IMPROVING COORDINATION AND TRANSITIONS OF CARE FOR STROKE PATIENTS WITH AN ATTENDING NURSE: a comparative effectiveness single center study comparing models of nursing care.

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List of Abbreviations

AE: Adverse event
AHA: American Heart Association
AMA: Against Medical Advice
ASA: American Stroke Association
BSN: Bachelors in Science of Nursing
ICH: Intracerebral Hemorrhage or Hemorrhagic stroke
IRB: Internal Review Board
IS: Ischemic Stroke
DMC: Data Monitoring Committee
MMAS-4: Four question Morizky Scale
MMACE: Major cardiovascular and cerebrovascular events
NIHSS: National Institutes of Health Stroke Scale
PHI: Personal Health Information
RN: Registered Nurse
SPER: Stroke Patient Education Retention
TIA: Transient Ischemic Attack

Study Summary

Title	**IMPROVING COORDINATION AND TRANSITIONS OF CARE FOR STROKE PATIENTS WITH AN ATTENDING NURSE**
Short Title	Attending Nurse Model
IRB Number	.
Protocol Number	
Phase	Phase III
Methodology	Comparative Effectiveness
Study Duration	7 months
Study Center(s)	Single-center
Objectives	Our central hypothesis is that the attending nurse will enhance critical patient-centered elements of care that will in turn improve patient education and shared decision-making, medication adherence, stroke-related health literacy, and reduce early readmissions to ultimately yield improved patient quality of life. Our primary objective is to determine whether the attending nurse model of care improves stroke patients' health at 7 days, 30 days, and 90 days after hospital discharge as assessed through questionnaires.
Number of Patients	372 patients

Main Inclusion and Exclusion Criteria	We will include all adult patients admitted to the Vascular Neurology Service with a clinical diagnosis of stroke, brain hemorrhage, or transient ischemic attack. We will exclude patients whose level of care is limited to comfort care or hospice, those with severe dementia prior to admission, and those who are both non-communicative and have no family or other social support.
Investigational Product	None This is a comparative effectiveness study comparing two models of nursing care delivery to stroke patients (attending nurse model vs. conventional inpatient nursing care)
Duration of administration (if applicable)	The duration of the intervention phase will depend on the duration of a patient's hospital admission.
Reference therapy	The reference therapy is standard inpatient nursing care.
Statistical Methodology	Our primary outcome will be scores on scales of medication adherence and stroke education retention. The scores on these tests will be compared between patients who were assigned to the attending nurse model of care versus standard nursing care. Secondary outcomes will include comparisons between groups of the thirty day readmission rate, scores on a patient-centered stroke impact scale, 2 modified quality of life scales, results of a newly designed series of 13 Likert style questions, and a global statistic that includes the results of all scales.
Safety Evaluations	All enrolled patients will be evaluated via telephone interview at 7, 30, and 90 days following hospital discharge and screened for major cardiovascular and cerebrovascular events. While in the hospital, subject safety will be assured via already existent quality assurance mechanisms.
Data and Safety Monitoring Plan	The PIs will be responsible for monitoring the data quality and the ongoing safety of patients.

1 BACKGROUND AND STUDY RATIONALE

This document is a clinical research protocol and the described study will be conducted in compliance with the protocol, Good Clinical Practice standards, associated federal regulations, and all applicable University of Pennsylvania Research Policies and Procedures and all applicable Federal and state laws and regulations.

Introduction

Stroke is a leading cause of morbidity and mortality in the United States. Hospital units dedicated to stroke care have been shown to improve patient outcomes compared to other units,[1] but the optimal models of care delivery within stroke units have not been well studied, particularly in a patient-centered context. We propose to study the role of an attending nurse in the inpatient stroke unit compared to standard nursing care. The attending nurse will serve as a continuous source of support for stroke patients and families, communicate the plan of care, and provide education.

1.1 Background and Relevant Literature

Every year, approximately 610,000 people experience a first stroke and another 185,000 have a recurrent stroke in the United States.[2] Further, among 307,887 ischemic stroke patients in a Medicare database, 14% were readmitted to hospitals within 30 days of discharge.[3] Stroke patients are thus a high risk population worthy of increased treatment interventions to prevent early complications. Patients with recurrent stroke have poorer outcomes and higher healthcare costs than those with first stroke.[4] Despite the substantial burden of recurrent stroke, many patients with prior strokes are ill informed about stroke risk factors and have suboptimal personal health behaviors.[5,6] Existing care delivery models thus may not optimally aligned with stroke patients' needs and goals.

Poor adherence to prescribed medications following hospital discharge likely plays an important role in stroke recurrence, disability, other complications, and death.[7] In the largest observational study of medication compliance following stroke, the Adherence eValuation After Ischemic stroke–Longitudinal (AVAIL) registry, independent predictors of 1-year medication persistence included fewer medications prescribed at discharge, having an adequate income, having an appointment with a provider, and a greater understanding of why medications were prescribed and possible side effects.[8] Earlier studies have also noted that inadequate care transitions and poor patient–provider communications contribute to medication non-adherence.[9] Unfortunately, no educational or organizational interventions have clearly been shown to effectively improve adherence to secondary stroke prevention strategies.[10]

Attending Nurse

The attending nurse model of in-hospital care delivery may work to improve patient understanding, shared decision-making, medication adherence, and reduce early readmissions after discharge to ultimately yield improved patient quality of life. The care delivered and directed by the attending nurse will be guided by the principles of relationship based nursing developed by Koloroutis in which commitment to care and service to patients hinges upon a therapeutic relationship.[11] On the inpatient stroke unit, the attending nurse will take ownership of essential aspects of an individual stroke patient's care, education, and transition out of the hospital. By serving as the patient care coordinator, advocate, and educator, the attending nurse will be able to create a deep and meaningful therapeutic relationship with patients. To further contribute to the patient's plan of care, the attending nurse will be present on daily teaching rounds.

