**Research Protocol**

**Study Title: Does the physical hospital environment have an impact on activity levels in patients recovering within an Acute Stroke and Sub-Acute Inpatient Rehabilitation Unit.**

**Short Title:** Observing activity levels within an Acute Stroke and Sub-Acute Inpatient Rehabilitation Unit pre and post transition to a new hospital

**Acronym:** MONACT (monitoring activity)

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*Other staff members:*

Behavioral Mapping: There will be students/ staff responsible for the behavioral mapping. Behavioral mapping will be on one weekday and one weekend day from 8:00 till 5:00 pm.

**Institutions and addresses where the research will take place:**

Acute Stroke Unit, Nambour General Hospital, Hospital Road, Nambour, 4560

Rehabilitation Assessment Unit, Caloundra Hospital, West Terrace, Caloundra 4551

Sunshine Coast University Hospital Acute Stroke Unit, Sunshine Coast University Hospital, Kawana Way, Kawana 4575

Sunshine Coast University Hospital, Rehabilitation Unit, Sunshine Coast University Hospital, Kawana Way, Kawana 4575

University of the Sunshine Coast, School of Sport and Exercise Science, 90 Sippy Downs Road, Sippy Downs 4556

**Abbreviations:**

ASU Acute Stroke Unit

RAU Rehabilitation Assessment Unit

NGH Nambour General Hospital

CAL Caloundra Hospital

SCHHS Sunshine Coast Hospital and Health Service

SCUH Sunshine Coast University Hospital

BM Behavioral Mapping

AM Activity Monitoring

**Introduction**

Patients in acute stroke and sub-acute inpatient rehabilitation units spend most of their day inactive and alone limiting optimal recovery [1]. A systematic review of observational studies quantifying physical activity levels in hospitalized stroke patients found that patients in acute stroke units and inpatient rehabilitation demonstrate low levels of physical activity, with the most severely affected patients spending more time of the day inactive and alone [1]. Another study conducted in four rehabilitation centres in Europe found that patients spend more than half the day alone and inactive but that there was considerable variation in the quality and intensity of therapeutic activities received [2]. Unfortunately, observational data from Australian studies are showing similar activity levels with 61% of a working day spent in bed and only 13% participating in transfer and gait activities [3]. There is very little evidence available on how much social and cognitive activity is occurring in acute stroke and sub-acute inpatient rehabilitation centres. In one rehabilitation centre, patients were observed spending around 30% in social activities and 5% on cognitive activities [4]. Taken together, evidence in acute stroke and sub-acute inpatient rehabilitation centres are indicating that participation levels in all activity domains are low.

Australian and United Kingdom Stroke Guidelines recommend that rehabilitation should be structured to provide as much practice performing activities of daily living as possible within the first six months after stroke [5, 6]. This can be achieved by mobilising early and frequently, and engaging stroke survivors in functional upper limb activity to prevent secondary complications like learned non-use [7]. There is strong evidence supporting intense meaningful practice of functional upper limb activity and gait re-training to achieve optimal functional recovery, but intense therapy is therapist driven and costly [8-11]**.**

High levels of social support have been associated with better health-related quality of life in individuals with stroke [12] and other medical conditions [13, 14]. Some studies also suggest an association with improved functional status [15, 16] perhaps mediated via assistance and increased support to comply with treatments [16, 17]). Even less evidence is available regarding the impact of cognitive engagement, but it has been reported that listening to music can improve focused attention, memory, language, mood and unilateral neglect [18-20].

How active patients are depends on many factors including therapy intensity provided, staff culture encouraging activity, and equipment available. There is a huge growth in evidence that hospital design has an impact on patient recovery [21] but we are unable to find evidence regarding the effect of hospital physical environment on activity levels. The published literature contains strong evidence that single rooms reduce infections and falls, increase privacy and sleep and prevent medication errors in patients [22]. However, the reduction in falls is linked to a decline in patient activity as bathrooms are closer [23-25] and this raises concerns that single rooms may reduce physical, social and cognitive activity levels in patients. Bed rest is known to not be an effective treatment for most conditions [26].

