Principal Investigator's Report
Advanced Technology QA Consortium

RTOG Meeting – San Diego, CA
January 17, 2008

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Department of Radiation Oncology
UC Davis Medical Center
Sacramento, CA, USA

Supported by NIH U24 grant CA81647,
"Advanced Technology QA Center"

New *ATC Grant*

The goals as specified in the RFA for our ATC renewal application are to be accomplished through the following ***developmental*, *coordination*, and *service* objectives**:

1. Eliminate duplication of infrastructure developmental efforts and facilitate sharing of QA resources among cooperative groups.
2. Help to insure that appropriate and uniform QA procedures and criteria for advanced technology trials are developed across all cooperative groups.
3. Facilitate/help manage the uniform credentialing of institutions for advanced RT trials.
4. Facilitate/manage digital data protocol submission.
5. Facilitate/manage the QA review of submitted data.
6. Further development of methods for rapid analysis of volumetric treatment planning data.
7. Assist clinical trial Coop. Groups in development of clinical trials including: (a) credentialing requirements; (b) TV definitions; (c) QA procedures; and (d) data submission instructions.
8. Develop, implement, and maintain innovative methods for electronic exchange of digital planning data between institutions participating in clinical trials and between QA Centers.
9. Develop, implement, and maintain innovative web-based software tools to facilitate protocol digital data reviews by Study Chairs, Dosimetry Groups, RPC, and QARC.
10. Develop, implement, and maintain archival treatment planning and QA databases that can be linked with the cooperative groups' clinical outcomes databases.
11. Demonstrate understanding of and ability to achieve compatibility with existing software and electronic health record standards, including caBIG and DICOM RT.

Agenda

4:00 PM:	ATC Project Officer Report (Deye)
4:10 PM:	ATC P.I.'s Report (Purdy)
4:25 PM:	Update on ATC QuASA2R system: (Bosch)
4:40 PM:	Update on CERR developments in support of ATC (Deasy)
4:55 PM:	Update on ATC DICOM WG7 and IHERO efforts: (Bosch)
5:00 PM:	Update on RTOG informatics infrastructure and VIEW pertinent to ATC (Young, Galvin)
5:05 PM:	Update on QRRO efforts pertinent to ATC (e.g., edata) (Chris Rose)
5:10 PM:	RPC/ATC Report (Ibbott, Followill)
5:30 PM:	RTOG/ATC Service Report (focusing on current problems/issues regarding the service provided by ITC and RPC in support of advanced technology protocols): (Martin, Galvin)
5:45 PM:	RTOG/ATC Medical Physics and ATIC Committees activities pertaining to ATC (Gillin, Michalski, Galvin)
6:00 PM:	Dinner served
6:05 PM:	ITC/ATC Service Report (focusing on current problems/issues regarding the service provided by RPC and RTOG in support of advanced technology protocols): (Straube, Bosch, Purdy)
6:15 PM:	QARC/ATC Report (Urie)
6:30 PM:	Discussion; New Business
7:00 PM:	Adjourn

ATC P.I.’s Report

- ATC Subcontractors/Research Admin Offices issues
- ATC meeting at ITC on Mar. 27-28
- ATC Progress Report due to Dr. Purdy by April 1, 2008

ATC P.I.’s Report

- ATC Steering Committee Mtg Review
  - Imaging
  - Data sharing
- Role of ATC in development of standards for imaging to assess RT
  - Propose that the ATC put together a collaborative working group (CWG) whose deliverable would be a "white paper" that took the approach of the NCI IRAT initiative, but focused on radiation oncology protocols
    - focus on what is needed to make quantitative imaging one of the key structural components of an RT clinical trial.

ATC Developmental Objectives

- **Develop / Implement / Maintain …**
  - Electronic exchange of digital planning data
  - Web-based tools to facilitate protocol digital data reviews
  - Archival treatment planning, verification, imaging, and QA databases
  - Methods for data analysis
  - Compatibility with electronic health record standards and software including the Cancer Biomedical Informatics Grid (caBIG) and DICOM RT.

