INVESTIGATION OF ISCHEMIC STROKE PATIENT OUTCOMES

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Abstract— **An Ischemic stroke is a curse to the mankind which eventually leaves barely few hours to give proper treatment before it could paralyze the body. So in this scenario, it is very important that in the intensive care unit immediate and accurate treatment should be given to the patient so that he/she could not go into the deep stroke. So in the ICU there is very less time is there in the hands of the doctor to take the right decision about the medicines and other procedures which eventually take the big step to save the patient's life. So it is very important to learn the all aspects of the emergency procedure before any circumstances arise. So Machine learning is the boon to this kind of scenario where it gives the best option to learn the past treatment history and evolved with the precise treatment technique. So proposed methodology put forwards an idea of using past treatment dataset using K nearest neighbor and Fuzzy ANN techniques which is powered with Random forest algorithm to produce the best possible prediction outcomes for ischemic stroke patients.**

Keywords— Ischemic Stroke, K- Nearest Neighbor, Random Forest.

I. INTRODUCTION

Stroke is defined as a Medical Emergency. Hemorrhagic, Ischemic, and TIA (Transient Ischemic Attack) are the stroke types. Hemorrhagic Stroke happens when enfeeble blood vessels fracture. Ischemic stroke happens due to the blood clot which blocked the blood vessels transferring blood to a brain, this obstructs the blood transfer to the brain and when the blood transfer to brain affected for a long time TIA stroke occurs. TIA stroke is the signals of more serious strokes are going to happen. Ischemic stroke is occurring more in comparison to the other two strokes.

The ischemic stroke is of two types first one is Thrombotic stroke in which blood clot is found in single arteries that transfer blood towards brain and the second one is Embolic stroke in which the blood clotting has happened in heart or different body part and they rake through blood flow and place in small brain arteries which causes blood clot (embolus) in arteries and result in stroke.

Ischemic stroke happens due to the obstacle in blood supply to the brain. High BP is the big risk factor for ischemic stroke. In a thrombotic Ischemic stroke a fatty deposit built up in arteries that ruptured the arteries and affect the blood transfer to the brain which lead to stroke. In Embolic stroke embolus in arteries affect blood transfer and causes a stroke. Symptoms that signal strokes are an unexpected weakness of the arm, leg or face, trouble in understanding and speaking, severe headache, walking trouble, dizziness, coordination problem, visibility problem etc.

Immediate treatment of stroke is necessary to save a person. If any sign of stroke is seen in the person it is necessary to see the doctor immediately. The doctor recommends Blood Thinners after checking patient which is used to prevent the stroke by quickly removing or dissolving the blood clot.

There are lots of factors that arise stroke risk and heart attack. Some factors are related to our lifestyles such as obesity, less physical activity, heavy alcohol consumption, smoking, drugs such as methamphetamines and cocaine and some are related to medical risk like high BP, diabetes, sleep apnea, cardiovascular disease, high cholesterol, genetic etc. Age, sex, race, hormones are other factors that are associated with a substantial risk of strokes.

Complications arise after stroke is depending on the intensity of stroke. Disabilities after stroke are temporary or Permanent based on the prolonged flow of blood to the brain was disturbed. Complications arise after strokes are paralysis (whole body or one side), speech or swallowing problem, memory loss, pain, emotional problems, depression, difficulty in performing an everyday task, behavioural changes etc. A person has also become sensitive to temperature changes, especially cold weather.

There are several drugs available in the market which is prescribed by the doctor to lessen the chance of one more stroke after the first stroke. Anti-Platelet Drug makes platelets (that cause blood to clot) less sticky and lessen the risk of clotting. Aspirin is the most recommended drug used for this purpose. Aggrenox is another drug which is the combination of a mild dose of aspirin and dipyridamole (an antiplatelet drug) is utilized to lessen the blood clotting. Another form of a drug that is utilized to lessen the risk of blood clotting is Anticoagulants like heparin which utilize in the hospital for immediate treatment after stroke.

Many safeguard strategies are helpful to control chance of stroke if we apply them in our day to day life like regular exercise, reducing cholesterol level, lowering high BP, moderate alcohol, quitting tobacco, controlling diabetes, reducing weight, including a healthy diet rich in vegetables and fruits, avoid illegal drugs etc.

