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Implementing a Stroke Process Improvement Group to Reduce Time to Thrombectomy in Patients with Acute ischemic Stroke at Greenwich Hospital

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A DNP project submitted in partial fulfillment of the requirements for the degree of Doctor of Nursing PracticeDavis & Henley College of Nursing

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This is to certify that the DNP Project Final Report by
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has been approved by the DNP Project Team on
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for the Doctor of Nursing Practice degree

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Abstract

Introduction: Delays in door to skin puncture time for patients with ischemic stroke are associated with worse clinical outcomes. The following quality improvement study was conducted at Greenwich Hospital which aimed to decrease door to skin puncture time for endovascular stroke treatment. Greenwich Hospital began its new stroke program in January 2020 and opened thrombectomy capable interventional radiology (IR) services. Delays to door to skin puncture times existed with average time being 100 minutes with a goal time of 90 minutes or less for 50% or more of patients directly arriving to the hospital and 60 minutes or less for 50% or more of patients transferred from another hospital.

Materials and Methods: Our stroke team implemented a series of quality improvement measures to decrease door to skin puncture time with a target of 90 minutes or less. A monthly interdisciplinary stroke committee meeting was utilized to identify and remedy delays to timely treatment with thrombectomy using the theoretical framework of Plan, Do, Study, Act (PDSA) cycles. Each monthly meeting reviewed the previous month's thrombectomy cases in the format of a stroke report card which analyzed door to skin puncture times for each case. 9 thrombectomies were performed at Greenwich Hospital from July to December 2021. PDSA cycles were used to identify delays in door to skin puncture times and garner solutions for delays.

Results: Mean door to skin puncture times decreased 19.5 minutes to 80.5 minutes in 71% of patients directly arriving to Greenwich hospital. The following solutions were implemented during the data collection period: appropriate IV catheter placement size by EMS prior to arrival to hospital to save time in cat scan, stroke clinical pathway created in EPIC, heparinized saline bags stocked in Interventional Radiology procedural area and a nurse navigator was hired in October.

Conclusion: A thorough quality improvement process can significantly improve door to skin puncture times. This analysis demonstrates the effectiveness of a formal quality improvement system at a thrombectomy capable hospital.

Problem Identification, Development of Clinical Question, and Evidence Review

Background and Significance of Problem

Greenwich Hospital (GH) is one of the delivery network hospitals apart of the larger Yale New Haven (YNHH) Healthcare System. Greenwich Hospital began performing thrombectomy procedures in January of 2020 and achieved advanced Primary Stroke Center recertification by the Joint Commission in 2020. There are multiple departments involved in the care stroke patients eligible for a thrombectomy. Specifically, thrombectomy procedures are performed in a designated procedural area (interventional radiology) that includes bi-plane imaging technology. The multiple areas of care involved leaves room for multiple areas of delay to occur (see Appendix A). The current door to skin puncture time goal at Greenwich Hospital is 90 minutes based on the American Heart Association's (AHA) benchmark for thrombectomy treatment for eligible stroke patients. The new primary goals for phase III of the AHA's Target Stroke is to achieve door to skin puncture times in 90 minutes or less for 50% or more of direct-arriving patients and 60 minutes or less in 50% of patients transferred from an outside hospital for acute ischemic stroke patients (American Heart Association, 2021). However, Greenwich Hospital does not currently accept transfers from outside hospitals for thrombectomy cases. Discussions with the stroke coordinator of Greenwich Hospital and Dr. Zetchi indicated that Yale New Haven Hospital strives to achieve door to skin puncture in 60 minutes or less and a stretch time of door to skin puncture time in 45 minutes or less (Yale New Haven Hospital, Tier 2 Stroke Lab Activation, 2020. Prior to the following quality improvement project, 19 thrombectomy procedures had been performed at Greenwich Hospital since January 2020. Current door to skin puncture times averaged 100 minutes. Sixty percent of thrombectomy cases achieve door to skin puncture time in 90 minutes or less, ranging between 34 to 218 minutes. Although not yet a

requirement, making strides toward meeting a 60-minute door to skin puncture time benchmark is also an advantage to Greenwich Hospital's goal of becoming a Thrombectomy-Capable Stroke Center (TSC) in 2021.

Current Research

The literature discusses that timely door to skin puncture time (DGPT) allows for faster revascularization of the affected vessel, a vital component in a positive patient outcome (Cheung et al., 2018; Allmallouhi et al., 2019, Mehta et al., 2014). Cheung et al. (2018) discuss how delays in DGPT for ischemic stroke patients needing a mechanical thrombectomy caused by a large vessel occlusion are associated with poorer clinical outcomes. Cheung et al. (2018) implemented a monthly stroke process improvement group in their hospital with a new stroke program. The group reviewed cases from the previous month and identified points of delay in DGPT. Suggestions for improvement were developed into action items for the next month. The enhancements from their improvement group's initiative significantly shortened their DGPT times for mechanical thrombectomy, ultimately allowing the patient to receive faster revascularization of the affected vessel. This study highlights the importance of establishing effective workflow between different departments when expediting a critical stroke patient through multiple areas of care (Cheung et al., 2018; Almallouhi et al., 2019; Mehta et al., 2014). In addition, decreased door to skin puncture time may save brain tissue and ultimately improve patient outcomes (Almallouhi et al., 2019, Mehta et al., 2014, Cheung et al., 2018). See evidence tables in Appendix C for additional literature pertaining to problem.