Allowing nurses to function as attending nurses is in keeping with the dictates of the Institute of Medicine recommendation to have nurses practice to the full extent of their education and training as well as treating nurses as full partners in redesigning health care.[12] Though an attending nurse has been studied in outpatient settings,[12] this model of care has not been used extensively for inpatient care.[13] Quantitative data for the effect of an attending nurse on inpatient care are lacking, but qualitative data suggest that

attending nurses ameliorated shared decision making with patients, resulting in a more proactive, confident and informed relationship between patients and providers.[13,14] Feedback from nursing staff and administrators after an attending nurse model was launched at other institutions revealed no negative consequences.[13,14] To our knowledge, the attending nurse model has not been studied in any disease-specific inpatient population. Stroke is potentially an ideal disorder for this model of care because of its medical complexity, individual patient burden, and high early risk of recurrence, yet is amenable to aggressive preventative and rehabilitative measures.

1.2 Name and Description of the Investigational Product

There is no investigational product. We are investigating which model of nursing care is most effective: the attending nurse model, as detailed above, or the standard care model. The tasks performed by the attending nurse for each patient will be documented during the patients' hospitalization to assure individual patient goals are being met. Patients who receive care from the attending nurse will be compared to those who are cared for by staff nurses alone.

1.2.1 *Clinical Data to Date:*

For 3-4 months, the attending nurse model has been in use on the vascular Neurology inpatient service for some patients. No patient has ever refused care from the attending nurse and we have noticed no in-house complications from attending nurse care as evaluated by standard quality metrics. Additionally, we have piloted our survey instruments. The instruments take a median of 15 minutes to administer.

Stroke readmissions at our institution over the past 2 years were estimated from the GWTG registry at our center. Our readmission rates (~10%) are lower than the national average (~15%) for stroke patients.

2 Study Objectives

2.1 Primary Objective

- To determine whether patients report better understanding of stroke facts and medication adherence when cared for by an attending nurse compared to routine nursing care.

2.2 Secondary Objectives (if applicable)

- To determine whether a nurse attending model of care improves overall outcome following stroke or TIA
- To determine whether newly devised questions focused on the inpatient experience as well as patient satisfaction can detect valid differences between treatment groups.
- To assess whether an attending nurse improves patient perception of deficits and quality of life compared to routine nursing care.
- To assess whether an attending nurse reduces patient readmission rates compared to standard nursing care.

3 Investigational Plan

3.1 General Design

We propose a phase III comparative effectiveness study to evaluate the added value of an attending nurse to the inpatient care of stroke patients compared to routine care. Both types of care are currently available on the inpatient Vascular Neurology service at the Hospital of the University of Pennsylvania as well as at other institutions. Currently, the nurse attending works randomly with patient she selects based on her availability.

In the standard model of inpatient nursing care, stroke education is provided largely in the form of pamphlets distributed to patients and their families. Patients are cared for by a team of physicians and staff nurses with access to social workers and case managers, however, staff nurses do not routinely round on their patients with other members of the care team.

Screening of patients for this trial will occur once the clinical decision to admit a patient to the Vascular Neurology service has been made. All patients who meet inclusion criteria will be assigned to a study arm, addition of an attending nurse versus routine nursing care, according to the day of the week they are admitted to the hospital. Patients who are admitted on even numbered week days will have their care supplemented by the attending nurse. This is effectively a stratified random assignment, as there are no clinical or systematic features that otherwise are associated with odd or even numbered days. The duration of the intervention will depend on the duration of a patient's hospital admission.

To compare the two models of nursing care, we will survey all patients directly about the care they receive in the hospital once they are discharged. Surveys tools designed to ascertain medication adherence, disease specific knowledge, as well as satisfaction with care and hospital readmissions will be assessed at 7, 30, and 90 days via follow-up structured telephone interviews. We will consider the 7 day follow-up phone call the baseline assessment. The Morizky scale (MMAS-4),[15] a well validated tool that has been studied in stroke victims,[16] will be used to determine medication adherence. The Stroke Patient Education Retention (SPER)[17] tool will be used to assess patient knowledge. The Stroke Impact Scale (SIS)[18] will be used to evaluate self-perception of stroke deficits by patients. Thirteen other survey questions designed specifically for this study will also be posed to patients at 7, 30 and 90 days from follow up along with two overall quality of life questions at 7 and 90 days. As a secondary outcome, we will calculate and then use a global statistic as a general marker for success to compare the effectiveness of each nursing care model in improving patients' overall outcomes.[19] All interviews will be performed by a trained research assistant who will not be involved in the inpatient care of patients and will be blinded to study allocation. Subject participation will conclude after 90 days.

We will request a waiver of consent for initial enrollment in this study. Follow-up calls to patients will explicitly state according to an IRB-approved script that the questions are part of a research study. Patients will also be asked if they consent to collection of data from their medical record as part of the study. Patients will have the option to participate or decline. If they choose to participate in the interview survey and allow collection of data from their recent hospitalization, then the study will proceed with their verbal consent.

