ATC Informatics Report

W. Bosch

ATC Meeting – April 15, 2009

RPC, Houston, TX

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Providing support in quality assurance and data management for radiation therapy clinical trials

ATC Informatics Report

- Update on 2-year QuASA2R developmental schedule including integration of CERR, Velocity/MiMVista, TeraMedica, Remote Terminal Server

- Update on ATC DICOM WG7 efforts

- Update on ATC IHE-RO efforts

- Update on ATC TPS Vendor efforts

- Update on ATC-NCIA-RTOG 0522 Project

- Update on ATC-RTOG Consensus Atlas Projects

- Updates on other QA Center/Group informatics efforts
  - MAX – QARC
  - TRIAD – ACR
  - VIEW – QARC, ACR

Data Format Conversion using CERR

- ## Data format conversion
  - RTOG 0522 treatment planning data export to NCIA as CERR, DICOM
- ## Transfer of TP data for RPC Phantom Dosimetry Test
  - Since April 2008, 395 RPC Phantom Datasets have been converted to CERR for comparison with film/TLD dosimetry using FilmQA tool

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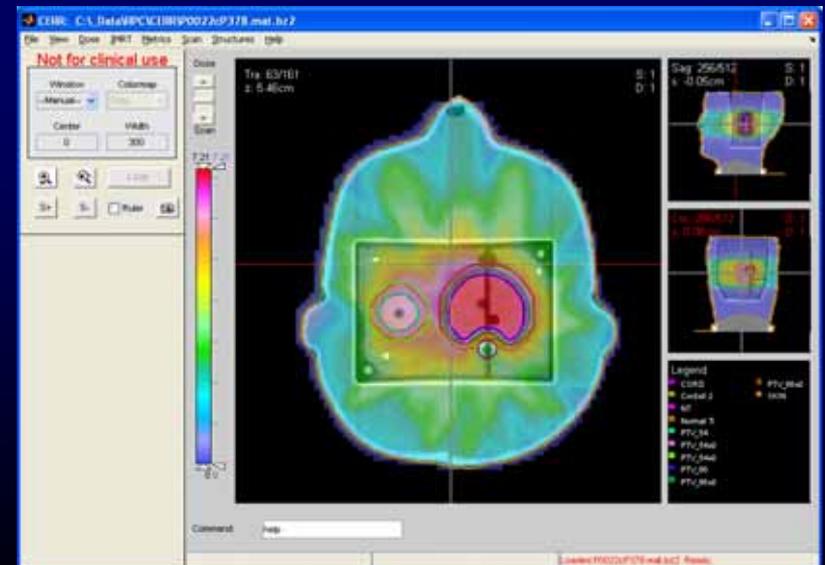
Diagnostic Image / RT Review Tools

- Tools currently being evaluated for review of PET, MR, CT images and RT data:
  - MIMvista
  - Velocity AI
- Features
  - CT, MR, PET registration (rigid, deformable)
  - RT Structure Set, RT Dose display

Teramedica Archive Loading

- Consistent re-identification of DICOM dataset
  - Consistent use of DICOM attributes to facilitate Query/Retrieval from archive (Patient Name and ID, Study ID and description, etc.)
  - Add Clinical Trial ID attributes
- Re-identification scheme is being tested with RTOG 0522 data uploaded to NCIA
- Tools developed using open-source POSDA toolkit (http://www.posda.com)

ITC Citrix Remote Access Server

- The ITC Citrix server farm was installed April 2009:

- Secure, remote access to image and treatment review applications software via the WU Citrix Access Gateway.

- Scalable resource that permits current and future review tools to be shared worldwide in an efficient, controlled environment.

