Childhood Cancer Data Initiative Webinar Series

Kids Aren't Small Adults: Building Intentional AI for Pediatric Brain Tumors

Pallavi Tiwari

NIH NATIONAL CANCER INSTITUTE

IDiA Lab

Integrated Diagnostics and Analytics (IDiA) Laboratory for Precision Medicine

VA U.S. Department of Veterans Affairs

Today's Speaker

Pallavi Tiwari, Ph.D.

- University of Wisconsin-Madison
  - Vilas Distinguished Achievement Professor
  - Associate Professor, Departments of Radiology, Biomedical Engineering, Medical Physics
  - Co-Director, Imaging and Radiation Science, Carbone Cancer Center
- William S. Middleton Memorial Veterans Affairs Healthcare
  - Research Health Scientist

Agenda

1. *Challenges Developing AI Tools in Pediatric Brain Tumors*
2. *Medulloblastoma Risk Stratification*
3. *Opportunities and Future Directions*

Kids Aren’t Small Adults: Lessons Learned Building AI Tools for Pediatric Brain Tumors

Pallavi Tiwari, Ph.D.

Conflicts of Interests

- LivAi Inc. – Founder, Equity
- Scientific Consultant – Interventional Oncology, Johnson & Johnson Inc.
- University of Wisconsin receives research support from GE Healthcare

Healthcare & AI: The Next Frontier

2 in 3 physicians are using health AI—up 78% from 2023

Feb 26, 2025

Physicians' use of health care augmented intelligence (AI) for certain tasks nearly doubled in just o
enthusiasm for the technology is growing even if some doubts still linger, says a recently released AM

Nearly two-thirds of physicians, 66%, surveyed reported using health care AI—often called artificial i
2024. Among other things, physicians are finding uses for AI for documentation of billing codes, me
visit notes; creation of discharge instructions, care plans or progress notes; translation services, assi
and more. The 66% usage rate marks a 78% jump from the 38% of physicians who said they used it i

Four key takeaways

The survey provides these four key insights into where physicians stand on AI.

There has been substantial growth in physicians using AI in practice. In addition to 66% of physicians reporting they used AI in 2024, there was a dramatic drop in the number of physicians who reported being nonusers. In 2024, just 33% of physicians reported that they didn't use AI in any of the ways the study inquired about. A year earlier, 62% of physicians said they didn't use AI.

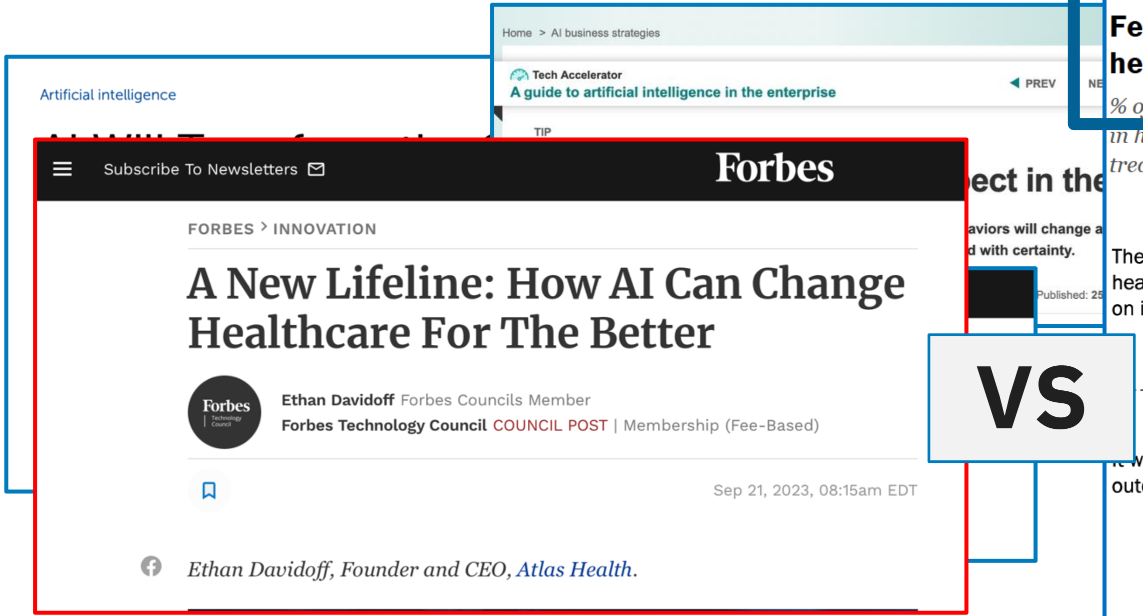
Physicians have a more positive sentiment and increased enthusiasm toward AI, with growing recognition of the benefits the technology can offer. Among physicians surveyed most said that they recognized AI's benefits, with 68% reporting that AI had definite at least some advantage in patient care. That's five percentage points higher than it was in 2023.

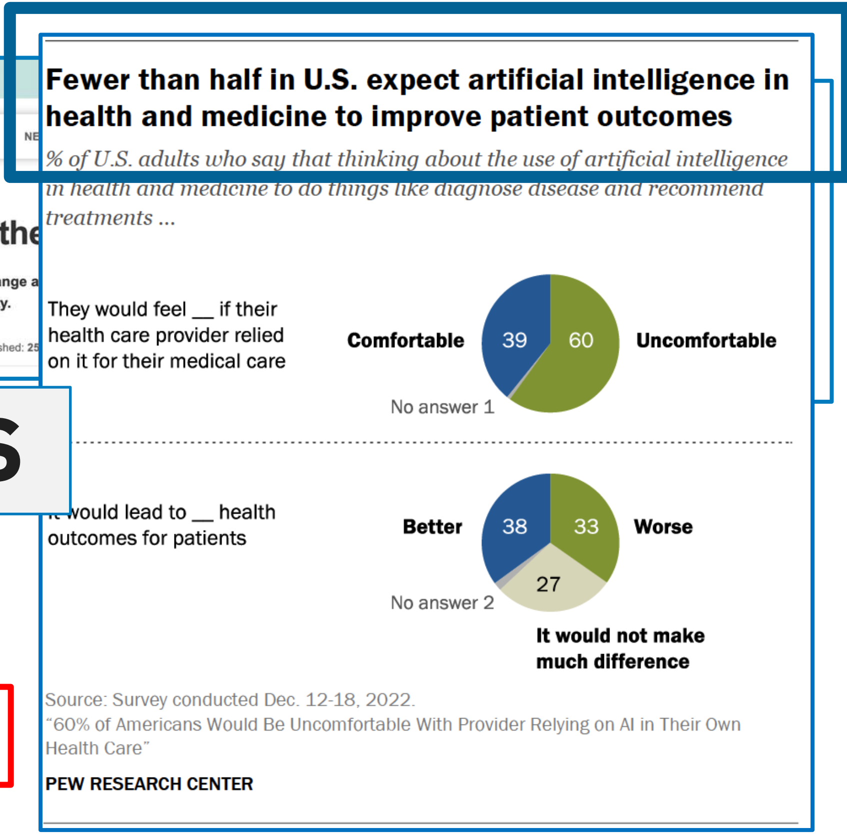
Physicians believe that one of the key areas of opportunity with AI is using it to address administrative burdens. More than half of physicians—57%—said reducing administrative burdens through automation was the biggest area of opportunity for AI. Physicians in the near term are focused on adopting AI that helps with documentation.

Physicians still expressed that key needs must be met for them to build trust and advance their AI adoption. A feedback loop, data privacy assurances, seamless workflow integration and adequate training and education are the critical things that physicians said they need to adopt AI. Nearly half of physicians surveyed—47%—ranked increased oversight as the number one regulatory action that needed to happen to increase their trust in

ama-assn.org/practice-management/digital-health/2-3-physicians-are-using-health-ai-78-2023

Healthcare & AI: The Next Frontier

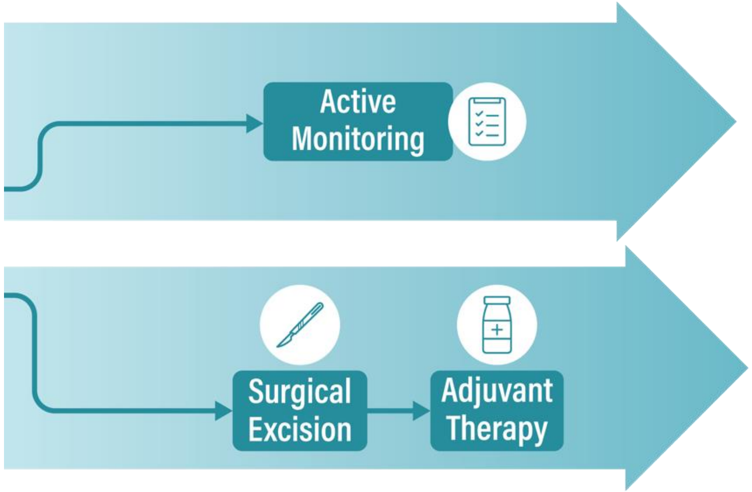




What does it mean to bridge this gap?

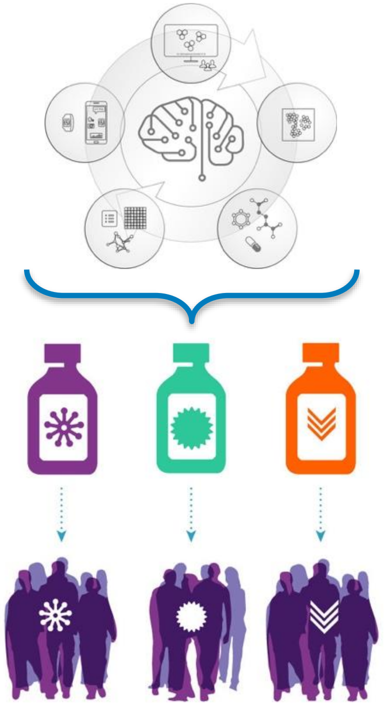
The Gap Between Where We Are Today…

…vs how we ideally *want* to treat patients



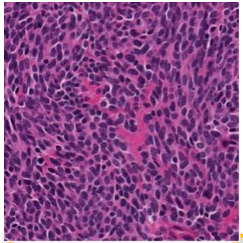
Goal: "Design" AI to Bridge the Gaps in Precision Medicine

- Precision Medicine: Using prognostic and predictive tools for tailoring therapy for a patient based off specific risk profile
  - Prognostic: Predicting disease outcome, progression
  - Predictive: Predicting response to treatment
- Computational Imaging: Extraction of quantifiable features via
  - Radiomics – using radiographic imaging (MRI, CT, PET, etc.)
  - Pathomics – digital pathology (high-res scans of stained tissue)

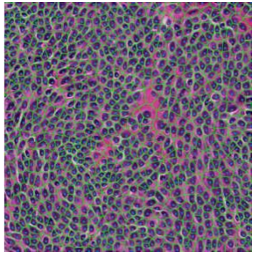


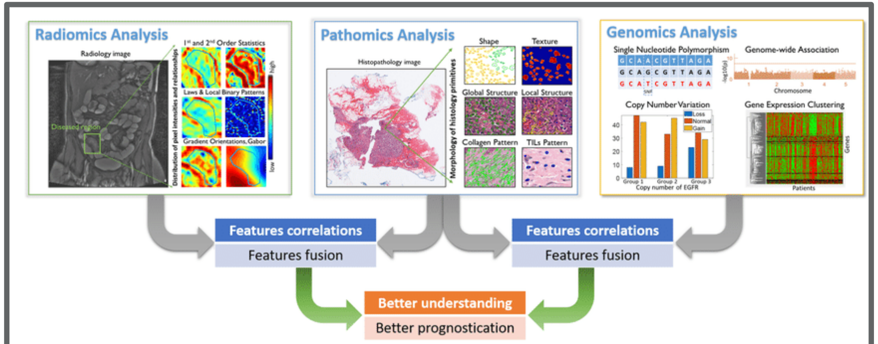
Leveraging AI to Identify Disease Biomarkers

