Machine Learning (ML) Applied to Real-World Data to Guide Prescription of Immune-Therapies in Metastatic Melanoma: A Pilot Study

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INTRODUCTION

Early detected melanoma can often be treated using surgical excision with good outcomes. In the case of metastatic disease development, molecular targeted therapy and immunotherapy are mainly used. However, while effective in many patients, the percentage of treated patients responding is lower than anticipated.

OBJECTIVES

Newly diagnosed metastatic melanoma patients are often treated with molecular targeted therapy (TT) or with immunotherapy (IO). However, only a limited proportion of patients respond to those therapies, resulting in reduced survival and substantial inefficiencies for health systems. The purpose of this work is to explore and identify early predictors of IO responses measured in real-world practice with the goal of guiding prescribers at the point of care.

METHODS

A real-world data registry of over 5,000 melanoma patients from 11 Canadian hospitals was interrogated for this research. The registry was built using the Pulse Infoframe platform that collects routine care data including clinical profile, diagnosis, procedures, treatment history and outcomes. A cohort of 600 metastatic melanoma patients receiving IO as first line of therapy was extracted from the registry;

these patients also had data entered in the registry for 21 potential predictors for IO-responsiveness based on literature reviews and medical expertise. A suite of statistical models and ML algorithms was assessed and compared for accuracy in predictive performance via within-model cross-validation for IO response at first line treatment initiation.

Figure 1. Population repartition per treatment arm

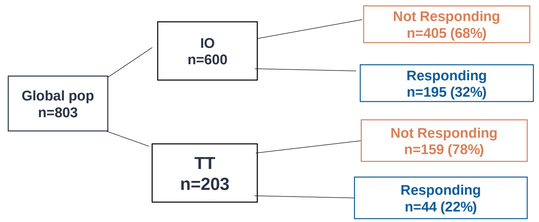
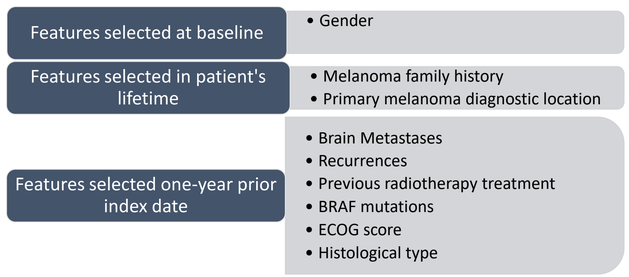


Figure 2. Features Included in Model

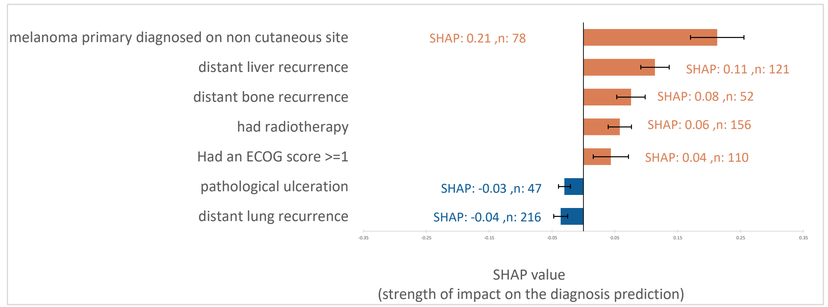


RESULTS

Light Gradient Boosted Machine algorithms outperformed all others, with 7 predictors from the disease stage or disease and care history clinical domains, such as primary tumor site at diagnosis, site of recurrence, previous radiotherapy and ECOG score.

Having a non-cutaneous melanoma is the strongest predictor of not responding to treatment. On the contrary, the presence of pathological ulceration and presence of metastases in lung decrease the probability of not responding.

Figure 3. Features Impact on Prediction



Categorial features' presence increasing probability of not responding

Having a non-cutaneous melanoma is the **strongest predictor** of not responding to treatment

Categorial features' presence decreasing probability of not responding

On the contrary, the presence of pathological ulceration and presence of metastases in lung **decrease the probability of not responding**

CONCLUSION

This first evaluation confirmed that ML algorithms applied to real-world data can be a powerful tool to characterize best responders and guide medical practice. Further work is planned to improve and deploy generalizable, performant ML algorithms applicable to real-world data, and evaluate the operational feasibility and cost effectiveness.