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cancer Biomedical Informatics Grid®

Mouse GBM: A Pilot Collection on NBIA

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Collaboration with
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Introduction

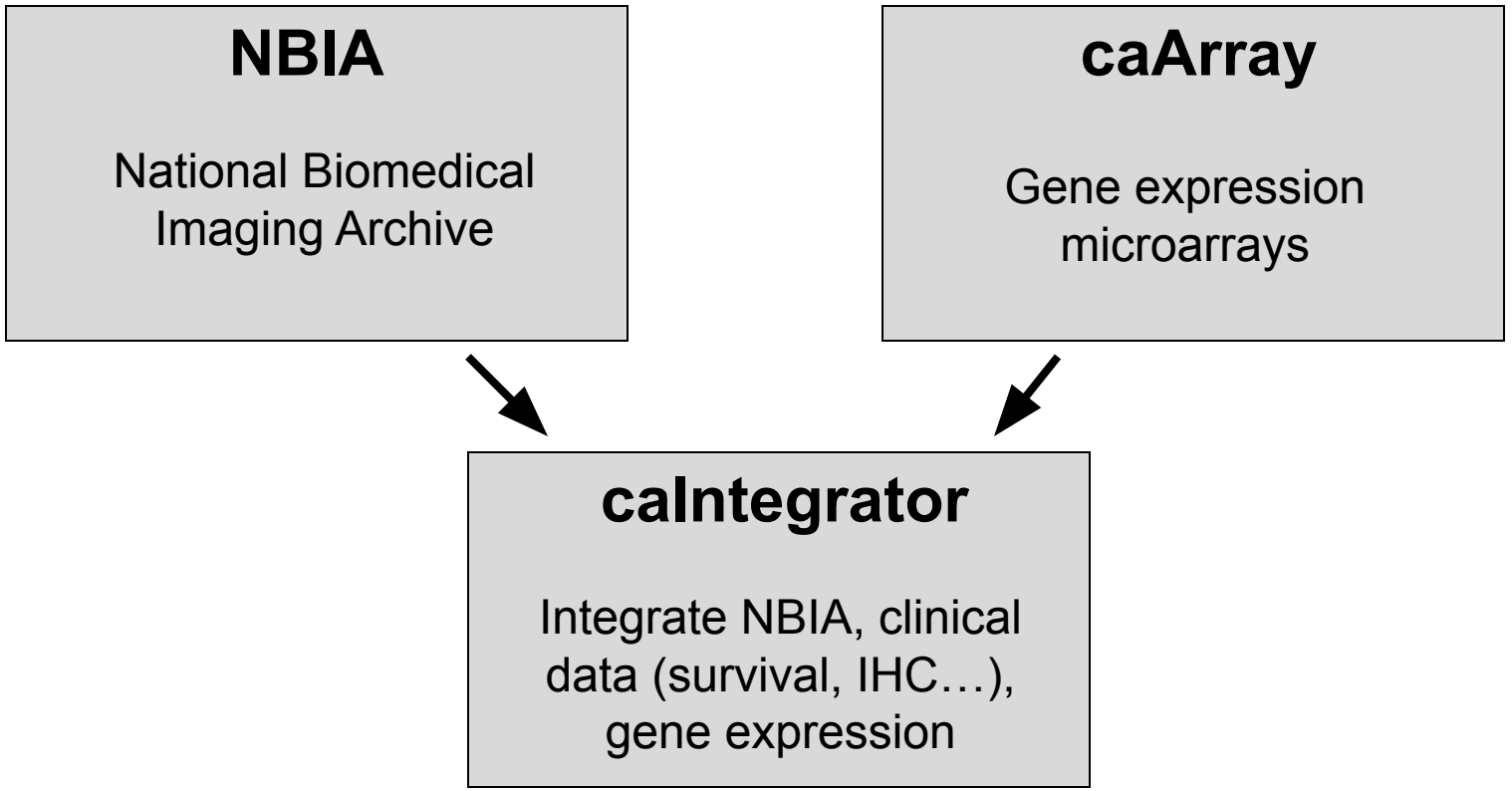
Preclinical Goals

- **Goal 1:** Develop a molecular and imaging based classification for genetically engineered mouse models (GEMs) of glioblastoma multiforme (GBM)

- **Goal 2:** Use imaging to asses response of GBM GEMs to novel therapeutic regimens

Introduction

caBIG® Tools for Preclinical Data



Mouse GBM Pilot Collection

Purpose

- Utilize NBIA and caIntegrator to correlate image-based features with ‘clinical’ data in GBM mouse models
  - Image-based features
    - Qualitative
    - Quantitative blood brain barrier permeability
  - ‘Clinical’ features
    - Genotype
    - Tumor histologic characteristics
    - IHC— e.g., CD31
- One time imaging in n=62 mouse patients

Mouse GBM Pilot Collection

Animal models

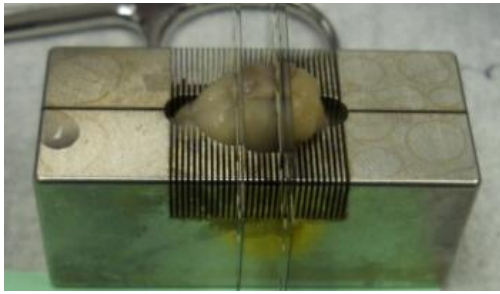
- Intracranial injection of cell lines derived from several GEMs
- **Genotypes:**
  - Rb inactivation + Ras activation (TR)
  - Rb inactivation + Ras activation + PTEN loss (TRP)
  - Rb inactivation + Ras activation + EGFR loss (TRE)