Pathomics

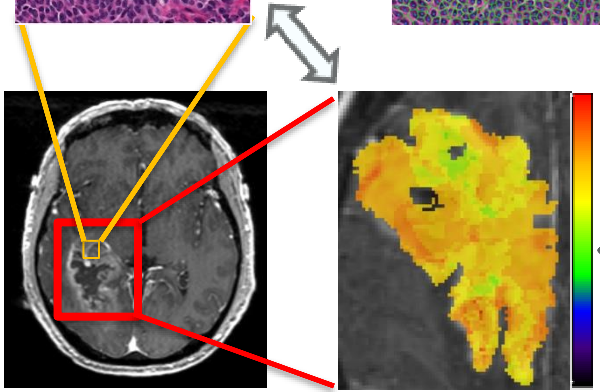


Radiomic-pathomic correlations



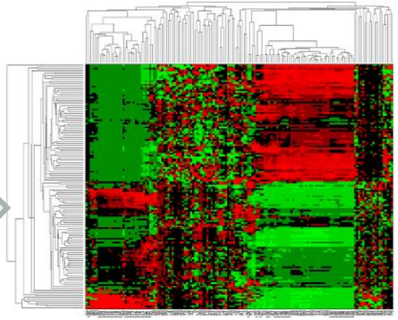


Omics Correlation/Fusion



Radiomics

Genomics

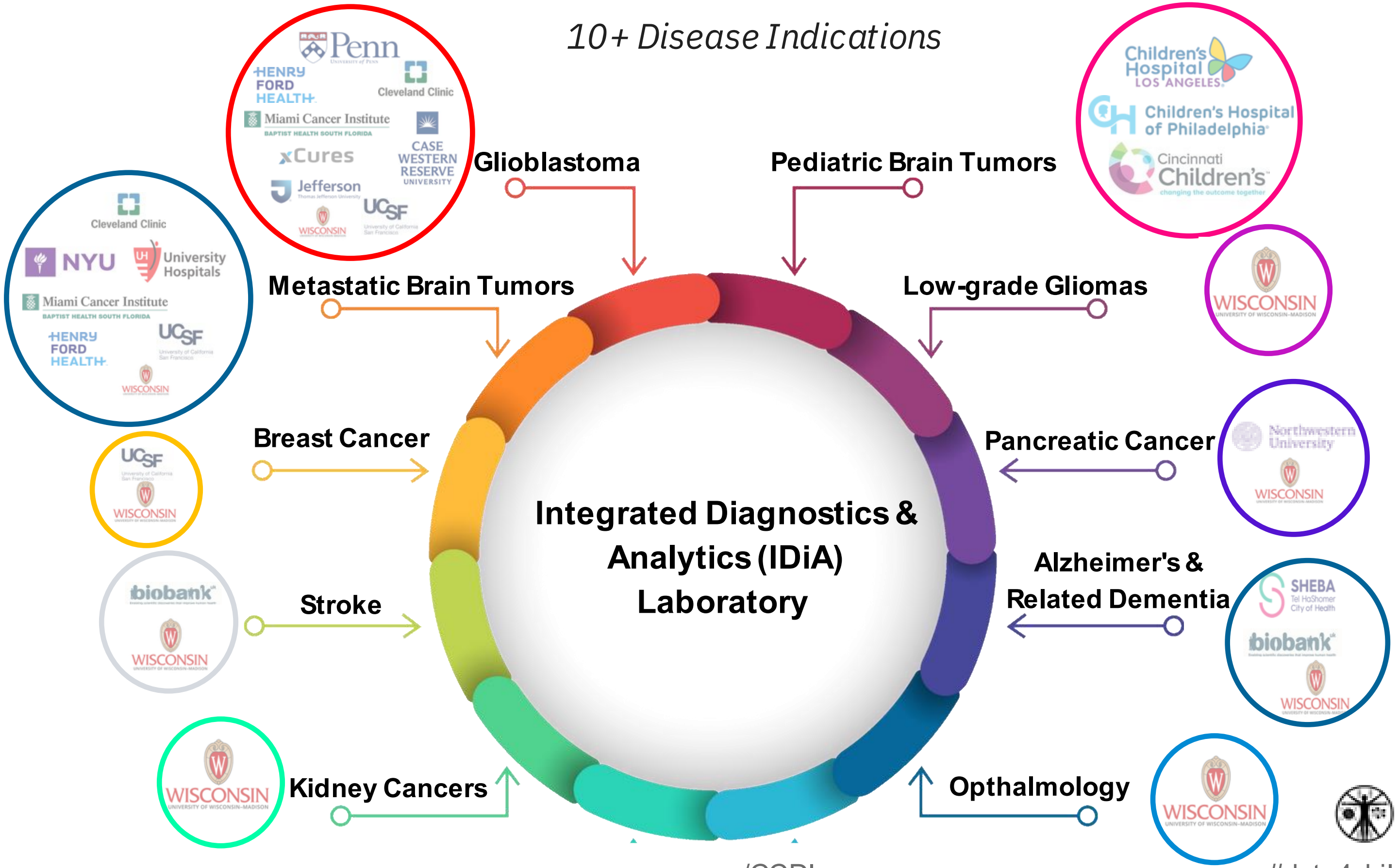


Radiomic-genomic correlations

Lu – Chin J Cancer Res. 2021

Research Empowered by Collaborations (20+ Institutes)

10+ Disease Indications



IDiA Lab

Research Entry into Pediatric Brain Tumors

2018


First-Time Mom


Dr. Peter DeBlank,
Neuro-oncologist

2019 – 2021

Children's Brain Tumor Network
Until every child is cured

Children's Hospital LOS ANGELES
We Treat Kids Better

2021

U01CA248226 – CCDI Supplement

2025

NCI ITCR 1U01CA294415-01A1

ITCR Informatics Technology for Cancer Research

IDiA Lab

Key Challenges with AI Models for Childhood Tumors

Rarity of Data: Pediatric cancers constitute <1% of all cancer diagnoses.

Children Are Not "Small Adults." Their anatomy & physiology evolve; lack of tools to capture age, location, tumor phenotypic differences

Standardization Issue: Heterogeneous protocols (MRI/CT, slice thickness, resolution) across institutions make it difficult to create reliable models.

Model Generalizability: AI models fail to perform well across different populations or institutions, limiting their utility in diverse clinical settings.

Limited Commercial Interest: Small market size for pediatric AI tools reduces investment in development of specialized solutions.

Pediatric Medulloblastoma

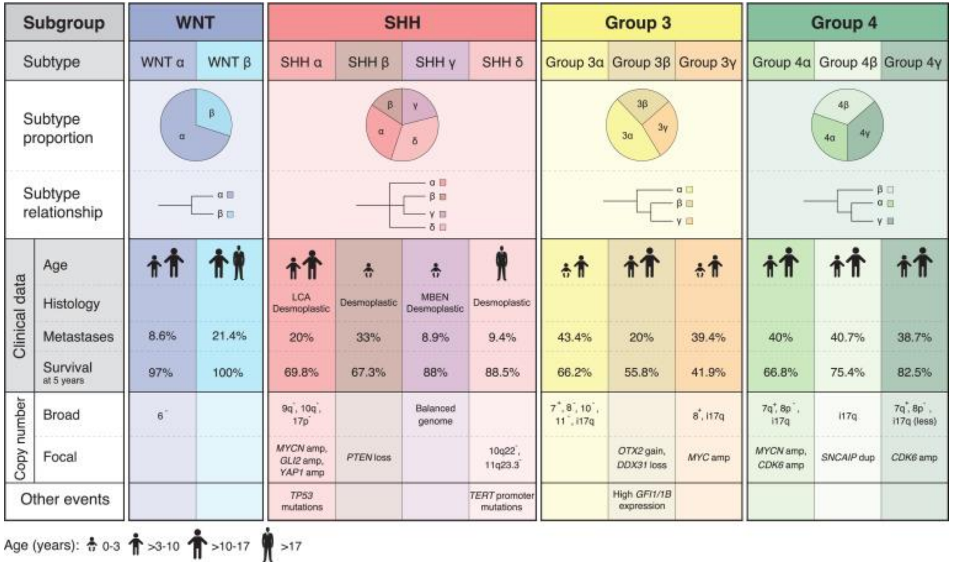
Dr. Peter DeBlank
Neuro-oncologist

Most frequent malignant brain tumor in children.

Heterogeneous disease and disseminates along the neuroaxis. The 5-year survival rate is 60-80%.

Treatment consists of surgery, radiation, and chemotherapy, and the protocol depends on the patient's staging (risk level).

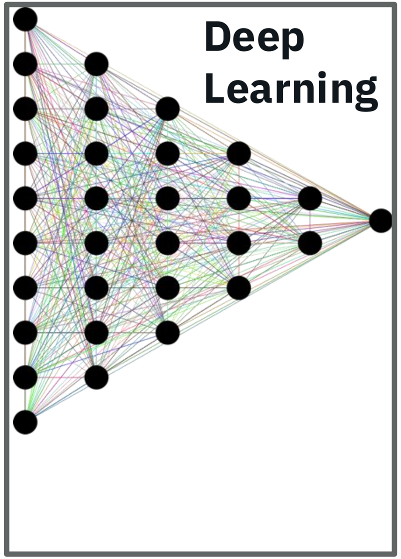
Risk assessment: Clinicopathological criteria along with **genomics** (molecular subgroups into 4 primary subgroups: WNT, SHH, Group 3, Group 4).

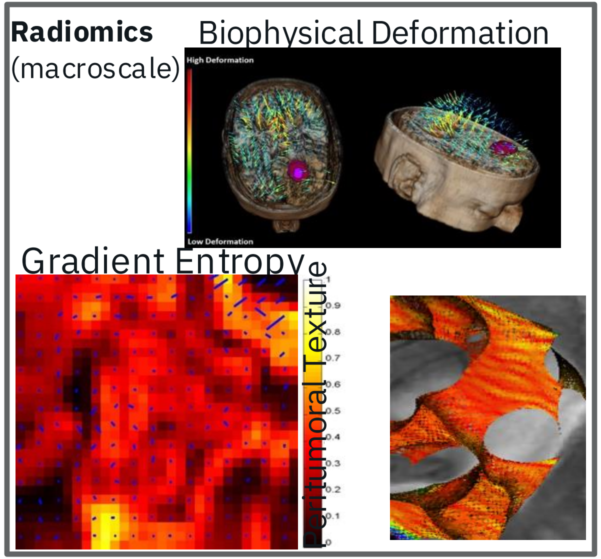


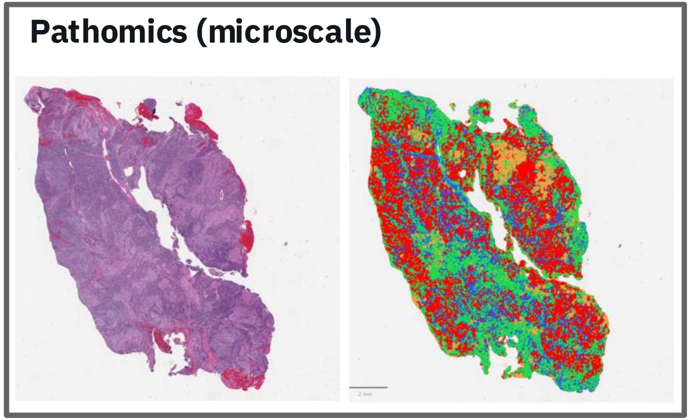
Cavalli – Cancer Cell 2017
Szalontay – Current Oncology Reports 2020

Challenges in Pediatric Medulloblastoma Management

- Molecular tests could take weeks
- Children are overtreated (long-term sequelae)/undertreated (poor prognosis)
- ***Untapped opportunity*** *to develop specialized risk-assessment AI tools that characterize MB heterogeneity and are* ***non-disruptive*** *the current clinical workflow*



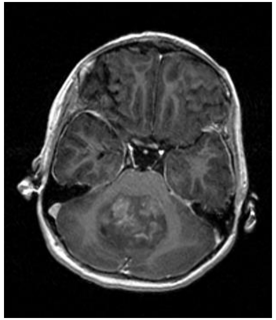


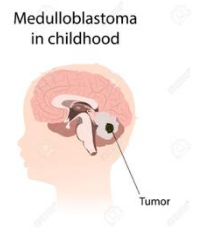


Ismail – Frontiers in Oncology 2022
Ismail – SNO 2025

Need for Tools in Pediatric Brain Tumors

- Biologically different from adult brain tumors
  - More likely to develop tumors in the lower parts of the brain (brainstem, cerebellum)
  - Aggressive treatment results in detrimental side effects in a child's developing brain
  - Decisions around therapy escalation and de-escalation are extremely important





Tumor Habitat Segmentation

Feature Extraction

Model Development

Poor quality images and artifacts

Segmentation is laborious & error-prone

Lack of specialized tools to capture age, location, phenotypic differences

Pediatric Brain Tumor Image Informatics (PBTi^2) Toolkit

Funded by NCI ITCR 1U01CA294415-01A1

Dr. Satish Viswanath
(Emory)

CuPed: Cohort curation tool for efficiently triaging and selecting pediatric scans based on image quality

SegPed: Human-in-the-loop segmentation tool for deeply annotated pediatric MRI data sets

RaPed: Age- and location-aware radiomics descriptors unique to the pediatric brain tumors

Children's Brain Tumor Network
Until every child is cured

PBTC
Pediatric Brain Tumor Consortium

Cincinnati Children's

Children's Hospital Los Angeles
We Treat Kids Better

CHILDREN'S ONCOLOGY GROUP

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

NIH NATIONAL CANCER INSTITUTE
CHILDHOOD CANCER DATA INITIATIVE
Community-driven progress through data

Children's Healthcare of Atlanta

Key Challenges with AI Models for Childhood Tumors

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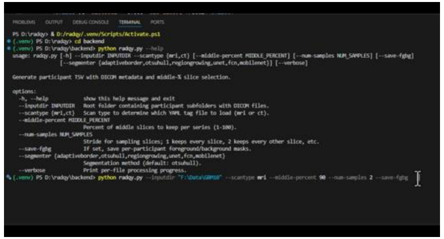
RadQy: Quality Control of Radiology Images

Dr. Satish Viswanath
(Emory)

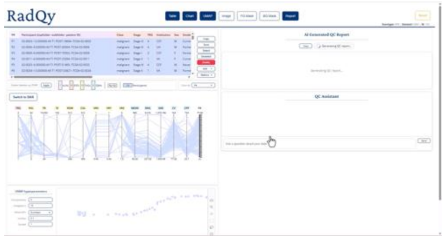
- Check the quality of large data cohorts, visualize trends in quality measurements
- Evaluated 3 TCIA cohorts, identified artifacts & batch effects between scanners & sites
- Ran on CPTAC-GBM, TCGA-CESC, KIRP, pediatric brain tumors



