Predicting Cerebral Performance Category (CPC) Following Cardiac Arrest (CA) with Machine Learning Algorithms
Introduction

- Approximately 750,000 in-hospital cardiac arrest (CA) resuscitations annually in the US
- The Cerebral Performance Category (CPC) score is commonly used to assess functional outcome after CA
- Using machine learning, an algorithm can predict CPC based on admission data, therefore, enabling families to make informed medical decisions as early as possible

<table>
<thead>
<tr>
<th>CPC 1. Good cerebral performance: conscious, alert, able to work, might have mild neurologic or psychologic deficit.</th>
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<tbody>
<tr>
<td>CPC 3. Severe cerebral disability: conscious, dependent on others for daily support because of impaired brain function. Ranges from ambulatory state to severe dementia or paralysis.</td>
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<tr>
<td>CPC 4. Coma or vegetative state: any degree of coma without the presence of all brain death criteria. Unawareness, even if appears awake (vegetative state) without interaction with environment; may have spontaneous eye opening and sleep/awake cycles. Cerebral unresponsiveness.</td>
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<tr>
<td>CPC 5. Brain death: apnea, areflexia, EEG silence, etc.</td>
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</tbody>
</table>

Methods

We collected data on admission and long-term outcome for 400 CA patients admitted to the Neurological ICU at Columbia University Medical Center. Because our algorithm was designed to facilitate a two-year study requiring a minimum of 20 positively selected candidates (survivors of CA with a CPC score of 1 or 2 at eventual discharge), it needed a strong enough recall to support the rate at which patients who suffered CA enter our facilities. Since we see approximately 15 CA patients per month and approximately 14% have a CPC score of 1 or 2, the algorithm needed a recall >50%. Given this data and these parameters, we experimented with several feature selection/data reduction and classification techniques. Cognizant of the use case for this algorithm, feature selection/data reduction was done with an emphasis on strong generalization and classification with an emphasis on simplicity.
Methods

Intermediate Assessment of Required Monthly CA Entry-rate for Candidate Methods
Results

• Current solutions involve pairing Principle Components Analysis for dimensionality reduction with a K-Nearest-Neighbors classifier

• Currently, there is approximately a 75% precision and 50% recall, which requires a 13 person total monthly entry

• This is not the final iteration of the classifier, which should enhance as more data becomes available

```python
def varset_1_features(row):
    return {'get_age': get_age(row),
            'get_gender': get_gender(row),
            'get_bmi': get_bmi(row),
            'get_pre_htn': get_pre_htn(row),
            'get_pre_myocardial_infarction': get_pre_myocardial_infarction(row),
            'get_pre_heart_failure': get_pre_heart_failure(row),
            'get_pre_iddm': get_pre_iddm(row),
            'get_pre_niddm': get_pre_niddm(row),
            'get_pre_cerebrovascular_disease': get_pre_cerebrovascular_disease(row),
            'get_pre_renal_disease': get_pre_renal_disease(row),
            'get_pre_liver_disease': get_pre_liver_disease(row),
            'get_pre_cpc': get_pre_cpc(row),
            'get_rearrest': get_rearrest(row),
            'get_initial_rhythm': get_initial_rhythm(row),
            'get_bystander_cpr': get_bystander_cpr(row),
            'get_bystander_defibrillation': get_bystander_defibrillation(row),
            'get_rosc': get_rosc(row)}
```

*graphic includes selected features from the CA dataset*
Conclusion

Benefits of our current approach:

• PCA is used to mitigate the high-dimensionality of the data, transforming it into linearly uncorrelated features

• K-Nearest-Neighbors is robust in its simplicity and handles the class imbalance

With a larger dataset and/or continued experiment with additional feature selection and classification methods, algorithms could offer more insight into predicting CPC among CA patients based on admission scores.
Disclosures

There are no disclosures for this study and poster.