- ITC will build on this foundation to deploy a variety of commercial and open-source tools for image and treatment plan review:
  - CERR, K-Pacs
  - CMS/Focal,
  - Velocity AI,
  - MIMvista, …

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QuASA^{2}R Timeline (1)

	Project	Date / Status
1	**Pillar Data Storage System** • Stable support for existing QuASA^{2}R components • Foundation for DICOM Archive	Installed Jan 2008, Upgraded May 2008 • Storage for SFTP, RRT, Evercore operational
2	**ITC DDIQA Server/Tape Backup Upgrade**	Begin Summer 2008 • Backup is operational • Migration and testing of existing tools on new platform is in progress
3	**DICOM-based RT Archive (TeraMedica)** • Data anonymization / ID reconciliation • Archive loading • Case data management (inventory, revision)	Installed June 2008 • Data re-identification/ archive loading tools in development using RTOG 0522 datasets for testing
4	**Data format conversion tools** • DICOM conv. for legacy (RTOG) data • CERR conv. for phantom dosimetry • CERR use for case review (0418)	Production as of June 2008 • Batch conv. Apr 2008 • CERR conv. for RTP phantoms now routine

QuASA^{2}R Timeline (2)

	Project	Date / Status
5	Digital Data Integrity QA workflow tools (CERR) • Structure naming / Structure editing / Dose summation • DICOM consistency checks (DVTk)	Begin Summer 2008 • CERR installed on DDIQA server • Implementation of QA workflow capabilities in CERR continues
6	Diagnostic Image/RT Review Tools • MIMvista • Velocity AI	Evaluation in progress • Q/R tests with Evercore June 2008
7	QuASA^{2}R / Commercial TPS Integration • Varian / Eclipse • Philips / Pinnacle • CMS / FOCAL	Begin Fall 2008

QuASA^{2}R Timeline (3)

	Project	Date
8	Grid-enabled CERR for production case review at ITC • Secure download, seamless review • Anticipatory data push	Begin Fall 2008 • Grid-CERR prototype demonstrated at ITC Jan 2009 • IVI middleware installation, evaluation at ITC Jan 2009
9	Server-side review tools • Image Digest / QA Report Generator (WebTrev) • Multi-planar (T/S/C) tool for contour and dose review	Begin Spring 2009 • Collaborative work with J. Deasy (WU), J. Saltz (Emory) • Developmental work in progress

Update on ATC DICOM WG7 efforts

- The ATC(ITC) continues to be active in DICOM Working Group (WG7).
- Current efforts of WG7 are focused on the design of enhanced RT objects:
  - make use of new DICOM segmentation and registration objects,
  - support a broader range of treatment delivery techniques, and
  - better support treatment planning and delivery workflow.
  - Provide an RT Course "container" object, which will identify and record the context of all DICOM information objects associated with a patient's course of treatment.

Update on ATC DICOM WG7 efforts (2)

- DICOM WG 7 meetings held in Charleston, SC (Oct. 21-24, 2008) and Arlington, VA (Mar. 17-20, 2009) to continue work on enhanced RT Information Object Definitions (IODs) and related issues:
  - RT Physician Intent IOD (represents dose prescription and dose-volume constraints for treatment planning),
  - RT Segmentation Properties IOD (RT-specific information for regions of interest delineated in DICOM Segmentation and Surface Segmentation IODs),
  - RT Enhanced Dose IOD (references treatment planning information represented by enhanced RT Radiation Set IODs),
  - RT Dose Histogram IOD (represents dose-volume histograms for enhanced RT Radiaiton Set and Segmentation IODs).
  - Patient Positioning IOD (represents patient positioning instructions and results), and
  - Requirements for de-identification of RT object attributes for DICOM WG-18 de-identification profile (draft Supplement 142).

Update on ATC IHE-RO efforts

- The ATC(ITC) became an **Organizational Member of the International Integrating the Healthcare Enterprise** (IHE) as of March 6, 2008 and continues to be active in the IHE-RO initiative.

- The IHE-RO Technical Committee (TC) is comprised of clinical medical physicists, industry and research medical physicists, and software designers / engineers from approximately 25 vendors whose products are affected by IHE-RO activities.

- The IHE-RO Technical Committee develops Integration Profiles that provide solutions to the issues identified by the IHE-RO Planning Committee.

- IHE-RO TC Connectathon activities evaluate interoperability by testing adherence of products to IHE-RO Integration Profiles.

