Effects of Clinical Pathways on Stroke Outcomes at a Tertiary Rural Hospital

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ABSTRACT

Stroke is the most common neurologic admission in our Center. Healthcare needs to be sustainable, while maintaining the standard of care. Will codifying acute stroke care into a pre-written clinical pathway reduce mortality, lengths of hospital stay, and costs? We pilot-tested an Acute Stroke Clinical Pathway based on the Stroke Society of the Philippines, Department of Health, and other international guidelines. Mortality rate, lengths of hospital stay, excess hospital costs and complication rates were compared. Those enrolled into the Ischemic Stroke pathway stayed one day less compared to those who were not. The hospital share for mild hemorrhagic stroke, mortality rate for moderate hemorrhagic stroke, and length of stay and hospital share in severe hemorrhagic stroke patients enrolled into a Hemorrhagic Stroke pathway were statistically significantly less. The savings in some patient groups (e.g., in Mild Hemorrhagic strokes) were offset by losses in others (e.g., in Moderate to Severe Ischemic Strokes). Patients enrolled into a stroke pathway were recorded to have more nosocomial infections. The findings show that using a pre-written clinical pathway reduces stroke patient mortality, length of stay, and hospital cost, but only in specific patient groups. The increase in reported nosocomial infections in stroke-pathway-enrolled patients is hypothesized to be due to better reporting.

INTRODUCTION

Problem Description

Stroke is the most common neurologic admission in our Center.[1] In 2016, 427 cases of stroke were admitted at our Center; 9% succumbed to their illness, while 24% developed complications. It is the most common cause of disability among the admissions.[2]

Available Knowledge

Healthcare needs to be sustainable.[3] However, the Philippine Health Insurance Corporation only gives Php19,600 to Php26,000 (USD389.15 to USD516.22) for its stroke case rates.[4,5] The challenge is to maintain the standard of care despite limited resources.[3] Thus, management must be effective but prudent.

Rationale

Clinical Pathways were introduced to streamline care and improve health outcomes.[6] As directed by the Chief of the Medical Professional Staff (CMPS) of our Center, a pilot test for a clinical pathway was planned, hence this paper was done to confirm or validate the efficiency of using a pre-written acute stroke/brain attack pathway to improve patient outcomes.

Specific Aim

Will codifying acute stroke care into a clinical pathway reduce mortality, lengths of hospital stay, and costs?

METHODS

Context

Our Center is a Department of Health-retained, tertiary training hospital which admits Stroke/Brain Attack patients. Its catchment area extends from Ilocos Sur, to Ilocos Norte, northern Cagayan, and the northern part of the Cordillera Autonomous Region. However, no specific memorandum or document specifically directs acute stroke/brain attack patients to our Center.

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Patients are transported to our center from the local government units and small hospitals using various mode of transportation including ambulances, private cars and motorcycles.

Our Center's Internal Medicine Residency Training Program is accredited by the Philippine College of Physicians, and Stroke care is one of the expected residency trainee competencies to be acquired upon graduation.[7] Since the initiation of the Stroke Medicines Access Program in 2016, regular in-house training courses for the stroke staff has been held several times per year. Every new batch of residents has a learning curve in the care of stroke and other conditions, and this pathway may be used a standard of care for most patients.

Definition of Terms

1. stroke: sudden-onset neurologic deficit due to an underlying vascular pathology[8]
2. Stroke Society of the Philippines Classification of Stroke Severity[8]
    a. mild stroke:
        i. NIHSS score 0 to 5; or,
        ii. alert patients with any or a combination of the following:
        iii. mild pure motor weakness of one side of the body, can raise arm above shoulder, has clumsy hand, or can ambulate without assistance
        iv. pure sensory deficit
        v. slurred but intelligible speech
        vi. vertigo with incoordination
        vii. visual field defects alone
    b. moderate stroke:
        i. NIHSS score 6 to 21; or,
        ii. awake patient with significant motor and/or sensory and/or language and/or visual deficit; or,
        iii. disoriented, drowsy, or light stupor with purposeful response to painful stimuli
    c. severe stroke:
        i. NIHSS score > 21; or,
        ii. deeply stuporous or comatose patient with non-purposeful responses, decorticate or decerebrate posturing to painful stimuli; or,
        iii. comatose patient without response to painful stimuli.
        iv. T-test: test for significant differences between two means[9]

Intervention

The Stroke/Brain Attack Pathway was based on the guidelines from Stroke Society of the Philippines,[8] Acute Stroke Training Program of the Department of Health,[10] and American Heart Association..[11,12] In January 2016, members of the medical and nursing staff of the Center underwent didactic training and had a clinical rotation in the Stroke Centers of the Jose R Reyes Memorial Medical Center and the Baguio General Hospital & Medical Center. The staff then adapted local and international guidelines into a Brain Attack pathway for local use by the Center. Standard vital signs monitoring, intravenous hydration, diet, laboratory tests and initial management were incorporated, with the intent to provide the standard of care in Stroke/Brain Attack, without leaving out the necessary, or adding on extraneous tests and interventions. All the staff neurologists were involved in the revision of the pathway, before the hospital staff was oriented in its execution. The pathway was reformatted so that it could be attached into the patient's medical record instead of being transcribed manually by the medical staff. Periodic updates and revisions were made roughly every two weeks, until the pathway evolved into its current format (see Appendix).

This is a retrospective cohort study which included charts of patients admitted from October 2017 to March 2018 were reviewed for compliance to the clinical pathway. The control group consisted of clinical data from patients who were

managed before implementation of the care pathway. However, the reasons for the admitting clinician's decision to use the pathway, or to hand-write their orders in the chart, were not reviewed. No interventions were done to increase adherence to using the pathway. Clinical data from patients who were not placed in pathway care was added to the baseline/pre-intervention/control group during analysis. Chronic stroke patients admitted for other conditions were excluded.

Measures

Data was gathered from the patients' charts, histories and physical examination forms, progress notes, and statements of account incorporated into the patients' respective medical records. Due to the varying technical skills of the admitting clinicians, stroke severity was described based on the SSP Classification as mild, moderate and severe instead of the National Institutes of Health Stroke Scale.[8]

Analysis

T-test was used to compare mortality rates, lengths of stay, and hospital shares (i.e., the cost of care to be shouldered by our Center) in between those enrolled and those who were not enrolled in the pathway.

Ethical Issues

The Stroke/Brain Attack Pathway was reviewed by the CMPS before being incorporated into the patients' medical records. The physician executing the pathway had the option to drop any patient out of the pathway at any time based on his/her clinical judgement at the time of his/her assessment of the patient. The primary author was not necessarily the attending neurologist of all the stroke patients who were enrolled in the pathway. This study was reviewed and approved by our Center's Research Ethics and Review Committee/ institutional review board.

RESULTS

Outcomes

The records of 173 patients admitted to the Department of Internal Medicine, or referred for co-management by another service, with an impression of acute stroke, from 01 October 2017 until 31 March 2018, were reviewed. One hundred one patients were male (58.3%).

One hundred and fourteen (66%) were cerebral infarctions, 43 (25%) were intracerebral hemorrhages, eleven (6%) were subarachnoid hemorrhages. Data from five charts (one subdural hematoma, and four whose CT scans were not done or could not be recovered) was excluded. Thirty-four patients (19%) were admitted within three hours of onset. Ninety-four (54%) were mild, 59 (34%) were moderate, and 17 (10%) were severe strokes. Three patients had in-hospital stroke. The patient groups With Pathway versus Without Pathway were grossly comparable.

Twenty-three out of 104 records reviewed from the last quarter of 2017, and 17 of 69 records reviewed from the first quarter of 2018, were enrolled into a Stroke clinical pathway (23% in total).

Hypertension, smoking, ethanol intake, diabetes, and prior stroke were the most commonly seen risk factors. Rheumatic heart disease and atrial fibrillation were more seen in cerebral infarctions.

Overall, there was less mortality among those enrolled in the acute ischemic stroke pathway with mild, moderate and severe strokes (see Fig 1).

In general, those who were enrolled also stayed admitted at least one day less compared to those who were not enrolled into a Pathway. In general, the mild ischemic stroke patients stayed in-hospital for about five days, the moderate ischemic stroke patients stayed for about a week, and the severe ischemic stroke patients stayed for two weeks (see Figures 2 & 3).

Grossly, the hospital was also able to save up to P5,000 in patients with Mild

Ischemic Stroke who used the Pathway, but these gross differences, however, were not found to be statistically significant (see Figures 4 & 5).

In general, mean hospitals stays were shorter and hospital shares were less in the patient groups enrolled into a Hemorrhagic Stroke Pathway, compared to those who were not; but, the differences in hospital shares for mild hemorrhagic stroke, mortality for moderate hemorrhagic stroke, and lengths of stays and hospital shares in severe hemorrhagic stroke, were not statistically significant (see Figures 6 to 12, and Appendix 2).

None of the eleven patients admitted for subarachnoid hemorrhage were enrolled into a pathway. Of these eleven, four succumbed; most stayed admitted for at least a week, and the hospital contributed around P60,000 to their hospital bill.

When pooled by stroke severity, the total cost of the hospital share increased with the severity of the stroke. The most savings was in the Mild Strokes With Pathway group (see Table 1 and Figure 15).

DISCUSSION/CONCLUSION

In this report, many of the findings were not statistically significant by T-testing. Hospital savings in terms of lengths of stay and costs in some patient groups appeared to have been offset by the losses in the other patient groups. The increase in nosocomial infections in the patients enrolled into a stroke pathway against those who were not, is hypothesized to be due to better detection and reporting when enrolled into a pathway.

In a 2003 report, Americans received approximately only half of recommended medical care practices,[13] whereas in a Singapore report, stroke complications and mortality rates most drastically reduced within five years of adoption of clinical pathway system.[6] Locally, among physicians treating young ischemic stroke patients, most complied with SSP Guidelines regarding emergency diagnostic tests, but compliance with therapeutic recommendations were less.[14]

Limitations

This study was hampered by a small sample size. All the patients in this study were admitted to, referred to, or comanaged by, a neurologist. However, as this was a pilot study, pathway adherence was only encouraged and was not compulsory. The author also does not discount staff inertia in accepting new formats of an old system which has been shown to be working.[13]

Recommendations

This report shows that using clinical pathways in acute stroke care reduces hospital costs and mortality rates in specific patient groups, at best. Further updates may be made in the future as more data is reviewed and analyzed.

ACKNOWLEDGEMENTS

Dr. Shiela Grail J Ganangan-Mandaiayas conducted the initial profile of stroke patients in 2016 which was used as a reference in this paper. Mrs. Francisca Sagisi performed the statistical analyses for this paper.

STATEMENT OF ETHICS:

Study Approval Statement: This study protocol was reviewed and approved by the Research Ethics and Review Committee of the Mariano Marcos Memorial Hospital & Medical Center, protocol number MMMH-RERC-2018-012.