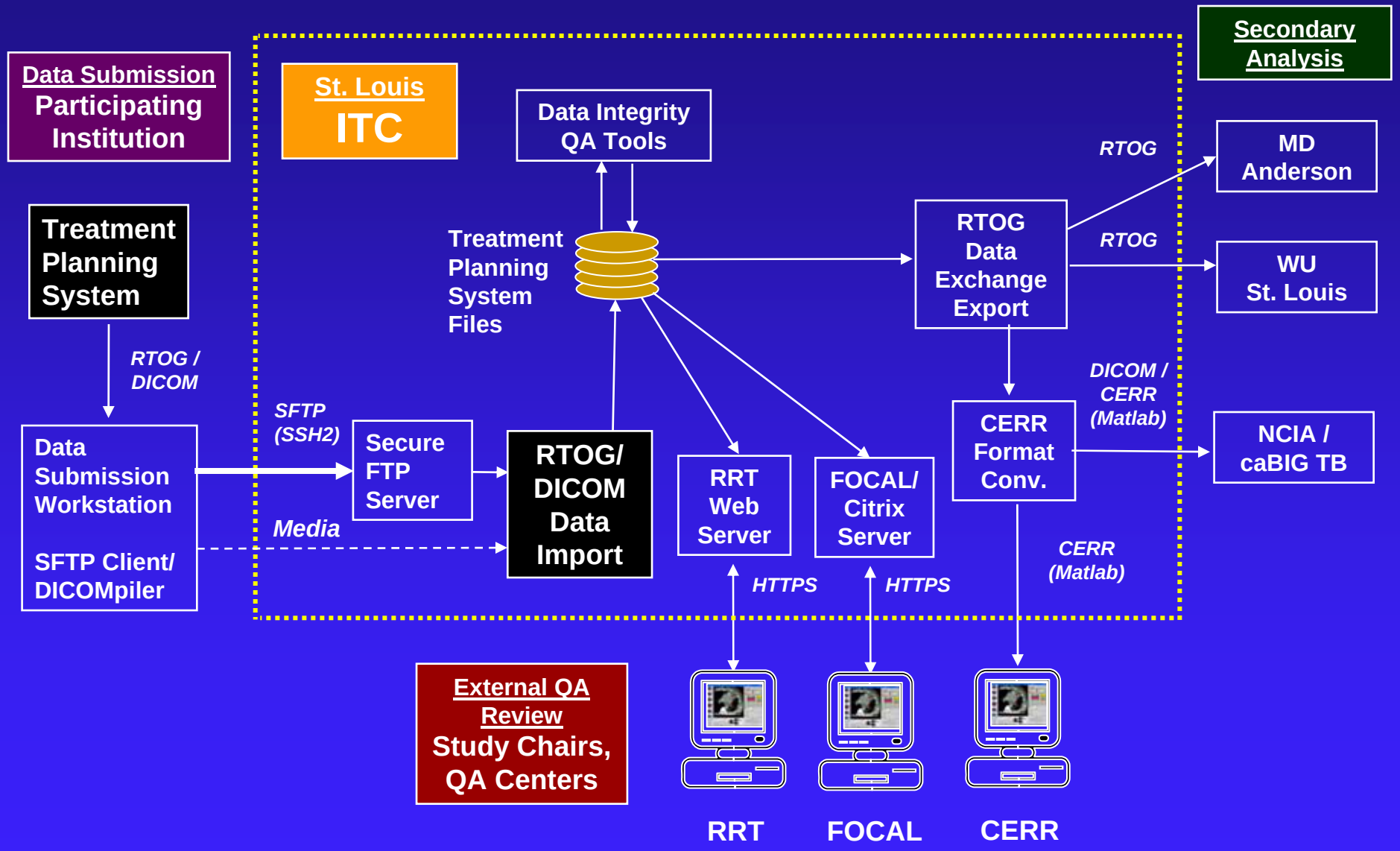
ATC Coordination Objectives

- Eliminate duplication / facilitate sharing of QA resources among cooperative groups, QA Centers.
- Help to insure that appropriate and uniform QA procedures and criteria for advanced technology trials are developed across all cooperative groups.
- Assist clinical trial cooperative groups in the development of clinical trials protocols including:
  a) credentialing requirements;
  b) target volume definitions;
  c) quality assurance procedures; and
  d) data submission instructions.

ATC Service Objectives

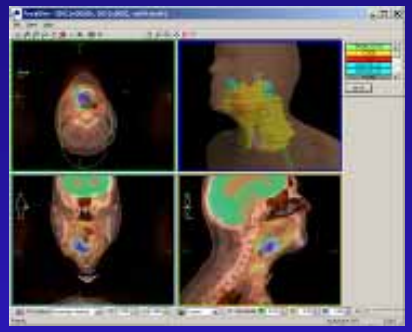
- **Facilitate/manage (Mostly ITC)**
  - Uniform credentialing of institutions for advanced radiotherapy trial protocols.
  - Digital data submission.
  - QA review of submitted data.

QuASA²R – *Current Components & Data Flow*



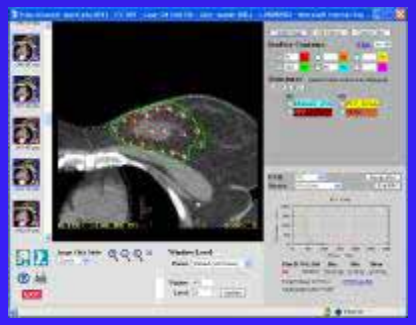
New ATC Developmental Strategy

CMS Focal®



CERR

Remote Review Tool



- **Emphasis on integration of commercial and open-source products**
  - Commercial RT Archive and TPS software
  - Open-source middleware and database systems
- **Developmental efforts emphasize special-purpose QA tools and utilities for connecting commercial software with ATC infrastructure.**
  - CERR
  - Film QA tool
  - Image Registration QA tool
  - Monte Carlo dose recalculation tool
- **New thin client applications for distributed QA review**
  - Next-generation RRT
- **Limit software development to what is absolutely needed and not available**

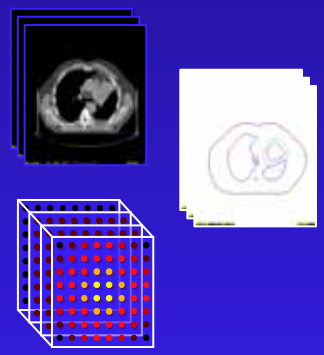
Radiotherapy TP Data Collection for Advanced Technology Clinical Trials (9406)

Old Way

- **What data are needed?**
  - Film, paper forms inadequate
  - Participants must submit digital, volumetric treatment planning and verification data
- **Data Objects for ATC-supported trials**
  - Volumetric, digital images (planning CT)
  - Contours (TV, OAR)
  - 3-D dose distributions (fractionation)

  - Treatment plans
  - DVHs
  - Treatment verification images

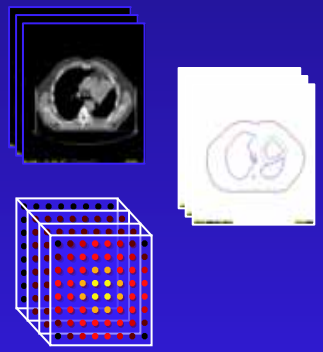
New Way



Typical Digital Data Set per Patient ~ 100 MB

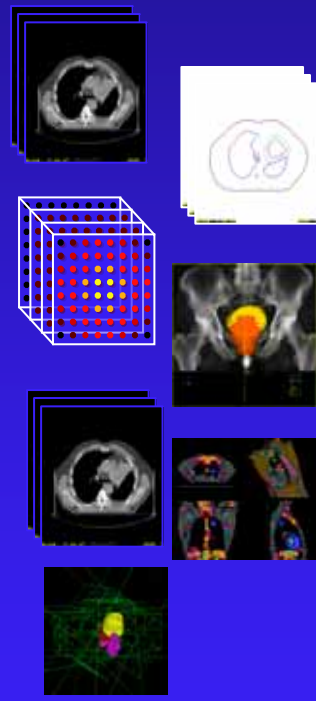
Radiotherapy TP Data Collection for Advanced Technology Clinical Trials (2008)