If they decline to participate in the interview survey, then no further study specific tools will be used, but they will be asked if they consent to chart abstraction. However, patients cannot participate in interviews without agreeing to data collection. Patients can decline to participate in both the interviews and allow for data collection. If they fully decline to participate in the study, their data will be expunged and no further data collected.

3.1.1 Screening Phase

Patients will be screened upon admission to the Vascular Neurology non-intensive care unit service. As part of standard intake procedures, a physician on the admitting team will determine patient study eligibility. There will be no extra evaluations or laboratory tests needed at the screening visit.

As this is a comparison of two effective nursing models, both of which are available and employed in clinical practice, the study is of minimal risk to patients. All patients will receive a standard treatment currently in use at our facility. Patients may be unaware of our ongoing comparative effectiveness trial while they are hospitalized. However, informed consent will be obtained at the time of follow up phone calls.

3.1.2 *Study Intervention Phase*

All of the standard medical care will be identical in both arms of the study. Health literacy will be assessed in all patients upon admission to assure educational interventions are directed accordingly. Patients who

are assigned to standard nursing care will receive standard care which includes educational interventions from staff nurses in keeping with current Joint commission and AHA/ASA guidelines Patients assigned to routine care will not interact with the attending nurse. Patients who are assigned to the intervention will receive additional patient-centered supplementary care and education from the attending nurse.

3.1.2 *Follow Up Phase*

Patients will be followed for a total of 90 days following discharge from the hospital. Patients will be contacted at 7, 30, and 90 days following discharge via telephone call. When patients are unable to communicate their own views due to aphasia or other disability, caregivers will be asked to answer the applicable survey questions.

3.1.3 Allocation to Interventional Group

Stroke patients who are admitted on even-numbered weekdays and enrolled in this trial will be assigned to care with an attending nurse; patients admitted on odd-numbered weekdays will get usual routine care. The attending nurse will query the electronic medical record as well as communicate with the physician team so that all incoming admissions on even-numbered days to the Vascular Neurology service are known to the attending nurse.

3.2 Study Endpoints

3.2.1 Primary Study Endpoints

- Primary endpoints will be stroke education retention as measured by the SPER and medication adherence as measured by MMAS-4 as these are the areas where we anticipate the largest potential effect of the nurse attending. The mean scores on these two tests will be compared between groups at each time interval that they are administered.

3.2.2 Secondary Study Endpoints

- We will compare the results of the newly designed survey questionnaire to capture patient impression of their in-hospital care, transition home, and quality of life.
- The results of the SIS will be captured at 30 days and compared between groups.
- The proportion of patients with readmissions within 30 days will be compared between groups at 30 days.
- A global statistic that incorporates all survey measures to determine whether the attending nurse model of care is consistently and persuasively more effective than routine nursing care will be compared between groups.

3.2.3 Primary Safety Endpoints [if applicable]

As this is a comparative effectiveness study of two models of nursing care that are currently both in use so there are no safety endpoints. Safety data will be collected during patients in hospital stay in keeping with current quality control process.

4 Study Population and Duration of Participation

4.1 Inclusion Criteria

- > 18 years of age
- Admission to the Hospital of the University of Pennsylvania Vascular Neurology service
- Incident or recurrent:
    - Ischemic stroke: focal neurological deficit of likely ischemic vascular origin
    - Intracerebral hemorrhage: blood seen on initial head CT

- Transient Ischemic attack: focal neurological deficit of likely ischemic vascular origin that has clinically resolved

4.2 Exclusion Criteria

- Pregnancy
- Comfort or hospice care
- Severe dementia prior to stroke
- Non-communicative and have no family/social support

4.3 Subject Recruitment

Patients will not be formally recruited for this study, but instead enrolled upon admission to the Vascular Neurology inpatient service.

4.4 Duration of Study Participation

For each subject, the study intervention phase will vary as this phase will depend on the duration of each individual inpatient admission. The follow up time period will extend to 90 days after discharge for all patients.

4.5 Total Number of Patients and Sites

The Hospital of the University of Pennsylvania will be our only enrollment site. We plan to enroll 180 patients in each arm of the trial. At this site, there are approximately 700-800 stroke patients admitted per year, so we anticipate recruitment will require approximately 7 months.

4.6 Vulnerable Populations:

Children, pregnant women, fetuses, neonates, or prisoners are not included in this research study.

5 Study Intervention (Study drug, device, biologic, vaccine, food etc.)

There is no investigational product for this trial as it is a comparative effectiveness study designed to determine whether an attending nurse or standard nursing care improves outcomes for stoke patients. .

5.1 Description

The Attending Nurse will meet patients and their families within the first 24 hours of their admission to begin the integrated care process and follow them until discharge. If assigned to the attending nurse model, patients will be followed by her if they are transferred to another service or unit rather than drop out of the study. The attending nurse will record the tasks she completes with each patient and the time each task required. This record will then become a part of the patient's medical record.

The Attending Nurse will have, in addition to a BSN and RN, at least 5 years of experience managing stroke and other neuroscience patients at the Hospital of the University of Pennsylvania. Additionally, she will also have training specific to the role of attending nurse through mentorship by nurses who currently work in this role at our institutions and at other institutions.

