A Physics Database for a Multi-Institutional Quality Consortium

JM Moran[1], M Feng[1], L Benedetti[2], M McMullen[3], MM Matuszak[1], T Nurushev[4], M Hess[1], KA Griffith[1], J Hayman[1], J Fisher[5], S Brossard[6], M Grubb[1], L Pierce[1]

[1]University of Michigan, Ann Arbor, [2]William Beaumont Hospital, Royal Oak, [3]St. Joseph Mercy Hospital, Ann Arbor, [4]Henry Ford Health System, Detroit, [5]Mercy Health Partners, Muskegon, [6]Munson Medical Center, Traverse City

MROQC
Michigan Radiation Oncology Quality Consortium

INTRODUCTION

- The Michigan Radiation Oncology Consortium (MROQC) was created in 2011 with six partner institutions to share best practices in radiation therapy methods and outcomes for early stage breast and lung cancer patients
- MROQC has expanded to 14 institutions statewide to include different types and sizes of practice environments
- A database was created to include physician and patient reported outcomes, physics data, and photographs for breast patients
- Data elements were determined by a multi-disciplinary and multi-institutional team including physicists, physicians, and a statistician
- It is funded by Blue Cross Blue Shield of Michigan and coordinated by the University of Michigan

GOAL

- Describe elements of the physics portion of the database & example analysis regarding practice patterns

MATERIALS & METHODS

DATABASE

- Dynamic graphs created with Matlab for the dose volume histogram (DVH) tool

- Java and Pixelmed DICOM library are used for the DICOM upload tool
- Each patient has an institutional ID only known at the institution and an MROQC ID which denotes the patient in the database
- Each person doing data entry uses two-factor authentication

Three tools were created to capture physics data: web-based questionnaires, a dose volume histogram wizard, and a DICOM-RT anonymizer for plans.

1. WEB-BASED QUESTIONNAIRES

- Facility-specific questionnaire covers hardware, software and standard practices

Treatment Delivery and Image Guidance
Specify the motion management techniques used for this patient for treatment delivery.
Check any that apply
- ☐ No special instruction
- ☐ Voluntary breath hold (no device)
- ☐ Forced breath hold (with device)
- ☐ Gating of radiotherapy
- ☐ Other

What type of imaging was used to verify this patient's setup?
Check any that apply
- ☑ kV/MV portal
- ☐ CT (CBCT or TomoTherapy CT)
- ☐ Films
- ☐ Video-based systems
- ☐ Other

Patient-specific questionnaire covers:
- Simulation
- Target definition for breast and lung
- Dose prescription
- Treatment planning
- Treatment delivery

MATERIALS & METHODS (cont.)

2. DOSE VOLUME HISTOGRAM WIZARD

- Tool accepts numeric data based on the composite delivery of all plans from any treatment planning system
- The user selects the structures and type of DVH
- The user reviews the data for quality control at time of data submission
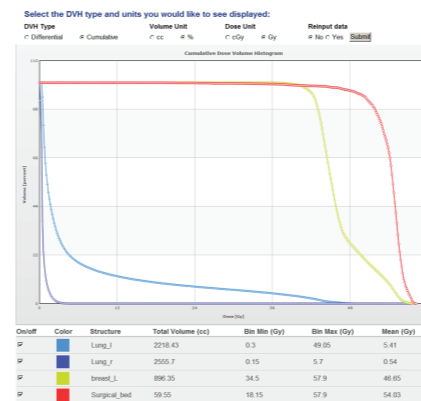
Structures for which DVHs are submitted

Breast cancer patients	Targets	Contoured treated breast or surrogate based on 95% isodose surface
		Surgical cavity
	Organs at risk	Ipsilateral Lung, Heart if within 2 cm of the 50% isodose surface

Lung cancer patients	Targets	Primary tumor PTV
		Involved nodal PTV*, Elective nodal PTV*, Nodal PTV*
	Organs at risk	Normal lung: Right + Left Lung minus GTV or CTV
		If within 2 cm of 50% isodose surface: Spinal Cord, Esophagus**, Heart, Brachial Plexus

*Nodal PTVs are only submitted if nodes are contoured separately from other target volumes. The options allow for variations in practice among institutions.
**Instructions are provided to follow the RTOG guidelines for contouring the esophagus.