Backend batch processing

View trends, label outliers

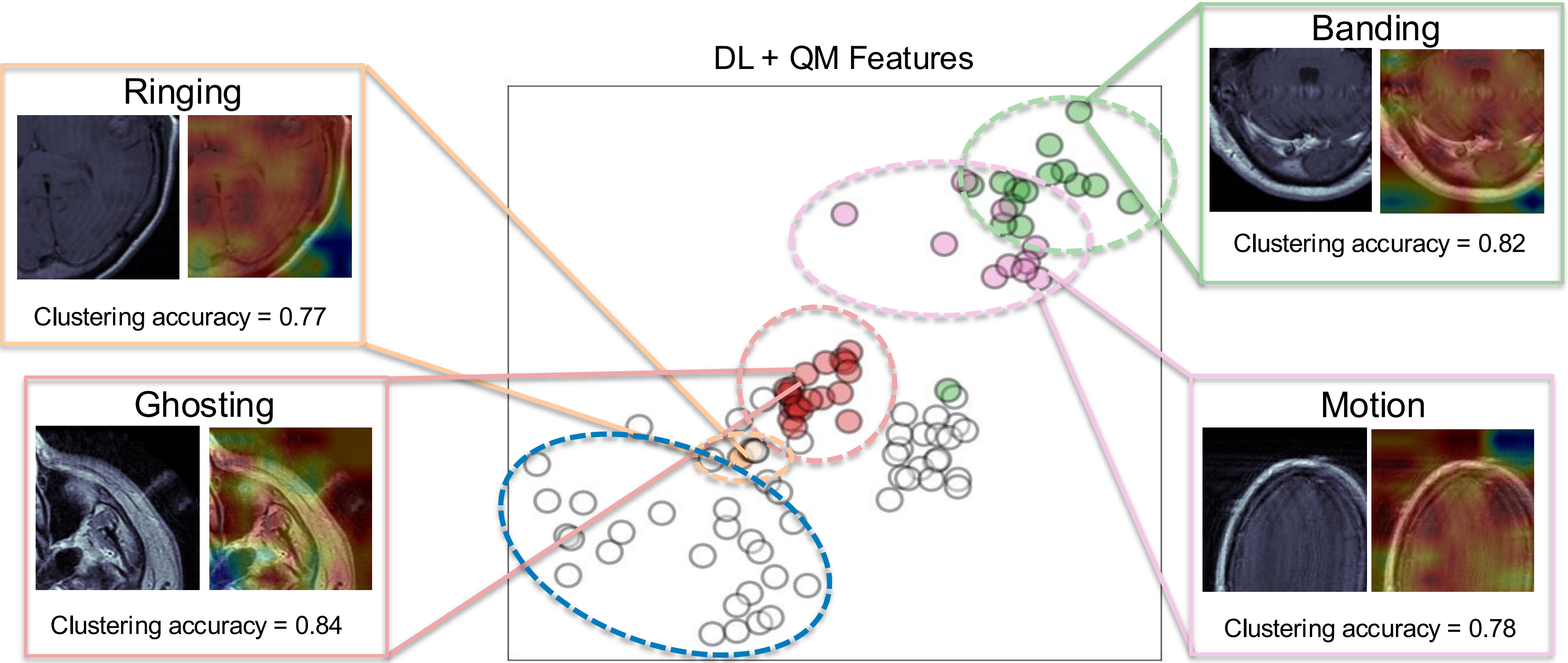
Create representative splits



Interactive LLM report

doi.org/10.7937/K9/TCIA.2020.JHZ2-T694

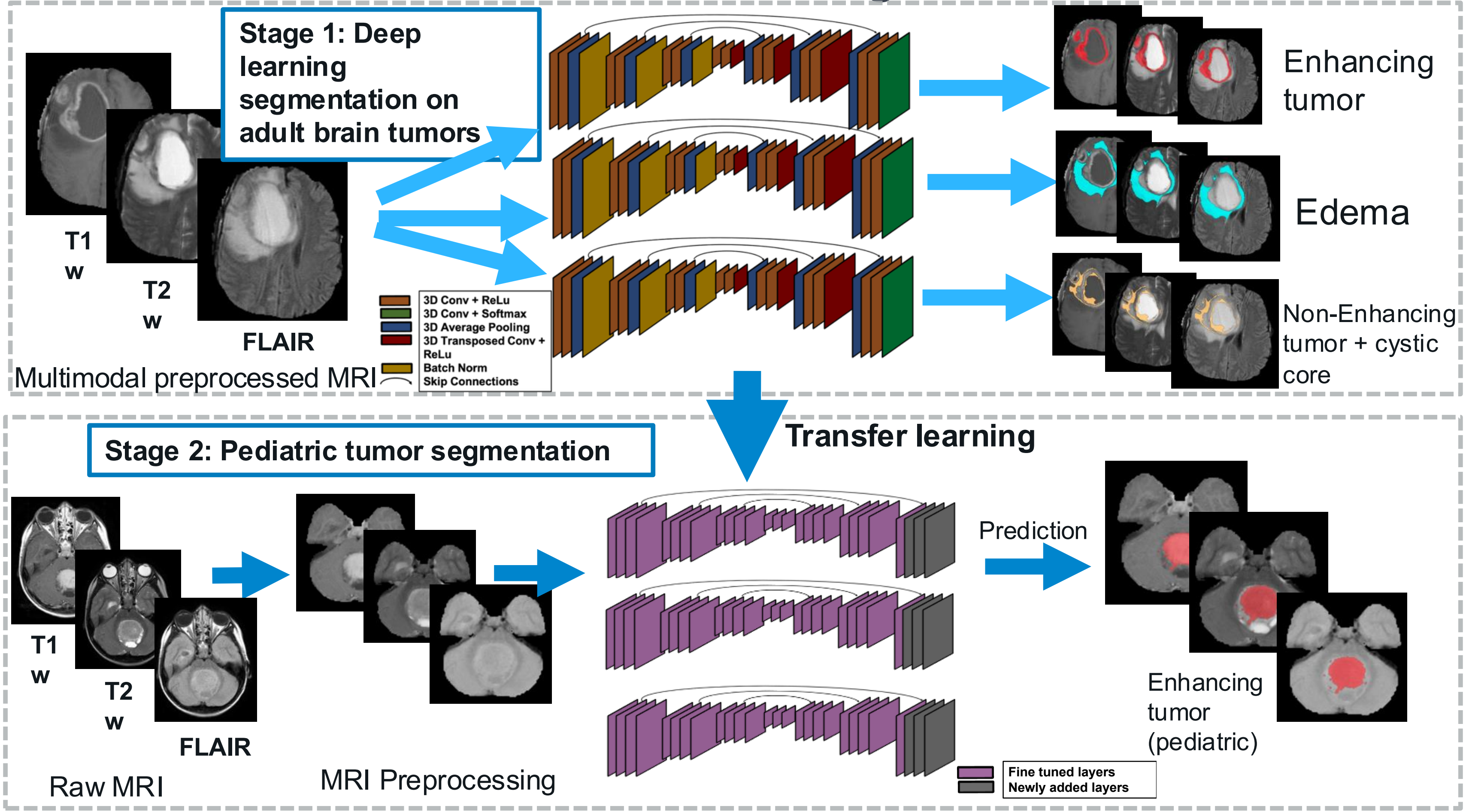
Augmenting RadQy with DL to Identify MRI Artifacts



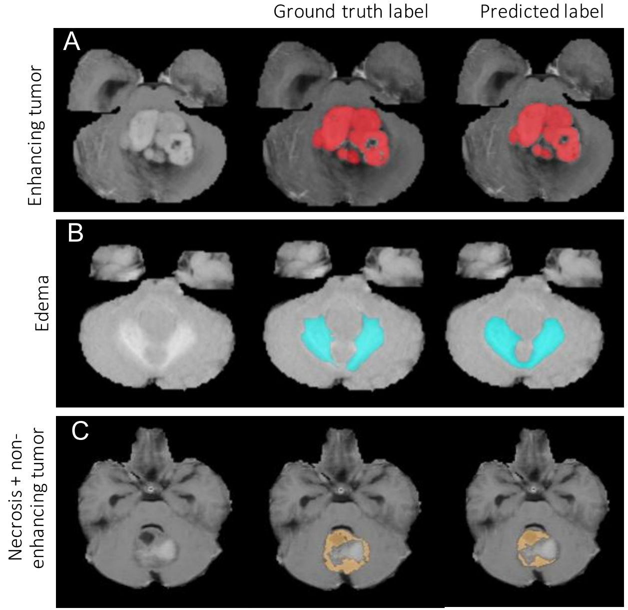
Sadri, Viswanath, et al, RSNA 2023

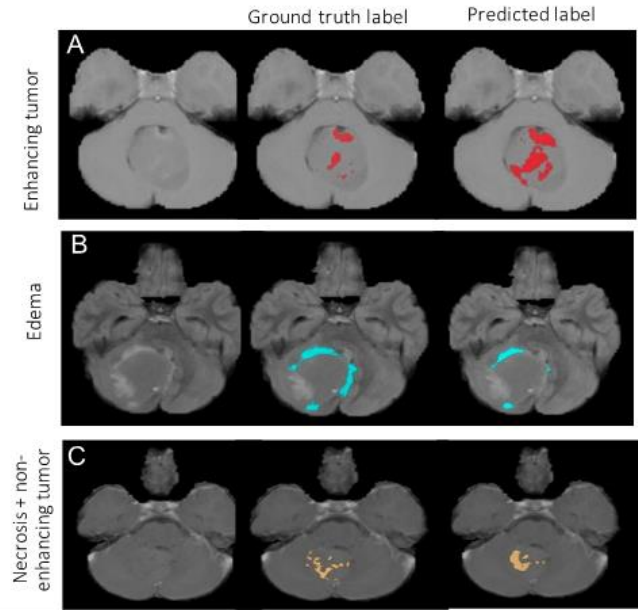
Automated MB Tumor Segmentation

Bareja-Radiology: AI 2024



Automated Segmentation of Medulloblastoma Regions





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Good predictions: (**a**) Gd-T1w, (**b**) FLAIR, (**c**) T1w MRI of a patient with dice scores of 0.78., 0.76 and 0.55 on enhancing tumor, peri-tumoral region, and non-enhancing tumor + cystic core.

Poor predictions: (**a**) T1w, (**b**) FLAIR, (**c**) T1w MRI of a patient with dice scores of 0.55, 0.55 and 0.52 on enhancing tumor, peri-tumoral region, and non-enhancing tumor + cystic core compartments.

Bareja, Tiwari et al.- Radiology: AI 2024

Need for Tools in Pediatric Brain Tumors

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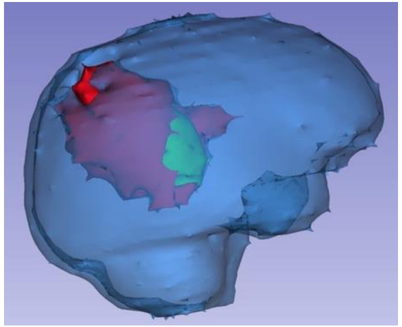
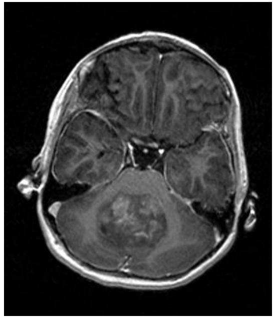
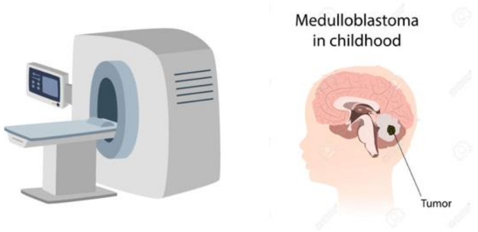
  - Tumors develop in lower parts of the brain (brainstem, cerebellum)
  - Aggressive treatment results in detrimental side effects in a child's developing brain







