



# caGrid, caBIG, CVRG and NCIBI

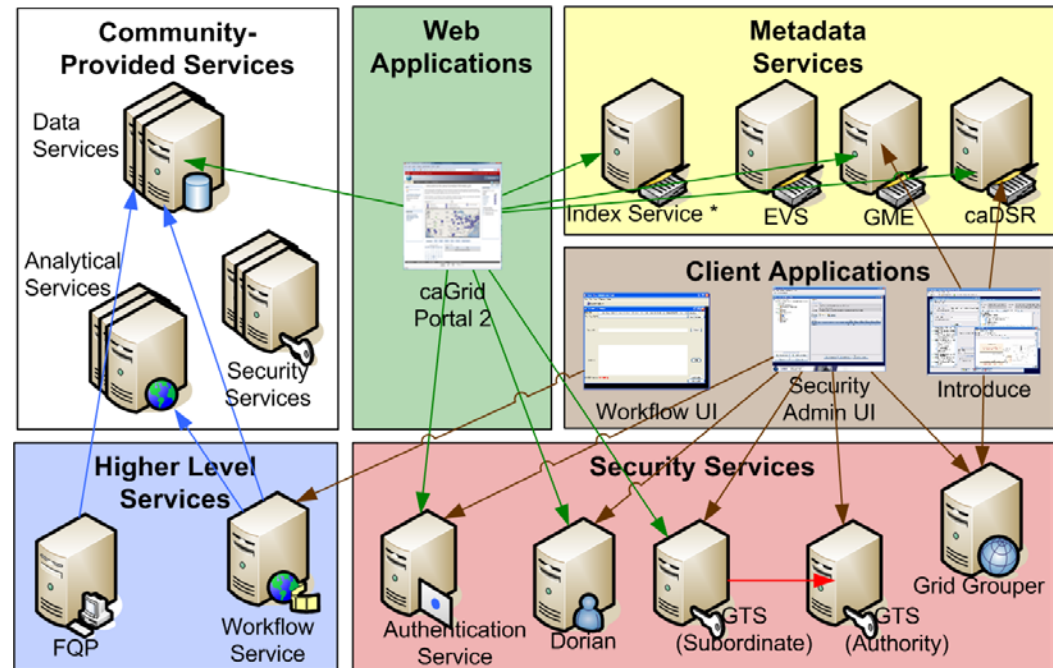
*Joel Saltz MD, PhD*  
*Director Center for*  
*Comprehensive Informatics*



# Biomedical Middleware: caGrid

## caGrid Components

- Security (GAARDS)
- Language (metadata, ontologies)
- Semantic/Federated query
- Workflow
- Grid Service Graphical Development Toolkit (Introduce)
- DICOM, IHE compatibility
- Advertisement and Discovery



\*All Services Register with the Index Service



# Translation: Same ideas, different words

مرحبا  
환영  
Welcome  
ようこそ  
Bienvenido  
Bienvenue  
Willkommen  
Benvenuto  
歡迎  
Dobro пожаловать  
Salamat Datang



caBIG™ cancer Biomedical Informatics Grid™

an initiative of the National Cancer Institute

# Vocabulary/Ontology

## Prostate Adenocarcinoma

### Identifiers:

name	Prostate_Adenocarcinoma
code	C2919

Concept Code

### Relationships to other concepts:

Disease_Has_Abnormal_Cell	Adenocarcinoma Cell
Disease_Has_Associated_Anatomic_Site	Male Reproductive System
Disease_Has_Associated_Anatomic_Site	Prostate Gland
Disease_Has_Normal_Cell_Origin	Glandular Cell
Disease_Has_Normal_Tissue_Origin	Epithelium
Disease_Has_Primary_Anatomic_Site	Prostate Gland

Relationships

### Information about this concept:

Preferred_Name	Prostate Adenocarcinoma
Semantic_Type	Neoplastic Process
Unified Medical Language System Concept Identifier	C0007112

