Identifying delays occurring in out-of-hours FAST calls causing increasing door-to-treatment time

AUTHOR(S)

Kyra O'Dwyer

CITATION

O'Dwyer, Kyra (2020): Identifying delays occurring in out-of-hours FAST calls causing increasing door-to-treatment time. Royal College of Surgeons in Ireland. Thesis. https://doi.org/10.25419/rcsi.12688769.v1

DOI

10.25419/rcsi.12688769.v1

URL

https://repository.rcsi.com/articles/thesis/Identifying_delays_occurring_in_out-of-hours_FAST_calls_causing_increasing_door-to-treatment_time/12688769/1

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MSc Physician Associate Studies 2018

Submitted in part fulfilment of the degree of MSc in Physician Associate Studies, RCSI.

Student Name: Kyra O'Dwyer
Student ID: 17172276
Submission Date: 19th September 2019
Word Count: 12, 850
Supervisor: Dr Pauline Joyce

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Declaration Form

I declare that this dissertation, which I submit to RCSI for examination in consideration of the award of a higher degree MSc Physician Associate Studies, is my own personal effort. Where any of the content presented is the result of input or data from a related collaborative research programme this is duly acknowledged in the text such that it is possible to ascertain how much of the work is my own. I have not already obtained a degree in RCSI or elsewhere on the basis of this work. Furthermore, I took reasonable care to ensure that the work is original, and, to the best of my knowledge, does not breach copyright law, and has not been taken from other sources except where such work has been cited and acknowledged within the text.

Signed:

Date: 19/09/2019

Acknowledgements

I would like to acknowledge the following people:

Firstly I would like to thank the Stroke team for their guidance in carrying out this quality improvement project, in particular I would like to mention Dr Colm Byrne and Professor David Williams, thank you for your support. Thank you to the ED staff for their assistance and recommendations. Thank you to the telecommunications team for setting me up with the DECT phone to monitor the incoming stroke calls. Thank you to my classmates for their encouragement and for the cheeky Nando's dates when I was feeling stressed. Thank you to my family for cheering me on and keeping me focussed. I would like to say a huge thank you to Dr. Pauline Joyce our academic Director of Physician Associate Studies. Your feedback and continuous support was much appreciated, not only throughout the dissertation but throughout the entire program. Finally, I would like to thank my partner in crime, Carl. Your constant love, support, funny puns and the continuous replenishment of my empty cups of tea got me through it all and kept me sane.

Abstract

Stroke is one of the leading causes of death and disability worldwide and is a huge economic burden. The management of stroke is time dependant. Shorter times result in reduced mortality and morbidity. National Guidelines in Ireland suggest a door-to-treatment time of one hour or less from presentation to the emergency department. Despite this recommendation, delays are still occurring for patients accessing timely treatment. This quality improvement project was carried out in a busy North Dublin hospital- one of the largest acute stroke centres in Ireland. A total of nine patient journeys were followed and door-to-treatment times were documented over a three-month period. Five of these patients presented out-of-hours and four presented in-hours, whilst a specialised stroke team was on-site. The average door-to-treatment time for a stroke patient presenting out-of-hours was 72 minutes, whereas, the average door-to-treatment time for a stroke presenting in-hours was 54.25 minutes. The DMAIC framework and QI tools guided this project and recommendations were made following data analysis, to meet the aim to reduce door-to-needle times or acute ischaemic stroke patients. These included regular on-site teaching by the stroke team, improving communication with the emergency services to ensure pre-alert to an incoming FAST positive patient and the presence of a stroke crash trolley within the radiology department. Following implementation of these changes, a plan will be put in place to monitor and sustain improvements. This quality improvement plan requires a collaborative team approach to meet the national guidelines in treating this important life-threatening condition.

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Abbreviations

AIS Acute Ischaemic Stroke

CNS Clinical Nurse Specialist

CT Computed Tomography

CTA Computed Tomography Angiography

CVA Cerebral Vascular Accident

DECT Digitally Enhanced Cordless Telephone

DMAIC Define Measure Analyse Improve Control

ED Emergency Department

EMS Emergency Medical Services

FAST Face Arms Speech Time

HSE Health Service Executive

INR International Normalised Ratio

IV Intravenous

NICE National Institute for Health and Care Excellence

NIHSS National Institute of Health Stroke Scale

PA Physician Associate

PIPE Patient Information Profile Explorer

SALT Speech And Language Therapy

SHO Senior House Officer

SMART Specific Measurable Achievable Realistic Timely

SOP Standard Operating Procedure

tPA Tissue Plasminogen Activator

QI Quality Improvement

QIP Quality Improvement Plan

Chapter 1.0 – Introduction

1.1 Introduction

In this chapter the writer discusses the organisation within which this research was conducted in section 1.2. The rationale for identifying delays occurring in the treatment of patients with Acute ischaemic stroke (AIS) will be discussed in section 1.3. The chapter then outlines the aims and objectives of the quality improvement project (QIP) and the role the writer undertakes in conducting this project. The final section provides a brief overview of each chapter.

1.2 Organisational Context

The setting for this Quality improvement project (QIP) is within a large university hospital located in the North of Dublin, comprising of 820 beds. It is one of the busiest acute stroke centres in Ireland. It caters to a catchment area of around 290,000 people. An acute stroke is defined from the onset of symptoms and the next 24 hours to follow (Dahn et al., 2019). Care of acute stroke patients is provided by a mixture of physicians and medical personnel. Between the hours of 8am-6pm there is a stroke team on-site and on-call. The encompasses a highly skilled, specialised team that deals primarily with stroke and FAST (Face, Arms, Speech, Time) positive calls (HSE, 2018 and Mellon et al., 2015). The cohort of patients that receive treatment provided by the stroke team are designated to the in-hours category for data collection. After these hours the medical registrar on call receives the stroke digitally enhanced cordless telephone (DECT) and they then treat any further FAST calls that arrive to the emergency department (ED) whilst the team is off-site. There is no stroke physician on-site 24/7. The stroke team do not work weekends but a stroke consultant

is on-call to offer advice over the phone if required. Therefore, the cohort of patients presenting with AIS within the hours the stroke team are off-site are designated to the out-of-hours category for data collection.

1.3 Rationale for Quality Improvement

The purpose of this project is to outline an area within a secondary care environment that requires improvement. The aim of this QIP is to measure the door-to-treatment times during out-of-hour stroke calls, also known as FAST positive calls and compare these to the door-to-treatment times when there is a specialised stroke team onsite. The secondary objective is to evaluate possible causes for these discrepancies, if any, and to suggest possible solutions. Like Sepsis and myocardial infarction early stage treatment is the most effective. Therefore, early recognition is key (Harmon et al., 2019). Patient delay in presenting to the hospital with stroke symptoms remains one of the major barriers to thrombolysis treatment in Ireland. The FAST campaign (appendix 2) is a mass media campaign aimed to educate the community in the recognition of stroke symptoms and the importance of timely presentation in order to obtain treatment (Mellon et al., 2015). This is why the calls are referred to as FAST calls.

Stroke is a leading causes of both death and disability in developed countries. In affects an estimated 10,000 patients in Ireland each year. This accounts for roughly 8-10% of all admissions through Irish emergency departments. it is estimated that approximately 2,000 of these patients will die annually. This Equates to more deaths than breast cancer, prostate cancer and bowel cancer combined. A further 30,000 patients are 4 living with residual disabilities as a result of their stroke (Brewer et al.,

2014). These include hemiparesis, cognitive impairment, loss of independence and the requirement for assistance with activities of daily living. Clinical depression is also common amongst these patients. These rates will continue to rise with population growth and longevity of life (Layte R. et al., 2017).

Stroke results from the sudden decrease in the blood supply to the brain. This can be caused by a blockage, also known as an ischemic stroke. A haemorrhage may also occur and it is important to differentiate between the two types as this will ultimately influence the treatment provided by the physicians. An emergent computed tomography (CT) scan is performed. The time taken from patient presentation to the performance of this imaging is known as door-to-CT time. Door-to-decision time is similar and is defined as the time taken from the presentation of the patient to the ED, till the CT is performed and a decision is made regarding treatment. So therefore, door-to-treatment time is the time it takes from patient presentation to treatment administration following a confirmed diagnosis of stroke. Approximately 87% of stroke patients suffer an ischemic stroke. This is caused by a thrombus or embolism. The remining 13% are known as haemorrhagic stroke and result from bleeding within the brain sue to damaged vasculature.

Mortality rates for ischemic stroke are high, with 12% of patients dying within the first 30 days. On average 20.9% of patients die if they are admitted to a general ward for treatment. This was found to decrease to 14.2% for patients who were managed in a specialised stroke unit (Rocha et al,. 2013). One of the major issues facing most healthcare systems worldwide is the availability of resources and issues with patients accessing care (World Health Organisation,. 2019). Ireland is no different. The Irish healthcare system is already overwhelmed by the growing aging

population and it is not always possible to admit a patient to a specialised stroke unit (Mellon et al., 2015).

As these rates continue to climb so will the economic burden and mortality associated with the cardiovascular event (IHA., 2018). Once thought to be a condition associated with old age, more and more young people are suffering strokes. Most hospitals carry out immediate investigations if stroke is suspected and offer thrombolytic therapy (Kelly et al., 2012). This involves the use of pharmacological agents to dissolve blood clots causing the cerebral infarction. However this is only beneficial if the patient has suffered an ischaemic stroke. If a haemorrhagic stroke occurs tissue plasminogen activator (tPA) is contraindicated as this may result in the risk of bleeding (see appendix 4 for the contraindications of tPA). Therefore, an emergent non-contrast Computed Tomography (CT) scan is performed before treatment is administered. Treatment with tPA is also time sensitive and must be carried out within 4.5 hours of symptom onset, or if this is unknown the time is measured from when the patient was last seen well (Brewer et al., 2014). It is important to confirm this time as the risks begin to outweigh the benefits of receiving thrombolysis. For every minute that treatment is delayed there is an estimated loss of 1.9 million neurons and 13.8 billion synapses (Kelly et al., 2012). In simple terms, *time is brain*. It is important to identify avoidable delays and inefficient processes that result in time wasting. By identifying probable reasons for delays in treatment, protocols can be developed and implemented to further reduce door-to-treatment times and ultimately improve patient outcomes.

1.4 Aim & Objectives

The aim of this QIP was developed using the SMART model. SMART stands for smart, measurable, attainable, realistic, and time. It is a systematic approach to developing appropriate and realistic project aims (Aghera et al., 2018). This model was applied to the already existing baseline data and following the advice received from the first stakeholders meeting it allowed the writer to clearly define the focused aim and set of objectives of this project.

1.4.1 Aim

The aim of this QIP was to Identify the delays occurring in out-of-hours FAST calls causing increasing door-to-treatment times.

1.4.2 Objectives

The objectives of this project were to

(i) Investigate door-to-treatment times for acute ischaemic stroke patients presenting to ED out-of-hours and establish baseline data.

(ii) Investigate the time taken from patient presentation to ED to the transfer of patient to CT.

(iii) Identify the cause of these delays by monitoring the process closely and comparing this to values obtained from in-hour FAST calls.

(iv) Suggest solutions to improve these issues by June 2019.

1.5 Role of the student in the organisation and project

As a physician associate student, the writer will be working as part of the stroke team, headed by three consultants. The writer will be intermittently attached to this service for a period of 3 months in order to gather sufficient data. The role will require the writer to document several processes that occur during out-of-hour FAST calls. This will require the use of a pager or DECT that will alert the writer to any FAST positive calls presenting to the ED or calls that occur within the hospital itself, i.e. if an inpatient suffers a stroke. This has been arranged with the staff in the switch room onsite. It is important to note that the writer will not partake in any active treatment of the patient for insurance reasons, but will be present to document arrival times, times bloods are taken and received in the lab, the time the National Institute of Health Stroke Scale (NIHSS) is completed, the time IV access is gained and the time the patient arrives to the radiology department for their CT brain. Several other processes including patient co-morbidities and gender will also be noted. There may be other parameters the stroke consultant may wish the writer to record, however this is to be discussed at the next meeting.

The writer will then compare the times obtained to the data collected by the stroke clinical nurse specialist (CNS) when the stroke team is on-site. This project will involve the writer liaising with the thrombectomy nurse, radiology, emergency department doctors and the stroke consultants regularly. In addition to measuring the door-to-treatment times, the writer will also collect relevant information to identify any issues the staff mentioned above have encountered in relation to possible delays in their provision of treatment. The writer meet with the project supervisor and stakeholders to discuss the resulting data collected and use this opportunity to obtain general feedback on the project itself. In doing this The writer will then be able to

identify areas that may require improvement or issues that arise resulting in prolonged door-to-treatment times. Following analysis of the data, it may be possible to remove redundant processes or improve the current standard operating protocols (SOP) in place.

1.6 Summary

In conclusion, time is brain. Any possible delays in door-treatment-time can have detrimental effects on patients, not only in regards to their mortality but their quality of life following the cerebral vascular accident (CVA). Therefore, even if it is not feasible to implement a protocol to reduce these delays due to the time constraints of the QIP, it is important to identify and outline any issues that result in a delay in access to treatment for these patients and remove any redundant processes within the current SOP. Reduction in door-to-treatment times will result in better outcomes for patients.