Old Way



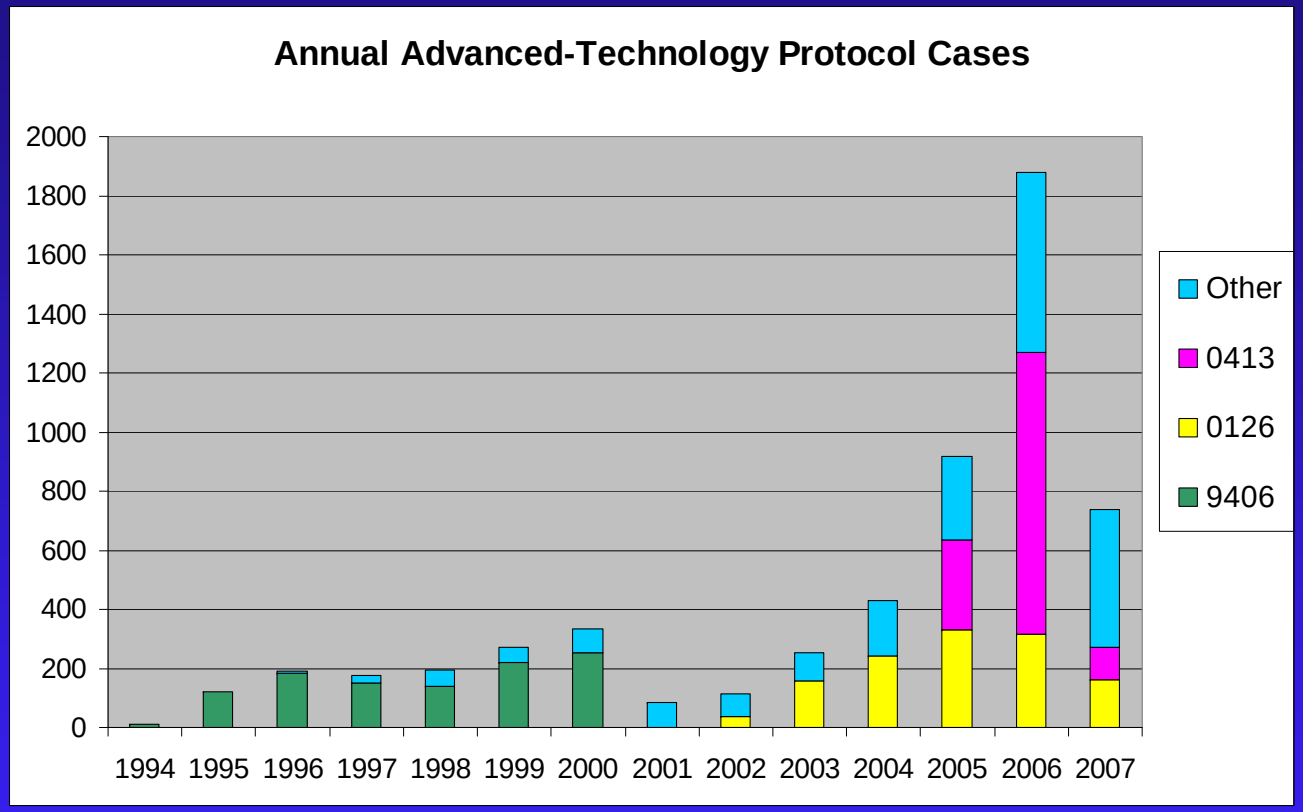
- **What data are needed?**
  - Volumetric, digital images (planning CT); Contours (TV, OAR); 3-D dose distributions (fractionation) no longer adequate
- **Data Objects needed for 2008 ATC-supported trials**
  - Volumetric, digital images (planning CT)
  - Contours (TV, OAR)
  - 3-D dose distributions (fractionation)
  - Treatment verification images (planar, kV CBCT, MV CT, Calypso,…)
  - Diagnostic imaging studies (pre- & post-, MRI, MRS, PET/CT,…)
  - Treatment plans (and other parameters for dose recalculation