Consent to Participate Statement: A written informed consent was not required by the Research Ethics and Review Committee of the Mariano Marcos Memorial Hospital & Medical Center

Conflict of Interest Statement

The primary author is himself a neurologist involved in the care of stroke patients. The use of the pathway on Private or Charity patients was left to the discretion

of the attending physician. The author manages the Stroke Program of the MMMH&MC, and he is the designated contact person for Boehringer Ingelheim Philippines (BIPhi). BIPhi has agreed to provide the author with training including but not limited to the conduct of the Angels Initiative Stroke Certification Course at the MMMH&MC. The MMMH&MC Stroke Program uses recombinant Tissue Plasminogen Activator (rTPA), which at the time of this writing is the only Level-A-evidenced acute therapy for acute ischemic stroke available at MMMH&MC; and rTPA is exclusively acquired from BIPhi.

Data Availability, Privacy, Confidentiality and Information Handling Statement:

A letter of permission was addressed to the head of the Health Information Management Service (HIMS), to access inpatient charts for review, to collect the data listed in Appendix 1. The anonymized data was collated in a password-protected Microsoft Excel file in the safekeeping of the primary author. The patients' physical charts were reviewed only at the HIMS Office. At the end of the study, only one copy of the file will be retained, and other backup copies will be deleted. Data of charts of minors were not reviewed, and assent was not requested. Stroke risk factors were reviewed cross-sectionally, and not identified to a specific patient, to maintain anonymity and to reduce vulnerability.

Funding Source

This study is author-funded.

Author Contributions: Guillermo L Manalo III: conception and design, data acquisition, analysis and interpretation, drafting and revision, final approval, accountability

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Fig. 1. Mortality rate among patients with ischemic stroke.