Mouse GBM Pilot Collection

Brain Imaging Workflow

Four mice imaged
at once

Philips Intera Achieva
3.0T MRI clinical scanner
~1hour imaging time

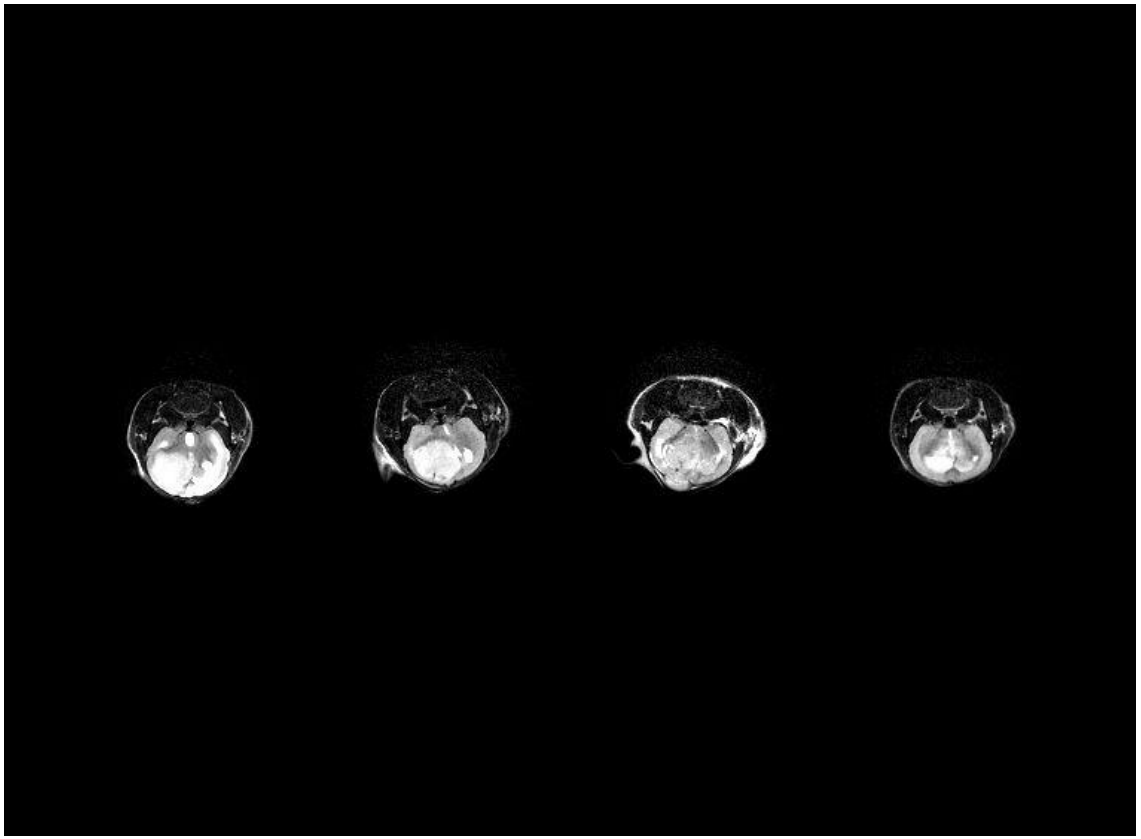


Post imaging euthanize
and histology

Mouse GBM Pilot Collection

MRI Pulse Sequences

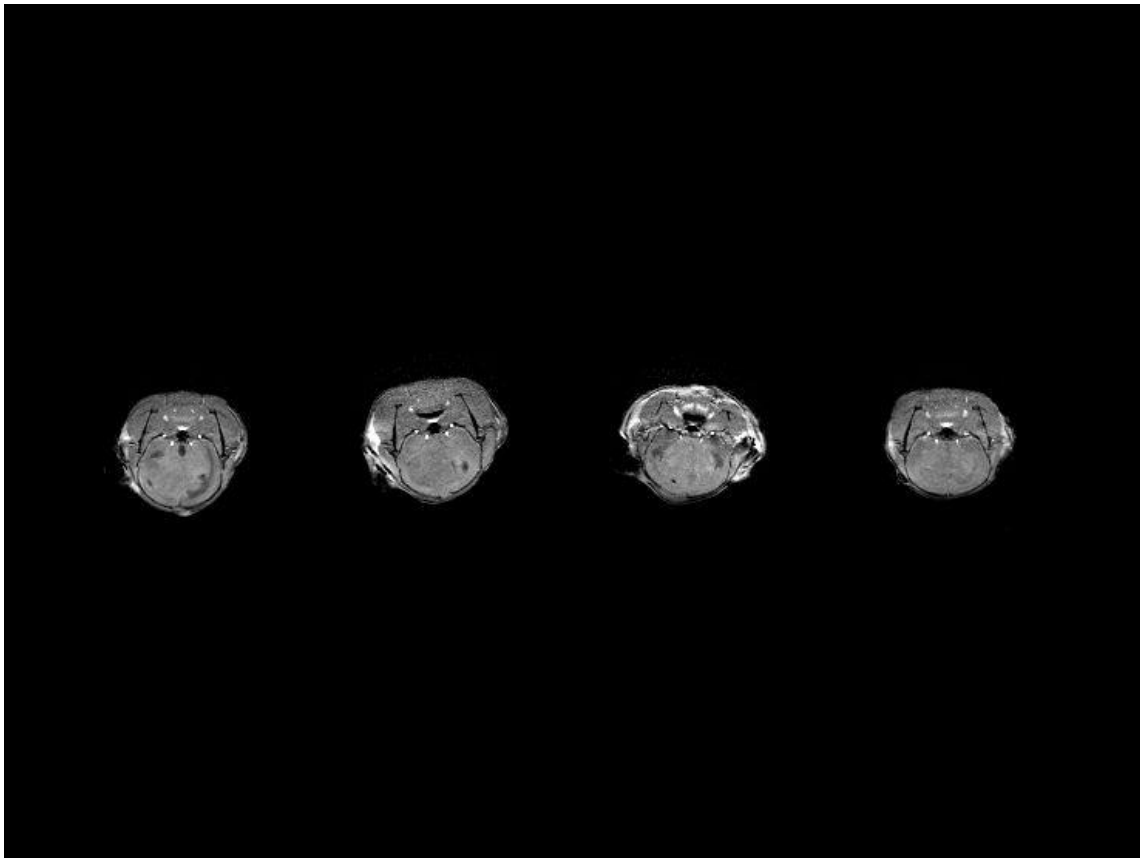