Description of Local Problem

In order to reduce door to skin puncture times, it is essential to decrease interdepartmental delays to thrombectomy in patients with acute ischemic stroke to achieve a

door to skin puncture goal of within 90 minutes for 50% or more of eligible patients directly arriving to Greenwich Hospital. There are multiple departments and steps involved in the care of this type of stroke patient. If there is a delay in any of the involved departments, door to skin puncture times will increase. The current door to skin puncture time goal at Greenwich Hospital is 90 minutes based on the American Heart Association's (AHA) benchmark for thrombectomy treatment for eligible stroke patients. The new primary goals for phase III of the AHA's Target Stroke is to achieve door to skin puncture times in 90 minutes or less for 50% or more of direct-arriving patients and 60 minutes or less in 50% of patients transferred from an outside hospital for acute ischemic stroke patients (American Heart Association, 2021).

Organizational Priority: YNHH Nursing Strategic Framework

This DNP project quality improvement (QI) project will align itself with the Nursing Strategic Framework of YNHH hospital system. It will inspire a culture of excellence in that it will provide timely care to stroke patients receiving thrombectomy and this will assist stroke patients with increased circulation and better chances of recovery. It will provide patient-centered care in the IR lab in GH in that there will be a structured format that will provide decreased door-to-skin puncture time based upon evidence for practice, which will be discussed later in this letter. Along the lines of Enhanced Clinical Services, this QI project will align with the goals of YNHH/GH for seeking their Thrombectomy-Capable Stroke Center (TSC) certification in 2021. This certification will create a center for stroke excellence at YNHH/GH. Finally, this QI project will manage total cost of care and sustain financial strength in providing shorter door to skin puncture times thus decreasing the length of time patients are waiting for thrombectomy and providing greater overall chances for recovery.

Focused Search Question

The literature was searched for evidence to answer the following clinical question in PICO format: For patients presenting with thrombotic stroke (P) does a monthly stroke process improvement group focusing on reviewing the stroke report card for all thrombectomy patients at Greenwich Hospital (I) compared to standard stroke committee meetings (C) decrease door to skin puncture time(O)?

Evidence Search

Databases searched include CINAHL Complete, MEDLINE full text, Cochrane Database of Systematic Reviews and PUBMED with key words: stroke, door to skin puncture time, thrombectomy, quality improvement, patient outcomes, workflow, communication, nursing handoff, cardiac catheterization. Searches were limited to those articles published in English between 2010-2020, adult, and English language. Inclusion criteria for article selection were quality improvement projects or strategies to improve door to skin puncture time or patient outcomes in stroke patients. See appendix C for evidence search tables.

Evidence Appraisal, Summary, and Recommendations

Six articles were reviewed focusing on decreasing door to skin puncture times for thrombectomy eligible stroke patients, decreasing delays in care of a stroke patient, the effects of timely care in long term function outcomes for patients and quality improvement strategies to improve stroke programs at various institutions. The literature demonstrates that multiple methods have been used to improve door to skin puncture times in different stroke programs. Door to skin puncture times were improved in three of the six through different quality improvement processes including: monthly stroke quality improvement meetings, stroke code

alarm clock and early mobilization of the neurointerventional suite and team during diagnostic imaging (see appendix C for evidence summary tables).

Project Goals

The purpose of this project is to implement a monthly stroke process improvement group that focuses on reducing interdepartmental delays to thrombectomy in patients with acute ischemic stroke with a door to skin puncture goal of within 90 minutes for 50% or more of eligible patients directly arriving to Greenwich Hospital.

Context

Greenwich Hospital (GH) is a 206-bed regional hospital, serving Fairfield County, Connecticut and Westchester County, New York. As previously noted, it is one of the delivery network hospitals a part of the larger Yale New Haven (YNHH) Healthcare System and began performing thrombectomy procedures in January of 2020 achieving advanced Primary Stroke Center certification by the Joint Commission in 2020. There are multiple departments involved in the care of stroke patients eligible for a thrombectomy. Specifically, thrombectomy procedures are performed in a designated procedural area (interventional radiology) that includes bi-plane imaging technology. Areas involved in the care of stroke patients includes: EMS, medical inpatient floors, Cat Scan imaging, pharmacy, Interventional Radiology, Emergency Department and Greenwich Hospital page operating system. Greenwich Hospital's thrombectomy capabilities will save time in needing to transport patients to outside hospitals for treatment.

Project Team Members and Roles

Sheryl Feldheim is the Stroke Coordinator of Greenwich Hospital. Her role will be to continue to trend and collect all time sensitive data on any stroke patient that receives a thrombectomy. In addition, she currently leads each monthly stroke committee meeting and will be able to assist with implementing PDSA cycles at each meeting. She will also assist with communicating the need for change to other departments after PDSA cycles are run.

Rose McElwain is the Nurse Manager of the Heart and Vascular Center (HVC) at Greenwich Hospital She is currently responsible for filling out the stroke report card associated with each thrombectomy case that is performed. The report card includes all metrics that are tracked based on The Joint Commission's clinical quality measures for stroke certification, specifically door to skin puncture time (see Appendix B). Door to skin puncture times will be reviewed in each of the stroke report cards before and after the implementation of the monthly improvement meetings. Times will be compared to analyze if they are faster post implementation. She also attends the monthly stroke committee meetings.

Maureen Caspare is the Clinical Coordinator of Interventional Radiology (IR) at Greenwich Hospital. Anytime a thrombectomy procedures occurs during the day Maureen is present to help minimize delays in the care of a thrombectomy eligible stroke patient as she oversees the area this procedure is performed in. She will also be involved in sharing any new solutions that are implemented in the monthly meetings to minimize delays with IR nurses, especially if the solution is action required by IR nurses as she attends the monthly meetings as well.