Communal areas and outdoor spaces also play an important role in activity levels for patients in hospital. The presence of communal and outdoor areas that stimulate patients, families and staff to explore outside their room may optimise activity levels and mental wellbeing [21, 27]. There is a growing body of evidence in healthy populations that factors such as greenspace and performing physical activity outdoors or in a more natural environment can greatly reduce adverse mental health outcomes, cardiovascular disease and mortality [28, 29]. However, during our literature search we were unable to find evidence of the effect that physical hospital environment including bedroom type, communal and outdoor spaces has on physical, social and cognitive activity, and therefore this requires further exploration.

Activity patterns in patients are likely to alter when the Sunshine Coast Health and Hospital Service transitions to a new hospital in 2017. The new hospital will have 16 single (80%) and 2 (20%) double bedrooms in the acute stroke unit and the rehab unit will have 20 single rooms and 14 double bedrooms for their patients. In the current acute stroke unit in Nambour General Hospital there are 8 single bedrooms and 4 double rooms and minimal communal space. The Caloundra Rehab Unit has 5 single rooms, 4 double rooms and 2 x 3 and 2 x 4 multi-bedrooms which indicates that the new hospital will have a higher ratio of single bedrooms. Also, the current rehabilitation unit is at ground level, patients have easy access to a lounge area, outside garden area and kiosk while in the new hospital the rehab unit will be situated at level 5, with outdoor areas at ground level and some communal spaces at ward level. Patient, family and staff activities within these newly designed communal and outdoor areas will be of particular interest given the positive relationship physical, social and cognitive activity has with rehabilitation outcomes. However, how frequently these areas are utilized is unknown and there is no evidence how they may influence patient activity levels. It would therefore be very beneficial to investigate if the change in hospital design with the move from old to new wards has an impact on activity levels in patients. Given the evidence that stroke patients spend the majority of their time alone and inactive in current ward environments, and the known associations between this and poor outcomes, it is imperative that we understand the impact of the forthcoming transition to SCUH on activity levels in patients.

The planned transition of Acute Stroke and Rehabilitation Units provides an excellent opportunity to investigate the effects of a change in built environment on physical, social and cognitive activity levels within a hospital setting. This observational study will contribute to current knowledge in regards to how hospital design plays a role in changing patient activity levels when such a transition takes place.

The gold standard of observing activity levels in patients is through behavioral mapping [30, 31]. Behavioral mapping is an observational method, which involves a staff member observing patient activities for 1 minute at 10 minute intervals for a period of 8 to 12 hours a day using a checklist of defined definitions of activities. It provides very rich data for all activity domains but is very costly and analysis is time consuming. Recent innovations in technology have made it possible to monitor physical activity levels and location of patients. This non-invasive, wearable technology has presented a means of objectively evaluating upper and lower limb activity throughout an entire day allowing an insight into the holistic function of a patient not just what is seen in specific time periods [32]. This technology includes accelerometers that resemble wrist-watches which have successfully been used to monitor upper limb [32, 33] and lower limb physical activity [34]. Data can be downloaded to a base station ready for statistical analysis. In combining behavioural mapping and this technology we are able to measure patient activity pre and post transition to a new hospital, investigating the impact of hospital design and at the same time comparing different methods of quantifying activity.

This study using new technologies provides an opportunity for the SCHHS to build collaborative links with local universities, setting the district to be a leader in the area and providing baseline data for future research and model of care enhancement. Increasing patient engagement in their care using these new and novel monitoring technologies to provide biofeedback options including timing and location of activity will be a great mechanism to increase patient involvement in their own care. Knowing when, where and how much activity takes place will provide invaluable information to guide the journey to optimal recovery and potentially improve the efficiency of rehabilitation. Embedding the use of this technology into future clinical practice will set the SCHHS as a leader in the area of activity tracking.

To control for other factors that will influence patient activity when transitioning to a new hospital we will consider the following:

1. Physical environment. This includes bed configuration – total beds (single, double, multi - bed bays)

Floor space /patient, Communal areas, Therapy spaces, Outdoor access, Walking distances (bed to- toilet / gym / common area /outdoors).