Tumor Habitat Segmentation

Feature Extraction

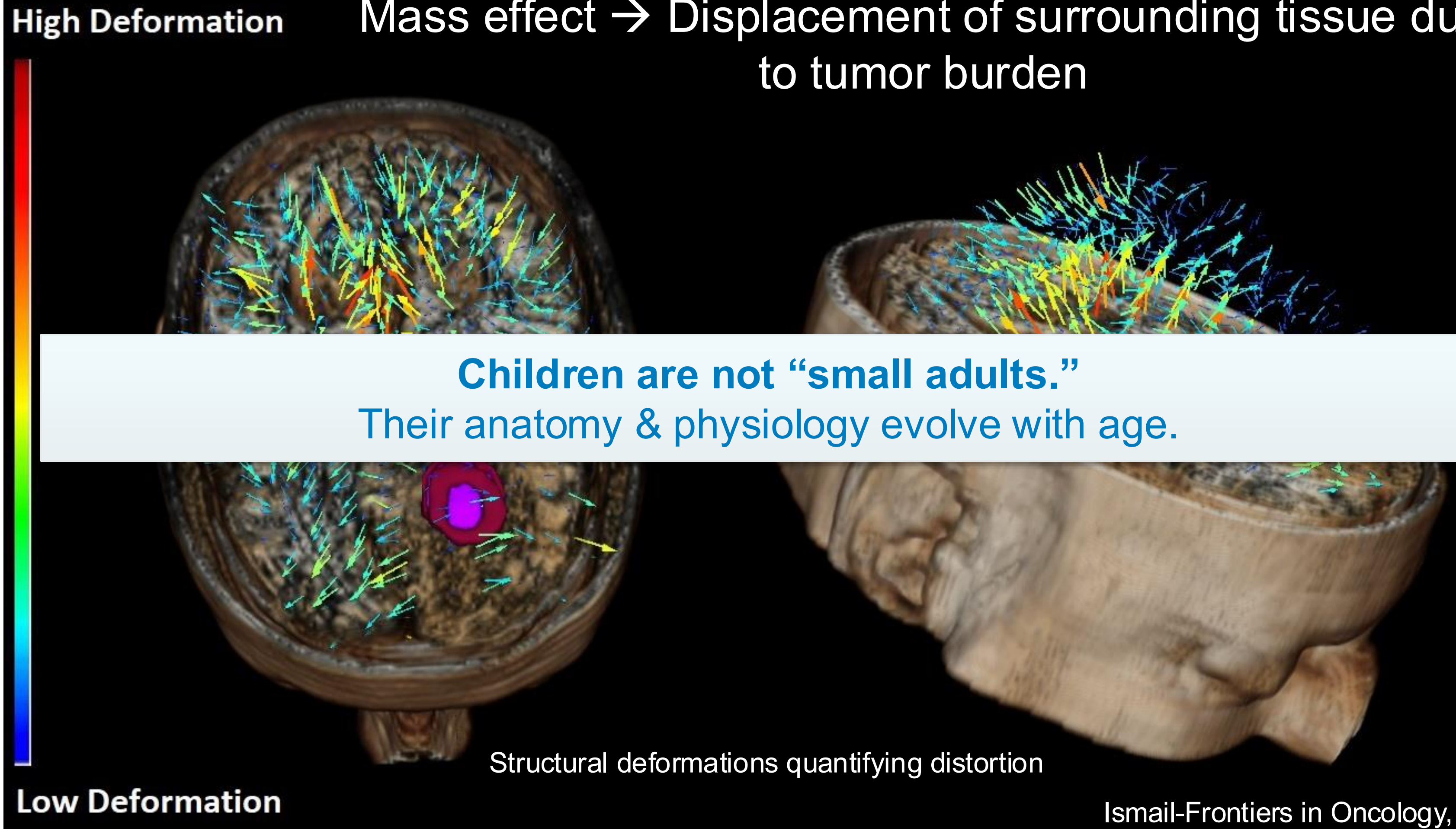
Model Development

Poor quality images and artifacts

Segmentation is laborious & error-prone

Lack of specialized tools to capture age, location, phenotypic differences

Mass effect → Displacement of surrounding tissue due to tumor burden

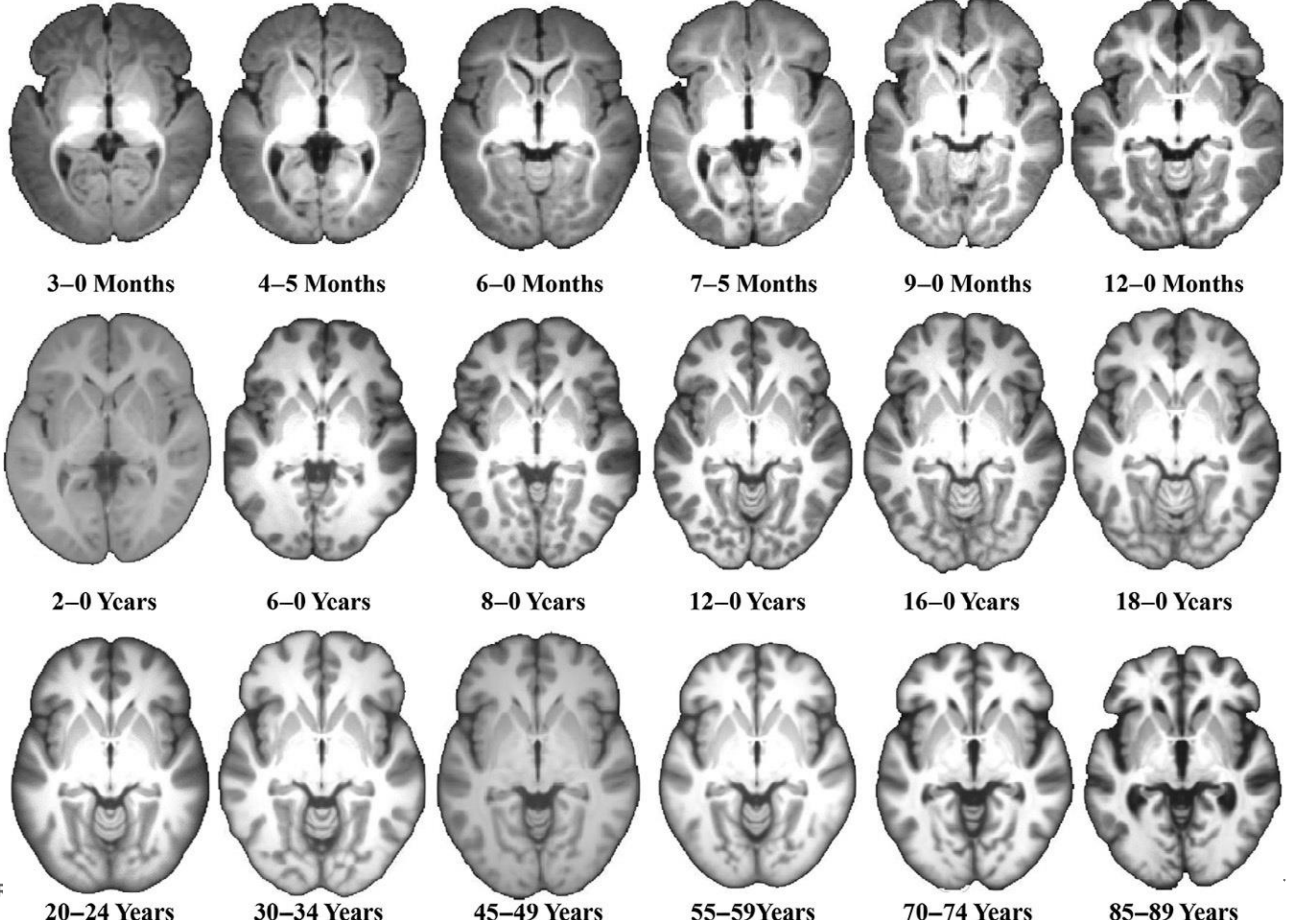


Children are not "small adults."
Their anatomy & physiology evolve with age.

Structural deformations quantifying distortion

Ismail-Frontiers in Oncology, 2022

Age-Specific Brain Atlases

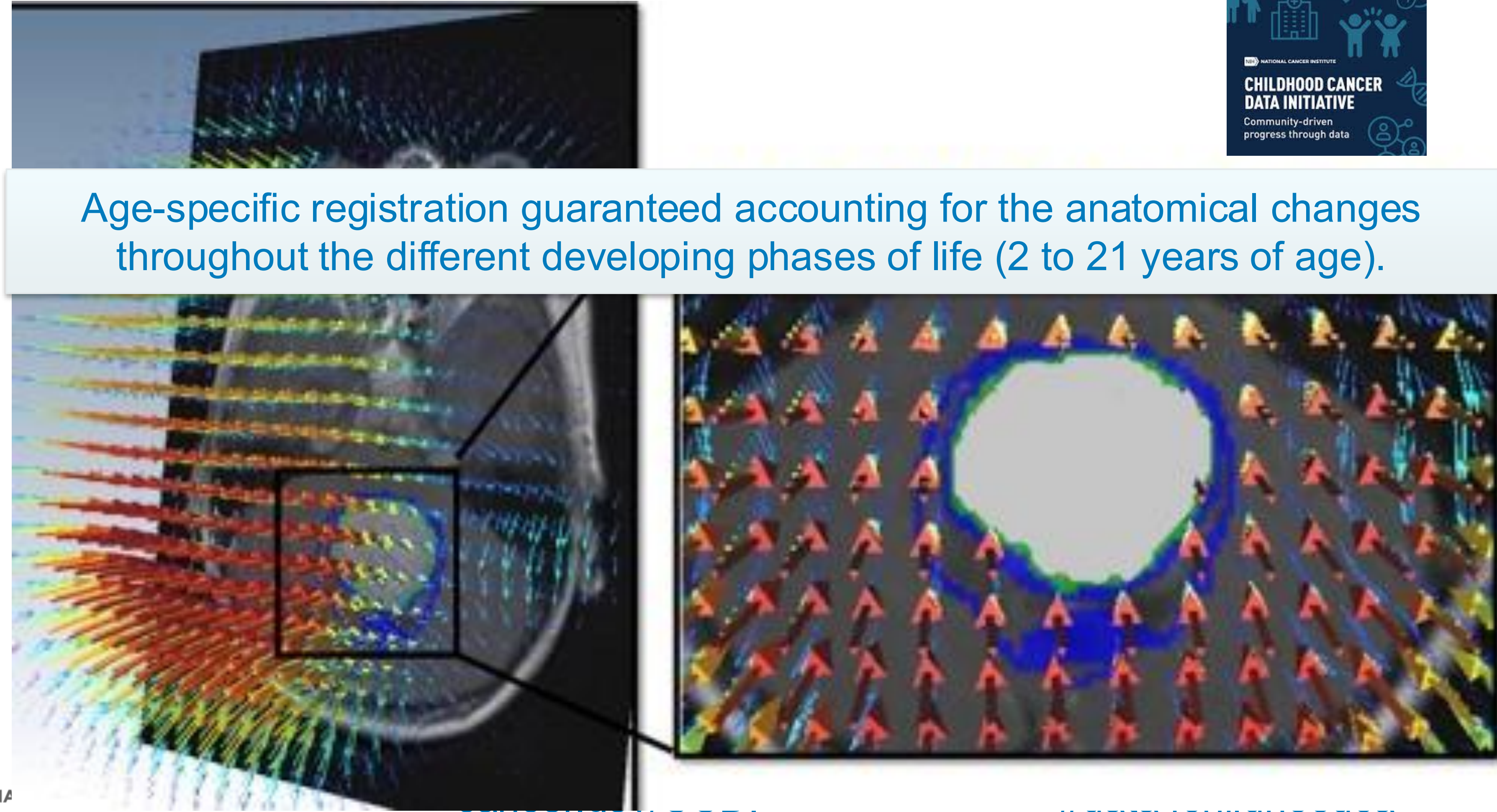


Richards and Xie et al. Advances in Child Development and Behavior, 2015

Age-Specific Features to Predict Outcomes

CHILDHOOD CANCER DATA INITIATIVE
Community-driven progress through data

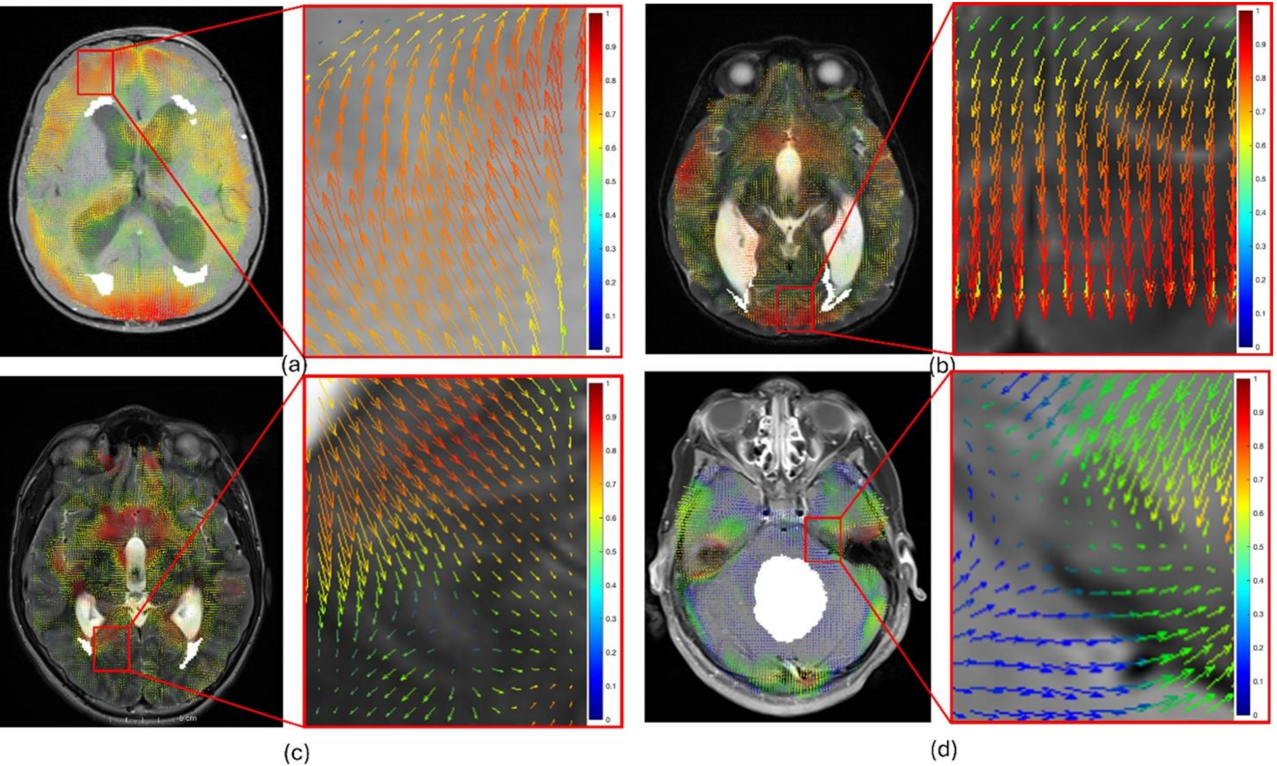
Age-specific registration guaranteed accounting for the anatomical changes throughout the different developing phases of life (2 to 21 years of age).

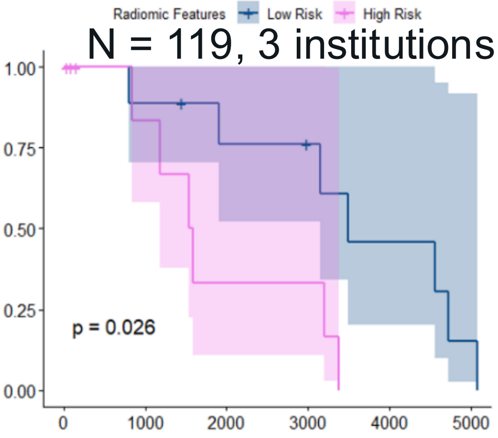


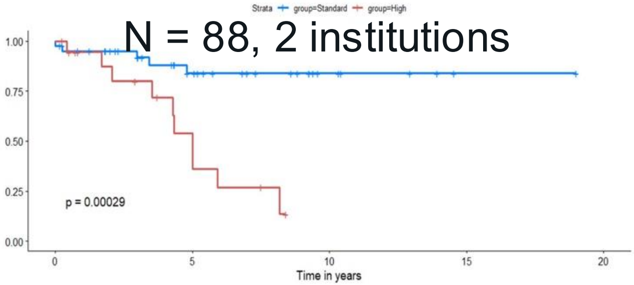
Age-Specific Deformation for MB Survival Prediction