Lastly, Dr. Zetchi is the Cerebrovascular Neurosurgeon performing thrombectomy procedures at Greenwich Hospital and also decides with the stroke team if the patient is experiencing a large vessel occlusion meets criteria for a thrombectomy to improve blood flow to

the affected area of the brain. Dr. Zetchi is responsible for communicating with ED physicians and providers and is responsible for activating the IR department to report to the hospital should a thrombectomy need to be performed during off hours.

Target Population

The target population is patients with acute ischemic stroke arriving to the emergency department (ED) who are experiencing this type of stroke as an inpatient and identified as having a large vessel occlusion meeting criterion for a thrombectomy to improve blood flow to the affected area of the brain at the neuro-interventionalist discretion in collaboration with the stroke team. Greenwich Hospital is predicted to have approximately 20 thrombectomy cases per year. Since the program started in January of 2020, there have been between 0 to 4 thrombectomy cases each month.

Framework

There is currently a monthly stroke committee meeting at Greenwich Hospital lead by the stroke coordinator of the hospital. Participants involved in the meetings including nursing leadership (HVC Nurse Manager, ED Nurse Manager, Medicine floor managers), Physicians (ED, Neurology service), and lead pharmacists at GH. The meetings currently discuss the stroke program as a whole and do not always specifically focus on the thrombectomy eligible stroke patients, which is determined by the Neurovascular physician on call, as there are many different types of stroke patients encompassed in the new program. Meetings will address patients who had a thrombectomy procedure performed from the previous month and discuss delays that occurred with possible solutions. Solutions agreed upon will be trialed in the following month and then reviewed.

Plan Do Study Act. The quality improvement framework used for this project will be the Institute for Health Improvement's (IHI) Model for Improvement consisting of the Plan-Do-Study-Act (PDSA) cycle to accelerate improvement for Greenwich Hospital's Stroke Program. This model emphasizes forming a team to implement change (Institute for Healthcare Improvement, 2021). The current attendees of the meeting adequately represent the wide range of departments that are all involved in the care of a stroke patient and need to work together to prevent interdepartmental delays. Monthly PDSA cycles will be crucial to identifying delays and implementing possible solutions. Meetings will address thrombectomy cases from previous month and discuss delays that occurred with possible solutions as part of the planning portion of the PDSA cycle. Solutions to delays will be trialed in the following month and then reviewed during the next stroke improvement process meeting to see if such solutions are addressing the identified delay appropriately as the study part in the PDSA cycle to determine if the change is an improvement. Each monthly review with all account for one cycle in the PDSA method. Data will be collected for three months. This will include three cycles of the PDSA method.

The stroke report card addresses multiple phases of the process to get a patient to the Interventional Radiology (IR) lab for a thrombectomy and indicates some phases need more work than others. PDSA cycles using monthly meetings of the stroke committee will be used to evaluate the following six phases of the stroke report card: door to stroke code, stroke code to CT scan, CT scan to stroke tier 2 Lab activation, stroke tier 2 lab activation to Interventional Radiology (IR) lab patient arrival, IR lab patient arrival to arterial access, door to skin puncture, arterial access to reperfusion, and door to reperfusion. With each cycle of the PDSA, the 6 phases of the stroke report card will be evaluated, and all gaps will be addressed. The plan that comes from each cycle will be what is executed and reevaluated in the next monthly meeting and

a new cycle will begin. Ultimately, the monthly improvement meeting will create the plan which will be put into action and the results of this plan will be studied in the next meeting.

Stroke report card. Currently in Interventional Radiology at GH, a stroke report card is completed for each thrombectomy case by the HVC nurse manager. The report card includes all metrics that are tracked based on The Joint Commission's clinical quality measures for stroke certification, specifically door to skin puncture time (see Appendix B). The report will show the time in which each goal was met and if any delays occurred, an explanation is also included. The current goal for door to skin puncture time is 90 minutes or less for 50% or more of direct-arriving patients. Door to skin puncture times will be reviewed in each of the stroke report cards before and after the implementation of the monthly improvement meetings. Times will be compared to analyze if they are faster post implementation. The goal is to obtain door to skin puncture times well under 90 minutes for direct admit patients to comply with AHA's new target stroke goal to achieve these door to skin puncture times.

Possible Barriers to Implementation

Barriers to implementation of delays in door to skin puncture times may involve resistance to possible solutions for delays by the performing department due to practice or the culture of the department. Plans to address resistance include staff education of the department involved in a delay and follow up with managers of these departments to ensure solutions are being carried out by staff members for future stroke patients. In addition, solutions for delays will continue to be reviewed at each monthly stroke committee meeting to reassess if changes are being made and sustained by staff involved.

Sustainment

The following project met the criteria for a quality improvement project as indicated in the attached quality improvement checklist located in Appendix E. In addition, this quality improvement project was approved and backed by crucial attendees of the monthly stroke committee meetings and hospital administration including Greenwich Hospitals stroke program coordinator, Interventional Radiology nurse manager and the neurointerventionalist performing all thrombectomy procedures which is a key step towards sustainability. Given the significant results of decreasing average door to skin puncture times, thrombectomies will continue to be reviewed at all subsequent monthly stroke committee meetings. The nurse navigator at Greenwich Hospital will be working together with the stroke coordinator to present each previous month's thrombectomy procedures so that there can be a continuation of PDSA cycles to address and remedy delays. Together they will follow up with the involved departments to ensure solutions to delays are being carried out without additional issues.

Dissemination

The plan for dissemination includes attending the monthly stroke committee meeting in March to discuss results of the project. Results will also be presented at the annual Janet Parkosewich research conference for Yale New Haven Healthcare System in April. In addition, a poster of the project will be created for the DNP program faculty and students. This poster will also be on display at Greenwich Hospital for nurses, providers and additional staff involved in the care of stroke patients. Possible journals being considered for submissions are *Journal of Stroke and Cerebrovascular Diseases* and *Journal of the American Heart Association*.

