Initial Description of a Framework on the Radiation Oncology Database Access

Taesun Yoo[1], Patrick Kwok[1], Ned Veletic[1], Philip Au[1], Ananth Ravi[1], Melanie Davidson[1-2], Mark Ruschin[1-2]

Sunnybrook HEALTH SCIENCES CENTRE

Department of Medical Physics, Odette Cancer Centre[1], Department of Radiation Oncology, Sunnybrook Odette Centre, University of Toronto[2]

Radiation Oncology UNIVERSITY OF TORONTO

Introduction

Modern radiotherapy techniques hold the promise of reducing toxicity and may permit dose escalation to improve tumor control. Prediction of radiation-induced complications in radiotherapy treatments using dosimetric, anatomic, and clinical variables has therefore become the major focus of recent studies.

Firstly, enable data querying of treatment plans at the population level based on specific sites (i.e., breast, prostate, head & neck, and other clinical sites of radiotherapy treatment).

Secondly, automated quality assurance on dose distribution (isodose line at deserved prescription level: $D_{95\%}$, $D_{80\%}$ and $D_{38\%}$), total number of beam segments, total monitor units per treatment (MU/Tx), organs at risk (OARs) and other plan parameters can be checked.

Finally, improvement in six major objectives of state of the art radiotherapy cancer treatment is possible which include clinical studies, plan review, adaptive radiotherapy, plan quality improvement, clinical decision making and quality assurance checking on treated plans which have been delivered to cancer patients.

In the present study, we describe an initial framework of radiation oncology database.

Purpose

The main goal of the present project is to test out the feasibility and utility of storing DICOM RT data from historical plans to batch-analyze prospectively (e.g 2009 treatment plans data at the Odette Cancer Centre).

Methods and Results

Framework on Radiation Oncology Database Access

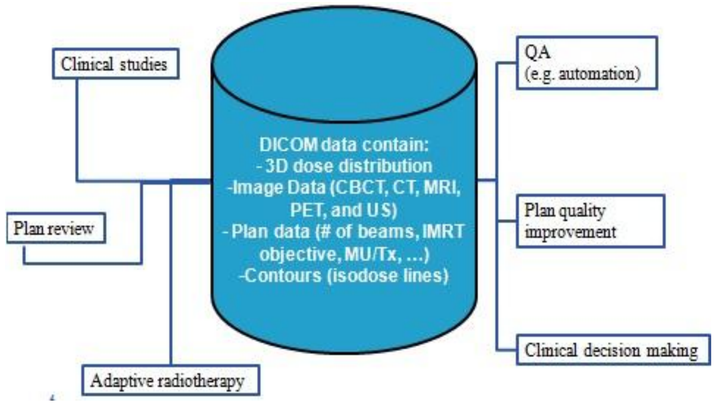

Figure 1. Basic Outline of Radiation Oncology Database.

Clinical Workflow: DICOM Data Retrieval

The present project mainly involves two steps which are DICOM RT export and import.

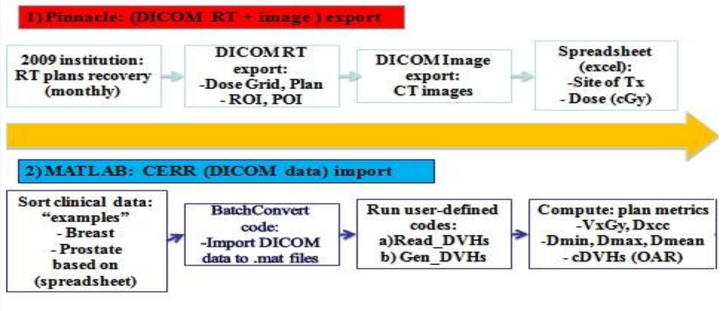

Figure 2. Workflow of DICOM Data Export and Import within the Pinnacle and CERR.