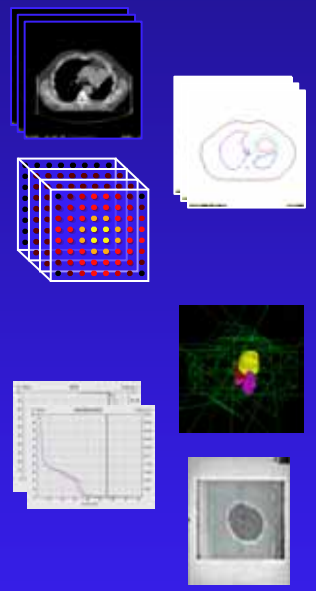
New Way



Typical Digital Data Set per Patient >> 100 MB

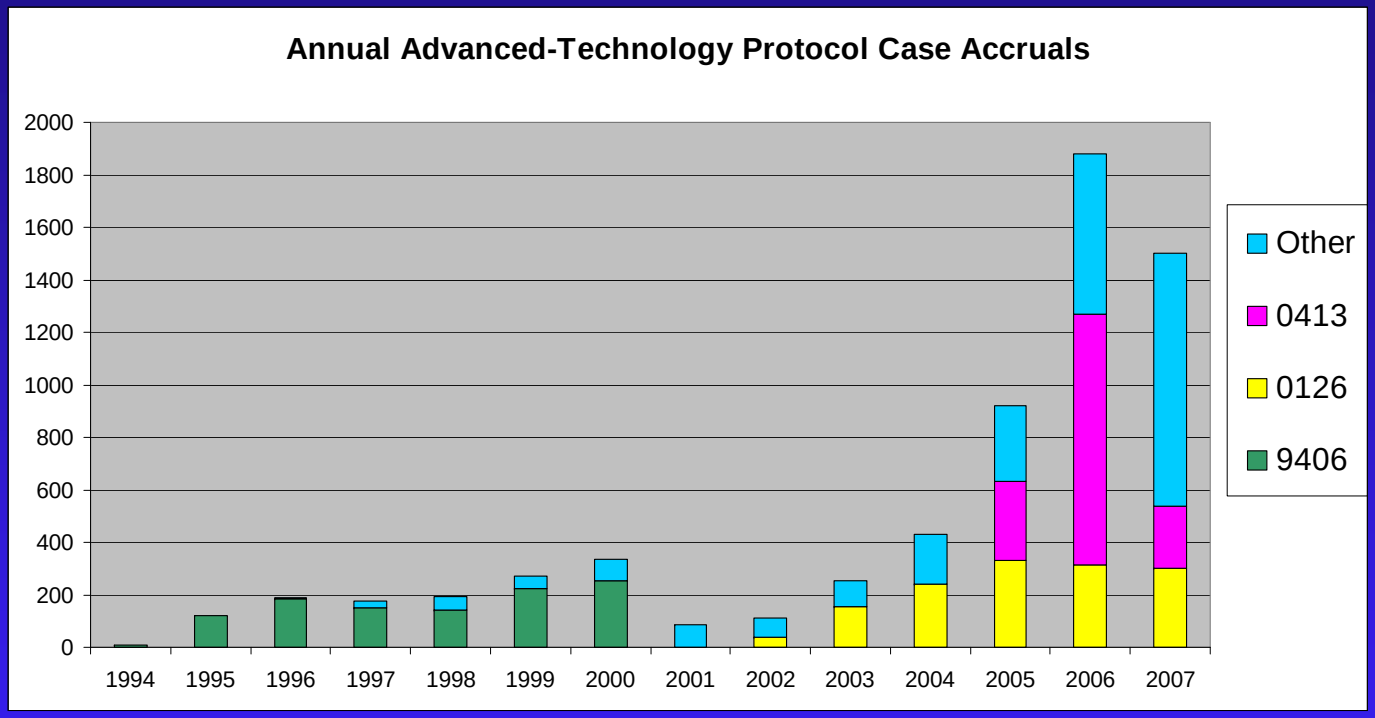
- **As of June 12, 2007 ATC Mtg: 5706 Complete, Protocol-Case, Volumetric Digital Data Sets Submitted Over 13+ Year Period using QuASA²R System**

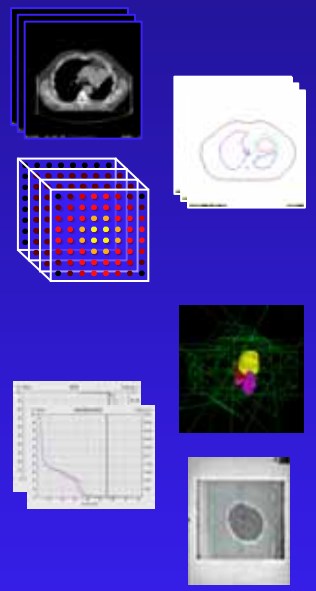




- 9 commercial TPS vendors (16 TPSs) have implemented ATC compliant export capability.
- 523 institutions able to submit data

- **As of December 31, 2007: 6190 Complete, Protocol-Case, Volumetric Digital Data Sets Submitted Over 14 Year Period using ATC QuASA²R System**





- **11 commercial TPS vendors (20 TPSs) have implemented ATC compliant export capability.**
- **553 institutions able to submit data**

ATC Compliant Treatment Planning Systems Per Modality

- 11 commercial TPS vendors (20 TPSs) have implemented ATC compliant export capability.

