

AMERICAN UNIVERSITY OF BEIRUT

ESTABLISHING AN ACUTE STROKE
MANAGEMENT PROGRAM AT AUBMC EMERGENCY
DEPARTMENT: A PROPOSAL

by
ASHRAF IBRAHIM EMARA

A project
submitted in partial fulfillment of the requirements
for the degree of Master of Science in Nursing Adult Care Track
to Hariri School of Nursing
of the Faculty of Medicine
at the American University of Beirut

Beirut, Lebanon
May 2014

AMERICAN UNIVERSITY OF BEIRUT

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ACKNOWLEDGMENTS

Special appreciations and thanks are for Dr. Hala Darwish, Dr. Samar Nouredine and Mr. Anthony Shamoun for their great help and guidance during my research project without your assistance this project would not have been successful.

My recognition and gratitude are addressed to my parents and my fiancé for their understanding and endless love, through the duration of my studies.

AN ABSTRACT OF THE PROJECT OF

Ashraf Ibrahim Emara for Master of Science
Major: Nursing

Title: Establishing an Ischemic Stroke Management Program at AUBMC Emergency
Department: A proposal

Stroke is considered the fourth leading cause of mortality in the United States. According to the American Heart Association and American Stroke Association, many patients diagnosed with ischemic stroke are not receiving thrombolytic therapy within the recommended window of treatment because of delays in the assessment and management by emergency department (ED) personnel. At the American University of Beirut Medical Center (AUBMC), the average time frame from stroke symptoms onset to intravenous recombinant tissue plasminogen activator is beyond the target set by the National Institute for Neurological Disorders and Stroke (NINDS), which is 60 minutes. Consequently, to accelerate assessment and management of “brain attacks” a stroke team is recommended. The aim of the project was to review the literature on emergency management of stroke and propose a new management process based on research evidence. This will ensure that treatment with rt-PA is administered within one hour of patient’s arrival to the ED.

The project included a process map of the current management of patients presenting with stroke to AUBMC. A gap analysis was made to identify discrepancies from recommended management guidelines. Then a new process was proposed that involved creation of an adult stroke team and a paging system that is feasible at AUBMC. To improve the care delivered to stroke patients, an accelerated ED admission process along with an acute ischemic stroke order set, rt-PA checklist for inclusion and exclusion criteria, and the National Institutes of Health Stroke Scale are proposed to be followed by the health care team. Plans for implementation and evaluation are also proposed.

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CHAPTER I

INTRODUCTION

Stroke or brain attack is an acute emergency medical condition coupled with long-term disability. Patients who seek immediate emergency service for stroke signs and symptoms and are treated as a priority with no significant delays in triaging, imaging, or treatment are at low risk of death and neurological deficits (Nazir & Petra, 2009). Cerebrovascular accident is considered the fourth leading cause of mortality in the United States killing over 160,000 people each year, and it is responsible for more than 795,000 new strokes annually, one happening every 40 seconds and taking a life every 4 minutes (Alan et al., 2013). The saying “time is brain” indicates the need for urgent stroke care because every minute 1.9 million neurons, 14 billion synapses and 12 km of myelinated fibers are lost if a stroke is left untreated (Saver, 2006). This ranks stroke as the number one leading cause of disability worldwide (Roger et al., 2012). To prevent such losses, one effective intervention taken by hospitals in developed countries is establishing a stroke team to accelerate the assessment and management of “brain attacks”.

There are two types of stroke: ischemic and hemorrhagic. Ischemic stroke (IS) accounts for 87% of cases and is preceded by decreased blood supply to a specific area of the brain because of arterial occlusion with a thrombus or embolus. On the other hand, hemorrhagic stroke (HS) causes intracerebral or subarachnoid bleeding because of the rupture of brain blood vessels and accounts for 13% of stroke cases

(Krock & Massaro, 2008). The treatment for both types is crucial; however, thrombolytic therapy remains the most effective treatment for ischemic stroke to save the brain from damage if it is administered within 3 to 4.5 hours of symptom onset in patients with well-defined eligibility criteria (Del Zoppo et al., 2009). Thus, patients treated with intravenous recombinant tissue plasminogen activator (rt-PA) within the above timeframe have favorable outcomes; 30 % to 50% chance for complete recovery or minimal disability three months following ischemic stroke onset (Joseph et al., 2005). Many patients are not receiving rtPA because they arrive after 3 hours of stroke symptoms or there are delays in the assessment and management by ED personnel. Therefore, the American Heart Association and American Stroke Association (AHA/ASA) recommended extending the time frame of administering the thrombolytic medication from 3 to 4.5 hours.

In Lebanon, Non-Communicable Diseases and Behavioral Risk Factor national household survey of a cluster random sample of 2671 adults aged 18 and above was conducted in 2009. The prevalence of stroke for participants aged 40-59 years was found to be 1.2% (men) and 0% (female); whereas, in those aged 60 years and above it was 1.9% (men) and 2 % (women). The prevalence of stroke for both genders aged 18-39 years was 0% versus 1.4% in those aged 50 years or above (Sibai, Tohme, Mahfoud, Chaaya & Hwalla, 2009).

Personal communication with Dr. Mazen EL-Sayed, director of the emergency department at the American University of Beirut Medical Center (AUB-MC), to inquire about his clinical observations indicates that 87 stroke patients presented to AUB-MC ED in the year 2012. However, only seven patients received rt-PA; unfortunately, there was not sufficient data about the remaining 80 patients and whether they were eligible for the treatment or not. According to Dr. El-Sayed

observations, the time intervals from onset of stroke symptoms to ED could be categorized into three periods 0 to 4.5 hours, 4.5 to 6 hours and more than 6 hrs. He also calculated the percentages of the patients' admissions to ED within these periods and they were around 38%, 6.8 % and 55.2%, respectively. Also, he estimated the average time from ED arrival to CT brain completion along with symptoms onset to rt-PA administration. On average, it took 49 minutes from ED-to-CT completion and 102 minutes for the latter. These periods exceeded the target set by the National Institute for Neurological Disorders and Stroke (NINDS), which are 25 minutes and 60 minutes respectively.

Stroke care is divided into two phases; the emergency or hyper-acute phase, which involves the first 3 to 24 hours after the onset of the stroke when activation of Emergency Medical Services (EMS) and ED acute stroke protocols is expected. Phase II is the acute in-patient care phase, which extends from 24 to 72 hours after the onset of the stroke. The focus during this phase is to identify the cause of stroke, prevent medical complications and prepare the patient for discharge (Summers et al., 2009). In this project, we will focus on introducing a multidisciplinary team approach to handling stroke patients during the hyper-acute phase in the ED. The emergency department is the optimal place for high acuity medical conditions, particularly stroke; therefore, it is the ideal time to prevent permanent brain impairment and long-term disability if stroke patients are admitted early enough and managed efficiently.

A. Background

The AUB-MC Emergency Department (ED) is divided into three sections: ED1 is designed for high acuity conditions such as cardiac or respiratory arrest,

anaphylactic shock, major trauma, signs of stroke, hypoglycemia, and hypoperfusion or chest pain. ED2 is for low acuity cases such as gastroenteritis, simple laceration, minor traumas, and flank pain and ED3 is where all pediatric population are treated except those admitted with surgical conditions. Adult patients are triaged and directed to designated areas based on the Emergency Severity Index (ESI), which is recommended by the Emergency Nurses Association and the American college of Emergency Physicians (Gilboy et al., 2012). The ESI is a five-level triage system ranging from one to five, and is based on the guidelines set by the Agency for Healthcare Research and Quality (AHRQ). This system helps the triage registered nurse (RN) prioritizing and directing patients to ED1 or ED2 by estimating both the acuity and the number of resources needed. Resources in the ED include lab tests, intravenous (IV)/intramuscular (IM) medications, simple or complex procedures and radiology testing (Gilboy et al., 2012). ESI level 1 is the highest acuity level requiring immediate medical attention, a physician and a nurse evaluate those patients immediately because timeliness of life-saving interventions can affect morbidity and mortality. ESI level two patients are very ill and high-risk situations, but the patient is not dying; therefore, the bedside nurse can initiate ED care protocols such as inserting IV, obtaining an EKG, administering oxygen before a physician is physically present. Patients with ESI level 1 or 2 meet high acuity medical conditions and are directed to ED1. ESI level-3 patients who need more than two resources are directed to high acuity area (ED1), whereas those who require only two resources are directed to low acuity area (ED2). Patients with ESI level 4 and 5 have the lowest acuity level and they do not require urgent attention. The ED physician evaluates them once they finish the paper registration. The sections below

describe the current practice related to the emergency management of stroke patients at AUBMC.

