# *Predicting Brain Aging After Radiation Using an Image-Based Machine Learning Model*

Translational Science Benefits Model

# IMPACT PROFILE

This study used an existing machine learning model to predict brain "age" based on MRI scans. We applied the model to compare how the brain ages after two types of radiation therapy, compared to healthy people who did not receive radiation. This research could help find early signs of cognitive problems after radiation treatment.

## The Challenge

Cognitive decline occurs in 50-90% of patients who receive whole brain radiation for the treatment of brain metastases, tumors that have spread to the brain from another part of the body. Cognitive side effects can significantly reduce a patient's quality of life and exacerbate caregiver stress. Currently, there are no methods to predict or monitor radiation-induced cognitive decline.

## The Approach

The research team applied the following approach to evaluate brain aging after radiation therapy:

- Retrospective study of patients treated at WashU radiation oncology
- Identification of patients who received whole brain radiation therapy (WBRT) and stereotactic radiosurgery (SRS)
- Estimate "brain age" from pre-radiation and post-radiation MRI scans
- Compare aging pace after WBRT and SRS with normal aging in healthy controls

## The Impact

Our study used machine learning to predict brain age before and after two different types of radiation therapy compared to healthy controls. This model has the potential to track cognitive side effects from radiation. The ultimate goal of this project is to improve personalized clinical monitoring and patient counseling after treatment. Additionally, an imaging biomarker can streamline research in radiation induced neurocognitive decline, towards potential new therapies and preventions.

## RESEARCH HIGHLIGHTS

- The whole brain aged **7 times faster** after WBRT and **4 times faster** after SRS vs. healthy controls
- WBRT and SRS **both aged the cortex** while WBRT **only aged the subcortical structures**
- **Potential biomarker** for radiation-induced cognitive decline

## Key Benefits

This machine learning brain aging study resulted in **clinical** and **community** benefits.

Clinical

**Diagnostic procedures**: Potential identification of a novel imaging biomarker to monitor and diagnose cognitive decline post-radiation

Clinical

**Investigative procedures**: Better understand mechanisms of cognitive decline for future research on treatment and prevention

Community

**Health care quality**: Potential to improve clinical guidance and support for patients with cognitive side effects after treatment

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