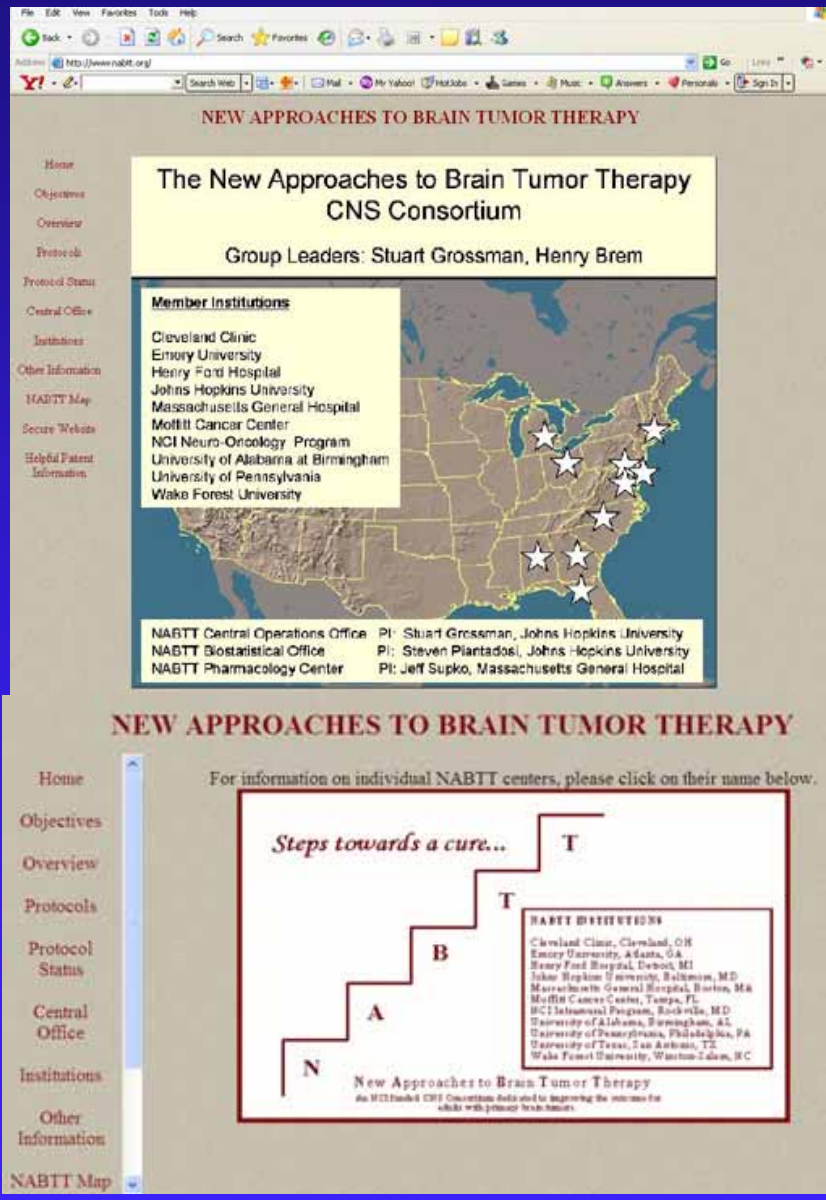
Treatment Planning Systems			Exchange Format	Treatment Modality					
Vendor	System	Version[1]		3DCRT	IMRT	SBRT[2]	Seed Brachy	HDR Brachy	Protons
Accuray	MultiPlan	1.5.2	D			✓			
CMS	Focus/XiO	3.1	R	✓	✓	✓	✓		✓
	XiO	4.3.1	D	✓	✓				
Elekta	RenderPlan 3D		R	✓					
	PrecisePlan	2.01	D	✓	✓	✓			
Nomos	Corvus		R		✓[3]				
Nucletron	Helax TMS		R	✓	✓				
	TheraPlan Plus		R	✓					
	Oncentra MasterPlan	1.5	D	✓	✓				
	PLATO RTS	2.62	D	✓					
	PLATO BPS	14.2.6	D					✓	
Philips	Pinnacle[3]		R	✓	✓	✓			
	AcqPlan	4.9	R	✓					
Prowess	Panther	4.41	D	✓	✓		✓		
Rosses Medical	Strata Suite CTPlan	4.0	R				✓		
RTek	PIPER	2.1.2	R				✓		
TomoTherapy	Hi-ART	3.0[4]	D		✓				
Varian	BrachyVision	6.5 (Build 7.1.67)	D					✓	
	Eclipse	7.1	D	✓	✓	✓			✓
	VariSeed	7.1	D				✓		

ATC Service Activities

- RTOG
- NSABP
- JCOG
- EORTC
- NABTT
- AstraZeneca

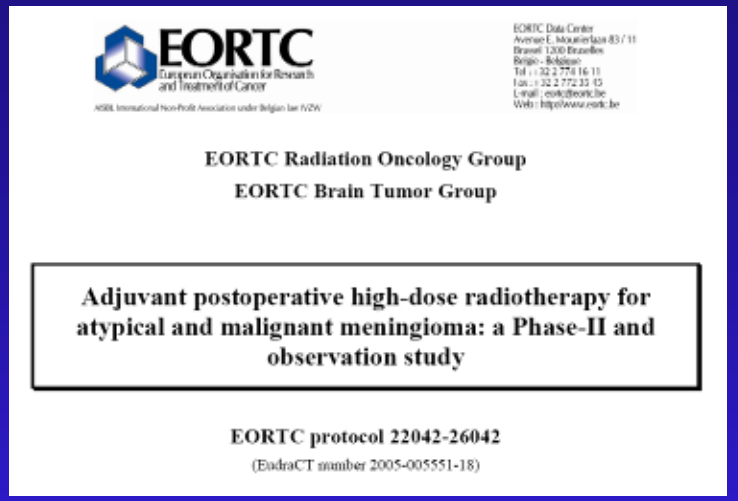
ATC(ITC) Support of NABTT Clinical Trials

- NABTT (ATC(ITC) is working with Dr. John Fiveash, M.D., Department of Radiation Oncology, Univ. of Alabama Birmingham)
  - There are 9-10 NABTT institutions participating in these studies.
  - Protocols are Phase I/II with maximum of 90-100 cases.
  - Plan is to review approx. 30-50% of protocol cases (all IMRT and first case for 3DCRT)
  - Credentialing involves planning a benchmark case and submitting data (same benchmark for all protocols)
  - QA for currently active study (NABTT 0603) to be done by Drs. J. Fiveash and Bob Lustig. ATC will identify this protocol as N0603.