1. ED Door to Paper Registration Process at AUB-MC (see Appendix A)

Not all patients with suspected stroke are brought to the AUBMC ED by an ambulance. The family members may drive the patient to the ED using their private vehicle. In both cases, the triage nurse and ED orderly are the first to encounter these patients. Since it is inappropriate for the triage nurse to leave a patient in the triage room to assess other patients who arrive at the same time and decide whether they can wait or must be seen immediately, ED orderlies are instructed to direct all the medical cases brought by an ambulance to ED1 without referring to the triage nurse. In addition, they can directly transport patients to ED1 or instruct them to wait for their turn in the triage waiting area based on the chief complaint and the signs and symptoms such as acute coronary symptoms. When a patient with a suspected stroke is escorted directly inside the ED, the nurse in-charge receives the patient and secures a monitored bed and another RN will complete the triage form. According to ENA guidelines all stroke patients should be assigned ESI level 2. At AUBMC some patients with ESI 2 are seen by the ED resident or ED attending physician; medical and nursing interventions such as dextrose level, IV insertion, cardiac monitoring, and EKG are performed in parallel.

At times, stroke patients are assigned ESI 3; in that case the patient is evaluated by the ED resident, intern or fourth year medical student according to their availability, afterward a summary of the case is reported to the ED attending that a possible stroke is suspected; nursing interventions are initiated accordingly. After

completion of the triage assessment sheet, the accompanying patient's relatives are asked to secure ED admission registration paperwork that includes personal information, financial coverage and billing. These data are given to the bedside registration clerk when available; otherwise, the family will be directed to the ED admitting office where they have to wait in turn to complete the registration process. The admitting registrar then determines financial clearance, when the patient has medical insurance or can afford the expenses; this process is completed in a relatively short period. However, when the patient is not medically insured and lacks the sufficient financial funds, the ED attending will sign an "urgently needed" or "to be settled later" form to speed up the medical process. Finally, the cashier approves all the medical treatment for emergency purposes and defers the payments for later negotiation with the family.

2. Paper Registration to Disposition (see Appendix B)

Radiology and lab testing cannot be ordered unless paper registration is completed. To perform a procedure or a lab test the family is requested to get the payment receipts after waiting in turn at the cashier's office. When a computed tomography (CT) brain is ordered, the ED RN or ED clerk calls the radiology technician to send an orderly to transport the patient from the ED to the radiology department, which is one floor below the ED premises. After completing the CT brain, the ED attending checks the images electronically and consults either the neurology fellow or the neurosurgery fellow depending on the type of stroke. If an ischemic stroke has symptom onset less than 4.5 hours and the patient is found to be eligible for IV rt-PA, the neurology fellow consults the neurology attending on call to

secure approval for rt-PA administration. In that case, the ED RN sends an orderly to the pharmacy to bring the IV rt-PA medication. The ED RN will administer the medication per instructions and will monitor the patient's vital signs.

If symptoms onset is between 4.5 and 6 hours, the neurosurgery resident is consulted for possible intra-arterial thrombolytic therapy. Dr. Joseph Saleme is the only neurosurgery-attending physician at AUB-MC who performs this procedure. If the onset of symptoms exceeds 6 hours, medical management is initiated.

When the patient is medically stable, the patient is transferred to the neuroscience unit. If beds are not available, the stroke patient remains in the ED and the nurses will monitor the patient until a hospital bed is available under the care of the neurologist.

As noted in the above description, patients coming in with stroke need to undergo a number of steps that may get in the way of their receiving prompt treatment as recommended. Thus, the purpose of this project is to perform a gap analysis to track the current practice of stroke admission in the ED and identify the gaps that lead to delay in the management. A new process that aims to ensure that treatment with rt-PA is administered within one hour of the patient's arrival to the ED will be proposed when the onset of stroke symptoms is less than 4.5 hours. This new process will include the development of a new ED stroke management plan. It consists of creating an adult stroke team along with a paging system that is feasible at AUBMC, implementing an acute ischemic stroke order set for rt-PA that includes the proper inclusion and exclusion criteria, adopting the stroke rating scale according to the National Institutes of Health Stroke Scale (NIHSS), and an evaluation plan for monitoring the clinical outcomes.

CHAPTER II

LITERATURE REVIEW

A. Etiology and Differential Diagnosis of Stroke

Ischemic strokes occur when extracranial or intracranial sections of the carotid or the vertebrobasilar arteries become atherosclerotic and impede blood supply to the brain. There are four causes of ischemic strokes: large-vessel thrombosis, small-vessel disease that causes lacunar or subcortical infarction, cardiogenic embolism that arises from atrial fibrillation and cryptogenic stroke for which the exact cause remains unclear. The percentage of occurrence of each type is close to each other (Summers et al., 2009).

Hemorrhagic strokes are caused by intracranial (ICH) or subarachnoid hemorrhage (SAH). The primary cause of ICH is hypertension and it accounts for around 10 % of all strokes whereas the principal predisposition to SAH is a ruptured cerebral aneurysm accounting for about 3 % of all strokes, (Summers et al., 2009). This chapter reviews the emergency assessment and treatment of patients presenting with stroke.

Treatment of acute stroke depends on its type, which is differentiated through the non-contrast enhanced compute tomography (NCECT). The early ischemic signs that can be visualized by the radiologist within the first few hours of symptom onset are loss of distinction between gray and white matter, which is visible after one hour of occlusion or cortical hypodensity associated with “gyral swelling” that yields “sulcal effacement” or hyperdense of the middle cerebral artery (MCA) (Nakno et

al., 2001). The presence of MCA sign is the most common indicator of large arterial occlusion and is correlated with the severity of stroke and poor neurological outcomes. Hemorrhagic infarct can be easily seen as a white density after brain injury that can extend into the subarachnoid space and ventricles.

Some features of clinical situations may direct the physician toward alternative diagnoses. Mimicking stroke are psychogenic, seizures, hypoglycemia, migraine with aura, hypertensive encephalopathy, CNS tumor and drug toxicity (Jauch et al., 2013).

B. Stroke Recognition

Emergency nurses are the first medical personnel involved in stroke recognition. Therefore, they should be able to recognize the stroke symptoms promptly and accurately by adopting a well- investigated tool such as the Cincinnati Prehospital Stroke Scale. This scale helps ED nurses triage patients with suspected stroke in less than a minute. This scale assesses three items: Face, Arm and Speech. It checks for facial drooping by asking the patient to smile; or arm drifting. In addition, it detects speech abnormality by evaluating the patient conversation and comprehension of words. This scale has a 72 % probability of correctly diagnosing a stroke if any of the above items was abnormal during the initial assessment (Krock & Messero, 2008).

Face Arm Speech Time (FAST) test is a newly developed tool that is similar to the Cincinnati Prehospital Stroke Scale except that it assesses for an additional factor, which is the time from symptom onset (Higashida et al., 2013). Adopting this test is important because it helps the ED nurses assign the ESI level by identifying the last-

seen-normal time that is defined as patients went to bed and woke up with new neurological abnormalities.

