

# Combining Delta-Radiomics and Clinical Biomarkers Based On KNN-PCA Classification to Improve Treatment Outcome Prediction for Pancreatic Cancer

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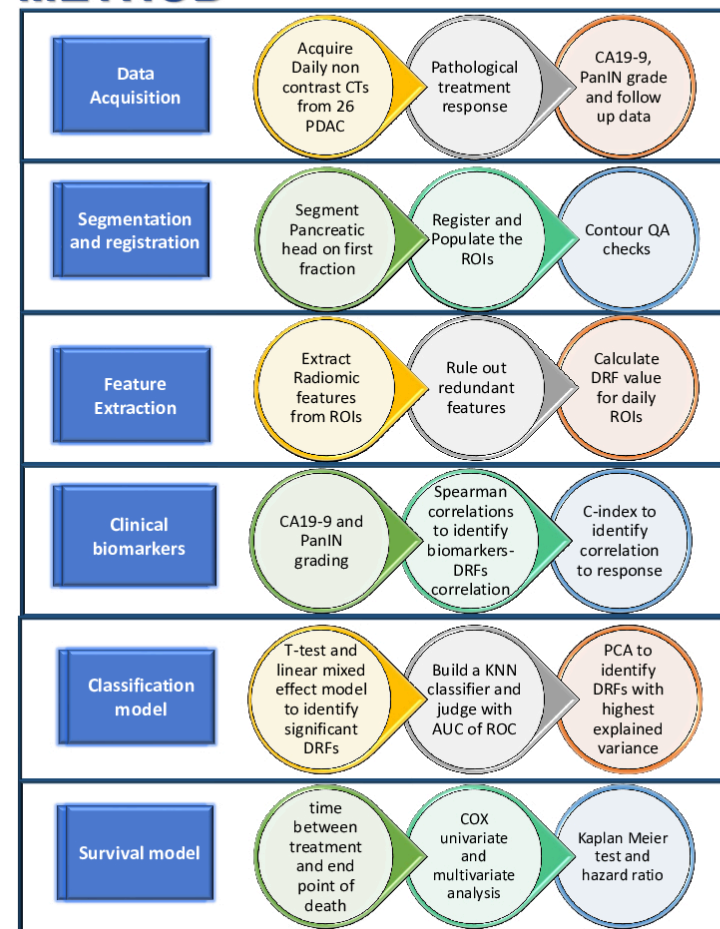
## INTRODUCTION

- ❖ Pancreatic cancer is one of the leading causes of cancer death in the United States.
- ❖ Detecting treatment response in early stages is a critical step that can aid in determining the best treatment plan for these patients.
- ❖ CT delta-radiomics is a quantitative tool that can assess the relative net change of radiomic features over time and can be used to predict tumor response.
- ❖ Recently we showed that some delta-radiomics feature changes significantly with response and if combined with CA19-9 can lead to a faster discovery of tumor response.

## AIM

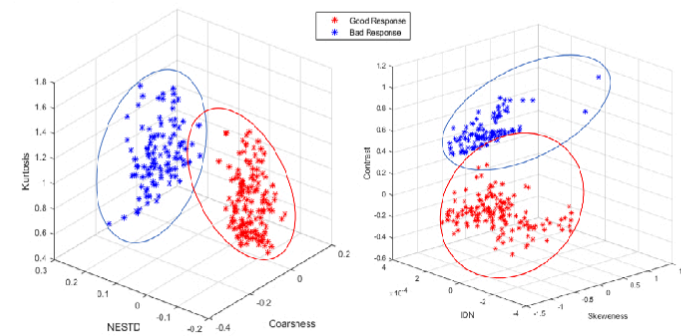
The goal of this study is to extend this work to investigate the effect of including the precursor lesion (PanIN) into the biomarker panel and to determine if a KNN-PCA based classifier can identify appropriate DRFs that can be combined with CA19-9 and PanIN grade to improve treatment outcome prediction