Chapter 2.0 - Literature Review

2.1 Introduction

In this chapter, the literature on delays in door-to-treatment time in acute ischaemic stroke is reviewed. The current quality improvement strategies implemented to decrease such delays is also discussed. Section 2.2 outlines the search strategy applied in researching the relevant literature. Section 2.3 reviews the themes identified, and these are discussed in detail. Section 2.4 discusses the implications of the QI project, and section 2.5 briefly summarises the rationale behind identifying delays in treatment of ischaemic stroke patients.

2.2 Search Strategy

A broad search of the literature was executed, using terms such as ‘stroke’ ‘door to needle time’, ‘tPA’, ‘morbidity and mortality and ‘delays in management of stroke’ using PubMed and Google Scholar. The literature included in this dissertation was limited to the past ten years, unless it was essential to include a seminal piece of literature. A more detailed search was conducted using mesh search engines and terms such as ‘quality improvement’, ‘wait times’, ‘ischaemic stroke’, ‘barriers’, ‘CT-scan’ and ‘thrombolysis’. This search yielded hundreds of literature papers. However, papers were only reviewed based on their relevance. Information relating to this topic was also obtained from approved websites including www.irishheart.ie, www.hse.ie, www.beaumount.ie, www.strokeassociation.org and from the National Institute of Health Care and Excellence.

2.3 Review of Themes

Three main themes emerged from the literature and are discussed in detail below. These are: - the economic burden of stroke, the management of acute ischaemic stroke and the strategies to Improve Door-to-treatment times in the acute setting.

2.3.1 The Economic Burden of Stroke

Stroke is a leading cause of death worldwide. It is the fifth leading cause of death in the US alone (Dahn et al., 2019). It is the third biggest cause of death and the most common cause of acquired disability in the western world (Katan et al., 2018). An estimated 15 million people suffer from stroke worldwide each year. Of these, 5 million die and another 5 million are permanently disabled (World Health Organisation., 2019). Stroke is the second leading cause of disability in Europe, with ischaemic heart disease being the first. In Europe approximately 650,000 deaths occur each year due to stroke. In Ireland, roughly 10,000 patients are admitted to our emergency departments suffering from a stroke each year. This accounts for roughly 8-10% of all hospital admissions. Stroke has an in-hospital mortality rate of 14.2%. It is estimated that approximately 2000 of these patients will die annually (Brewer et al., 2014). This alone equates to more deaths caused by breast cancer, prostate cancer and bowel cancer combined (Brannigan et al., 2016). A further 30,000 patients are living with residual disabilities as a result of their stroke (Brewer et al., 2014). In Ireland, a large

proportion of the population aged 65 years and over accounts for about 70% of all stroke presentations. This is estimated to increase from 11% to 15% by the year 2021 (Smith et al., 2012). The number of documented strokes occurring in Europe in the year 2000 was approximately 1.1 million. This is expected to rise to 1.5 million by the year 2025. As the prevalence of stroke continues to climb, so too does the economic burden and mortality associated with this cerebrovascular event (Hannon et al., 2014). In EU countries, the annual economic burden of stroke costs an estimated €27 billion. This includes both direct and indirect costs, with the addition of another €11.1 billion for informal care provided to survivors within the community (World health Organisisation.int., 2019).

In Ireland in 2007 treatment of stroke alone cost approximately between €345 million to €557 million. The same study estimated the cost of stroke growing from this to cost between €743 million to €1,266 million euro by the year 2021. This is an increase of some 52-57%. These are the projected increases in the cost of stroke for both direct and indirect treatment, therapies and care (Smith et al., 2012). One Irish study conducted quantified the cost of stroke caused by one particular modifiable risk factor. It looked specifically at stroke patients who suffered from atrial fibrillation. They calculated the cost of stroke in the 568 patient sample size cost a massive €33.84 million (Hannon et al., 2014). Of those patients 177 had atrial fibrillation which accounted for 31%. They concluded that these patients acquired markedly higher costs and also suggested that by targeting atrial fibrillation itself it may have substantial economic benefits, in addition to health benefits (Brewer et al., 2014, Hannon et al., 2014)

Whilst mortality rates are high, morbidity rates are even higher for survivors of stroke. There is an increased lifetime risk of developing a stroke in females

versus males. Due to the success and complexity of modern medicine, the ageing population continues to grow but so does the prevalence of stroke (irishheart.ie, 2018). In Ireland a large proportion of the population aged over 65 years accounts for about 70% of all stroke presentations. This is estimated to increase from 11% to 15% by the year 2021. (Smith et al., 2012)

2.3.2 Management of Acute Ischaemic Stroke and associated time constraints

The current recognised treatment for acute ischaemic stroke is intravenous thrombolysis with altepase. This is administered with greater effect and safety 4.5 hours from the onset of the initial symptoms Kim et al., 2017). Prior to the administration of tPA, it is important to rule out any contraindications to the treatment (Xu et al., 2019). These include patients with bleeding disorders, patients who have undergone recent extensive surgery and patients suffering from a haemorrhagic stroke. There are several treatment pathways available to medical practitioners to aid in the management of different types of stroke and neurological events depending on the diagnosis Kim et al., 2017). The diagnosis of stroke relies heavily on imaging techniques such as CT scans or magnetic resonance imaging followed by vascular recanalisation and supportive care, preferably within a specialised stroke unit (World Health Organisation., 2019).

According to the NICE guidelines, any patient suffering from a suspected stroke should be imaged and treated within an hour following presentation and once the stroke has been confirmed and they have undergone the initial management within the acute setting, they should be transferred to a stroke unit within 4 hours (National Institute for Health and Care Excellence, 2018). Irish guidelines recommend acute

ischaemic stroke patients receive treatment within 60 minutes or less (Irish Heart Foundation, 2010). This is referred to as the “golden hour’’. The current organisation in which this QIP has taken place was audited as part of the national stroke audit. The median door-to-treatment time was found to be of one hour and 31 minutes with an interquartile range of 00:49-02:04 (National stroke audit., 2018). According to National standards these results were found to be suboptimal.

The faster a patient receives tPA, the better the prognosis. In a study by Xian et al. (2017) each minute of delay in treatment increases hospital in-patient stay by an average of 2 days (Xian et al., 2017). In 1995, the National Institute of Neurological Disorders and Stroke (NINDS) trialled and demonstrated the benefits of patients given tPA. These patients were found to have a significant reduction in disability 30 days following the ischemic event (Advani et al., 2017). By 30 days, 43% of these patients reported functional independence with 50% reporting either no impairment or reporting only minimal disability in comparison to the placebo group who did not receive thrombolysis with tPA (Xian et al., 2017). “Time is Brain’’ is a phrase utilised consistently throughout the literature associated with stroke. It emphasises the importance to act fast and provide treatment so as to prevent the rapid and irretrievable loss of human nervous tissue following the ischaemic event (Kim et al., 2017).

The human brain contains an estimated 130 billion neurons (Saver et al, 2006). Saver and his team quantified the extent of damage to the brain resulting from a large vessel supratentorial acute ischaemic stroke. Although this study is over 10 years old, it is a seminal study which first determined the extent of damage following the ischaemic event. It is also highly referenced and supported throughout stroke literature and the National Institute of Neurological Disorders (Saver et al., 2006). Saver further

highlighted the importance of timely treatment and management of stroke in relation to improving patient outcomes and prognosis.

Every second, 32,000 neurons are lost. This increases to 1.9 million neutrons lost per hour. On average a stroke that occurs within a large vessel equates to approximately 1.2 billion neurons and a massive 8.3 trillion synapses lost within the ischaemic territory. This massive loss in nervous tissue is the equivalent of the brain ageing 36 years from a single ischaemic event (Desai et al., 2019). Several studies demonstrate a correlation between reduced door-to-treatment times and better patient prognosis and a reduction as minimal as 15 minutes can reduce the in-hospital mortality rate of up to 5% (Fonarow et al., 2014). Another study reported a reduction in both mortality and disability in patients treated with tPA within the first 60 minutes of presentation with a reduced mortality rate from 10.4%, vs. 19.0% in the control group (Goyal et al., 2019). This is evidence that rapid endovascular treatment improved functional outcomes and reduced mortality. The prognosis of stroke is patient specific and is highly influenced by the pathophysiological processes of the indicia, so although time is not a sole determinant on patient outcomes, delays in treatment result in substantial neuronal loss and also decrease the chances of a good prognosis (Desai et al., 2019). Therefore, early recognition of stroke is essential as the success of treatment is time dependent. (Jauch et al, 2018)

According to the National Stroke Audit 2018, out of 219 stroke patients seen within one Irish hospital, 96 underwent diagnostic imaging within 45 minutes of presentation to hospital. The overall median time was 52 minutes. Of these patients 51 of them received tPA within 58 minutes. 69% of patients were seen by the stroke team within 3 hours following presentation to the ED. This is a 54% increase from 2016 alone but also demonstrated the need for improvement (National stroke audit.,

2018). The central objective is that ‘’time is brain’’ regardless of the heterogeneity in the rate of neuron loss.

2.3.3 Strategies to Improve Door-to-treatment Times in Stroke Patients

Numerous interventions to reduce delays in both confirming the diagnosis and the administration of intravenous tPA in acute ischaemic stroke have been assessed and this a common theme in the literature (Tai et al., 2012). One study conducted in a University Central Hospital in Helsinki, Finland, demonstrated a 20-minute reduction in Door-to-treatment time following extensive monitoring of the stroke algorithm in place. They applied multiple concurrent strategies between the years 1998 to 2011 (Meretoja et al., 2013). Not only did they reduce the time taken to administer treatment, they maintained it. They claimed the key to their success was having as little to do as possible after the patient arrived. They were pre-alerted by paramedics and had the scans, bloods and several other steps within the process set up prior to patient arrival to the emergency department (Tai et al., 2012). Healthcare systems differ worldwide so what works in one country may not necessarily work in another. It is important to test the transferability of these quality improvement strategies to healthcare systems that differ greatly (Meretoja et al., 2012).

Several studies took the Helsinki model and applied it to an acute hospital in Melbourne, and within 4 months of its application door-to-treatment time had been reduced by 25 minutes (Meretoja et al., 2013). One of these steps included inserting the IV line in the patient whilst they were on the CT table which saved almost 10 minutes of the process. The patients were also pre-registered prior to their arrival and transferred straight to the CT room containing a crash trolley, blood trolley and stroke

specific medication. Pre-alerts by the emergency services allowed the stroke team or medical doctors on-call to gather all the equipment required to treat the patient and to alert the radiology department to the incoming of a stroke patient. This also reduced the time taken to hand-over patient information to the radiology department (Meretoja et al., 2013).

In Ireland, national guidelines suggest a door-to-treatment time of less than 60 minutes. However, this is proving difficult in our already over-congested emergency departments (McGrath et al., 2018). Treatment of stroke patients has shown to be delayed due to many avoidable interruptions. Identifying the cause of these delays is essential in order for us to improve the quality of the services provided. Speed is essential for positive clinical outcomes in stroke patients (Olson et al., 2011). One study conducted in a large acute Irish university hospital reduced their door-to-treatment median time from 99 minutes in 2015 to under 60 in 2016. (McGrath et al., 2018). This was achieved within this Irish hospital by the introduction of a pre-alert system, early clinical assessment of patients, early CT imaging and early standardised bloods. Unfortunately, there is no pre-registration of patient option available in Ireland. The reason provided for this was related to data protection laws. However, it has proven to be beneficial in the reduction of door-to-treatment times in the Helsinki and Melbourne stroke models and could be trialled within the Irish healthcare system (Meretoja et al., 2013).

Although reductions in delays have been made, maintaining these numbers has proven to be difficult and requires a team effort and continuous support in the treatment of acute ischaemic stroke (Mowla et al., 2017). This indicates the importance of both quality improvement and clinical audits.

2.4 Implications for the Project

Stroke is a chronic and disabling neurovascular condition. As the ageing population increases so too does the prevalence of stroke, requiring the need for more complex and specialised services available for stroke patients. This includes both direct and informal care (Brewer et al, 2014). The Irish government has determined there will be a 20% increase in the incidence of such diseases and the associated economic burden (Houses of the Oireachtas, 2017). It is estimated that stroke and all associated costs will increase by 52-57% by 2021 (Smith et al., 2012) The literature suggests that by reducing door-to-treatment times in acute ischaemic stroke, it will ultimately lead to improved clinical outcomes for these patients and thus reduce the costs in informal and formal care. However, it is an uphill battle as we still need to achieve a maintained reduction in times. Therefore, quality improvement projects and audits must continue to explore the causes of any unnecessary delays blocking stroke patients from appropriate timely treatment within our struggling emergency departments. The epidemic of stroke is not only an issue nationally but worldwide. By improving and investing in the Irish healthcare system and providing more training for staff, these suboptimal waiting times can be improved and in the long term reduce the costs, both human and financial, associated with this debilitating condition.