The AHA/ASA set guidelines in 2013 to improve stroke care within the first few hours of symptoms onset. Introducing a new practice based on these guidelines (Listed in the gap analysis section) will reduce the complications associated with stroke, especially the morbidity and mortality. Studies have shown that creation of stroke team will expedite care for quick evaluation and treatment of stroke patients, especially if rt-PA medication is needed (Justice et al., 2008). The stroke team consists of ED RNs, ED physicians, neurologists, pharmacists, laboratory technician, radiologists and APN. The role of the advanced practice nurse (APN) in the stroke team is to provide his/her expert opinion in decision-making, offer educational sessions for nurses, and monitor the process of stroke team activation. The role of nursing supervisor is to ensure the smooth transport of stroke patients from the ED to an open or closed unit (Krock & Massaro, 2008).

C. Early Management of Acute Ischemic Stroke

In its most recent guidelines for the acute care of stroke, The AHA/ASA provided a number of recommendations for the early management of acute ischemic stroke (Jauch et al., 2013). The recommendations are classified from I to III with I denoting the strongest recommendation; II is weaker, depending on the benefit to risk ratio, and III is a recommendation against an intervention because of associated harm or lack of benefit. The strength of a recommendation is based on the level of evidence, which is rated from A (for meta-analysis and randomized controlled trials) to C (expert opinions). The recommendations are:

1. Establish an ED protocol to evaluate patients with suspected stroke in order to determine eligibility for fibrinolytic therapy and begin fibrinolytic therapy within 60 minutes of their arrival. (Class I, Level of evidence B)
2. Adopt the National Institutes of Health Stroke Scale (NIHSS) as a stroke rating scale (Class I; Level of Evidence B).
3. Ask for necessary or essential laboratory tests and obtain a baseline EKG. Obtain a finger-stick glucose level before starting IV rt-PA (Class I; Level of Evidence B).
4. Measure troponin level at baseline but this should not delay the initiation of the fibrinolytic therapy (Class I; Level of Evidence C).
5. The need for obtaining a chest X-Ray in the absence of underlying cardiopulmonary disease is unclear. If indicated, results should not defer the launch of IV rtPA (Class IIb; Level of Evidence B).
6. Do brain imaging such as non-contrast CT or MRI brain to exclude intracranial hemorrhage and to determine whether CT hypodensity or MRI hyperdensity is present before starting any specific therapy (Class I; Level of Evidence A).
7. A physician with expertise must read and interpret the CT brain or MRI within 45 minutes of patient's arrival to the ED (Class I; Level of Evidence C).
8. IV rtPA is recommended in the setting of early ischemic changes on CT and must be given within 60 minutes of arrival to ED (Class I, level of evidence 2).
9. IV rtPA should not be considered in patients with frank hypodensity on CT brain because of increased risk for intracranial hemorrhage. IV rtPA should be withheld in patients with frank hypodensity involving more than one third of MCA (Class III; Level of Evidence A).

D. Recommendations for General Supportive Care

Jauch and colleagues (2013) proposed the following recommendations for managing acute ischemic stroke in the ED.

1. Patients with acute ischemic stroke require continuous cardiac monitoring for at least the first 24 hours to detect any serious arrhythmias (Class I; Level of Evidence B).
2. Patients who meet the criteria for IV rtPA (discussed later) should have their systolic blood pressure less than 185 mmHg and diastolic blood pressure less than 110 mmHg before fibrinolytic therapy is initiated. This blood pressure reading should be maintained below 185/105 mmHg for at least 24 hours after the treatment (Class 1; Level of Evidence B).
3. Patients with elevated blood pressure and who are not eligible for IV rtPA should have their blood pressure lowered by 15 % during the first 24 hours after the onset of stroke. “The level of blood pressure that would mandate such treatment is unknown”. Antihypertensive medications should be withheld unless the SBP/DBP is > 220/120 mmHg (Class I; Level of Evidence C). There is no data to guide the selection of antihypertensive medication for patients with acute ischemic stroke (Class IIa, Level of Evidence C).
4. Airway should be supported in patients with decreased level of consciousness through oxygen supplement and ventilator assistance to maintain oxygen saturation above 94 % (Class I; Level of Evidence C).
5. Antipyretic should be used to treat fever when temperature is > 38° C (Class I; Level of Evidence C). The preferred route to assess the core body temperature is rectal unless contraindicated.

6. Hypovolemia and hypoglycemia (blood glucose < 60 mg/dl) should be corrected per ED protocol prior to IV rtPA (Class I; Level of Evidence C).

E. Recommendations Regarding Administration of Rt-Pa

The recommendations for the administration of rt-Pa include (Jauch et al., 2013):

1. The dose for IV rtPA is 0.9 mg/kg with a maximum dose 90mg for selected patients who present in the ED within 3 hours of acute ischemic stroke symptoms onset (Class I; Level of Evidence A).
2. The door-to-needle time should be within 1 hour of patient's arrival to the ED (Class I; Level of Evidence A).
3. Patients with acute stroke symptoms can benefit from an extended time to treatment of 3 - 4.5 hours after the onset of stroke symptoms unless they have one of the following additional exclusion criteria:
(1) age > 80 years old, (2) NIHSS > 25, (3) on anticoagulant therapy regardless of INR level, (4) a history of both stroke and diabetes mellitus (Class I; Level of Evidence B).
4. Patients who had a seizure at the time of onset of stroke can benefit from the treatment as long as the residual impairment is secondary to the stroke (Class IIa; Level of Evidence C).
5. The administration of streptokinase for acute stroke patient is not recommended (Class III; Level of Evidence A).

6. The benefit to risk ratio should be considered in patients with conditions of mild stroke deficits, rapidly improving symptoms, major surgery in the past 3 months, and recent myocardial infarction (Class II b; Level of Evidence C)

F. Recommendations for Endovascular Interventions

For patients who are not eligible for rtPA and other select patients who receive rtPA, endovascular interventions are another treatment option .Related recommendations include (Jauch et al., 2013):

1. IV rtPA is not approved by the FDA for intra-arterial use and its optimal dose is not well established. However, patients who are not eligible for peripheral IV rtPA or the time of middle cerebral artery stroke with onset of symptoms is less than 6 hours' duration can benefit from intra-arterial fibrinolysis (Class I; Level of Evidence B).
2. The use of intra-arterial reperfusion therapy has better clinical outcomes if delays in time to treatment are minimized (Class I; Level of Evidence B).
3. Intra-arterial treatment requires rapid access to cerebral angiography and qualified interventionists (Class I; Level of Evidence C).
4. Intra-arterial fibrinolysis or mechanical thrombectomy is indicated when the use of intravenous fibrinolysis is contraindicated (Class IIa; Level of Evidence C).
5. Intra-arterial fibrinolysis or mechanical thrombectomy may be indicated in patients who did not respond to intravenous fibrinolysis (Class IIb; Level of Evidence B).

G. Recommendations for ED Bedside Registered Nurses

The bedside nurse should initiate the following measures during the first 10 minutes of patient care and according to a pre-printed order set (jauch et al., 2013):

1. Assess the dextrose level by finger-stick test since hypoglycemia signs mimic stroke symptoms through its neurological manifestations and can lead to permanent brain damage if not treated. Blood glucose level below 60 mg/dl should be corrected rapidly per protocol; IV bolus of 25 ml of 50% dextrose. Hyperglycemia is also a common problem in more than 40% of stroke patients, especially those who have diabetes mellitus and has been linked to poor clinical outcomes because it endorses lactic acidosis and production of free radicals during the anaerobic metabolism process. Therefore, blood glucose level should be maintained between 140 and 180 mg/dl in those patients.
2. Stroke patients are at risk for hypoxia and desaturation that leads to decreased level of consciousness, and may be due to underlying lung or cardiac disease, and “central periodic breathing” like Cheyne-Stokes respirations. Therefore, oxygen therapy should be given to patients with oxygen saturation of < 92 % (Class I, Level of Evidence C).
3. Elevate the head of the bed approximately 30° to minimize the risk for aspiration and keep the head of the patient in a neutral position to increase cerebral blood flow and maximize oxygen delivery to the brain tissues (Class I, Level of evidence C).
4. Have an electrocardiogram (EKG) to rule out myocardial infarction (MI) or atrial fibrillation (AF). Stroke patients must undergo cardiovascular evaluation for paroxysmal AF and MI especially if the EKG is normal. There is a strong

relationship between stroke and cardiovascular diseases. Thus, continuous cardiac monitoring and serial troponin levels are necessary to identify the above causative factors