Nowadays Machine learning (ML) techniques are applied a lot in the field of medical science. It becomes a useful tool in neurological disease diagnosis, prediction, and treatment. ML uses pattern recognition algorithms for data

extraction and calculates the chance of occurrence of disease. In ischemic stroke case, the Machine Learning algorithm are used to diagnosis the chance of stroke and personalized treatment decision for the patient. Machine learning gives the best option to learn the past treatment history and evolved with the precise treatment technique.

In this paper, section 2 is dedicated for literature review of past work and Finally Section 3 concludes this paper .

II. Literature Review

[1] Explores the varying fatality rates in different European countries in comparison with the East European countries. The East has significantly higher fatality rates which are accelerating as compared to west Europe which has heart strokes on a constant decline. The researchers utilized data collected by WHO, which aggregated the studies performed on hospital registers and death certificates. The researchers list the potential uses of maintaining a database of patients and the treatments performed, as it can be extremely valuable resource for the medical community. Ideally the stored data would behave as reference for future incidents that can be utilized to reduce confusion and give immediate relief to the critical patient. In the medical community, timely response is the deciding factor between life and death, and the authors aim to reduce the dependence on only a particular set of skills limited to one professional, hospital etc. This study also reflects the ever-increasing rates of stroke and comment that this is a crucial time to implement the said framework to reduce the loss of lives and provide a higher quality of life.

[2] Discusses the prevalence of lesions produces due to arteriosclerosis as a consequence of ischemia. Lesions include thrombosis, cerebral softening, embolism and hemorrhage. These are almost very difficult to quantify, as most of the fatalities would occur due to hemorrhages and the autopsy is generally positive in that aspect. Therefore, the authors conclude that lesions are an unreliable source and are of limited value. The researchers examined various other consequences suffered by patients due to the ischemic stroke specifically for patients above the age of 60. The researchers find the practice of bloodless surgery for the treatment of hypotension in ischemic stroke patients as it leads to cerebral softening. The researchers concluded that certain prognosis have to be taken into account and studied extensively to implement the preventive measures.

[3] Explores the validity of an integer-based score to estimate an end result in AIS (Acute Ischemic Stroke) using parameters that are readily available in an emergency room situation. The researchers performed regression on earlier patients with AIS, with the help of ASTRAL to estimate factors for an unfavorable result. The authors also refer to the NIH stroke scale that measures the severity of the stroke in addition to the age of the patient, admission time, glucose level, and visual field range and consciousness level. These parameters are essential for the calculation of the ASTRAL score, which was calculated for 1645 patients. Then the score was validated by the authors through a two-fold validation technique to determine the authenticity of the scores. And two external and independent agencies were also tasked with the verification of the scores namely, Athens and Vienna Stroke Registries. The researchers concluded with the importance and the usefulness of the ASTRAL score as a simple integer score for a functional outcome.

[4] Investigates the possibility of functional results estimated via a score relying on rapid treatment offered to ischemic stroke patients undergoing the IV alteplase. The researchers performed the study in 1,319 patients in Helsinki, Finland. The researchers concluded after experimenting for 3 months with valuable results and insights which were extremely accurate and reliable. According to the value of the logistic regression coefficients, the authors validated the reliability of the method by bootstrapping. The authors weren't too convinced by the verifications and wanted the validation to be done by an independent agency. Therefore, an external verification was carried out on a group 330 patients The University Hospital Basel, Switzerland. The scores performance was evaluated with help of AUC-ROC. The DRAGON score is made up of various parameters such as, Dense cerebral artery sign, modified Rankin scale, Glucose level at baseline, Age, Onset-to treatment time and NIH stroke scale score. The DRAGON score is an integer-based score that has values in the range of 0-10. The researchers culminated their study by demonstrating that, it can support add on strategies and perform clinical decision making effectively.

[5] Introduces the prediction of long-term outcome after Endovascular stroke treatment. As Endovascular procedures are in widespread use for the treatment of strokes. Therefore, the authors presented a validation to determine the usefulness of these procedures and finding out which section of patients have the most benefit from these procedures. The researchers obtained their data from 2 single-arm analysis of a thrombectomy device. Utilization of MERCI and MultiMERCI techniques and pooling them together yielded substantial results and a pre-emptive score was developed by utilizing the self-contained contribution of variables. History of Hypertension, History of diabetes mellitus and Atrial Fibrillation were the most instrumental in anticipating the results. These 3 specifications equally contribute to a Chronic Disease Scale that anticipates the consequences irrespective of other variables such as, vessel recanalization, stroke severity and stroke. A 0-10 scale was developed named THRIVE, which incorporates all the parameters into account and predict the outcome at 90 days.