Update on ATC IHE-RO efforts (2)

- An IHE-RO Connectathon was held (August 2008 in Houston, TX) to test adherence to the following profiles:
  - ***Normal Treatment Planning Integration Profile*** (contouring, treatment planning, plan review, PACS/archive retrieval and storage), and
  - ***Multimodality Registration Profile*** (spatial registration, registered contouring, and registered dose display).
- IHE-RO TC meetings were held in Boston, MA (Sept. 24-27, 2008), Mountain View, CA (Dec. 15-19, 2008) and Fairfax, VA (Mar. 23-25, 2009) to continue developmental work on the following profiles:
  - ***Radiation Therapy Treatment Workflow Integration Profile*** (treatment delivery with patient position verification and treatment management system/archive integration),
  - ***Advanced RT Objects Interoperability Profile*** (interoperability among Treatment Planning Systems (TPS) and between TPS and Treatment Management Systems for a broad variety of external-beam techniques), and
  - ***Dose Compositing Profile*** (registered dose compositing and re-planning with registered prior dose).

Update on ATC TPS Vendor efforts

- 11 TPS vendors (22 TP systems/versions) have achieved "ATC Compliant" status.
- ITC continues to work closely with TPS vendor on data exchange issues.
  - **CMS/Elekta** (XiO) and **Varian** (Variseed) submitted test datasets to check ATC compliance of new software versions.
  - **Accuray** sent test data for evaluation of software they are modifying.
  - **Brainlab** is looking for a clinical site to send data to ITC to allow "iPlan RT Dose" to become ATC compliant.
  - **Nucletron** is working on export of Ultra-Sound based prostate seed pre-plans; ITC expecting HDR data from Oncentra
  - **SonoTECH/Isodose Control**, a Netherlands-based company with an image based HDR planning system, is "Vendor Complete" as of 4/14/09
  - **Radionics** indicated (August 2008) that they would submit test data to ITC but have not yet done so.

Format of Data Submitted to ITC
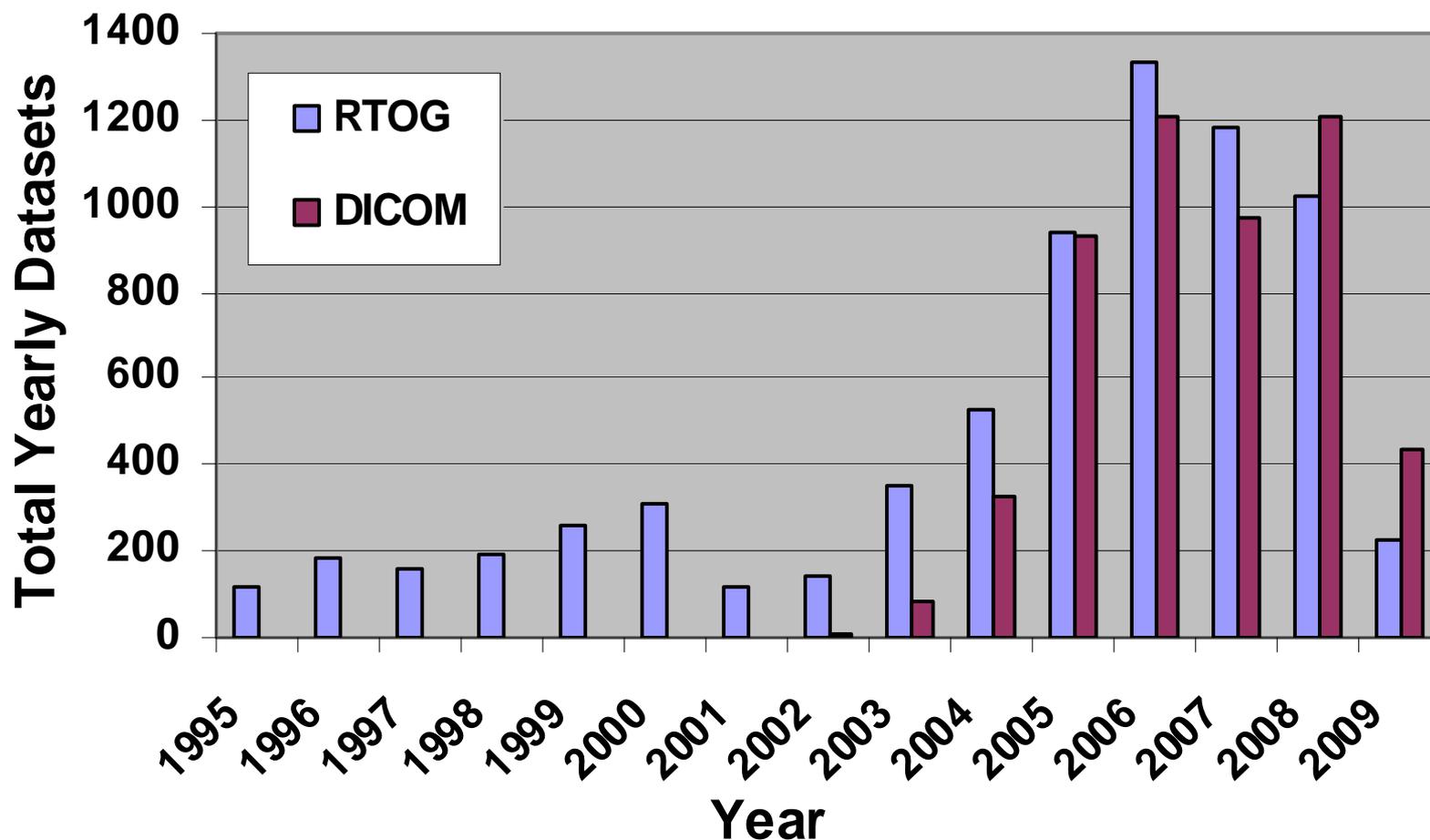
Datasets processed as of April 13, 2009

