

Computerized Quantitative Imaging Assessment of Tumor Burden



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OBJECTIVES

We are developing a software framework built on caBIG technologies to standardize quantitative imaging assessment of tumor burden and to enable researchers to integrate and analyze a spectrum of quantitative imaging biomarkers to leverage quantitative imaging to better enable assessment of cancer and its treatment response. Our aims are (1) to create tools to reproducibly assess quantitative imaging features of tumor burden; (2) to develop methods to analyze quantitative image metadata and to help oncologists evaluate image-based quantitative criteria of treatment response; and (3) to evaluate the utility of our methods by applying them in two clinical trials and showing an improvement in response assessment in individual patients and patient cohorts.

Challenges we address:

- Poor *reproducibility of image measurements*
- Lack of *coordination and effective communication* between oncologists and radiologists in making quantitative imaging assessments
- No *standards* for collecting and using quantitative imaging data
- Lack of *tools* for recording image metadata to enable data sharing and data mining

AIM 1: Tools and Algorithms

ePAD (the *electronic Physician Annotation Device*) implements AIM in a rich Web client.

ePAD rich Web client showing ROIs and annotation template

ePAD enable semantic annotation of lesions:

Controlled terminology:

- Finding: **mass**
- Location: Lung, LUL
- Length: **2.3cm**
- Width: **1.2cm**
- Margins: **spiculated**
- Cavitary: **Y**
- Calcified: **N**
- Spatial relationships: Abuts **pleural surface** invades **aorta**
- Texture: {T1, T2, T3,...}
- Shape: {S1, S2, S3,...}

Our System Architecture for quantitative imaging includes tools and resources for cancer researchers:

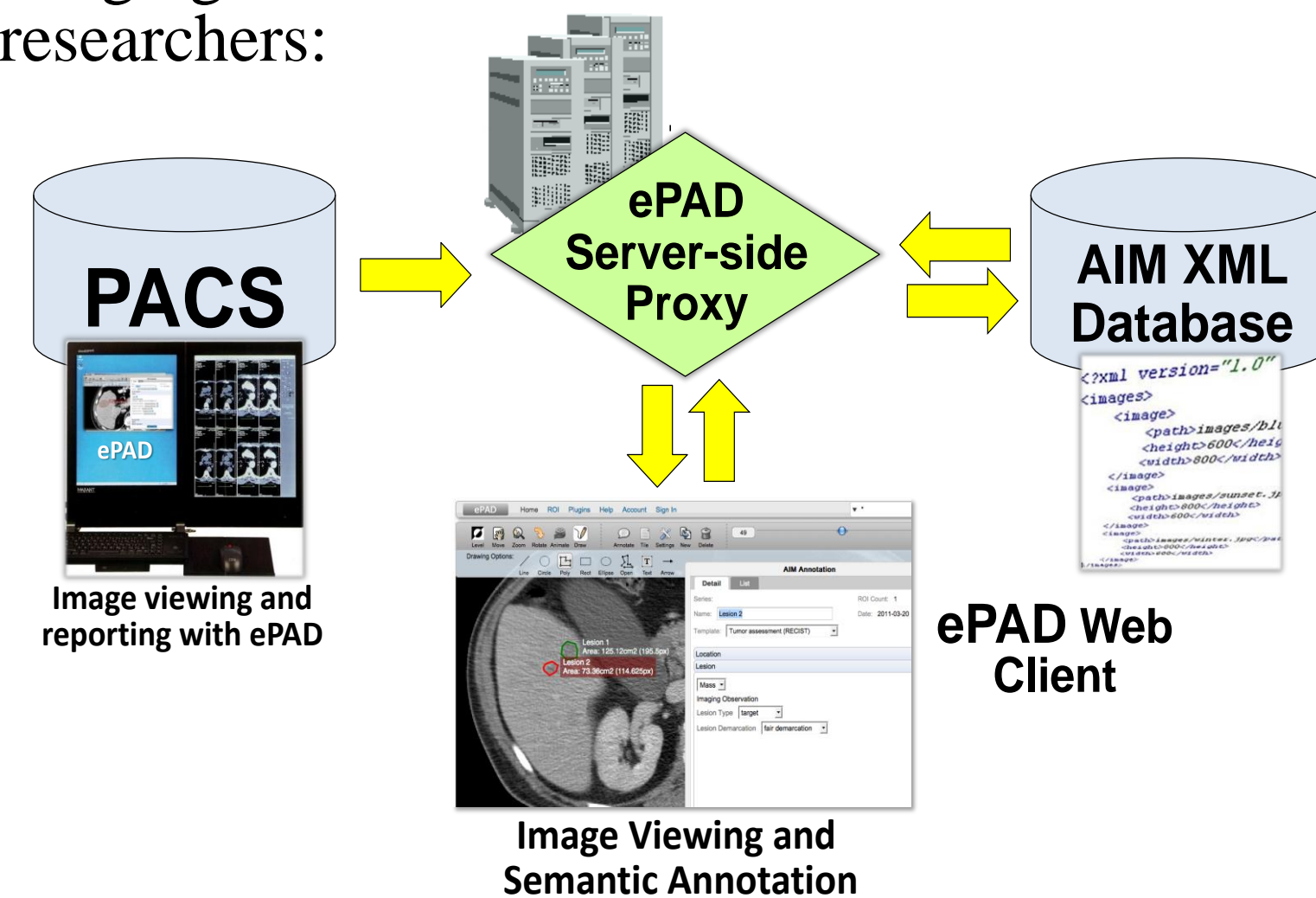
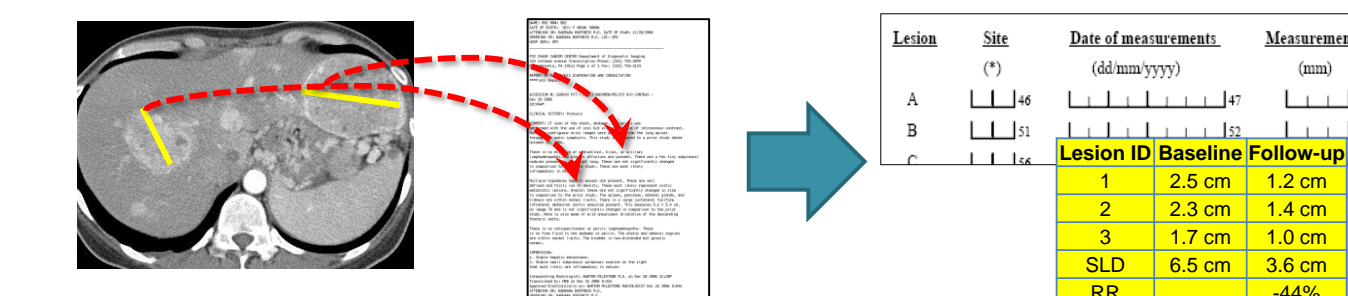
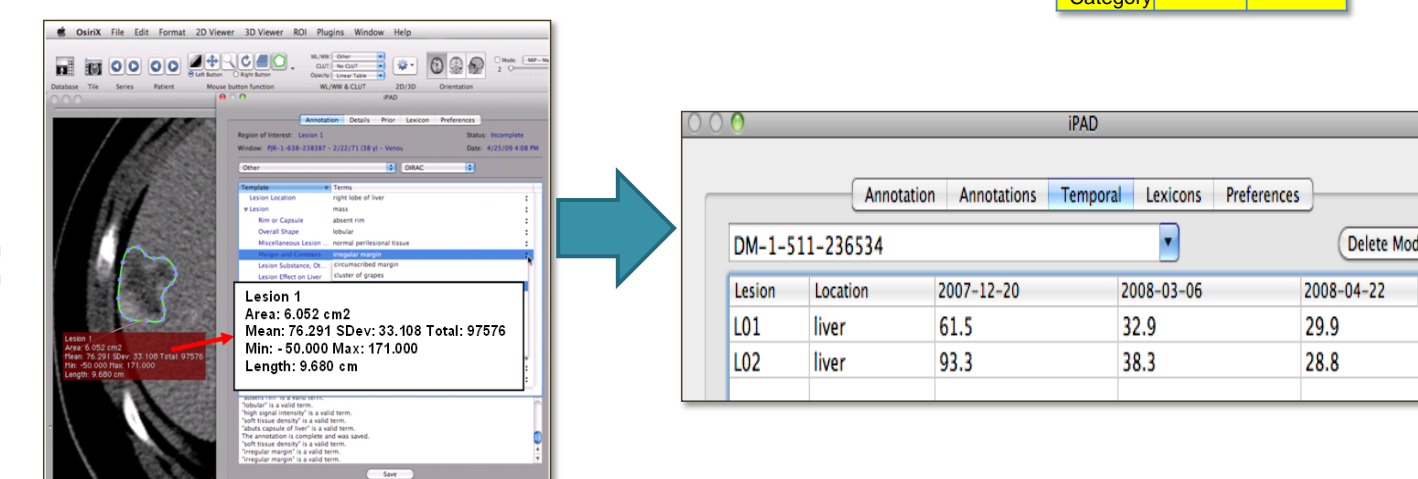