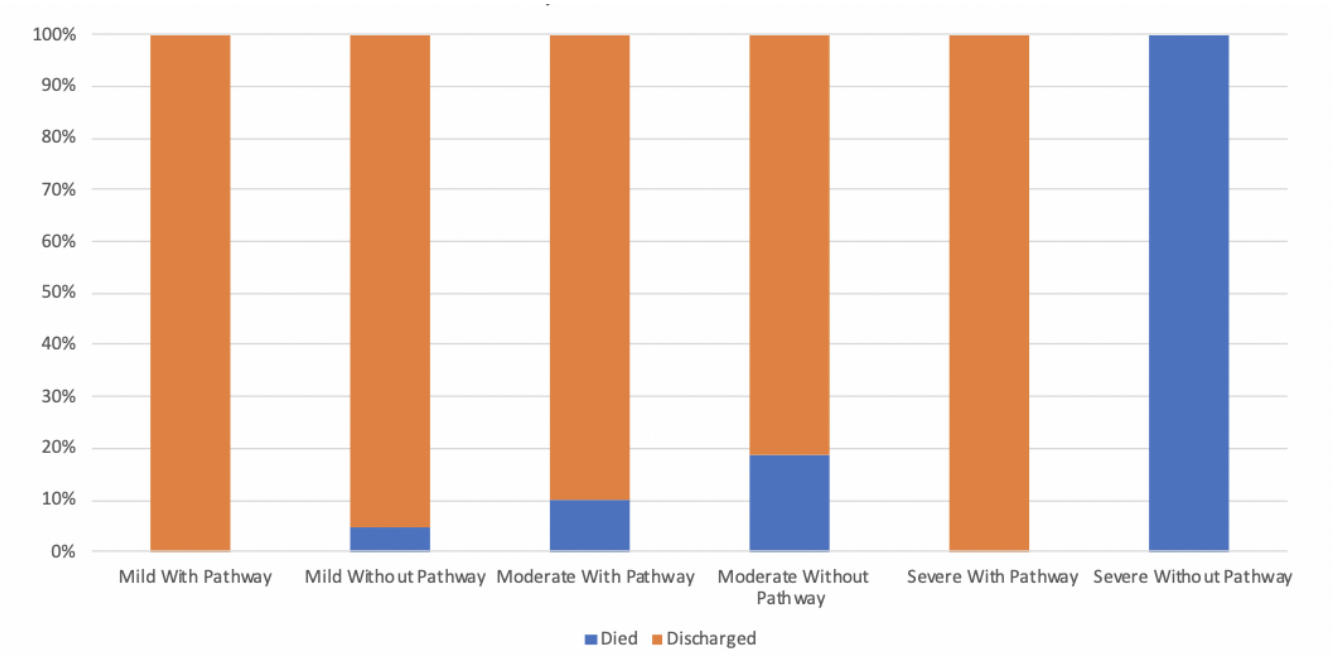

Fig. 2. Length of stay: Mild Ischemic Stroke

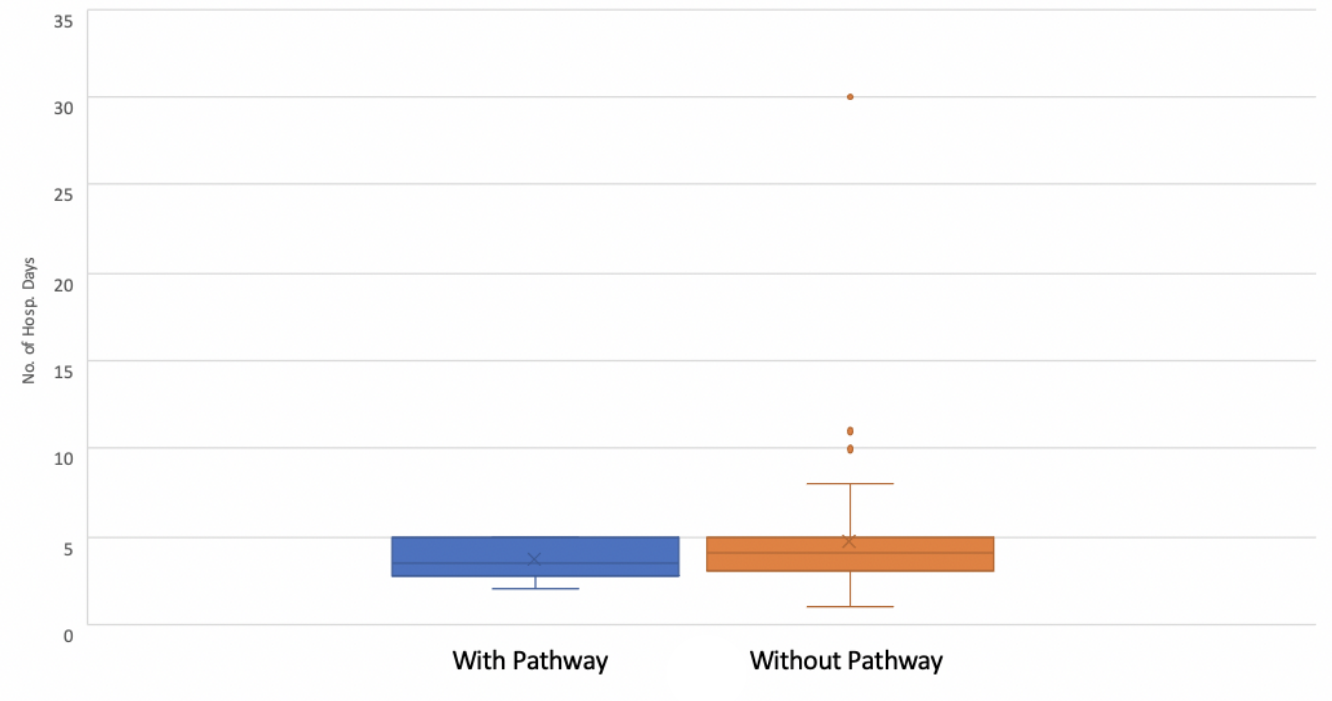

Fig. 3. Length of stay: Moderate Ischemic Stroke

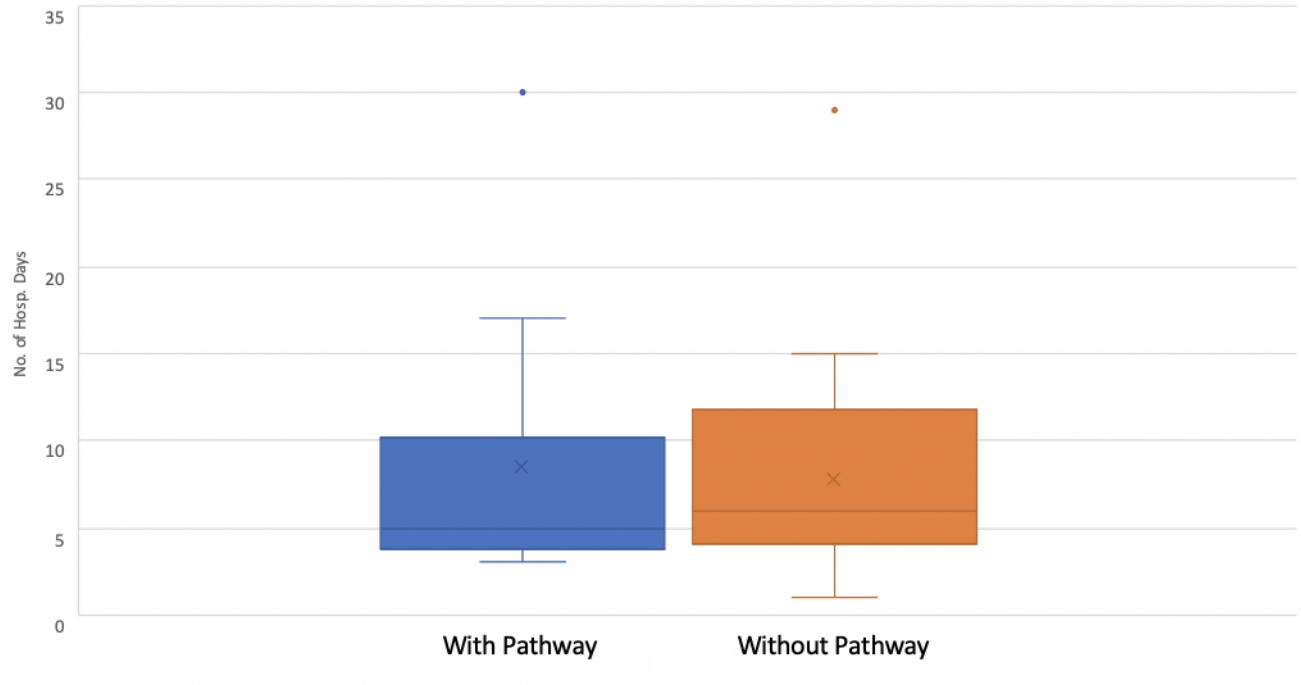

Fig. 4. Hospital share: Mild Ischemic Stroke

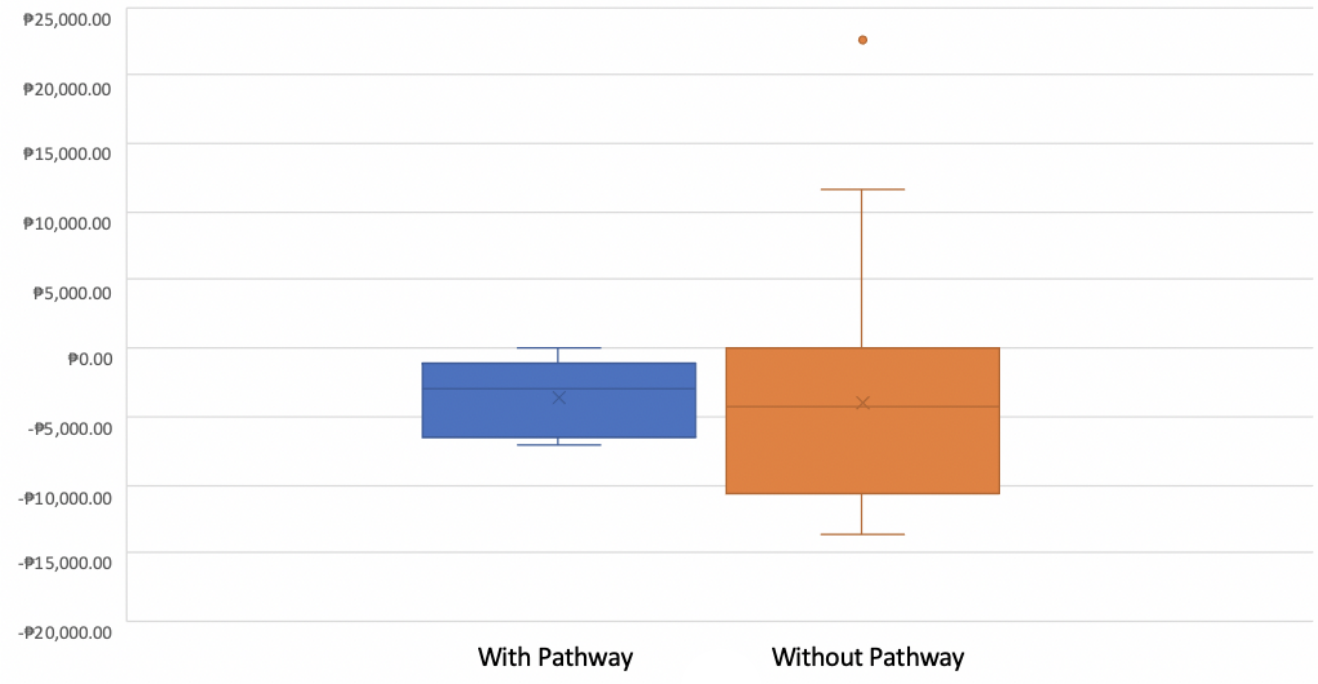

Fig. 5. Hospital share: Moderate Ischemic Stroke

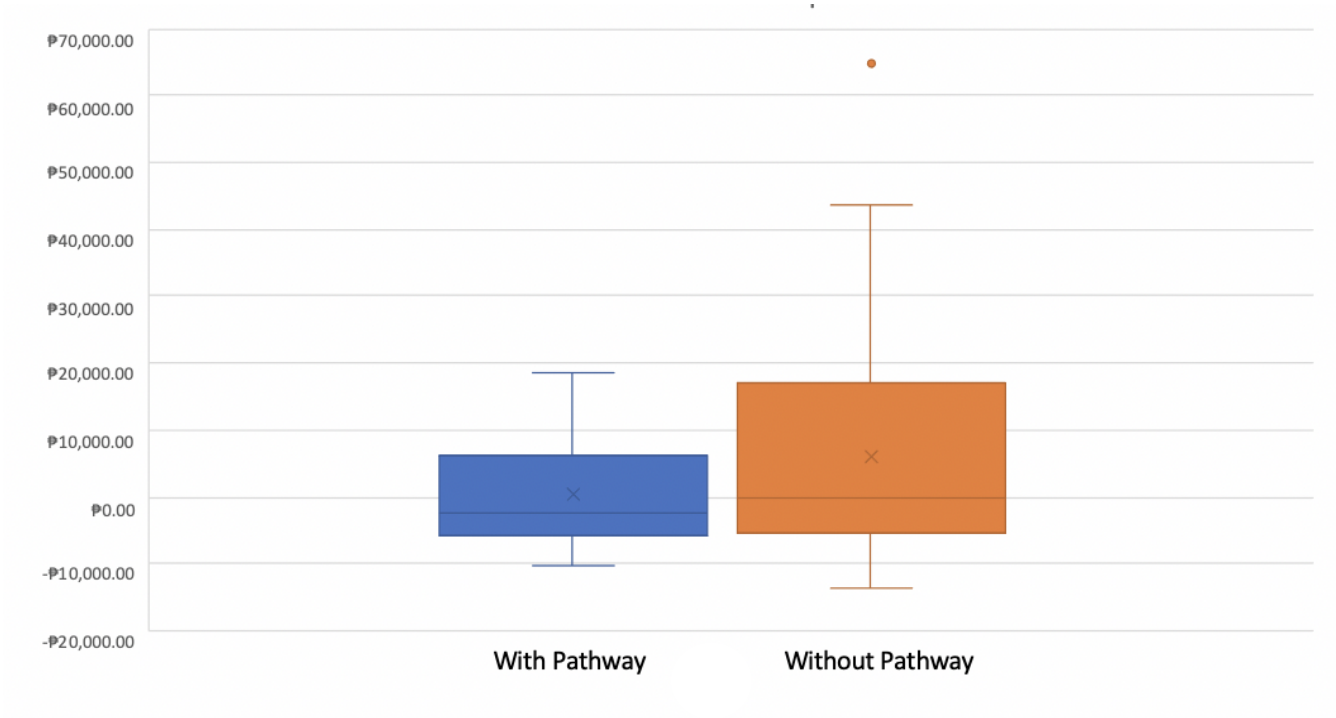

Fig. 6. Mortality rate among patients with hemorrhagic stroke

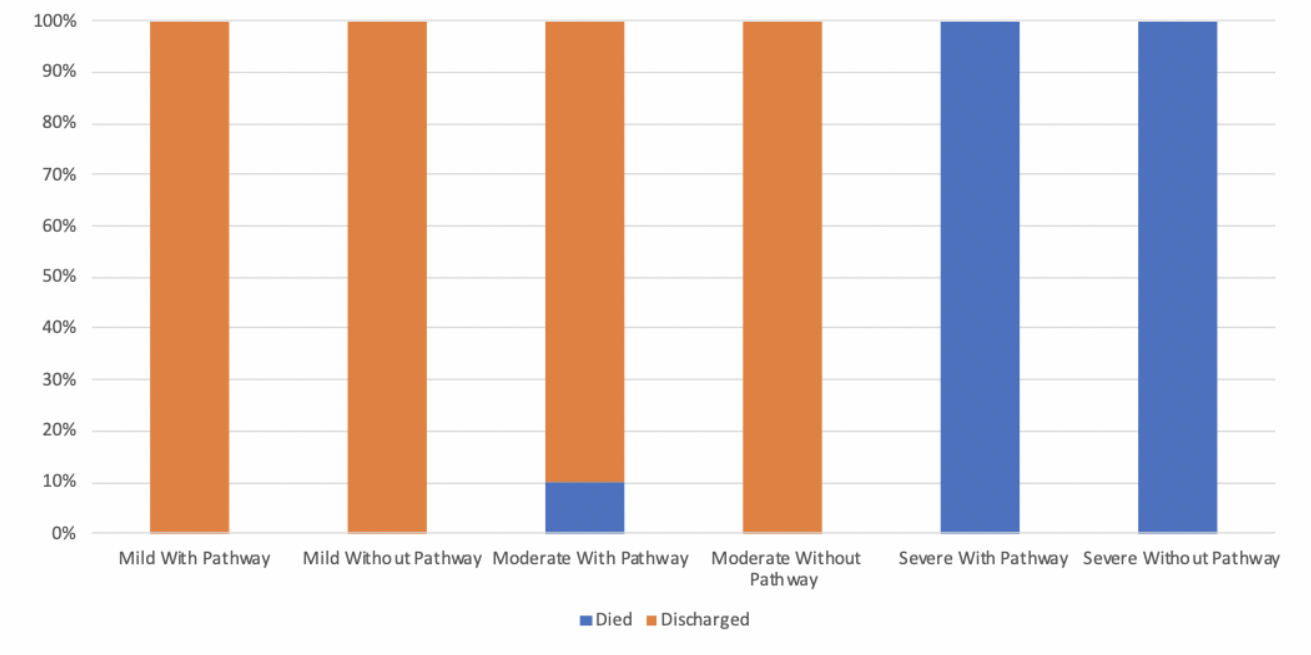

Fig. 7. Length of stay: Mild hemorrhagic stroke

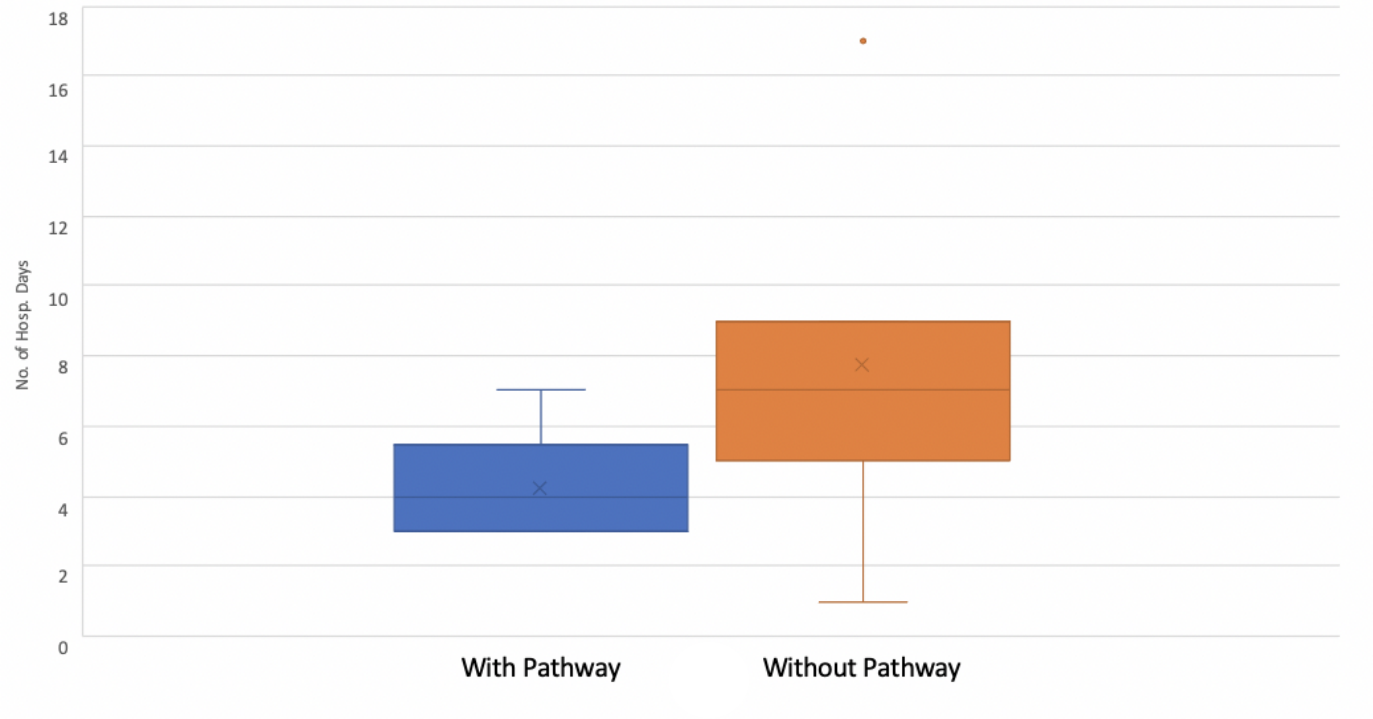

Fig. 8. Length of stay: Moderate hemorrhagic stroke

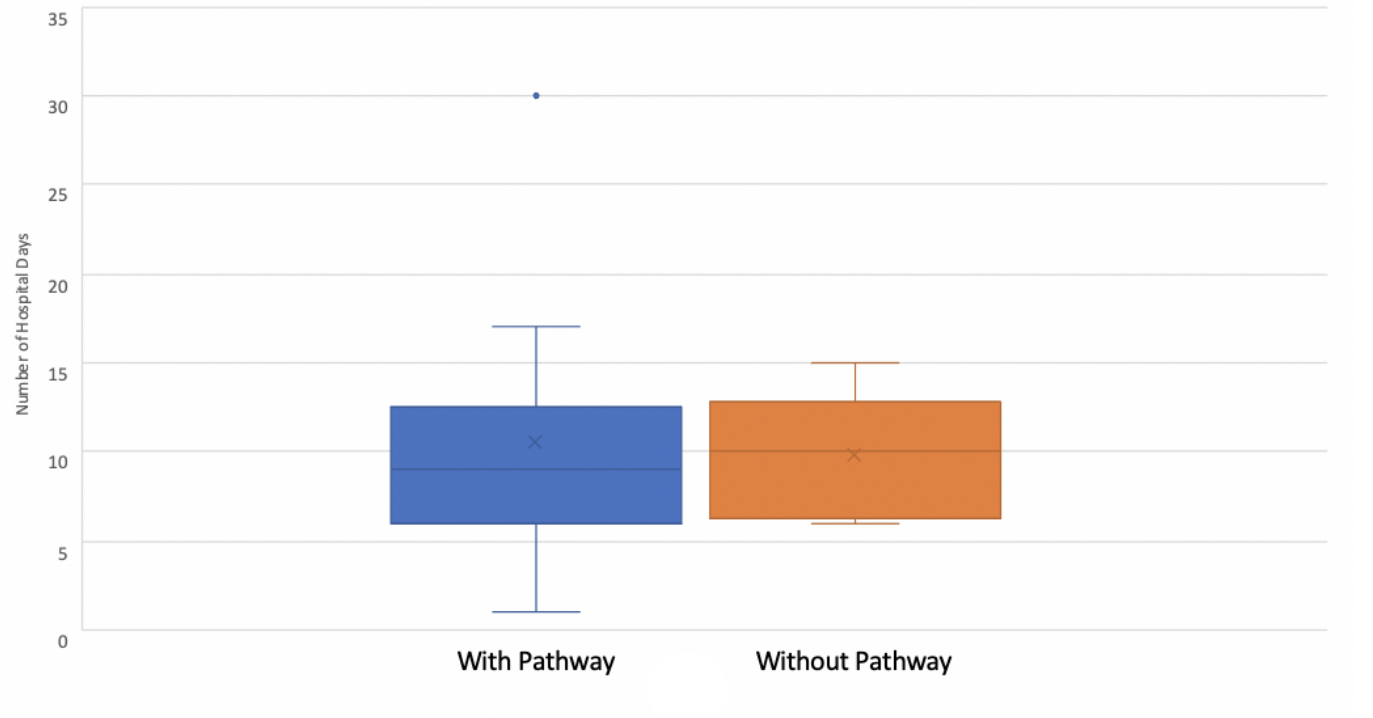

Fig. 9. Length of stay: Severe hemorrhagic stroke

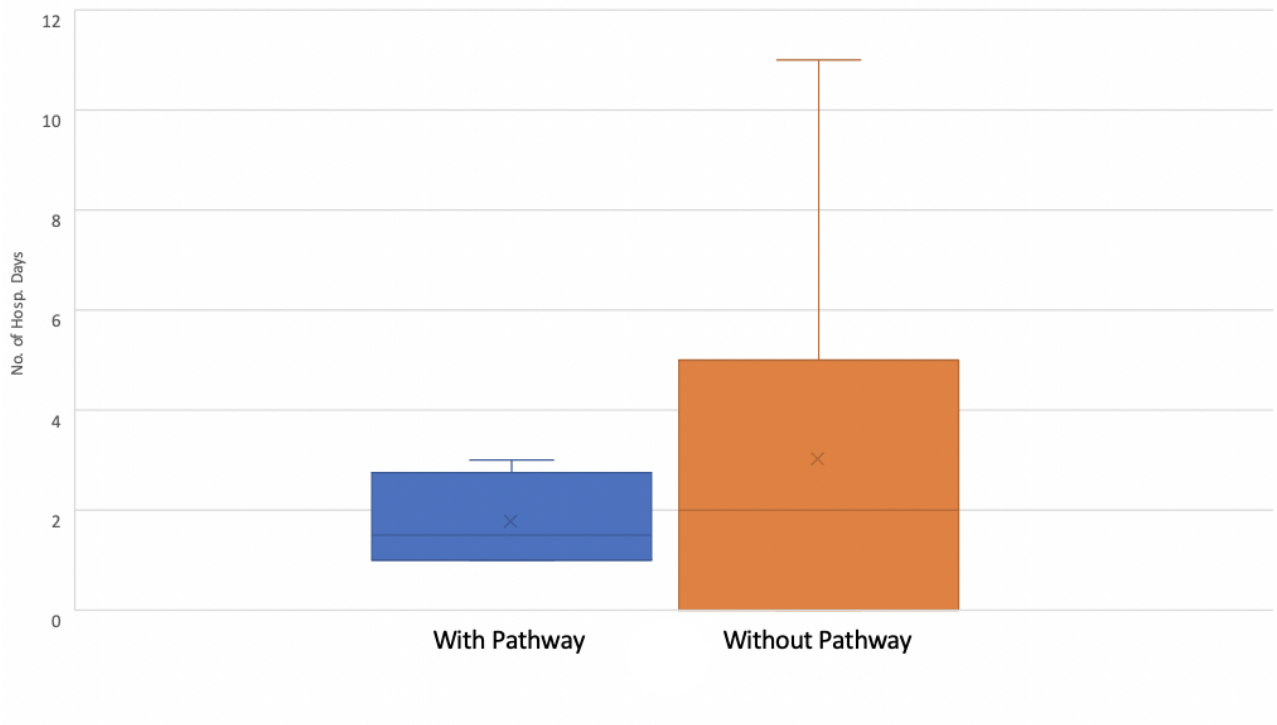

Fig. 10. Hospital share: Mild hemorrhagic stroke

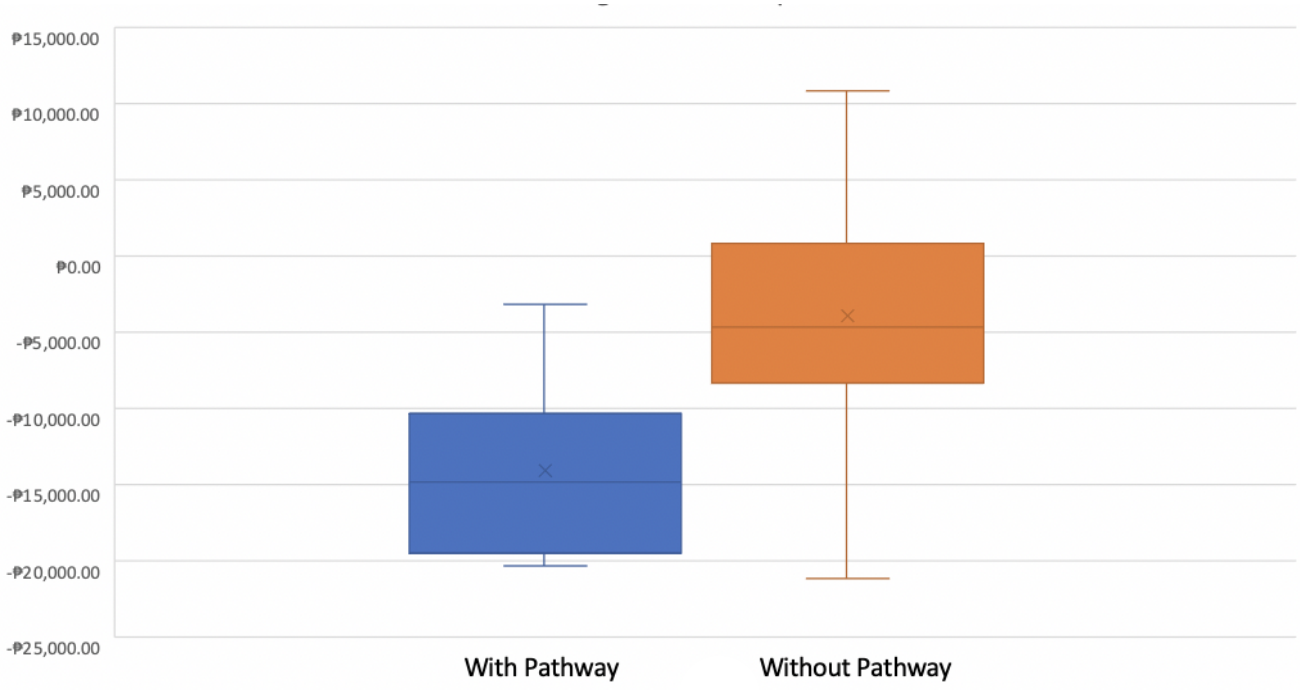

Fig. 11. Hospital share: Moderate hemorrhagic stroke

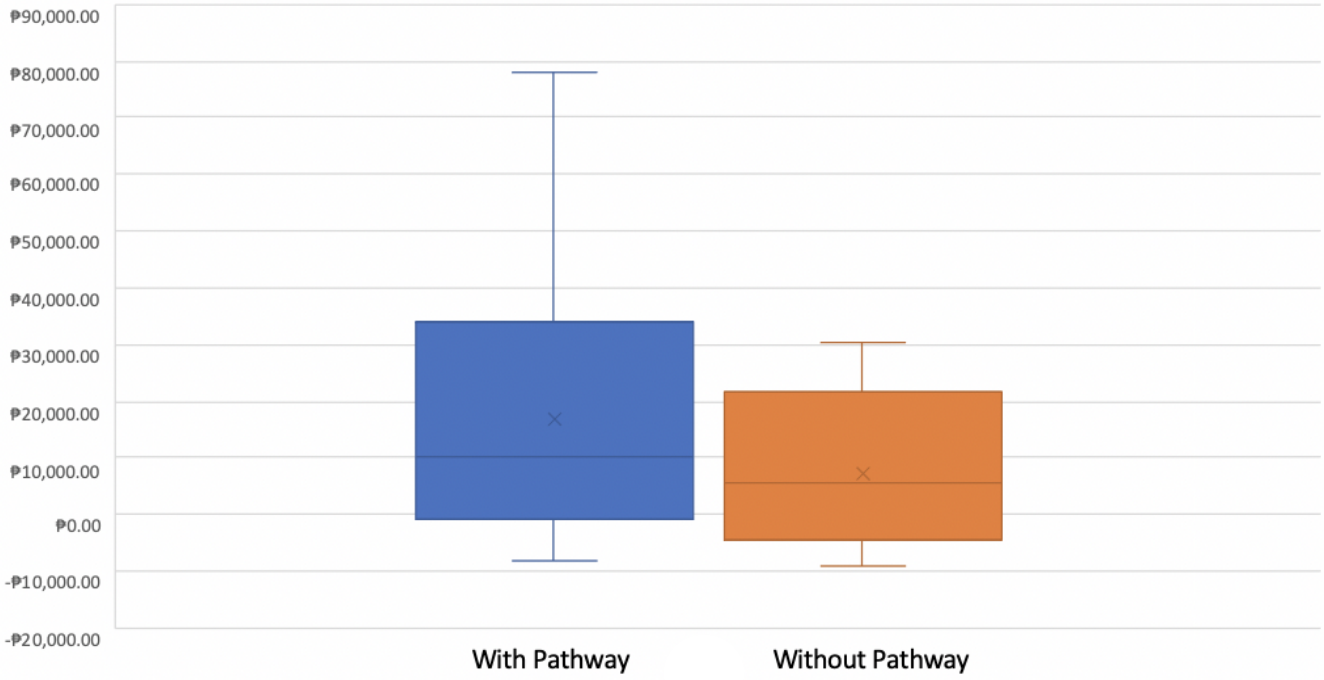

Fig. 12. Hospital share: Severe hemorrhagic stroke

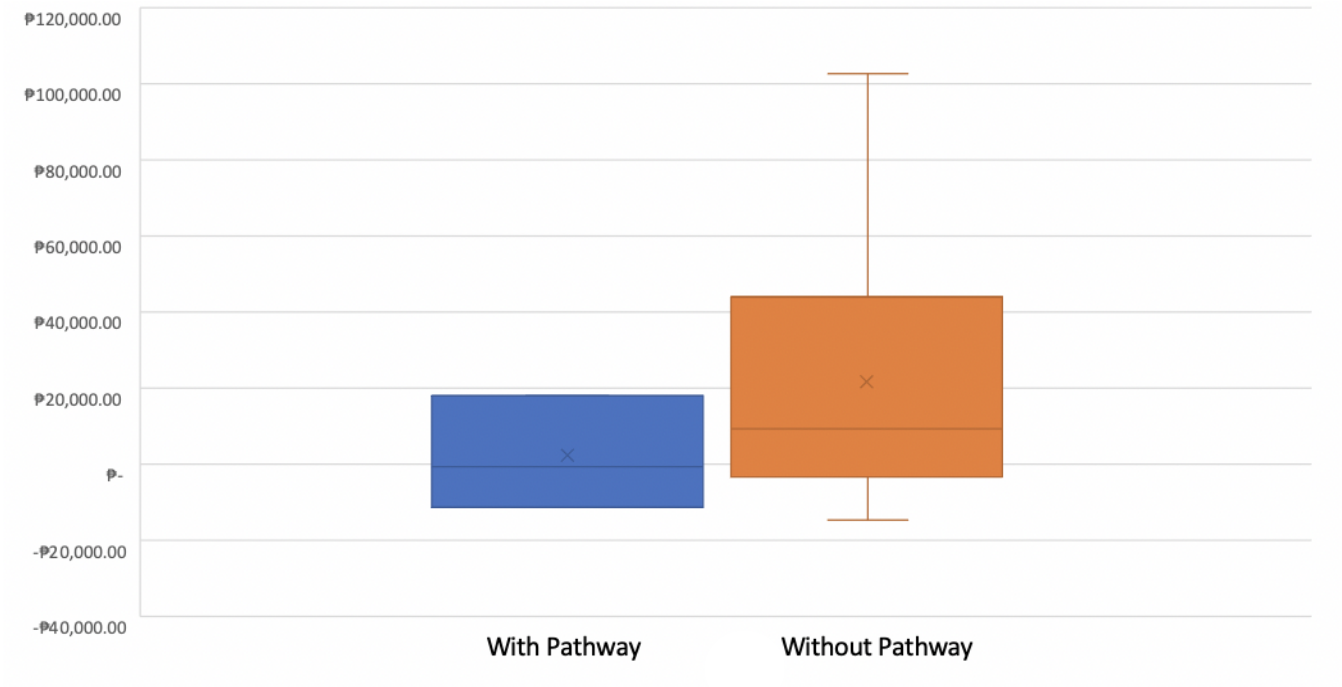

Fig. 13. Complication rate among patients with acute ischemic stroke

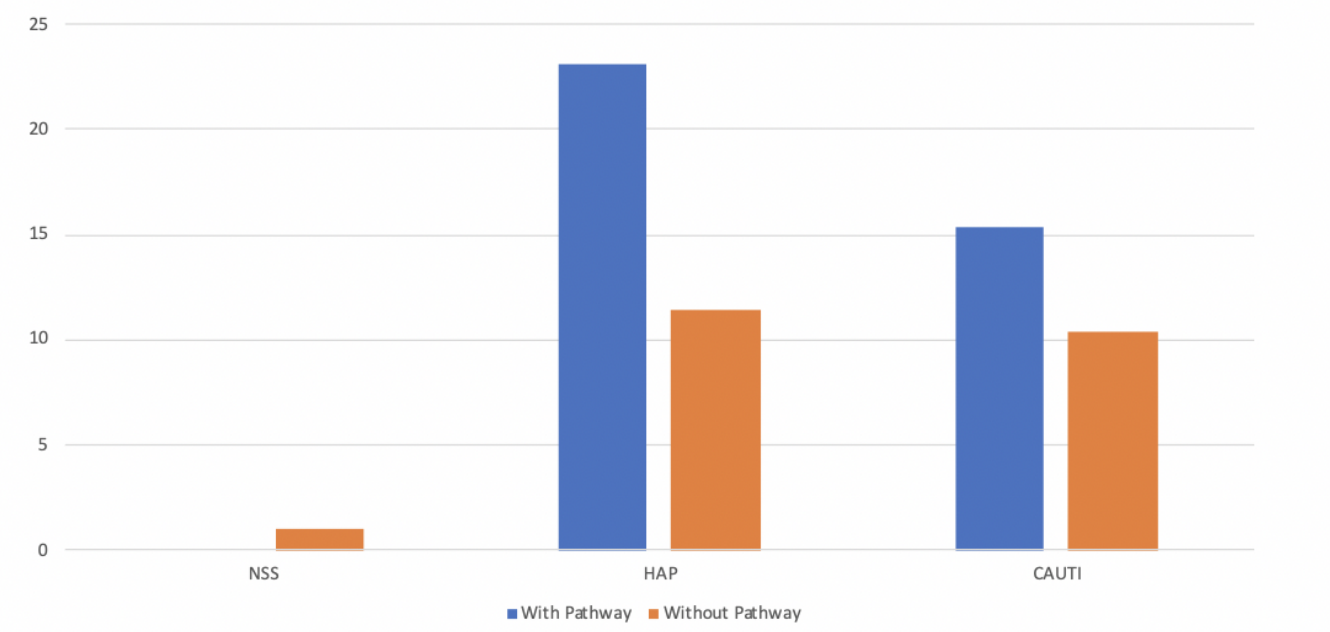

Fig. 14. Complication rate among patients with acute hemorrhagic stroke

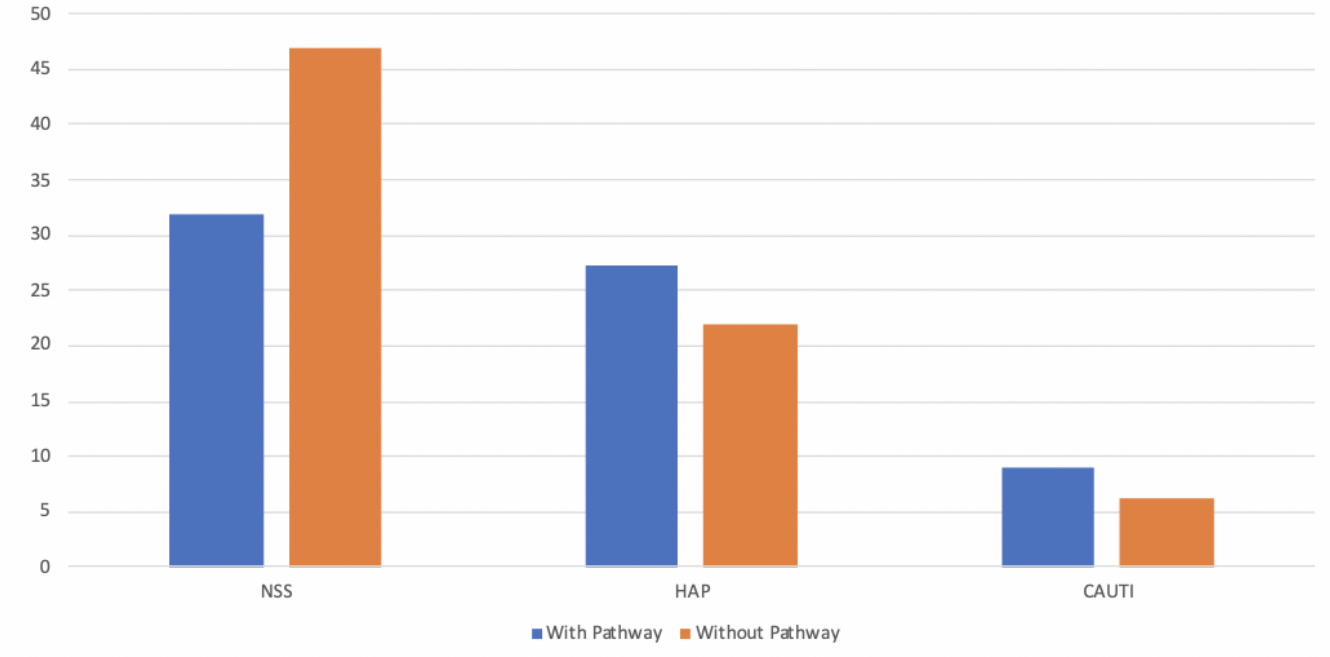

Fig. 15. Hospital share in relation to pathway use, pooled by stroke severity

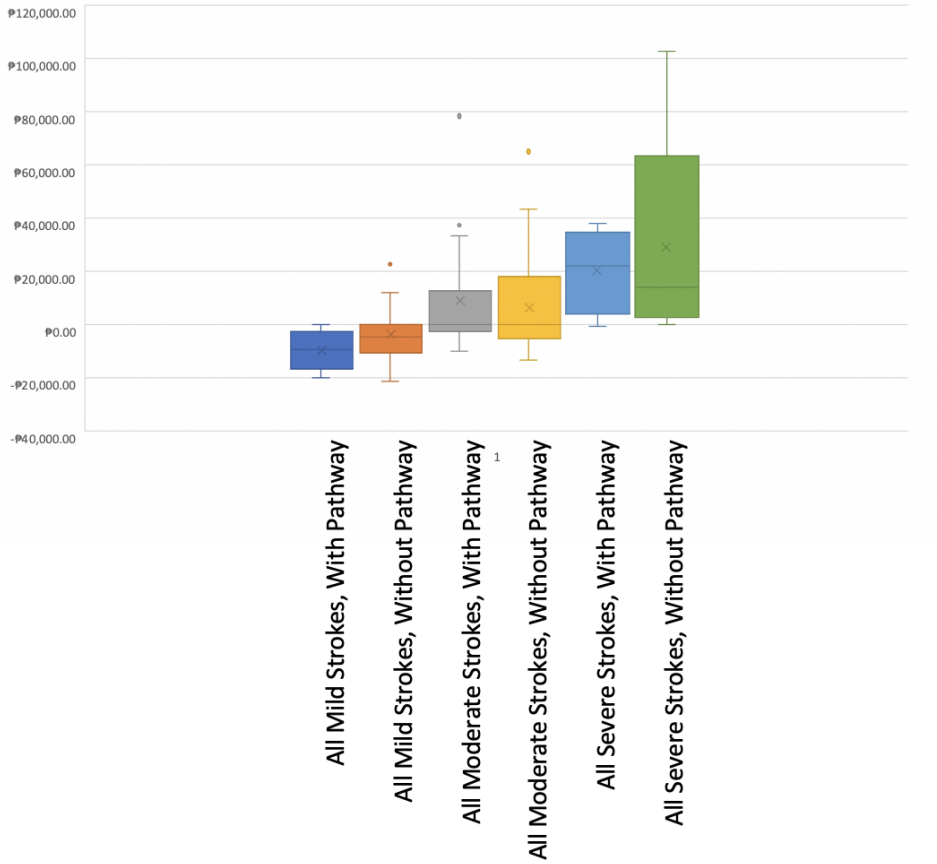

Table 1: Average Hospital Share in Relation to Pathway Use, pooled by Stroke Severity

	All Mild Strokes	All Moderate Strokes	All Severe Strokes
With Pathway	-₱10,076.56	₱9,083.74	₱20,021.43
Without Pathway	-₱4,072.78	₱6,265.46	₱29,066.12

Appendix 1: Brain Attack Clinical Pathway

Date (MM/DD/YR): _____/_____/_____ Time: _____:_____ AM/PM (please encircle)

Inclusion Criteria (pls. check if present):		rTPA Absolute Contraindications (pls. check if present):	