Estimated Timeline

The expected duration is approximately six months depending upon the number of thrombectomy cases experienced at GH post implementation of the monthly improvement meetings. Each monthly meeting review will account for one cycle in the PDSA method. Data will be collected for three to six months depending upon the number of thrombectomy cases that occur each month. This will include three cycles of the PDSA method. See appendix D for full project timeline.

Review for Ethical Considerations

This project was reviewed as a quality improvement project by the Nursing Scientific Review Committee (NSRC) of the System Nursing Research and Evidence-based Practice Steering Committee. This committee provides oversight for the conduct of student projects that require use of Yale New Haven Health System data. A letter of intent and scholarly project overview was submitted to the committee in May, with final approval being granted July 1st, 2020.

Project Implementation

Participants

Patients involved are those with acute ischemic stroke arriving to the emergency department (ED) or experience this type of stroke as an inpatient and meet criteria for a thrombectomy to improve blood flow to the affected area of the brain at the neuro-interventionalist discretion in collaboration with the stroke team. Additional participants include individuals attending the monthly stroke committee meeting at Greenwich Hospital led by the stroke coordinator of the hospital. Participants involved in the meetings include nursing leadership (HVC Nurse Manager, ED Nurse Manager, Medicine floor managers), Physicians

(ED, Neurology service), and lead pharmacists at GH. In addition, nurses working in other clinical areas involved in the care of a stroke patient including medicine floors, ICU, Emergency Department and Interventional Radiology. Imaging technologists in the Cat Scan department are also involved in the project as they are responsible for performing the necessary imaging which is a vital step in determining if the stroke patient is a candidate for a thrombectomy procedure. Physicians are also important participants for this project. Not only will those who attend the meetings be involved in running the PDSA cycles at each monthly quality improvement meeting, but physicians interact with stroke patients and offer potential areas of delay including deeming a patient a stroke code, attending an inpatient stroke code promptly, prompt ordering of imaging and timely paging of the neurovascular surgeon on call to review imaging and decide if the patient is a candidate for a thrombectomy. IR technologists are involved in the thrombectomy procedure and are responsible for arriving to the lab within 45 minutes of a page during off hours, setting up for the procedure and prepping the patient. Lastly, EMS is an especially important participant as they are often the first people to witness the stroke if the patient is not already in the hospital. It is their responsibility to notify the Greenwich Hospital Emergency Department of an incoming stroke patient prior to arrival at the Emergency Department.

Evaluation

Effectiveness of this project will be evaluated based upon door to skin puncture times in thrombectomy cases performed. The stroke report card completed for each thrombectomy case by the HVC nurse manager will track door to skin puncture time. The current goal for door to skin puncture time is 90 minutes or less for 50% or more of direct-arriving patients. The report card will show the time in which each goal was met and if any delays occurred with an

explanation of why the delay occurred which will be useful in the next month's PDSA cycle to identify and remedy areas of delay. Door to skin puncture times will be reviewed in each of the stroke report cards before and after the implementation of the monthly improvement meetings. Times will be compared to analyze if they are faster post implementation. The goal is to obtain door to skin puncture times well under 90 minutes for 50% of direct admit patients eligible for a thrombectomy to comply with AHA's new target stroke goal to achieve this door to skin puncture times.

Process Measures

Door to skin puncture times will be used to track the progress of this project as it is an essential metric that encompasses all the potential areas involved in the care of a thrombectomy eligible stroke patient because it marks the start of the thrombectomy procedure. In addition, the six metrics of the stroke report card previously mentioned will be tracked as well to continue to monitor the improvement of potential areas of delay leading up to door to skin puncture.

Stroke report cards used to collect data will be provided by the HVC nurse manager. Specifically, door to skin puncture times will be extracted from the report cards and trended over a three-month period. The committee will be investigating delays based on data from the stroke report cards that does not meet goal times. The DNP student will be assisting with this as she will particularly address any metrics on the report card that indicated a delay at the monthly meetings when discussing the prior month's thrombectomy cases. The DNP student's investigation will include discussing the metric that is over the time goal with the stroke committee to understand which departments were involved. The meeting attendees will discuss at the meeting how to remedy the delay and the DNP student will follow up with the department throughout the month after the meeting to ensure the solution is being carried out (as previously

discussed in the intervention section). This is an example of why this project is important because the HVC nurse manager does not look into the specifics of delays that occurred outside of HVC (IR lab specifically). Thus, often times only problems that occurred in IR are addressed with IR staff and this does not address the problems that can occur in the multiple areas of care involved in getting the stroke patient to the IR lab for a thrombectomy.

Information shared with members of Greenwich Hospital outside of the stroke committee will be in regard to solutions being implemented to resolve various delays across involved departments. None of the information shared will be able to identify any of the patients on which a thrombectomy was performed on as this information is not pertinent to the data being collected.

Outcomes Measures

The data to be used for this project will be extracted from the existing quality reports, specifically stroke report cards described above. This data will be provided to the stroke process improvement group to compare door to skin puncture times pre- and post-implementation of the monthly stroke improvement meetings.

Exclusion criteria. The exclusion criteria for the data set will be patients who did not meet criteria for the project if their door to skin puncture time is delayed for a specific reason. For example, if the patient refuses the procedure at first or if a family discussion is needed before proceeding with the thrombectomy or if a patient has an MI while in the ED or any untoward event that would delay door to skin puncture time that is not part of the routine admission of these patients. In addition, patients who receive TPA that dissolves the clot and no longer require a thrombectomy will be excluded, even if groin access is obtained, as the patient did not technically receive a thrombectomy.