5.2 Intervention Regimen

The attending nurse will spend 30 minutes to 45 minutes upon initial evaluation to determine the patients' goals, barriers, and needs. The amount of time spent with each subject following the initial visit will vary based on the patient. To limit the demands on the attending nurse, she will never carry a case load of more than 8 patients at a single time. If on an even-numbered weekday the attending nurse has 8 patients, than the subject will be assigned to the routine care arm of the trial. Patients who are assigned to the attending nurse model of care will be seen by that nurse on a daily (weekday) basis in addition to being cared for by their regular care team of physicians and rotating staff nurses. All staff nurses as well

as the attending nurse will participate in morning interdisciplinary table rounds in keeping with preexistent quality processes.

5.3 Blinding

The 7, 30, and 90 phone surveys will be blinded to patients' group assignment. Staff nurses will not be blinded as to which patient the attending nurse is caring for. The PIs will not be blinded to subject treatment assignment as they will need to assure subject assignment is preformed correctly. Patients will not be formally blinded to their arm assignment, though patients may not realize that alternative models of care exist on the Vascular Neurology service. Waiving consent upon admission will help maintain patients' blinding. During the first follow up phone call, as part of the consenting process, we will specify that we are comparing different nursing styles of care. The interviewer preforming follow up phone calls and collecting data from the patient electronic medical record will be blinded to study group assignment.

5.4 Administration and Accountability

The survey questionnaires will be administered by trained staff that will be blinded to group assignment. Responses will be inputted by a study coordinator into a secure electronic database. All data will be monitored periodically to assure accuracy.

Patients will be assigned case numbers at the time of enrollment. The key explaining the linkage between patients' PHI and case number will be kept in another password protected computer so that each patients' PHI is well protected. Surveys responders will be identified via a case assignment number. Subject responses will be recorded on a standard form that will be kept on a password protected computer during the study period. Any clinical data that is abstract from the electronic medical record for each patient will also be recorded in a standard form which identifies patients only by their case numbers.

5.5 Subject Compliance Monitoring

Patients will be called at 7, 30, and 90 days following discharge to evaluate their response to the questionnaires. Incomplete response at 7 days will not preclude a phone call directed to patients at 30 and 90 days. Patients who are not reachable via phone interview will not undergo an analysis of their clinical data due to lack of consent.

5.5.1 Return or Destruction of Investigational Product

Completion of data collection will occur when all patients enrolled in the study have completed the study and are greater than 90 days from discharge. All response data as well as clinical data will be destroyed after data analysis. Study completion will be defined as completion of the analysis.

6 Study Procedures

At follow up phone calls, interviews will be conducted with results of questionnaires recorded after consent is obtained. Consent for abstraction of clinical data collected during routine care from the electronic medical record will also be obtained.

TABLE 1: SCHEDULE OF STUDY PROCEDURES

Study Phase	Screening	Intervention	Follow-up

Visit Number		**1**			
Study Days	**0**	**Variable (depends on patient length of stay)**	**7 from discharge (+/- 3 days)**	**30 from discharge (+/- 7 days)**	**90 from discharge (+/- 14 days)**
Informed Consent/Assent			X		
Review Inclusion/Exclusion Criteria	X				
Demographics/Medical History		X			
Physical Examination		X			
Pregnancy Test	X				
Prior/Concomitant Medications		X			
Treatment allocation		X			
Health Literacy Screen		X	X		
Morisky medication adherence			X	X	X
Stroke Patient Education Retention (SPER)			X		X
13 Likert style questionnaire			X		X
2 Modified Euroqol global quality of health questions			X		X
Stroke Impact Scale				X	
Readmission question			X	X	X
Unanticipated Problems Assessment			X	X	X
Nurse attending document		X			

6.1 Screening

Patients will be screened for trial enrollment upon arrival to the floor. All of the below are obtained at admission for all patients as part of standard of care procedures.

- Physical Exam including mental status evaluation (standard of care)
- Diagnosis (standard of care)
- Baseline functional status (standard of care)

6.2 Study Intervention Phase

If patients satisfy inclusion criteria and lack exclusion criteria they will be assigned to the intervention arm or the control arm depending on their admission date. The intervention phase will be the duration of the patient's hospital stay.

No research related procedures that differ from standard of care will be conducted as this is a comparative effectiveness trial.

6.3 Follow Up Phase of the Study

Follow-up visits will be conducted by telephone only. Informed consent for phone interviews will be obtained prior to the interview. Consent will also be obtained for data collection from the patients Hospital of the University of Pennsylvania electronic medical record. Whether the patient, a family member, or other person is answering the pertinent survey questions will be recorded. Patients may become fatigued when answering the survey questions in which case they can simply ask to stop and the phone conversation will end.

6.3.1 7 days following discharge

At 7 days after hospital discharge, the MMAS-4, SPER, the exploratory 13 Likert-style questions and two modified overall health questions will be administered. There are no well validated surveys regarding the inpatient experience that are patient centered and stroke specific so we designed 13 questions which focus on subject's perception of their inpatient stay as well questions designed to assess quality of life following stroke. The newly devised Likert-style questions as well as the 2 modified overall quality of health questions have been reviewed by a stroke-survivor in her role as patient advocate who was cared for at our institution. The single health literacy question will also be repeated at the 7 day follow up visit and interviewees will be asked about readmission. Though ideally patients will answer all survey questions themselves, responses to survey questions will be accepted from a legal representative provided they can answer accurately. Each interviewee will be identified based on their relationship to the patient on survey collection forms.

