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It's time to act FAST: A quality improvement program (QIP) to improve acute stroke imaging times

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Abstract

Introduction

We performed a retrospective review of the stroke imaging times in our institution prior to, and following the implementation of a QIP to improve the acute stroke imaging pathway.

Methods

As part of the QIP, three changes were introduced; a new dedicated mobile was carried by the radiology registrar, the need for stroke team review prior to transfer to CT was abolished and a protocol for immediate transfer of the patient from the emergency department to CT was established.
A retrospective review was performed of all the CT Brain Fast Positive (CTB-FB) studies was prior to the QIP, after the QIP and again one year on.

Results

Prior to the QIP, mean time from request to imaging (2020) was 32.9 minutes. Immediately post QIP in 2021, mean time was 21.3 minutes and one year post QIP, mean time was 22.08 minutes.
A statistically significant reduction in time to imaging was identified between 2020 and 2021 following introduction of the QIP (p=0.0001). This was sustained one year later with time to imaging significantly shorter in 2022 compared to 2020 (p=0.0003).

Discussion

Rapid imaging is the cornerstone of acute stroke management. Expediting imaging in suspected acute stroke will improve patient outcomes.

Introduction

Time is brain. In one minute of ischemia, 1.9 million neurons die and the brain ages approximately 3.6 years each hour without treatment[1,2]. Acute stroke is a medical emergency which despite recent improvements in reperfusion techniques can result in significant morbidity and mortality for patients. Stroke places a large financial burden on the healthcare service due to the long-term labour-intensive care required in cases of severe disability post stroke[3].

Rapid imaging is the cornerstone of our diagnostic pathway in acute stroke. Time to intervention correlates with the severity of outcomes[1,4]. National guidelines recommend a door-to-imaging time of less than 60

minutes in suspected stroke[3,8]. The National Office of Clinical Audit (NOCA) published the 'Irish National Audit of Stroke Report' in 2020 and in our institution, there were a documented 193 ischaemic strokes diagnosed in 2020.[3] This 2020 published national data reports a national median time from 'door to imaging' (DTI) of 63 minutes in cases of suspected ischaemic stroke in Ireland. In cases of patients who underwent thrombectomy, Irish data from 2020 reports a median national DTI of 23 minutes.[3]

A well-documented measurable improvement in door to imaging time occurs when clear protocols and steps such as immediate CT transfer are appropriately implemented.[5, 6]

In April 2021, a quality improvement project (QIP) was initiated in St James's Hospital to improve the acute stroke diagnostic imaging pathway. In this paper we describe our quality improvement project and the subsequent improvement in our time to imaging.

Methods

This quality improvement project was undertaken as a combined project with input from the radiology department, stroke medicine department, emergency department and ancillary support staff in St James's Hospital. The project was designed to clarify and improve structures already in place and introduce new processes where required. The first step was to codify the current St James's Hospital acute stroke imaging pathway. Subsequent potential pitfalls in the patient journey to the CT scanner and barriers to rapid imaging and interpretation were identified. These included unreliable communication methods between the emergency and radiology departments; typically via several different landline phone numbers which may or may not be attended during the day. The lunch time hour from 13:00-14:00 was identified as a particular risk period. Additionally, confusion from the emergency department and radiography staff regarding initiation of patient transfer from the emergency department to the CT scanner was identified. In addition, as is frequently the case in busy CT control rooms, the landline phone in the emergency CT scanner was frequently engaged leading to further difficulties in confirming transfer. There were also delays in patient transfer due to tasks such as attaining intravenous access, taking bloods, recording vital signs and patient registration. Delay of patient transfer to the radiology department whilst awaiting unnecessary stroke team patient review was also identified.

These key issues were disseminated to the relevant stakeholders and following a period of consultation a number of important changes were implemented.

A dedicated radiology department stroke mobile phone was procured. This was to act as a hotline from the emergency department to the radiology registrar on call at the time of acute stroke imaging request. Activation occurs via a single bleep which conveniently also contacts the stroke team to alert them to the presence of a code-stroke in the emergency department.

The open communication loop between radiology, radiography and the emergency department was closed. All discussion with CT radiographers was undertaken by the radiology registrar. At the time of contact to the radiology registrar, the emergency department staff were instructed to instigate transfer to the scanner

Prioritisation of imaging and patient transfer to the CT scanner was adopted as a key strategy. Failure to site an IV line or take bloods was deemed not a barrier to a non-contrast CT brain and the potential to site a line while in the scanner was highlighted to the emergency department.