2. Bed and staffing levels will be investigated within the observational period as an increase in staff ratio would impact on activity. Beds serviced in the acute stroke unit will grow from 16 to 20 and in the rehabilitation center from 25 to 30 beds at the new location and staff ratios will be calculated according to patient numbers.

3. Experience of staff will be investigated. The expectation is that the majority of staff from each unit will move to the new unit in the new hospital. We expect that staff change will not be a major factor but the levels of new and old staff will be monitored.

4. Familiarity with the new facility. All staff new and old will be unfamiliar with the new hospital. To control for this factor we will allow sufficient time (3 months) for staff to get used to the new facility before the post observation period will start.

5. Models of care. The models of care are changing during transition to the new hospital. The main difference will be that the allied health service will go from a weekday service to a 6-day service. As we will monitor activity levels on weekdays and a weekend day during the pre and post transition period we are able to adjust for any changes due to change in model of care.

As time spent practicing a task is the key determinant of the level of recovery achieved [35], creating an environment for patients that facilitates activity in all activity domains is of the utmost importance for the Sunshine Coast Hospital and Health Service. This study will investigate if hospital design impacts on patient activity levels and will contribute to evidence for designing future hospitals. By measuring activity levels during pre and post transition it also provides knowledge and skills in patient activity tracking so that future fluctuations may be identified and appropriate responses implemented in a timely manner.

**Primary Aim**In a prospective observational study we will:

1. Determine if the physical hospital environment has an impact on total, physical, social and cognitive activity levels using behavioral mapping and accelerometers in patients recovering in one acute stroke unit (ASU) and one sub-acute rehabilitation unit (RAU) pre and post transition to a newly built hospital ward
2. Quantify body position, patient location and people present with the patient using behavioral mapping in patients recovering in one acute stroke unit (ASU) and one sub-acute rehabilitation unit (RAU) pre and post transition to a newly built hospital ward

**Primary Hypothesis**

1. Activity levels (physical, social and cognitive) and location of patients will decrease with change of physical environment to a single and double bed room ward.

**Secondary Aims**

1. To compare the role of different methods of measuring physical activity and location: behavioral mapping and accelerometer in inpatient ward environments.
2. Determine baseline data for patient activity levels within the Sunshine Coast University Hospitals Acute Stroke and inpatient Rehabilitation Units

**Secondary Hypothesis**

1.That accelerometer analysis of gait and upper limb provides equivalent data on physical activity compared to behavioral mapping and are cost effective alternatives.

**DESIGN:**

Prospective observational study of activity levels of patients recovering within an acute stroke unit and a sub-acute inpatient rehabilitation unit over 4-months before transition and 4-months after transition to newly built wards. The same four months of the year will be used during pre and post transition to account for any seasonal variability that may exist.

The 4-months before transitioning will involve activity monitoring of patients while in a regional acute stroke unit and sub-acute inpatient rehabilitation unit. The second 4 months after transitioning to the new hospital will focus on activity monitoring of an identical number of participants in an acute stroke unit and inpatient rehabilitation unit.

**SETTING*:***

***Observation Period I:***

The first observation period will occur at the current acute stroke unit in Nambour General Hospital and in the Caloundra Rehabilitation and Assessment Unit (RAU). Participants will receive standard care and treatment of an Acute Stroke Unit and Sub-Acute Inpatient Rehabilitation Unit.

