# Prediction of treatment response in a longitudinal glioblastoma dataset using deep learning

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# Declaration of Financial Interests or Relationships

Speaker Name: Ana Matoso

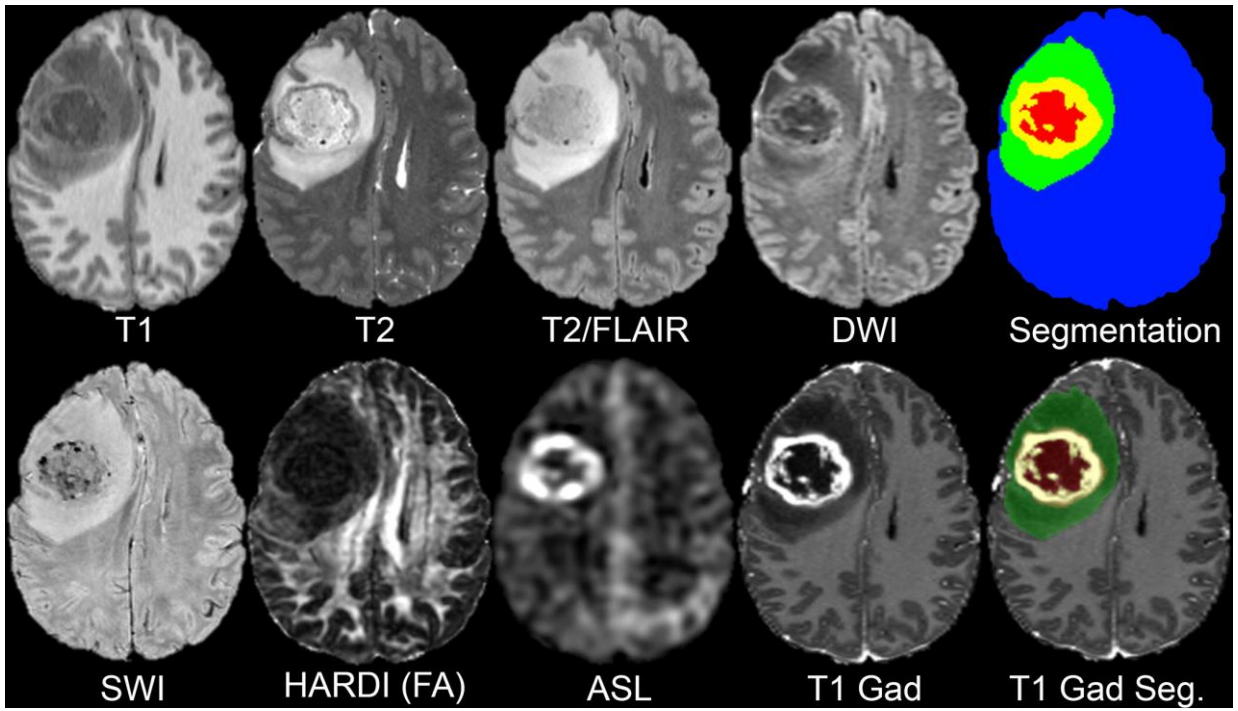
I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

# Introduction

Glioblastoma

Glial cells Tumor

- Prevalence: ~3/100 000 per year
- Poor prognosis
  - Average survival: 9 months
  - 41% survival after 1 years
  - 13% survival after 2 years
- Frequent MRI scans to assess treatment




