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Machine Learning for Predicting Delayed Onset Trauma Following Ischemic Stroke

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Introduction

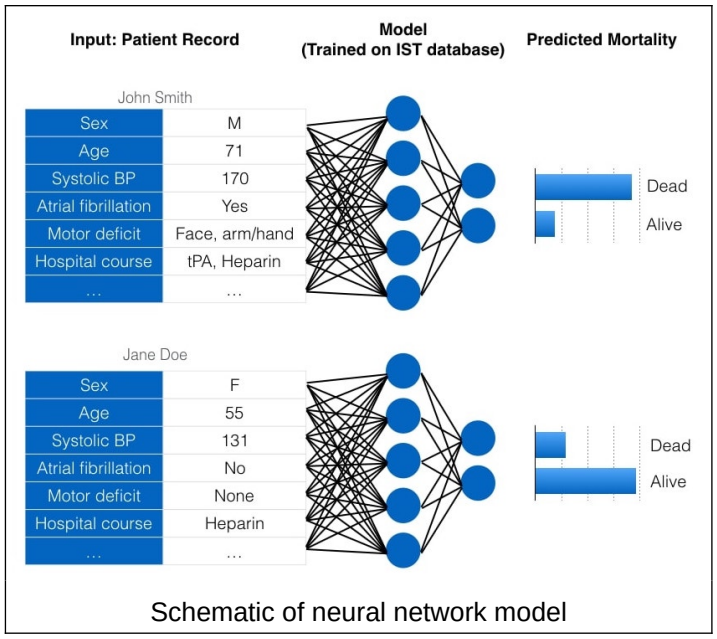
Stroke is currently the fifth leading cause of death in the United States. Interestingly, only 18% of stroke patients die from the initial trauma. Most patient deaths following an acute stroke resulted from complications weeks to months after the initial event. These complications include a recurrent stroke, MI, pneumonia, pulmonary embolism, etc. In this study, we aim to gain a clinical understanding of the most likely risk factors following an ischemic stroke and apply machine learning techniques to predict the likelihood of mortality following an initial stroke event.

Learning Objectives

1) Describe the epidemiology of stroke patients.
2) Predict the likelihood of post stroke complications and mortality

Methods

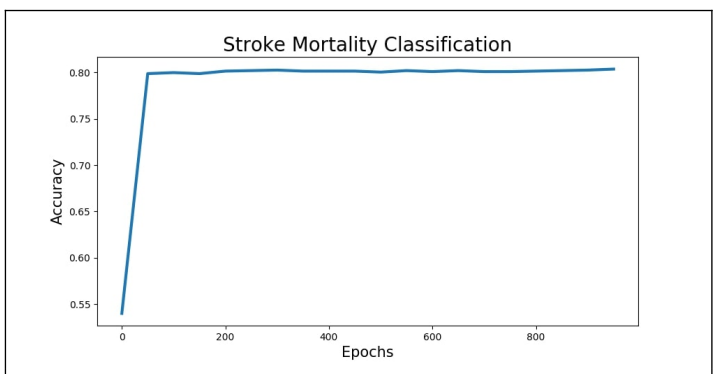
Patient profile data was obtained from the International Stroke Trial (IST) database with 6 years of accumulated data and over 19,000 patient cases. We trained a neural network on 7391 training examples (balanced between those that died of complications and those that remained alive) with 48 features such as age, gender, blood pressure, and presence or absence of infarct to predict the likelihood of delayed mortality due to post-stroke complications. Our model was trained evaluated on 1848 (20%) cases.



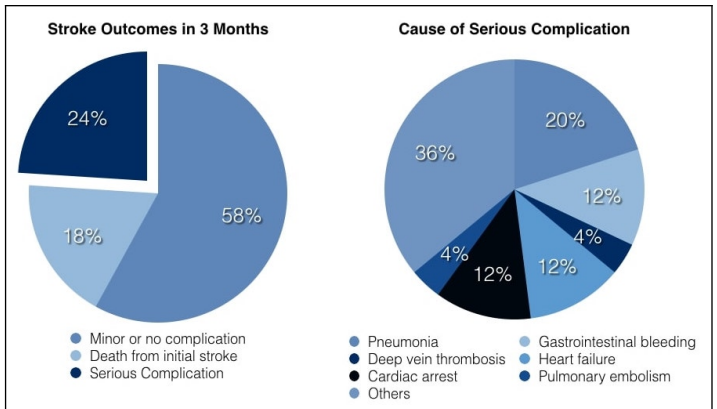
Schematic of neural network model

Results

Initial profiling of the 19,000 patients in the IST database showed that only 18% of patients died from stroke within 3 months, 24% faced serious complications, and 58% had only minor to no complications. The most common serious complications included 20% pneumonia, 12% heart failure, 12% gastrointestinal bleeding, and 12% cardiac arrest. Our best model achieved a classification accuracy of 81.0% (std err = 0.011%).



Accuracy of classifiying post stroke mortality



Epidemiology of post stroke outcomes

Conclusion

Few stroke victims die from the initial trauma. Most patients have a prolonged time window before facing secondary causes of mortality. We applied AI principles to identify the minority of patients that will face secondary mortality. Combining the epidemiological understanding of stroke with machine learning approaches for survival prediction may guide the future of post-stroke management.

Future Directions

- Build the model a more comprehensive patient dataset
- Extend classification problem to better predict exact cause of mortality
- Desconstruct model to identify risk factors for delayed onset trauma

References

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