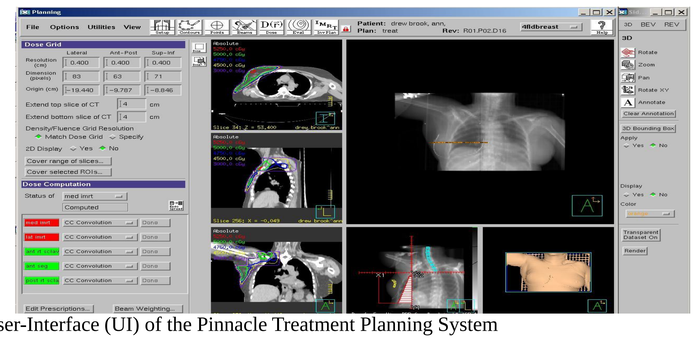

Figure 3. User-Interface (UI) of the Pinnacle Treatment Planning System

Clinical Data: Populations of Prostate Cancer (89 patients)

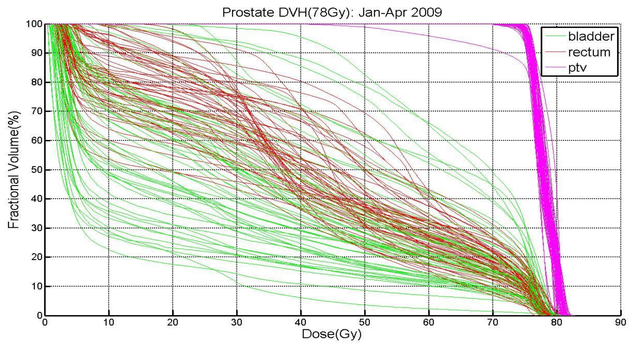

Figure 4. Prostate Cumulative Dose Volume Histograms of PTV, Bladder and Rectum.

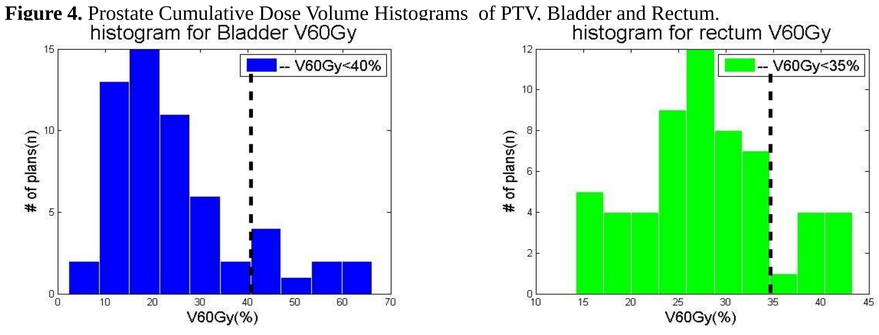

Figure 5. Prostate (78Gy) Histograms of OAR on Bladder and Rectum at V60Gy

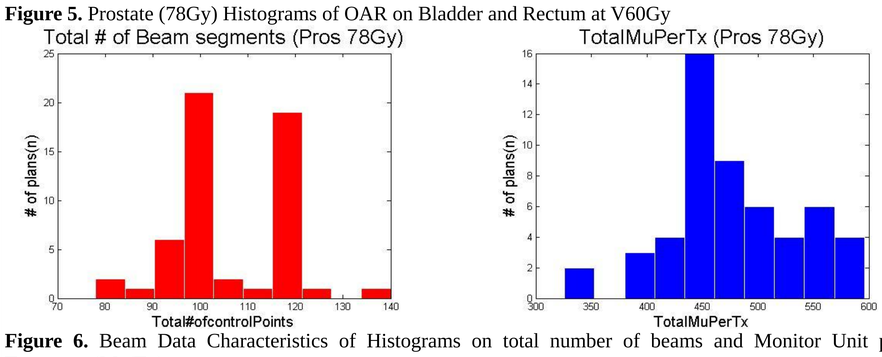

Figure 6. Beam Data Characteristics of Histograms on total number of beams and Monitor Unit per Treatment (Mu/Tx)

Clinical Data: Populations of Breast Cancer (343 patients)