The previous requirement for stroke team review prior to transfer for neuro-imaging was abolished.

In addition to these changes, the radiology department reviewed the acute stroke scanning protocol. Variations in imaging protocolling were identified. The protocol used was often dependent on the personnel involved and was generally determined at the time of image acquisition. Radiology registrars and emergency CT radiographers were advised that the default imaging bundle should include CT angiography (CTA) and CT perfusion (CTP), thereby reducing the time previously taken to determine the most appropriate imaging protocol by ensuring standardisation.

The QIP changes were communicated to stakeholders and implemented in April-June 2021.

Following implementation of these changes, after an appropriate adjustment time of six months, the lead author performed a retrospective review of the radiological reports and electronic patient record of all CT Brain Fast Positive (CTB-FP) studies performed during October-December 2020 and October-December 2021. These time periods represented a random consecutive three-month period prior to and post the implementation of the QIP.

Patient age, time of CT brain request and image acquisition time were recorded. The time from CT Brain request to imaging timestamp was chosen as the key performance indicator (KPI).

Statistical analysis was performed using Student's T test with a two-tailed hypothesis for continuous variables. Mean and standard deviation values were calculated using Microsoft Excel's intrinsic statistical package. Results were considered statistically significant where $p<0.05$.

Results

October-December 2020
82 patients were imaged via the CT Brain Fast Positive (CTB-FP) protocol between October 2020 and December 2020. The mean patient age was 70 years in 2020 (Min 30 years; Max 92 years). The mean time from request to imaging was 32.9 minutes (95% CI 28.1 to 37.7) and the median time was 28 minutes.

October-December 2021
81 patients underwent CTB-FP studies during October to December 2021. The mean patient age was and 66 years (Min 20 years; Max 103 years). The mean time from request to imaging was 21.3 minutes (95% CI 19.1 to 23.6) and the median time was 20 minutes.

April-June 2022
96 patients were imaged between April and June 2022 via the CTB-FP pathway. The mean time from request to imaging was 22.08 minutes (95% CI 18.95-25.82) and the median time was 18 minutes.

Reductions in stroke imaging times
A statistically significant reduction in time to imaging was identified between 2020 and 2021 with a mean time reduction of 11.6 minutes (95% CI 7.2-16.9, p=0.00003).
These improvements in imaging times were sustained one year later with time to CT significantly shorter in 2022 compared to 2020 by a mean of 10.82 minutes (p=0.00045).

Figure 1: Old Acute Stroke Imaging Pathway.

CT: Computed tomography, ED: emergency department, CTA: CT Angiogram, CTP: CT Perfusion, NIMIS: National Integrated Medical Imaging System.

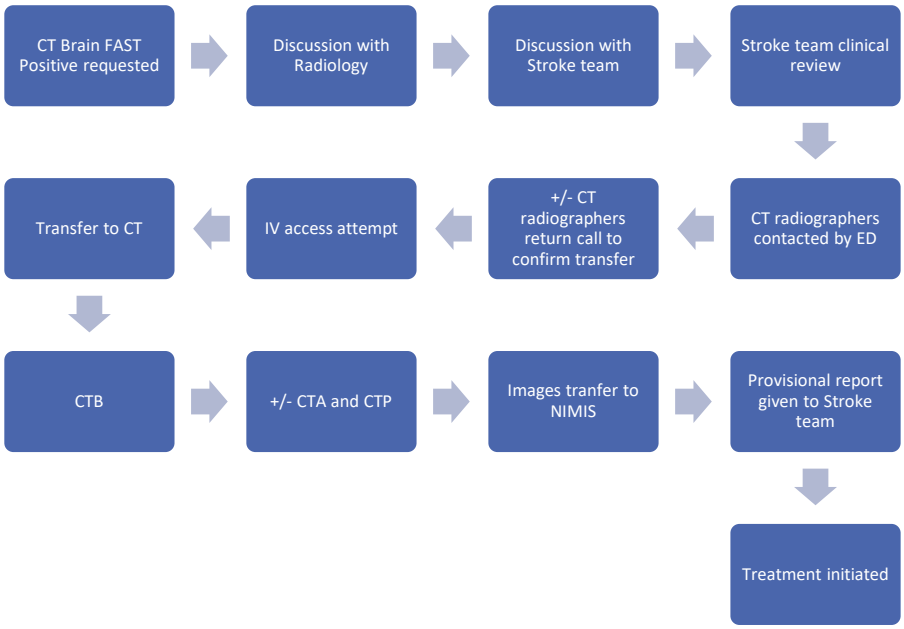


Fig 2: New Acute stroke imaging pathway.