- **T2 weighted pre contrast**



Mouse GBM Pilot Collection

MRI Pulse Sequences

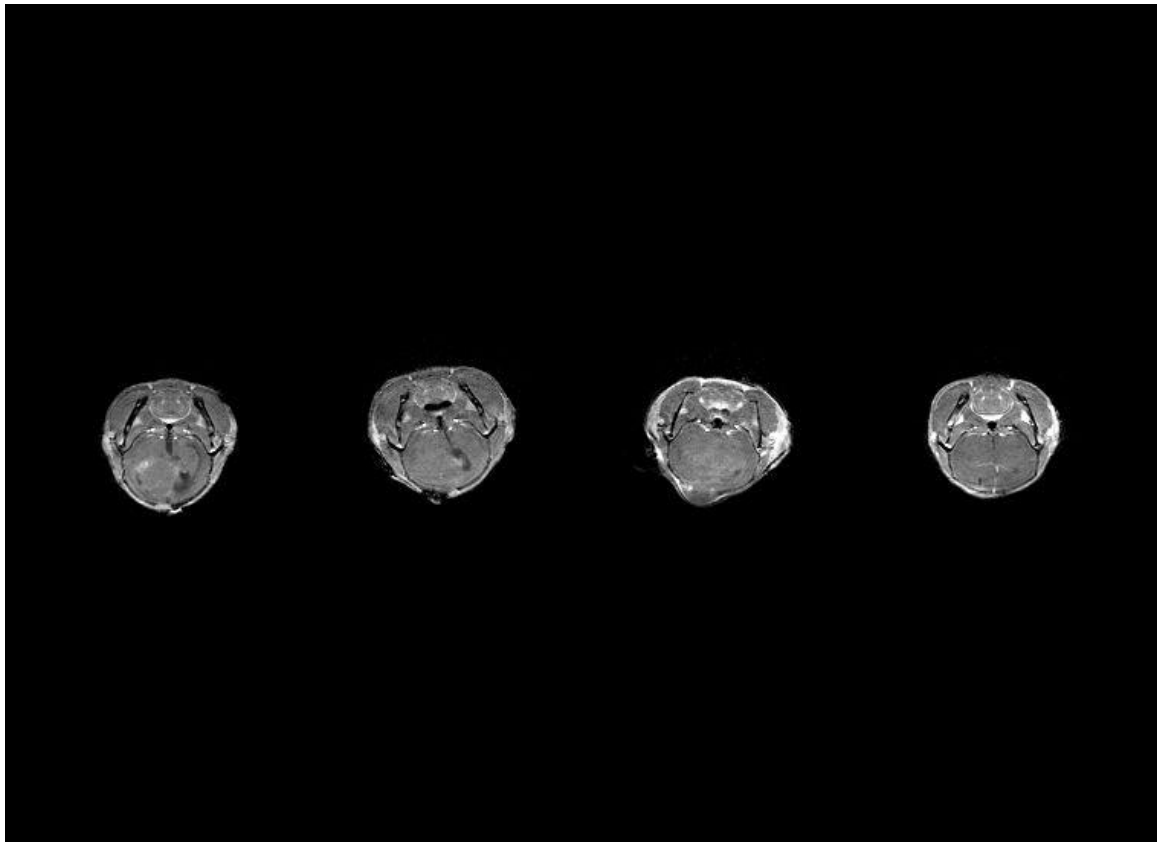
- **T1 weighted pre contrast**



Mouse GBM Pilot Collection

MRI Pulse Sequences

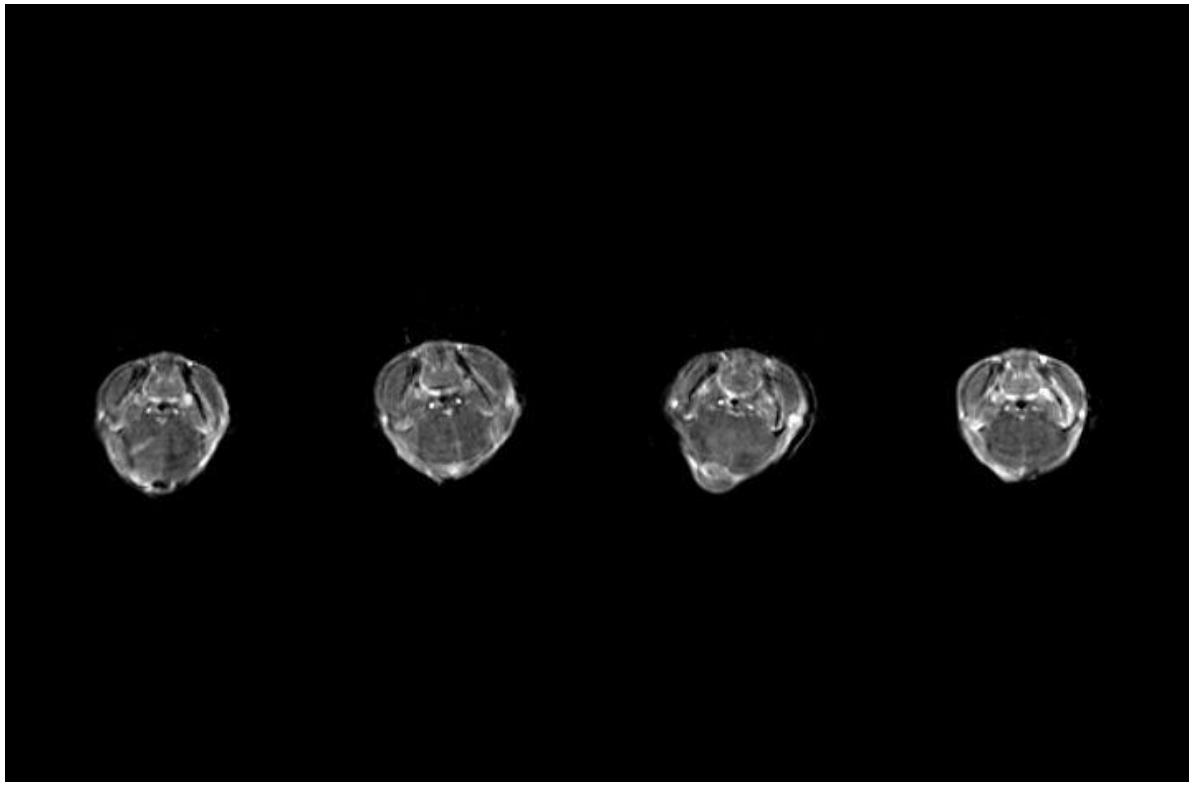
- **T1 weighted post contrast**



Mouse GBM Pilot Collection

