Scientific abstract

KEY RESEARCH QUESTIONS

1. How do stroke centres vary in their selection of patients for thrombolysis (IVT) and thrombectomy (MT)?
2. How does variation in use and speed of IVT and MT affect patient outcomes, in-patient length of stay, and discharge destination?
3. How can the digital twin model and web app user interface be implemented, embedded and normalised in practice to inform improvements in service delivery? a) What are barriers and facilitators to implementation? b) What resources should be developed to facilitate implementation?

BACKGROUND

The NHS long term plan for use of IVT in stroke is 20% of patients. The actual use is 11%, with individual hospitals ranging from 5-25%. It is estimated that 15% of stroke patients could be suitable for MT, compared to actual use in 3% of patients. Using clinical pathway simulation and explainable machine learning we have previously shown that the majority of variation in use of IVT comes from variation in selection of patients for IVT, and we have identified key subgroups of patients where variation is highest, and where explainable machine learning of outcomes predicts thrombolysis improves outcomes. These models (including clinical simulation to model patient flow) are made available to teams via a web app. We wish to extend the modelling to include MT, and modelling of inpatient lengths of stay with and without IVT and MT.

AIMS AND OBJECTIVES

We will build on previous work in substantial ways:

1. Extend the pathway simulation and explainable machine learning to include MT (in addition to IVT).
2. Extend model output to predict inpatient length of stay and discharge destination (in addition to likelihood of receiving treatment, and disability at discharge).
3. Update IVT modelling to include latest stroke guidelines for extended use of IVT.
4. Combine all modelling in a single 'digital twin' model that is accessed via a web app (targeted at stroke leads and Integrated Stroke Delivery Networks).
5. Identify barriers and facilitators to adoption of the above modelling and identify what training materials are required to support adoption.

METHODS

Individual patient flow will be modelled with discrete event simulation. Individual patient clinical decision making and outcomes (in-patient length of stay, disability on discharge, discharge destination) will be learned and modelled with explainable machine learning. A resulting web app will be produced using Streamlit.

Qualitative work will prospectively examine barriers and facilitators to implementation using Normalisation Process Theory via ‘real-life’ vignette interviews presenting modelled data (n=40). The web app will then undergo qualitative usability testing via Think Aloud interviews, followed by co-production workshops to develop theory-informed implementation resources.

TIMELINES FOR DELIVERY

The project will take 2 years to complete from September 2024. Additional capability of the modelling will be added to the web app as it is developed.

ANTICIPATED IMPACT AND DISSEMINATION

By working with the National Stroke Audit and as part of NHS England's 'Thrombolysis in Acute Stroke Collaborative' (working to improve thrombolysis use in England), we have excellent routes to lever impact. The potential impact is to improve patient outcomes in stroke by better use of thrombolysis and thrombectomy, and by reducing unwarranted variation in emergency stroke care. Work will be disseminated through open code, a web app, and academic publications and presentations.