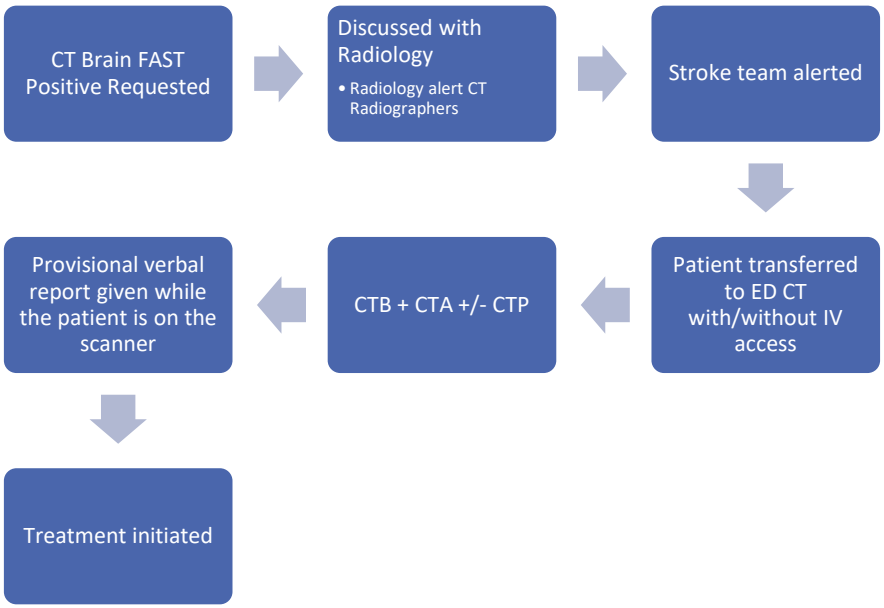
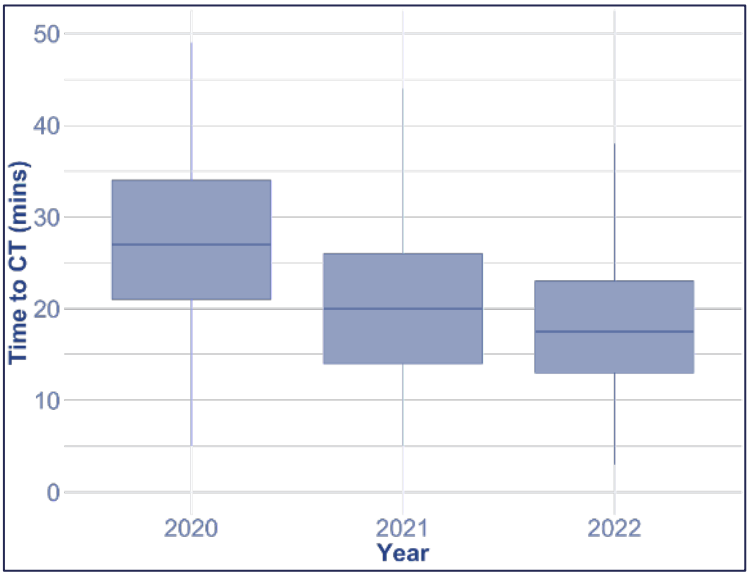


Table 1: Mean and median times (minutes) from CT request to image acquisition.

Year	Mean (min)	95% CI (min)	Median (Min)
2020	32.9	28.1-37.7	28
2021	21.3	19.1-23.6	20

2022	**22.08**	**19.0-25.8**	**18**

Fig 3: Box and whisker plot showing mean and IQR of time-to-imaging in 2020, 2021 and 2022 (minutes).



Discussion

Improving door to treatment (DTT) time improves patient outcomes.[7,1] Each one-hour delay in reperfusion is associated with increased disability and reduced independence.[1] It behoves institutions to put in place protocols which minimise time to imaging; a surrogate marker for DTT.

