Update on Medical Physics Practice Guideline #1

Jonas Fontenot, Ph.D.

MPPG #1

Evaluation and Quality Assurance of X-ray Based Image Guided Radiotherapy Systems

Committee Members:

- Jonas Fontenot (chair) – Mary Bird Perkins Cancer Center
- Andrew Jensen – Mayo Clinic
- Jack Yang – Monmouth Medical Center
- Hassaan Alkhatib – Richland Memorial Hospital
- Jeff Garrett – Mississippi Baptist Medical Center
- Steve McCullough – Methodist Richardson Cancer Center
- Brent Parker – University of Texas Medical Branch at Galveston

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Overview

- Use of imaging systems for daily alignment and localization in radiation therapy IGRT is expanding rapidly
- Challenges for the therapy physicist
  - New technology
  - Not traditionally associated with clinical therapy physics

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Rationale

- IGRT systems come in many flavors
  - Megavoltage imaging systems
    - Two-dimensional
    - Three-dimensional
  - Kilovoltage imaging systems
    - Two-dimensional
      - Gantry-mounted
      - Room-mounted
    - Three-dimensional
      - Gantry-mounted
      - Room-mounted

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Rationale

- Guidance documents are available
  - TG-58
  - TG-75
  - TG-101
  - TG-104
  - TG-135
  - TG-142
  - TG-148
  - TG-179
- Obstacles to successful implementation of an IGRT program
  - Unfamiliarity with technology
  - Variety/complexity of guidance documents
  - Few process descriptions

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Goals

- "Clinical recipe" for the solo physicist
- Inform the reader of the needs of this particular technology (time, effort, resources)
- Succinctly state the minimum acceptable standards for using IGRT, similar to ACR-ASTRO technical standards
- Provide necessary references for further investigation

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Intended Users

- Medical physicists
  - What is required for safe and effective use?
    - Tools
    - Time/effort
    - Procedures
- Administrators
  - How much will it cost?

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Approach

- Survey and consolidate existing TG recommendations
- Survey of IGRT practices at MPPG members' institutions
  - University clinics
  - Community clinics
- Expansion of process descriptions, categorized by IGRT approach
- Address applicable areas of need identified by SPG

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Elements of Guidelines

- Staff Responsibilities
- Implementation Guidelines
  - Staffing/time
  - Equipment
  - Commissioning/quality assurance
    - Process descriptions
  - Staff training
  - Common pitfalls

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Staff Responsibilities

- IGRT implementation requires a team approach
  - Radiation Oncologist
    - Patient positioning procedures
    - Imaging modalities/frequencies
    - Registration targets/thresholds
    - Review
  - Medical Physicist
    - Acceptance/Commissioning
    - Quality assurance program
    - Standard operating procedures (with radiation oncologist)

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Staff Responsibilities

- IGRT implementation requires a team approach
  - Medical Dosimetrist
    - Generation and transfer of IGRT structures
  - Radiation Therapist
    - Implements IGRT strategy

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Implementation Guidelines
Example: kV-CBCT

- Resources
  - Staffing/time
    - Acceptance/commissioning: 1.5-2 days
    - Routine quality assurance
      - Daily: 10-15 minutes
      - Monthly: 1-2 hours
      - Annually: 4-8 hours
    - Ongoing (troubleshooting, upgrade, repair): 1-2 hrs/wk
  - Equipment
    - CatPhan, AAPM CT phantom, or equivalent
    - Ionization chamber
    - Ball-bearing phantom or equivalent

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Implementation Guidelines
Example: kV-CBCT

- Acceptance/commissioning
  - Customer Acceptance Procedures
  - RV/OIS integration
  - Routine QA baselines
- Routine quality assurance
  - Daily
    - Interlocks, phantom localization/repositioning/shift
  - Monthly
    - Image quality
  - Annually
    - Imaging dose
    - Dx-Tx coincidence
- Upgrade/Repair
  - Repeat QA baselines upon major upgrade or replacement

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Implementation Guidelines
Example: kV-CBCT

- Staff training
  - Medical Physicist
  - Dosimetrist/Therapists
- Common pitfalls
  - X-ray tube performance (kV accuracy, mAs linearity, etc) may be *required* by individual state regulatory agencies

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Conclusions

- IGRT implementation and QA is challenging
- There are QA elements common to all x-ray based IGRT systems
  - Safety
  - Image quality
  - Geometric fidelity
    - Scaling
    - Tx-Dx iso
    - Table shifts
  - Dose
- A successful MPPG1 will improve the quality of clinical support for various IGRT strategies

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Thank You

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