[6] Investigates the validity of ASTRAL and DRAGON scores that are in wide spread use for predicting the possibility of a stroke. The researchers performed external validation on large datasets involving patients registered with both the scores. The authors observed the patients with a modified Rankin score from 3 to 6 for each score point and contrasted with the estimated proportion governed by the risk scores. Regression was applied extensively to the variables for assessment using area under the curve and its characteristics. The ASTRAL and DRAGON scores show a justifiable estimation performance. As imaging data is not compulsory of ASTRAL prediction, it has an advantage in emergency situations. The research concluded that the scores have admissible performance and would require more studies for the sustained benefits to be validated.

[7] Proposes a framework for predicting Thrombolytic Haemorrhage Risk in ischemic stroke patients. The researchers utilized the data accumulated from Virtual International Stroke Trials Archive to verify the accuracy of Totaled Health Risks in Vascular Events score in a large collection of tPA or other acute treated patients. The authors aim to recognise the relationship amongst THRIVE and haemorrhage after administering tPA with various other accessible prediction scores. The researchers concluded that the correlation between THRIVE and the result is not affected by any independent relationship of TPA administration. They also concluded that despite being simple THRIVE scores outperforms many conventional scores and their tools used for prediction.

[8] Explores the viability of THRIVE scores in Chinese patients with acute ischemic stroke after intravenous thrombolysis treatment. The researchers validated the accuracy of the scores against other popularly used scores to determine the validity of THRIVE. The authors examined 1128 patients who have suffered an acute ischemic stroke, and tried predicting their death rate. This provided valuable insight that a higher THRIVe score would lead to a increased risk of developing symptomatic intracranial hemorrhage, inferior functional outcomes, or death. The results exhibit increased accuracy which is at par with the other scores such as ASTRAL and DRAGON.

[9] Investigates the possibility of functional results estimated via a score relying on safe implementation offered to ischemic stroke patients undergoing the IV alteplase. The researchers performed the study in 6483 patients from 285 centers. The researchers concluded after experimenting for 3 months with valuable results and insights which were extremely accurate and reliable. The results after randomizing and pooling the controlled trials the proportion of patients with the same conditions were contrasted with the mortality rates in 3 months of administering the drug. The researchers concluded that altepase is effective and relatively safe for usage in these conditions as a clinical routine after not more than 3 hrs. from the onset of a stroke.

[10] Explores the measurements of acute cerebral infarction through a presented 15 item neurologic examination. The researchers utilized a set of 24 patients for reliability of the examination methods. The validation of the scores was constant irrespective of the professional performing them. The stroke verification was examined by correlating the scores derived from 65 acute stroke patients to their infarction size as validated by CTS and scale validity. The most unreliable item out of the 15 used waspupillary response. The researchers have validated the examinations and proposed methods to increase accuracy in the future.

[11] Describes the operation of XGBoost a scalable tree boosting system that is in widespread use by scientists. It provides sophisticated outcomes on many data science problems. The researches presented an innovative sparsity aware algorithm for handling infrequent data and a justified weighted quantile sketch for indefinite learning. The researchers bring to attention that sharding, data compression and cache access patterns are important parameters for consideration while constructing a end-to-end scalable tree-boosting system. The research concludes that XGBoost is capable of providing the solutions to real-world scale problems using very less resources.

[12] Introduces Scikit-learn a python integrating module designed to implement various conventional machine learning algorithms for solutions on unsupervised and supervised problems. The main area of expertise of this particular package is that it enables easier integration by amateurs or people introduced to the field very recently. The pivotal area in consideration for building of such a package was API consistency, performance, documentation and the most important ease of use. The researchers suggest its use as building blocks for approaches for a particular use case. One of the examples is in application of machine learning in the field of medical imaging, an area of expertise explored heavily by the researchers and has validated extremely positive results as it has minimal dependencies as it is a module based on python.

III. CONCLUSION

Immediate and accurate treatment for ischemic stroke patient is very necessary to save the patient's life. This research article analyzes all the past work on ischemic strokes and also try to understand the different machine learning techniques which can be implemented in evaluation of the right treatment for ischemic patients. After analyzing most of the works this research article finds some methodologies that can overcome the past flaws like accuracy. This leads us to use K- nearest neighbor and Linear Regression methodologies to deal with the outcome of the prediction ischemic patient data. And this process is supported by Fuzzy ANN and Random Forest algorithm techniques.

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