Preferred Name

Definition

### DEFINITION

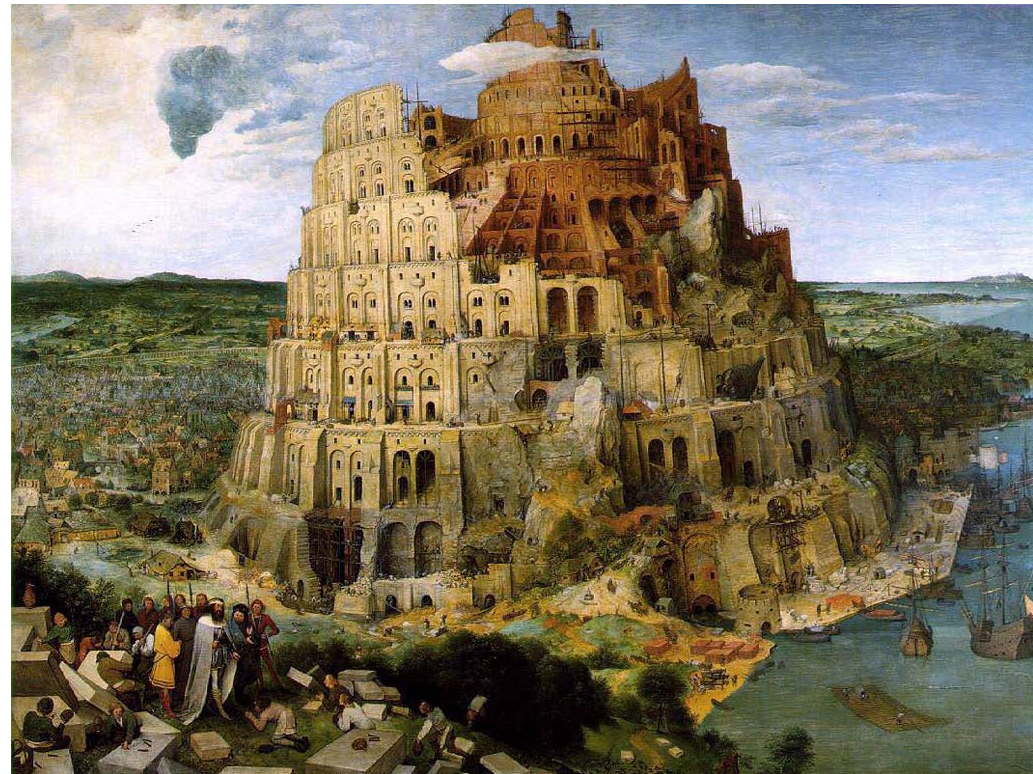
NCI|Prostate adenocarcinoma is one of the most common malignant tumors afflicting men. The majority of adenocarcinomas arise in the peripheral zone and a minority occur in the central or the transitional zone of the prostate gland. Grading of prostatic adenocarcinoma predicts disease progression and correlates with survival. Several grading systems have been proposed, of which the Gleason system is the most commonly used. Gleason sums of 2 to 4 represent well-differentiated disease, 5 to 7 moderately differentiated disease and 8 to 10 poorly differentiated disease. Prostatic-specific antigen (PSA) serum test is widely used as a screening test for the early detection of prostatic adenocarcinoma. Treatment options include radical prostatectomy, radiation therapy, androgen ablation and cryotherapy. Watchful waiting or surveillance alone is an option for older patients with low-grade or low-stage disease. --2002

Synonym with source data	Adenocarcinoma of Prostate SY NCI
Synonym with source data	Adenocarcinoma of the Prostate SY NCI
Synonym with source data	Prostate Adenocarcinoma PT NCI

Synonyms

# Interoperability

- Registered metadata
- Ontology concept codes used to annotate models
- XML schemas that define data structures also registered
- Thus both data semantics AND data structures are registered. That is how we achieve (relative) interoperability.