5. Insert two 20 gauge or larger intravenous (IV) lines and use one site to administer fluids or medications and the other for possible thrombolytic therapy (Class I, Level of Evidence C)
6. Stroke patients are at high risk of hypotension and cerebral hypoperfusion because of their presentation with hypovolemic state. Intravenous bolus such as normal saline can be administered with close cardiovascular evaluation; however, solutions with dextrose component should be avoided because of the adverse effect of glucose in acute brain injury settings (Class I, Level of Evidence C).
7. One third of stroke patients will have hyperthermia (temperature $> 37.6^{\circ}\text{C}$) within the first hours of their hospital presentation due to underlying infection. Therefore, health care professionals should identify the source of infection and attempt to treat it by antibiotics and antipyretic medications to bring the temperature below 37.5°C . This will reduce metabolic needs and decrease free radical production.
8. Obtain blood samples for complete blood count with platelet count (CBCD), serum electrolytes with renal function test, troponin, coagulation panel such as prothrombin time (PT), international normalized ratio (INR), and activated partial thromboplastin time (aPTT). The laboratory specimens should be labeled as STAT to accelerate processing, especially if the patient is in the time window to receive thrombolysis.

9. The nurse should complete the dysphagia screening before allowing the patient to take anything orally (Class I, Level of Evidence B).
10. The nurses should use a reliable, brief, simple and standardized tool for neurological examination such as NIH stroke scale (NIHSS). This is an AHA/ASA recommendation as it is the preferred stroke rating scale because it measures the severity of stroke, neurological improvement or deterioration and early prognosis (Jauch et al., 2013, Summer et al., 2009).

The healthcare providers should follow the below instructions set by the National Institute of Neurological Disorders And Stroke (2009) when using this scale:

- Follow the order and the exam technique for each item tested.
- Do not go over the scores and change them.
- Scores should reflect the patients' real status where they need to answer questions and perform some activities by themselves.
- The healthcare providers should not have preconceptions of what the patients can do.

The NIH Stroke Scale takes less than 10 minutes to complete and contains 15 items that assess the effect of stroke on the level of consciousness, best gaze, visual, facial palsy, arm and leg strength, limb ataxia, sensory, best language, dysarthria, extinction and inattention (kasner et al.,1999) . The maximum score given by the observer is 42, indicating severe stroke and the minimum score is zero, signifying normal exam. Stroke severity and neurological deterioration prediction such as intracranial hemorrhage (ICH) could also be based on the NIHSS score. Patients with NIHSS score of <10 have better prognostic outcomes at 1 year than those with

an NIHSS more than 20. Additionally, those who received thrombolytic therapy and had NIHSS score more than 22 have a 17 % risk of developing ICH, whereas those with NIHSS score of less than 10 had only 3 % risk of ICH (Summers et al., 2009).

H. Recommendations During and After Thrombolytic Therapy

The nurse should address the following measures during and after the infusion of rtPA:

1. Perform neurological assessment and monitor vital signs (except temperature) every 15 minutes for the first 2 hours during and after rtPA infusion and every 30 minutes afterward for the next 6 hours, then hourly for the next 24 hours from treatment. Temperature should be taken every 4 hours or as required (Summers et al., 2009).
2. Discontinue the infusion and send the patient for an emergency CT scan if signs and symptoms of severe headache, acute hypertension, nausea, or vomiting are present (Summers et al., 2009).
3. Administer antihypertensive medications to maintain systolic blood pressure (SBP) below 185mmHg or diastolic blood pressure (DBP) below 110 mmHg (Summers et al., 2009).
4. Voiding problems such as neurogenic bladder or urinary retention is common problem in patients with AIS. Therefore, the physician should place an indwelling bladder catheter, if indicated before administering IV rtPA (Summers et al., 2009).

5. Repeat CT brain or MRI scan after 24 hours of initiation of thrombolytic therapy and before starting anticoagulant or antiplatelet medications (Summers et al., 2009)

I. Inclusion and Exclusion Criteria For Rt-Pa

Patients, who are aged 18 years or more, have ischemic stroke with neurological deficit and the onset of symptoms is within 3 to 4.5 hours are eligible for intravenous rtPA (Catangui & Slark, 2012).

Patients who are diagnosed with significant head trauma, have a history of stroke in the past 3 months, subarachnoid hemorrhage, intracranial hemorrhage, aneurysm or tumor should be excluded from the therapy. Additionally, those who have hematological disorders such as active internal bleeding, platelets count less than 100,000/mm³, use of anticoagulant with INR more than 1.7 or PT more than 15 seconds are not qualified for the treatment. Moreover, patients are not eligible for tPA if they have: arterial puncture at non-compressive site within the past 7 days, on heparin therapy within the past 48 hours causing an abnormal elevation of PTT, blood glucose less than 50 mg/dl, or brain hypodensity more than one third of cerebral hemisphere (Catangui & Slark, 2012).

In addition, the physician should weigh benefit to risk ratio before administering IV rtPA if patients satisfy the following conditions: Those who are more than 80 years old, have severe stroke (NIHSS more than 25), and take oral anticoagulant regardless of INR level are considered for relative exclusion criteria. Additionally, patients could be carefully excluded from the therapy if they present with the following: spontaneously improving stroke symptoms, having seizure with

residual neurological impairments, undergoing major surgery within the past 14 days, or complaining of gastrointestinal or urinary tract bleeding within the previous 21 days or experiencing recent myocardial infarction within the previous 3 months (Catangui & Slark, 2012).

J. Management of Hypertension in Acute Ischemic Stroke

Patients who do not have hypertension can experience a transient rise in blood pressure. This compensatory mechanism occurs in around 80 % of AIS patients to increase collateral blood supply to the occluded area in the brain (Summer et al., 2009). However, every 10 mmHg increase of blood pressure above 180 mmHg is associated with 40 % risk of neurological deterioration and 20 % risk of poor outcomes (Adam et al., 2007). There are other causes of blood pressure elevation such as increasing ICP, full bladder, pain, nausea or a loud environment. On the other hand, rapid lowering of blood pressure is associated with poor neurological outcomes (Adams et al., 2007).

Nonthrombolytic candidates can benefit from antihypertensive medications only if systolic blood pressure is more than 220 mm Hg or diastolic blood pressure is more than 110 mm Hg. Patients eligible for thrombolytic therapy can benefit from labetalol 10-20 mg IV over a period of 1 to 2 minutes if SBP > 185 mm Hg or DBP >110 mm Hg. This dose can be repeated once if needed. Another adjunctive treatment is nicardipine drip, which is started at 5 mg/hour and titrated up by 2.5 mg/hour at 5 to 15 minutes interval. The maximum allowed dose is 15 mg/hour. Blood pressure should be reduced and maintained at the desired level in order to give rtPA. If DBP was found to be more than 140 mm Hg after rt-PA infusion then sodium nitroprusside is administered initially at 0.5 mcg/kg per minute. This dose

should be titrated to the desired blood pressure level. If SBP >230 mmHg or DBP > 121-140 mm Hg labetalol 10 mg IV over an interval of 1–2 minutes is considered. The nurse may repeat the medication every 10–20 min with a maximum dose of 300 mg. Another approach is to give labetalol 10 mg IV followed by an infusion at a rate of 2–8 mg/minute. Nicardipine can be also administered initially at 5 mg/hour IV drip titrated up to desired effect by increasing 2.5 mg/hour every 5 minutes to maximum dose of 15 mg/hour. If SBP is between 180 and 230 mmHg or DBP between 105 and 120 mmHg then the nurse should only give Labetalol 10 mg IV over a period of 1–2 minutes. The nurse can repeat or double labetalol dose every 10–20 minutes to a maximum dose of 300 mg. She/he can also administer labetalol 10 mg IV followed by an infusion at a rate of 2–8 mg/minutes (Adams et al., 2007).