	≥19 years old		any prior intracranial hemorrhage (ICH)
	sudden weakness/facial asymmetry		clinical presentation of subarachnoid hemorrhage (SAH)
	sudden numbness		known AVM/aneurysm/brain neoplasm
	sudden slurred speech/difficulty with speaking		known bleeding diathesis/active bleeding
	sudden severe headache		severe liver disease/failure/cirrhosis/portal hypertension
	sudden severe dizziness		ischemic stroke/significant head trauma within 3 months
	other clinical diagnosis of acute stroke, causing a measurable neurological deficit		traumatic heart massage/obstetrical delivery/arterial puncture at a non-compressible site within 10 days
	≤3 hours from the time last seen normal		recent intracranial or spinal surgery
date last seen normal (MM/DD/YEAR): ____/____/____ time last seen normal: ____:____ AM/PM			current warfarin/NOAC (direct thrombin inhibitor, direct factor X inhibitor, etc.) use
			heparin use within 48 hrs
Pre-Morbid Modified Rankin Scale (pls. encircle): 0 (no symptoms at all) 1 (no significant disability despite symptoms) 2 (slightly disabled, but able to look after own affairs without assistance) 3 (moderately disabled, but able to walk without assistance 4 (moderately severely disabled, unable to walk/attend to bodily needs without assistance 5 (severely disabled, bedridden, incontinent, requiring constant nursing care and attention)			bacterial endocarditis/pericarditis/acute pancreatitis
			rapidly improving stroke symptoms (clearing spontaneously)
		rTPA Relative Contraindications (pls. check if present):	
			myocardial infarction within 3 months
			gastrointestinal or urinary tract hemorrhage within 21 days
			minor surgery or serious trauma (excluding head trauma) within 14 days
			seizures at the time of onset of stroke symptoms with post-ictal neurologic impairment
			pregnancy