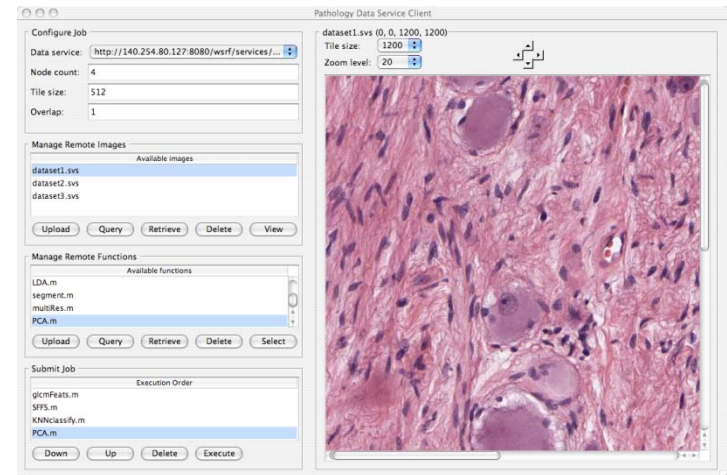
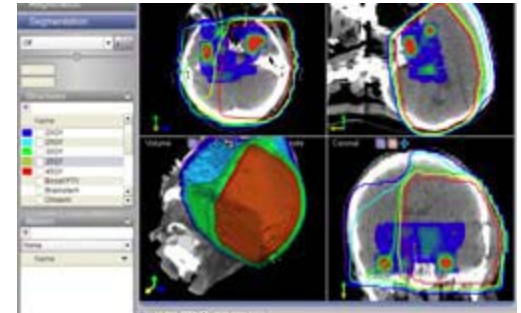
# Will Treatment work and if not, why not?

Motivating Example: Avastin and Glioblastoma in RTOG-0825

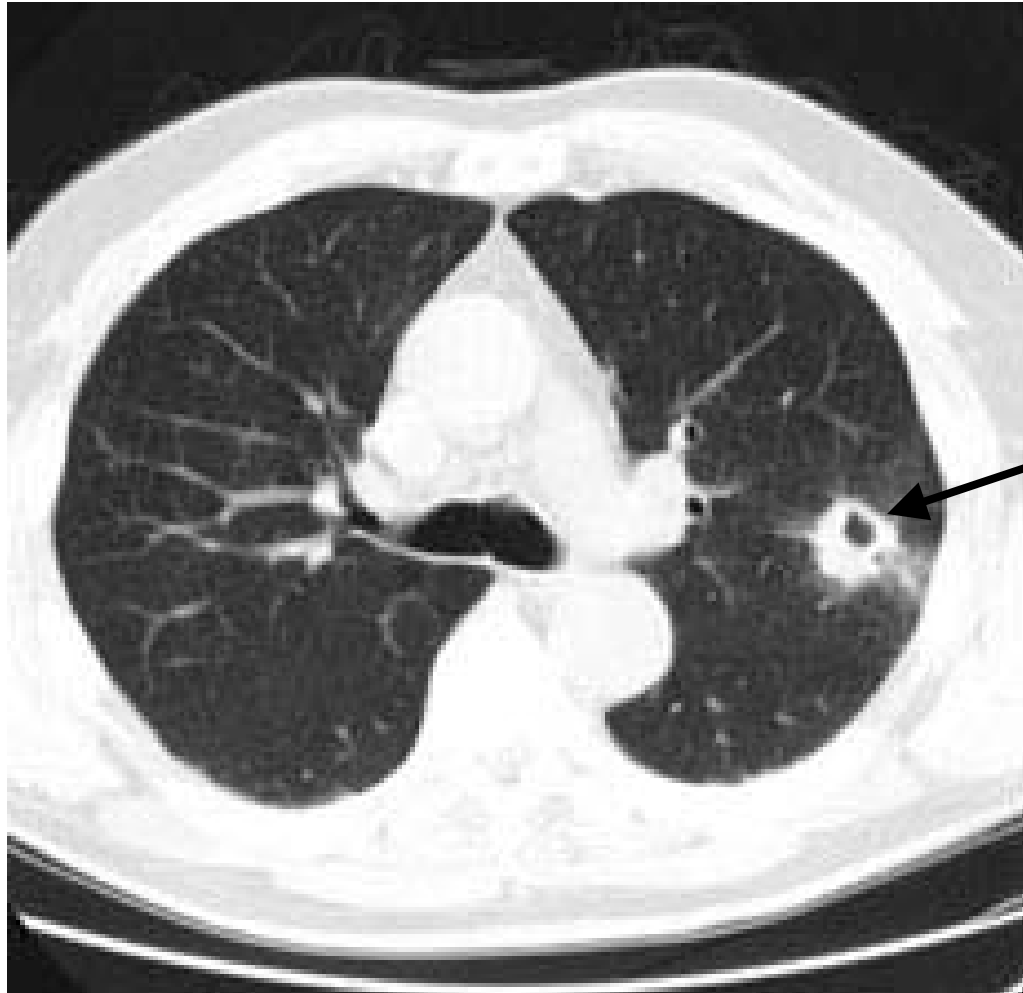
Treatment: Radiation therapy and Avastin (anti angiogenesis)

