Title: Machine Learning assisted human in the loop system to assist physicians in decision making for patients with ischemic stroke in terms of short- and long-term outcomes

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Stroke is a leading cause of mortality as well as chronic disability in India and other low- and middle-income countries (LMIC). According to the Global Burden of Diseases, Injuries and Risk factors study of 2010, approximately 65% of ischemic strokes worldwide are reported in LMIC and 55% of deaths associated with ischemic stroke occur in LMIC. South east Asian and the Indian population demonstrates disproportionately higher susceptibility to stroke due to the presence of cardiovascular risk factors. Further, timely intervention in cases of acute ischemic cerebrovascular episodes requires rapid decision making for initiating reperfusion therapies within the first few hours from the appearance of initial signs and symptoms.

While non contrast Computed tomography (CT) remains the first imaging technique offered to the patient due to its rapid availability as well as affordability, the primary limitation of this imaging technique is the limited sensitivity in the acute setting. Magnetic Resonance imaging (MRI), is a technique that overcomes this limitation since within minutes of cerebral arterial occlusion, Diffusion weighted imaging (DWI) demonstrates a significant increase in the signal and at the same time shows a reduced Apparent Diffusion Coefficient (ADC) values. ADC is a measure of diffusivity of water molecules in tissue and in the event of an ischemic stroke, the ensuing edema due to neural death and cytotoxicity results in significant reduction in the ADC. This is a step up from conventional MRI sequences such as T1W1, T2W2 & FLAIR images, which might not demonstrate an infarct for at least 6 hours after the episode. Amongst other factors, location and size of the restricted diffusion lesion are deciding factors in determining therapy. However, both in the clinical setting as well as stroke studies, DWI-driven detection & manual delineation of ischemic core is time consuming as well as dependent on the experiences of the consulting physician.

The research objectives of the present research proposal are four-fold:

1) Through comparison with normal DWI MRI images with individuals suffering from ischemic stroke, develop an automated machine learning based method to detect, determine the threshold of ADC values and ADC based lesion volume; and find coherence with clinical determination of the radiologist.

2) Develop a ML based predictive model contingent on the clinical presentation, location of restricted diffusion, diffusion-FLAIR mismatch, ADC values, ADC based lesion volume, longitudinal history (chronic conditions) as well as lab investigations (CBC, HbA1c, Kidney Function Test, Liver Function Test, LDH, Ferritin, C Reactive protein, D-dimer, Serum creatinine) of the patients suffering from ischemic stroke, to predict long term clinical outcomes.

3) Develop a ML based predictive model to determine the risk factors that are associated with poor outcomes after being identified with MRI defined ischemic stroke.

4) Develop a human in the loop system to assist the interventional neurologist/radiologist in decision making regarding the long-term risk associated with the success/failure of reperfusion therapy.

Expected qualifications and experience:

1. MTech in Computer Science/Electronics
2. Programing skills are essential
3. Experience with image processing is desirable
4. Clear appreciation of ML basics
5. We would be making significant use of Decile (https://decile.org/)

Skills to be gained:

1. Integrating novel machine learning and data analytic techniques to address clinically relevant questions.
2. Collaborating with experts from other scientific specialties especially leading radiologists of the country to develop the necessary skill to work within a team of diverse expertise.
3. Elaborate sophisticated poster and oral presentations
4. Scientific writing and manuscript development to communicate the results