			heavy or frequent ethanol intake
Risk Factors (pls. check if present):			
	hypertension		stress
	myocardial infarction		diabetes
	rheumatic heart disease		smoking
	obesity or snoring		hypercholesterolemia
	atrial fibrillation		angina pectoris
	heavy or frequent ethanol intake		peripheral arterial disease
	oral contraceptive use in females		others (specify):

Date (MM/DD/YR): _____/_____/_____ Time: _____:_____ AM/PM (please encircle)

Clinical Notes		Physicians' Orders	Nurses' Action	Signature	Variance			
					A	B	C	D
SBP _____ mmHg DBP _____ mmHg MAP _____ mmHg HR _____/min RR _____/min T _____.___°C O2Sat _____ % CBG: _____ mg% pupils:		Admit to ER; secure consent.						
		Check CBG now and record.						
		If: [ ] CBG >80 mg% or <300 mg%, AND [ ] BP >90/60: CALL BRAIN ATTACK.						
		VS, GCS, NIHSS q15; Temp, repeat CBG q4; NPO for now. Standby O2 if SaO2 <95%.						
		Insert gauge 18 IV cannula. Start IVF pNSS 1 L x 12/_____ hrs. Elevate head 30 degrees.						
R pupil:		For:						
L pupil:		[ ] STAT [ ] CBC plt ct. diff.ct.						
E	M	[ ] STAT [ ] PT/PTT						
V	GCS	[ ] STAT [ ] plain cranial CT						
1a	6a	[ ] BUN Crea Na K Alb						
1b	6b	[ ] blood typing						
1c	7	[ ] 12-L ECG						
2	8	[ ] CXR AP at highest truncal elevation						
3	9	[ ] swallowing screening						
4	10							
5a	11							
5b	NIHSS							
[ ] CBG <80 mg% [ ] CBG >300 mg% [ ] BP <90/60		Refer to Internal Medicine Resident on Duty for possible diabetic/cardiac emergency. (END PATHWAY.)						
[ ] CBG = 181-220 mg%		Give 4 units regular insulin subcutaneously						
[ ] CBG = 221-260 mg%		Give 6 units regular insulin subcutaneously						
[ ] CBG = 261-300 mg%		Give 8 units regular insulin subcutaneously						
[ ] SBP >220 mmHg [ ] DBP >120 mmHg [ ] MAP >130 mmHg		If blood pressures are above acceptable limits, start nicardipine 10 mg in 100 mL solution at 10 mL/hr (1 mg/hr); increase or decrease by 5 mL/hr every 15 mins until MAP = 110-130 mmHg.						