Dr. Marwa Ismail

Poor prognosis | **Good prognosis**

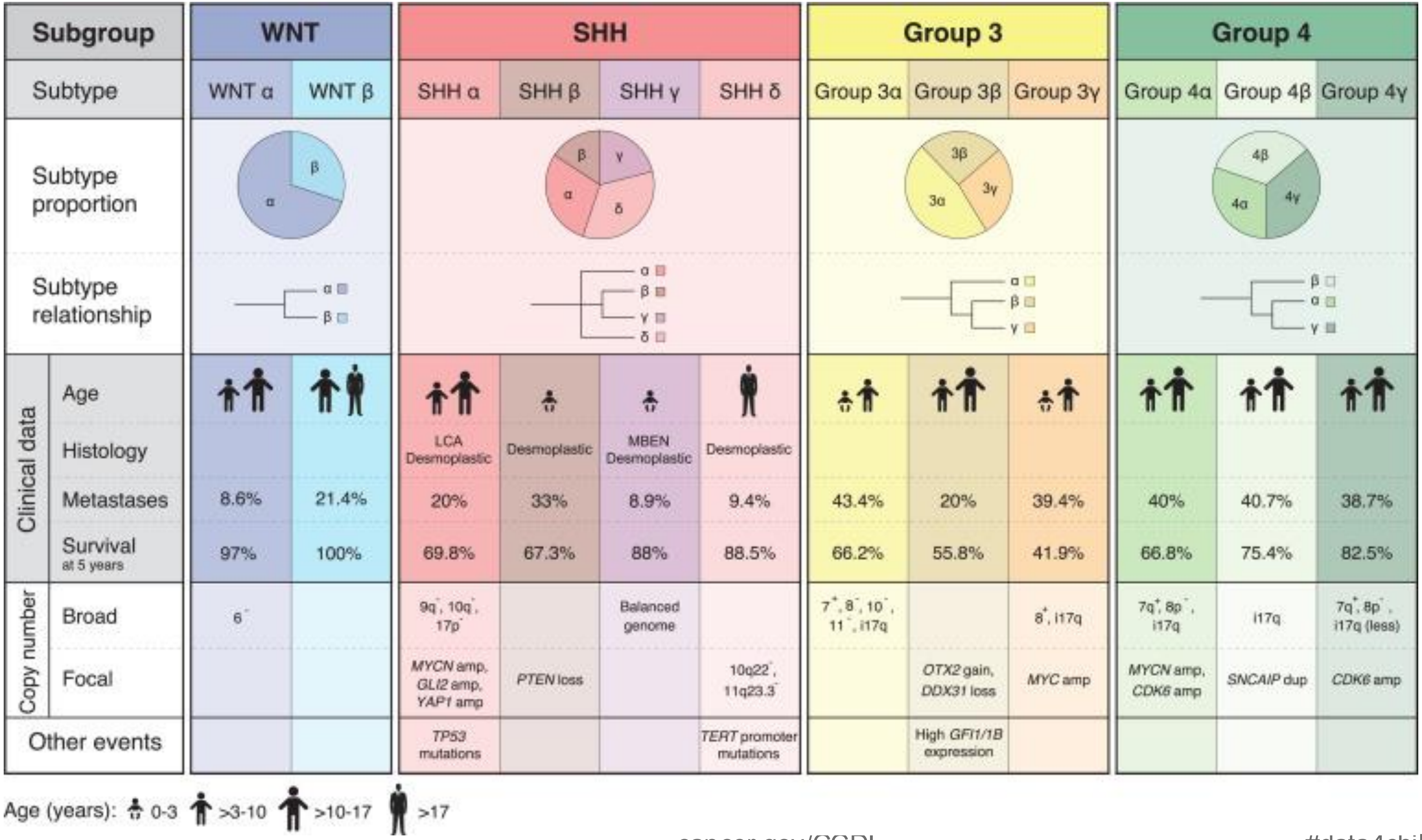






Ismail-Neuro-oncology advances 2025 Ismail- Frontiers in Oncology, 2022

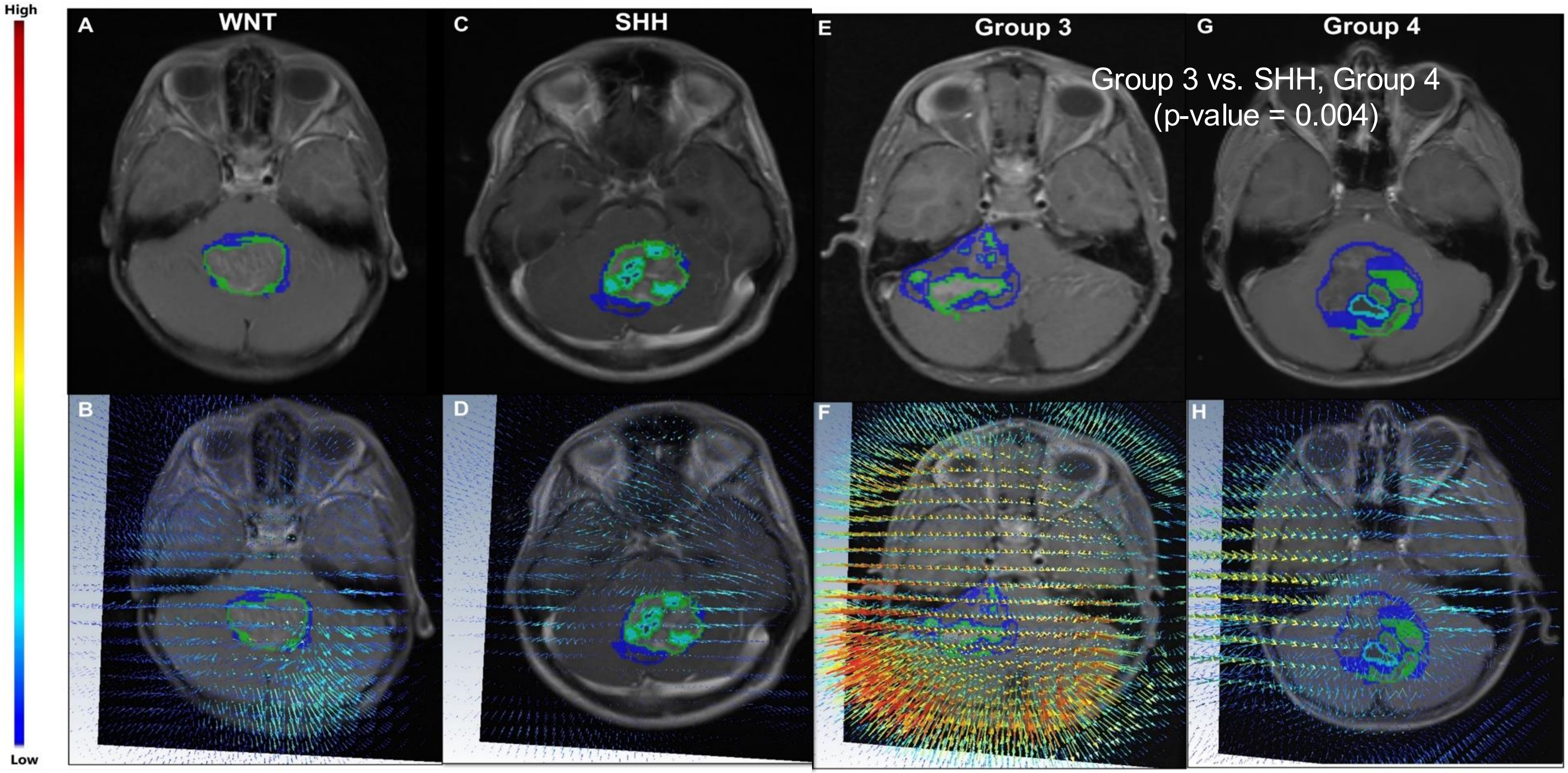
Molecular Stratification in Medulloblastoma Tumors



Subgroup	WNT		SHH				Group 3			Group 4		
Subtype	WNT α	WNT β	SHH α	SHH β	SHH γ	SHH δ	Group 3α	Group 3β	Group 3γ	Group 4α	Group 4β	Group 4γ
Subtype proportion												
Subtype relationship												
Clinical data: Age												
Clinical data: Histology			LCA Desmoplastic	Desmoplastic	MBEN Desmoplastic	Desmoplastic						
Clinical data: Metastases	8.6%	21.4%	20%	33%	8.9%	9.4%	43.4%	20%	39.4%	40%	40.7%	38.7%
Clinical data: Survival at 5 years	97%	100%	69.8%	67.3%	88%	88.5%	66.2%	55.8%	41.9%	66.8%	75.4%	82.5%
Copy number: Broad	6^-		$9q^-$, $10q^-$, $17p^-$		Balanced genome		7^+, 8^-, 10^-, 11^-, i17q		8^+, i17q	$7q^+$, $8p^-$, i17q	i17q	$7q^+$, $8p^-$, i17q (less)
Copy number: Focal			*MYCN* amp, *GLI2* amp, *YAP1* amp	*PTEN* loss		$10q22^-$, $11q23.3^-$		*OTX2* gain, *DDX31* loss	*MYC* amp	*MYCN* amp, *CDK6* amp	*SNCAIP* dup	*CDK6* amp
Other events			*TP53* mutations			*TERT* promoter mutations		High *GFI1/1B* expression				

Age (years): 0-3, >3-10, >10-17, >17

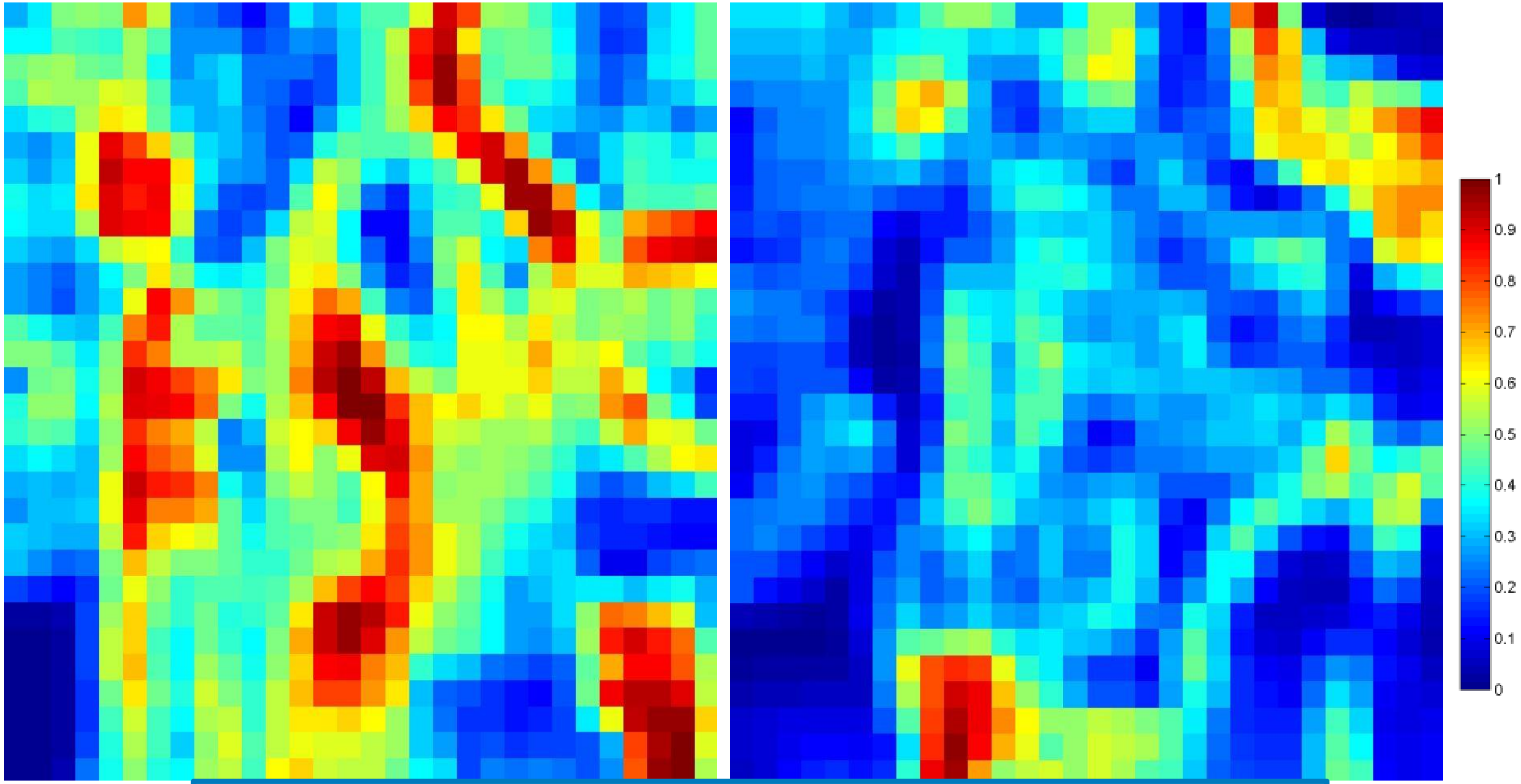
Identifying Molecular Sub-Types in Medulloblastoma



Group 3 vs. SHH, Group 4
(p-value = 0.004)

Ismail – Frontiers in Oncology 2022

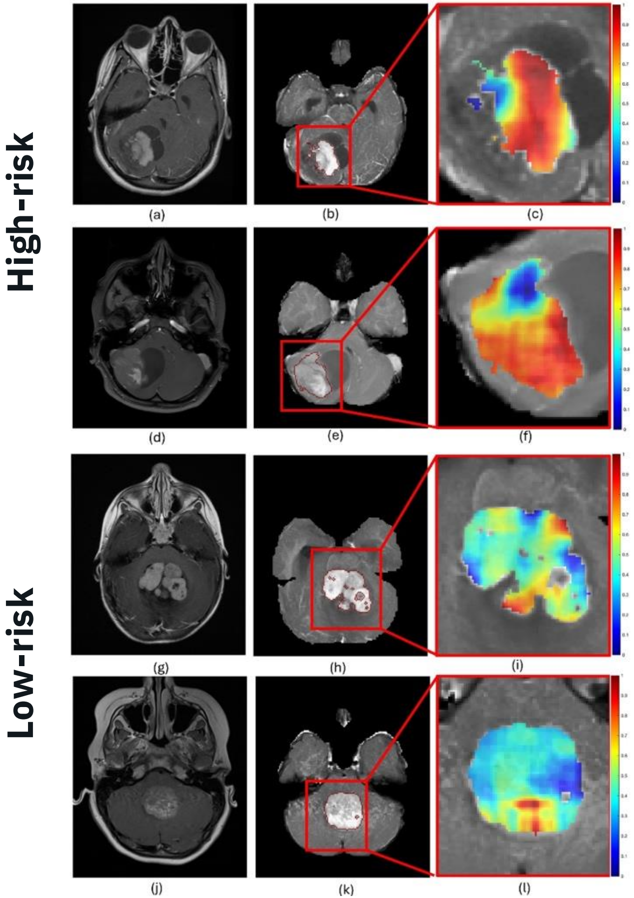
COLLAGE: Entropy of Localized Gradient Orientations