3. DICOM-RT ANONYMIZER TOOL

```
AccessionNumber : none
Modality : RTPLAN
Manufacturer : Varian Medical Systems
ReferringPhysicianName : none
StationName : none
SeriesDescription : none
PhysiciansOfRecord : none
OperatorsName : none
ManufacturerModelName : Aria RadOnc
PatientName : 162
PatientID : 162
PatientBirthDate : 18000101
PatientSex : O
OtherPatientIDs : none
DeviceSerialNumber : none
SoftwareVersions : 8.9.15
```

- Sample searchable text-only preview from the upload process
- Protected health information (PHI) are removed during upload
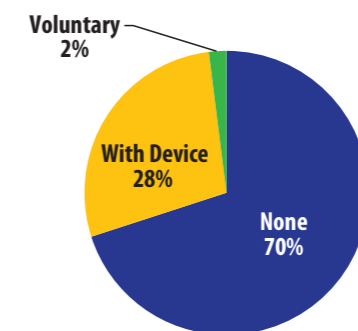- The user reviews the data for absence of PHI before final submission

RESULTS

- As of July 2013, survey, DVH, and DICOM-RT data have been submitted for more than 1,000 patients
- Data quality is regularly monitored by the statistical and physics team
- An audit strategy has been developed which includes an onsite evaluation

RESULTS (cont.)

User feedback and a review of the data quality have led to the following improvements.

- Web-based questionnaires
  - Removal of redundant questions
  - Rewording of questions which inadequately captured the actual practice
- DVH tool – breast cancer patients
  - Data for the ipsilateral lung structure no longer collected because average doses <2.5 Gy
  - Surgical cavity structure optional because it is not always contoured
- DICOM-RT anonymizer tool
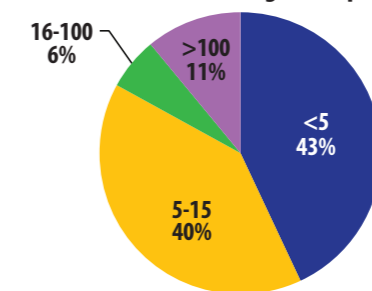 - Attestation statement added
  - Internal error reporting launched
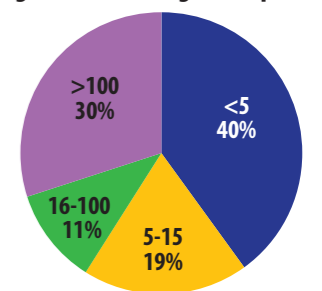

Left Breast: Use of Breath Hold Control — Voluntary 2%, With Device 28%, None 70%

Lung: Use of Breath Hold Control — With Device 1%, Other 1%, Use of ITV 16%, None 82%
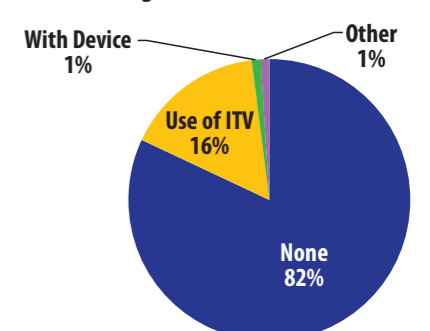
Breast: Number of Segments per Plan — 16-100 6%, >100 11%, <5 43%, 5-15 40%

Lung: Number of Segments per Plan — >100 30%, <5 40%, 16-100 11%, 5-15 19%

SUMMARY

- A database was created to capture detailed physics information from web-based questionnaires, and DVH and DICOM-RT plan data
- Data continues to be regularly submitted for eligible breast and lung cancer patients
- High quality data are crucial for determining how treatment technique and doses affect patient outcomes

ACKNOWLEDGEMENTS