Update on Medical Physics Practice Guideline #1
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MPPG #1
Evaluation and Quality Assurance of X-ray Based Image Guided Radiotherapy Systems

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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
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

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

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

### 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

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

Staff Responsibilities

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

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
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

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

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
Thank You