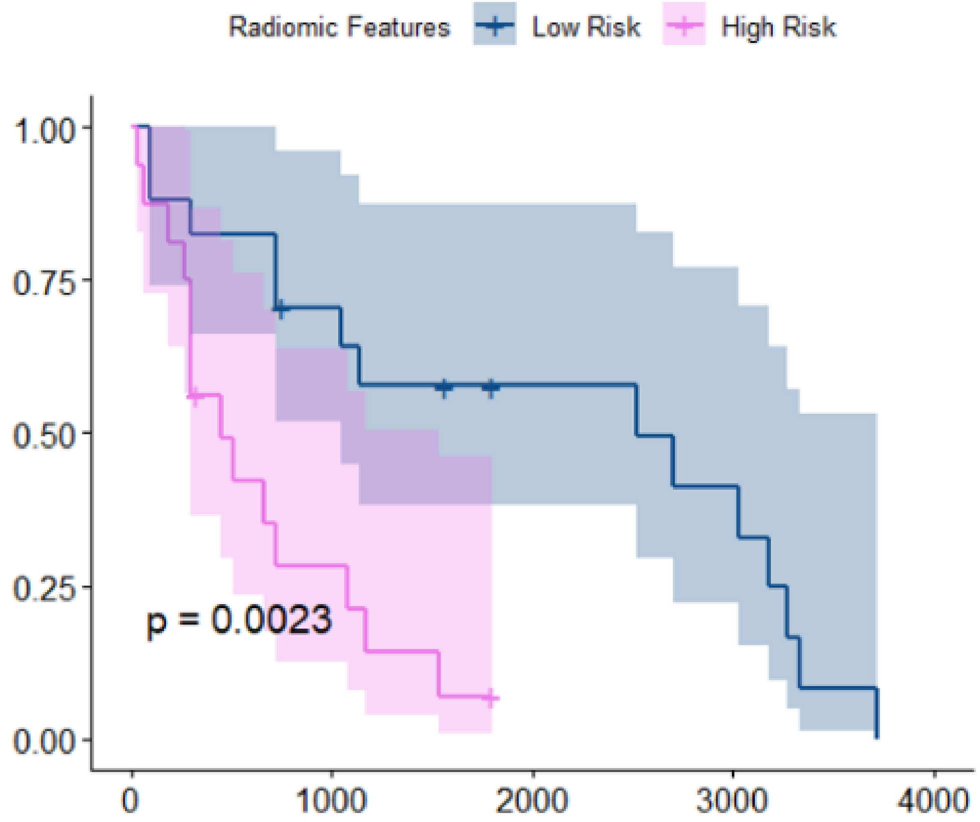


Entropy of the resultant gradient field is indicative of the degree of disorder in the pathology

Age-Specific COLLAGE for Survival Predication in MB

[redacted]





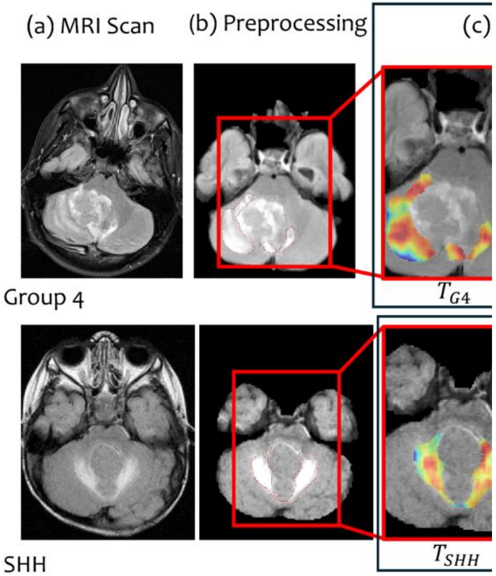
[redacted]

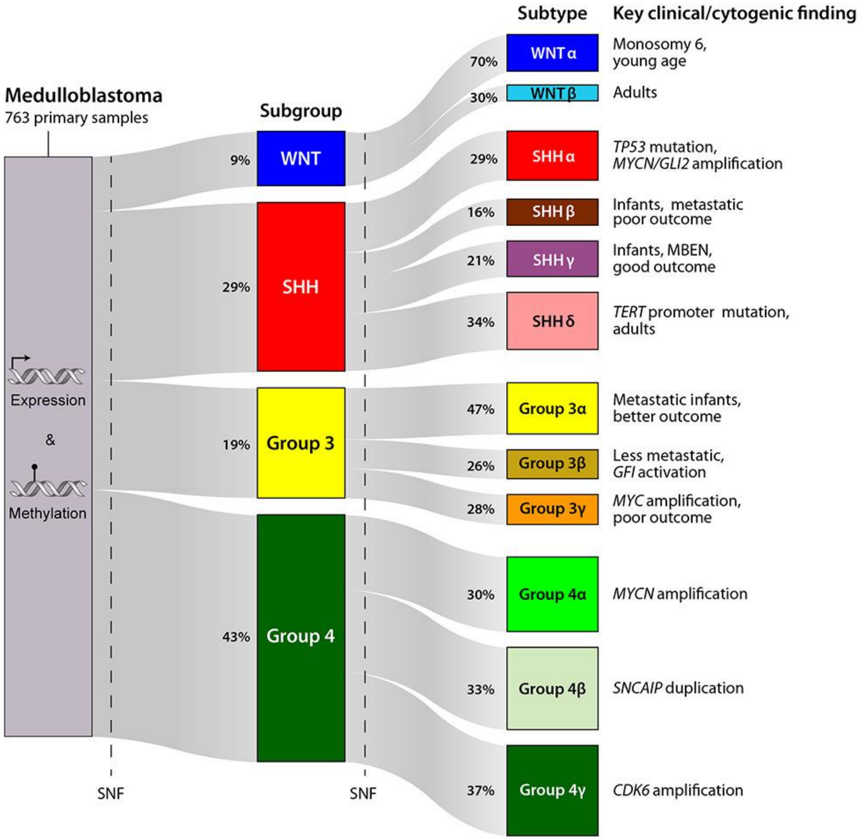
Ismail-Neuro-oncology advances 2025

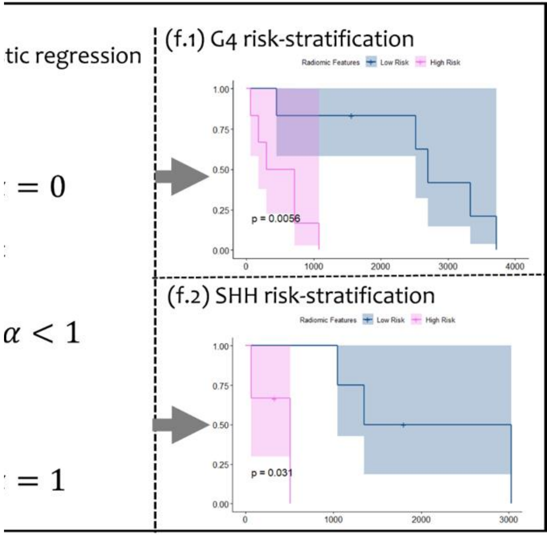
Outcome Prediction Within Individual MB Subgroups

Dr. Marwa Ismail

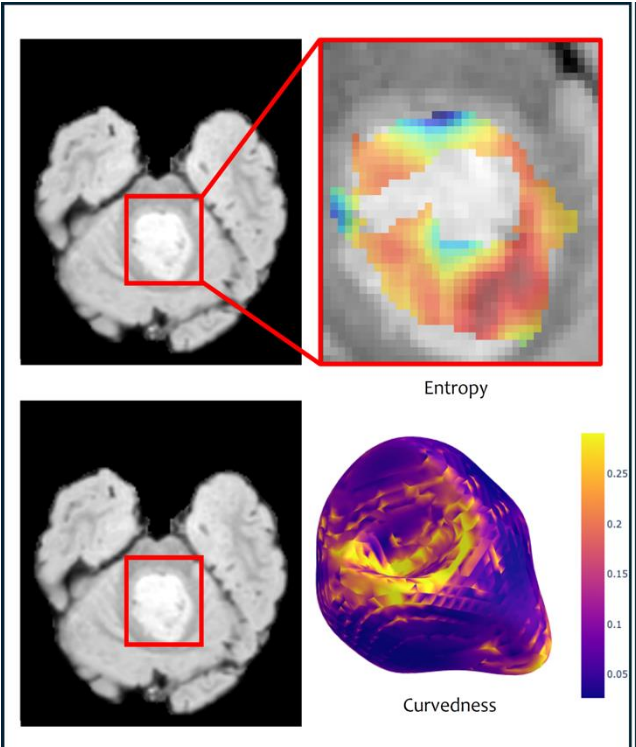
Outcomes within MB molecular sub-types are known to be heterogeneous.



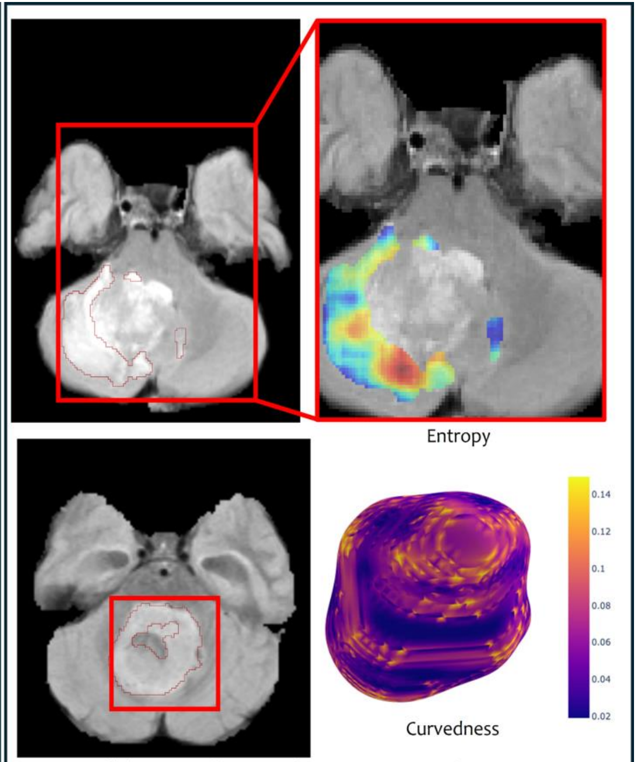




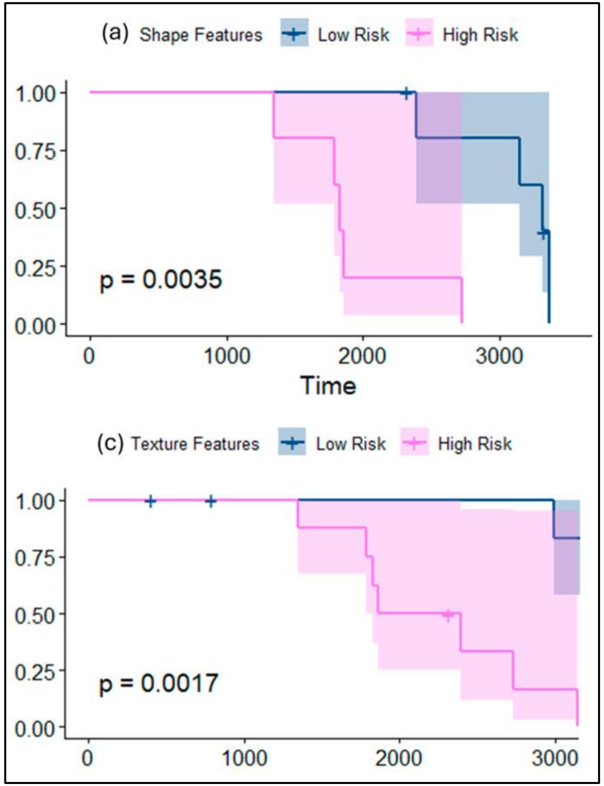
Intra-Subgroup Heterogeneity in Group 4 Subgroup