6.3.2 30 days following discharge

At 30 days following hospital discharge, the SIS and the MMAS-4 will be administered. Inquiry as to whether or not the patient has been readmitted will occur.

6.3.3 90 days following discharge

At 90 days following hospital discharge, the MMAS-4, SPER, the exploratory 13 Likert-style questions and the 2 modified global quality of health questions will be administered again. Patients will also be asked about any readmissions.

6.4 Unscheduled Visits

Clinic visits and other unscheduled visits will not replace phone interviews and will be entirely separate from this study.

6.5 Subject Withdrawal

Patients may withdraw from the study at any time without impact to their care. Patients may also be discontinued from the study at the discretion of the PIs for lack of adherence to intervention or study procedures or difficulty obtaining follow up or unexpected events. The PI may also withdraw patients who violate the study plan, or to protect the subject for reasons of safety or for administrative reasons. It will be documented whether or not each subject completes the study.

6.5.1 Data Collection and Follow-up for Withdrawn Patients

If patients decide to stop participating in inpatient care when recommended by the treating team, documentation for patient decisions against medical advice (AMA), this will be documented in keeping with standard practice. Follow up phone calls will still be sought on patients who leave AMA. Patients who are lost to follow up or decline to participate in follow up phone calls and do not consent to data abstraction from the inpatient record will not have any further data collected.

Patients who request to be removed from the study will have all available data expunged.

6.6 Early Termination Visits

We will not perform early termination visits or early phone calls.

7 Statistical Plan

7.1 Primary Endpoint

The primary endpoint for this study will be a comparison of the mean scores on the SPER and the rate of adherence on the MMAS-4 (score < 2) and the SPER between groups at 7 and again at 90 days.

Scores on the MMAS-4 and SPER will be calculated per protocol. On the MMAS-4, affirmative answers will receive a point and negative answers will be assigned zero. The total score will be the sum of the answer to all four questions. The SPER, question 1 and 2 are scored as follows: 0 = no correct content in response to the question, 1= the patient provided some but not all of the correct content in response to the question, and 2 = patient provided all key content in response to the question. Question 3-5 were scored as follows as 0 = no correct content in response to the question and 2 = the patient provided the correct response to the questions. A score of 10 indicates all correct responses to the key content.

The SIS is a patient-based, self-report scale in which each item is rated in a 5- point Likert scale in terms of the difficulty the patient has experienced in completing each item. A score of 1 = an inability to complete the item and a score of 5 = no difficulty experienced at all. Using an algorithm, summative scores are generated for each domain.

7.2 Secondary Endpoints

The secondary endpoints for this study are the SIS at 30 days, newly devised patient centered outcome survey scales at 7 and 90 days, as well as hospital readmission at 30 days in each group.

The SIS is a patient-based, self-report scale in which each item is rated in a 5- point Likert scale in terms of the difficulty the patient has experienced in completing each item. A score of 1 = an inability to complete the item and a score of 5 = no difficulty experienced at all. Using an algorithm, summative scores are generated for each domain. The SIS is scored in the following way, for each domain: Transformed Scale = [(Actual raw score - lowest possible raw score) / Possible raw score range] x 100.

The newly devised 13 Likert-questions are all scaled 1 to 5 with 1=strongly disagree and 5 = strongly agree. We have also included two modified global quality of health questions based on the EuroQol instrument where scales range from 1 to 100 and are described in the stem of the question.[20] Scores on each set of questions will be added together to compute a total score that can be compared between groups. The overall quality of health questions have scales ranging from 1 to 100 and are described in the stem of the question. Scores on these two questions will be compared between the two groups. These newly devised survey tools were reviewed by a stroke patient representative to assure relevance.

We will likely be underpowered to detect differences in readmission rates between the two groups, given the aforementioned currently low rates of readmission here. However, given the high clinical relevance of readmission we will evaluate this as a secondary outcome in our study.

7.3 Sample Size and Power Determination

For this pilot project, we anticipate that 65% of patients in the control arm will be adherent to medications (MMAS-4 < 2) based on literature reporting 60%[16] adherence as evaluated using these scales in stroke patients and 70%[21] adherence in patients with hypertension. To achieve success on the primary endpoint, we estimate that patients must improve to by 15% in order to make this intervention worthy of future investigation in a larger study. Assuming an alpha of 0.05 and a power of 80%, with a 1:1 assignment to each arm, we will require 186 patients in each arm for a total of 372 patients. With that number of patients

we will be able to powered to detect a very small difference of 0.3 (delta = .15 (SD=2)) in the mean scores of the SPER based on the published data.[17] Each outcome will be evaluated independently so that we will not need to make any power readjustments. Readmission rates at 30 days are typically low[4] and likely lower at our institution based on prior data so we will be underpowered for this outcome. Clinically differences on the SIS will depend on the initial stroke severity of patients within each group and therefore the study cannot be powered for this secondary endpoint.

7.4 Statistical Methods

In our primary analysis, we will first compare baseline demographics between groups. For our results section, we will compare all patients in the control group to all patients in the intervention arm for outcomes. Mean scores on the SPER will be compared between groups using student t-tests. We will compare proportions of adherent patients on the MMSA-4 between groups using the Pearson chi-square test. Total scores on the SIS, quality of life questions, and the 13 newly devised questions will be compared between groups using t-tests.