MRI Pulse Sequences

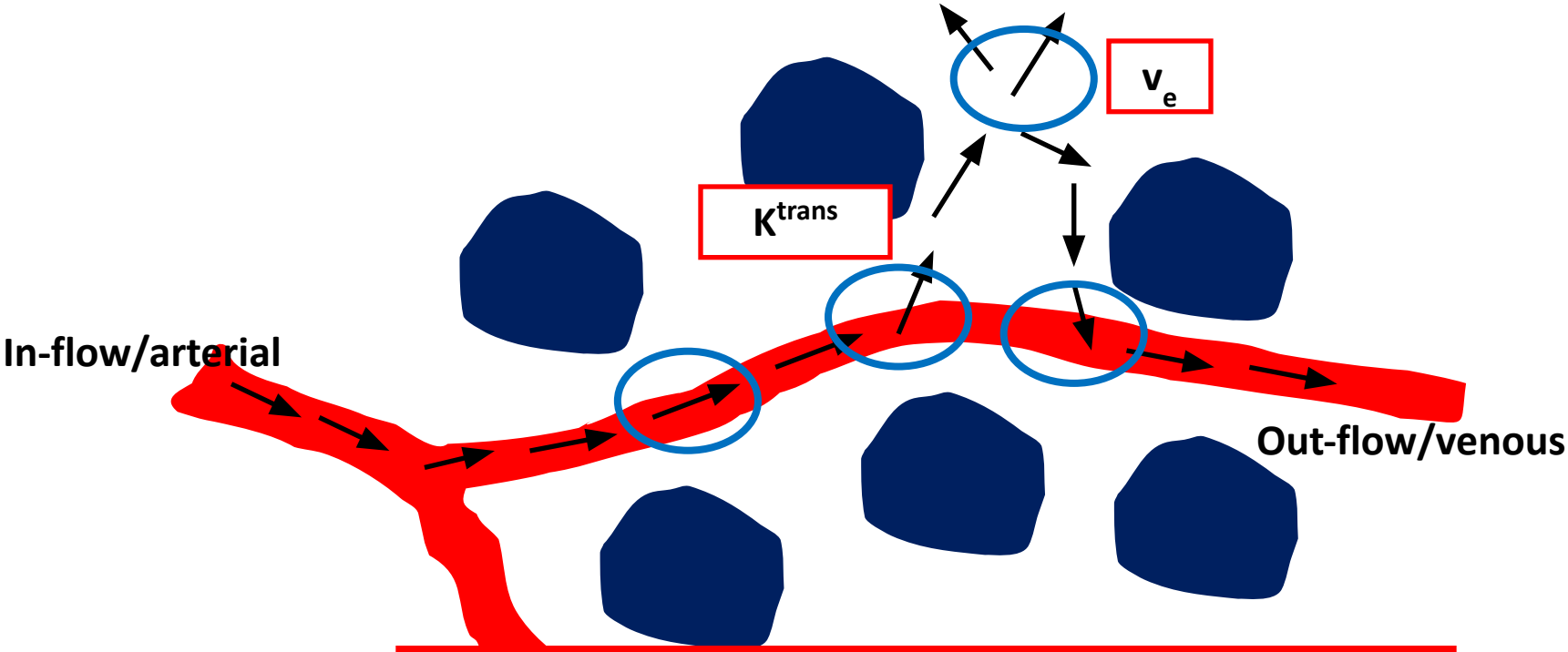
- **Dynamic contrast enhanced series**



Mouse GBM Pilot Collection

DCEMRI and two compartment model parameters

- Quantifiable information on the blood brain barrier permeability is extracted from the pattern of contrast agent uptake