ATC(ITC) Support for EORTC Trials

- **EORTC Protocol 22042**
  - ITC performs data integrity QA for Protocol 22042 “Adjuvant postoperative high-dose RT for atypical and malignant meningioma: a Phase-II and registration study”
  - Sample size: 64, ~10 institutions
  - Data submission testing and institutional credentialing are underway



EORTC

EORTC Radiation Oncology Group

EORTC Brain Tumor Group

Adjuvant postoperative high-dose radiotherapy for atypical and malignant meningioma: a Phase-II and observation study

EORTC protocol 22042-26042

(EudraCT number 2005-005551-18)

EORTC

AGREEMENT FOR THE PERFORMANCE OF THE QUALITY ASSURANCE REVIEW FOR AN INTERGROUP CLINICAL TRIAL

22042-26042

INVOLVING

Advanced Technology Consortium (ATC) & Image-Guided Therapy QA center (ITC)

Registered Office: Washington University, 4511 Forest Park Ave., Suite 200, St. Louis, MO 63108

AND

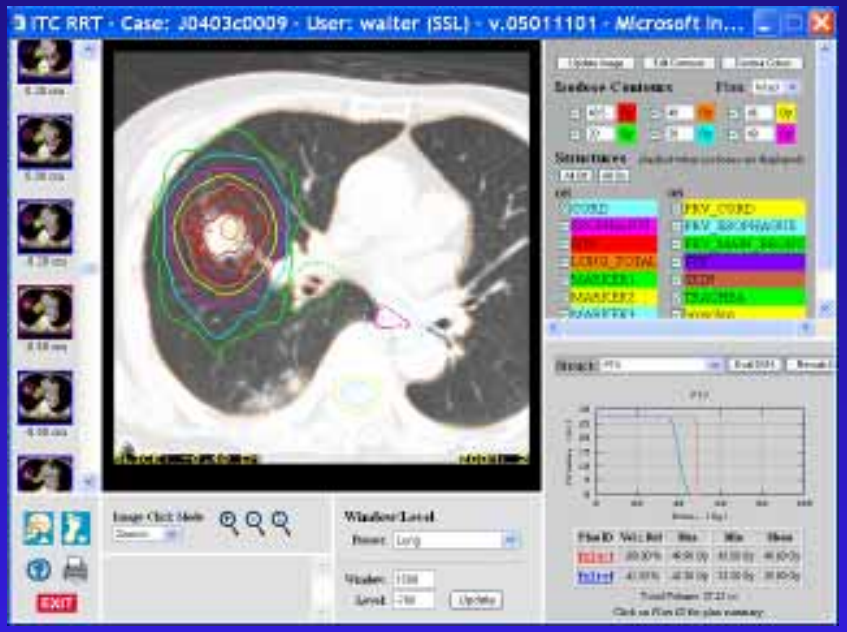
European Organisation for Research and Treatment of Cancer
International non-profit association

Registered Office: Av. E. Mounier 83/11
B-1200 Brussels

Version 1.0

ATC(ITC) Support of JCOG Clinical Trials

- JCOG 0403: SBRT (48Gy in 4 fx over 4-8days) for medically inoperable Stage IA NSCLC, Endpoint: 3-yr overall survival, Sample size: 165
- Institutions participating in protocol JCOG 0403 submit digital data representing CT images, structure sets, treatment plans, 3D dose distributions, and DVHs to Dr. Satoshi Ishikura, Director of the Radiotherapy Support Center, Tokyo, JAPAN.



- Dr. Ishikura forwards submitted data to ITC in St. Louis for processing.
- Data are reviewed by Dr. Ishikura or his delegate using the ITC Remote Review Tool.
- Currently, 14 institutions are eligible to enroll patients and capable of digital data submission on JCOG 0403; 128 patients are registered to study.

ATC(ITC) Support for AstraZeneca Trials

- RT QA for AstraZeneca ZD6474 (Tyrosine Kinase Inhibitor) Trial
  - Three institutions credentialed
  - 10 case data sets have been submitted and reviewed

ATC(ITC, QARC, RTOG) is working with caBIG/NCIA

- ATC is one of the funded participants in the caBIG In Vivo Imaging Workspace.
  - ATC members (ITC, RTOG, QARC) and ACRIN are actively participating in the Testbed Special Interest Group (SIG).
  - Exploring project with Ohio State Univ., QARC, ITC, and CALGB
  - Working with OSU on RSNA demonstration project “Application of caGrid® Middleware to Facilitate Quality Assurance for Advanced Technology Radiation Therapy Clinical Trials”
    - Volumetric CT images, target-volume/organ-at-risk (TV/OAR) contours, treatment plans, and 3D dose distributions submitted by study participants converted to Matlab format using CERR.
    - CERR datasets are then used for distributed protocol compliance review of image segmentation and dosimetry.
    - To facilitate distributed review of the CERR datasets, a secure grid-based infrastructure is used for distribution of data sets and collection of reports

Cancer Biomedical Informatics Grid (caBIG)