Results and Discussion

Sample

Patients involved are those with acute ischemic stroke arriving to the emergency department (ED) or experience this type of stroke as an inpatient and meet criteria for a thrombectomy to improve blood flow to the affected area of the brain at the neuro-interventionalist discretion in collaboration with the stroke team. Data collection transpired from July 2021through December 2021 with the final PDSA cycle completed in December to review November thrombectomy cases. A total of eight thrombectomy cases were performed from July 1 to December 1st, 2021.

Exclusion criteria. Patients were excluded from the data set if their door to skin puncture time is delayed for a specific reason. One of the eight patients was excluded from the data set due to multiple reasons that delayed the calling of a Tier 2 stroke alert. The stroke occurred during the patient's spinal surgery when decreased absent motor and sensory activity was noted on EEG. The surgery did not end until approximately one hour after symptom onset. Patient was obtunded after extubation from surgery. A stroke code was not called until after the patient received a CT scan which should have first been called prior to ordering a head CT. This delayed the neuro-interventionalist being notified and calling a Tier 2 lab Activation to perform the thrombectomy.

Project Design and Methods

Door to skin puncture times were used to track the progress of this project as it is an essential metric that encompasses all the potential areas involved in the care of a thrombectomy eligible stroke patient and because it marks the start of the thrombectomy procedure. In addition, the six metrics of the stroke report card were tracked as well to continue to monitor the

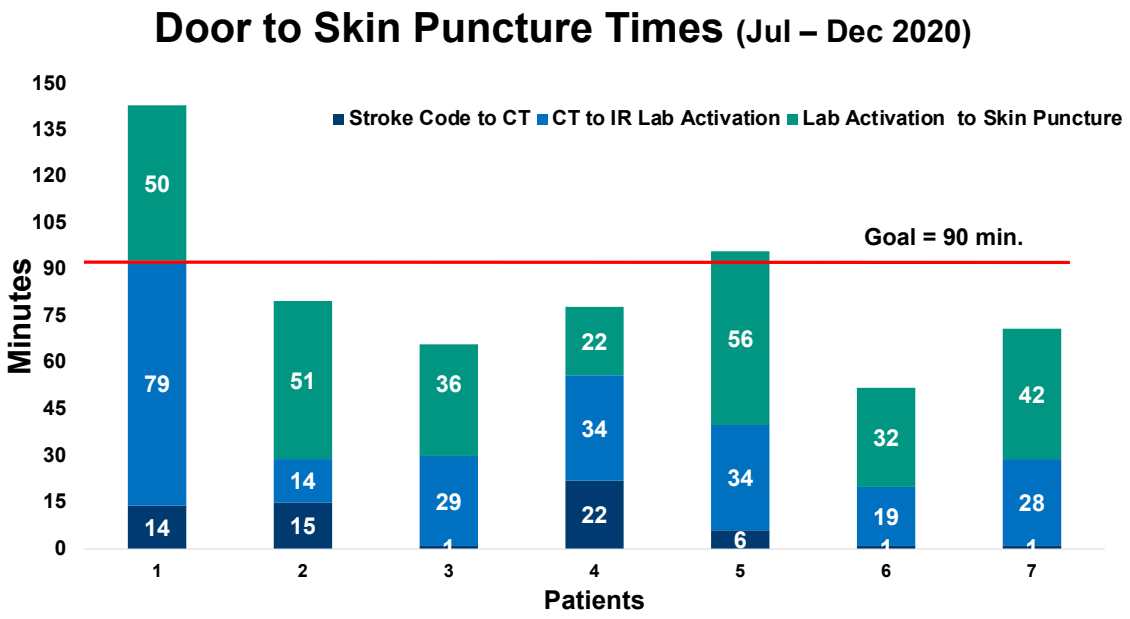
improvement of potential areas of delay leading up to door to skin puncture. Door to skin puncture times were extracted from each report card and provided to the stroke process improvement group to compare door to skin puncture times pre- and post-implementation of the monthly stroke improvement meetings. Table 1 depicts the door to skin puncture times for seven of the eight thrombectomies performed during the data collection period as one case was excluded.

With each cycle of the Plan-Do-Study-Act (PDSA) the 6 phases of the stroke report card were evaluated, and all gaps were addressed at the stroke committee meeting. Solutions aiming to improve door to skin puncture times with each cycle were reevaluated in the next monthly meeting, starting the beginning of a new PDSA cycle. Follow up with each department involved with a potential solution outside of the meetings to ensure they were able to carry out the initiative discussed was completed and are explained in the discussion section of this paper.

Clinical Question

The clinical question, “For patients presenting with thrombotic stroke, does a monthly stroke process improvement group focusing on reviewing the stroke report card for all thrombectomy patients at Greenwich Hospital compared to standard stroke committee meetings decrease door to skin puncture?” can be answered given the results obtained from the data collection period. Table 1 represents door to skin puncture times for the current data set. Average door to skin puncture times decreased by 19.5 minutes to 80.5 minutes after the implementation of this project in comparison to the average door to skin times of 100 minutes pre-implementation.

Table 1



Discussion

The findings of this project demonstrate a decrease in the average door to skin puncture time being 19.5 minutes faster after five months of utilizing the process improvement group. Greenwich Hospital's goal is to achieve door to skin puncture time in within 90 minutes for 50% or more of eligible patients directly arriving to Greenwich Hospital. The results obtained represent door to skin puncture times that were within 90 minutes for 71% of patients directly arriving to Greenwich Hospital meeting the goal times set by the American Heart Association. This demonstrates a successful intervention and quality improvement change.

