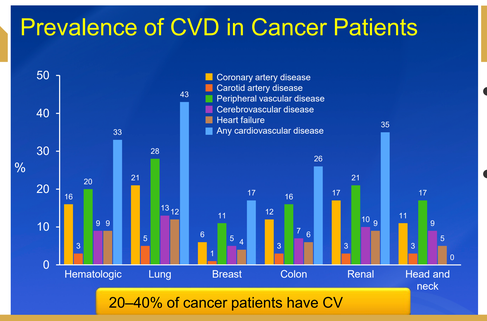
MACHINE LEARNING MODELING TO SUPPORT CARDIO-ONCOLOGY MEDICAL PRACTICE

Samer S. Al-Droubi, MS[1,8], Eiman Jahangir, MD[1], Karl M. Kochendorfer, MD[2], Marianna Krive, DO[3], Michal Laufer-Perl[4], MD, Dan Gilon, MD[5], Tochukwu M. Okwuosa, DO[6], Christopher P. Gans, MD[10], Joshua H. Arnold, MD[2], Shakthi T. Bhaskar, MD[1], Hesham A. Yasin, MD[1], Jacob Krive, PhD[2,7,8,9]

[1] Vanderbilt University Medical Center, Nashville, TN; [2]University of Illinois at Chicago, Chicago, IL; [3]Advocate Aurora Healthcare, Park Ridge, IL; [4]Sourasky Medical Center, affiliated to the Sackler School of Medicine, Tel Aviv University, Israel; [5]Hadassah Medical Center, Faculty of Medicine, Hebrew University of Jerusalem, Israel; [6]Rush University Medical Center, Chicago, IL; [7]NorthShore University Health System, Evanston, IL; [8]Nova Southeastern University, Fort Lauderdale, FL; [9]University of Chicago Pritzker School of Medicine, Chicago, IL; [10]University of Michigan, Ann Arbor, MI.

What is Cardio-oncology?

- New cardiology subspecialty focused on preventive and acute treatment of cardiovascular side effects associated with toxicity from chemotherapy, radiology, and immunotherapy.
- 2nd most prevalent cause of death among oncology patients, less common than only the primary cancer diagnosis itself



Goal

- Calculate risk scores to identify and refer patients who are susceptible to cardiotoxicity to oncologists.
- Standardize recommendations among oncologists and cardio-oncologists by incorporating risk scores within the EHR as best practice alerts or timely reports which leads to more equitable patient care.

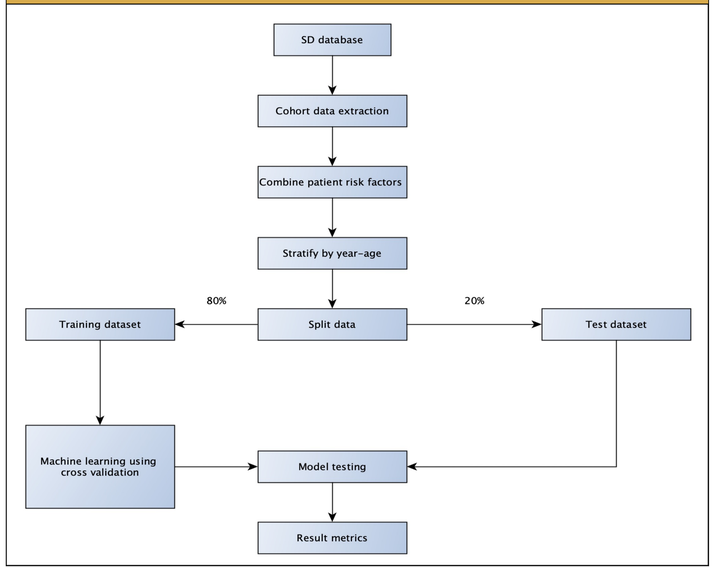
METHODS AND RESULTS

Cohort	Treatment
Breast Cancer	Doxorubicin, Bevacizumab…etc.
B-cell Lymphoma	Acalabrutinib, Cisplatin...etc.
Renal Cancer	Everolimus, Sorafenib...etc.
Immunotherapy (limited to melanoma, lung cancer and kidney cancer patients)	Nivolumab, Pembrolizumab…etc.

Risk Scores

- Diabetes
- Cholesterol
- Ejection Fraction
- A1C
- BMI
- Smoking
- Race
- BNP Levels
- Coronary Artery Disease
- …etc.

Model Training and Evaluation



Algorithms and Outcomes

- Random Forest and artificial neural network models were trained.
- Multiclass predictive scores of Major, Moderate, Low and Potential were generated.
- Research study models performance exceeded 92% on accuracy and 90% on AUC.

Conclusion

Predictive models are ready for translation into oncology practice to identify and care for patients who are at high risk of cardiotoxicity. Limited validation identified 86% of the lymphoma and 58% of the renal cancer patients with “Major” risk for cardiotoxicity who were not referred to cardio-oncology. A renal cancer pilot project is underway to integrate model predictions with Epic workflows by leveraging data in the VUMC Data Lake (Microsoft Azure) along with cloud compute in the Azure Databricks (Spark) platform.