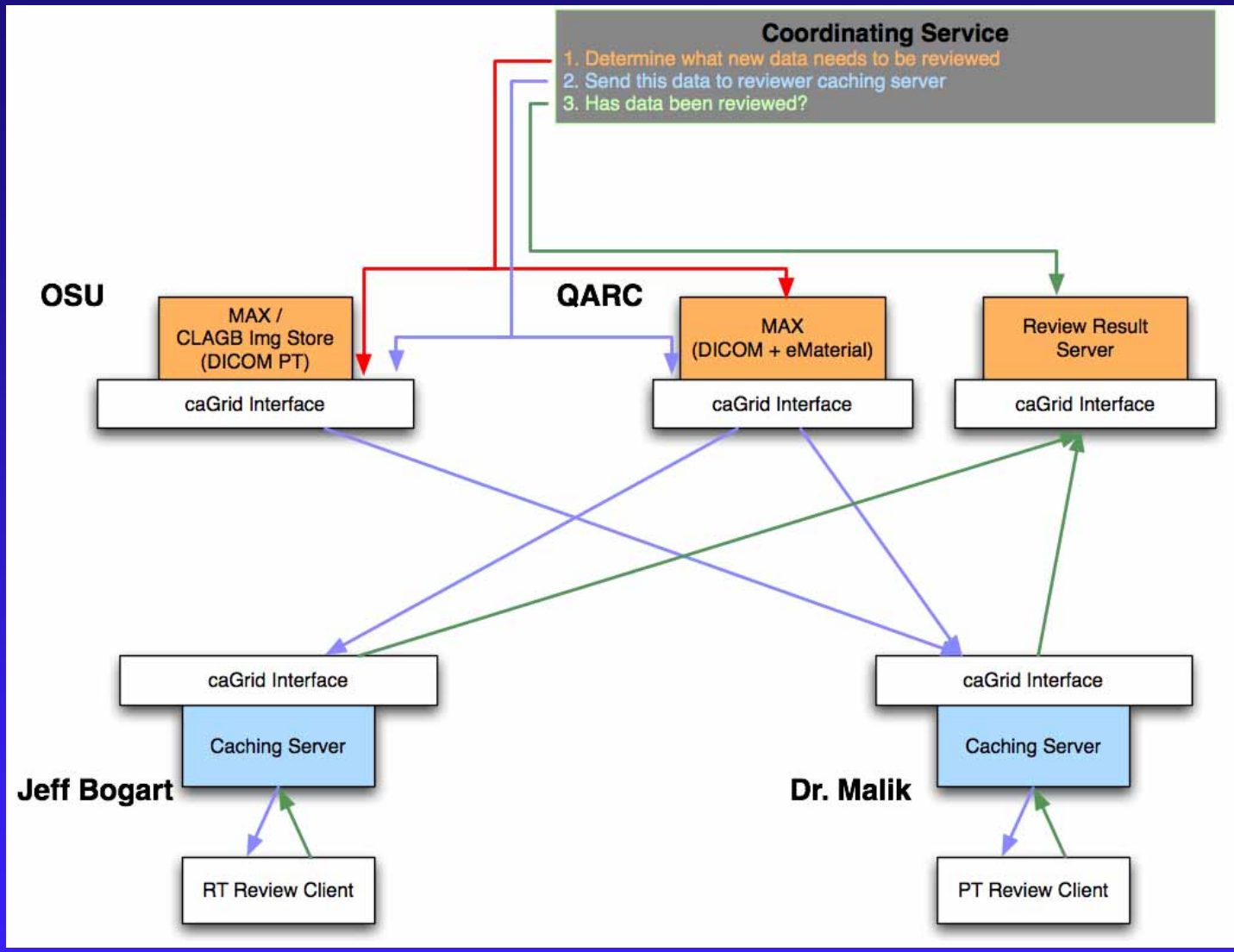
- A National Cancer Institute initiative to create a biomedical informatics network for cancer research.
- Includes a common, widely distributed infrastructure (caGrid) that permits the cancer research community to focus on innovation via a collection of interoperable applications developed to common standards.
- Includes a shared, harmonized set of terminology, data elements, and data models that facilitate information exchange.
- ATC is one of the funded participants in the caBIG In Vivo Imaging Workspace.

Application of caGrid® Middleware to Facilitate Quality Assurance for Advanced Technology Radiation Therapy Clinical Trials

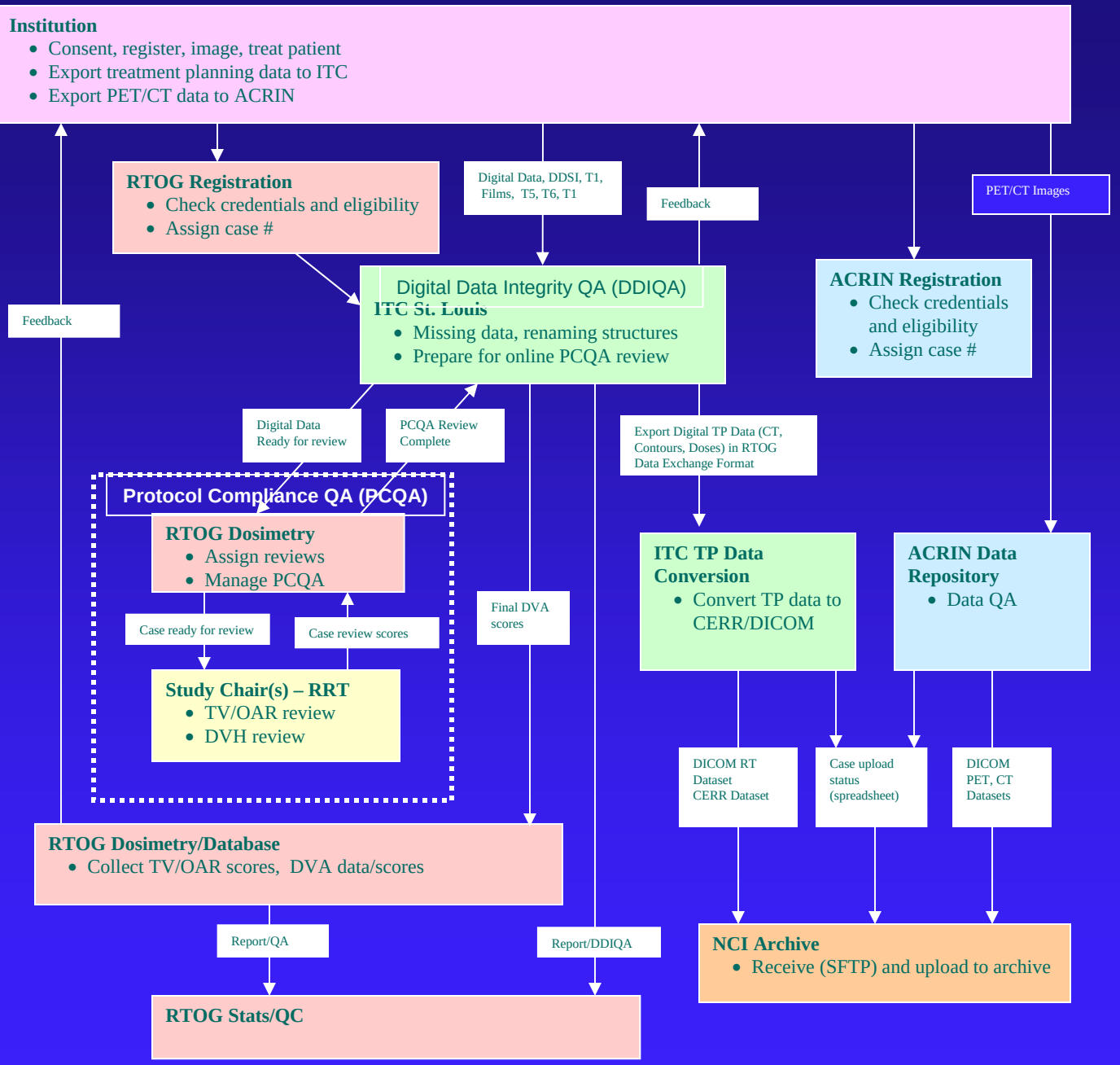
Joel H. Saltz[1], MD, PhD, Ashish Sharma[1], PhD, Tony C. Pan[1], MS,
Walter R. Bosch[2,3], DSc, Joseph O Deasy[3], PhD,
James A. Purdy[4], PhD