* ASU:
  + Acute Stroke Unit at Nambour General Hospital
    - Bed configuration – total beds (8 x single, 4 x double)
    - Floor space /patient (55.2 sqm and 16 patients )
    - Common areas (Reception Seating area 6.6sqm, Elevator Seating Area 11.7sqm, Corridor gym seating area 6.4sqm)
    - Therapy spaces ( Therapy Gym floor space 30 sqm)
    - Outdoor access (no access at level, distance from elevators to front of hospital is 114m, to courtyard level 87m, to outdoor undercover area is 42m)
    - Walking distances (bed to ensuite 2.7m -single and 5.6m -double / Pod A (room 1-6) 12.1m and Pod C (room 11-16) 45.4m mean distance to gym / common area /outdoors)
* RAU:

Rehabilitation and Assessment Unit at Caloundra Hospital

* + - Bed configuration – total beds (5 x single, 4 x double, 2 x 3 bed and 2 x 4 bed bays)
    - Floor space /patient ( m2 and 24 patients )
    - Common areas (one dining room with TV, lounge with TV/audio and puzzles, recreational room with puzzles, fuzzball and painting materials)
    - Therapy spaces (The physiotherapy gym is located an average of 71 meters from rooms on the east wing and 103 meters from rooms on the west. The room is 98 square meters and should not be used when no staff member is in this room. The occupational therapy gym is located an average of 65 meters from rooms on the east wing and 93 meters from rooms on the west wing. The room is 60 square meters and should not be used when no staff member is in this room. The Speech therapy room is located an average of 61 meters from rooms on the east wing and 93 meters from rooms on the west wing. The room is 9 square meters and should not be used when no staff member is in this room)
    - Outdoor access (wheelchair ramp access 22m from ward doorway to main undercover BBQ area it is located an average of 46 meters from rooms on the east wing and 40 meters from rooms on the west wing, in front of hospital is located a sitting area an average of 78 meters from rooms on the east wing and 115 meters from rooms on the west wing, outside room 5/6 located 8m from those rooms, outdoor area close to occupational therapy room is located an average of 65 meters from rooms on the east wing and 93 meters from rooms on the west wing).
    - Walking distances (bed to- toilet distance for rooms on the east wing is 6m and west wing 4m /The physiotherapy gym is located an average of 71 meters from rooms on the east wing and 103 meters from rooms on the west. The occupational therapy gym is located an average of 65 meters from rooms on the east wing and 93 meters from rooms on the west wing. The speech therapy room is located an average of 61 meters from rooms on the east wing and 93 meters from rooms on the west wing/ The Dining room is located an average of 53 meters from rooms on the east wing and 23 meters from rooms on the west wing/ The TV lounge room is located an average of 20 meters from rooms on the east wing and 24 meters from rooms on the west wing/ The recreational room is located an average of 20 meters from rooms on the east wing and 47 meters from rooms on the west wing)

***Observation Period II:***

The second observation period will be recorded at the Sunshine Coast University Hospital Acute Stroke Unit and Inpatient Rehabilitation units. Participants will receive the normal standard care and treatment of an Acute Stroke Unit and Sub-Acute Rehabilitation Unit.

* Sunshine Coast University Hospital Acute Stroke Unit:
  + - Bed configuration – open beds (16 x single, 2 x double)
    - Floor space /patient (once access is granted to the site floor space sqm will be calculated and will open with 20 patients)
    - Common areas
    - Therapy spaces ( one gym area located on ward level)
    - Outdoor access (via lifts to ground level)
    - Walking distances (bed to- toilet / gym / common area /outdoors
* Sunshine Coast University Hospital Acute Rehabilitation unit:
  + - Bed configuration – open beds (20 x single, 14 x double)
    - Floor space /patient (once access is granted to the site floor space sqm will be calculated and will open with 30 patients)
    - Common areas (2 lounge and 2 dining rooms)
    - Therapy spaces (one large gym with an outdoor mobility garden, one OT gym, one multi-purpose gym, two large assessment rooms)
    - Outdoor access (at the ward level a outdoor mobility garden and sitting area near the therapy gyms and doors from the 2 lounge and 2 dining rooms lead to a large sitting area)
    - Walking distances (will be calculated once we have access to the site)

**PATIENTS**

**Participants in the Acute Stroke Unit:**

Patients admitted to the acute stroke unit with a diagnosis of stroke will be assessed for eligibility and consecutively enrolled. Every fortnight a new group of up to 5 participants will be recruited for a period of 4 months.