2.5 Summary

This chapter highlighted the importance of the timely treatment of acute ischaemic stroke patients and provided evidence for the correlation between early treatment and better prognosis. By researching the relevant literature, the writer was able to highlight not only the consequences regarding the mortality and the morbidity of stroke, but also the associated economic burden of stroke survivors. This was discussed from

a global perspective but also on a national level. Similar issues regarding the delays in treatment of stroke patients have been identified worldwide and common themes regarding the cause of these delays occurring in other healthcare systems emerged. Quality improvement strategies used to tackle these were investigated. The issue of transferability of such strategies to a vastly different healthcare setting was also discussed. The rationale for carrying out a quality improvement project in this particular field and the methodology will be discussed in the next chapter of this dissertation.

3.0 Methodology

3.1 Introduction

This chapter discusses and provides an overview of several QI tools/models that can be applied to healthcare and a detailed overview of the selected framework chosen to suit this project. In particular the rationale for the use of the DMAIC (Define, Measure, Analyse, Improve and Control) model will be reviewed. This section outlines the reasoning behind the preferred QI approaches the writer has chosen to assist in the identification for the area of improvement, for the management of acute ischaemic stroke in both in-hours versus out-of-hour FAST calls. Analysis of the data obtained and its contributions to the chosen QIP and evidence of its benefits will be discussed in detail. The chapter ends with a summary of the methodology tools utilised and it will conclude with a brief overview of the pertinent findings.

3.2 Approaches to Quality Improvement

Quality improvement is utilised regularly within the manufacturing industry. However, it is also applied to other systems, including healthcare. Quality improvement efforts have become widespread amongst the healthcare profession (Alhamali., 2019). It involves the combined and continuous efforts of everyone within the hospital environment, from healthcare professionals, patients, family members and investors. These individuals share a similar goal, to make changes to current practices that will ultimately lead to improved patient outcomes and better professional development and working environments (Batalden and Davidoff, 2007). Without the combined effort of the people listed above healthcare will not reach its full potential, unless the proposed change becomes an intrinsic part of everybody's daily practice. However,

this can prove to be challenging.

The use of various methodical tools can assist in implementing and maintaining change (HSE., 2017a). The sole focus of quality improvement processes is consistent throughout the literature, improving patient outcomes. It is important to identify first and foremost current barriers and delays in delivery of appropriate patient care in a safe and timely manner. It is common knowledge that quality improvement projects tend to fail more so than succeed and only an underwhelming 30% of attempts made to improve models within the healthcare environment succeeding in improving outcomes. Although changes may occur they may not always lead to improvement and may result in further problems developing in the future (Kotter, 2009).

Delivery of high quality care relies on everyone involved in the process continually striving for improvement and monitoring the current quality of the services provided. Therefore, it is imperative to identify and choose the appropriate tools to aid the user in this process (Crowl et al., 2015). Quality improvement is a key player in the practice of medicine and it is important to place the patient at the centre of the practice model (Kitson et al., 2012). The models utilised depend on the area of the healthcare system that requires improvement. In this chapter, the writer discusses and reviews the QI models used in healthcare and briefly outlines the rationale for the models chosen for this quality improvement project. The application of these models is discussed and the chapter concludes with a short summary.

3.3 Rationale for Model Selected

The DMAIC framework (Figure 1) was the preferred model for this QI project as it provided the required tools to aid in identifying the delays occurring in the treatment of acute ischaemic stroke. It permits the user to define a problem and using both quantitative and qualitative tools, it measures, analyses and allows for the implementation of change using the results obtained from the data collected. Initially, the writer was using the Plan-Do-Study-Act (PDSA) cycle (Alyoubi et al., 2017). Although this tool proves to be useful in quality improvement, the DMAIC framework provides an organised, stepwise and more detailed approach for the monitoring door-to-treatment times in out-of-hour FAST calls. The PDSA cycle was limited as it was too simplistic and broad.

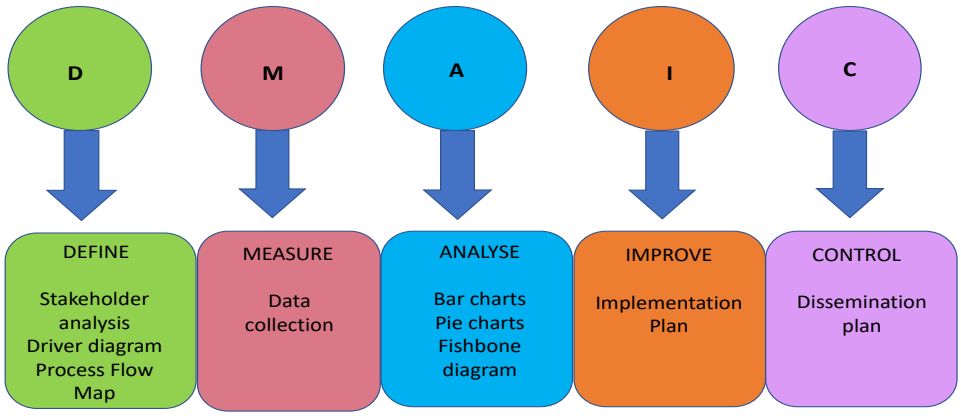

Figure 1: An overview of the DMAIC model and associated tools used in quality Improvement.

Figure 2: An overview of the Plan-Do-Study-Act (PDSA) cycle.

3.4 Model Overview

The DMAIC model is a methodological tool used to improve already existing processes (Kuwaiti et al., 2017). It is a cycle that breaks down processes into five steps. These are define, measure, analyse, improve and control as depicted in the figure below (figure 3) (Mason et al., 2015). This process is a data driven approach to Six sigma, a QI tool used in the healthcare industry since the late nineties. The ultimate goals of using these tools is to improve workplace safety and to identify any redundant steps involved in the processes in place (Kuwaiti et al., 2017). This may ultimately reduce the workload and help avoid inconsistencies arising.

The define phase of the model identifies the current problems within the process. The measure segment focuses on the data collection itself and how the data is to be measured. The analyse section concentrates on verifying the problem and identifying redundant steps that result in wasted time (Alhamali., 2019). The improve

segment will allow the user to recommend and implement improvements and the control phase enables the user to confirm if the proposed changes being implemented are sustainable and financially viable- or if re-evaluation is required. Applying the six-sigma QI methodology to common healthcare practices has been shown to reduce the application of ineffective steps in the provision of care and standardise practices by reducing time wasted in response to avoidable accidents (Batalden and Davidoff., 2007).

What is the problem?	What data is available and how will it be collected?	What are the root causes of the problem?	Do we have the right solutions to this issue?	What are our recommendations?
What is the scope?	Is the data accurate?	Have these causes been confirmed?	Have the solutions been piloted?	What is our plan to implement?
Who are the stakeholders?	What graphs should be used to display data?	What causes should we focus on amending?	Have we reduced variation of results?	Are the results sustainable?

Figure 3: A brief summary of the five phases of the DMAIC framework used in QI.

3.4.1 Define

Acute medical services continuously endeavour to improve access times and treatment for patients (Meretoja, A et al., 2012) In the case of ischaemic stroke this is not only essential for improving the quality of care the patient receives, but early treatment has been shown to reduce the morbidity and disability rates following the neurological incident (Brewer et al., 2012). Reducing door-to-treatment times in acute ischaemic stroke is an ongoing issue within the medical field today, so it did not require much exposure to clinical placement in order to identify this was an area where problems often arise. In order to establish the key players within the QI project a stakeholder analysis was constructed. A stakeholder can be identified as an individual or departments within an organisation whose interests may be affected if the project is implemented following its completion (Brugha., 2000). They must be considered even if their interest is low as their participation or influence may impact the success of the project so they should be identified as early as possible prior to initiating the QIP.

Constructing a stakeholder analysis is an important tool for identifying prospective stakeholders and reviewing their needs and influence. It helps identify those who have an interest in the change proposed by the project manager (Varvasovszky and Brugha, 2000). Constructing a stakeholder analysis has several benefits. It helps to identify the interests of all stakeholders and may highlight early on any potential issues that may affect the success of the project. It is key in identifying those who may contribute most and even aid in the execution of the project (Van der Duin, 2016). It also acts as an important tool for communicating and planning the process itself. Project success is not always guaranteed but engaging with all stakeholders, regardless of their interest within the project is key. It gives all individuals

a chance to express their concerns, ideas, expectations and it also offers a chance to obtain constructive criticism and may identify road blocks or barriers the author may have not previously thought of or planned for. Therefore, managing stakeholders and ensuring they are included throughout the process is important to the success and ease at which the project evolves (Van der Duin., 2016).

The completed stakeholder analysis can be seen below in figure 4 and represents all essential staff or stakeholders involved in the treatment of acute ischaemic stroke. There are 4 categories that differentiate the level of power and the level of interest of each stakeholder. They are as follows. There are 4 categories that differentiate the level of power and the level of interest of each stakeholder. They are as follows: -

(i) High power high interest

(ii) High power low interest;

(iii) Low power high interest;

(iv) Low power low interest.

It is imperative to designate each stakeholder to the appropriate section and it is essential to include every person involved in the process of treating ischaemic stroke in an acute setting. The stakeholder analysis constructed by the writer designates the key stakeholders as being the stroke team the ED staff and the Bed management staff. As per national guidelines a patient suffering a stroke should be admitted to a specialised stroke unit (Irish Heart Foundation, 2010).

Furthermore, depending on the severity of the stroke this can affect the recovery time and therefore it was seen fit to include the bed management team as improvements made in door-to-treatment time may ultimately improve the patient's

clinical prognosis and may possibly reduce the length of stay, freeing up beds for other patients. The writer was unaware of the influence reduced door-to-treatment times may have on the staff within the bed management department, until this was highlighted in a follow-up meeting with a member of the stroke team. As a result, this department was included in the stakeholder analysis and was placed within the high power, high interest category as advised by the other stakeholders involved.

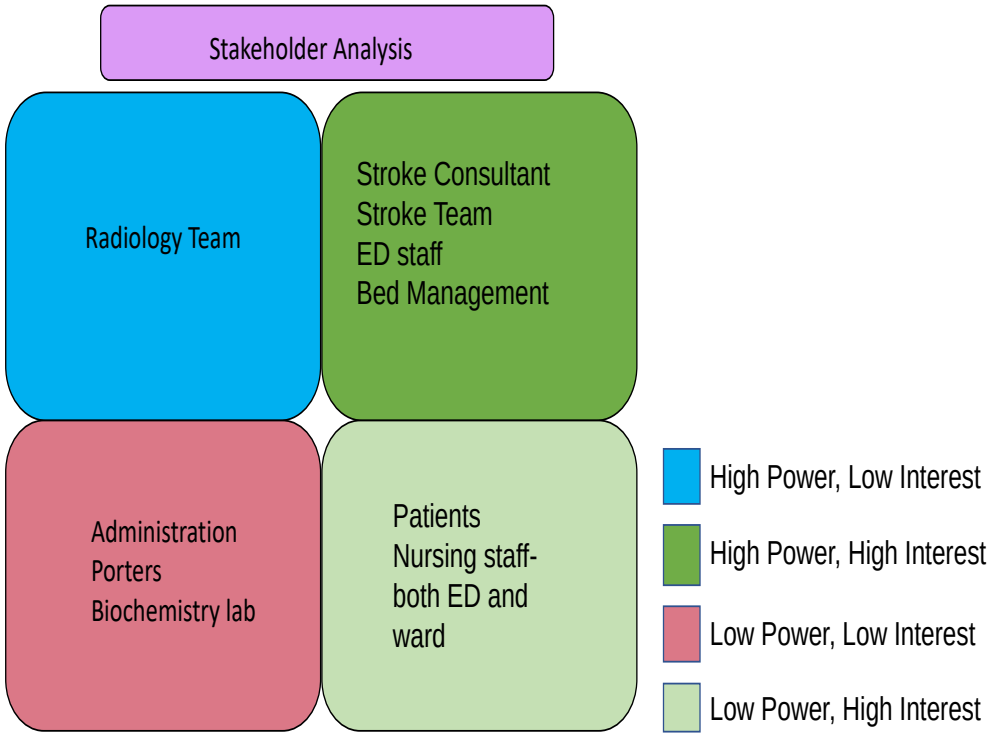

Figure 4: Stakeholder analysis.

It is important to note that the patient is always at the center of care within the quality improvement process (Kitson et al., 2012). However, although they have high interest they have low power in regards to their ability to implement change within the current process in the treatment of stroke and within the healthcare system itself. Within this category are the nursing staff within the ED and the stroke unit. These staff members are keen to streamline the process, but like the patient they are limited to what they can do. The highest influencer and the driving forces behind this QIP are Identified in the top two squares of the figure 4. These were the people who expressed their concerns in delays in door-to-treatment times occurring in out-of-hour strokes. These stakeholders were eager to engage and showed enthusiasm in regards to identifying barriers in the treatment of stroke patients. The radiology team expressed interest, but not in the medical work-up prior to the patient reaching the CT department. However, they maintain high power and low interest so it was important to keep them involved (Varvasovszky and Brugha, 2000). Both squares have high power but differ in relation to their specific interests. It was vital to keep both in the loop and ensure their active involvement and that their expectations were met.