7.4.1 Baseline Data

Baseline and demographic characteristics will be summarized by standard descriptive statistics (including mean and standard deviation for continuous variables such as age and standard percentages for categorical variables such as gender). Stroke severity and PMH will also be collected and compared between the groups.

7.4.2 Efficacy Analysis

Our efficacy endpoint is the same as our primary endpoints as this is a comparative effectiveness study.

7.4.3 Safety Analysis

Given that we are comparing two models of nursing care, safety of subjects will be tracked via the general quality controls already in place for inpatient safety. There are no unique safety outcomes for this trial.

7.5 Subject Population(s) for Analysis

The entire subject population who undergo treatment assignment will be studied primarily via intention to treat analysis comparing data from follow up phone calls between groups. An as-treated analysis will also be performed.

Analysis will be performed on some pre-defined subgroups where we may expect to see effect modification: major stroke vs. minor strokes (NIHSS ≤ 5), multiple medications vs. few medications, patients who were admitted following a recurrent stroke vs. a new stroke, and hemorrhagic stroke vs. ischemic stroke subtypes.

8 Safety and Adverse Events

This protocol is extremely low risk as it assigns patients to already existent forms of inpatient care. This study does not include any experimental treatment. Given there is no proposed intervention or proposed management beyond two existing forms of standard clinical care, the routine collection of adverse events is not relevant, as those will be part of routine care. However, there may be a difference between the two arms in terms of specific events of interest. These specific events of interest include falls, aspiration pneumonia, and subsequent (post-discharge) major cardiovascular and cerebrovascular events (MACCE) including stroke (ischemic, hemorrhagic, or unknown), myocardial infarction, and death of any cause. Transfers to a higher level of care (e.g. to the Neuro ICU or medical ICU from the floor) that occur as part of routine care will also be considered events of interest. We will also report any unanticipated events.

All of the aforementioned events of particular interest will be assessed while the subject is in the hospital in keeping with standard clinical care. During follow up phone calls, the interviewee will ask patients and/or their family members specifically about the occurrence of MACCEs including and death of any cause.

The safety of each mode of nursing care while the subject is in-house will be tracked using the quality control processes that are already in place as part of standard inpatient care.

9 Study Administration, Data Handling and Record Keeping

9.1 Confidentiality

Information about study patients will be kept confidential and managed according to the requirements of the Health Insurance Portability and Accountability Act of 1996 (HIPAA).

9.2 Data Collection and Management

Data will be abstracted regarding demographics, medical/surgical history, stroke location, and dates of hospital stay. The results of follow-up phone calls will be recorded by the interviewer and directly inputted into the RedCap database. The database will be kept in RedCap prior to data cleaning. Hard copies of survey results will be kept in locked file cabinets.

Data will be managed and stored using REDCap, the software toolset and workflow methodology for electronic collection and management of research data, developed specifically around HIPAA-Security guidelines. REDCap (Research Electronic Data Capture) is a secure, web-based application that is flexible enough to be used for a variety of types of research. REDCap provides an intuitive user interface that streamlines project development and improves data entry through real-time validation rules (with automated data type and range checks). REDCap also provides easy data manipulation (with audit trails for reporting, monitoring and querying patient records) and an automated export mechanism to common statistical packages (SPSS, SAS, Stata, R/S-Plus). In addition to traditional data capture functionality, REDCap's survey capabilities are a powerful tool for building and managing online surveys. The research team can create and design surveys in a web browser and engage potential respondents using a variety of notification methods. All data collection projects rely on a thorough, study-specific data dictionary, defined by all members of the research team in an iterative, self-documenting process. This iterative development and testing process results in a well-planned and individualized data collection strategy.

The REDCap MySQL database is replicated in real time to a completely redundant instance of MySQL. The redundant instance is available for restoration of the primary database or for manual failover in the case of primary database failure. Time-stamped backup files are made from the replicated database daily by HUP Research Information Systems using automated backup routines.

Data and backups are stored in the HUP Research Information Systems Storage Area Network (SAN). Access to the SAN directories where data are stored will be limited to Research Information Systems personnel, with authentication performed using HUP's enterprise Active Directory service. De-identified data will be analyzed using STATA or SPSS.

The data that is collected will have a unique code assigned by the investigator when it is acquired to code each subject at the time of data harvesting to ensure duplicate data is not collected and PHI is protected. This unique case number will not be possible to link to any other information pertaining to each subject. By doing this, the patients' privacy will be protected. Patients' names and medical record numbers will be coded and kept separately from the database in a password protected file. The PI will ensure that data is coded correctly so that PHI is protected.

All data will be maintained on a password protected computerized database on a computer that will have a protected login. No data in the database will contain PHI as each subject will have been assigned a unique code at the time of data acquisition. The coded identifiers list will be stored in a password protected file separate from the main database in a computer that requires a unique university ID to access.

Only the PIs and the clinical research team will have access to the database. Only the PIs will have access to the coded identifier list so as to minimize the risk of a confidentiality breach. Confidentiality of the data will be ensured for as long as it is kept.

9.3 Records Retention

Any patient data will be held only until data analysis is complete. Once data is no longer needed for research, it will be electronically destroyed in a way that leaves no trace. Both the coded-identifiers list as well as the data set will be destroyed.