Image metadata storage and workflow for quantitative imaging is now more seamless, with separate data stores for images and their associated metadata, enabling new efficient workflow.

Classic Workflow:

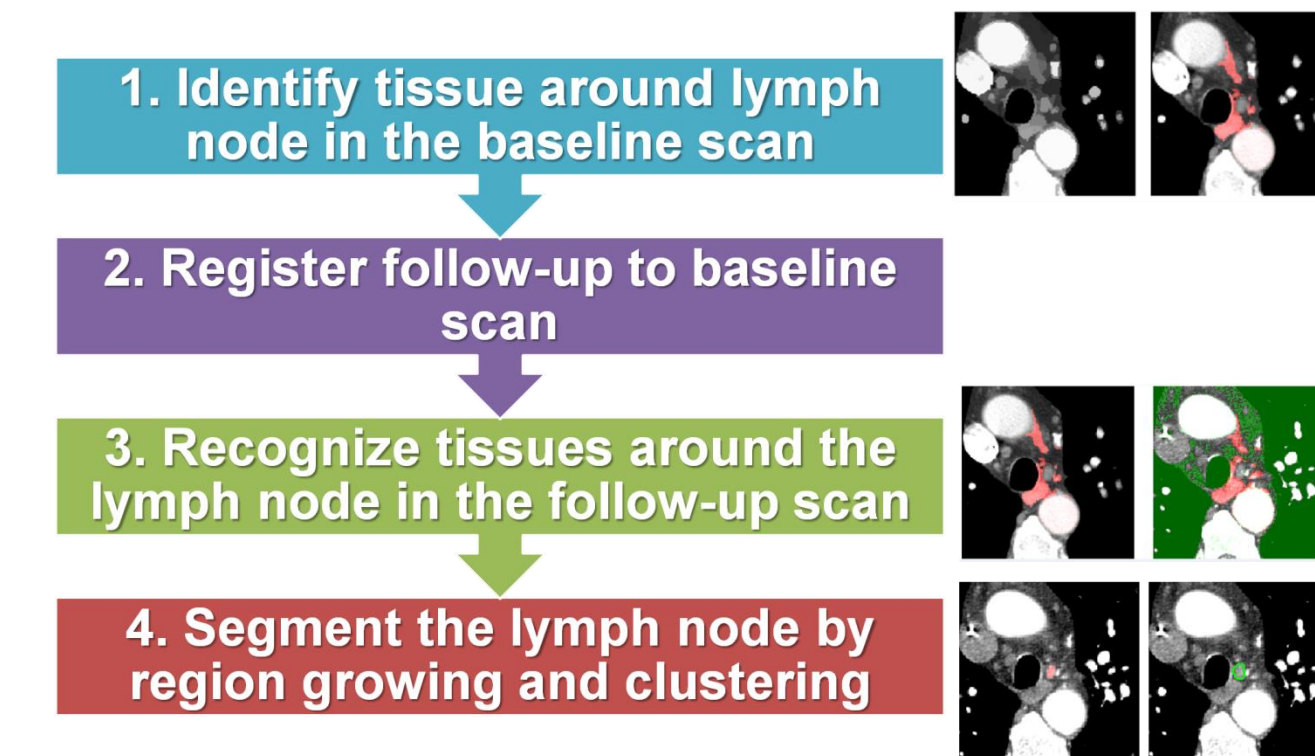


NEW Workflow:



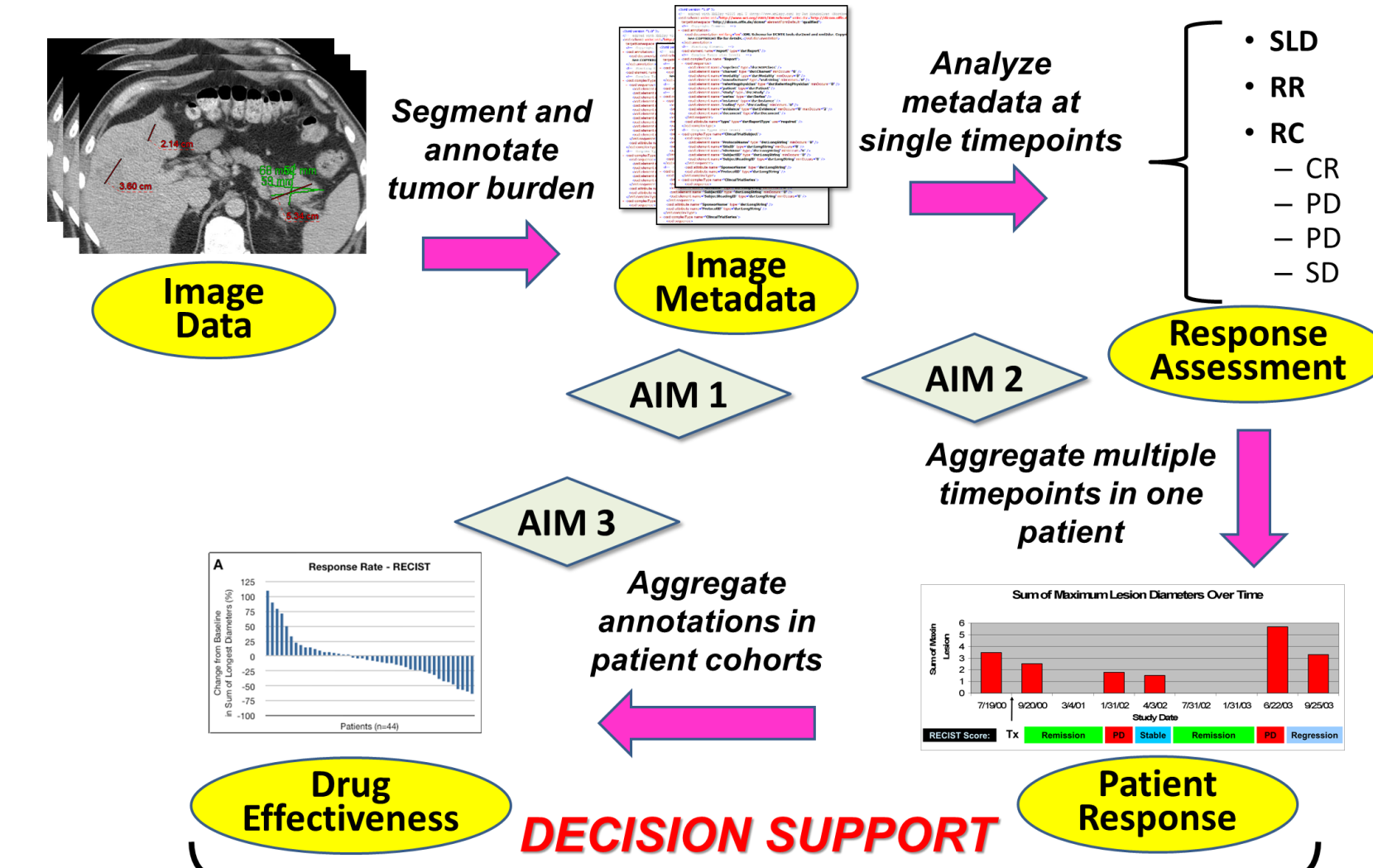
AIM 2: Analysis Algorithms

Algorithms: Automated lesion identification and segmentation on follow up CT imaging. We use the baseline scan to automatically locate and segment cancer lesions on follow up studies.