As the project evolved some of the stakeholder's categories changed. This demonstrated further the importance of developing a stakeholder analysis and opening the lines of communication in the early stages of the projects development (Van der Duin., 2016). Biochemistry labs are important and have high power in regards to processing coagulation profiles for stroke patients however decision for tPA should not be delayed whilst waiting for these blood results so they were moved from high power, low interest to low power, low interest. Others within this category include hospital administrators (involved in registering the patient once they arrive to the ED department) and the porters involved in transporting the patient to the CT department

from the emergency department as quickly as possible. Regardless of their power and interest these are the frontline staff involved in the patient journey of stroke patients and all are essential. It is important to consider the influence and motivation each member of the stakeholder analysis has in the project as this may influence the success of the project itself (Crowl et al., 2015). Special considerations for the people with low interest and high power were made as it was important to keep them satisfied so as prevent further barriers arising throughout the QI project. It is essential to establish, build and maintain a rapport with all relevant stakeholders and members of the team (Van der Duin., 2016).

One of the initial quality improvement tools the writer became acquainted with was the process flow map. This is a visual tool used to display the patients journey from their arrival to ED to the onset of treatment if required (Heher and Chen, 2017). It not only maps the steps within the patients journey but allowed the author to examine things from a patient's perspective. By providing an overview of the original process before attempting to implement change may help us identify possible redundant steps (Heher and Chen, 2017). Several patient journey were documented in both in and out-of-hour FAST calls. The associated process maps were then devised.

The process flow varies depending on the time of day the stroke occurs and the stability of the patient. The in hours process map is seen in figure 5. A total of 9 patient journeys were documented. Five of which occurred out-of-hours and four of which occurred in-hours. It is important to note the writer did not actively partake in the treatment of any patients and was present merely to observe the process. Times taken to complete each step within the process are shown and the averages were calculated. There was a significant difference in the time taken for several steps to occur when a specialised stroke consultant is present versus when the medical

registrar is on-call. When possible, the writer documented reasons for these differences.

Not all were factors that could be altered and this was also noted. Nonetheless, there is a clear variation not only in time taken to complete each step but the fluidity of the process in treating acute ischaemic stroke patients and may pose an argument for further training of all ED doctor specifically in use of the NIHSS tool and in the future the presence of a specialised stroke physician onsite 24/7. Constructing this process map also helped identify stakeholders and the importance of team work when dealing with this neuroemergency.

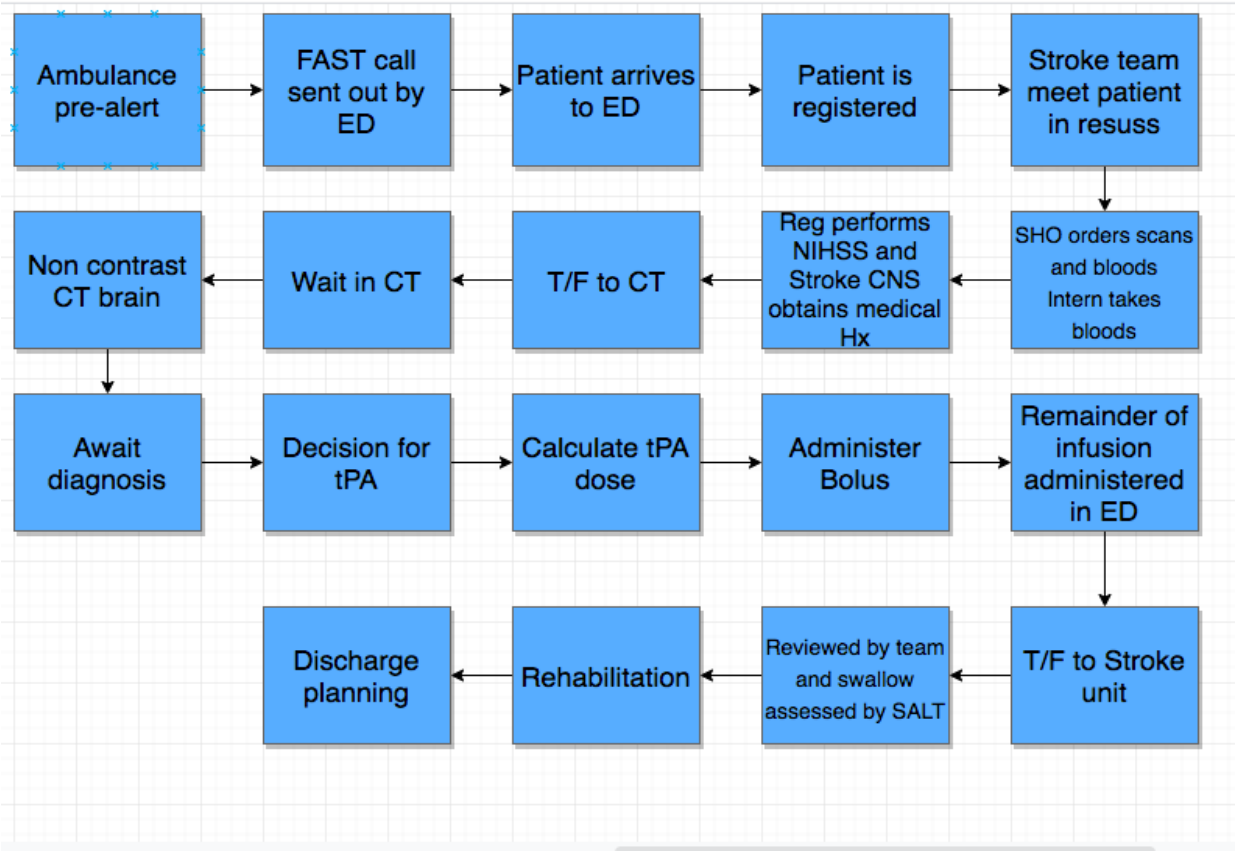

Figure 5: Process Flow Map. FAST, Face Arms Speech Time; ED, Emergency Department; SHO, Senior House Officer; NIHSS, National Institute of Health Stroke Scale; CNS, Clinical

Nurse Specialist T/F, Transfer; CT, Computer tomography; SALT, Speech and Language Therapy.

In order to construct this map, several patient journeys were documented during a FAST call whilst the stroke team were on-site. Following this as a guideline, a process flow was then constructed whilst the stroke team were off-site and both were compared. This allowed the writer to Identify time-delays occurring out-of-hours within the protocol and provided areas of focus for further encounters. A Gantt chart (Appendix 1) was also constructed. It is one of the oldest planning tools and is often utilised in Quality improvement projects. This allowed the writer and supervisor to track the progress of the project and ensure goals and deadlines were met in order to complete the QI project within the given timeframe (Wilson, 2003).

The next quality improvement tool utilised for this project was a fishbone diagram. This diagram is also known as an ishikawa diagram and was constructed originally by a Japanese doctor who specialised in quality control. It is a useful visual tool for brainstorming sessions and pointing out the area requiring improvement (Reilly et al., 2014). It allows the user to identify the root cause of the problems not just the effects it has on a particular process or system. It is designed to look like a fish skeleton like the name suggests and each branch includes smaller bones with more detail. it is typically used in the analyse section of six sigma's DMAIC approach to solving problems with the head of the fish typically listing the problem, in this case, delays in door to needle times. The writer and stakeholders constructed this diagram early on within the project and following the authors exposure to responses in out-of-hour FAST calls the diagram was added to once relevant. There are several factors outlined within the environment that cannot be altered without a significant cause like the operation

of a second CT scanner out of hours or a stroke consultant on site for 24 hours. Further revision of the areas impacting timely access to treatment were identified and documented in figure 6.

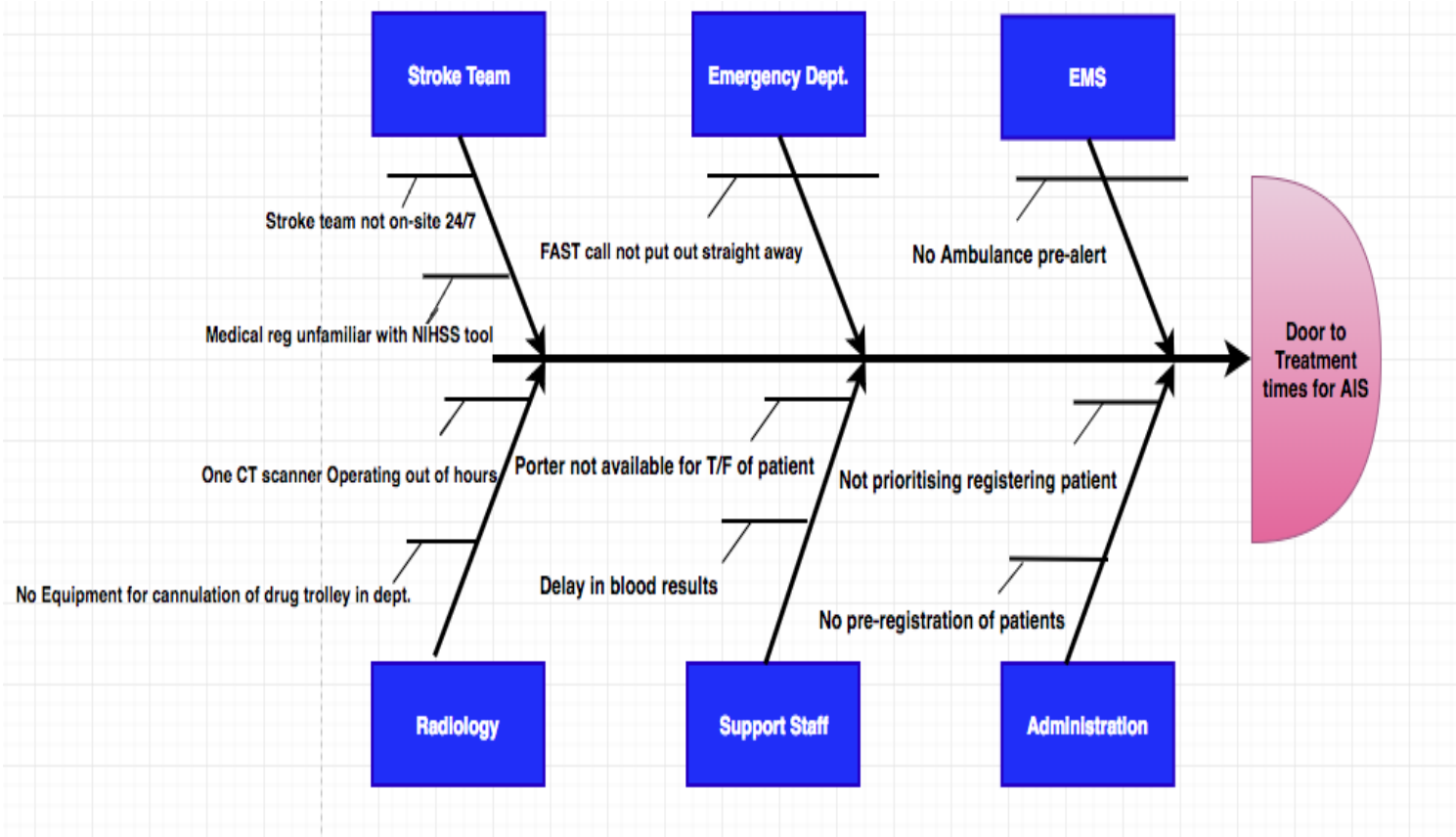

Figure 6: Fishbone diagram representing the causes of delays in Door-to-treatment times in acute ischaemic stroke.

3.4.2 Measure

In order to Identify delays in door-to-treatment times in out-of-hour FAST calls the writer was required to stay back following placement on several evenings and attend the ED at the weekend as there was no specialised stroke team on site. However, there is always a stroke consultant on call if required. A total of 9 patients presenting with suspected acute ischaemic stroke were included. The time of registration of each

patient was electronically documented and available on the ED notes.

The purpose of a quality improvement project is to fundamentally Identify an area requiring improvement based on the data collection and to measure the outcomes. If this cannot be measured then it is not feasible to suggest it can be improved (Drucker et al., 2012). In the case of ischaemic stroke and its associated treatment data collection justifies the aim of the project itself, in this case determining discrepancies between treatment when a specialised stroke team is on-site versus when they are off-site. The data collected acts as a baseline and allows for comparisons to be made. In addition, discrepancies and time-delays can be identified and the suggestion for implementing changes to reduce these delays can be made once the data is analysed.

In order to Identify delays in door-to-treatment times in out-of-hour FAST calls the writer was required to stay back following placement on several evenings and attend the ED at the weekend as there was no specialised stroke team on-site. The writer was alerted to a patient presenting with a possible stroke via a DECT phone. This call was made once a patient was confirmed to be FAST positive. This was done via ambulance pre-alert or following triage of the patient once they arrived to the ED. As well as the medical registrars and ED staff, the radiology department also have once of these phones alerting them in advance at the possibility of an ongoing stroke and if possible allowing them to free-up or reserve the CT machine for the patient once a clinical handover was obtained.