As noted in the above review the guidelines that are based on research evidence and experience in the field clearly delineate the importance of prompt diagnosis and early treatment.

CHAPTER III

PROPOSED STROKE MANAGEMENT

Based on the situation analysis presented in chapter 1 and the recommendations for acute ischemic stroke management in the literature, the new proposed stroke management at AUBMC emergency department is described to help meet the goals of quality stroke care Roles and responsibilities of the stroke team and ED nurses, as well as the process of management are delineated.

A. Gap Analysis

After describing the current emergency care of stroke patients, a gap analysis is followed to highlight how our practices differ from the recommended practice set by AHA/ASA. These recommendations will be explained later on.

ED based care Action	Best Practice Strategies	How Our Practices Differ From Best Practice	Barriers to Best Practice Implementation	Will Implement Best Practice (Yes/No; why not?)
I-Door-to physician within 10 minutes	1.Adopt FAST screening tool and give educational sessions to ED nurses 2.Bypass triage room to ED1 3.Assign ESI level 2 to all stroke patients	1.No screening tool for stroke 2.Walk-in patients may wait for vacant triage room 3.EMS patients are transported directly to ED1 4.Nurses depend on their clinical judgment when assigning the ESI level	None	Yes

<p>II- Door-to-stroke team ≤ 15 minutes</p>	<p>1. Multidisciplinary meetings between the emergency, neuroscience, laboratory, radiology, and pharmacy department is necessary to establish the stroke team and identify the job description of each member.</p> <p>2. Stroke team will be activated through a paging system. The members will accompany the patient during the transportation to the radiology department.</p>	<p>There is no stroke team currently at AUBMC</p> <p>The ED physician consult the neuroscience fellow after completion of CT brain with suspicion of ischemic or hemorrhagic stroke</p>	<p>None</p>	<p>Yes</p>
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<p>III- Door-to-CT initiation ≤ 25 minutes</p>	<p>1. Pre-notify the CT technician during the activation of stroke team to reserve the scanner for immediate imaging of AIS patients.</p> <p>2. ED auxiliary will attach the patient to the monitor (defibrillator) and transport the patient by stretcher to the radiology department accompanied by RN and MD</p>	<p>1. When CT brain is ordered the ED RN or ED clerk asks the CT technician to move the patient to the radiology room.</p> <p>2. Radiology department auxiliary is the only personnel accompanying the patient unless the patient underwent life-saving interventions</p> <p>3. Patients may be transported without being attached to a monitor (defibrillator)</p> <p>4. Patients have to wait for a vacant scanner machine before transportation</p>	<p>None</p>	<p>Yes</p>
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<p>IV- Door-to- CT interpretation ≤ 45 minutes</p>	<p>1. A CT technician should be available 7 days a week and 24 hours a day. 2.The radiologist should give his report after 25 minutes of CT completion</p>	<p>The radiologist will report his preliminary result within 2 hours from CT completion</p>	<p>Radiologist on call is responsible to read all the imaging studies ordered from the ED</p>	<p>Yes</p>
<p>VI- Door-to- stroke unit admission ≤ 3hours</p>	<p>Patients with AIS should be admitted to stroke unit within 3 hours of arrival to the ED</p>	<p>Patients will stay in the ED until bed is secured at the stroke unit. This will take hours or days</p>	<p>Availability of beds at a specialized unit</p>	<p>No. At the current time ED nurses can provide the optimal care to stroke patients until bed is secured</p>
<p>VII- Emergency personnel should be highly trained in stroke care</p>	<p>1.Frequent neurological/stroke assessments should be done 2.Create order set that addresses issues like blood pressure management and control of complications</p>	<p>1. There is no order sets. 2. ED RNs are not trained to use NIHSS and monitor neurological deteriorations especially after fibrinolytic therapy</p>	<p>None</p>	<p>Yes</p>

Table 1. GAP Analysis of the Current Emergency Care Of Acute Ischemic Stroke

B. Recommendations for the New Process Map

The following list is the recommended practice that should be followed at AUBMC (See Appendices C and D):

1. Stroke patients should bypass the triage room.
2. The triage nurse will assign ESI level two to all stroke patients, unless life-saving interventions are required, then ESI level 1 is to be assigned.
3. Activation and notification of a stroke team should be over within 15 minutes
4. ED nurses should be highly trained in stroke care
5. Door-to-physician first sees patient should be completed within 10 minutes
6. Door-to- CT should be completed within 25 minutes and door-to-CT reading should be finished within 45 minutes
7. Door-to-lab results should be obtained within 45 minutes
8. Door-to-needle time frame should be 60 minutes

1. Bypassing the Triage Room

Patients who present with signs and symptoms consistent with acute stroke should be transported directly to ED1 without waiting for a vacant triage room. To ensure that stroke patients are identified immediately the optimal solution is to have two triage RNs available at all times. Due to staffing shortage, an alternative option can be implemented. The Clinical and Professional Development Center (CPDC) personnel will organize educational sessions about the FAST test so that AUB-MC ED RNs and auxiliaries can base their transport decision on a reliable tool. The reason for giving the ED escorts the decision of admitting suspected walk-in stroke patients directly to ED1 or asking them to wait for their turn in the waiting triage area is based on the goal of the FAST test, which was created to increase public

awareness about stroke signs and symptoms and was not intended to be used only by health care professionals. The FAST test is designed for rapid identification of the stroke patient at triage; it is a simple tool and will not be difficult for the ED escorts to use and identify patients with suspected stroke based on its criteria.

2. Assign ESI level Two to All Stroke Patients

After taking the medical history questions, the nurse assigns an acuity level based on the currently used 5-level ESI tool. The RN should assign ESI level 1 to patients with stroke symptoms who need immediate life-saving interventions such as endotracheal intubation or cardiopulmonary resuscitation. If the symptoms started less than 12 hours prior to presentation or the patient has one positive finding on the FAST stroke scale, then ESI level two would be appropriate. After obtaining the initial information from the patient or the caregiver, the ED registration clerk should prioritize and finalize the paper registration at bedside.

3. Activation of the Stroke Team within 15 Minutes

The in-charge RN will receive the patients with suspected stroke from the ED orderly or the second triage RN (if available) and secure a monitored bed. She/he will inform the ED attending physician immediately and assign a RN for triaging and nursing care. At the same time, a notification will be sent to the stroke team through a paging system. This team should be available within 15 minutes to ensure that all stroke patients are triaged, examined and treated according to NINDS treatment time for rtPA (Higashida et al., 2013). The stroke team physician and the emergency nurse or APN will accompany the patient during the transfer to the radiology department.

The ED stroke team will consist of ED physician, an emergency nurse, an advanced practice nurse (APN), a nursing supervisor, a neurology fellow or attending, a pharmacist, a radiologist, and a laboratory employee. The stroke team should be available 7 days a week and 24 hours a day (Maze & Bakas, 2004).

4. Train ED Nurses in Stroke Care

The triage nurse will collect the following information: When was the patient last known or witnessed to be normal? Was anyone with the patient when the symptoms began? Is there any history of diabetes, hypertension, seizures, myocardial infarction, cardiac arrhythmias, prior stroke, transient ischemic attack (TIA), or trauma related to the current event? Does the patient take anticoagulation therapy? At the same time the second bedside RN along with the help of a practical nurse will attach the patient to continuous cardiac monitoring and will perform NIHSS and document its score as a baseline.