## METHOD

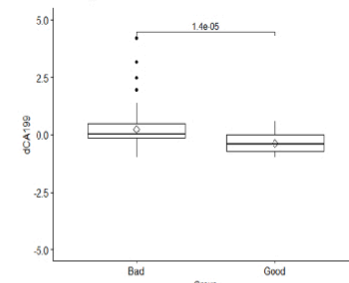


## RESULTS

- ❖ 13 DRF are correlated to pathological treatment response and show significant differences between the two response groups. 3D scatter plot of three DRFs combinations for the 2-4 week of treatment shows a separation between the two response groups. Of these DRFs, CA19-9 and PanIN are each correlated to 3 DRFs.

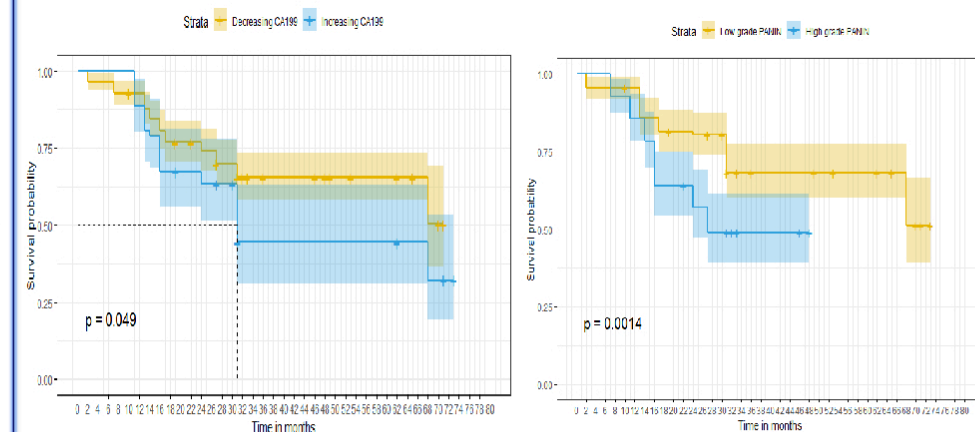


- ❖ The changes in normalized CA19-9 levels and different PanIN grades were significantly different between the two-response groups. Increasing CA19-9 levels during treatment or a high PanIN grade was correlated to bad response.

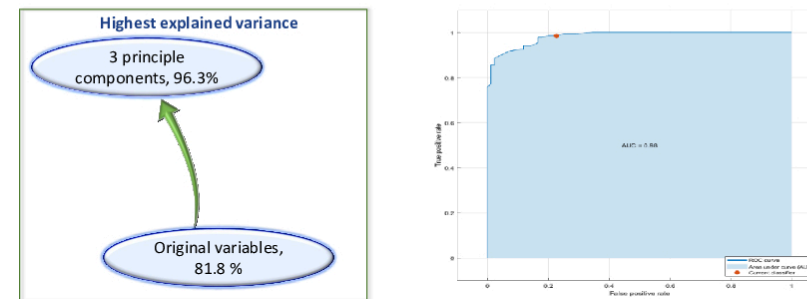


- ❖ The Cox proportional multivariate hazard analysis showed that treatment related decrease in CA19-9 levels (p=0.031), low PanIN grade (p=0.03) and DRFs (p=0.001) were independent predictor of survival.