Follow up with each department involved with a potential solution outside of the meetings to ensure they were able to carry out the initiative discussed was completed and including the following interventions:

- Discussions with manager of CT scan and with lead technologist to identify delays in stroke code to start of CT scan. Delays identified included: doctor evaluation in CT room prior to obtaining scan and needing prior intravenous access to administer contrast for scan (greater than 20g needle required). *Solution:* Education with local EMS to place 18g intravenous access in all stroke patients if able in the field when calling in a stroke code to Greenwich Hospital Emergency Department (ED) to avoid time being wasted on placing new IV when first arriving to hospital. Discussion with head physician of Greenwich Hospital ED to ensure that neurological assessment of patient is obtained after the CT scan is completed given the extremely short duration and importance of scan in guiding treatment.
- Delay in physician placing order in EPIC for thrombectomy case request which created delays in the Interventional Radiology (IR)suite. *Solution:* New clinical pathway was created in EPIC for stroke code order set for physicians. It originally did not include the IR case request for thrombectomy but was revised after the first PDSA cycle to be included in the order set.
- Delay in time from patient arrive to IR lab to arterial access due to delay in receiving heparinized saline bags needed to start procedure from pharmacy. *Solution:* Standard Operating Procedure (SOP) was developed with Heart and Vascular Center Nurse Manger to stock heparinized saline bags in the lab appropriately and safely.
- Stroke nurse navigator was hired in October. The stroke nurse navigator is not only responsible for following up with stroke patients during their admission but will also help expedite a thrombectomy eligible stroke patient through all phases of their care. She receives the initial alert for a Tier 2 stroke code activation and will stay with the

patient as they move through different departments to ultimately reach Interventional Radiology to perform the thrombectomy procedure.

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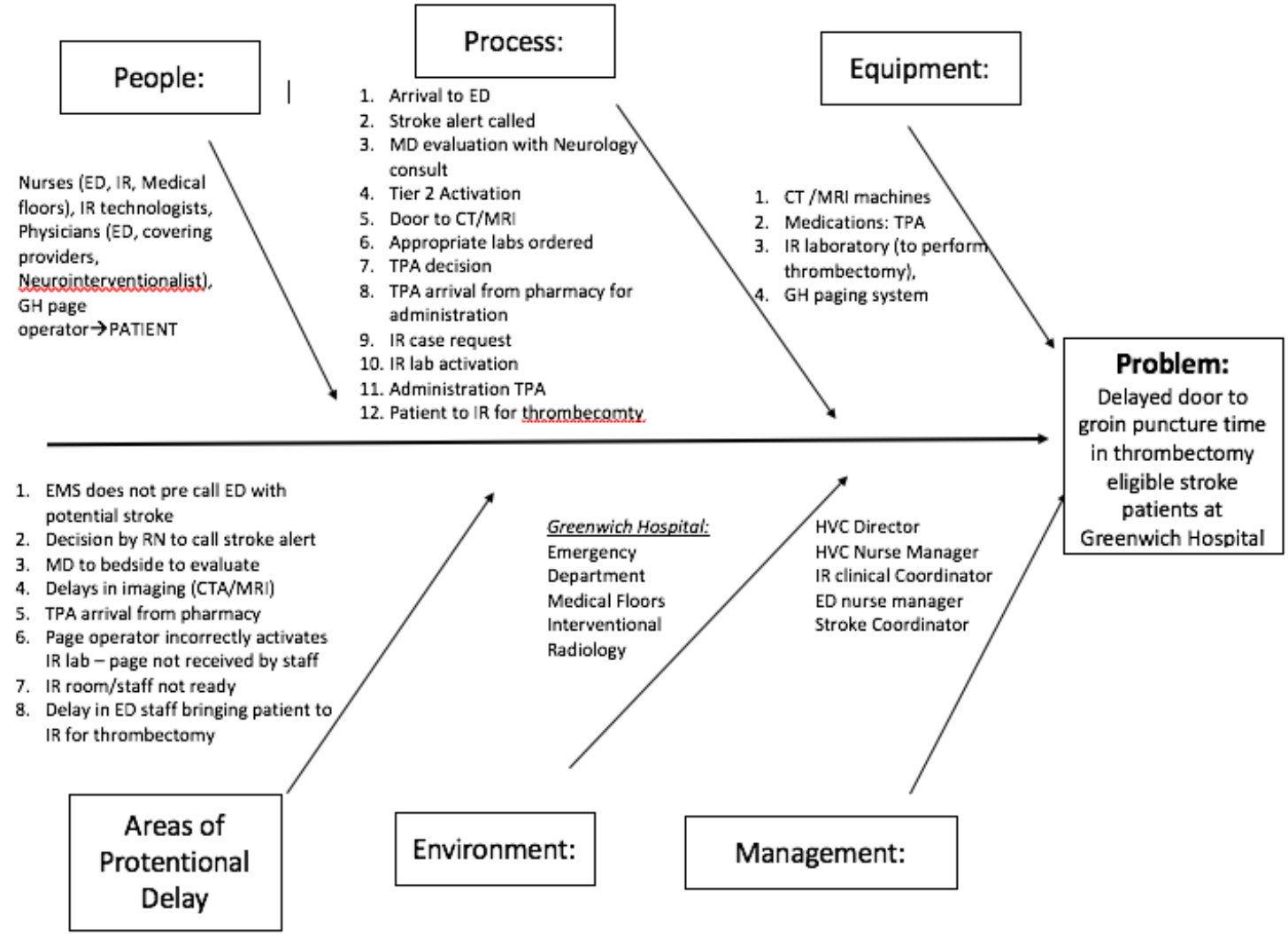
Appendix A



Based upon a fishbone diagram examining of the process for a stroke patient that is a candidate for a mechanical thrombectomy, many gaps were identified in the process once patients are admitted to the ER at GH. The recommendation based upon this data would be to fix the delays occurring in each area before the patient ultimately arrives to the IR suite and to address any delays that occur in the IR suite.