Glioblastoma on different MRI modalities

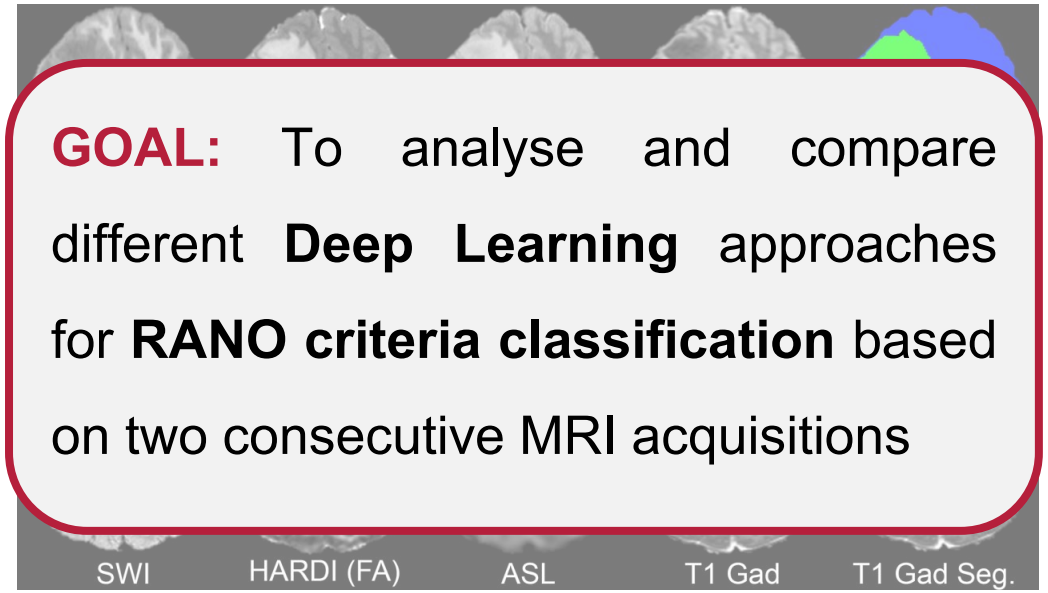


Nicholas F. Brown, et al. *Cancers*. 2022; Quinn T. Ostrom, et al. *Neuro-Oncology*, 2015; Evan Calabrese, et al. *Radiology: Artificial Intelligence* 2022.

# Motivation

Response Assessment in Neuro-Oncology (RANO) criteria

- Complete Response
- Partial Response
- Stable Disease
- Progressive Disease




**GOAL:** To analyse and compare different **Deep Learning** approaches for **RANO criteria classification** based on two consecutive MRI acquisitions

| | Complete Response | Partial Response | Stable Disease | Progressive Disease[a] |
|---|---|---|---|---|
| T1-Gd+ | None | ≥50% ↓ | <50% ↓– <25% ↑ | ≥25% ↑* |
| T2/FLAIR | Stable or ↓ | Stable or ↓ | Stable or ↓ | ↑* |
| New lesion | None | None | None | Present* |
| Corticosteroids | None | Stable or ↓ | Stable or ↓ | NA |
| Clinical status | Stable or ↑ | Stable or ↑ | Stable or ↑ | ↓* |
| Requirement for response | All | All | All | Any* |



Evan Calabrese, et al. *Radiology: Artificial Intelligence* 2022; Patrick Y. Wen, et al., J. Clin. Oncol., 2010

# Methods – Data

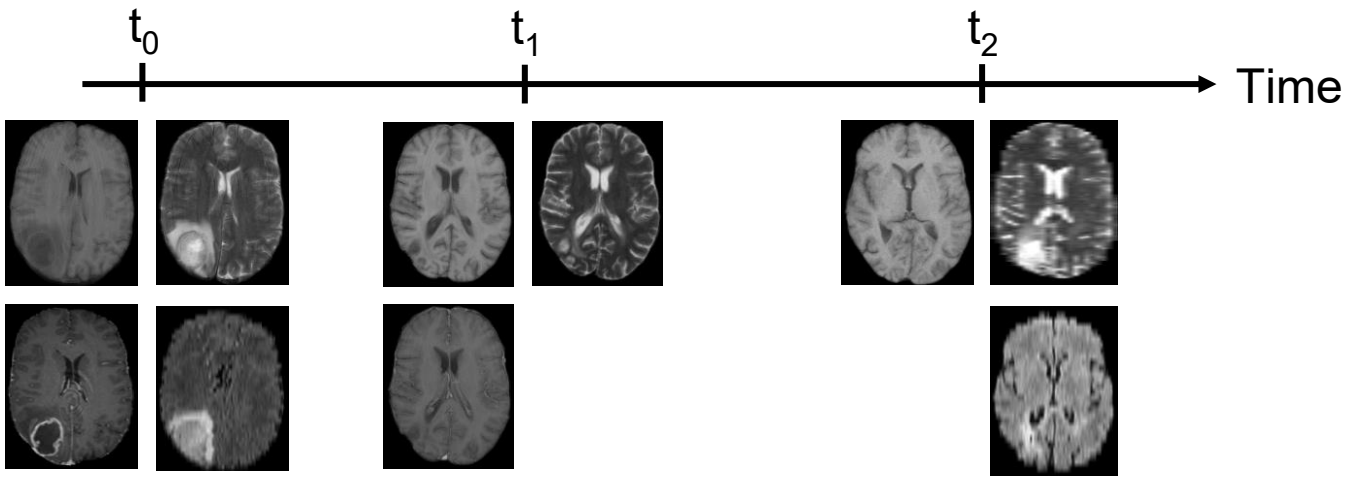
LUMIERE longitudinal dataset

- T1w
- CT1 (T1w contrast enhanced)
- T2w
- FLAIR
- Clinical Data
- RANO classification

