University of Southampton & the Institute for Life Sciences

A machine-learning approach to predict Upper Gastrointestinal multidisciplinary team treatment decisions

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Background and Objectives

The Upper GI multi-disciplinary team (MDT) is complex

Rising workload, time pressures and demands

This creates heterogeneity or 'noise' within decision-making for oesophageal cancer (OC)

Machine learning (ML) can standardize, automate and increase consistency through, data-driven decisions

SO...

Can we create an ML model that uses only initial data available to MDTs to predict whether an OC patient gets one of the following treatment pathways?

Neoadjuvant Chemotherapy

Neoadjuvant Chemoradiotherapy

Surgery alone

Methodology and Results

399 post-oesophagectomy cases between 2010-2020

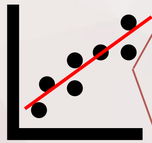
20 pre-treatment variables available to MDT at first discussion including staging, demographics and co-morbidities

Data analysis coded using RStudio

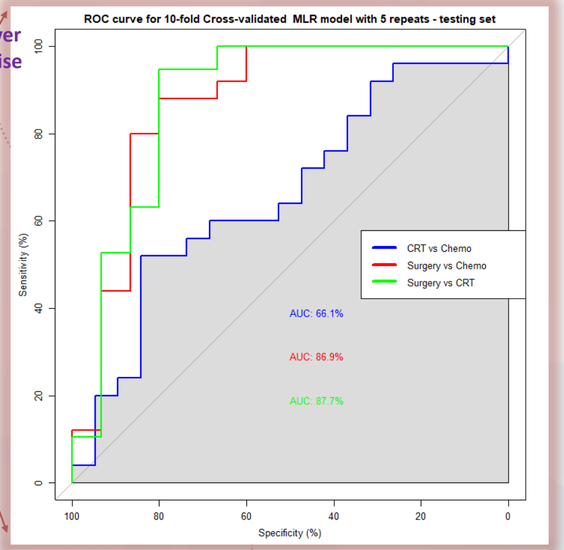
L2 regularised k=10x Cross-validated Multinomial Logistic Regression classifier model produced

Model performance assessed on Receiver Operator Characteristic (ROC) on pairwise comparison of class predictions

$$y = c + b_1x_1 + b_2x_2 + \ldots$$



Model designed to classify into Surgery, Chemo or CRT as 1st treatment outcome prediction



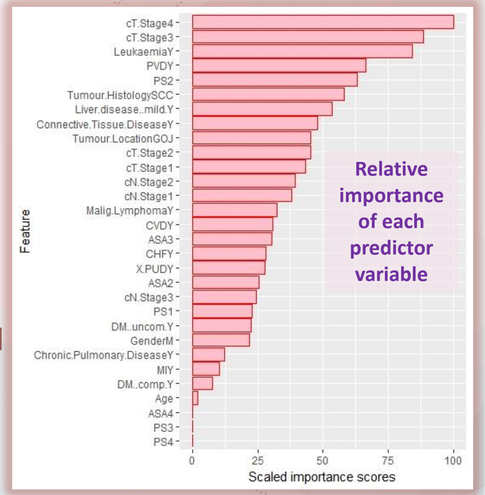
Area Under Curve

CRT vs Chemo = 66.1%

Surgery vs Chemo = 86.9%

Surgery vs CRT = 87.7%

N = 399
Median Age = 66.1yrs (range 32-83)
Male: Female = 3.6:1



Relative importance of each predictor variable

Abbreviations:
PVD = Peripheral vascular disease, PS = WHO performance status class (0-4), CVD = cardiovascular disease, ASA = American society of Anaesthesiologists grade (1-4), CHF.= congestive heart failure, X.PUD = History of peptic ulcer disease, DM = Diabetes (uncomplicated/complicated). Suffix "–Y" indicates condition present.

Conclusions

1
Even basic ML models are capable of predicting MDT treatment decisions e.g., surgery vs neoadjuvant therapy (NAT).

2
Our model also highlights uncertainty ("noise") in the MDT over Chemo vs CRT – reflective of ongoing debate? (c.f. NeoAegis Trial)

3
Such models in future may improve efficiency, reduce MDT discussion time, and offer solutions for consideration where more complex cases pose challenges

4
This study is the first step. Future work will need to incorporate additional data e.g., medical imaging, histopathology, social data plus expansion to other classifier algorithms

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