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
1. patient's medical condition 2. patient's or family's decision 3. patient or family availability 4. non-compliance to treatment 5. no funds 6. others, pls. specify: _____	1. medical order 2. provider's decision 3. provider's response 4. others, pls. specify: _____	1. results availability 2. delay in test results 3. delay in procedure 4. cancellation of procedures 5. delay in patient transfer 6. supplies or equipment needed 7. appointment or availability 8. weekend or holiday 9. others, pls. specify: _____	1. condition or transportation 2. home care availability 3. others, pls. specify: _____

Date (MM/DD/YR): _____/_____/_____ Time: _____:_____ AM/PM (please encircle)

Clinical Notes	Physicians' Orders	Nurses' Action	Signature	Variance			
				A	B	C	D
Ictus: ___:___ AM/PM (encircle) SBP ____ mmHg MAP ___ mmHg DBP ____ mmHg HR _____/min T _____.___°C RR _____/min [ ] infarction [ ] TACI: _____ [ ] > 1/3 cerebral hemisphere [ ] PACI: _____ [ ] LACI: _____ [ ] PoCI [ ] dense L / R MCA [ ] loss of grey/white matter differen'n in L / R (pls encircle) internal capsule/ basal ganglia/ insula (pls encircle) [ ] ICH/SAH/IVH [ ] midline shift/non-communicating hydrocephalus [ ] others, specify: _____ [ ] no infarct/hemorrhage	Follow-up pending labs. (Select succeeding path below.) If [ ] without CT contraindication(s) for rTPA infusion, continue on Brain Attack Pathway. If with: [ ] well-defined infarct, OR [ ] chronic infarct > 4.5 hrs SKIP TO PAGE 7. If [ ] with hemorrhage: DEFER rTPA. (TRANSFER TO CVD BLEED PATHWAY.) Refer to Neurosurgery due to: [ ] total anterior circulation infarct [ ] cerebral hemorrhage > 30 mL [ ] cerebellar hemorrhage > 10 mL [ ] SAH/IVH [ ] other: _____ (END PATHWAY.)						