Data will be recorded for a period of 3 days (2 weekdays and 1 weekend day) with the Stepwatch and Actigraph Activity Monitors and 2 days (one weekday and one weekend day) with Behavioral Mapping.

**Participants in the Rehabilitation Unit:**

To maximize generalizability and comparability of cohorts, enrolment will be stratified across the top three diagnostic groups admitted to public inpatient rehabilitation units in Australian Public and Caloundra Rehabilitation units: stroke, orthopedic fractures and de-conditioning [36]. Patients within these groups with the most frequently admitted functional capacity strata as defined by AN-SNAP classes (98) will be included: Stroke 3-204, 3-206, 3-208, 3-209; Orthopaedic fractures 3-227, 3-228, 3-229, and Re-conditioning 3-242, 3-243 and 3-244. Patients within these categories comprise 72% of all, and 90% of stroke/fracture/deconditioning diagnosis related groups (DRG's) admitted to Caloundra Rehabilitation Unit in 2015. This will exclude outliers with uncommon extremes of functional capacity to maximize comparability between the cohorts. Patients admitted to the inpatient Sub-Acute Inpatient Rehabilitation Unit with the above AN-SNAP classes will be assessed for eligibility and consecutively enrolled. Every fortnight a new group of up to 5 participants will be recruited to the study for a period of 4 months.

Activity monitoring which will commence between 7 and 14 days after admission, with the weekend day being the first Saturday occurring more than 7 days post-admission and the weekdays being the 2 days either immediately preceding this, or in the situation where this would be less than 7 days post admission, in the week after.

Data will be recorded for a period of 3 days (2 weekdays and 1 weekend day) with the Stepwatch and Actigraph Activity Monitors and 2 days (one weekday and one weekend day) with Behavioral Mapping.

**ELIGIBILIY CRITERIA**

***Inclusion criteria:***

**Participants in the ASU:**

* The patient is admitted to the Acute Stroke Unit with the diagnosis of a stroke and enrollment to the study will occur within 7 days after stroke onset.
* Patient is an adult > 18 years.
* Patients have an expected stay of more than 2 days.
* The patient is fit for rehabilitation. The patient requires assistance for basic ADL’s at the time of recruitment.
* The patient is not deteriorating in the 24 hours before recruitment.
* The patient or their substitute decision maker is able to provide written informed consent.

**Pre morbid status for ASU:**

* The patient was walking independently.

**Participants in the Rehabilitation Unit:**

* The patient is admitted with one of the following AN-SNAP codes; Stroke 3-204, 3-206, 3-208, 3-209; Orthopaedic fractures 3-227, 3-228, 3-229, and Re-conditioning 3-242, 3-243 and 3-244.
* Patient enrollment will occur within 7 days of admission to the rehab unit
* Patient is an adult > 18 years and older.
* The patient or their substitute decision maker is able to provide written informed consent.
* Patients are in the Rehabilitation Assessment Unit (RAU) during their admission or Acute Inpatient Rehabilitation ward at the Sunshine Coast University Hospital.
* Patients expected length of stay is of no less than 14 days on admission to the inpatient rehabilitation unit

**Pre morbid status for Rehabilitation Unit:**

* The patient was walking independently.

***Exclusion criteria:***

**Participants in the Acute Stroke Unit**

* with an extensive psychiatric history and who are unable to participate in rehabilitation due to current active medical condition/s

**Participants in the Rehabilitation Unit**

* with an extensive psychiatric history and who are unable to participate in rehabilitation due to current active medical condition/s

***Recruitment processes***

**Patients**

Patients who are potential participants will be informed of the research and invited to participate by a member of the research team. The purpose of the study and the procedures involved will be explained, and patients who express an interest in participation will be provided with a Participant Information Sheet (see Participant Information Sheet), Consent Form and Revocation form.

Some potential participants may not have capacity to consent for themselves because of cognitive or language impairments e.g. aphasia from stroke. A patient’s capacity to decide whether or not to participate will be determined by the treating medical team. If the patient lacks capacity to consent to the study the substitute decision maker will be approached and provided with information regarding the study.