The data was collected between the months of March to May. The Data obtained can be summarised in the table below (Table 1). A more detailed data collection containing patient symptoms, times of various stages of the process and associated demographics and co-morbidities can be reviewed in the appendix 5 for

in-hour stroke data and appendix 6 for out-of-hour stroke data. Most of this information was collected manually and in real-time by the writer. However, for more specific times such as when the scans and bloods were ordered two separate electronic systems were utilised. These were McKesson a well-known radiology program used nationwide in Ireland and Patient Information Profile Explorer (PIPE). Due to the time constraints of the project and to prevent burnout of the writer as the data collected was primarily out-of-hours, the data collection was limited to a small cohort of patients. The grade of the doctor responding to the FAST call was also documented. If any intervention was required prior to imaging such as stabilizing a patient's blood pressure (BP) this was also documented as were any reasons that resulted in delays of treatment.

Door-to-treatment times	
Out-of-hours (mins)	In-Hours (mins)
141	50
36	91
85	50
60	26
39	

Table 1: Door-to-Treatment times collected in both in-hours and out-of-hour FAST calls.

While collecting the data during out-of-hour FAST calls, it was clear not all the steps within the process map where being followed each time a patient presented with a possible stroke. There was a substantial amount of variation of this process map out-of-hours versus in-hours. It is worth mentioning that an NIHSS score was not always

documented in the out-of-hour FAST calls. One reason for this as observed by the writer was the lack of printed out copies available in the ED department at the time the patient presented. Some out-of-hours data was collected was collected retrospectively using the McKesson and PIPE systems as the author was not always guaranteed a stroke would take place on the nights and weekends they chose to attend the ED to collect data. As a result, delays in the medical management of the patient prior to their arrival to the CT scanner were noted but could not be explained. The emergency services did not always pre-alert to their arrival with a FAST-positive patient so as a result it took the stroke team/medical registrar on-call longer to arrive to the resuscitation room. In the data collected out-of-hours, not one ambulance pre-alert was documented. This seemed more common during the day whilst the stroke team was on-site. A pie chart representing this result can be seen below in figure 6. Sometimes the paramedics would separate and one would bring the patient to the resuscitation room and provide the medical staff with a history whilst the other registered the patient so this also resulted in anomalies and was more common during in-hour stroke presentations versus out-of-hour stroke presentations. The data was only manually collected for in-hour stroke calls while the writer was on placement. The inpatient charts were also reviewed to collect data on any risk factors the patient had that may have contributed to the stroke, as this was a parameter to be collected as requested by the project supervisor.

3.4.3 Analyse

The data was collected, organized and carefully analyzed. It is important to note that these patients presented with FAST positive symptoms, but not all received a confirmed diagnosis of stroke. From the figures documented there was a moderate

variation in the time responding to out-of-hour FAST calls versus when a specialized stroke team was on-site. The mean time for door-to-decision treatment time was documented to be 54.4 minutes if a stroke occurred in-hours and the medical management was provided by the stroke team. Whereas, there was a mean time of door-to-treatment time of 72.2 minutes if the stroke occurred out-of-hours in the absence of a specialised stroke team. This can be viewed below in table 2.

	Mean Door-to-treatment time (mins)
In-Hours	54.25
Out-of-Hours	72
Difference	17.75

Table 2: Mean Door-to-treatment time documented for in-hours versus out-of-hour strokes with calculated time difference

Some of these delays were occurring within the radiology department as there was only one CT scanner operating at the time. It is important to note that these delays did not seem to occur as often if there was an ambulance pre-alert prior to the patient arriving as this allowed radiology to triage and free up the scanner whilst awaiting the stroke patient.

It should be noted, that in all the out-of-hour FAST calls documented, not one ambulance pre-alert occurred so this was recorded at 0%. In contrast, 75% of FAST calls occurring in-hours received a pre-hospital alert from the ambulance service.

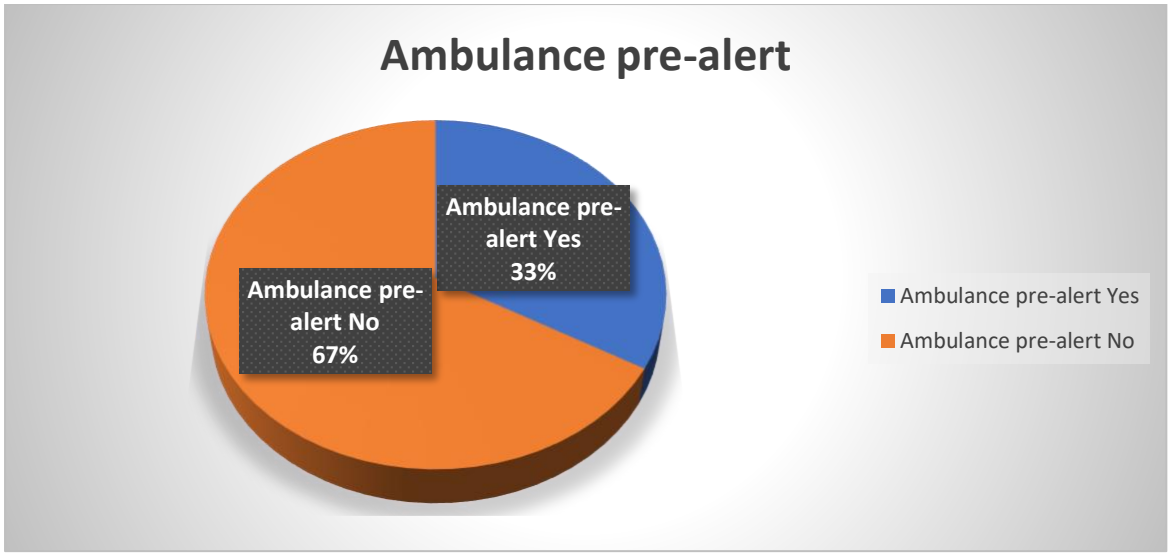

Figure 7: This pie-chart depicts the overall frequency of ambulance pre-alerts in both out-of-hours versus in-hours FAST-positive patients. 0% of these pre-alerts were documented in the out-of-hour data collected.

75% of patients underwent imaging within one hour of presentation whilst a stroke team was on-site. Whereas, only 60% of patients reached CT following one hour from initial presentation to ED out-of-hours. The reasons for these delays were documented and can be viewed below in table 3 with the corresponding pie chart in figure 8.

Reason for delay	Occurrence
Delay of med registrar arrival to resuss	2
Delay in NIHSS completion	3
Patient unstable due to HTN	1
No ambulance pre-alert	4

Table 3: Reasons for delays occurring in door-to-treatment times in both in-hour and out-of-hour FAST calls as observed by the writer.

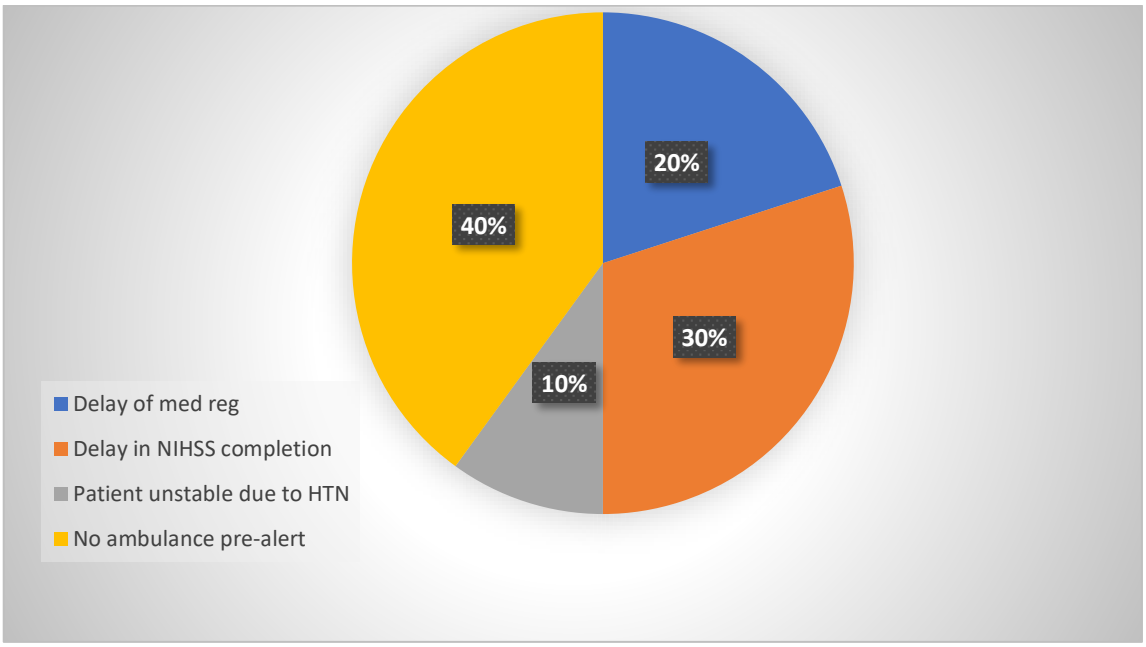

Figure 8: Colour coded pie-chart depicting the reasons for delays occurring in and out-of-hours in door-to-treatment times.

From the data collected 55% of patients from both the in-hours and out-of-hour cohorts had atrial fibrillation. 78% had previously been diagnosed and was undergoing treatment for hypertension (HTN). High blood pressure contributes to more than 12.7 million strokes worldwide (World Health Organisation., 2019). This is depicted in the figure 9 below.

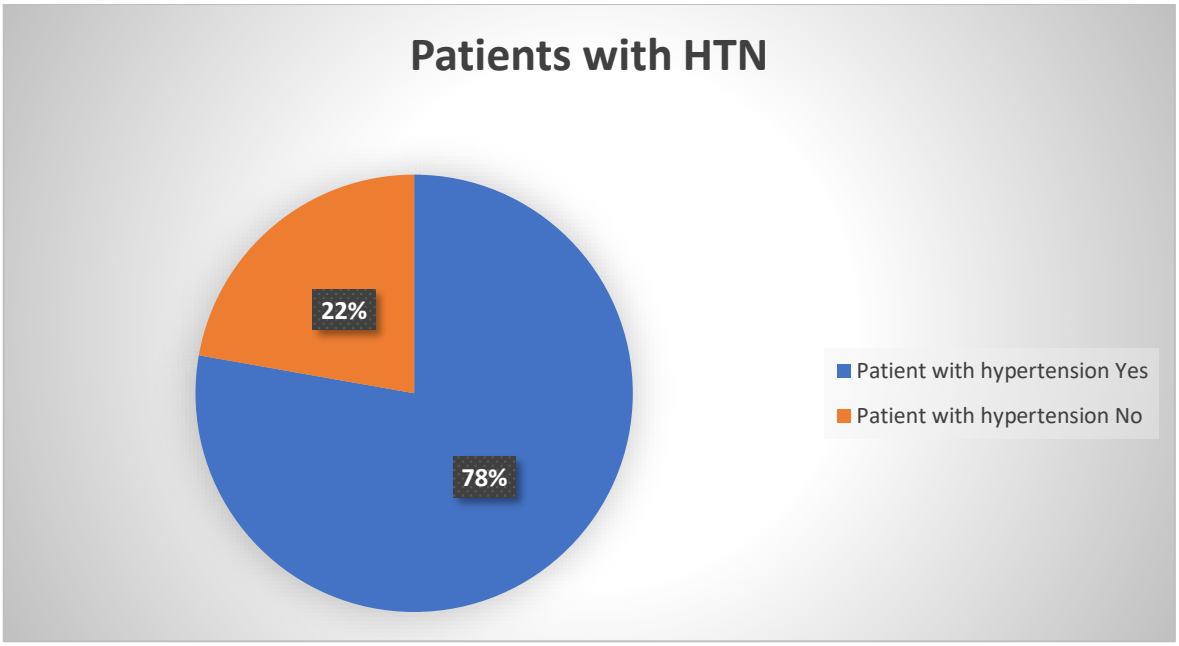

Figure 9: A pie-chart representing the percentage of stroke patients previously diagnosed and treated for hypertension.

The majority of the patients documented in both the in-hour and out-of-hour cohorts were male as demonstrated below in figure 10.

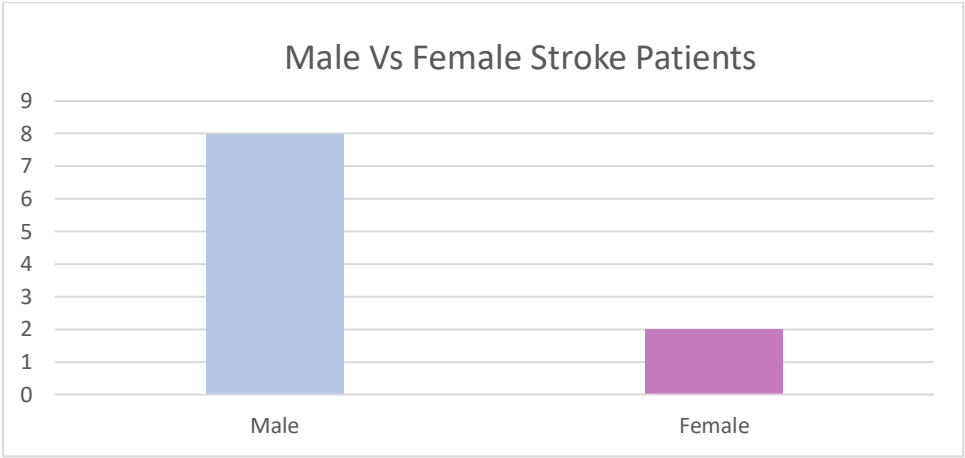

Figure 10: Male versus Female stroke patients documented from both the in-hours and out-of-hours cohort.