5. Physician Must See the Patient within 10 Minutes

The ED physician should evaluate possible stroke patients within 10 minutes of patient's arrival, unless there is need for immediate lifesaving interventions. The emergency physician should assess and stabilize the ABCs (airway, breathing, and circulation), vital signs (temperature, heart rate, blood pressure, and oxygen saturation) and screen for neurological deficits. He/she should ask for immediate diagnostic studies for all patients with stroke suspicion: CT brain without contrast, blood glucose, oxygen saturation, serum electrolytes/ renal function test, CBCD, cardiac ischemia markers, PT/PTT, INR and EKG. The physician can also add the

following labs for patients with suspicion of underlying conditions: Hepatic function test, toxicology screening, pregnancy test, arterial blood gases (ABGs) and chest X-Ray. All of the preceding interventions are important; however, CT brain should be a priority over EKG or chest X-Ray and should not be delayed.

5. Complete CT brain within 25 Minutes and Interpret within 45 Minutes

Non-contrast-enhanced compute tomography (NECT) brain should be performed within 25 minutes of the patient's arrival to the ED. To abide by the target time frame, the AUB-MC nurse will pre-notify the CT technician to reserve the scanner for immediate imaging of the patient with suspected acute stroke. The ED orderly will transport the patient using a stretcher accompanied by a physician and a nurse to the radiology department without any delay. The nurse will attach the patient to a cardiac monitor and provide supplemental oxygen if needed during transportation.

A CT scanner and technician is available 7 days a week and 24 hours a day to image the patient without any delay. The AHA/ASA recommends that a physician who is proficient in interpretation of CT scan of the brain analyzes the images and give his report within 25 minutes. Since it may be difficult for the radiologist at AUBMC to give his report within the NINDS target due to increase patient's load, the stroke team neurologist will read the CT scan and differentiate between ischemic or hemorrhagic stroke in less than 45 minutes. The presence of a neurologist will ensure that CT brain is read within 45 minutes rather than waiting the preliminary result from the radiology resident that needs around 2 hours, knowing that ED is given priority.

6. Obtain Lab Results within 45 Minutes

The laboratory technician needs to process the received blood specimens labeled as priority and report the results within 45 minutes. To reach this process, a stroke lab panel will be added to our current electronic system that includes the most commonly ordered stroke laboratory tests (stated previously). By clicking the stroke lab panel the ED attending or the ED resident will ensure that all the necessary labs are ordered without missing any test required for rtPA eligibility.

7. Give RT-PA within 60 Minutes

After diagnosing the patient with ischemic stroke and excluding other alternative diagnoses, the team will check the inclusion and exclusion criteria for fibrinolytic therapy and medication will be given according to the guidelines. (Adams et al., 2007). Therefore, the usual dose of fibrinolytic therapy is 0.9 mg/kg with a maximum total dose of 90 mg/kg. The initial 10% of the total dose should be administered as an IV bolus over 60 seconds and the remaining 90 % through an infusion pump over 60 minutes (Glenview, 2004).

In order to facilitate implementation of these recommendations, an order set is proposed (see Appendix E). The form included demographic data, assessment and laboratory tests, and main treatments

C. Program Implementation

To implement this program based on the above recommendations, a multidisciplinary task force needs to be created and the above program presented to them. The task force must include at minimum ED physicians, RNs, ED clinical

educator, neurologist, neurosurgeon, and pharmacist for feedback. Then the final program will be presented in a proposal to the AUBMC administration for approval. Once the program is approved, the members of the taskforce will disseminate the educational material (process map, order sets, criteria for stroke team activation...) to all concerned staff. There will be multiple educational sessions organized by the team members and offered to nurses, physicians, pharmacists, laboratory technicians about the program and the role of each member during stroke care. RNs will be asked to become NIHSS certified and the program will be piloted for three months or until we have eight patients presented to ED with new onset of stroke signs and symptoms. Changes will be discussed during the regular meetings of the task force based on staff feedback about ease of implementation, delays and recommendations.

CHAPTER IV

MONITORING CLINICAL OUTCOMES

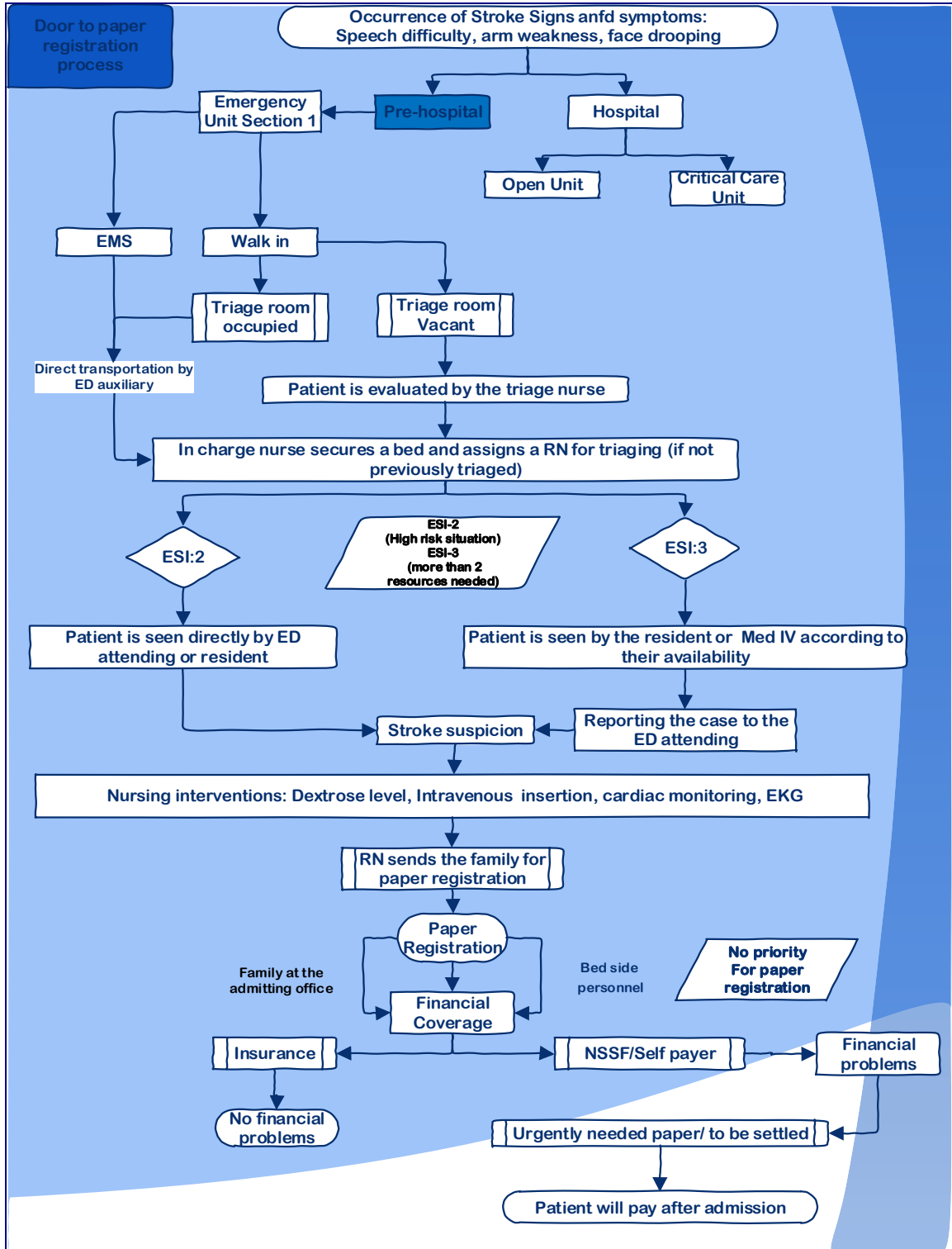
This proposed protocol aims to help acute ischemic stroke (AIS) patients receive thrombolytic therapy within 60 minutes of their arrival in the ED. A multidisciplinary team from ED nurses, ED physicians, ED technicians, a neurologist, and an APN should meet frequently to review the new process and identify the reasons for not administering or delaying IV t-PA for eligible patients. Moreover, they will recommend improvements based on the information provided from retrospective chart review and the data collection sheet (see Appendix F) that will track the timeliness of care provided to each patient presented to the ED with stroke signs. According to the AHA/ASA ED protocol outcomes are measured by calculating the following:

