Starting from the feasibility study of a chatbot to help with paediatric obesity (Stephens et al.), we can see that the chatbot received very good results when analysed with regards to the metrics set out in the paper. However, as with the study of a smartphone-based healthcare chatbot to promote self management of chronic pain (SELMA) (Hauser-Ulrich et al.) the users in the study did not have much improvement over the control group in the study, i.e., the patients not using a chatbot. This shows that when it comes to patient self-care, the patients are not likely to receive as much of a quantifiable benefit from the chatbots. It could be argued that the benefits of the chatbot in these studies was more subtle, as most users reported that they liked communicating with the chatbot and did find it helpful, perhaps it is worth looking into the less obvious advantages in patient care that the chatbots can have.

For my research project, I am looking at developing a chatbot to help with cardiovascular awareness and education. This chatbot is meant to help people suffering from cardiovascular diseases find out more about their condition, and help them with the background knowledge around it. This is where the rest of the research papers considered here are exceptionally relevant. Most of the papers I have included are also about cardiovascular education using technology, some of which explore chatbots. From these papers I can see that the benefits of a chatbot like this are numerous. For example, Montagna et al. discusses a chatbot based recommendation system that educates people about blood pressure and home blood pressure monitoring. They used patient data and doctors’ recommendations to provide patients with more information about their blood pressure and what it means. The recommendation system exists to send messages to patients about their adherence to prescriptions. Being able to do this while the patient is at home and without having a doctor present can save a lot of time for both the patient and the doctor, as the patient would not need to travel to the clinic, and the doctor would not have to take an appointment for such a simple thing. This system was more about the aggregation of prescription data and blood pressure data to make recommendations to the patients about their specific problems, rather than education and awareness. This shows the many different ways that people are bringing technology into medicine.

Bringing in chatbots to the field of medicine may be able to greatly improve patient care outside of the hospital, as having an educated chatbot that can respond to patient questions at any time can help put patients minds at ease. This also reduces the patient interaction for the doctor, allowing them to see more patients and spend more time in other parts of their job. There has already been good amounts of research and development into chatbots in medicine, specifically the papers Echeazarra et al., Softic et al. and Chen et al. These papers are about chatbots that exist to provide information, educate and track trends with the patients’ symptoms. Since I am focussed on cardiovascular health and hypertension, I considered these three papers especially as they are in the same area. For example, Echeazarra et al. discusses a Telegram chatbot that can take in blood pressure data and track trends with it. This chatbot was created to allow patients to send blood pressure information to their doctor without having to go to the clinic. This chatbot has some preprogrammed commands and acts more as a basic communication agent. It can provide graphs of the patients’ blood pressure over time and some other auxiliary information but is otherwise very limited. The other 2 chatbots were created for educational purposes, with Softic et al. being about general medical education, and Chen et al. being more specific to cardiovascular health. Softic et al. also provides some good background information as it starts by detailing the background research that they did on other health chatbots however, they do not include any chatbots related to cardiovascular health in this analysis. This is beneficial to my research as it further confirms that chatbots are an emerging technology within medical education, but that there is a gap in the market for one focussed primarily on cardiovascular health. The chatbot developed and evaluated in Softic et al. can give a lot of information on a wide range of topics, but it cannot give out actual medical information that is known to have been approved by doctors. The chatbot developed in Chen et al. is different however. Since it has been trained on 222 videos and 45 medical documents by medical experts, it is able to give out information that can be confirmed by doctors as medically accurate, reducing the potential for patients to receive misinformation. The data was designed to be at an introductory level for patient understanding and was evaluated before use with the Patient Educational Material Assessment Tool (PEMAT). This means that the information given out by the chatbot will be accurate and easy to understand. As I am basing my chatbot response data on a website created by a doctor about cardiovascular health, I can also be confident that my chatbot will be able to provide information that is accurate and correct. The chatbot in Chen et al. is very similar to the kind of chatbot that I will be making as it is a chatbot about cardiovascular health education in Taiwan, however the paper does not include any evaluation or trails done by users. Therefore, there is still benefits to me creating this chatbot and analysing its effectiveness. This can allow for us to draw conclusions about what role the chatbot should fill such that it can help doctors and patients where they need it. These three papers about chatbots show that within healthcare, there are a lot of ways to look at introducing a chatbot, however the current focus seems to be on education. These papers were very helpful for me to understand the process of creating, testing and evaluating a chatbot in medicine.

There is also a good amount of research done on using machine learning to help with medical problems, Bhattacharya et al. is a paper that explores a remote cardiovascular health monitoring system. This is to help people find the most suitable medication for their cardiovascular health problems and uses machine learning to predict heart disease. The researchers proposed a system to remotely monitor the health of CVD patients. As part of this, they used a chatbot to perform a general medical interview with the patients. They also used other machines such as a temperature sensor, an ECG sensor and a blood pressure sensor. They then used machine learning to predict the likelihood of heart disease in the patients. Here we can see an example of the benefits technology can have within cardiovascular health, as an accurate prediction of heart disease could help patients catch on earlier and prevent it. This paper compares different machine learning algorithms and bases them on their prediction accuracy and found that neural networks were 98.59% accurate, which is a collated accuracy from a set of fourteen variables. This paper does not focus as much on creating and testing a chatbot however it is still relevant to my research as it allows me to see the other work people have done in this area and how they are looking at improving patient care out with hospitals.

There is also some research work that has taken a selection of mobile apps designed to help with hypertension and analysed them, one such paper is Alessa et al. While these apps are not necessarily chatbots, this study provides a lot of background information on what options are already available to suffers of cardiovascular diseases. The analysis of these apps allows me to see what other people have done to help patients, and how effective the ideas have been. Their evaluation showed that most of the apps received positive reviews on the mobile game stores and have been met with general success. This helps me to understand what people are looking for in an app about cardiovascular health and how my chatbot can help provide that.

Overall, I would say that this project has the potential to fill an essential gap in patient care, allowing easy access to essential information and educational resources without the input of a medical professional. The chatbot I am developing will be using the information from the Optima BP website about blood pressure and hypertension, this means that medical professionals have written the information. This solves the problem with some of the chatbots I have looked into as there is a reliable source behind the information and therefore patients can act on it with more confidence. This chatbot will also be able to include/link to educational videos helping people see visual demonstrations of medical procedures like a blood pressure reading, this will especially help users that are trying to take their blood pressure at home and are unsure about it. The current state of the chatbot allows users to select the information that they want from multiple different menus, with the chatbot providing only the essential information to answer the users’ question. This will hopefully cut down on the excess information the user is exposed to that may make it harder for them to find what they are looking for. In future development, the plan is to implement typing input such that the user can ask questions to the chatbot directly, this will further cut down on the time the user spends trying to find the information. A large language model or a machine learning implementation is being considered for improvements to the chatbot, this can make it more conversational and allow it to properly work out the intent behind user messages. This will improve the accuracy of the chatbot and lower the rate of incorrect responses.