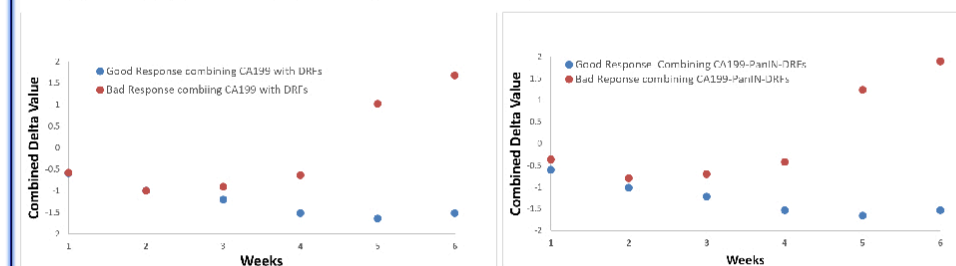
- ❖ The univariate analysis showed that patients with decreasing CA19-9 or low PanIN grade has an improved median survival (68 month) compared to those with increasing levels (31-month) and high PanIN grade (27 months).



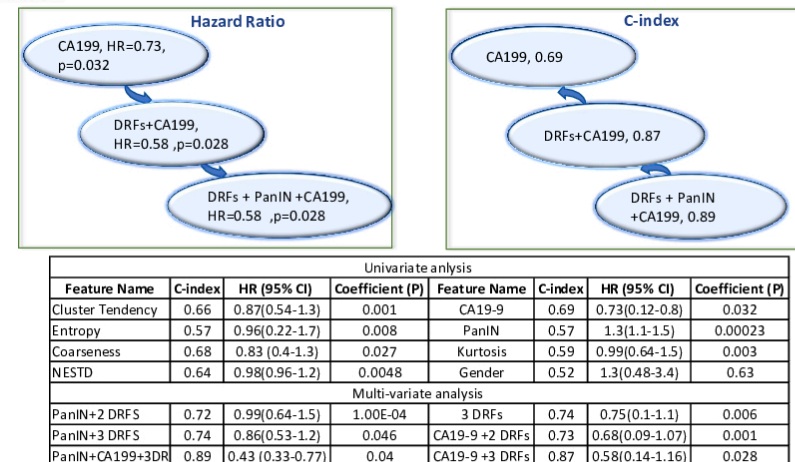
- ❖ Using the original DRFs, the highest explained variance by a single variable was 77%; increased to 80% using one PC while the lowest explained variance dropped from 4.6% to less than 0.04%.
- ❖ The highest explained variance by three variables also increased, from 81.8% to 96.3% enabling a better classification model while reducing dimensionality of data.
- ❖ The AUC of the KNN classifier increased from 0.57 using single variable to 0.89 incorporating PanIN-CA19-9-DRFs combination. Using the PCA, the highest explained variance by three variables increased from 81.8% using original variables to 96.3% using 3 PCs. The AUC of the KNN-PCA classifier was further improved to 0.98 with 0.9 accuracy (Figure 4) indicating a better classification model with reduced dimensionality.



- ❖ Using CA19-9 alone, the earliest significant differences between the good and bad response groups were seen by the 4th week of the treatment as demonstrated by the significant p-values of the t-test. The treatment response prediction shifted to the 3<sup>rd</sup> week of treatment incorporating CA19-9 with DRFs to 2<sup>nd</sup> week incorporating PanIN, CA19-9 and DRF-PCs leading to a faster discovery of treatment response



The hazard ratio was reduced from 0.73, p=0.032 with a c-index of 0.69 using CA19-9 only to 0.58, p=0.028 with c-index of 0.87 combining DRFs to CA19-9 to 0.43, p=0.04 with c-index of 0.89 using PanIN-CA19-9-DRFs combination.



## CONCLUSIONS

- ❖ We have introduced a new oncologic profile combining delta radiomics and clinical biomarkers.
- ❖ KNN-PCA based classifier can identify appropriate DRF-PanIN-CA199 combinations to improve the predictions of pathology response and survival for CRT of PDAC.
- ❖ Once verified with a larger data set, this oncologic profile can be developed into biomarker that has the potential to
  - ❖ lead to a faster prediction of treatment response
  - ❖ increase the prognostic value
  - ❖ increase the possibility for response-based treatment adaptation
  - ❖ and hence, lead to better patient specific outcomes

## ACKNOWLEDGEMENTS

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