(a) High-risk cases from Group 4 subgroup

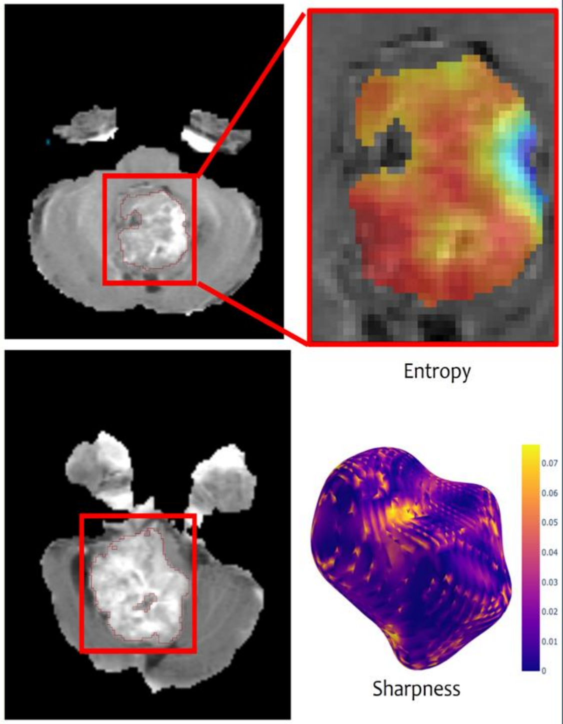


(b) Low-risk cases from Group 4 subgroup



Ismail – Cancers 2024

Intra-Subgroup Heterogeneity in SHH Subgroup



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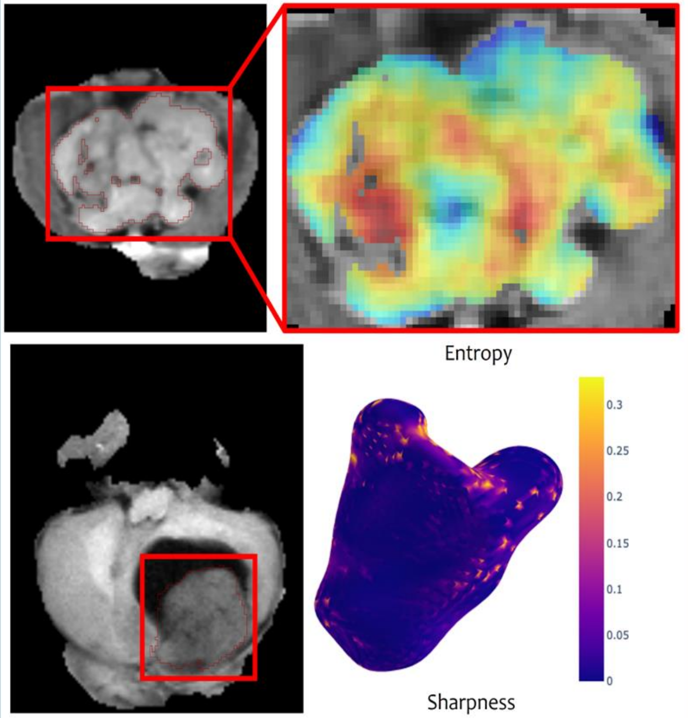
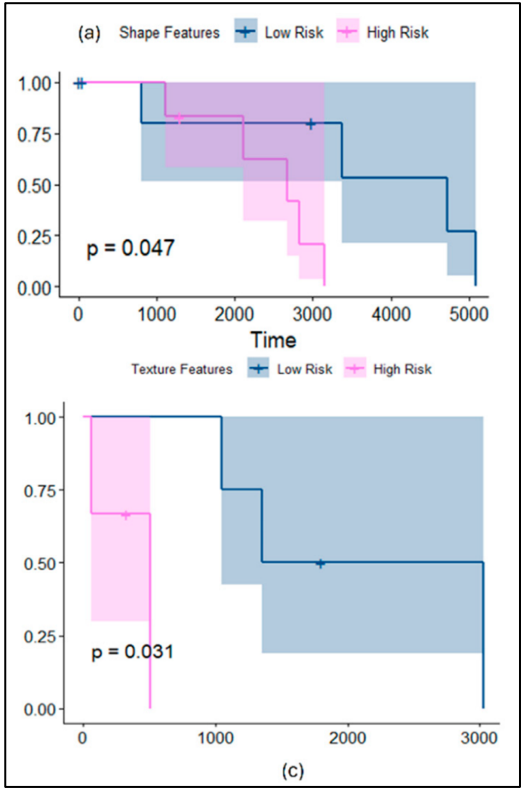
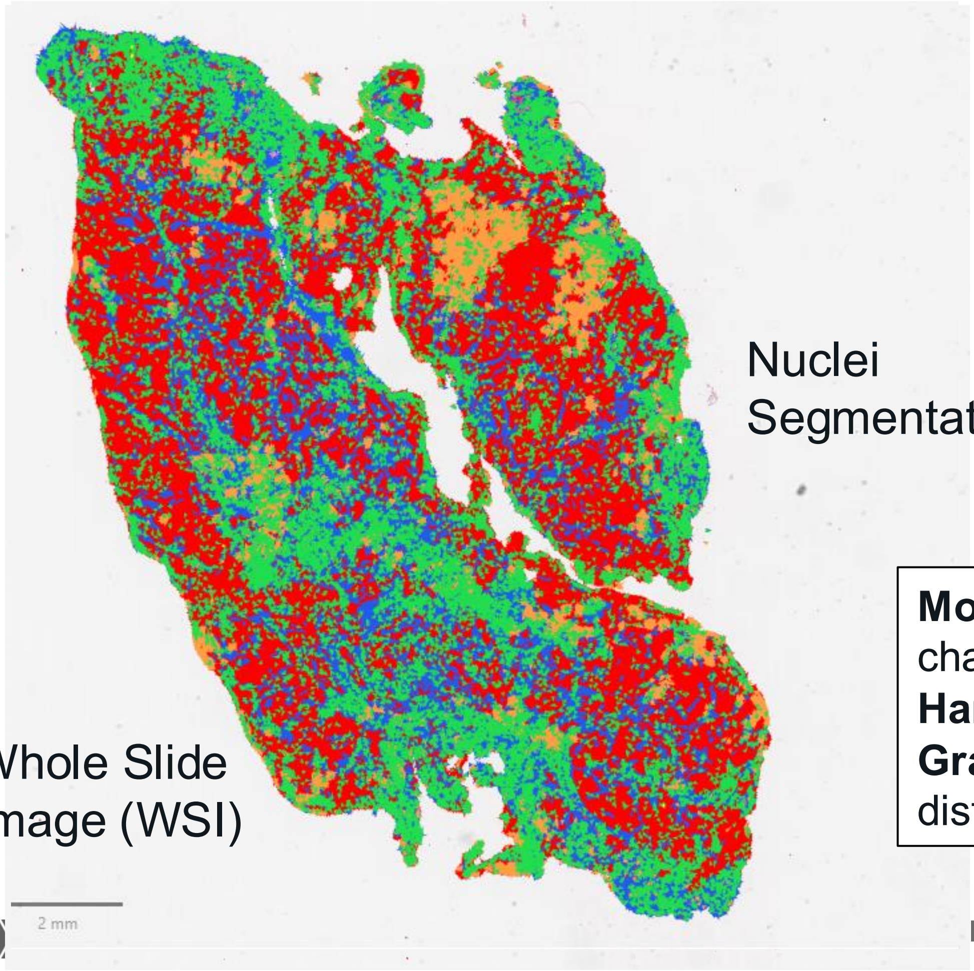


(b) Low-risk cases from SHH subgroup



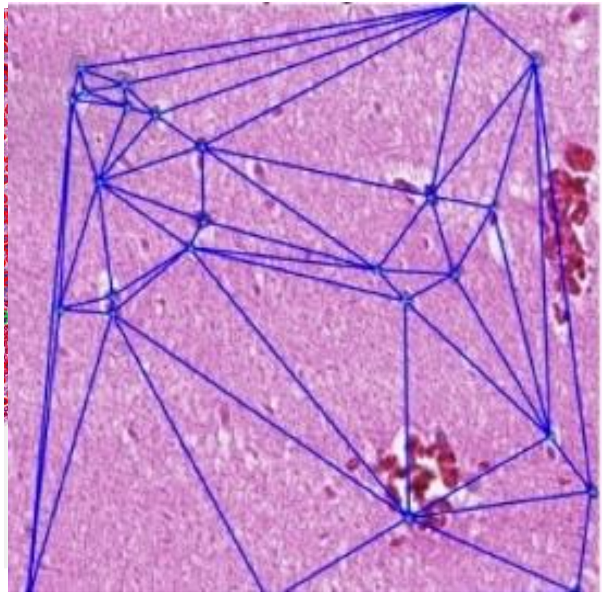
Ismail – Cancers 2024

Pathomics for Survival Prediction



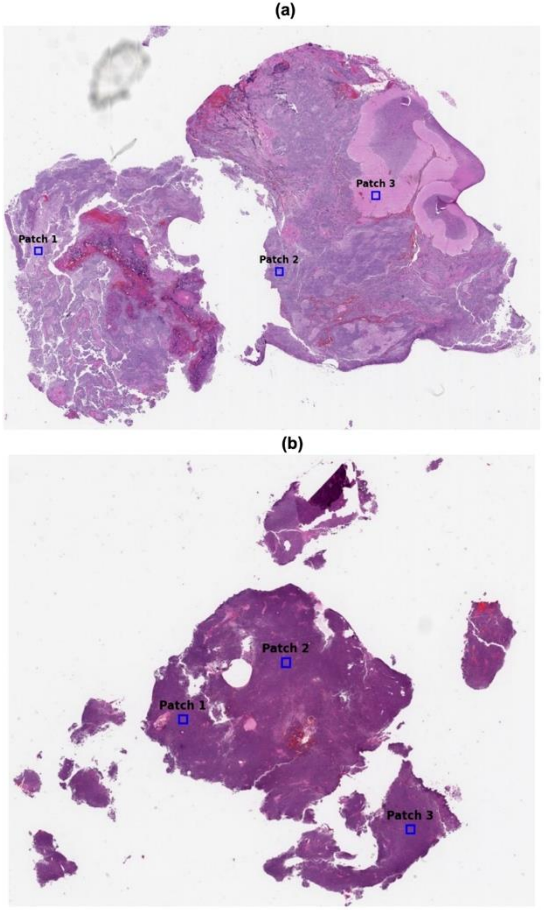
Whole Slide Image (WSI)

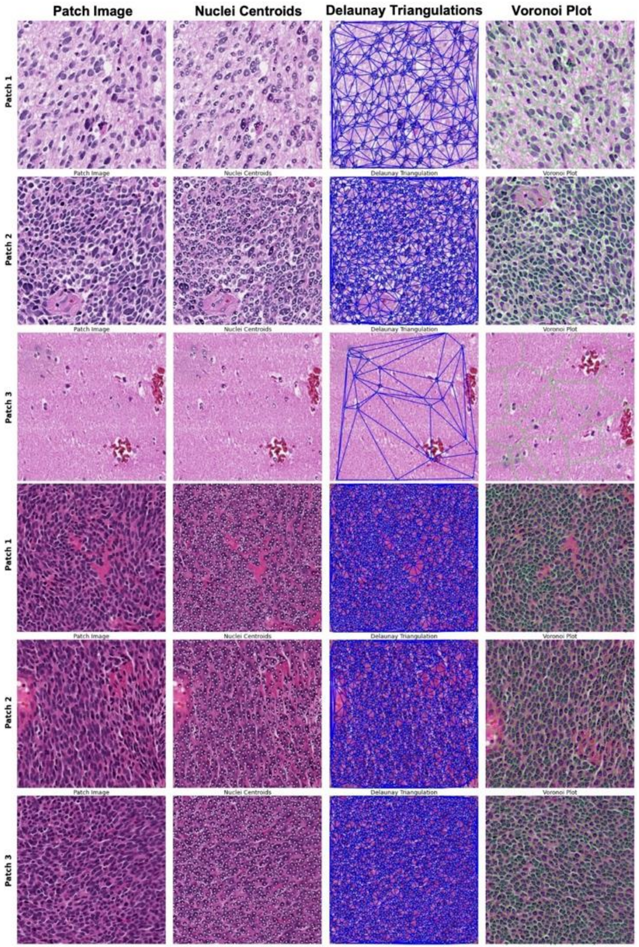
Nuclei Segmentation



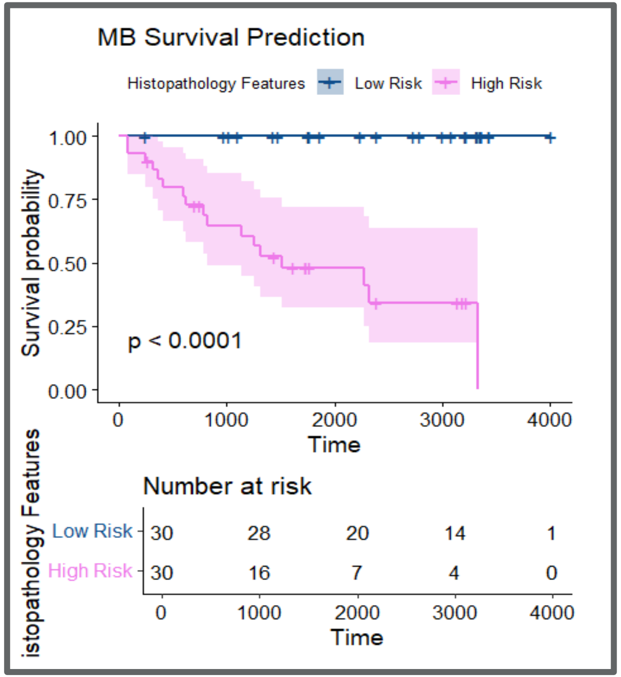
Morphological: Nuclei contour characteristics
Haralick: Variations in chromatin staining
Graph-based: Changes in lengths & distances between nearest vertices

Pathomics for Survival Prediction in Medulloblastoma





Dr. Marwa Ismail



Ismail-SNO 2025

Key ~~Challenges~~ Opportunities for Childhood Tumors

NCI ITCR 1U01CA294415-01A1

Rarity of data	→	Consorted efforts on data collection
Children are not "small adults”	→	Building intentional AI for children
Standardization issue	→	“Quality in, Quality out"
Model generalizability	→	Multi-institutional, Clinical-trial validation
Limited commercial interest	→	?