Predict and Explain: Genetic, gene expression, microRNA, Pathology, Imaging

RT, imaging, Pathology markup/annotations



For the sake of quality control, reproducibility and data sharing, results of RT, imaging, Pathology observations and analyses need to be described in a well defined manner

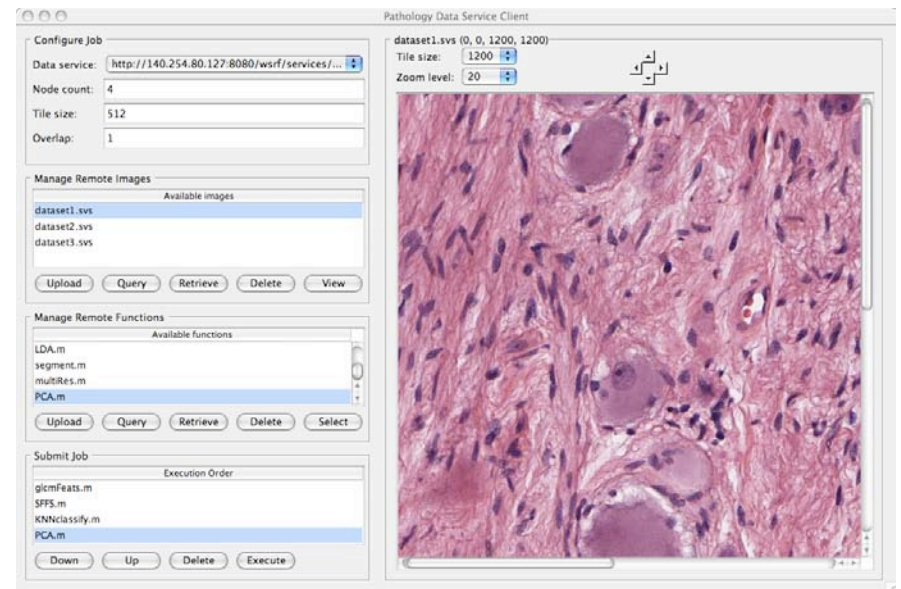


**Finding: mass**  
**Mass ID: 1**  
**Margins: spiculated**  
**Length: 2.3cm**  
**Width: 1.2cm**  
**Cavitory: Y**  
**Calcified: N**  
**Spatial relationships: Abuts pleural surface; invades aorta**

# Digital Pathology



Multiheaded Microscope



caMicroscope



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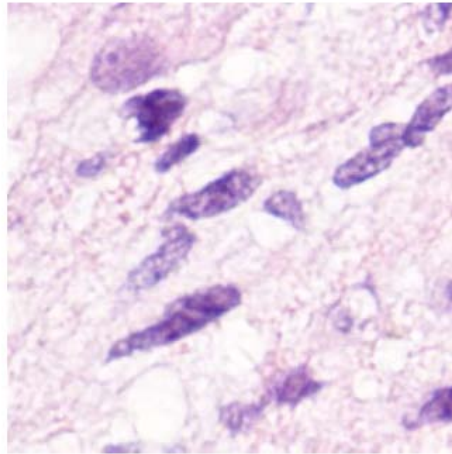


In Silico Center Collaboration: Distinguish (and maybe redefine) astrocytic, oligodendroglial and oligoastrocytic tumors using TCGA and Rembrandt ***Important since treatment and Outcome differ***