Appendix B

Stroke Thrombectomy Report Card # 2
FY 2021 (October 2020-September 2021)

Date: 12/14/2020 **Arrival Time:** 15:32 **Location:** ED **MR:** MR4430944

History: Patient is a 55 y.o. male with a PMHx of HTN, AS (s/p biologic AVR in 2015), aortic root dilation (5 cm), paroxysmal AFib, phlebitis, GERD and retinal detachment. Patient was recently admitted in November 2020 with bacteremia suspected to be from endocarditis and sepsis. Patient presented to the ED after experiencing 30 minutes of sudden onset of right arm weakness, blurry vision and difficulty with speech while he was teaching class. EMS was called. Stroke Alert called. CT Scan showed occlusion of the proximal portion of an M2 segment of the left middle cerebral artery with evidence of ischemia. Tier 2 Lab Activation called.

Process	Time	Goal	Outcome	Actions to improve
Door to **Stroke Code**	13 minutes	5 minutes		
Stroke Code to **CT Scan** started	13 minutes	10 minutes		
CT Scan started to **Stroke Tier 2 Lab Activation**	15 minutes	20 minutes		
Stroke Tier 2 Lab Activation to **IR Lab Patient Arrival**	23 minutes	40 minutes	Excellent	
IR Lab Patient Arrival to **Arterial Access**	19 minutes	15 minutes		
Door to Skin Puncture/Access	***83 minutes***	***90 minutes***		
Arterial Access to **Reperfusion**	64 minutes	60 minutes	Patient required multiple passes with aspiration and stent retriever to obtain TICI 2B reperfusion flow.	
Door to Reperfusion	***147 minutes***	***150 minutes***		

Outcome: Cerebral Angiogram showed proximal left M2 occlusion. Mechanical thrombectomy performed with 4 passes of aspiration, stent retriever, stent and distal aspiration devices with TICI 2B reperfusion obtained to main branch of the MCA.

CONFIDENTIAL QUALITY REVIEW DOCUMENT

Appendix C

- Search Question in PICO format: For patients presenting with thrombotic stroke (P) does a monthly stroke process improvement group focusing on reviewing the stroke report card for all thrombectomy patients at Greenwich Hospital (I) compared to standard stroke committee meetings (C) decrease door to skin puncture time(O)?

Level of Evidence Synthesis

Article Number	1	2	3	4	5	6
Level I: Systematic review or meta-analysis						
Level II: Randomized controlled trial						X
Level III: Controlled trial without randomization						
Level IV: Case-control or cohort study		X	X	X		
Level V: Systematic review of qualitative or descriptive studies						
Level VI: Qualitative or descriptive study, CPG, Lit Review, QI or EBP project	X				X	
Level VII: Expert opinion						

Level of Evidence Synthesis

The level of evidence for the six studies pertaining to the problem were a mix of levels 2, 4 and 6.

Outcomes synthesis

Article Number	1	2	3	4	5	6
Decreased door to skin time	X	X			X	
Improved stroke patient outcomes	X	X			X	X
Improved communication between two departments			X	X	X	X
Implementation of communication tool between two departments			X	X		

Outcomes Synthesis

The literature demonstrates that multiple methods have been used to improve door to skin times in different stroke programs. Door to skin puncture times were improved in studies 1,5 and 6 through different quality improvement processes including: monthly stroke quality improvement meetings, stroke code alarm clock and early mobilization of the neurointerventional suite and team during diagnostic imaging.

Evidence Summary Table

	First author year	Purpose	Evidence type, level of evidence	Sample, setting	Major Variables Study and their Definitions	How major variables were measured	Findings that help answer question	Worth to practice/project, quality of evidence
	Cheung (2018)	Decrease door to groin time	Level VI- single descriptive/qualitative study	Thrombectomy eligible stroke patients Sample: two groups- patients who received endovascular stroke treatment in 2015 and those who received the following year in 2016 after improvement protocols were rolled out	Door to groin time (DGPT) defined as 90 minutes or less for skin puncture time from patient arrival/time of stroke code	Door to groin time in minutes	DGPT was significant faster in patients who were treated after the full implementation of improvement protocols – met or exceeded DGPT in 90 min or less.	This study represents an idea that would be extremely beneficial for a new stroke program because it outlines many of the problems that were causing prolonged door to groin puncture times Demonstrates how the institution improved each problem to obtain target DGPT → could be extremely helpful for a new stroke program like ours at Greenwich Hospital to help with workflow.
2	Almallouhi (2019	Investigate outcomes for stroke patients who received a thrombectomy during off-hours versus	Level IV- cohort	Study was conducted December 2014 – December 2016	Long term functional outcome of patient: defined using modified Rankin Scale (mRS).	Comparison two groups (on hours vs. off hours) modified Rankin Scale	higher probability of better functional outcomes in those who received a thrombectomy during on-hours	A key factor with door to groin time we have seen thus far at GH (on hours vs. off hours) – patient to lab time significantly faster