Following the advice obtained from the previous stakeholder meeting the delays occurring due to the presence of one CT machine and reduced support staff during out of hour fast calls were not taken into account or documented as these

issues are quite costly and at present are not seen to be modifiable. One common delay emerging as the project evolved was the unfamiliarity of the use of the NIHSS tool. As a result, the time taken to complete this was documented for each case where available during out-of-hour calls. The NIHSS was not utilised for every call out-of-hours but was utilised for 100% of in hours calls and these generally took less than 10 minutes. However, they took significantly longer in out of hour stroke calls.

One patient that presented with a stroke out of hours was an inpatient at the time- the process in treatment for this was much quicker than that of those who presented to ED and presentation to imaging time only took 36 minutes.

3.4.4 Improve

The fourth segment of the DMAIC framework is the Improve phase. This involves devising a solution to the problems identified following the completion of the third segment of the DMAIC model. These solutions will then have an impact on the overall aim of the QIP. In this case, the reasons why delays are occurring in door-to-treatment times of acute ischaemic stroke patients were reviewed. Following the analysis of the data collected and the advice obtained from the stakeholders. Following a brainstorming session, the areas requiring improvements were identified. Of the 9 patient journeys documented only 6 received treatment within one hour following presentation to ED. Most of the delays were occurring whilst the stroke team was no longer on-site. Some reasons for these delays are already known to the stroke team and include delays due to the operation of only one CT scanner and the time taken to stabilise vitally unstable patients prior to imaging. These issues cannot be helped. Based on the information outlined in the sections above and multiple brain-storming

sessions where each suggestion was evaluated based on how simple it would be to implement and maintain. The suggestions cannot be costly so in keeping with these criteria, the implements chosen to improve the current situation will be discussed in the next section. The aim of the project was to Identify the cause of delays occurring in out-of-hours FAST calls resulting in increasing door-to-treatment times.

3.4.5 Control

The control phase is the final phase of DMAIC framework. This element is vital as the aim is to maintain changes or improvements made. The sustainability of these changes correlates with the success of the QI project. For this project implementing any proposals for change to the protocols in place was not required (Kassardjian et al., 2015). However, it is important to mention. Without consistency the project will fail. The author will discuss some ideas on some improvements to be made in streamlining the out of hours door-to-treatment protocol in the next chapter.

3.5 Summary

Without change there is no innovation or incentive for improvement. QI models have been utilised in healthcare to facilitate these improvements. The DMAIC model is a firmly established tool and was the primary choice for this particular project. It is important to identify specific areas requiring improvements and identify the barriers resulting in delays to patients access to treatment within a timely fashion. The data collected demonstrated a need for improvement and assisted in outlining the specific areas that require focus as some of these delays are modifiable. The improve phase

discusses a plan to introduce changes to protocols already in place. Methods focusing on control of the improvements suggested by the writer and stakeholders involved with the project will be evaluated in the next chapter.

Chapter 4.0- Evaluation

4.1 Introduction

In this chapter the writer discusses the evaluation methods that will contribute to implementing the proposed changes following analysis of the data. Section 4.2 will review the expected outcomes following implementation of these changes. Section 4.3 will review the sustainability and success of the QI project by discussing in further detail the control phase of the DMAIC framework and how the plan both affected and was received by the stakeholders involved in the project.

4.2 Overview of QI Plan and Expected Outcomes

Several QI tools were utilised throughout this project. The aim of the project was to identify delays occurring during out-of-hour FAST calls and compare the management of acute ischaemic stroke occurring in hours versus out-of-hours. The overall goal is to suggest and implement changes that will further reduce these delays ensuring that the patients affected receive treatment within a safe and timely manner.

In order to understand the complexity of this issue a literature review was carried out and some common themes were identified. This aided in narrowing down the focus of the writer and gave some suggestions as to how the goal could be achieved and if it was attainable. According to the literature patients presenting with AIS should be treated within an hour of presentation to the ED, unless of course there is a contraindication to them receiving tPA. This is known as the ''golden hour''. Treatment within this time-frame has been linked to better short term outcomes and reduced mortality rates in stroke patients (Hebant et al., 2018). Introducing regular tutorials given by the stroke consultants or registrars to the ED doctors and medical

registrars on-call could be implemented by the stroke team. It could improve the fluidity of the process in the management of stroke in an acute setting.

Familiarising all staff involved with the NIHSS stroke assessment tool and identifying redundant processes within the current local management of stroke within the selected hospital may also lead to improvements. Furthermore, the writer noticed several risk factors consistently associated with the patients that presented to the ED as FAST positive, so a campaign to manage these risk factors more aggressively within the community setting may help reduce the incidence and impact of stroke. The expected outcomes of the project are to streamline the out-of-hours management of AIS.

Following discussions with the stakeholders involved in this QIP reasons for some of these delays were discussed and measures were suggested to improve this. Some were costly and therefore not possible to implement, such as assigning a stroke consultant 24/7 or the introduction of another CT scanner. However a simpler issue could be to communicate the importance of ambulance pre-alert, as this was lacking in all documented out-of-hour FAST calls attended by the writer. The next sections will discuss methods that will evaluate these suggestions.

4.3 Evaluation plan

4.3.1 Aim of Control stage of DMAIC

The fifth and final phase of the DMAIC framework is the control phase. The aim of the control phase is to ensure sustainability of the proposed changes that have been implemented. As this is a QI project plan this section of the DMAIC model was not

carried out. However, the control phase is a vital component of any QIP and confirms the success of the quality improvement made (Alhamali., 2019). In order to sustain change and quality we must strive to continuously evaluate and correct issues or delays occurring in the management of stroke. Improvements are not only to benefit patients but the healthcare professionals and the healthcare system collectively. In order to confirm the success of the QIP the process should be reassessed consistently and the data collected should be compared to any previous data collected. Revision of the process flow map is an effective tool to monitor and control changes made, as not all changes are improvements.

4.3.2 Monitoring & Review

In order to maintain quality improvement it must be tackled collaboratively by all members of staff involved in the process. Everyone is responsible for continuously evaluating if the current process is working effectively and suggesting improvements if needed (Alyoubi, et al., 2017). In order to evaluate the success of this QIP continuous collection of data would be required. This data would be collected in a similar fashion to that outlined in the measure phase of chapter 3. In doing so, the team can confirm if the changes implemented have had the desired outcome and if they have reduced or prolonged delays in door-to-treatment times for stroke patients.

If problems arise additional changes may have to be implemented as unforeseen problems not previously planned for during the stakeholders meeting may arise. Consistency and compliance in collecting data following implementation of new protocols must occur. If the project does not have the desired outcomes it is important to reflect on why this is the case (Varkey et al., 2007). Continuously communicating

with the stakeholders throughout the process is required so things do not become lost in translation. Everyone must be on the same page. Monthly meetings could be arranged with a representative from each department to discuss any observations or issues that may arise and to compile the results of the data collected. A shared excel document could be distributed amongst the stakeholders so data, opinions and concerns can be aired in real-time. Documentation is key. This can allow for further improvement and refinement of processes in place.

Visual representation of improvements could also boost morale and inspire continuity of the ongoing project amongst the staff. If this QIP is a success it will not only improve patient outcomes and reduce morbidity and mortality but reduce waste and free up hospital services that are in high demand. A collaborative approach can be taken to ensure better patient outcomes and improvements in the standard of care received through continuous monitoring, education and team work.

4.3.3 Expected Results

It is expected that all medical registrars and ED doctors will undergo training in the use of the NIHSS stroke tool. This will be provided by the stroke team and arranged onsite at the hospital. This QI project plan has not been designed to change the way in which acute ischaemic stroke is managed within the emergency setting but to identify and avoid delays in patients accessing treatment. Although some EMS staff alerted the ED to the incoming of a possible stroke patient, this is not consistent. So further communication and maybe a lecture given to paramedics could reinforce the importance of this issue and highlight the importance of the hospital pre-alert. The majority of staff within the ED are already aware of the urgency associated with stroke

but despite this unnecessary delays are still occurring, like the time taken to insert a cannula and order bloods. Although these are all important steps within the protocol prioritising more critical steps within the process may help avoid further delays.

The presence of a stroke trolley within the CT room itself could allow us to transfer the patient directly to CT and place the cannula and obtain bloods on the CT table. Continuous monitoring would be required and would involve all the stakeholders mentioned in the methodology chapter. These changes, although they seem relatively simple will require consistency in order to sustain improvement and a collaborative approach of all staff members the patient encounters from time of presentation will be required.

4.4 Dissemination Plan

This involves the distribution of the collected data and analysis of the results by the writer to the stroke team and other stakeholders. Further dissemination of the results obtained can be discussed at tutorials organised by the stroke team. Alternatively the results could be displayed via a poster presentation or discussed at the 'Lunch and Learn' sessions arranged on-site within the hospital (McNamara et al., 2016). Following implementation of this project, continuously updating the stakeholders at such teaching sessions would be advised. Displaying improvements on the hospital website would allow us to share our results and success stories with patients and their families. Not only will this raise awareness amongst healthcare staff within the hospital environment but it will also inform and remind the general public of the urgency in recognising stroke and presenting to the ED faster.

4.5 Summary

In this evaluation chapter the writer has outlined how further evaluation of the QIP will be carried out once changes have been adopted. It also outlined methods to sustain and monitor these changes by highlighting the importance of continuously collecting data. Potential results and outcomes of the project were also discussed. Evaluating the QIP confirms if the project has been a success. Furthermore, a dissemination plan was also constructed. Communication of results obtained to all stakeholders is vital.

Chapter Five 5.0 Discussion & Conclusion

5.1 Introduction

In the final chapter the writer discusses the impact the project will have on all stakeholders involved including the hospital itself. Chapter 2 reviewed the literature outlining the benefits of improving door-to-treatment time and the implementation and impact of similar projects. The writer will outline the potential impact the QI project will have on door-to-treatment times and critique and discuss the strengths of the project and any associated limitations which may have come to light as the project evolved. The writer will also revise the important take home messages and the knowledge and experience gained in undertaking a QI project within the healthcare system. Although this project was not carried out, the potential impact the project may have made will be discussed following an extensive literature review to support predictions. Finally, the chapter will conclude with a brief summary of the salient points of the QIP.

5.2 Project Impact

The improve and control phases of the DMAIC framework were not carried out so the impact the project made can only be predicted based on the evidence researched in chapter 2. However, the potential impact this QIP on the stakeholders and practices within the hospital will be discussed in section 5.2.1.

5.2.1 Stakeholders and Practice

Early identification of the stakeholders is essential to ensure success of the QIP. Several of these stakeholders were identified all of which had various levels of interest and power. Maintaining communication consistently throughout the process with all stakeholders was vital to the QIP and contributed to its progression and success. Identifying the key champions in the initial phases of the project was instrumental to the development of this project. In this case it was the lead stroke consultants within the hospital and the stroke team. Recommendations were made throughout the process of the project following analysis of the data obtained.

5.3 Strengths of the Project

One of the major strengths of this project are that it was carried out with the use of QI tools. The Lean Six Sigma model and the DMAIC framework was utilised to define areas of existing processes within the healthcare system that required improvement. It allowed the author to clearly define the aims and objectives using the SMART (Specific, Measurable, Achievable, Realistic, Time) criteria in chapter 1 (Aghera et al., 2018). Stroke is a service that requires consistent efforts to improve the quality and timely deliverance of treatment. It requires continuous data collection and this further validates the rationale behind this QIP (Kamal et al., 2017). Although the data collected is comprised of a small cohort of patients it demonstrated delays were occurring during out-of-hour FAST calls. This further justified the relevance of the project. The project was carried out by the writer, a physician associate (PA) student, and not a member of the stroke team, meaning the project was not influenced by an existing bias. Another strength of the project was the continuous communication that occurred between the relevant stakeholders of the project.

The guidance and advice offered helped the writer overcome any barriers in data collection and combat any unforeseen problems that arose throughout the project. This project is something that can be continued and carried on by another member of the stroke team or a PA student.

5.4 Limitations of the Project

Like all QI projects it is vital to identify any limitations and analyse why they occur in order to implement any changes to a protocol or process (Toussaint and Berry., 2013) There were a few limitations noted from carrying out this project. It proved difficult to develop a cohort of patients as the data collected required the writer to stay back late following a full day of medical placement and collect data at the weekend. Although using the DMAIC framework was beneficial, due to time constraints of the project the improve and control phases were not completed. Given the fact this was acute management of an ischaemic event it was also difficult to collect some data parameters accurately due to the hectic environment and urgency associated with stroke. Collecting data retrospectively proved difficult as not all the relevant time points were documented.