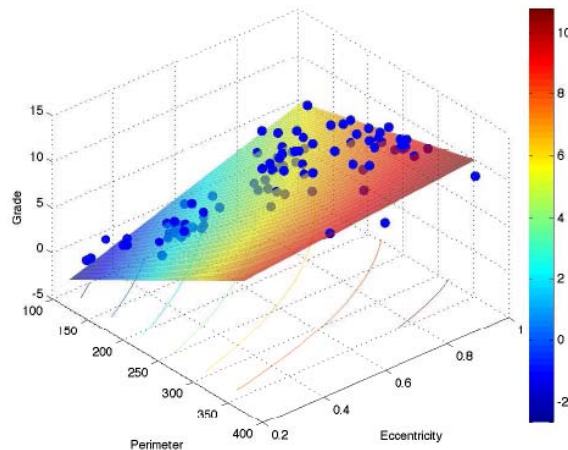
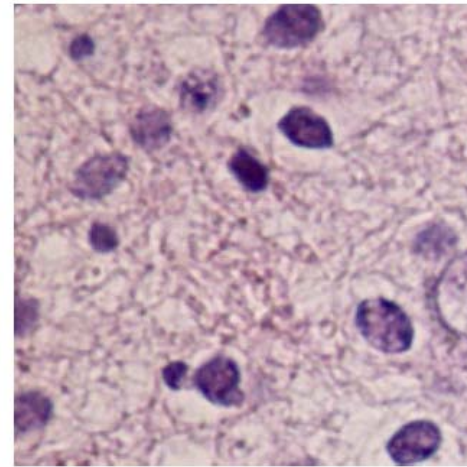
- Link nuclear shape, texture to biological and clinical behavior
- How is nuclear shape, texture related to gene expression category defined by clustering analysis of Rembrandt data sets?
- Relate nuclear morphometry and gene expression to neuroimaging features (Vasari feature set)
- Genetic and gene expression correlates of high resolution nuclear morphometry and relation to MR features using Rembrandt and TCGA datasets.



# Annotation and Markup of Pathology Data needs Human/Algorithm Cooperation



(a)

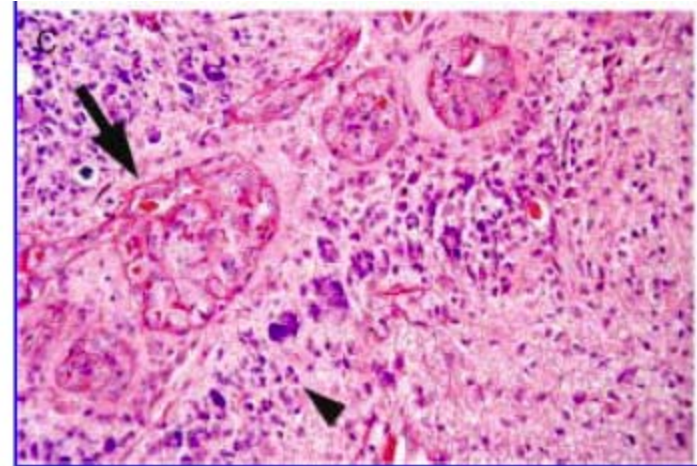
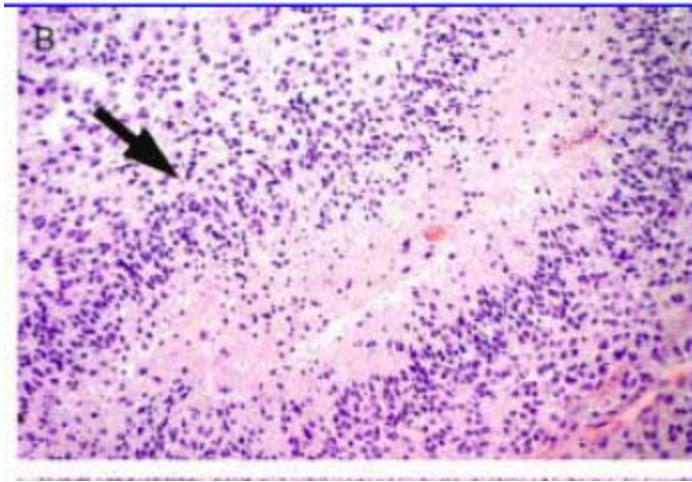


## Astrocytoma vs Oligodendroglioma

- TCGA finds genetic, gene expression overlap
- Pathologists have also long seen overlap
- Relationship between Pathology, Molecular, Radiology
- ***Relationship to Outcome, treatment response***