1a	6a
1b	6b
1c	7
2	8
3	9
4	10
5a	11
5b	NIHSS

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
1. patient's medical condition 2. patient's or family's decision 3. patient or family availability 4. non-compliance to treatment 5. no funds 6. others, pls. specify: _____	1. medical order 2. provider's decision 3. provider's response 4. others, pls. specify: _____	1. results availability 2. delay in test results 3. delay in procedure 4. cancellation of procedures 5. delay in patient transfer 6. supplies or equipment needed 7. appointment or availability 8. weekend or holiday 9. others, pls. specify: _____	1. condition or transportation 2. home care availability 3. others, pls. specify: _____

Date (MM/DD/YR): _____/_____/_____ 8 Time: _____:_____ AM/PM (please encircle)

Clinical Notes	Physicians' Orders	Nurses' Action	Signature	Variance			
				A	B	C	D
Ictus: ___:___ AM/PM (pls encircle) SBP _____ mmHg DBP _____ mmHg HR _____/min RR _____/min T _____.___°C Plt. Ct. _____ x 10^3 per cu.mm. (defer rTPA if <100) INR _____ (defer rTPA if <1.7) PTT Pt _____ sec (defer rTPA if >36 sec); Ctrl _____ sec	(Select succeeding path below.) CAUTION if: [ ] >80 yrs old [ ] hypertension AND diabetes [ ] NIHSS >24 If: [ ] <4.5 hours from stroke onset, AND [ ] SBP <185 mmHg, AND [ ] DBP <110 mmHg, AND [ ] ALL contraindications are ruled out: SECURE CONSENT FOR rTPA INFUSION. If [ ] with (any other) contraindication(s) for rTPA infusion, SKIP TO PAGE 7 and refer to Internal Medicine Resident on Duty for continuity of care.						
1a / 6a 1b / 6b 1c / 7 2 / 8 3 / 9 4 / 10 5a / 11 5b / NIHSS:							

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
1. patient's medical condition 2. patient's or family's decision 3. patient or family availability 4. non-compliance to treatment 5. no funds 6. others, pls. specify: _____	1. medical order 2. provider's decision 3. provider's response 4. others, pls. specify: _____	1. results availability 2. delay in test results 3. delay in procedure 4. cancellation of procedures 5. delay in patient transfer 6. supplies or equipment needed 7. appointment or availability 8. weekend or holiday 9. others, pls. specify: _____	1. condition or transportation 2. home care availability 3. others, pls. specify: _____

Date (MM/DD/YR): _____/_____/_____ 18 Time: _____:_____ AM/PM (please encircle)

Clinical Notes		Physicians' Orders	Nurses' Action	Signature	Variance			
					A	B	C	D
End of rTPA infusion.		Admit to ICU.						
SBP	MAP	Continue close monitoring; update ROD of VS, pupil size, GCS breakdown and NIHSS at 2nd, 6th, 10th, 14th 18th and 24th hour after start of rTPA infusion, and as needed. Complete bed rest.						
DBP								
HR	T							
RR	SaO2							
		Inform ICU re: airway/O2 requirement, if any.						
E	M	[ ] Start diet: _____						
V	GCS	Facilitate pending labs en route to ICU.						
Pupils (mm, reactivity):		Start rosuvastatin 20 mg tab HS.						
R pupil:		Start lactulose 30 mL syrup HS.						
L pupil:		Turn to sides q2; perform/assist in doing active/passive range-of-motion exercise.						
1a	6a	Check CBG q4 pre-feeding for the next 72 hrs. Refer if CBG <140 or >180 mg%, or T > 37.5°C.						
1b	6b							
1c	7							
2	8							
3	9							
4	10							
5a	11							
5b	NIHSS							
		[ ] See back page for additional orders.						

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
1. patient's medical condition	1. medical order	1. results availability	1. condition or transportation
2. patient's or family's decision	2. provider's decision	2. delay in test results	2. home care availability
3. patient or family availability	3. provider's response	3. delay in procedure	3. others, pls. specify: _____
4. non-compliance to treatment	4. others, pls. specify: _____	4. cancellation of procedures	
5. no funds		5. delay in patient transfer	
6. others, pls. specify: _____		6. supplies or equipment needed	
		7. appointment or availability	
		8. weekend or holiday	
		9. others, pls. specify: _____	

Date (MM/DD/YR): _____/_____/_____ 13 Time: _____:_____ AM/PM (please encircle)

Clinical Notes	Physicians' Orders	Nurses' Action	Signature	Variance A	B	C	D
Informed Consent for intravenous (IV) rTPA: Dr _____ has explained to me/ my family member/ guardian why they believe a stroke is happening, and which of the available treatment methods would be most likely to improve the condition. The doctor/ staff has explained the risks and benefits of the drugs available to dissolve blood clots in the brain and possible alternative treatments. The doctor/ staff has recommended the use of rTPA, a clot dissolver, to dissolve the blood clot causing the stroke. The risks of IV rTPA include: death, further stroke, or permanent neurologic injury, paralysis, coma, etc.; worsening of stroke symptoms from brain swelling or bleeding; bleeding in other parts of the body; need for blood transfusions to replace clotting factors; allergic reaction to medications; and other unexpected complications. All my questions were answered; and I, the patient/family member/guardian, consent to the procedure. I was given enough time before giving my consent to treatment with rTPA. I expressly agree to my anonymized patient data being stored for quality improvement of stroke therapy, and to be forwarded to third-party vendors as part of these quality improvement purposes. _____ Patient/Family Member's/Guardian's Signature Over Printed Name							
Patient Weight: _____kg Total Dose = _____ mg/kg x Pt Wt = _____mg Loading Dose = 10% of Total Dose = _____ mg Infusion Dose = 90% of Total Dose = _____ mg *Refer to Neurologist for total dose, between 0.6-0.9 mg/kg. **No need to use extra diluent in addition to sterile water provided in package. Maintain 1 mg/mL dilution as per manufacturer's instructions.	Using gauge 18 cannula, insert 2nd/separate IV line. Push _____ mL rTPA over 1 minute. Drip _____ mL rTPA over 1 hour from rTPA bottle using infusion pump. No need to dilute. Monitor VS, GCS, Pupil Size, NIHSS items 1a, 1b, 1c, 2, 5a, 5b, 6a, 6b, 9 and 10 q15 for the next 2 hours, q30 for the next 8 hours, then q1 thereafter for the next 14 hours. Refer to Neurologist/ROD ASAP if with ↑BP/ ↓HR/ abnormal RR/ ↑T/ ↓GCS/ ↑NIHSS/ headache. If [ ] with orolingual angioedema, give diphenhydramine 50 mg IV and inform Neurologist/ROD also.						
	[ ] See back page for additional orders.						

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
1. patient's medical condition 2. patient's or family's decision 3. patient or family availability 4. non-compliance to treatment 5. no funds 6. others (specify): _____	1. medical order 2. provider's decision 3. provider's response 4. others, pls. specify: _____	1. results availability 2. delay in test results 3. delay in procedure 4. cancellation of procedures 5. delay in patient transfer 6. supplies or equipment needed 7. appointment or availability 8. weekend or holiday 9. others, pls. specify: _____	1. condition or transportation 2. home care availability 3. others, pls. specify: _____

Date (MM/DD/YR): _____/_____/_____ 18 Time: _____:_____ AM/PM (please encircle)

Clinical Notes		Physicians' Orders	Nurses' Action	Signature	Variance			
					A	B	C	D
End of rTPA infusion.		Admit to ICU.						
SBP	MAP	Continue close monitoring; update ROD of VS, pupil size, GCS breakdown and NIHSS at 2nd, 6th, 10th, 14th 18th and 24th hour after start of rTPA infusion, and as needed. Complete bed rest.						
DBP								
HR	T							
RR	SaO2							
		Inform ICU re: airway/O2 requirement, if any.						
E	M	[ ] Start diet: _____						
V	GCS	Facilitate pending labs en route to ICU.						
Pupils (mm, reactivity):		Start rosuvastatin 20 mg tab HS.						
R pupil:		Start lactulose 30 mL syrup HS.						
L pupil:		Turn to sides q2; perform/assist in doing active/passive range-of-motion exercise.						
1a	6a	Check CBG q4 pre-feeding for the next 72 hrs. Refer if CBG <140 or >180 mg%, or T > 37.5°C.						
1b	6b							
1c	7							
2	8							
3	9							
4	10							
5a	11							
5b	NIHSS							
		[ ] See back page for additional orders.						

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
1. patient's medical condition	1. medical order	1. results availability	1. condition or transportation
2. patient's or family's decision	2. provider's decision	2. delay in test results	2. home care availability
3. patient or family availability	3. provider's response	3. delay in procedure	3. others, pls. specify: _____
4. non-compliance to treatment	4. others, pls. specify: _____	4. cancellation of procedures	
5. no funds		5. delay in patient transfer	
6. others, pls. specify: _____		6. supplies or equipment needed	
		7. appointment or availability	
		8. weekend or holiday	
		9. others, pls. specify: _____	

Date (MM/DD/YR): _____/_____/_____ 13 Time: _____:_____ AM/PM (please encircle)

Clinical Notes		Physicians' Orders	Nurses' Action	Signature	Variance			
					A	B	C	D
SBP	MAP	At 24h post-rTPA, [ ] repeat plain cranial CT. ([ ] Defer above order if jumped from page 3.)						
DBP								
HR	T	If [ ] no bleed on CT, start:						
RR		[ ] aspirin 80 mg 2 tabs daily						
E	M	[ ] enoxaparin 0.4 mL SC once daily vs DVT.						
V	GCS	If not yet started, start:						
Pupils		[ ] diet:_____.						
R		[ ] rosuvastatin 20 mg tab HS						
L		[ ] lactulose 30 mL HS						
1a	6a	Check CBG q4 pre-feeding for the next 72 hrs.						
1b	6b	Refer if CBG <140 or >180 mg%, or T > 37.5°C.						
1c	7	Refer to PM&Rehab due to:						
2	8	[ ] mild stroke (NIHSS 0-5).						
3	9	[ ] moderate stroke (NIHSS 6-21).						
4	10	[ ] severe stroke (NIHSS > 21).						
5a	11	(END PATHWAY.)						
5b	NIHSS							
		[ ] See back page for additional orders						

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
1. patient's medical condition	1. medical order	1. results availability	1. condition or transportation
2. patient's or family's decision	2. provider's decision	2. delay in test results	2. home care availability
3. patient or family availability	3. provider's response	3. delay in procedure	3. others, pls. specify: _____
4. non-compliance to treatment	4. others, pls. specify: _____	4. cancellation of procedures	
5. no funds		5. delay in patient transfer	
6. others, pls. specify: _____		6. supplies or equipment needed	
		7. appointment or availability	
		8. weekend or holiday	
		9. others, pls. specify: _____	

