RESEARCH PROTOCOL

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Combining Machine Learning and Ecological Momentary Assessment of Depression, Cognitive Function and Daily Activity Behaviour to Support Self- Management for Post-stroke Patients: A Feasibility Study

Background and Scientific Basis

Stroke represents a major global health issue, contributing significantly to mortality, morbidity, and disability worldwide. Post-stroke patients often experience depression, cognitive impairments, and functional limitations during the rehabilitation period, which can severely impact their quality of life and recovery process. Traditional methods for assessing these conditions may not adequately capture their dynamic nature. Ecological Momentary Assessment (EMA) has emerged as a promising approach to fully understand the regularity of symptom trajectory in post-stroke patients. Its real-time tracking of patients' individual mood and daily activity fluctuations may have potential to support self-management of post-stroke patients. However, the integration of EMA data with advanced analytical techniques, such as machine learning (ML), for enhancing self-management in stroke rehabilitation remains underexplored.

Aim of study

This study aims to explore the feasibility of integrating machine learning algorithms with EMA data to support self-management for post-stroke patients, focusing on monitoring and managing depression, cognitive, and functional impairments.

Study Design

It is a Prospective, 2-phase, mixed-method feasibility study, involving a one-group pre- and post-test and qualitative interviews

Hypothesis

There are statistically significant improvements in depression levels, cognitive function, and disability/functioning scores between pre-program and post-program assessments in post-stroke patients participating in the intervention."

Intervention

Post-stroke patients from Queen Elizabeth Hospital in Hong Kong will be recruited. The research team will collect EMA data (ie., depression, cognitive function, daily activity, and contextual data) from participants for seven days and analyze the data by machine learning in the first phase, while provide real-time, individualized, self-care messages to the participants via a personalized self-care AI app, RehabCare Companion, in the second phase.

Primary Outcome

Feasibility of the study will be evaluated by Acceptance, Adherence, and Experience of the participants in using the app.

Secondary Outcome

Depression Levels: Monitoring changes in participants' mood and emotional well-being (BDI)
Cognitive Function: Assessing improvements or changes in cognitive abilities (MoCA)
Disability and Functionality: Measuring changes in physical capabilities and daily living activities (WHODAS)

Study Subjects

Sample Size

Total: 50

Study Group

Inclusion Criteria:

(1) adults aged 18 years or older and
(2) having a confirmed diagnosis of stroke; and
(3) having sufficient proficiency in Cantonese to understand and respond to the assessments and prompts; and
(4) having a Hong Kong version of the Montreal Cognitive Assessment (HK-MoCA) score of 18 or higher; and
(5) having a smartphone.

Exclusion criteria

Patients will be excluded if
(1) they have moderate to severe cognitive impairment (a HK-MoCA score of 17 or lower) or
(2) they have active psychiatric disorders other than depression (e.g., schizophrenia, bipolar disorder) or
(3) they have a terminal illness or prognosis that suggests a limited life expectancy, and (4) they have conditions that compromise their self-care ability (i.e., bedbound).

Statistical Analysis

Intention-to-Treat methods will be adopted. The baseline descriptors will be presented as mean and standard deviation for continuous variables, median and quartile range when the continuous variables are not normally distributed, and percentage and frequency for categorical variables. Machine learning algorithms will be used to assess how EMA symptoms predict levels of depression, cognitive function, and overall functioning. The study will assess depression levels, cognitive function, and disability/functioning using validated scales and investigate the feasibility of the program to the post-stroke patients. The paired t-test or the Wilcoxon signed-rank test will be utilized to compare the differences of depression levels, cognitive function, and functioning between pre- and post-program. Content analysis will be utilized to analyze qualitative data from the focus group interviews. Statistical tests will be performed with the Statistical Package for Social Sciences (SPSS) version 25 software.