Quality Improvement

Quality improvement is a core function of healthcare professionals. Engaging with quality improvement allows clinicians and trainees to improve patient services and build relationships between departments.[9] Good quality improvement projects require several steps including; the identification of an achievable measurable improvement, identification of barriers, implementation of a quality improvement intervention, stakeholder feedback and measurement of improvements.[9]

Barriers to change

Unfortunately, many quality improvement projects start and end with initial data audit. (9) This can be due to institutional inertia, trainee churn and the setting of unattainable change. (9) Designing simple, non-labour-intensive, yet attainable changes to protocol helps ensure a QIP achieves buy-in from all quarters. Good communication from the outset with key stakeholders gives the department a sense of project ownership and helps to achieve interdepartmental cooperation.

Enhance communication methods

Make life easy for people. Even with modern communication modalities, contacting specific people in a busy department can be challenging. Minimising the amount of time the emergency department doctor spends

attempting to contact the radiology and stroke teams is an obvious time and resource-effective intervention. Establishing a rapidly activated telecommunication system which minimises the amount of wasted time contacting relevant services must be a priority for any acute stroke protocol. Using a single bleep to contact a dedicated radiology mobile phone and simultaneously send a code-stroke to the stroke team significantly reduces time spent on the phone for the emergency department doctor. This saved time can then be re-allocated to direct patient care and to ensuring the timely transfer of the patient to the radiology department. This therefore translates into enhanced patient outcomes in acute stroke management, where time is of the essence. In addition, closing off risk points, e.g. lunchtime where desktop phones in the radiology department can be left variably attended leading to obvious delays, is paramount in the modern 24/7 health service.

Close the communication loops

Close any open communication loops. Significant delays can occur when people at either end of a phone are waiting for the other person to call back. Policies should endeavour to have closed loop decision making at all times. A policy of immediate transfer to the ED CT scanner following discussion with radiology ensures that no confusion occurs regarding transfer initiation. In this QIP, the new dedicated FAST-mobile was instrumental in closing this open communication loop. This change resulted in the requirement of only one phone-call by the emergency department doctor to secure this urgent imaging request whilst simultaneously notifying all relevant parties including the stroke team. If the CT scanner was not ready to be used (a potential risk at the time of COVID-19) protocols were put in place for transfer to a nearby CT scanner.

Emphasise the protocol

Emphasis matters. Protocol emphasis should be placed on immediate transfer to the CT scanner. (10) This is the most time-critical rate-limiting step prior to initiating potentially life-saving treatment. Appropriate emphasis ensures staff are not side-tracked by non-time-critical tasks and that rapid imaging is prioritised appropriately.

Enhanced image-reporting

Finally, rapid imaging is just one part of the picture; it must be accompanied by rapid reporting. To facilitate this, each CTB-FP performed should be attended to by a radiologist proficient in reading acute stroke imaging. On-table verbal reports should be a routine part of practice. This enables the treating stroke team to begin early initiation of reperfusion therapies. At the time of imaging, focus should be directed towards image interpretation rather than protocolling. This is critical due to the high volume of images that will require interpretation by the attending radiologist. (11) This issue of protocolling can be minimised by making non-contrast CT brain, CT angiography and CT perfusion the default stroke-imaging care bundle. Nearly all acute stroke presentations require a minimum of CT Brain and CT Angiography. There is a natural time-gap following CTA which allows the radiologist to assess these images and, in consultation with the stroke team, determine the need for CTP. Having CTP as part of the routine imaging bundle ensures that radiographers anticipate the potential need for perfusion imaging and therefore scanning protocols are prepared in advance in the event it is required. The impact of this step was not part of our KPI but is an important change to highlight as it will hopefully impact door-to-decision time.

Project Limitations

This project has some limitations. Our KPI time of imaging request to time of CT is not immediately comparable to widely reported door-to-imaging time. This KPI was chosen as the project was designed at a local level for local implementation and it best probably best reflects the time to imaging in this institution.

Conclusion

This new stroke imaging protocol developed in our institution reveals the demonstrable change that can be implemented within a department to optimise patient outcomes.

Acute stroke is a life threatening and life-changing diagnosis which requires urgent intervention to optimise functional outcomes.

The quality improvement changes introduced succeeded in reducing the time taken to acquire the urgently-required neuro-imaging in patients presenting with acute stroke by approximately ten minutes per patient. This new stroke-imaging protocol has been proven to be effective and sustainable with its positive impact still evident one year on from its initial implementation.

This project demonstrates the power that healthcare workers have to continuously audit and improve healthcare provision for patients and the need for continuous re-evaluation of the essential services we provide.

Conflict of Interest:

None declared.

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