Update on ATC-NCIA-RTOG 0522 Project

- As of March 31, 2009, a total of 123 cases had been registered on the ACRIN 4500 companion trial, which collects quantitative pre- and post-treatment PET images for outcomes assessment and correlation with RT dose information. Available cases for which PET and RT data subsets have been sent to the NCIA are summarized below.
  - 34 cases have both pre-RT and post-RT PET
  - 64 cases have at least one PET study
  - 45 cases have protocol-compliant RT data
  - 42 cases have protocol-compliant RT and at least one PET study
  - 32 cases have protocol-compliant RT and both pre- and post-RT PET

Update on ATC-NCIA-RTOG 0522 Project (2)

- Work by Dr. Robert Jeraj (University of Wisconsin) and Dr. Tim Fox (Emory Universtiy) to test tools and methods for combining dosimetric and imaging information in this dataset has helped to identify and correct some technical issues related to attributes of DICOM PET and RT objects in the archive, thus making the process of combining RT and PET data more robust.
- Teleconferences
  - Jan 21, 2009 (W. Bosch, R. Jeraj, J. Kirby, B. Hughes, J. Freymann)
    - Worked out scheme for DICOM identifiers for RT and PET data.
    - Add Patient ID (of the form 0522cNNNN) to the NCI-transfer spreadsheet on the RTOG SiteServer.
    - Brian Hughes to send pre-configured CTP software to ITC to facilitate uploads
  - Apr 8, 2008 (W. Bosch, J. Kirby, B. Hughes, J. Freymann)
    - Review of procedures for loading RT, PET images into archive
    - Feature updates in RSNA CTP code have delayed deployment
    - B. Hughes to send per-configured CTP software to ITC after in-house testing with RT data provided by W. Bosch. (work in progress)

Uniform Tissue Names for AT Trials

- Work with RTOG Advanced Technology Integration Steering Committee (ATISC) to develop a uniform system of OAR and TV names.
  - Extensible list of standard OAR and TV base names
  - Rules for appending modifiers to indicate laterality and PRV extensions
  - Scheme for specifying prescription doses for ICRU-based target volume names and for distinguishing tumor versus nodal targets

Update on ATC-RTOG Atlas Projects

- The ATC has facilitated the development of several consensus-based atlases to guide the delineation of target volumes and normal tissues for RTOG advanced technology clinical trials

  1. Investigators develop instructions describing the extent of target volumes and normal structures to be delineated
  2. A representative clinical image set is selected to serve as the basis for contouring. The ITC fully anonymizes the images and makes them available for online contouring using the ITC Remote Review Tool or downloading and contouring using participants' TP systems.
  3. The images and resulting contours are collected by the ITC and co-registered using CERR.
  4. Consensus contours are computed by Dr. Issam El Naqa and coworkers at Washington University using an expectation-maximization algorithm for simultaneous truth and performance level estimation (STAPLE)..