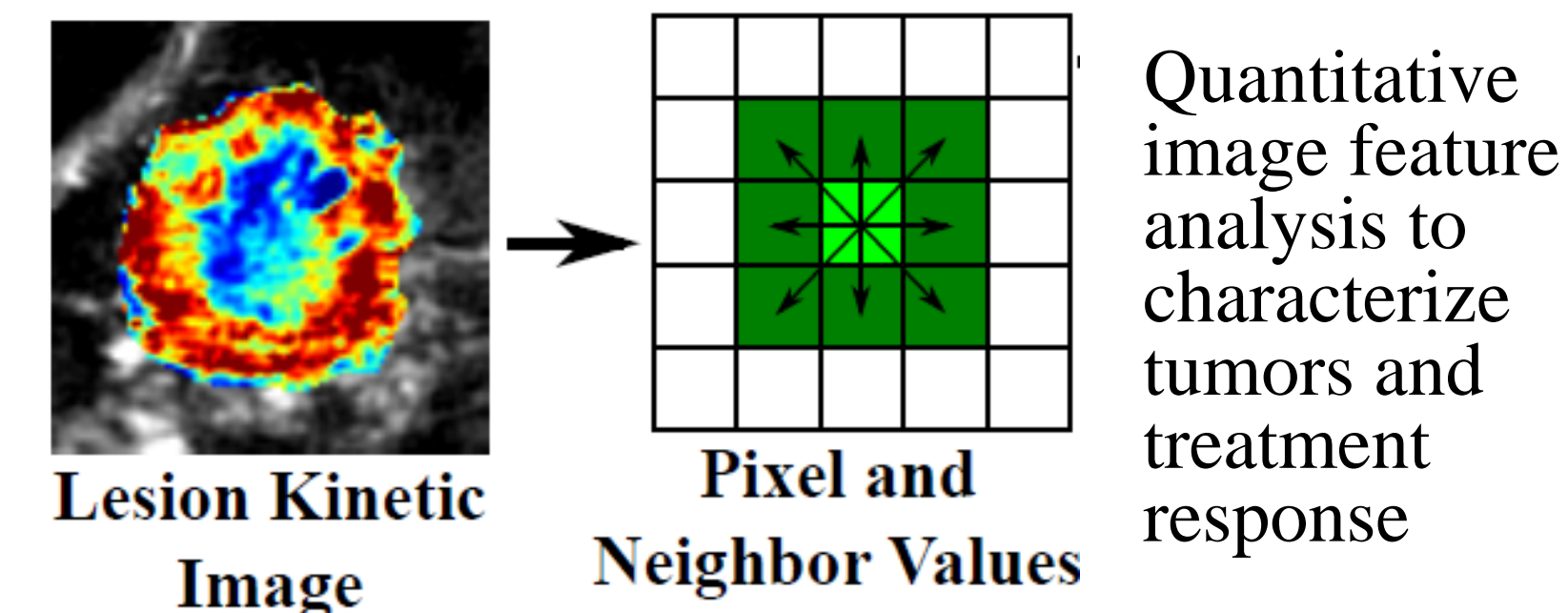


Tools for **decision support:**

1. **Resources for archiving/sharing images and image metadata**
2. **Data mining tools to discover alternative quantitative imaging biomarkers of cancer response**
3. **Decision support tools for evaluating patients and alternative treatments**



- Tools to automate evaluation of tumor burden
- Quantitative image analysis methods to enable assessing tumor burden
- Application in clinical trials demonstrating value of methods/tools
- Pilot projects/engagement with other QIN sites to prove value to QIN



AIM 3: Evaluation in Clinical Trials

Follicular lymphoma trial

- ECOG 2408 Randomized Phase II Trial of R-CHOP/R versus R-B-CHOP/R
- PI: Andrew Evens
- Study endpoints: CR rate after induction, DFS rate, TTP
- **Response criteria: IHC criteria** with six dominant lesions on CT plus PET

Colon Cancer trial

- Phase II Trial of Vandetinib with Capecitabine, Oxaliplatin and Bevacizumab
- PI: George Fisher, Stanford University
- Study endpoints: Response rates (RECIST 1.0), time to disease progression
- **Response criteria: RECIST 1.0**

OPPORTUNITIES FOR QIN

- **Tools for managing image metadata.**
- **Resources for archiving images and metadata.**
- **Data mining tools to discover alternative quantitative imaging biomarkers of cancer response.**
- **Tools for decision support for treating individual patients** (is the cancer responding?) and for **evaluating alternative treatments** (is the cohort response good?)

ACKNOWLEDGEMENTS

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