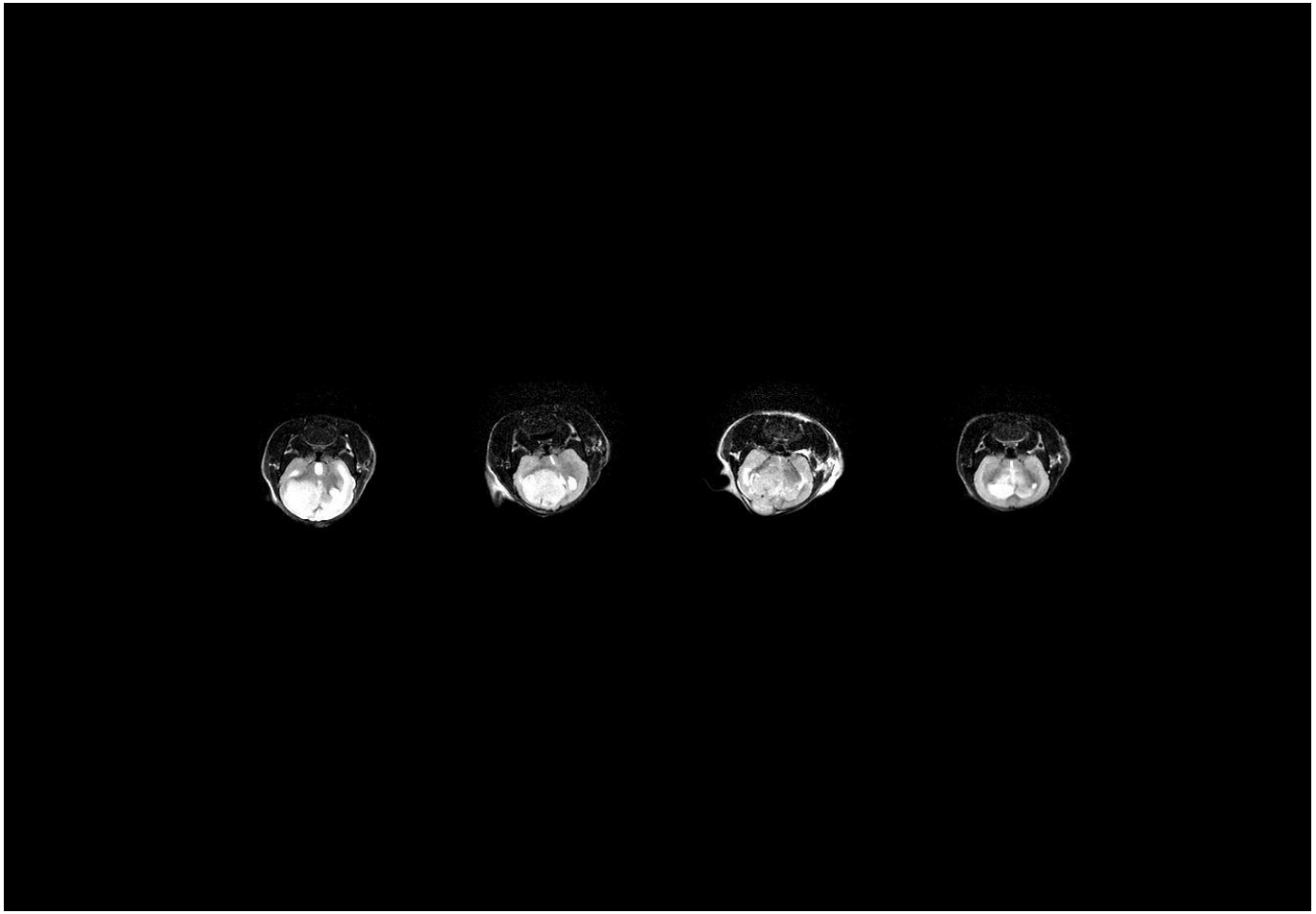


$$\frac{dC(t)}{dt} = K^{trans} \cdot \left(C_p(t) - C(t)/v_e\right)$$

From Cheng Yang

Mouse GBM Pilot Collection

Challenge: Cropping and splitting the image data



Mouse 10	Mouse 11	Mouse 66	Mouse 82

Mouse GBM Pilot Collection

Challenge: Cropping and splitting the metadata

- **DICOM header**

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(0010,0010) PN [SJ_DCE_10_11_66_82]                     #  18, 1 PatientsName
(0010,0020) LO [SJ_DCE_10_11_66_82]                     #  18, 1 PatientID
(0010,0030) DA [20100928]                               #   8, 1 PatientsBirthDate
(0010,0040) CS [M]                                      #   2, 1 PatientsSex
```

