MEDINFO 2023 — The Future Is Accessible
J. Bichel-Findlay et al. (Eds.)

doi:10.3233/SHTI231264

Towards an Explainable AI Platform to Study Interruptions in Cancer Radiation Therapy

Arash SHABAN-NEJAD[a,1], Nariman AMMAR[b], Fekede KUMSA[a], Soheil HASHTARKHANI[a], Brianna WHITE[a], Lokesh K Chinthala[a], Chase A OWENS[c], Neil HAYES[d] and David L SCHWARTZ[e]

[a] *University of Tennessee Health Science Center – Oak-Ridge National Lab (UTHSC-ORNL) Center for Biomedical Informatics, Department of Pediatrics, College of Medicine, Memphis, Tennessee, USA*
[b] *School of Information Technology, College of Applied Science and Technology, Illinois State University, Normal, Illinois, USA*
[C] *University of Tennessee Health Science Center, Memphis, Tennessee, USA*
[d] *Division of Med Hematology, Department of Medicine, University of Tennessee Health Science Center, College of Medicine, Memphis, Tennessee, USA*
[e] *Departments of Radiation Oncology & Preventive Medicine University of Tennessee Health Science Center, College of Medicine, Memphis, Tennessee, USA*
ORCiD ID: Arash Shaban-Nejad https://orcid.org/0000-0003-2047-4759

Abstract. Radiation therapy interruptions drive cancer treatment failures; they represent an untapped opportunity for improving outcomes and narrowing treatment disparities. This research reports on the early development of the X-CART platform, which uses explainable AI to model cancer treatment outcome metrics based on high-dimensional associations with our local social determinants of health dataset to identify and explain causal pathways linking social disadvantage with increased radiation therapy interruptions.

Keywords. Cancer informatics, public health informatics, explainable AI, causal inference, social determinants of health, disparities

1. Introduction

Most patients with solid tumors require radiation therapy (RT) to cure or control the disease. RT involves up to 1-2 months of daily treatment at specialized facilities. RT can produce severe side effects, necessitating intensive supportive care. It places strict logistical demands on patients and caregivers, similar to but distinct from those required by surgery or chemotherapy. Extended RT interruptions (RTI) are strongly associated with shorter survival across many tumor types. We have observed significant associations between RTI and unplanned hospital admissions during cancer treatment, a costly and potentially preventable outcome that administrators and insurers prioritize for

[1]Corresponding Author: Arash Shaban-Nejad, UTHSC, Memphis, email: ashabann@uthsc.edu.

prevention [1]. X-CART (eXplainable CAncer Radiation Therapy Platform) will provide secure access to individual and population-level social/health data to empower providers to select patients most in need of support. Such support is resource intensive, especially in impoverished areas, so accurate patient selection is critical to cost-effective impact.

2. Methods

We leveraged our previous digital platforms [2-4] all of which are designed to explain complex individual and social challenges in disadvantaged populations. Our design process approaches data collection, standardization, knowledge creation, and inferred intelligence with stepwise rigor. X-CART will use Social Determinants of Health data from community-level data sources, individual-level data about patients, and clinical data from Electronic Health Records to create a fully interoperable health data platform. Ontologies capture contextual knowledge to generate interactive knowledge graphs for clear causal pathway analysis. Our initial analytics outcome will be fed into subsequent refinement cycles to uncover new interactions. Our graph-based machine learning algorithms will improve classification, predict new relationships, and engineer new features and metrics.

3. Results

X-CART will be able to clearly explain to providers why individual patients are at risk for RTI, and then immediately triage them toward intervention. X-CART analytics pathway includes multi-level multimodal data collection to direct collaboration with practicing clinicians. Our infrastructure allows the automated collection of community-level social risk data along with individual patient-level clinical data. X-CART uses explainable AI to explain and display social risks and potential interventions.

4. Conclusions

This project will expand our work to disadvantaged cancer patients. While this work focuses on radiotherapy could be pivoted to other situations.

References

[1] Hubler A, Wakefield DV, Makepeace L, Carnell M, Sharma AM, Jiang B, Dove AP, Garner WB, Edmonston D, Little JG, Ozdenerol E, Hanson RB, Martin MY, Shaban-Nejad A, Pisu M, Schwartz DL. Independent Predictors for Hospitalization-Associated Radiation therapy Interruptions. Adv Radiat Oncol. 2022 Jul;7(6):101041, doi: 10.1016/j.adro.2022.101041.

[2] Ammar N, Bailey JE, Davis RL, Shaban-Nejad A. Using a Personal Health Library-Enabled mHealth Recommender System for Self-Management of Diabetes Among Underserved Populations: Use Case for Knowledge Graphs and Linked Data. JMIR Form Res. 2021 Mar;5(3):e24738, doi: 10.2196/24738.

[3] Brakefield WS, Ammar N, Shaban-Nejad A. An Urban Population Health Observatory for Disease Causal Pathway Analysis and Decision Support: Underlying Explainable Artificial Intelligence Model. JMIR Form Res. 2022 Jul;6(7):e36055, doi: 10.2196/36055.

[4] Schwartz DL, Stewart A, Harris L, Ozdenerol E, Thomas F, Johnson KC, Davis R, Shaban-Nejad A. The Memphis Pandemic Health Informatics System (MEMPHI-SYS)-Creating a Metropolitan COVID-19 Data Registry Linked Directly to Community Testing to Enhance Population Health Surveillance. Disaster Med Public Health Prep. 2022 Dec;17:e326, doi: 10.1017/dmp.2022.284.