- Percent of ischemic stroke patients for whom an initial NIHSS is documented on arrival.
- Percent of AIS patients who presented to the ED within 2 hours and 3.5 hours of symptoms onset and received IV t-PA within 1 hour from ED arrival.
- Percent of eligible AIS patients not treated with IV t-PA despite their presentation to ED within 3 hours and 4.5 hours of symptoms onset.
- Percent of AIS patients received IV t-PA and had bleeding complication
- The score of NIHSS after 3 months of acute stroke onset: mortality and morbidity

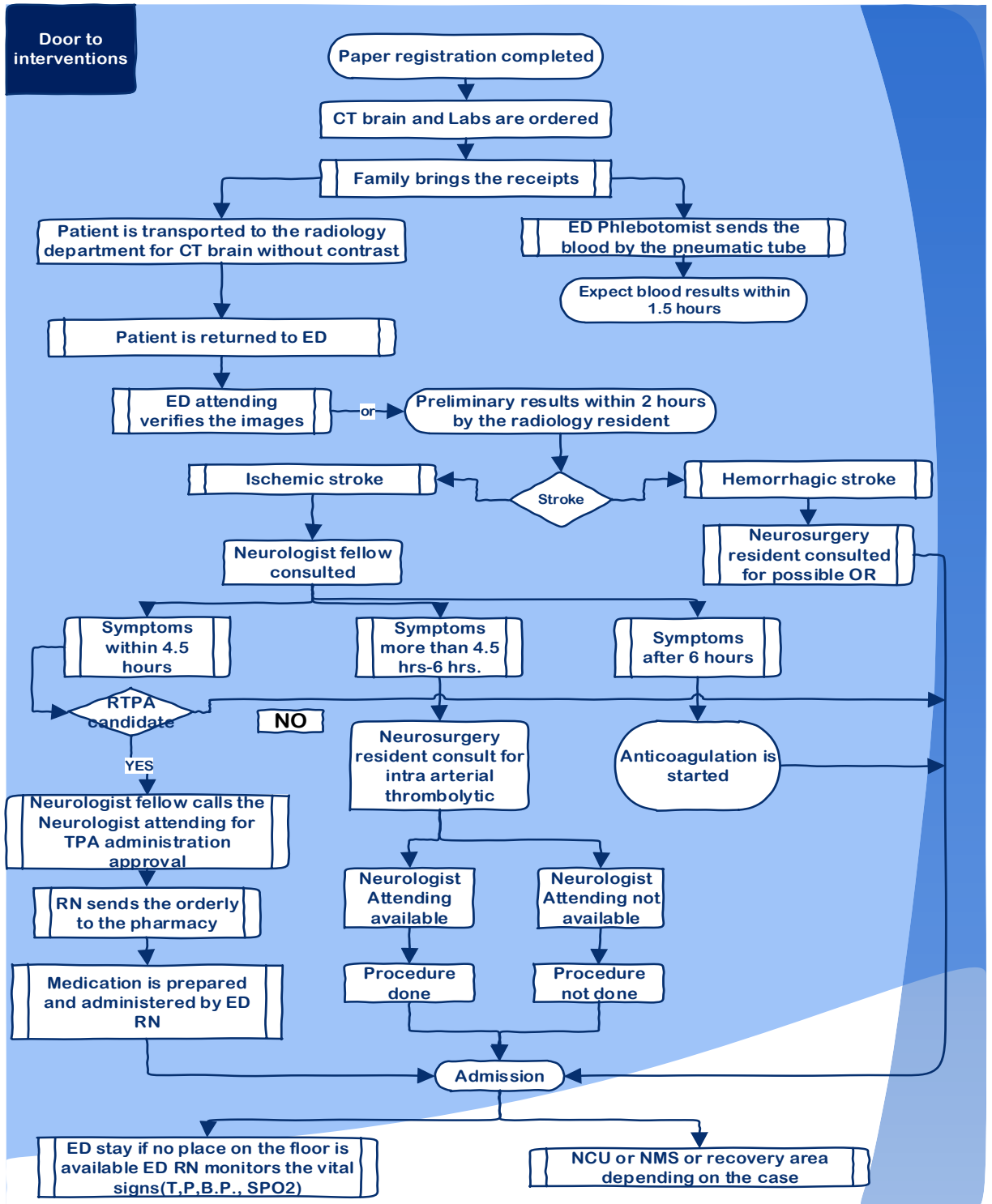
As data on these outcomes is not totally available, except what was gathered by Dr. El Seyed, a prospective study will be conducted starting three months after launching the new management process and data collected accordingly.

In conclusion, this project aims to ensure prompt treatment of acute ischemic stroke patients in order to promote their clinical outcomes. The implementation of the proposed new process is not expected to incur substantial costs, considering the available resources. The benefit obtained by stroke patients after implementing the new process outweigh the time, effort and cost involved in its implementation.