```
(0018,9089) FD 0\0\0                                                                  #  24, 3 DiffusionGradientOrientation
(0020,000d) UI [1.3.46.670589.11.17169.5.0.4584.20110215110131962l6] #  52, 1 StudyInstanceUID
(0020,000e) UI [1.3.46.670589.11.17169.5.0.4564.20110215115828019651 #  52, 1 SeriesInstanceUID
(0020,0010) SH [350910091]                                                            #  10, 1 StudyID
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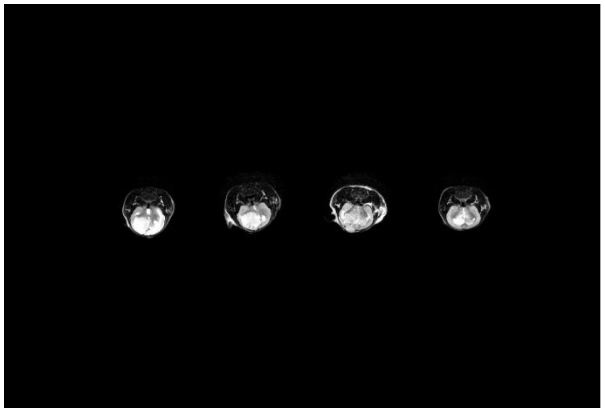
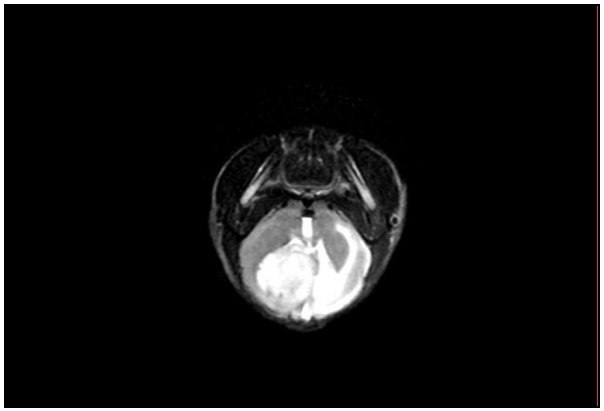
(0028,0010) US 1024                                                                   #   2, 1 Rows
(0028,0011) US 1024                                                                   #   2, 1 Columns
```

Mouse GBM Pilot Collection

Cropping and splitting the image data



Program written in IDL



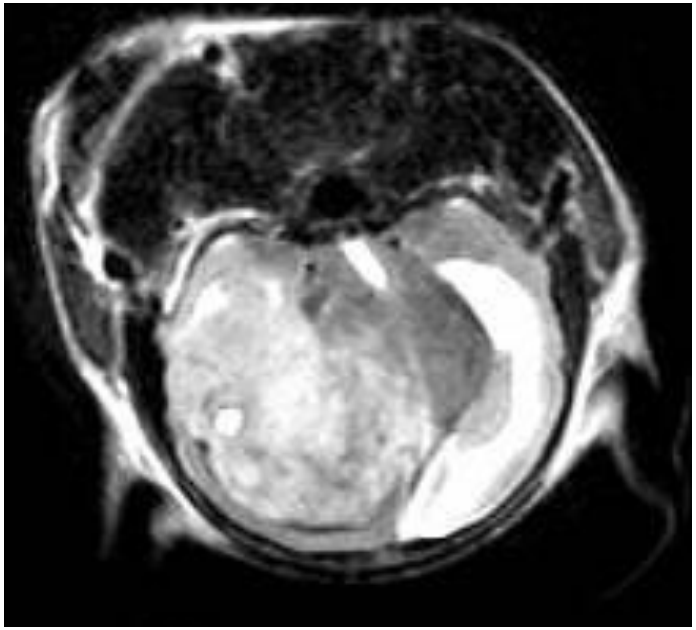
10 11 66 82

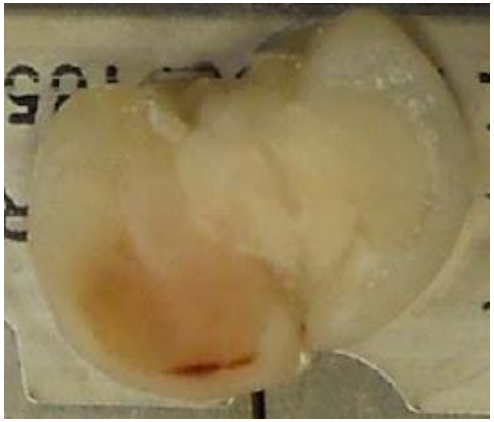
Mouse 10

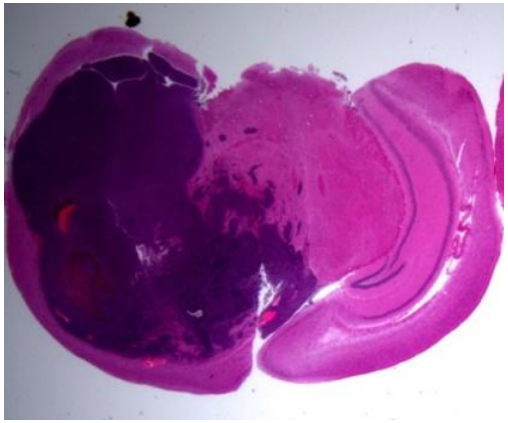
- **Advantage: Image arrays 16 times smaller**

Mouse GBM Pilot Collection

Cropping and splitting the image data







Mouse GBM Pilot Collection

Cropping and splitting the metadata

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```
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(0010,0030) DA [20100928]                                            #   8, 1 PatientsBirthDate
(0010,0040) CS [M]                                                   #   2, 1 PatientsSex
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Program written in IDL

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(0028,0011) US 256                                                   #   2, 1 Columns
```