Data was also collected over a relatively short time period. A longer time-frame would have been more beneficial and would have displayed seasonable variances such as handover times and team changes etc. Due to time constraints data was collected over a time period of 3 months. It was also collected intermittently as it was not possible for the writer to remain on-site for all calls. Stroke patients transferred from other hospitals were excluded from this study. Not all patients presenting as FAST positive were diagnosed with stroke but were still included as the QIP audited time taken from presentation to diagnosis, to the decision for treatment. The author

was on rotation in other services and this made real-time data collection difficult and this was also seen as a relevant limitation.

5.5 Recommendations

Any recommendations made cannot result in a cost. One of the potential delays was the unfamiliar use of the NIHSS tool and the lack of pre-hospital alerts from the ambulance staff prior to the patient arriving to the ED. In order to improve door-to-treatment times for acute ischemic stroke patients based on the data obtained, the following recommendations were made. The first is to organise in house tutorials for all medical registrars and ED staff provided by the stroke team. Another recommendation is to communicate the urgency in pre-alerting the ED staff to incoming stroke patients so a meeting with a representative from the emergency services should arranged. Another recommendation is a collaborative approach in documenting the medical process and radiological processes in door-to-treatment times in out-of-hour FAST calls to over a longer time-frame to identify if these implements had any positive impact on reducing time to treatment. A staff survey could be constructed to gain further understanding of why these delays are occurring and where do they feel improvements need to made as part as a future QI project.

5.6 Learning about Quality Improvement

This was my first attempt at orchestrating and managing my own QIP. Although this proved extremely challenging it allowed me to develop and improve existing skills such as research, communication, data collection, organisation and analytical skills. The completion of an extensive literature review improved my knowledge and

understanding of the QI tools implemented within the healthcare system. It also confirmed the integral role QI plays in improving access to care for AIS patients. The lean six sigma and the DMAIC model, although broad proved to be beneficial in allowing me to define, measure and analyse my data. Tools such as the stakeholder analysis, the fishbone diagram and the process flow map allowed me to pinpoint specific areas that required attention in the pathway of acute stroke management. Defining the problems is half the battle.

The exposure gained from responding to and measuring FAST calls has further confirmed and outlined not only the importance of timely management of stroke patients but that communication between the multidisciplinary teams involved is vital. This includes the staff that register the patients, to the first responders pre-alerting the ED of an incoming stroke patient. One thing certainly holds true - reducing door-to-needle-time will not only save the lives of patient suffering ischaemic strokes but it will improve patient outcomes and therefore quality of life for survivors. However QI is an constant uphill battle that require a collaborative approach in order to maintain and sustain any improvements (Alyoubi et al,. 2017). I feel now going forward in my career as a PA I will be more confident in undertaking other QI projects that may arise and that this project has introduced me to the tools required to apply to the healthcare setting I am posted in. Increasing staff awareness is vital. Stroke should be treated as seriously as cardiac arrest- because it ultimately results in disability and death.

QI is not something that can be undertaken alone, a team effort and collaborative approach is essential for implementation and sustainability (AlyoubI et al., 2017) Support from the stakeholders is essential and consistent communication with these key players is imperative to the success of the project. Completion of this task has allowed the writer to gain insight into the importance of

quality improvement within the healthcare environment and the integral role it plays in improving the services currently available to patients.

5.7 Summary and Conclusion

Stroke is a major economic burden not only in Ireland but worldwide, and is one of the leading causes of disability and claims the lives of millions of people annually (Katan and Luft 2018). The aim of this QIP was to identify barriers causing delays in AIS patients receiving timely diagnosis and treatment. Thrombolysis is the only pharmacological treatment available for AIS but its utilisation is suboptimal (Kendall et al., 2013). National guidelines state door-to-treatment time should be no more than 1 hour (Irish Heart Foundation, 2019).

Several QI tools were utilised in order to complete this project. Following the use of the lean six sigma and DMAIC framework, the author proposed several improvements and recommendations which have been discussed in this chapter. All recommendations made are designed to place the patient at the centre of care and improve access to treatment for AIS patients. The writer felt that by introducing further education and by increasing the awareness of the urgency of stroke would have a positive impact on the door-to-treatment times and increase the chance of survival of the patient and reduce the morbidity associated with this common neuroemergency.

Chapter 6.0- References

Advani, R., Naess, H. and Kurz, M. (2017). The golden hour of acute ischemic stroke. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine, 25(1), pp.1-5.

Aghera, A., Emery, M., Bounds, R., Bush, C., Stansfield, B., Gillett, B. and Santen, S. (2018). A Randomized Trial of SMART Goal Enhanced Debriefing after Simulation to Promote Educational Actions. *Western Journal of Emergency Medicine*, 19(1), pp.112-120.

Alhamali, R. (2019). Success Factors and Benefits of Six Sigma Implementation in Hospitals: A Systematic Review. Business and Management Studies, 5(3), pp.1-5.

Alyoubi, M., Alqahtani, J. and Aziz, A. (2017). Quality Improvement Methodologies – PDSA Cycle and Six Sigma in E-learning System. IARJSET, 4(5), pp.95-99

Batalden, P. and Davidoff, F. (2007). What is "quality improvement" and how can it transform healthcare?. Quality and Safety in Health Care, 16(1), pp.2-3.

Beaumont.ie. (2018). Beaumont Hospital. [online] Available at: http://www.beaumont.ie/ [Accessed 15 Nov. 2018].

Brannigan, C., Galvin, R., Walsh, M., Loughnane, C., Morrissey, E., Macey, C., Delargy, M. and Horgan, N. (2016). Barriers and facilitators associated with return to work after stroke: a qualitative meta-synthesis. Disability and Rehabilitation, 39(3), pp.211-222.

Brewer, L., Arize, C., McCormack, J., & Williams, D. (2014). Delays in the stroke thrombolysis pathway--identifying areas for improvement. Irish Medical Journal, 107(5), pp 143-146.

Brugha, R. (2000). Stakeholder analysis: a review. Health Policy and Planning, 15(3), pp.239-246.

Crowl, A., Sharma, A., Sorge, L. and Sorensen, T. (2015). Accelerating quality improvement within your organization: Applying the Model for Improvement. Journal of the American Pharmacists Association, 55(4), pp.364-376.

Dahn, C. (2019). Acute care for the three leading causes of mortality in lower-middle-income countries: A systematic review. International Journal of Critical Illness and Injury Science, 8(3), pp.117-142.

Desai, S., Rocha, M., Jovin, T. and Jadhav, A. (2019). Abstract WP38: High Variability in Neuronal Loss: Time is Brain, Re-quantified. Stroke, 50(Suppl_1), pp. 1-10

Fernandes, D. and Umasankar, U. (2016). Improving Door to Needle time in Patients for Thrombolysis. BMJ Quality Improvement Reports, 5(1), pp.21-29.

Fonarow, G., Zhao, X., Smith, E., Saver, J., Reeves, M., Bhatt, D., Xian, Y., Hernandez, A., Peterson, E. and Schwamm, L. (2014). Door-to-Needle Times for Tissue Plasminogen Activator Administration and Clinical Outcomes in Acute Ischemic Stroke Before and After a Quality Improvement Initiative. JAMA, 311(16), p.1632.

Goyal, M., Almekhlafi, M., Dippel, D., Campbell, B., Muir, K., Demchuk, A., Bracard, S., Davalos, A., Guillemin, F., Jovin, T., Menon, B., Mitchell, P., Brown, S., White, P., Majoie, C., Saver, J. and Hill, M. (2019). Rapid Alteplase Administration Improves Functional Outcomes in Patients With Stroke due to Large Vessel Occlusions. Stroke, 50(3), pp.645-651.

Hannon, N., Daly, L., Murphy, S., Smith, S., Hayden, D., Ní Chróinín, D., Callaly, E., Horgan, G., Sheehan, Ó., Honari, B., Duggan, J., Kyne, L., Dolan, E., Williams, D., Wiley, M. and Kelly, P. (2014). Acute Hospital, Community, and Indirect Costs of Stroke Associated With Atrial Fibrillation. Stroke, 45(12), pp.3670-3674.

Harmon, T., Hulsberg, P., McFarland, J., Villescas, V. and Matteo, J. (2019). Time is Brain: The Future for Acute Ischemic Stroke Management is the Utilization of Steerable Microcatheters for Reperfusion. Cureus, 21(6), pp 210-220.

Hebant, B., Triquenot-Bagan, A., Guegan-Massardier, E., Ozkul-Wermester, O. and Maltête, D. (2018). In-hospital delays to stroke thrombolysis: Out of hours versus regular hours and reduction in treatment times through the creation of a 24/7 mobile thrombolysis team. Journal of the Neurological Sciences, 392, pp.46-50.

Heher, Y. and Chen, Y. (2017). Process mapping: A cornerstone of quality improvement. Cancer Cytopathology, 125(12), pp.887-890.

Houses of the Oireachtas. (2017). Sláintecare Report. Retrieved from https://webarchive.oireachtas.ie/parliament/media/committees/futureofhealthcare/oireachtas-committee-on-the-future-of-healthcare-slaintecare-report-300517.pdf.

HSE- Irish Association for Emergency Medicine, (2018). [online] Available at: http://www.iaem.ie/wpcontent/uploads/2013/02/iaem_submission_to_hse_on_national_stroke_strategy_250607.p df [Accessed 15 Nov. 2018].

Health Service Executive (HSE), 2017b, National Service Plan 2017: Building a Better Health Service, Available at: https://www.hse.ie/eng/services/publications/serviceplans/service-plan2017/national-service-plan-2017.pdf [Accessed: 14th of April 2019]

HSE- National Stroke Register Report 2017- National clinical and integrated care programmes- The royal college of physicians of Ireland. Hse.ie. (2019). [online] Available at: https://www.hse.ie/eng/services/publications/clinical-strategy-and-programmes/national-stroke-register-annual-report-2017.pdf [Accessed 10 Jul. 2019].

Irishheart.ie. (2018). Irish Heart Stroke - Irish Heart Foundation. [online] Available at: https://irishheart.ie/our-mission/our-policies/stroke/ [Accessed 15 Nov. 2018].

Irishheart.ie. (2019). Irish Heart Learn about Stroke - Irish Heart. [online] Available at: https://irishheart.ie/your-health/learn-about-stroke/ [Accessed 1 Jul. 2019].

Jauch, E., Adams, H., Demaerschalk, B., McMullan, P., Rosenfield, K., Summers, D., Wintermark, M. and Yonas,, H. (2018). Correction to: 2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. Stroke, 49(6), pp. 33-44.

Kamal, N., Holodinsky, J., Stephenson, C., Kashayp, D., Demchuk, A., Hill, M., Vilneff, R., Bugbee, E., Zerna, C., Newcommon, N., Lang, E., Knox, D. and Smith, E. (2017). Improving Door-to-Needle Times for Acute Ischemic Stroke. Circulation: Cardiovascular Quality and Outcomes, 10(1).

Katan, M. and Luft, A. (2018). Global Burden of Stroke. Seminars in Neurology, 38(02), pp.208-211.

Kassardjian, C.D., Williamson, M. L., Van Buskirk, D. J., Ernste, F. C. & Hunderfund, A. N. 2015. Residency Training: Quality improvement projects in neurology residency and fellowship: applying DMAIC methodology. Neurology, 85, pp. 7-10.

Kelly, P., Crispino, G., Sheehan, O., Kelly, L., Marnane, M., Merwick, A., Hannon, N., Ní Chróinín, D., Callaly, E., Harris, D., Horgan, G., Williams, E., Duggan, J., Kyne, L., McCormack, P., Dolan, E., Williams, D., Moroney, J., Kelleher, C. and Daly, L. (2012). Incidence, Event Rates, and Early Outcome of Stroke in Dublin, Ireland. Stroke, 43(8), pp.2042-2047.

Kendall, J., Dutta, D. and Brown, E. (2013). Reducing delay to stroke thrombolysis—lessons learnt from the Stroke 90 Project. Emergency Medicine Journal, 32(2), pp.100-104.

Kitson, A., Marshall, A., Bassett, K. and Zeitz, K. (2012). What are the core elements of patient-centred care? A narrative review and synthesis of the literature from health policy, medicine and nursing. Journal of Advanced Nursing, 69(1), pp.4-15.

Kotter, J. (2009). Leading change: why transformation efforts fail. IEEE Engineering Management Review, 37(3), pp.42-48.

Kuwaiti, A. and Subbarayalu, A. (2017). Reducing patients' falls rate in an Academic Medical Center (AMC) using Six Sigma "DMAIC" approach. International Journal of Health Care Quality Assurance, 30(4), pp.373-384

Layte R, Barry M, Bennett K et al. (2017). Projecting the Impact of Demographic Change on the Demand for and Delivery of healthcare in Ireland. ESRI research series 132009. Dublin: Economic and Social Research Institute.

Mason, S. E., Nicolay, C. R., & Darzi, A. (2015). The use of Lean and Six Sigma methodologies in surgery: a systematic review. Surgeon, 13(2), pp. 91-100. doi:10.1016/j.surge.2014.08.002

McGrath, K., Cunningham, N., Moloney, E., O'Connor, M., McManus, J., Peters, C. and Lyons, D. (2018). Enhancing acute stroke services: a quality improvement project. BMJ Open Quality, 7(3), p.e000258.