# What you find depends on where you look

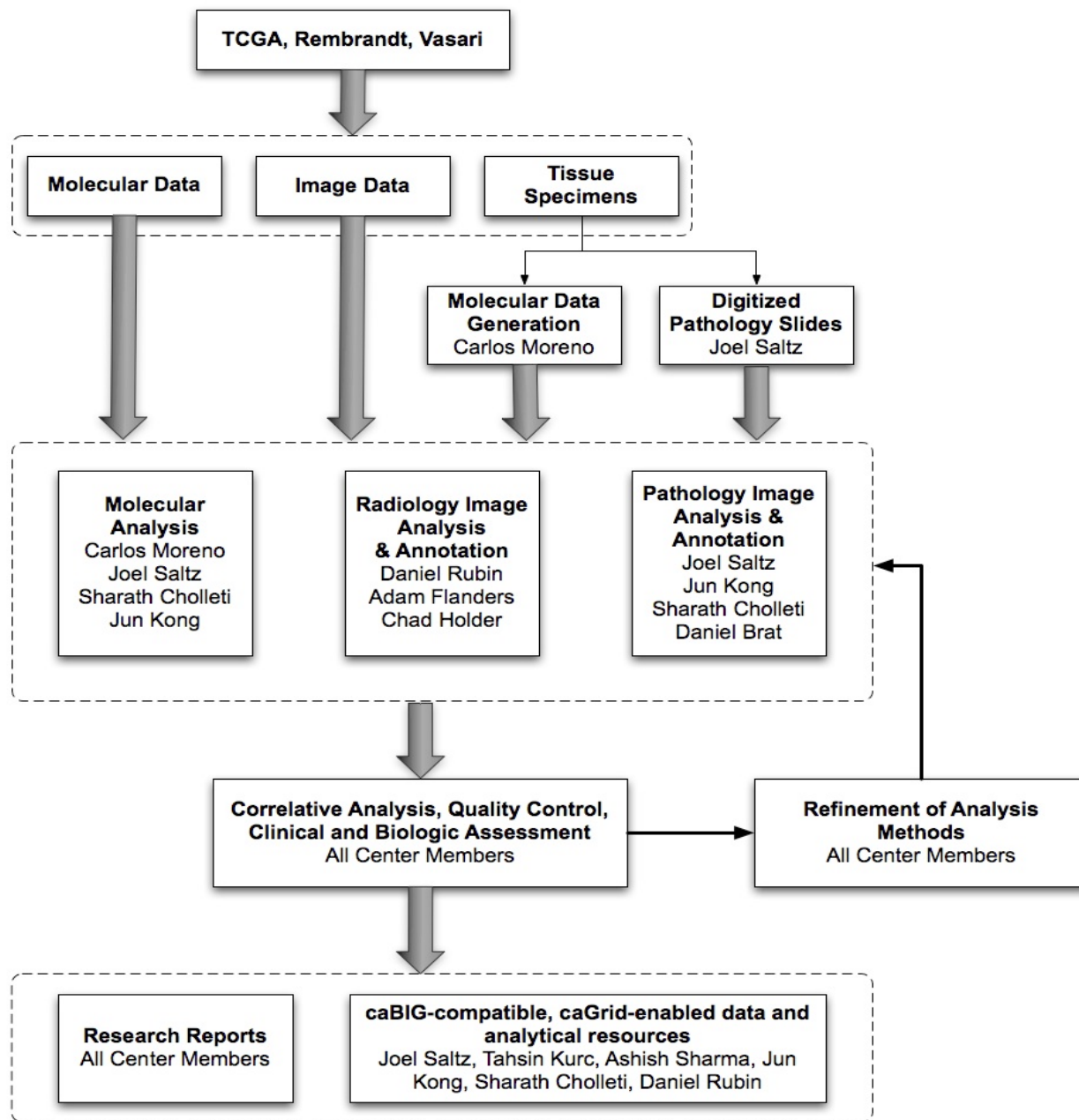


- GBM gene expression patterns will be influenced by necrosis, degree and type of angiogenesis
- Systems biology hypotheses being evaluated – ideal context for NCIBI collaboration
- Degree and pattern of necrosis/angiogenesis varies within a given tumor so ***molecular analyses need to be interpreted in the context of what was sampled***



# Use of randomly selected sample to determine whether the earth is wet or dry ...

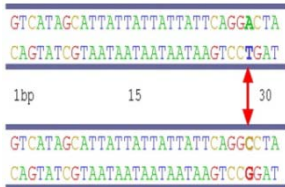




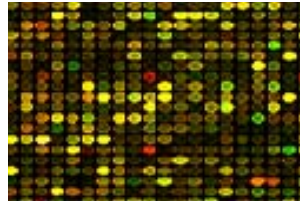
# Cardiovascular Research Grid: Reynolds Study