Update on ATC-RTOG Atlas Projects (2)

- In the past funding period, the ITC has contributed to two consensus contouring projects.
  - CTV for cervix cancer IMRT radiotherapy using MR images, undertaken by the RTOG Gyn Working Group, led by Dr. Anthony Fyles and collected contours from 19 experienced Gyn radiation oncologists.
  - CT-based normal tissue atlases for male and female pelvis, led by Dr. Joseph Barthold, is ongoing.
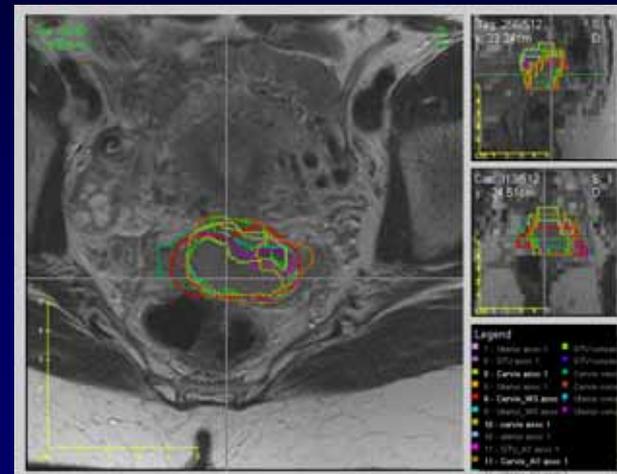
registered cervix contours
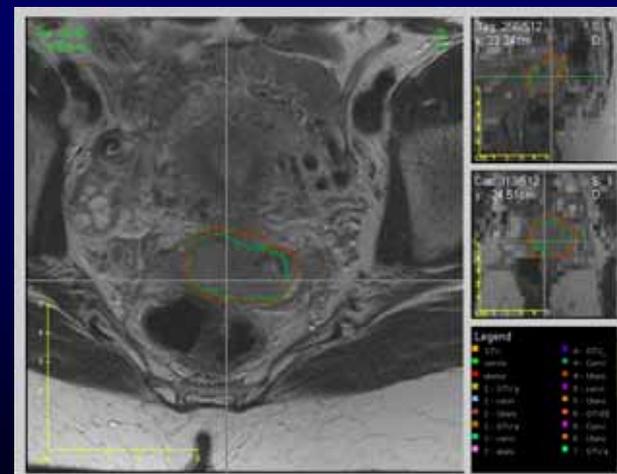
95% and 100% consensus

Developmental Milestones

1. Tools for onsistent re-identification of protocol case DICOM datasets have been built using the open-source POSDA toolkit. Testing is underway using RTOG 0522 datasets.
2. CERR is in routine use for RTOG Data Exchange format conversion
   - Export of TP data for RTOG 0522 to NCIA
   - RPC Phantom Datasets (395 datasets as of 4/13/09)
   - Case review of multi-CT-series protocol datasets (RTOG 0418)
3. Grid-enabled CERR and caGrid IVI Middleware prototypes have been demonstrated at ITC, allowing retrieval of data from the ITC Evercore archive from grid-connected image review software. Security (authentication/authorization) components remain to be implemented.
4. The ITC Citrix server farm has been installed (April 2009).

Continuing Efforts

1. Development of DDIQA workflow tools using CERR.
2. Security components for caGrid middleware to allow its use for distributed data review and archive replication among QA centers.
3. Integration of commercial diagnostic imaging and TP review software in QuASA2R.
4. Installation of additional diagnostic imaging and TP review software on the ITC remote access server and configuration of the secure environment to support remote reviews with this facility.