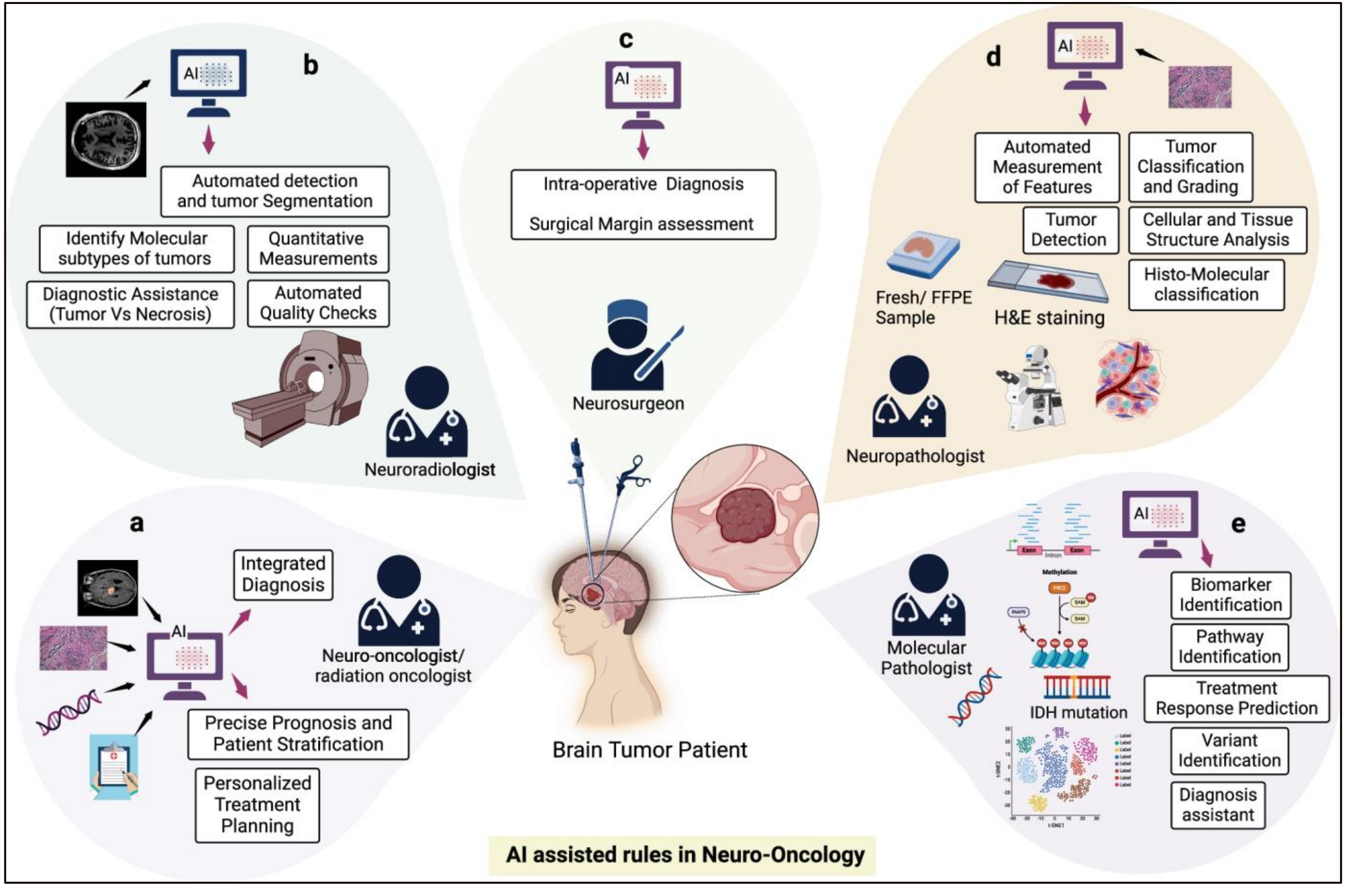
ARPA-H

January 16, 2026

ARPA-H Launches $50M Initiative to Improve Data Exchange For Pediatric Hospitals

Clinical Opportunities in Pediatric Brain Tumors

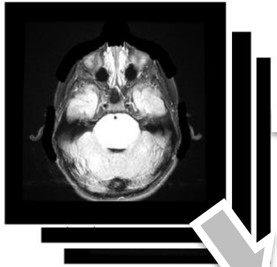
Khalighi et al. NPJ Precision Medicine (2024)



Ongoing Efforts on Improving Efficiency of Segmentation Models

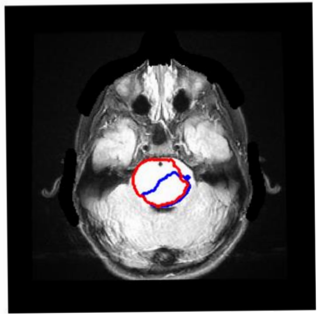
Dr. Satish Viswanath (Emory)

257 Training Patients from "BRATS-PEDS"

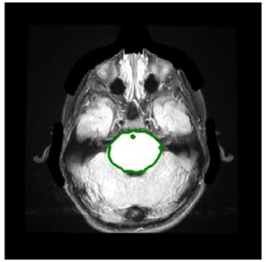


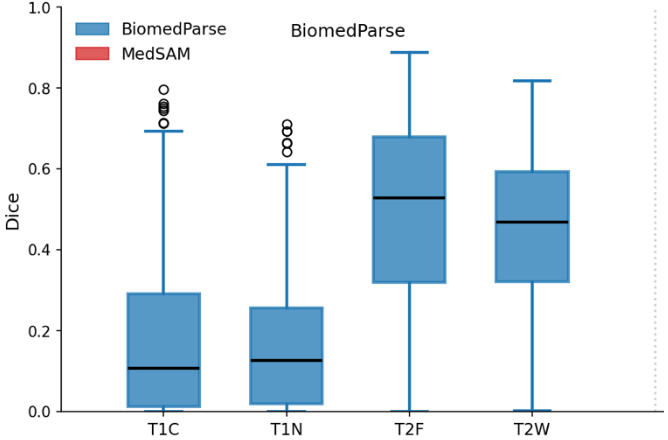
Text Prompt: "brain tumor segmentation"

BiomedParse



Manual Segmentation

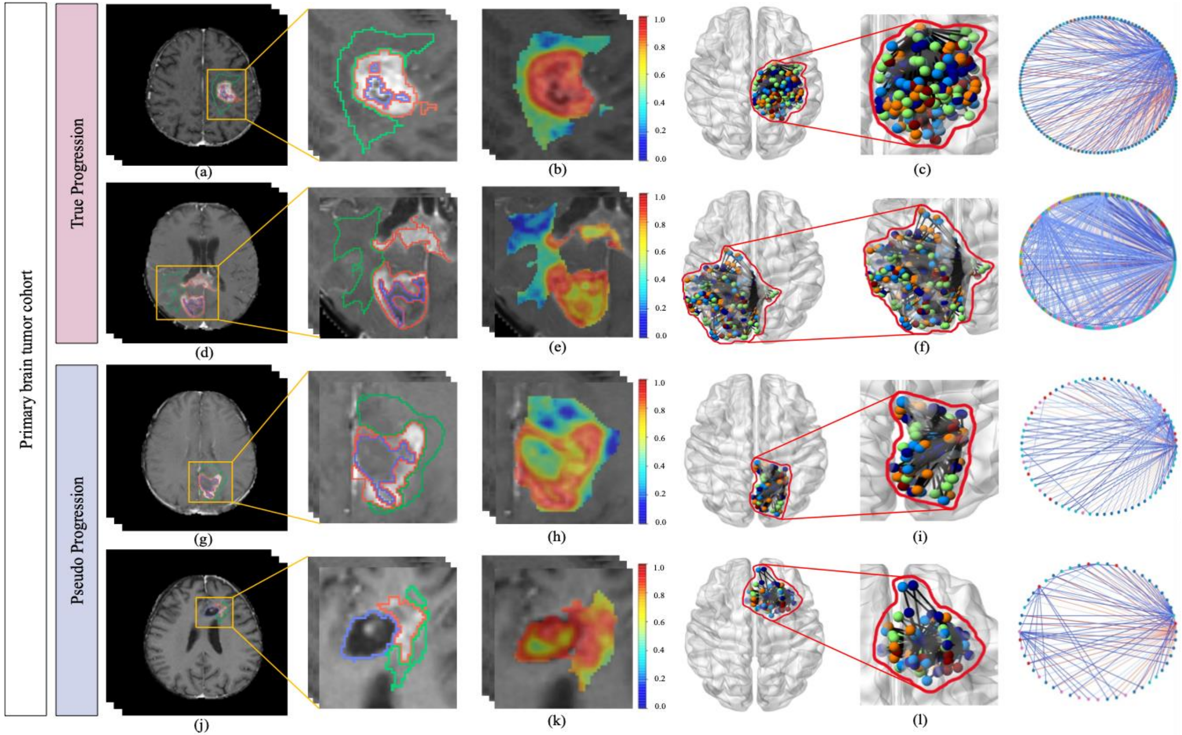


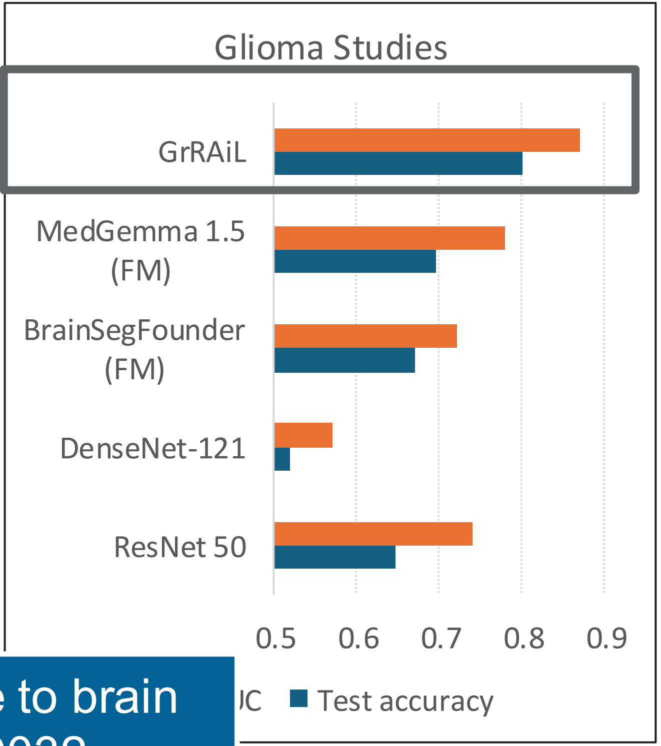


Opportunity to integrate vision-language models with specialized segmentation models.

Graph Radiomics Learning (GrRaiL)

Objective distinguishing radiation effects from tumor recurrence on GD-T1w MRI



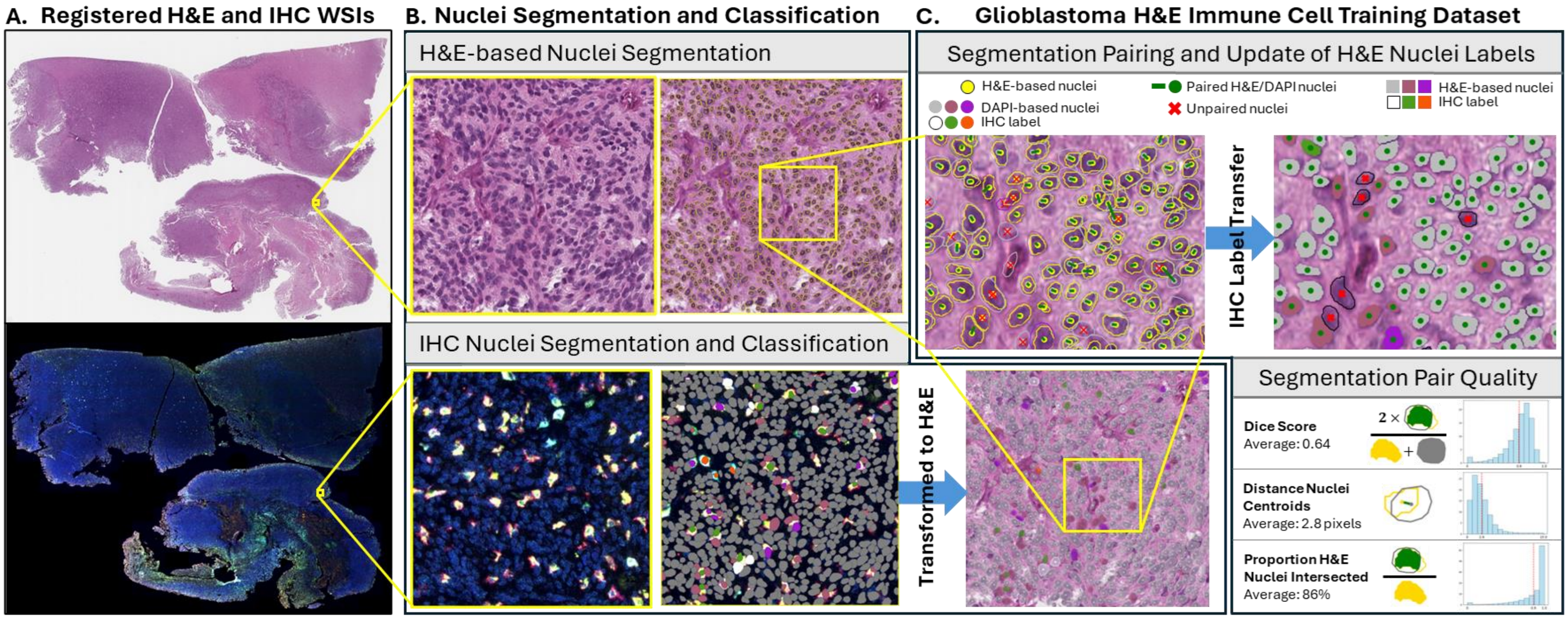


Adapting to account for age variability in MB tumors due to brain development. Validation underway on ACNS 0031, 0032.

' Precision Oncology (under review)

Current Efforts on Histopathomics

NOT PUBLISHED



*22 samples from unique cases

Immune Cell Subtype	Marker
T-cell-CD4+	CD4+CD11b–
MDSC	CD11b+CD74+CD68–HLA-DR–
Microglia	P2RY12+
Macrophage	CD11b+CD68+HLA-DR+
Monocyte	CD11b+HLA-DRA+P2RY12–CD68–
Other	

Capturing tumor immune micro-environment in MB tumors. Evaluation underway on ACNS 0031, 0032.

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- NIH/NCI, 1R01CA277728-01, 1R01CA264017-01
- Johnson & Johnson WiSTEM2D Research Scholar Award
- The V Foundation Translational Research Award
- DOD Career Development Award (W81XWH-18-1-XXX)
- Dana Foundation David Mahoney Neuroimaging Grant
- Coulter Translational Phase I, II, III Award
- Case Technology Validation Award
- Case Comprehensive Cancer Center Brain Tumor Pilot Award
- UW Institute for Clinical and Translational Research (ICTR)
- R&D Award, Dept of Radiology, UW-Madison
- WARF Accelerator Oncology Diagnostics Grant

No One Can Whistle a Symphony. It Takes An Orchestra to Play It.

Viswanath lab

Q&A

Join Us For Our Upcoming CCDI Virtual Symposium Series Events!

March 12	**March 18**	**March 25**	**April 2**	**April 7**	**April 8**

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Thank you for attending!

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