[1] Department of Biomedical Informatics, The Ohio State University, Columbus, OH
[2] Image-guided,Therapy QA Center, Washington University, St. Louis, MO
[3] Department of Radiation Oncology, Washington University, St. Louis, MO
[4] Department of Radiation Oncology, UC Davis Cancer Center, Davis, CA

Pilot study to evaluate the application of caGrid in vivo imaging technologies in imaging based NCI clinical trials



RTOG 0522
Quality Assurance Workflow



ATC Posters/Presentations at 2008 Meetings

- AAMD Annual Mtg: ATC should plan to do another workshop; to be held in New Orleans.
- AAPM: March 5 Deadline for receipt of abstracts and supporting data. (July 27-31, Houston, TX)
- ASTRO: March 17 Deadline for receipt of abstracts and supporting data. (Sep 21-25, Boston, MA)
- RSNA: ? Deadline for receipt of 300 word abstracts and supporting data. (Nov 30-Dec 5, Chicago, IL)

ATC is encouraging requests for secondary analysis using volumetric treatment planning data.

- Data Request Form

Request for Use of ATC Data Form

To: Cooperative Group Chair and ATC, Principal Investigator

From: _____

Affiliation: _____

_____

Date: _____

Protocol Study #(s): _____

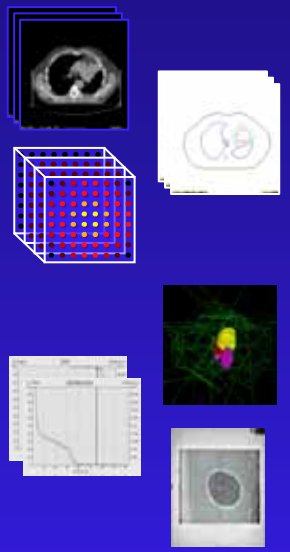
All requests must be accompanied by a research plan for the proposed data use. The research plan must include: names of investigators; objectives; background; type of data requested; and data analysis description.

Specify what data is being requested:

Cooperative Group Approval: Yes___ No___ :Signature_____ Date____

ATC, P.I Approval: Yes___ No___ :Signature_____ Date____

ATC, Sub-Contract P.I. Approval: Yes___ No___ :Signature_____ Date____



Head & Neck (IMRT, N=64)		Min	Max	Avg	
PTV	D_{98}	58.0	73.4	67.6	Gy
Spinal Cord	D_{mean}	32.8	44.8	39.6	Gy
Parotid	D_{mean}	21.2	50.3	32.4	Gy
Larynx	D_{mean}	3.9	57.7	32.9	Gy
Lung (3DCRT, N=158)		**Min**	**Max**	**Avg**	
PTV	D_{98}	50.3	98.2	77.4	Gy
Spinal Cord	D_2	0.1	60.1	26.0	Gy
Esophagus	D_{mean}	0.0	63.8	15.9	Gy
Heart	D_{mean}	0.0	45.3	10.5	Gy
Liver	D_{mean}	0.0	19.3	1.2	Gy
Brachial Plexus	D_{mean}	0.0	57.7	4.6	Gy
Lung	V_{20}	5.3	46.6	21.2	%
Prostate (3DCRT, N=984)		**Min**	**Max**	**Avg**	
PTV	D_{98}	52.2	81.6	75.0	Gy
Bladder	D_{mean}	4.9	75.9	37.7	Gy
Rectum	D_{mean}	12.9	72.5	42.7	Gy
Femoral Heads	D_{mean}	1.8	49.5	32.4	Gy

Challenges/Opportunities: ATC Supported Trials

- Continue to update QuASA^{2}R without disrupting support of ongoing clinical trials;
- Developing a more formal mechanism for evaluating how well ATC is meeting its ***developmental*, *coordination*, and *service*** objectives**;**
- Multi-modality imaging (PET, MRI, MRS) target definition (data import) and subsequent image fusion QA;
- IGRT data submission and QA (EPID, daily MV and kV Cone beam CT, Helical Tomotherapy MV CT, US,…);
- QA review of the accuracy and quality of the institution's motion management methodology;
- Heterogeneous dose calculations (QA evaluation criteria);
- Outcome analysis tools (e.g., for protocols such as lung in which the dose data archived have either poor or no dose heterogeneity corrections;
- Proton beam therapy;
- ATC compliant data export for stereotactic specialized treatment systems (e.g., Elekta Gamma Knife);
- New processes such as adaptive radiation therapy (need deformable registration QA tools)
- Data sharing
- NCI (Dr. Deye) to appoint independent Evaluation Committee (EC)