WHICH WAY SHOULD THE AMBULANCE TURN?
IS TIME TO HOSPITAL ARRIVAL OR TIME TO TREATMENT IMPORTANT?

Kerry Pearn[1*], Michael Allen[1], Martin Pitt[1], Ken Stein[1], Martin James[2]
*k.pearn@exeter.ac.uk [1]NIHR CLAHRC South West Peninsula (PenCLAHRC), University of Exeter Medical School, UK, [2]Royal Devon and Exeter NHS Foundation Trust, UK

Background

For acute ischaemic stroke, onset-to-treatment (OTT) time is critical to the efficacy of thrombolysis, reducing rapidly over the first few hours. After the patient calls for emergency help, the call-to-treatment time is determined by the performance of the healthcare system. Ambulance crews respond to this urgency by conveying patients to the closest hospital providing hyperacute stroke care. However, this disregards that there remains significant variation between the hospitals arrival-to-treatment (ATT) times. The earliest treatment may be achieved by travelling to a more distant hospital that has faster ATT times, Fig. 1.

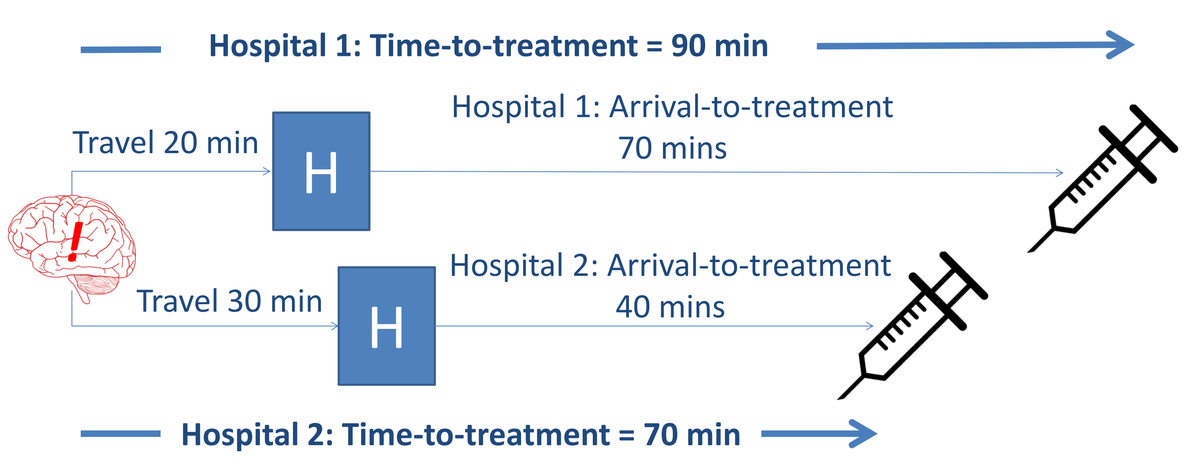

Fig. 1. Example of where choosing the closest hospital may delay treatment

We examined an acute stroke care system to see how frequently choosing the closest hospital may lead to delays.

Methods

We modelled the combined effect of ambulance call-to-arrival times and hospital ATT times. We modelled a system in South West England (population 4.5million, 201 people/km^2) with 14 acute hospitals receiving over 7,500 acute stroke admissions per year. Stroke admissions by geographical area (LSOA) were obtained from Hospital Episode Statistics (HES) using Lightfoot SFN tool (http://www.lightfootsolutions.com/), Fig. 2.

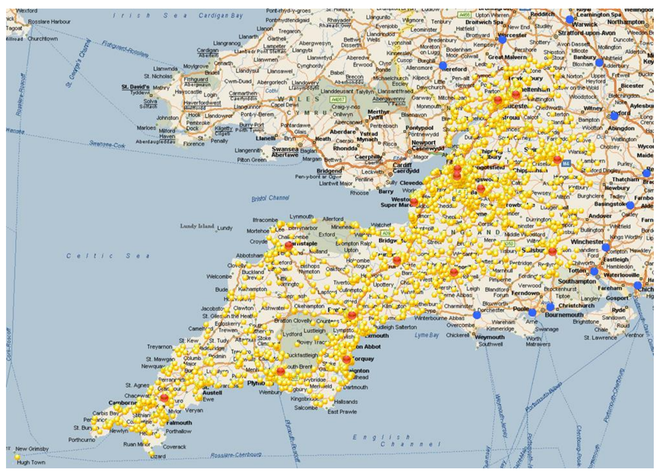

Fig. 2. Map showing patient nodes (yellow), in-region hospitals (red) and out-of-region hospitals (blue). Out-of-region hospitals are assumed to remain open in all modelled scenarios

Predicted ambulance travel time from each patient LSOA to each hospital was derived from Microsoft MapPoint. Median ATT times for each hospital were obtained from Sentinel Stroke National Audit Programme (SSNAP) data (2013/2014)[1].