Date (MM/DD/YR): _____/_____/_____ 17 Time: _____:_____ AM/PM (please encircle)

Clinical Notes	Physicians' Orders	Nurses' Action	Signature	Variance			
				A	B	C	D
[ ] ICH; est. vol.: _____ mL [ ] basal ganglia ([ ] > 30 mL) [ ] thalamus ([ ] > 30 mL) [ ] brainstem [ ] cerebellum ([ ] 10 mL) [ ] other, specify: _____ [ ] IVH [ ] hydrocephalus: _____ [ ] SAH (location): _____ [ ] hydrocephalus: _____ [ ] other, specify: _____ SBP _____ mmHg DBP _____ mmHg MAP _____ mmHg HR _____/min RR _____/min T _____.___°C CBG: _____ mg% GCS: E: _____ V: _____ M: _____ Total: _____ NIHSS: 1a: _____ 1b: _____ 1c: _____ 2: _____ 3: _____ 4: _____ 5a: _____ 5b: _____ 6a: _____ 6b: _____ 7: _____ 8: _____ 9: _____ 10: _____ 11: _____ Total: _____	Admit to MICU-Pay/ CCU/ MICU-Septic under_____ _____.						
	Secure consent.						
	Continue close monitoring; update ROD of VS, pupil size, GCS breakdown and NIHSS q-shift, or if with step-down, and as needed.						
	[ ] Start diet: _____						
	Facilitate pending labs en route to ICU. Aim for SBP < 160 mmHg. [ ] If with previous oral antihypertensives, resume _____						
	[ ] If without previous oral antihypertensives, start amlodipine 5 mg tab now then once daily						
	[ ] If with SAH: 1. schedule for CT angiography						
	2. start: a. nimodipine 30 mg 2 tabs q4						
	b. phenytoin 100 mg cap q8						
	Start lactulose 30 mL syrup HS; avoid straining.						
	[ ] Follow-up Neurosurgery referral for: [ ] ICH > 30 mL [ ] cerebellar bleed > 10 mL [ ] SAH/IVH [ ] other: _____						
	Elevate head 30°. Turn to sides and do passive range-of-motion exercises to all limbs q2.						
	Refer to PM&Rehab for: [ ] mild stroke (NIHSS 0-5). [ ] moderate stroke (NIHSS 6-21).						

	[ ] severe stroke (NIHSS > 21). (END PATHWAY)						

Variance Codes (fill up only if order was not carried out):

A. Patient or Family	B. Health Provider	C. MMMH&MC Systems	D. Outside MMMH&MC
7. patient's medical condition 8. patient's or family's decision 9. patient or family availability 10. non-compliance to treatment 11. no funds 12. others, pls. specify: _____	5. medical order 6. provider's decision 7. provider's response 8. others, pls. specify: _____	10. results availability 11. delay in test results 12. delay in procedure 13. cancellation of procedures 14. delay in patient transfer 15. supplies or equipment needed 16. appointment or availability 17. weekend or holiday 18. others, pls. specify: _____	4. condition or transportation 5. home care availability 6. others, pls. specify: _____

Appendix 2.1.: Demographics of Patients Admitted for Stroke from October 2017 to present

	AIS < 3 hrs	AIS > 3 hrs	ICH < 3 hrs	ICH > 3 hrs	SAH < 3 hrs	SAH > 3 hrs	SDH >3 hrs	t/c CVD, no imaging done or available, > 3 hrs
Mild	14	53	6	8	1	4	1	0
Moderate	10	27	1	16	0	2	0	2
Severe	0	2	2	5	2	1	0	0
In-hospital	3							

Appendix 2.2.: Risk Factor Profile of Patients Admitted for Mild Acute Ischemic Stroke:

Mild Acute Ischemic Stroke Patients	With Pathway n=3	Without Pathway n=67 (%)
Hypertension	3	41 (61)
Smoking	1	16 (23)
Diabetes	2	13 (19)
Alcohol intake	1	12 (17)
Prior Ischemic/Hemorrhagic/Unknown Type of Stroke		3/1/7
Heart Disease	1	4
Oral Contraceptive Use		2
Hypercholesterolemia		1
End-Stage Renal Disease on Hemodialysis		1
Acute Coronary Syndrome/Acute Myocardial Infarction		1
Rheumatic Heart Disease		1
Others: hepatic encephalopathy, myoma, intestinal obstruction		1 each

Appendix 2.3.: Risk Factor Profile of Patients Admitted for Moderate Acute Ischemic Stroke:

Moderate Acute Ischemic Stroke Patients	With Pathway n=13 (%)	Without Pathway n=27 (%)
Hypertension	11 (84)	19 (70)
Smoking	3 (23)	8 (29)
Alcohol intake	3 (23)	5 (18)
Diabetes	2	5 (18)
Prior Ischemic/Hemorrhagic/Unknown Type of Stroke	0/0/1	1/0/4
Dyslipidemia	1	
Acute Coronary Syndrome/Acute Myocardial Infarction	1	3
Ictal Seizure		2
Chronic Obstructive Pulmonary Disease	1	
Heart Disease		1
Alzheimer Disease		1
ESRD		2

Appendix 2.4.: Risk Factor Profile of Patients Admitted for Severe Ischemic Stroke:

Severe Acute Ischemic Stroke Patients	With Pathway n=1	Without Pathway n=1
Hypertension	1	
Smoking	1	
Alcohol intake	1	
Atrial Fibrillation	1	
Prior Ischemic Stroke	1	
Novel Oral Anti-Coagulant Use	1	
Gastrointestinal/Genitourinary Tract Bleeding	1	

Appendix 2.5.: Risk Factor Profile of Patients Admitted for Mild Acute Hemorrhagic Stroke:

Mild Acute Hemorrhagic Stroke Patients	With Pathway n=7	Without Pathway n=7
Hypertension	6	4
Smoking	1	1
Diabetes		2
Alcohol intake	2	3
Prior Ischemic/Hemorrhagic/Unknown Type of Stroke		0/0/1
Ictal Seizure	1	

Appendix 2.6.: Risk Factor Profile of Patients Admitted for Moderate Acute Hemorrhagic Stroke:

Moderate Acute Hemorrhagic Stroke Patients	With Pathway n=9 (%)	Without Pathway n=8 (%)
Hypertension	7	7
Smoking	3	1
Alcohol intake	3	
Prior Ischemic/Hemorrhagic/Unknown Type of Stroke		1/0/0
Acute Coronary Syndrome/Acute Myocardial Infarction	1	
Chronic Obstructive Pulmonary Disease		1

Appendix 2.7.: Risk Factor Profile of Patients Admitted for Severe Acute Hemorrhagic Stroke:

Severe Acute Hemorrhagic Stroke Patients	With Pathway n=2	Without Pathway n=5
Hypertension	1	2
Smoking		1
Alcohol intake		1
Heart Disease		1
Post-Stroke Epilepsy		1

Appendix 2.8.: Risk Factor Profile of Patients Admitted for Acute Subarachnoid Hemorrhage:a

Acute Subarachnoid Patients	Without Pathway n=10
Hypertension	7
Smoking	4
Diabetes	1
Alcohol intake	4
Prior Ischemic/Hemorrhagic/Unknown Type of Stroke	1

Appendix 2.9.: Mortality Rate, Length of Stay, and Hospital Share Among Mild Acute Ischemic Stroke Patients

Mild Acute Ischemic Stroke Patients	With Pathway n=5	Without Pathway n=65	T-value (* if significant)
Mortalities	0	3 (4.6)	
Length of Stay (days)	3.60	4.79	
Hospital Share (PHP)	-3,628.40	-4,083.28	

Appendix 2.10.: Mortality Rate, Length of Stay, and Hospital Share Among Moderate Acute Ischemic Stroke Patients

Moderate Acute Ischemic Stroke Patients	With Pathway n=10 (%)	Without Pathway n=17 (%)	T-value (* if significant)
Mortalities	1 (10)	4 (23)	
Length of Stay (days)	5.40	6.76	
Hospital Share (PHP)	313.85	-144.65	

Appendix 2.11.: Mortality Rate, Length of Stay, and Hospital Share Among Severe Acute Ischemic Stroke Patients

Severe Acute Ischemic Stroke Patients	With Pathway n=1	Without Pathway n=1	T-value (* if significant)
Mortalities	0	1	
Length of Stay (days)	12	19	
Hospital Share (PHP)	8,748.41	60,667.78	

Appendix 2.12.: Mortality Rate, Length of Stay, and Hospital Share Among Mild Acute Hemorrhagic Stroke Patients

Mild Acute Hemorrhagic Stroke Patients	With Pathway n=7 (%)	Without Pathway n=7 (%)	T-value (* if significant)
Mortalities	0	0	
Length of Stay (days)	4.28	7.71	
Hospital Share (PHP)	-14,329.20	-3,975.27	

Appendix 2.13.: Mortality Rate, Length of Stay, and Hospital Share Among Moderate Acute Hemorrhagic Stroke Patients

Moderate Acute Hemorrhagic Stroke Patients	With Pathway n=9 (%)	Without Pathway n=8 (%)	T-value (* if significant)
Mortalities	1	0	
Length of Stay (days)	8.33	9.87	
Hospital Share (PHP)	10,203.62	7,208.07	

Appendix 2.14.: Mortality Rate, Length of Stay, and Hospital Share Among Severe Acute Hemorrhagic Stroke Patients

Severe Acute Hemorrhagic Stroke Patients	With Pathway n=2	Without Pathway n=5	T-value (* if significant)
Mortalities	2	5	
Length of Stay (days)	1.5	3.6	
Hospital Share (PHP)	-11,214.55	21,219.96	

Appendix 2.15.: Outcomes of Patients Admitted for Subarachnoid Hemorrhage

	Mild	Moderate	Severe
Mortalities (n)	1	0	3
Average Length of Stay (days)	4.4	9.5	1.33
Average Hospital Share (PHP)	6,857.20	25,881.16	-P1,489.04

Appendix 2.16.: Nosocomial Infection Rates Among Ischemic Stroke Patients

4Q2017-1Q2018	
Nosocomial Pneumonia	
With Pathway (n=13)	Without Pathway (n=96)
23.1% (n=3)	11.4% (n=11)
Catheter-Associated Urinary Tract Infection	
With Pathway (n=13)	Without Pathway (n=96)
15.3% (n=2)	10.4% (n=10)

Appendix 2.17.: Nosocomial Infection Rates Among Hemorrhagic Stroke Patients

4Q2017-1Q2018, Hemorrhagic Stroke	
Nosocomial Pneumonia	
With Pathway (n=22)	Without Pathway (n=32)
27.3% (n=6)	21.9% (n=7)
Catheter-Associated Urinary Tract Infection	
With Pathway (n=22)	Without Pathway (n=32)
9.09% (n=2)	6.25% (n=2)