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Hi, my name is Aaron Willis. I am currently studying towards my Postgraduate Diploma in computer Science and today I will be presenting a research proposal based on the literature review topic that I submitted in the last assignment. Please note - This will not be used as a capstone project for the MSc

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The research question for this proposal is: What are the main barriers to the approval and implementation of new machine learning tools for the prediction of patient outcomes during weaning by the NHS and how can these be overcome to streamline the process and ensure important innovations such as these are implemented?

The primary aims and objectives of this research are:

To undertake a critical analysis of the pathway for the approval and implementation of new tools and techniques in the NHS.

To identify key decision makers, such as clinical application specialists and consultants, and to identify potential problem areas in this process.

To investigate how these issues and barriers can be overcome to get new innovations into clinical use.

And finally, to identify any trends in user resistance due to, for example, age, experience or other factors.

I will be using a machine learning tool for the prediction of patient outcomes during the process of weaning from life support mechanical ventilation as an example.

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I have selected this topic of research as I believe the underutilization of new innovations is a significant issue for the NHS and overcoming these challenges, and therefore streamlining these processes, can be very beneficial for the industry.

I have a strong understanding of the NHS processes, ventilation and weaning procedures and have many contacts within Intensive Care units and the Medical device industry.

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Machine learning technology can be a powerful tool which has already proved to be of significant value to the healthcare industry, however the healthcare industry is notoriously slow at approving and implementing new technologies and putting them into practice.

Understandably the medical industry is heavily regulated which can lead to significant difficulty in getting new tools and techniques approved for use. Other barriers such as user resistance, difficulty in recruiting multi-disciplinary teams to test these tools, training issues and many other issues has lead to the underutilisation of many techniques which could be very beneficial. By identifying these barriers, we can learn to overcome them to get new tools and techniques into practice which would provide value to doctors, patients and the healthcare industry as a whole.

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Some of the key literature for this research is listed here. Many studies have shown the value that machine learning algorithms can have within this area of medicine. For example, Fabregat showed, using a support vector machine algorithm on a sample of patient data that the predicted extubation failure rate can be reduced from 9% to 5.4% which can lead to significantly improved outcomes for the affected patients. Huang showed similar results

using a Random Forest algorithm, with failed extubations reducing from 12% to 8%. These studies illustrate the impact that such models can have on patient outcomes.

However, there are many barriers to the implementation of such models as discussed in the following literature:

Kononenko describes how machine learning has historically been heavily underutilised and presents some hypotheses on why this is the case. Foster observed that there is an extremely high volume of machine learning tools that are available, many of which are of questionable quality, and discusses the issues with identifying the most accurate and useful models available. Jarrett also discusses some further limitations to such tools and the need for caution before adopting them into clinical settings.

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This project will fall under the Exploratory research category, since the goal will be to generate insights and the research will be open ended.

I will also be using a qualitative method of research, data collection and data analysis because given the subject of this research I believe this is the most suitable method.

To begin, a thorough literature review will be undertaken to fact find and provide a starting point. The focus of this review will be in identifying the process in which new tools are identified, approved for use, and finally implemented within a clinical setting. Through this I will identify the key stages and the key decision makers and gain an initial understanding of the key issues with the process.

Following this, a small number of unstructured interviews will follow with key decision makers. These interviews will be used to create a survey, which will then be distributed to a greater number of participants. The results from this survey will then be analysed.

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As mentioned in the previous slide, the first stage will be a thorough literature review. I will focus on identifying:

- The approval requirements for new procedures in the NHS
- Key decision makers and approval bodies
- Implementation procedures
- Key issues and barriers

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The next stage will be the development and distribution of a questionnaire containing a mix of open ended and closed questions. This will be based on the information gathered from literature review and the interviews.

I will use a medium such as survey monkey and will distribute it to the target participants via email. In order to increase response rate I would reach out to staff in Intensive care units throughout the country.

While the responses will be anonymous, some key information such as age, position and level of experience will be requested in order to recognise potential trends in user resistance for example.

I will initially send the questionnaire to a small number of sample participants, in order to get feedback and ensure it is of a suitable quality.

I will then amend the questionnaire accordingly before sending out to a larger group of participants.

The target participants will be a mixture of Intensive care based clinical staff, namely:
Consultants, Doctors and ICU specialist nurses.

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The analysis of the gathered data will primarily be qualitative due to the nature of this research. Many of the responses will be open-ended and therefore a quantitative analysis would not be suitable.

Qualitative analysis will be required during the literature review and interview stages in order to develop the questionnaire.

I will use a software package, such as NVivo to clean and code the data gathered from the responses to the questionnaire.

All results will then be presented via discussions, tables and where applicable, diagrams such as bar charts.

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Aside from the research related ethical considerations, we must also consider any additional concerns relating to medical practice. No patient data will be collected as part of this research.

All participants will take part voluntarily and will be given the opportunity to do so anonymously. They will be treated fairly and equally.

The Confidentiality of all data will be ensured. Any data collected will be limited to only what is necessary and will be securely stored.

Any participant bias will be recognised and accounted for.

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This research has a 6-month (24 week) timeline for completion.

During the first 2 weeks I will be completing a Literature review.

In Weeks 3 and 4 I will then Design interview questions and arrange interviews

During week 5, I will be Carrying out the initial interviews

In Weeks 6 and 7, I will be analysing the information gathered during the literature review and interviews to Create a questionnaire and identifying potential participants.

From Week 8 to week 10 I will Send out the questionnaire to a small sample group and amend based on any feedback I receive.

In Weeks 10 to 15, I will then Send out questionnaires to all participants and follow up for responses

Weeks 15 to 19 I will focus on the Qualitative analysis of all responses

And finally during Weeks 20 to 24 I will Write up findings and complete report

Thank you for taking the time to watch this presentation.

References

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- Huang, K., Hsu, Y., Chen, H., Horng, M., Chung, C., Lin, C., Xu, J. & Hou, M. (2023) Developing a machine-learning model for real time prediction of successful extubation in mechanically ventilated patients using time-series ventilator-derived parameters. *Frontiers in Medicine* 10
- Jarrett, D., Stride, E., Vallis, K. & Gooding, M. (2019) Applications and limitations of machine learning in radiation oncology. *The British Journal of Oncology*. 92(1100)
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