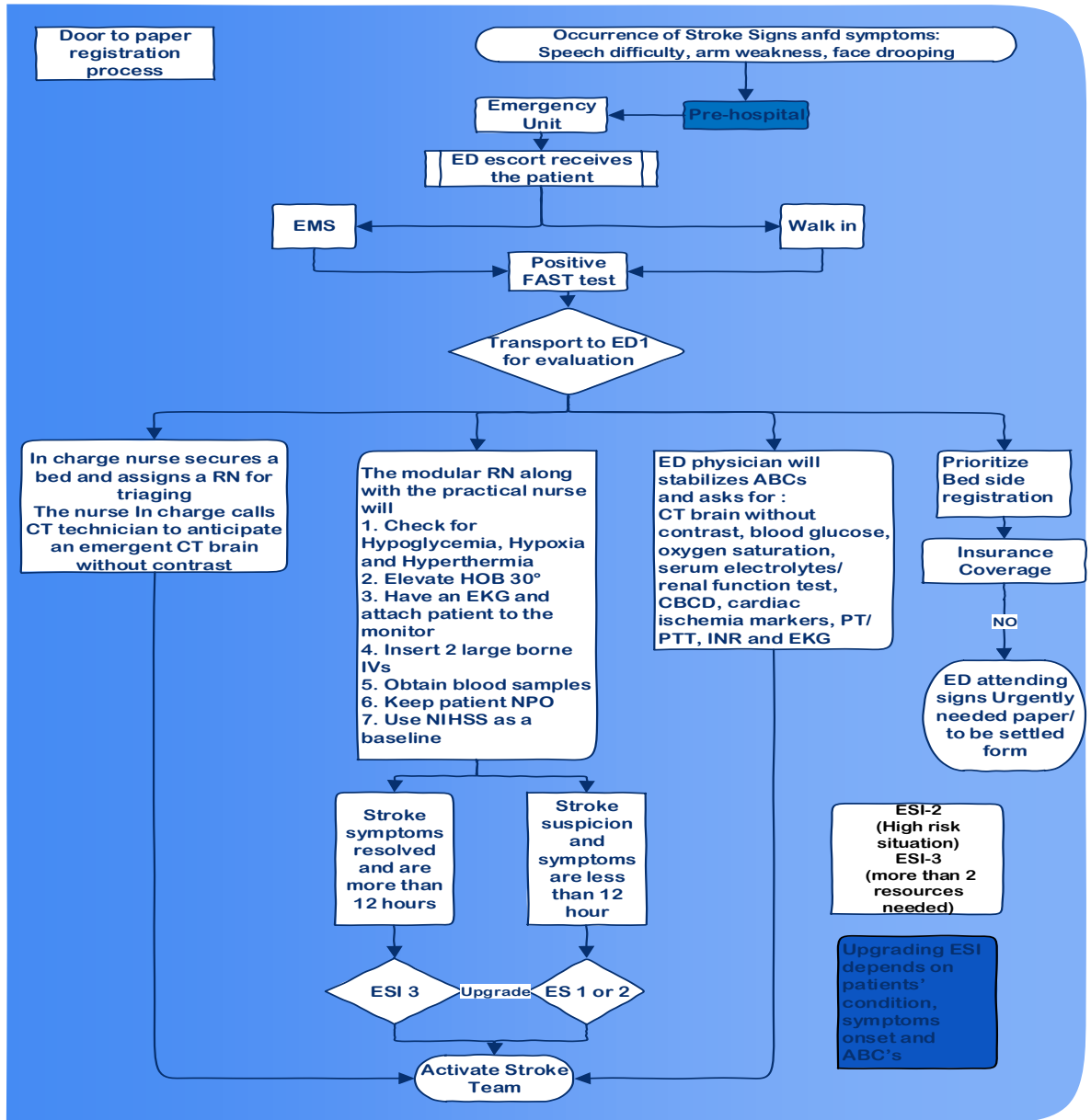
APPENDICES



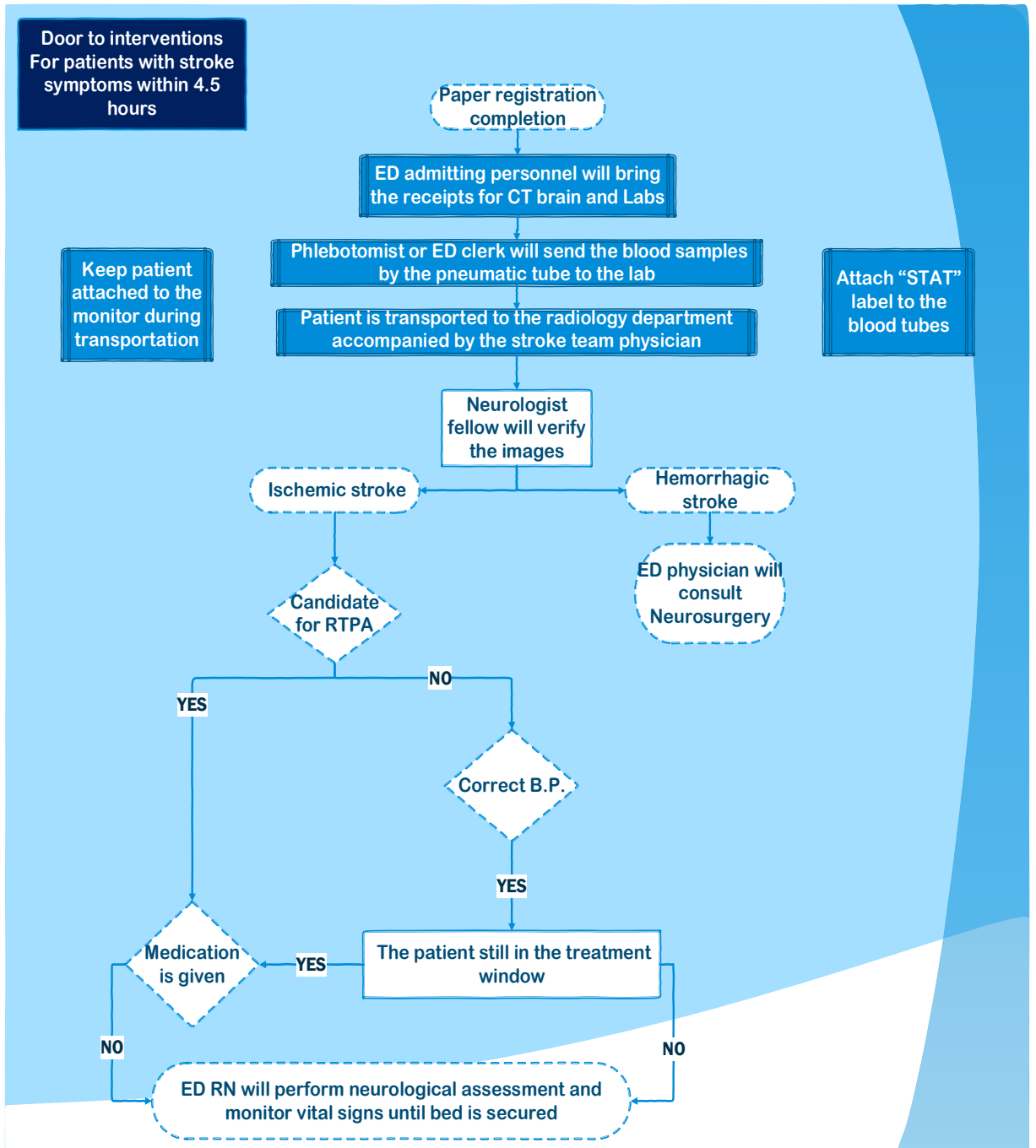
Appendix A: Process Map For the Current Emergency Stroke Care at AUBMC ED



Appendix B: Process Map for the Current Emergency Care of Acute Stroke



Appendix C: New Process Map of the Emergency Care of Stroke Patients



Appendix D: New Process Map of the Emergency Stroke Care at AUBMC



Identification Label

ED Acute Stroke Standard Order

Last Name: _____
 First & Middle Name: _____
 Patient Number: _____
 Date of Birth: _____ Age: _____
 Gender: Male Female
 Admission Date: _____
 Admitting Physician: _____

Unit: _____

 Weight: _____ Height: _____

 Other Precautions: _____

 Allergy (specify reaction): _____

The following abbreviations may not be used: U IU QD QOD .X mg X.0 mg MS MSO₄ MgSO₄ CC µg mcg
 Check the Applicable Order

<input checked="" type="checkbox"/> ED	Nurse's Name & Signature	Date & Time Noted
Initial Treatment: <input checked="" type="checkbox"/> Take blood sugar finger stick <input checked="" type="checkbox"/> Attach patient to continuous cardiac monitoring <input checked="" type="checkbox"/> 12 leads ECG <input checked="" type="checkbox"/> Oxygen at _____ continuously via _____ to keep O ₂ sat > 92%		
Vital Signs <input checked="" type="checkbox"/> Vital Signs & Neurology exam check every 1 hr. for 4 hrs; then every 2 hrs. for 8 hrs.; then every 4 hours for 48-hrs; then every shift if stable or other _____ <input checked="" type="checkbox"/> Notify Physician if: <ul style="list-style-type: none"> • Change in Neurology Status, • Temp >38 C, SBP >180 or <100, DBP >110, HR >120 bpm 		
IV Fluids <input type="checkbox"/> Insert IV1 _____ NSS 0.9% over _____ <input type="checkbox"/> Insert IV2 _____ NSS 0.9% over _____		
PREVENTION OF ASPIRATION <input checked="" type="checkbox"/> Keep patient NPO <input checked="" type="checkbox"/> Elevate HOB 30°		
Diagnostic and Lab Tests <input checked="" type="checkbox"/> CBCD <input checked="" type="checkbox"/> Chem6 <input checked="" type="checkbox"/> PT/PTT/INR <input checked="" type="checkbox"/> Troponin <input checked="" type="checkbox"/> CPK/MB <input type="checkbox"/> Others _____ <input checked="" type="checkbox"/> CT brain without contrast <input type="checkbox"/> Others _____		
NIH Stroke Scale <input checked="" type="checkbox"/> Perform NIHSS at baseline		
Antipyretics: <input checked="" type="checkbox"/> Perfolgan 1 gram IV drip PRN for temperature > 38 ° C		

Appendix E: ED Acute Stroke Standard Order Set

NINDS Recommended Window		Patient 1	Patient 2	Patient 3	Patient 4
Admission date and time					
Door -to- doctor first sees patients	10 min				
Door -to- CT completed	25 min				
Door -to- CT read	45 min				
Door -to- thrombolysis starts	60 min				
Physician's examination	15 min				
Neurosurgery available	2 hours				
Admitted to a monitored bed	3 hours				

Appendix F: Tracking Sheet

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