If the patient or substitute decision maker is interested in the study, the recruiting staff member will supply full information, including the participant information form and the consent form. When supplying the information to the participant, the study will be explained in more detail, including the risks involved e.g. skin irritation from wearing the Stepwatch activity monitor on the ankle. Patient and substitute decision makers will be informed that participation is voluntary and that they will receive normal care if not participating. All questions will be answered before seeking consent for study participation. Once signed consent is obtained, the patient will be enrolled in the study.

***Conditions of participation (eg. Withdrawal)***

**Patients**

Participants will be informed that their agreement or refusal to participate in the study will not affect their relationship with their therapists or the services they receive. If they consent to participate in the study they will maintain the right to withdraw at any stage and will not be required to state a reason for doing so. Their decision to withdraw will not affect their relationship with therapists or the therapy and medical services they receive. Patients can withdraw at any time from the study by signing the revocation form, which will be attached to the copy of the Information and Consent Form.

***Risks to Participants***

There are no identified risks to patients who choose to participate in this study as this is not an interventional study. To minimize risk for skin irritation we will check the skin for any signs of irritation after 2 hours wearing time. In the case of skin redness, itch or other irritation is noticed, sensor-based physical activity observations will be terminated.

**OUTCOME MEASURES**

***Data collection methods/ types of data to be collected***

**Methods of Activity Monitoring:**

* Behavioral mapping
* Ankle mounted accelerometer (Stepwatch)
* Upper limb wrist mounted accelerometer (Actigraph)

**Participants**

* Behavioral mapping

*Activity:*

One method of observing activity of participants is through structured observations (behavioral mapping) at 10-minute intervals. The behavioral mapping protocol by Janssen et al 2012 [37] will be used and adjusted for the inpatient rehab setting. In this mapping protocol processes are outlined and definitions of activity domains are specified. The data observation recording sheet with embedded checklist has been developed specifically for this protocol. Behavioral mapping has been extensively used in observational research involving stroke patients [30, 31, 38, 39] Utilizing the observational recording sheet makes it possible to observe more than one person; using checklists that record the patient’s type of activities, their location, patient’s position and whether other persons are present.

The observational data recording sheets will be used for one weekday and one weekend day in the same week from 8:00 am till 5:00 pm. Over the period of 9 hours, patients will be observed for 1-minute at 10 minute intervals and activities observed will be recorded. Behavioral mapping staff can take a break from 10:10-10:30, 13:00-13:30 and 15:20 -15:30 so in total 48 observations are made in one day.

(behavioral mapping protocol, behavioral mapping explanation document and final mapping recording sheets attached in appendix)

*Training of staff and students*

Staff and students undertaking placements with the hospital staff members involved in recording observational data will be trained in the behavioral mapping protocol, behavioral mapping explanation document and in utilizing the observational data mapping recording sheets. After the training the staff member will observe 4 different patients for one hour, providing 24 observations using the data recording sheets. Staff will be able to record data during the trial when the total number of observations are ≥ 90% accuracy as assessed concurrently by the educator. A list of all staff and students that passed the test will be recorded.

* Activity Monitoring

Instrumented monitoring of physical activity of participants will be performed using Stepwatch ankle mounted activity monitors for gait, and bilateral wrist mounted Actigraph accelerometers for upper limb activity. This will monitor participant’s physical activity for 3 consecutive days. These monitors are worn around the ankle of the less affected side, and both wrists during the entire period to provide outcome measures for the total number of steps, sedentary time, upper limb activity counts performed per day and sleep quality [33, 40]. Participants will be given the option to remove the ankle and one wrist accelerometers for sleep. We will encourage that one Actigraph accelerometer be worn during sleep on the non-paretic arm for stroke participants and on the wrist of choice for other participants to monitor sleep. If a participant wants all the accelerometers to be removed during the night we will remove all accelerometers. Following the three days monitoring period the Stepwatch and Actigraph monitors data will be downloaded to a basestation for analysis. These tools are the criterion reference systems for assessing lower and upper body physical activity patterns respectively [33, 41]. The accelerometers will be cleaned as per manufactures documented processes after each participant. The StepWatch monitor may be cleaned using a cloth dampened with mild soap and water or 70% isopropyl alcohol. The dock may be cleaned using a cloth dampened with mild soap and water or 70% isopropyl alcohol. The StepWatch straps may be hand washed with mild soap and water, or a solution of 70% isopropyl alcohol. ActiGraph devices are approved to be cleaned with a non-abrasive cloth and isopropyl alcohol for 15-20 seconds, and let air dry.