## Biomarker Construction: Imaging + Genetic + Genomic + ECG

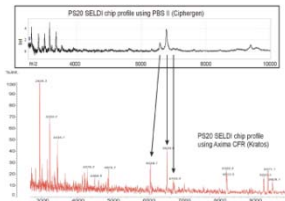
The Cardiovascular Research Grid (PI Rai Winslow -- JHU, OSU, UCSD)  
The D. W. Reynolds Cardiovascular Clinical Research Center



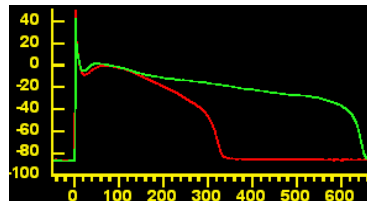
**Genetic Variability**



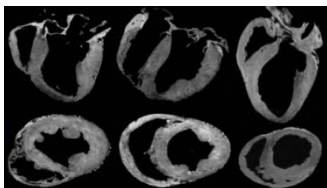
**Gene Expression Profiling**



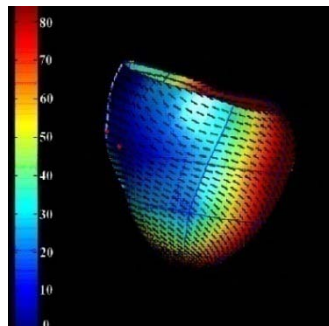
**Protein Expression Profiling**



**Electrophysiological Data**



**Multi-Modal Imaging**



**Data Analysis And Modeling**

- Who should receive ICDs?
- Large patient cohort (~ 1,200) at high risk for sudden cardiac death
- All have CAD, LV dysfunction, received ICD placement
- Multi-scale data from each patient
- Patients with appropriate ICD firings are defined as high risk, patients without as low risk
- Challenge – discover biomarkers that are predictive of high risk
- Test biomarkers on novel (~500) patient population