McNamara, D., Rafferty, P. and Fitzpatrick, F. (2016). An improvement model to optimise hospital interdisciplinary learning. International Journal of Health Care Quality Assurance, 29(5), pp.550-558.

Mellon, L., Doyle, F., Rohde, D., Williams, D. and Hickey, A. (2015). Stroke warning campaigns: delivering better patient outcomes? A systematic review. Patient Related Outcome Measures, pp. 61-78.

Meretoja, A., Strbian, D., Mustanoja, S., Tatlisumak, T., Lindsberg, P. and Kaste, M. (2012). Reducing in-hospital delay to 20 minutes in stroke thrombolysis. Neurology, 79(4), pp.306-313.

Meretoja, A., Weir, L., Ugalde, M., Yassi, N., Yan, B., Hand, P., Truesdale, M., Davis, S. and Campbell, B. (2013). Helsinki model cut stroke thrombolysis delays to 25 minutes in Melbourne in only 4 months. Neurology, 81(12), pp.1071-1076.

Mowla, A., Doyle, J., Lail, N., Rajabzadeh-Oghaz, H., Deline, C., Shirani, P., Ching, M., Crumlish, A., Steck, D., Janicke, D., Levy, E. and Sawyer, R. (2017). Delays in door-to-needle time for acute ischemic stroke in the emergency department: A comprehensive stroke center experience. Journal of the Neurological Sciences, 376, pp.102-105.

Nice.org.uk. (2019). Stroke and transient ischaemic attack in over 16s: diagnosis and initial management | Guidance | NICE. [online] Available at: https://www.nice.org.uk/guidance/CG68 [Accessed 1 Jul. 2019].

Olson, D., Constable, M., Britz, G., Lin, C., Zimmer, L., Schwamm, L., Fonarow, G. and Peterson, E. (2011). A Qualitative Assessment of Practices Associated With Shorter Door-to-Needle Time for Thrombolytic Therapy in Acute Ischemic Stroke. Journal of Neuroscience Nursing, 43(6), pp.329-336.

Reilly, J., Myers, J., Salvador, D. and Trowbridge, R. (2014). Use of a novel, modifiefishbone diagram to analyze diagnostic errors. Diagnosis, 1(2), pp.167-171.

Rocha, M., Almeida, A., Abath Neto, O., Porto, M. and Brucki, S. (2013). Impact of stroke unit in a public hospital on length of hospitalization and rate of early mortality of ischemic stroke patients. Arquivos de Neuro-Psiquiatria, 71(10), pp.774-779.

Saver, J. (2006). Time Is Brain—Quantified. Stroke, 37(1), pp.263-266.

Saver, J., Smith, E., Fonarow, G., Reeves, M., Zhao, X., Olson, D. and Schwamm, L. (2010). The “Golden Hour” and Acute Brain Ischemia. Stroke, 41(7), pp.1431-1439.

Smith, S., Horgan, F., Sexton, E., Cowman, S., Hickey, A., Kelly, P., McGee, H., Murphy, S., O'Neill, D., Royston, M., Shelley, E. and Wiley, M. (2013). The future cost of stroke in Ireland: an analysis of the potential impact of demographic change and implementation of evidence-based therapies. Age and Ageing, 42(3), pp.299-306.

Tai, Y., Weir, L., Hand, P., Davis, S. and Yan, B. (2012). Does a ‘code stroke’ rapid access protocol decrease door-to-needle time for thrombolysis?. Internal Medicine Journal, 42(12), pp.1316-1324.

Toussaint, J. and Berry, L. (2013). The Promise of Lean in Health Care. Mayo Clinic Proceedings, 88(1), pp.74-82.

Varkey, P., Reller, M. K. & Resar, R. K. 2007. Basics of Quality Improvement in Health Care. Mayo Clinic Proceedings, 82, pp. 735-739.

World Health Organisation. (2019). [online] Available at: https://www.who.int/medicines/areas/priority_medicines/Ch6_6Stroke.pdf [Accessed 17 Jul. 2019].

Wilson, J. (2003). Gantt charts: A centenary appreciation. European Journal of Operational Research, 149(2), pp.430-437.

Xian, Y., Xu, H., Lytle, B., Blevins, J., Peterson, E. D., Hernandez, A. F., Smith, E. E., Saver, J. L., Messe, S. R., Paulsen, M., Suter, R. E., Reeves, M. J., Jauch, E. C., Schwamm, L. H., & Fonarow, G. C. (2017). Use of Strategies to Improve Door-to-Needle Times with Tissue-Type Plasminogen Activator in Acute Ischemic Stroke in Clinical Practice: Findings from Target: Stroke. Circulation: Cardiovascular Quality and Outcomes, 10(1). doi:10.1161/circoutcomes.116.003227.

Xu, X., Vestesson, E., Paley, L., Desikan, A., Wonderling, D., Hoffman, A., Wolfe, C., Rudd, A. and Bray, B. (2017). The golden hour Performing an acute ischemic stroke workup. (2014). The Nurse Practitioner, 39(9), pp.29-30.

Chapter 7.0- Appendices

Appendix 1 − Gantt Chart

Project Plan	Sep18-Nov 18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19
Item	**Responsible**									
Define										
Identify an area requiring improvement										
Arrange meeting with sponsor										
Submit signed sponsorship form										
Meet Stroke team										
Project aim & objectives										
Carry our Stakeholder Analysis										
Measure										
Start data collection										
Identify measures										
Finish data collection										
Analyse										
Analyse data collected										
Identify delays in out of hours process										
Form recommendations based on data										
Activities										
Feedback information to team										
Search the literature										
Finish literature review and submit										
Methodology chapter										
Evaluation chapter										
Discussion and Conclusion chapter										
Abstract										
Revise and edit Introduction										
Submit draft dissertation										
Correct Draft										
Submit signed sponsorship form										
Final Submission of dissertation										
Key:	Complete									
	Planned									
	Behind Schedule									

Appendix 2- FAST Campaign

Appendix 3- NIHSS

N I H STROKE SCALE

Patient Identification. ___ ___-___ ___ ___-___ ___ ___

Pt. Date of Birth ___ ___/___ ___/___ ___

Hospital _____(___ ___-___ ___)

Date of Exam ___ ___/___ ___/___ ___

Interval: [ ] Baseline [ ] 2 hours post treatment [ ] 24 hours post onset of symptoms ±20 minutes [ ] 7-10 days
[ ] 3 months [ ] Other _____(___ ___)

Time: ___ ___:___ ___ [ ]am [ ]pm

Person Administering Scale _____

Administer stroke scale items in the order listed. Record performance in each category after each subscale exam. Do not go back and change scores. Follow directions provided for each exam technique. Scores should reflect what the patient does, not what the clinician thinks the patient can do. The clinician should record answers while administering the exam and work quickly. Except where indicated, the patient should not be coached (i.e., repeated requests to patient to make a special effort).

Instructions	Scale Definition	Score
1a. Level of Consciousness: The investigator must choose a response if a full evaluation is prevented by such obstacles as an endotracheal tube, language barrier, orotracheal trauma/bandages. A 3 is scored only if the patient makes no movement (other than reflexive posturing) in response to noxious stimulation.	0 = **Alert;** keenly responsive. 1 = **Not alert**; but arousable by minor stimulation to obey, answer, or respond. 2 = **Not alert**; requires repeated stimulation to attend, or is obtunded and requires strong or painful stimulation to make movements (not stereotyped). 3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, and areflexic.	_____
1b. LOC Questions: The patient is asked the month and his/her age. The answer must be correct - there is no partial credit for being close. Aphasic and stuporous patients who do not comprehend the questions will score 2. Patients unable to speak because of endotracheal intubation, orotracheal trauma, severe dysarthria from any cause, language barrier, or any other problem not secondary to aphasia are given a 1. It is important that only the initial answer be graded and that the examiner not "help" the patient with verbal or non-verbal cues.	0 = **Answers** both questions correctly. 1 = **Answers** one question correctly. 2 = **Answers** neither question correctly.	_____
1c. LOC Commands: The patient is asked to open and close the eyes and then to grip and release the non-paretic hand. Substitute another one step command if the hands cannot be used. Credit is given if an unequivocal attempt is made but not completed due to weakness. If the patient does not respond to command, the task should be demonstrated to him or her (pantomime), and the result scored (i.e., follows none, one or two commands). Patients with trauma, amputation, or other physical impediments should be given suitable one-step commands. Only the first attempt is scored.	0 = **Performs** both tasks correctly. 1 = **Performs** one task correctly. 2 = **Performs** neither task correctly.	_____
2. Best Gaze: Only horizontal eye movements will be tested. Voluntary or reflexive (oculocephalic) eye movements will be scored, but caloric testing is not done. If the patient has a conjugate deviation of the eyes that can be overcome by voluntary or reflexive activity, the score will be 1. If a patient has an isolated peripheral nerve paresis (CN III, IV or VI), score a 1. Gaze is testable in all aphasic patients. Patients with ocular trauma, bandages, pre-existing blindness, or other disorder of visual acuity or fields should be tested with reflexive movements, and a choice made by the investigator. Establishing eye contact and then moving about the patient from side to side will occasionally clarify the presence of a partial gaze palsy.	0 = **Normal.** 1 = **Partial gaze palsy;** gaze is abnormal in one or both eyes, but forced deviation or total gaze paresis is not present. 2 = **Forced deviation,** or total gaze paresis not overcome by the oculocephalic maneuver.	_____

Rev 10/1/2003

Appendix 4- Contraindications to tPA

CONTRAINDICATIONS:

- Evidence of intracranial hemorrhage on pretreatment evaluation
- Suspicion of subarachnoid hemorrhage
- Recent intracranial surgery or serious head trauma or recent previous stroke
- History of intracranial hemorrhage
- Uncontrolled hypertension at time of treatment (e.g., >185 mm Hg systolic or >110 mm Hg diastolic)
- Seizure at the onset of stroke
- Active internal bleeding
- Intracranial neoplasm, arteriovenous malformation, or aneurysm
- Known bleeding diathesis, including but not limited to:
  - Current use of oral anticoagulants (e.g., warfarin sodium) with prothrombin time (PT) >15 seconds
  - Administration of heparin within 48 hours preceding the onset of stroke and an elevated activated partial thromboplastin time (aPTT) at presentation
  - Platelet count <100,000/mm^3

Appendix 5- In-Hours Data

Patient no.	Patient 1	Patient 2	Patient 3	Patient 4
Sex	F	F	M	M
Arrival of patient to ED	8.55am	12.02pm	9.24am	12.26pm
Presenting symptoms	Slurred speech, dysphagia	L-sided facial numbness	R hemiparesis	R-sided facial droop
Ambulance pre-alert	Yes	No	yes	Yes
Scan ordered	9.12am	12.18pm	10.04am	12.33pm
Bloods ordered	9.13am	12.04pm	10.06am	12.29pm
Bloods received in lab	10.38am	12.26pm	10.18am	12.49pm
Bloods verified	10.41am	13.56pm	10.26aam	13.03pm
NIHSS	5	N/A	10	8
Arrival of patient to CT	9.14am	13.10pm	10.07am	12.50pm
Imaging performed	9.45am	13.33pm	10.14am	12.52pm
Diagnosis	Old areas of infarction	No acute findings	L caudate infarct	L cerebral infarct
Decision for tPA	N/A	N/A	10.14am	N/A
A.FIB	Yes	No	Yes	No
HTN	No	No	Yes	Yes
Time taken	50 minutes	1 hour 31 minutes	50 minutes	26 minutes

Appendix 6- Out-of-Hours Data

Patient no.	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
Sex	Male	Male	Male	Male	Male
Arrival of patient to ED	21.05pm	Inpatient	7.15pm	11.37pm	10.13pm
Presenting symptoms	R Transitional parathesia	R hemiparesis	dysarthria, limb weakness	Confusion, slurred speech	Weakness, confusion
Ambulance pre-alert	No	No	No	No	No
Scan ordered	21.46pm	18.38pm	20.14pm	12.08am	10.24pm
Bloods ordered	21.13pm	18.45pm	20.18pm	12.05am	10.20pm
Bloods received	21.36pm	19.00pm	20.29pm	12.50am	10.53pm
Bloods verified	21.41pm	19.09pm	20.35pm	12.58am	11.04pm
NIHSS	N/A	N/A	11	14	12
Arrival of patient to CT	22.56pm	18.40pm	20.20pm	12.25am	10.38pm
Imaging performed	23.26pm	18.58pm	20.40pm	12.37am	10.52pm
Diagnosis	Nil acute	Infarction	L V3 Segment occlusion	No acute findings	Old areas of infarct
Decision for tPA	N/A	19.14pm	N/A	N/A	N/A
A.FIB	No	Yes	No	Yes	Yes
HTN	Yes	Yes	Yes	Yes	Yes
Time taken	2 hours 21 minutes	36 minutes	1 hour 25 minutes	60 minutes	39 minutes