10 Study Monitoring, Auditing, and Inspecting

10.1 Study Monitoring Plan

Results of follow up phone calls will be discussed with the PIs on a weekly basis. The PI will review all data that is collected via REDCap. Data will be collected over the course of 6 months, cleaned for a month and analyzed for another month. The Investigator will also ensure that the monitor or other compliance or quality assurance reviewer is given access to all the above noted study-related documents and has adequate space to conduct the monitoring visit.

10.2 Auditing and Inspecting

The investigator will permit study-related monitoring, audits, and inspections by the EC/IRB, the sponsor, government regulatory bodies, and University compliance and quality assurance groups of all study related documents (e.g. source documents, regulatory documents, data collection instruments, study data etc.). The investigator will ensure the capability for inspections of applicable study-related facilities.

Participation as an investigator in this study implies acceptance of potential inspection by government regulatory authorities and applicable University compliance and quality assurance offices.

11 Ethical Considerations

This study is to be conducted in accordance with applicable US government regulations and international standards of Good Clinical Practice, and applicable institutional research policies and procedures.

This protocol and any amendments will be submitted to a properly constituted independent Ethics Committee (EC) or Institutional Review Board (IRB), in agreement with local legal prescriptions, for formal approval of the study conduct. The decision of the EC/IRB concerning the conduct of the study will be made in writing to the investigator and a copy of this decision will be provided to the sponsor before commencement of this study.

11.1 Risks

The major risk of this study is a breach in PHI. Data will be protected as detailed above to avoid the damaging effects of a PHI breech. If patients or their family find follow up interview questionnaires too burdensome or psychologically straining during phone interviews, they can simply stop answering them.

11.2 Benefits

The potential benefit of this comparative effectiveness study is improved inpatient care for stroke patients—an area that is not well understood. Regardless of whether or not the individual patients' benefits from care, gaining knowledge about the best modality of inpatient nursing care for stroke patients will help society as a whole in the future.

11.3 Risk Benefit Assessment

The potential societal and individual benefits of this study out way the minor risks. This study is low risk as both the standard model of inpatient nursing care as well as the nurse attending model of care are currently used in clinical practice; we are merely comparing the effectiveness of one to the other. The risks of breach of PHI will be guarded against by use of de-identified data, a secure data collection and storage plan, as well as good clinical practices. The risk of emotional stress associated with survey questions is also minimal as patients can simply refuse or stop answering these questions.

11.4 Informed Consent Process / HIPAA Authorization

A waiver of consent will be obtained for the initial intervention as detailed below. We will obtain informed consent using a verbal process, detailed below, for data abstraction from the medical record as well as follow up phone questionnaires at the 7 day phone call. We will thus request a waiver of written consent.

Consent will be obtained by the interviewer administering the questionnaires to the patient following verbatim a script approved by the IRB. Consent for all follow up phone surveys as well as chart abstraction from the inpatient stay will be obtained at the 7 day phone call. The consent process will take place over the phone. Subject privacy will be assured as all data will be stored securely and interviews will be conducted in private space.

Patients will be permitted to provide consent at the time of the consent discussion over the phone (e.g. verbal consent) given the low risks associated with this study. Patients can ask the interviewer to call back at a later time to avoid any coercion associated with time pressures. The subject will be informed that they can withdraw their consent at any point. Investigators will confirm that the patient understands the study by asking them if they have any questions or need any points clarified in keeping with the phone call transcript.

Documentation of informed consent (e.g. date and time, who obtained consent, who gave consent and subject ID number) will be made by the interviewer on the case report form as consent will be verbal. If the subject is unable to provide consent, their legally authorized representative may.

11.4.1 Alterations to Typical Consent Process (only include if applicable)

11.4.1.1 Waiver of Consent (In some cases for screening/portions of that study that qualify as minimal risk, a waiver of documentation of consent may be permissible per IRB SOPs)

The research involves no more than minimal risk to the patients as this is a comparative effectiveness trial of two modalities of inpatient care that are already in use at the Hospital of the University of Pennsylvania. Medical care itself will be no different between the two study groups. A major goal of this study is assessment of each individual patient's (and family's) perception of their care and their clinical outcomes. If patients or their family members know that they did or did not receive an attending nurse model of care, knowledge of that fact alone may bias their expectations and their satisfaction with their care. Blinded allocation is essential for unbiased assessment. The risk of patients not initially consenting or knowing that we are comparing the effects of two nursing modalities is minimal. It would be impractical to carry out this research without an initial waiver of consent.

After discharge from the hospital, all subjects will receive a 7 day follow up phone call. At that time, they will be provided with additional pertinent information, including the fact that they received one of two

modes of nursing care whose effectiveness we are comparing. At this follow up phone call subjects will be asked if they are willing to proceed with the administration of research-specific questionnaires and the abstraction of clinical information recorded in the medical record, and a verbal informed consent script will be employed. There will be no more than minimal risk for continued participation, which at this point will be limited to the collection of PHI as well as with the administration of surveys. If the patient consents, then the protocol will continue as outlined. For patients who do not consent to the questionnaires, they will be asked if they would consent to review of medical records alone. For patients who do not consent to either, no further research will occur.

Study subjects who agree to ongoing participation will be identified by a subject ID number for the questionnaires. This ID will be linked to their name and medical record number to allow for medical record data collection, and this linkage document will be password protected through REDCap and and destroyed when the study is completed.