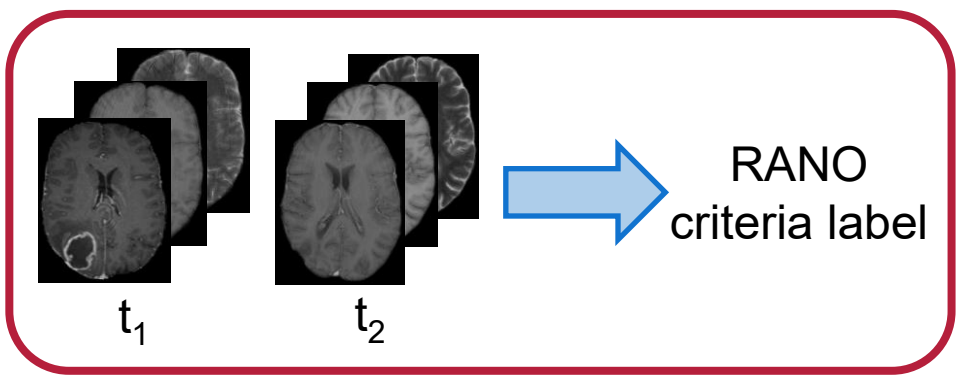
638 timepoints

91 patients

| Class | Prevalence |
|---|---|
| Progressive Disease (PD) | 67% |
| Stable Disease (SD) | 20% |
| Progressive Response (PR) | 6% |
| Complete Response (CR) | 7% |



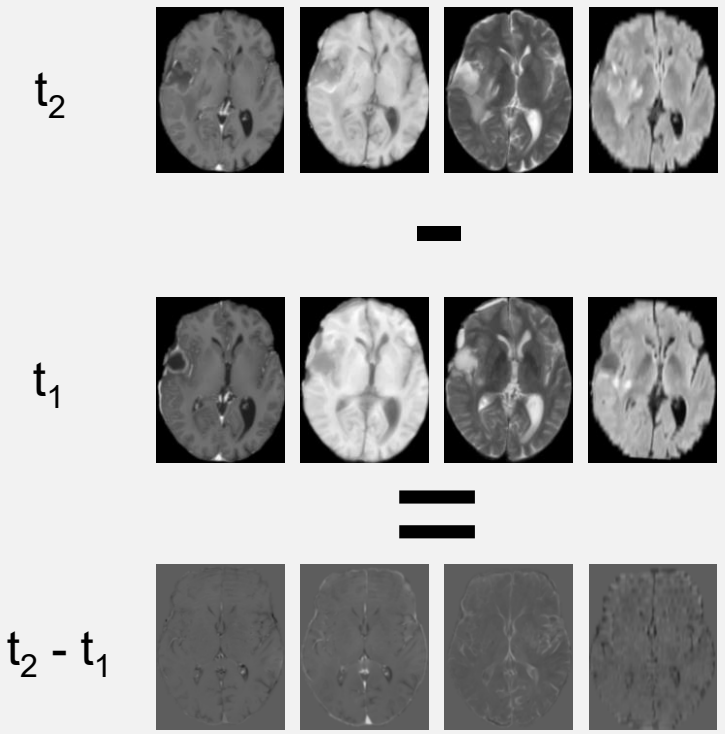

**GOAL:**



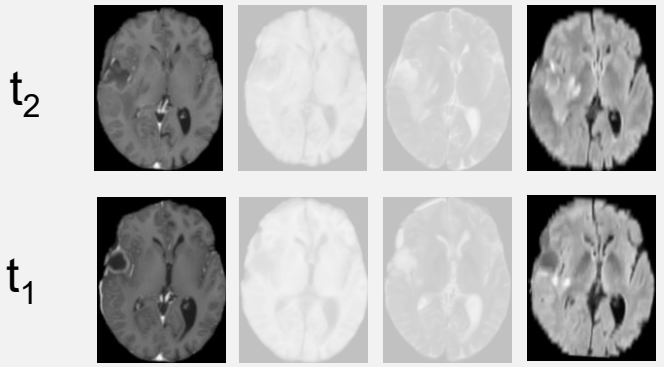

Yannick Suter, et al., *Scientific Data Data*, 2022

# Methods – Tested Approaches

## 1. Subtraction of timepoints




## 2. Combinations of modalities




| Combination of Modalities | Size of Dataset |
|---|---|
| CT1+T1+T2+FLAIR | 337 |
| CT1+FLAIR | 344 |
| T1+T2+FLAIR | 338 |
| CT1 | 355 |
| T1+FLAIR | 338 |

## 3. Model Architectures

- DenseNets:
  - DenseNet 121
  - DenseNet 169
  - DenseNet 264
- Vision Transformer
- Alexnet3D



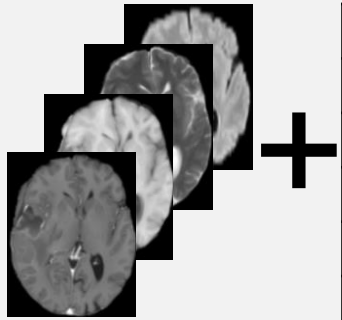
Jorge Cardoso, et al. *arXiv,* 2022.