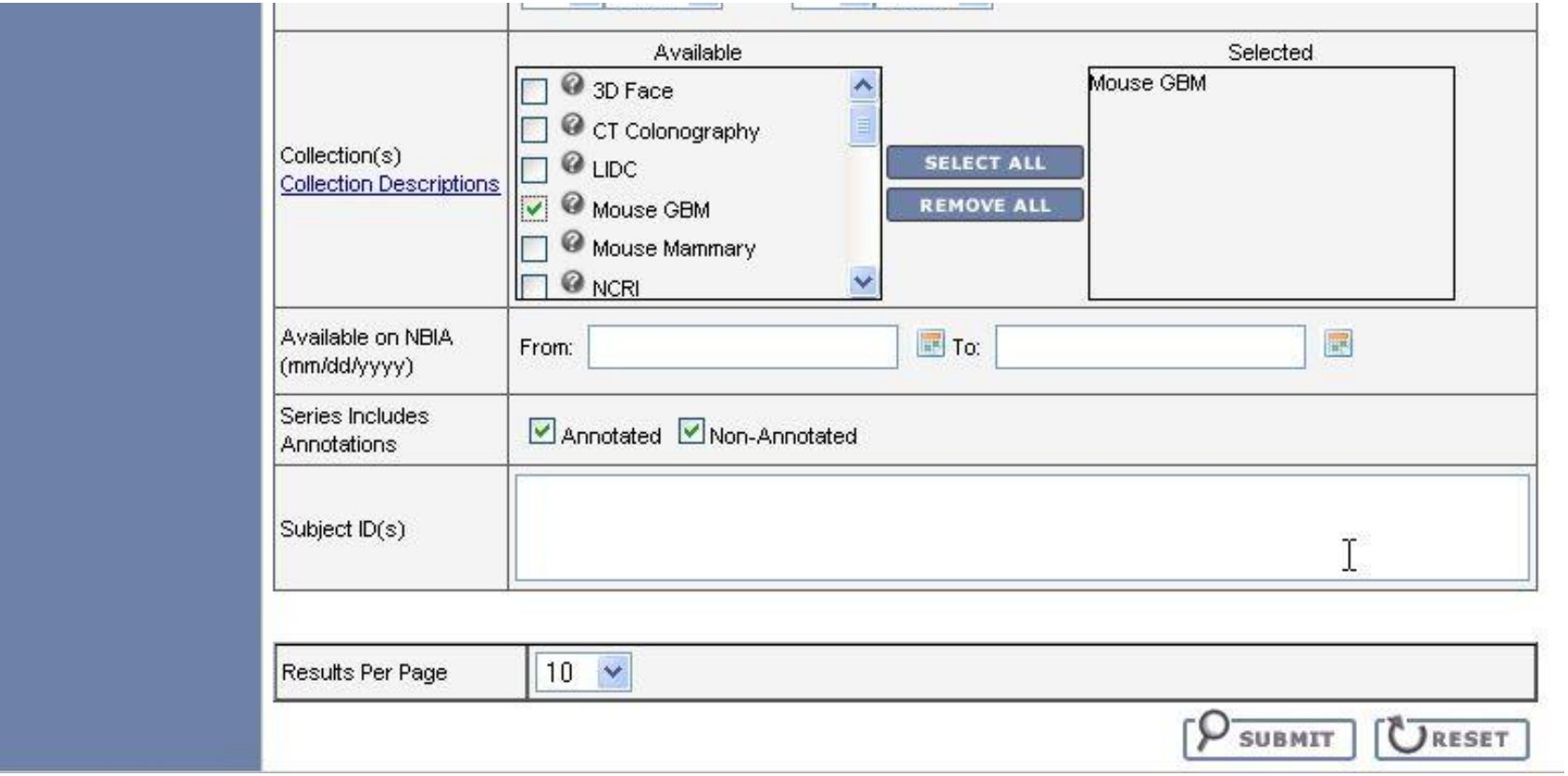
Mouse GBM Pilot Collection

Deployment to CBIIT instance of NBIA

- **Demo: Mouse GBM on NBIA**

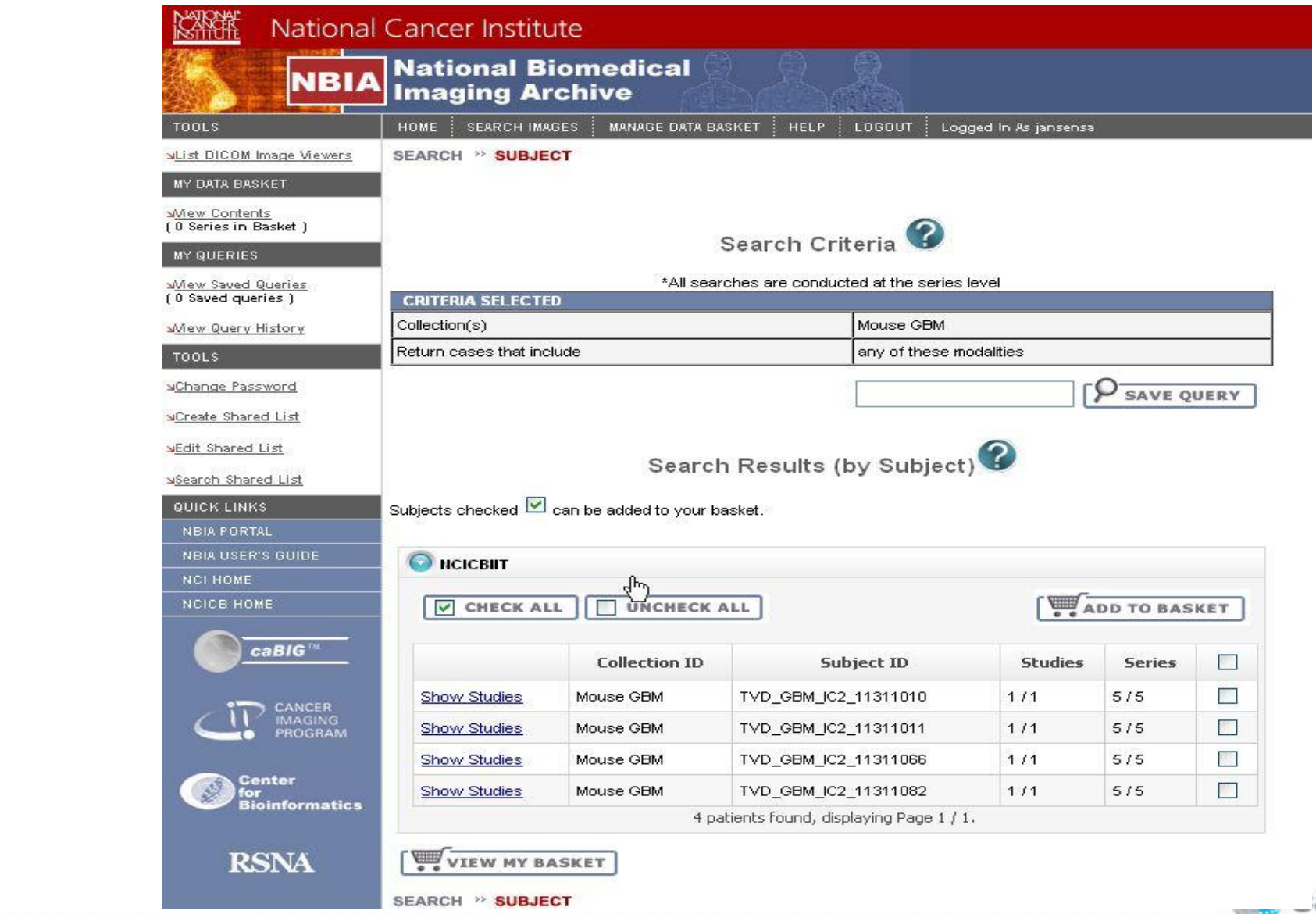
Mouse GBM Pilot Collection

Deployment to CBIIT instance of NBIA



Mouse GBM Pilot Collection

Deployment to CBIIT instance of NBIA



Mouse GBM Pilot Collection

Deployment to CBIIT instance of NBIA

National Cancer Institute

NBIA National Biomedical Imaging Archive

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Study Instance UID	Date
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Description	**Data Location**
GBM_intracranial	NCICBIIT

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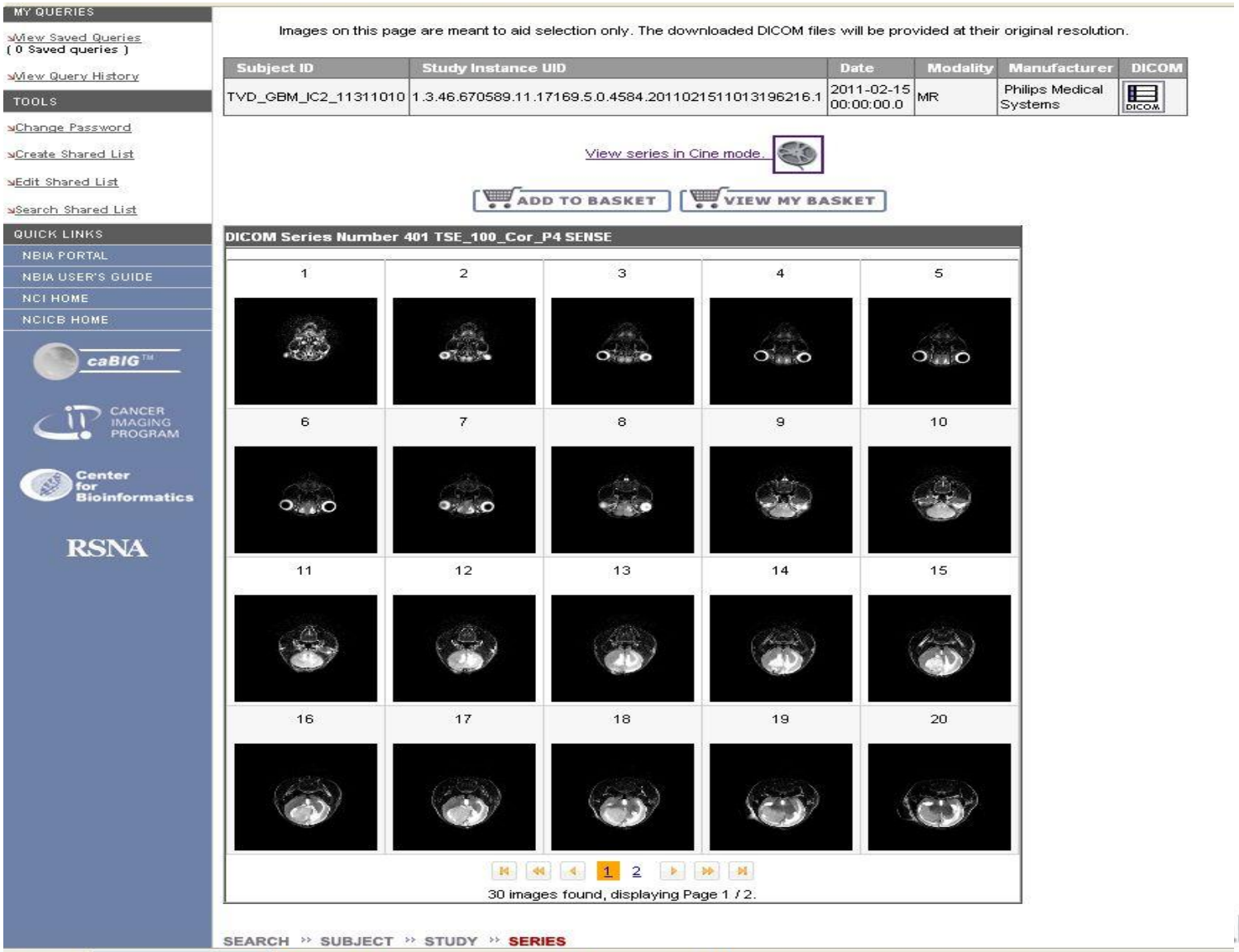
Mouse GBM Pilot Collection

Deployment to CBIIT instance of NBIA



Summary

- **Progress to date:** Successfully deployed individual mouse GBM MRI datasets to NBIA
- **Next steps**
  - Set up own instance of NBIA
  - Qualitative and quantitative image analysis
    - AIM features
    - K^{trans}, v_e
  - Correlation of image-based features with genotype, histology, pathology
    - caIntegrator

Mouse GBM Pilot Collection

Deployment to CBIIT instance of caInt

- **Demo: Mouse GBM on caIntegrator**

Summary

- **Future directions**
  - caArray
  - Center for Advanced Preclinical Research (CAPR)
  - Mouse Mammary pilot collection and image-based prognostic markers