11.4.1.2 Waiver of Written Documentation of Consent

There are no scheduled in-person follow up visits for our subjects, therefore obtaining a signed consent form would be impractical. We will obtain verbal consent as discussed above according to a prespecified script.

11.4.1.3 Waiver of HIPAA Authorization

We will ask for a HIPAA waiver for the screening stage of this study, but obtain verbal consent as discussed above to administer questionnaires as well as to collect data from the medical record.

12 Study Finances

12.1 Funding Source

The study is not funded, but will be supported on an as needed basis by the Stroke Team.

12.2 Conflict of Interest

All University of Pennsylvania Investigators will follow the University of Pennsylvania Policy on Conflicts of Interest Related to Research.

12.3 Subject Stipends or Payments

There is no subject stipend/payment.

13 Publication Plan

All publications will be reviewed by the PIs. Data publication will not depend on whether the trial is positive or negative. Approval from the PIs must be obtained before any information can be used or passed on to a third party.

14 References

1. Schwamm LH, Pancioli A, Acker JE, 3rd, et al. Recommendations for the establishment of stroke systems of care: recommendations from the American Stroke Association's Task Force on the Development of Stroke Systems. *Circulation.* Mar 1 2005;111(8):1078-1091.
2. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics--2015 update: a report from the American Heart Association. *Circulation.* Jan 27 2015;131(4):e29-322.

3. Lichtman JH, Leifheit-Limson EC, Jones SB, Wang Y, Goldstein LB. Preventable readmissions within 30 days of ischemic stroke among Medicare beneficiaries. *Stroke; a journal of cerebral circulation.* Dec 2013;44(12):3429-3435.
4. Samsa GP, Bian J, Lipscomb J, Matchar DB. Epidemiology of recurrent cerebral infarction: a medicare claims-based comparison of first and recurrent strokes on 2-year survival and cost. *Stroke; a journal of cerebral circulation.* Feb 1999;30(2):338-349.
5. Lichtman JH, Leifheit-Limson EC, Jones SB, et al. Predictors of hospital readmission after stroke: a systematic review. *Stroke; a journal of cerebral circulation.* Nov 2010;41(11):2525-2533.
6. Koenig KL, Whyte EM, Munin MC, et al. Stroke-related knowledge and health behaviors among poststroke patients in inpatient rehabilitation. *Archives of physical medicine and rehabilitation.* Sep 2007;88(9):1214-1216.
7. Shaya FT, El Khoury AC, Mullins CD, et al. Drug therapy persistence and stroke recurrence. *The American journal of managed care.* Jun 2006;12(6):313-319.
8. Bushnell CD, Olson DM, Zhao X, et al. Secondary preventive medication persistence and adherence 1 year after stroke. *Neurology.* Sep 20 2011;77(12):1182-1190.
9. Osterberg L, Blaschke T. Adherence to medication. *The New England journal of medicine.* Aug 4 2005;353(5):487-497.
10. Lager KE, Mistri AK, Khunti K, Haunton VJ, Sett AK, Wilson AD. Interventions for improving modifiable risk factor control in the secondary prevention of stroke. *The Cochrane database of systematic reviews.* 2014;5:CD009103.
11. Koloroutis M. *Relationship based care: A model for transforming practice.* first ed: Creative Health Care Management; 2004.
12. Ndosi M, Lewis M, Hale C, et al. A randomised, controlled study of outcome and cost effectiveness for RA patients attending nurse-led rheumatology clinics: study protocol of an ongoing nationwide multi-centre study. *International journal of nursing studies.* Aug 2011;48(8):995-1001.
13. Erickson JI, Ditomassi M, Adams JM. Attending registered nurse: an innovative role to manage between spaces. *Nursing economic$.* Sep-Oct 2012;30(5):282-287.
14. Fulmer T, Cathcart E, Glassman K, Budin W, Naegle M, Devanter NV. The attending nurse: an evolving model for integrating nursing education and practice. *The open nursing journal.* 2011;5:9-13.
15. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Medical care.* Jan 1986;24(1):67-74.
16. Kronish IM, Diefenbach MA, Edmondson DE, Phillips LA, Fei K, Horowitz CR. Key barriers to medication adherence in survivors of strokes and transient ischemic attacks. *Journal of general internal medicine.* May 2013;28(5):675-682.
17. Sanders K, Schnepel L, Smotherman C, et al. Assessing the impact of health literacy on education retention of stroke patients. *Preventing chronic disease.* 2014;11:E55.
18. Duncan PW, Bode RK, Min Lai S, Perera S, Glycine Antagonist in Neuroprotection Americans I. Rasch analysis of a new stroke-specific outcome scale: the Stroke Impact Scale. *Archives of physical medicine and rehabilitation.* Jul 2003;84(7):950-963.
19. Tilley BC, Marler J, Geller NL, et al. Use of a global test for multiple outcomes in stroke trials with application to the National Institute of Neurological Disorders and Stroke t-PA Stroke Trial. *Stroke; a journal of cerebral circulation.* Nov 1996;27(11):2136-2142.
20. van Agt HM, Essink-Bot ML, Krabbe PF, Bonsel GJ. Test-retest reliability of health state valuations collected with the EuroQol questionnaire. *Social science & medicine.* Dec 1994;39(11):1537-1544.
21. Irvin MR, Shimbo D, Mann DM, et al. Prevalence and correlates of low medication adherence in apparent treatment-resistant hypertension. *Journal of clinical hypertension.* Oct 2012;14(10):694-700.