***Patient demographics and clinical details***

*Patient demographic and clinical details*

Age, gender, date of hospital admission, date, type and side of stroke, past medical history, social situation and premorbid walking ability (FAC score).

* Initial NIHSS score in stroke patients

The National Institute of Health Stroke Scale is routinely used within the ASU and measures severity of stroke. Stroke severity will be classified as mild NIHSS < 8, moderate NIHSS 8 to 16, severe NIHSS > 16.

* Oxfordshire Classification of Stroke

The Oxfordshire Classification is also known as the Bamford classification, and divides people with stroke into four different categories according to the clinical symptoms and signs with which they present. This classification is useful for understanding the likely underlying pathology, which in turn gives information on treatments which may be useful and the prognosis. It is a relatively simple, robust, bedside classification using clinical information. The easiest way to use the Bamford classification is to look for the presence or absence of the four main features of stroke - hemiparesis, higher cortical dysfunction (including language problems), hemi-anopia and brainstem signs. Once you have this information, you can classify your patient's stroke type: lacunar stroke (LACS), partial anterior circulation stroke (PACS), total anterior circulation stroke (TACS) or posterior circulation stroke (POCS)

* Functional Ambulation Category

Clinician-completed tick box of 6 broad categories of walking ability, ranges from independent walking outside to non-functional walking. Patients can be rated on the following categories:

* + 0: Patient cannot walk, or needs help from 2 or more persons
  + 1: Patients needs firm continuous support from 1 person who helps carrying weight and with balance
  + 2: Patient needs continuous or intermittent support of one person to help with balance and coordination.
  + 3: Patient requires verbal supervision or stand-by help from one person without physical contact
  + 4: Patient can walk independently on level ground, but requires help on stairs, slopes or uneven surfaces
  + 5: Patient can walk independently anywhere
* Functional Independence Measure (FIM)

Provides a uniform system of measurement for disability based on the International Classification of Impairment, Disabilities and Handicaps; measures the level of a patient's disability and indicates how much assistance is required for the individual to carry out activities of daily living.

* Contains 18 items composed of: 13 motor tasks and 5 cognitive tasks (considered basic activities of daily living)
* Tasks are rated on a 7 point ordinal scale that ranges from total assistance (or complete dependence) to complete independence. Scores range from 18 (lowest) to 126 (highest) indicating level of function. Scores are generally rated at admission and discharge
* Dimensions assessed include: Eating, Grooming, Bathing, Upper body dressing, Lower body, dressing, Toileting, Bladder management, Bowel management, Bed to chair transfer, Toilet, transfer, Shower transfer, Locomotion (ambulatory or wheelchair level), Stairs, Cognitive comprehension, Expression, Social interaction, Problem solving and Memory
* Handheld Dynamometer

A handheld dynamometer will be used to assess strength of the ankle dorsiflexors and plantar flexors muscles and grip strength on both limbs. This is important because it will ensure that the strength levels of the muscle groups associated with gait capacity are comparable between the two cohorts of patients.

***Information to participants:***

**Patients**

It will be explained to participants that we are observing activity levels of patients in the current Acute Stroke Unit in Nambour and in the Caloundra Rehabilitation Assessment Unit and that we will repeat observing activity levels in a similar cohort of patients in these units once they have transitioned to the new hospital facility.

We will explain to participants that this study aims to determine activity levels while admitted to an Acute Stroke Unit and a Sub-Acute Rehabilitation Unit pre and post transition to a new hospital. We will inform participants that their participation will not influence the level of care provided while admitted.