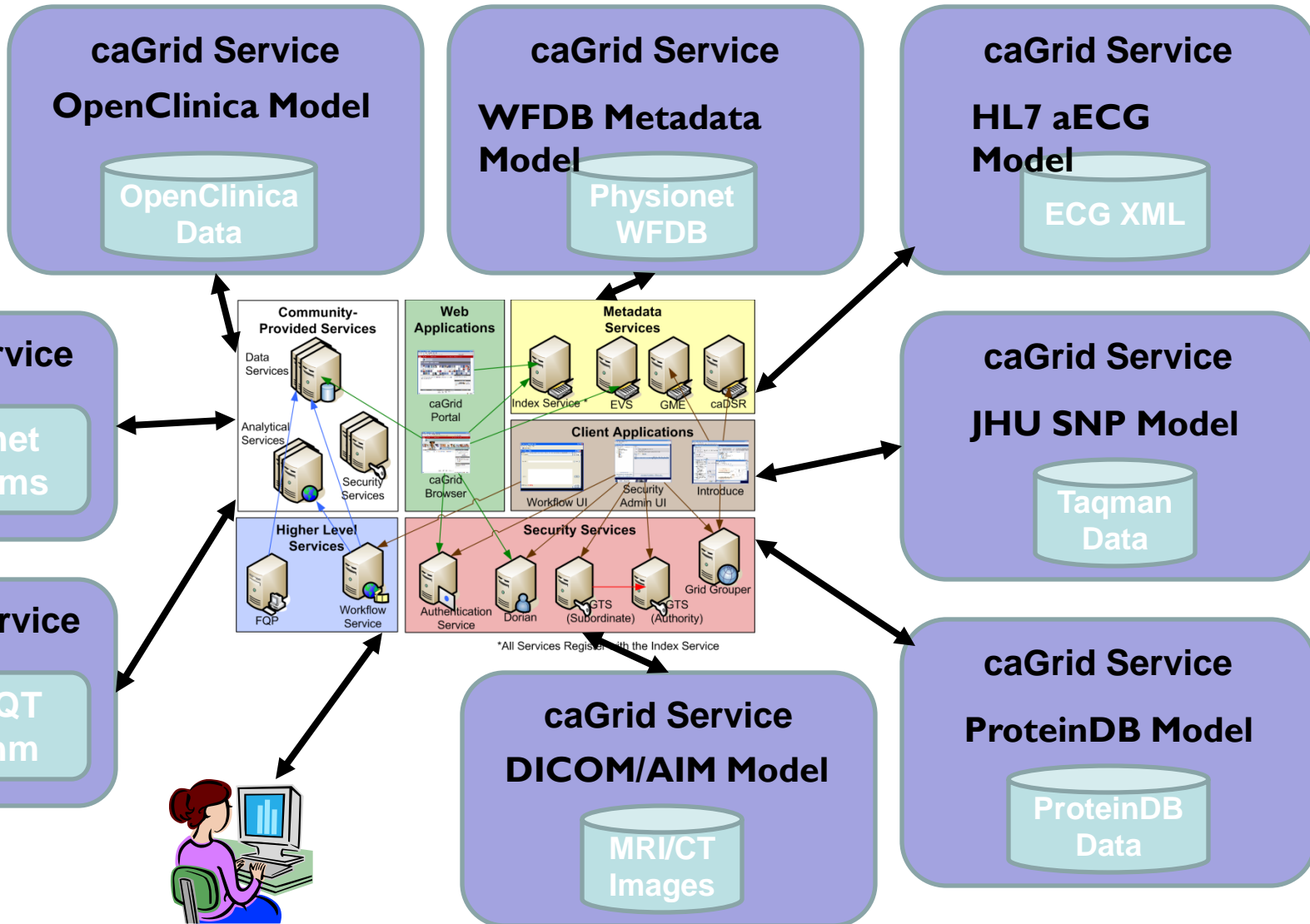


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# Common Application Services



## Links to NCIBI

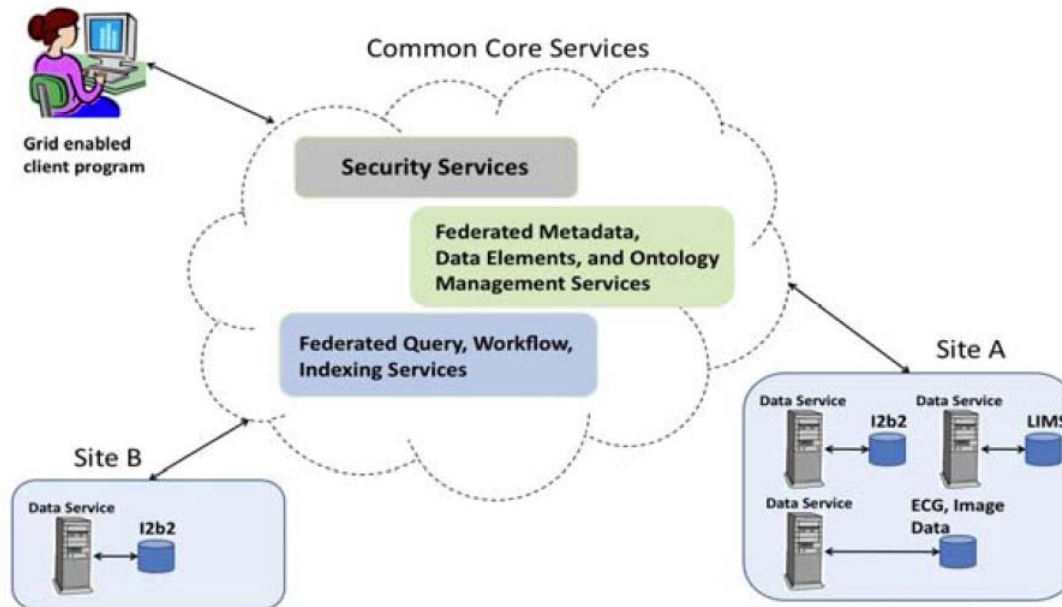
- Employ caGrid tools to wrap NCIBI tools
- Leverage NCIBI tools to explore systems biology hypotheses
- Leverage Pathology and Radiology analysis, annotation tools and middleware for joint integrative studies joint with NCIBI





# Final caGrid/CVRG Example: CTSA/RCMI Treatment Resistant Hypertension (Gary Gibbons)

- Leverage caGrid, i2b2, CVRG, CTSA TRIAD infrastructure
- Links to NCIBI via i2b2, caGrid connectivity
- Accrual from RCMI community clinics
- SNP, ECG, Echo, vascular studies





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# Thank you



**EMORY**  
UNIVERSITY