# Methods – Tested Approaches

## 4. Pretraining


- Self-Supervised Rotation Classifier
- MedMNIST Organ Classifier
- MedicalNet Segmentation Encoder

## 5. Use of Clinical Data

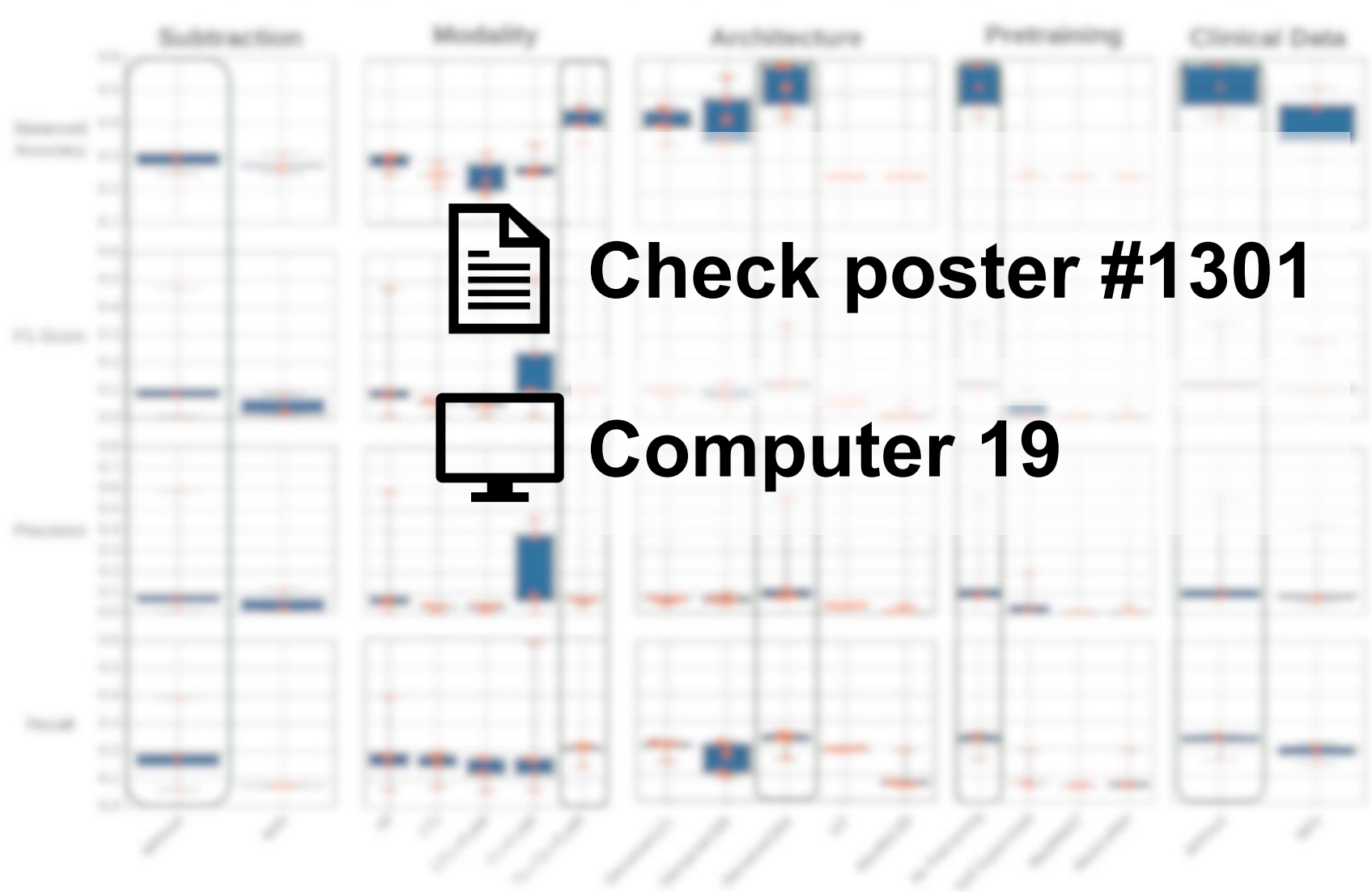


| Clinical Data | Value |
|---|---|
| Age | 66 |
| Sex | M |
| IDH | WT |
| MGMT | F |
| Time from 1st scan | 15w |



Jiancheng Yang, et al. *Scientific Data,* 2023; Sihong Chen, et al. *arXiv,* 2019.

# Results and Discussion

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**Computer 19**