Magnetic Resonance Imaging(MRI)-based radiomic models in prostate cancer diagnosis, staging, and treatment response prediction: systematic review and meta-analysis.

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Introduction

- Prostate cancer is the most common non-cutaneous cancer in men.
- Numerous Magnetic Resonance Imaging (MRI)-based radiomic models have been developed to predict presence, staging and treatment response of prostate cancer.
- The objective of this study is to pool the reported test utility of the radiomic models from the existing publications as well as to determine the most prevalent radiomic features with the goal of suggestion of best MRI-based radiomic model.

Methods

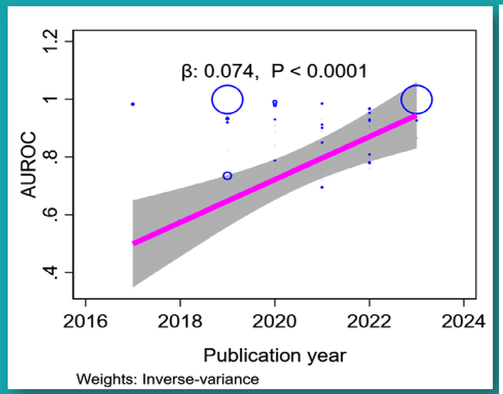
- PubMed database query, and the keywords (prostate AND MRI AND radiomics) revealed 264 studies. After exclusion of non-relevant publications, 68 studies were included in the meta-analysis.

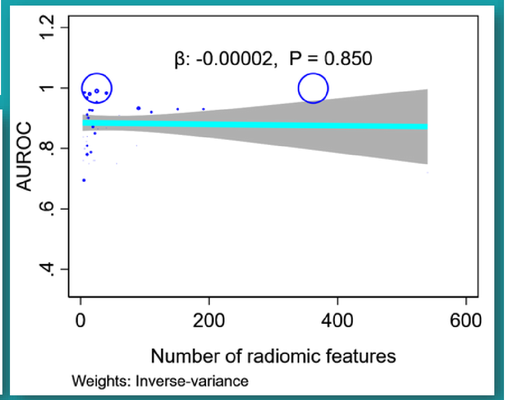
Results

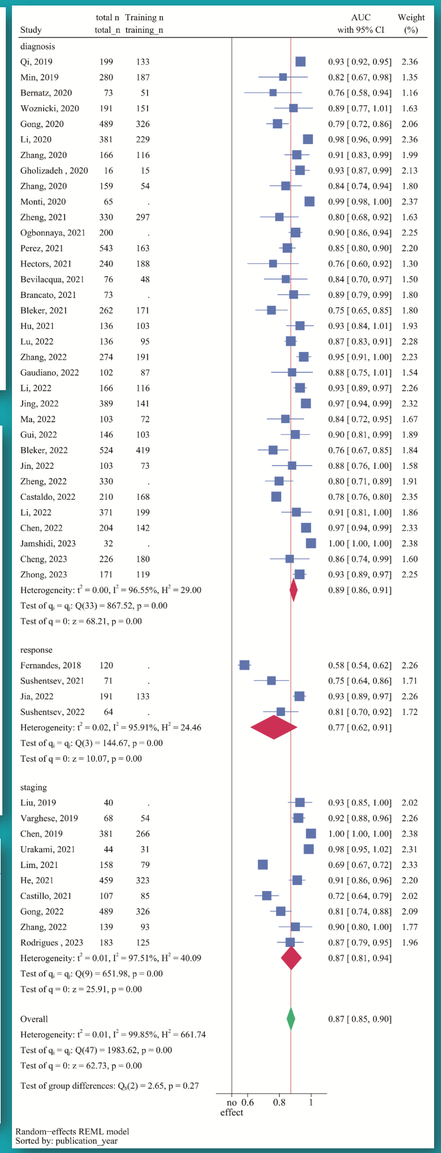
- Average sample size of the studies was 205 patients (range: 13-380), 20% of the studies had used external validation (14/68), outcome of interest was diagnosis in 62% (41/68), staging in 31% (21/68) and treatment response in 7% (5/68) of the studies.
- Most common modelling methods were logistic regression: 19% (13/68), support vector machine: 13% (9/68) and random forest: 12% (8/68).
- Most common feature categories: general features: 46% (452/986), wavelet: 27% (262/986) and log sigma: 11% (104/986).

Results

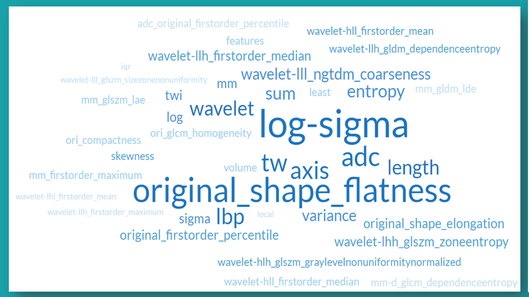
- Most common feature selection methods: least absolute shrinkage and selection operator (LASSO): 31% (21/68), maximum-relevance minimum-redundancy (m-RMR): 24% (16/68) and intraclass correlation coefficient (ICC): 18%(12/68).
- Pooled area under receiver operating characteristic (AUROC) curve (95% confidence interval) for the best models for diagnosis, staging and treatment response prediction were 0.889 (0.863–0.915), 0.872 (0.845–0.941) and 0.765 (0.616–0.915), respectively
- Significant positive association between publication year and AUROC in treatment response prediction studies but not other two categories (β: 0.074, P<0.0001).
- No association between the number of the radiomic features and model AUC (β: -0.0002, P=0.850).

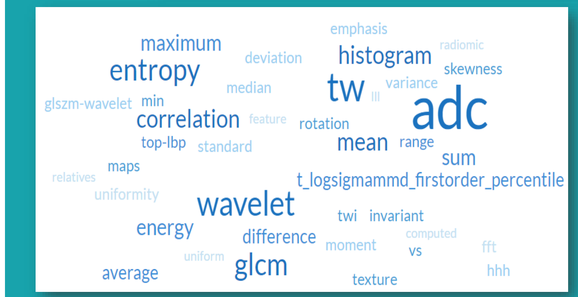




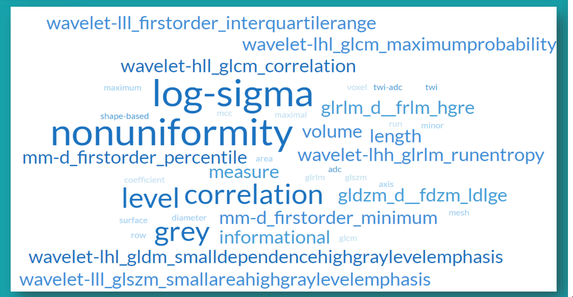


Diagnosis





Staging



Treatment

Conclusions

- MRI-based radiomic machine learning models show high validity in diagnosis, staging, and treatment response prediction of prostate cancer.
- Increase in the number of radiomic features does not improve predictive value of the models.
- Wide heterogeneity in patient selection and applied statistical models can limit their generalizability.
- Future studies should focus on: internal and external validation using multicenter/multiscanner datasets, utilize clinical and lab values in models, determine optimal protocol for imagine acquisition, segmentation, and feature extraction.

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