To gather information about their physical, social and cognitive activity levels with behavioral mapping the participants will be told they will be observed during one weekday and one weekend day of the same week from 8:00 am till 5:00 pm in 10-minute intervals. Participants will also be informed that physical activity levels will be monitored with accelerometers worn around the ankle (Stepwatches) and both wrists (Actigraph) for 3 consecutive days starting and finishing on the same days the behavioral mapping is to occur.

***Data analysis and end-points of the study***

The following outcome measurements will be obtained from patients at discharge from the study

**Primary Outcome Measures:**

* Percentage time in total, physical, social and cognitive activities (BM)
* Proportion of day mobilizing (AM)
* Average steps per day (AM)
* Average sedentary time per day (AM)
* Average upper limb activity counts per day for each upper limb (AM)

**Secondary outcome measures:**

* Observed activity in each subcategory by domain, position, location and people present (BM)
* Total activity levels weekday compared to weekend (BM)
* Average weekday steps per day compared to average weekend steps per day (AM)
* Physical activity by location with collation of behavioral mapping data and accelerometery data
* Average Hours Sleep per night

For the primary outcome we will use one-way ANCOVA to determine difference in activity levels between groups adjusting for covariates of age in all participants and stroke severity (NIHSS) in stroke patients only. We will determine the difference in activity levels for ‘total activity’ and for the physical, social and cognitive activity domains. We will also determine total percentage time spent in different postural positions, location and people present with the participant. Consistent with previous research in this field, missing and unobserved data will be excluded from the statistical analysis for the primary outcome [4].

We will analyze percentage observed total, physical, social and cognitive activity shown in participants occupying single, two or multiple bedrooms while present in their hospital room pre and post transition. We will also determine percentage observed total, physical, social and cognitive activity shown in communal and outdoor areas pre and post transition.

Activity data from the accelerometer will be analyzed using the proprietary software or established algorithms for identifying outcome measures implemented in custom written software. This will consist of loading the raw data into the software and extracting the steps per day (Stepwatch) or arm movements (Actigraph), along with the duration of intervals per day in which no steps or arm movements are recorded. These data will then be averaged across the three days to obtain the average score per day for that patient.

***Benefits / significance / outcomes***

Despite significant evidence regarding benefits of physical, social and cognitive activity in acute stroke and rehabilitation patients, little is known about how the layout of a hospital affects activity patterns. This study will

* Contribute to knowledge of how the physical environment impacts activity levels within different hospital designs
* Provide a baseline from which the effects of subsequent changes in model of care / environment can be measured
* Provide new knowledge regarding current activity levels in inpatient rehabilitation
* Embed monitoring of activity into usual practice within acute stroke and rehabilitation settings
* Lay the foundation for future research into mechanisms to alter activity levels within hospital patients

Hospital design has moved in the last decade towards a single bedroom design as evidence is indicating the beneficial effects of single rooms on infection control and reduced medication errors. Another major factor impacting on patient recovery is activity [11, 42] as it enhances recovery [11] and prevents secondary complications [42]. This study will be a first in contributing to new knowledge quantifying if patient activity alters in single versus multiple bedrooms and how communal and outdoor areas impact on activity levels in patients. The study will therefore provide direction for future developments in hospital design.

Tracking activity data at the same time as behavioral mapping will enable the validation of activity tracking within acute and sub-acute rehabilitation settings. These data can then be used to validate innovative technologies of activity monitoring in future research while building collaborative networks with University of the Sunshine Coast.

The dose, frequency and timing of therapy and its relationship to functional outcomes is a rapidly expanding area within neurological rehabilitation. These metrics of training have been, and continue to be, extensively studied in the able bodied population in efforts to optimize performance. The burden on our health care system is set to increase significantly in the coming years and considerable research is required to ensure effective and efficient therapy is provided within acute and sub-acute rehabilitation services. By embedding the use of technology and the building of collaborative networks with the University of the Sunshine Coast, our hospital and health service is set to lead the development of interventions that may guide national and international therapy interventions.

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