For each patient location the OTT time was calculated either:

1) choosing the closest hospital and adding the hospital's ATT time to the shortest travel time (Fig. 1, hospital 1)
2) choosing the hospital which would result in the fastest treatment after combining the ambulance transport time and hospital's ATT time (Fig. 1, hospital 2)

Outcome

Clinical benefit was estimated based on modelled OTT times, applying the described relationship between OTT time and the probability of being disability free at 3-6 months[2].

Results

26% of patients have a delay in treatment when closest hospital is used as the method for choosing which hospital to attend, Fig. 2. Those patients have their treatment delayed by 9 minutes, on average, with the maximum delay for any patient being 35 minutes. The majority of delays are less than 10 minutes, however 5% of all patients have a potential delay of more than 15 minutes. Choosing where to take a stroke patient based on the shortest call-to-treatment time equates to ~9 additional patients having a positive clinical outcome in this region.

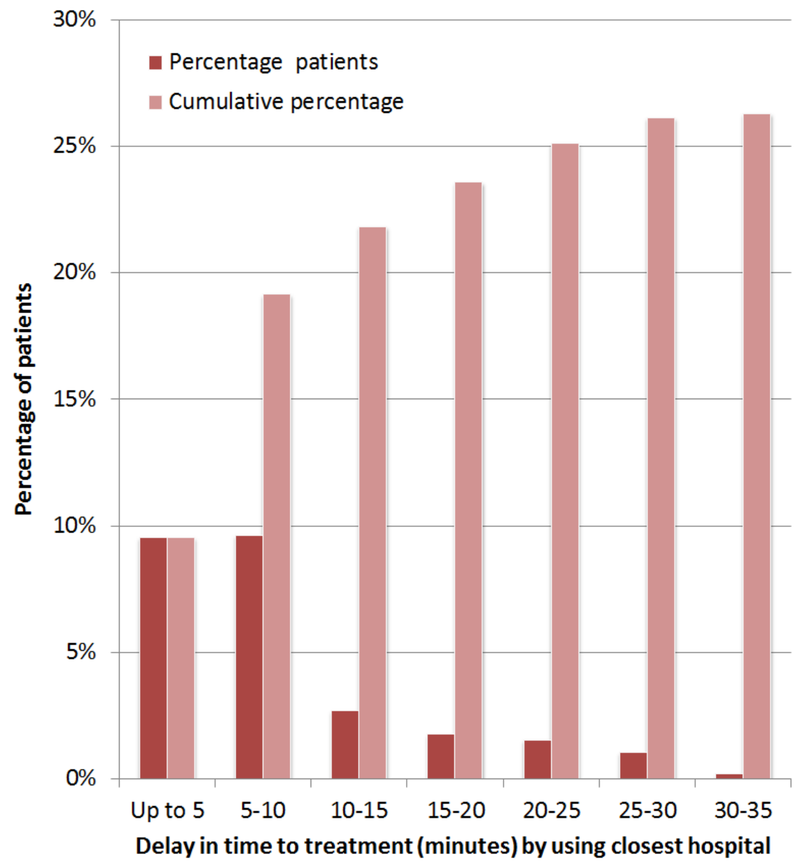

Fig. 3. How frequently choosing the closest hospital may led to delays in treatment, and the extent of those delays by 5 min time zones

Conclusions

In South West England choosing the hospital which is fastest to travel to potentially delays thrombolysis treatment by more than 15 minutes for 300-350 stroke patients per year.

Geographical analysis involving the whole hyperacute stroke pathway, from call to treatment, could have a significant impact on the overall clinical benefit from time-critical treatment for hyperacute stroke through the improved selection and use of hospitals delivering the quickest treatments to the greatest number of patients.

References

1. SSNAP Annual Portfolio for April 2013-March 2014 admissions and discharges: https://www.strokeaudit.org/Documents/Results/National/Apr2013Mar2014/Apr2013Mar2014-AnnualResultsPortfolio.aspx
2. Emberson J, Lees KR, Lyden P, et al. Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials. Lancet 2014;384(9958):1929-35.

NIHR CLAHRC South West Peninsula
NHS National Institute for Health Research
University of Exeter Medical School