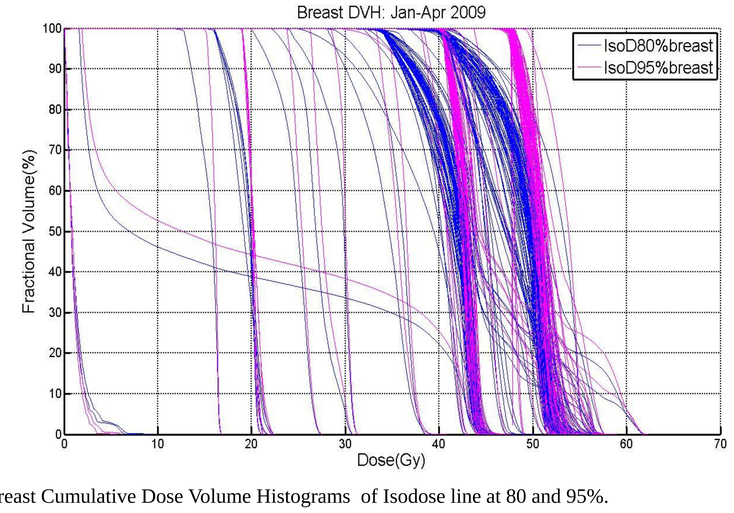

Figure 7. Breast Cumulative Dose Volume Histograms of Isodose line at 80 and 95%.

Results

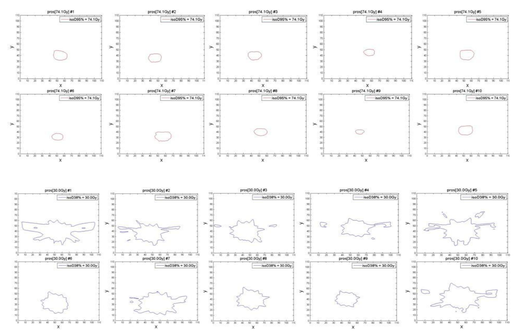

Figure 8. Prostate (78Gy) Isodose Line Levels. D95% and D38%: Top figure represents the isodose line of 95% of dose (Rx) of intermediate risk prostate from 10 (Tx) plans. Bottom figure represents the isodose line of 38% of dose (Rx).

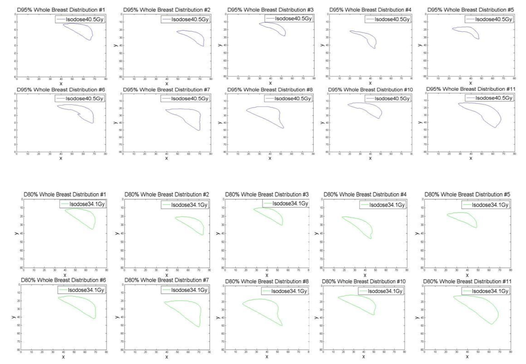

Figure 9. Left Breast (42.5Gy) Isodose Line Levels. D95% and D80%: Top figure represents the isodose line of 95% of dose (Rx) of breast from 10 (Tx) plans. Bottom figure represents the isodose line of 80% of dose (Rx).

Conclusion and Future Works

For prostate, there is a standard OCC guideline for each target (bladder, rectum and PTV) on "V_{xGy}" % of volume receiving at least amount of "x" Gy (dose). Thus, histograms of OARs on each target will be plotted to see how many treatment plans are meeting the minimum dose volume cut off value at different level of V_{xGy}.

Also automated QA on total number of beam segments and total monitor units per treatment (MU/Tx) average around 106 and 473 values are expected on 78Gy intermediate risk prostate treatment plans.

Finally, isodose line distribution on both prostate and breast are expected. At the lower level of isodose, dose distribution shape will be closer than higher level of isodose on each of dose prescribed plans for breast and prostate.

Future works involve outcome analyses on prostate and breast cancer patients using the DVH metrics. Automated quality assurance checks will be performed on isodose lines, gantry angles and other beam parameters via Principal Component Analysis (PCA).

References

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