Evidence Summary Table

	First author year	Purpose	Evidence type, level of evidence	Sample, setting	Major Variables Study and their Definitions	How major variables were measured	Findings that help answer question	Worth to practice/project, quality of evidence
		(nights, weekends, holidays) on-hours.					highlighting the importance of faster revascularization times improving patient outcomes	when stroke team already in house. Addresses patient outcomes after thrombectomy/faster DGPT
3	Potts (2018)	Decrease handoff delays from ED to unit	Level IV	Setting: 495-bed urban academic medical center Sample: ED and medical unit handoffs	Handoff delays from ED were defined as *ready to move (RTM) to occupied time* -time between RTM to when patient occupies clean medical bed *eSBAR*: instrument used which was the communication/reporting tool	RTM to occupied time were measured in time: time between RTM to when patient occupies clean medical bed pre- and post-implementation of eSBAR	RTM to occupied time from ED to inpatient unit significantly decreased (mean 84min to mean 49 min)	Tool is relevant to expediting patient from one unit to another
4	Sermersheim (2020)	Improve patient throughput – decrease assign to occupy time (bed assignment to bed occupancy)	Level IV	Rush University Medical Center 644 urban academic medical center	"assign to occupy time" is the time it takes for the patient to occupy the bed that is assigned to them in the HER system (how project's success was determined). Electronic SBAR handoff report tool	"assign to occupy time" measured in time specifically minutes, goal was 60 minutes or less.	Assign to occupy time was decreased from 97 minutes average to 55 minutes average after SBAR tool was implemented	Another idea for a type of SBAR tool to help communicate from one unit to another.
5	Mehta et al. (2020)	Improve door-puncture times for intra-arterial (IAT) therapy	Level VI	Sample: Acute ischemic stroke patients Setting: Stroke patients presenting to	Time intervals: In-hospital time delays associated with various phases from patient arrival to groin puncture time.	"picture to suite time" measured in minutes	"Picture to suite time" was reduced from average 62 minutes pre QI to average 29 minutes post QI.	A QI project that looked at multiple areas of delays and aimed to improve in hospital delays. They specifically targeted the greatest area of

Evidence Summary Table

	First author year	Purpose	Evidence type, level of evidence	Sample, setting	Major Variables Study and their Definitions	How major variables were measured	Findings that help answer question	Worth to practice/project, quality of evidence
				ED from March 2007 to October 2011 for stroke patients who underwent IAT.	Process change targeted to the phase with greatest delays (imaging to arrival in neurointerventional suite – "picture-suite") → Quality improvement processes implemented: Neurointerventional suite and anesthesia were assembled with suite set up in parallel with completion of imaging and decision making.		A 36-minute reduction in median door-to-puncture times were achieved.	delay which was significantly reduced with their QI implementation process. In addition, fixing the delay in picture to suite time resulted in reduced door to puncture times for IAT which is the goal of identifying delays at GH in the monthly stroke meetings.
6	Fousse et al. (2020)	To evaluate whether the use of a stroke clock demanding active feedback from the stroke physician accelerates acute stroke management	Level II – participants were randomly assigned to stroke clock procedure room or control procedure room in four week blocks	Setting: Department of Neurology, Saarland Medical Center-Homburg, Germany 107 Sample: patients with stroke symptoms	Stroke clock (a large digital-display timer with buzzer was installed into stroke room so it was easily visible. An alarm would sound for the following times after admission:15 minutes (end of clinical exam window), 25 minutes (treatment decision window and CT imaging), 30 minutes (needle time in which IV thrombolysis should have been started)	Time to achieve each time metric with stroke clock vs. time to achieve each metric without stroke clock modified Rankin Scale for outcomes	Door to needle times for IV thrombolysis were shorter in the stroke clock group	Aims to reduce in hospital delays and addresses the delayed throughout the multiple phases of care with stroke patients when attempting to obtain reperfusion

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Appendix D: Project Timeline

Project Timeline

January 2021- May 2021

- Complete official DNP project proposal and present to Sacred Heart University stakeholders/DNP advisor
- April 2021-May 2021: Revise proposal as needed

May – August 2021

- Identify & obtain the required ethical review and approval needed for implementation by YNHHS NSRC

September 2021- December 2021

- Implement project
- Track any deviations from project plan and make changes as needed

October – December 2021

- Data collection / outcomes

January-April 2022

- Compile and analyze data
- Present final DNP project
- Submit final DNP project
- Submit executive summary

Appendix E

100 CH.9 Clinical Quality Improvement

Investigators are encouraged to use the "QI Checklist" to help determine whether the proposed activity is considered a Quality Improvement project or whether IRB review is required.

1. Purpose YES ☒ NO ☐

- Is the project intended to improve the process/delivery of care while decreasing inefficiencies?

2. Funding YES ☒ NO ☐

- Is the project internally funded or externally supported by agencies for direct benefit to existing patients?

3. Project Staff YES ☒ NO ☐

- Is the proposed project conducted by the clinicians and staff who provide care or are responsible for the performance quality in the institutions where the project will take place?

4. Project Design YES ☒ NO ☐

- Is the project flexible, including rapid and incremental changes such as in a plan-do-study-act (PDSA) cycle?

5. Recruitment YES ☒ NO ☐

- Will the project involve a sample of the population (staff or patients) ordinarily seen in the institution where the project will take place?

6. Consent YES ☒ NO ☐

- Will the planned activity only require consent that is normally sought in clinical practice and could the activity be considered part of the usual care?

7. Benefits YES ☒ NO ☐

- Is it true that most of the current patients at the institution where the planned activity will take place could potentially benefit from the project?

8. Risk YES ☒ NO ☐

- A) Is the risk to the participants no greater than what is involved in the care they are already receiving? **OR**

- B) Can the burden of participating in the activity be considered acceptable or ordinarily expected when reforms are being introduced to the way care is provided?

If the answer to **ALL** of these questions is **YES** then the activity is a QI project and does not involve human subject research. **IRB review is not required.**
If the answer to any of these questions is NO, please consult with the IRB at 785-4688. IRB review may be required.