Quality Assurance
History, Current Status, and Future

Todd Pawlicki
Department of Radiation Oncology
University of California, San Diego

History of Quality

- Craftsmanship
  - Expert and apprentice

- European industrial revolution
  - Subdivided trades into multiple steps

- The U.S. departure to Taylor’s system
  - Significant increase in productivity


Quality in the U.S.
Telegraph and Telephony


Creating a Telephone system

- Engineering department
- Production department
- Inspection department
  - Sampling to inspect raw materials/products
  - Inspection to separate the good & bad

Parallels with Rad Onc

- Physicists entered the hospital
  - Craftsman
- Radiation treatments become ‘routine’
  - Industrialization
- Quality = Checking parameters
  - Inspection

Improving Quality

- Bell Telephone Laboratories
  - Control Chart invented in 1924
  - Emphasis on the process
- Western Electric
  - Social science research (~ 1924)
  - Quality Management


WWII and Post-War Japan

- General MacArthur needed to rebuild Japan’s communication system
- In 1948, the U.S. government invited Western Electric managers to Japan
- Management training courses started
  - Practical knowledge of quality control

Japan’s Most Important Export

- Japanese manufacturers’ reputation for superior quality
- In 1986, a group of AT&T manufacturing officials visited Japan
  - Their goal… to ‘learn’ QA methods

QUALITY TOOLBOX: ~112 tools with variations
Different Tools for Different Problems

One Time Only Process (e.g. Linac Commissioning)
- Design
- FMEA/MEA
- PDP
- Mistake-Proofing
- Deployment
- FTA

Repeated Process (e.g. IMRT QA)
- Design
- Deployment
- Statistical evaluation
- Design Improvement

Issues in Quality

- Two dimensions of quality
  - High-quality decision making
  - High-quality performance
- Decision making quality
  - Peer-review
- Performance quality
  - Process analysis

Where are we now?

- Measure and inspect against specifications
- Investigate incidents once they have occurred
  - Does charts rounds really improve quality?
- “If it ain’t broke, don’t fix it.”
  - This can lead to latent errors in a process that can be manifested long into the future
- Hard work and best efforts are the main mode of operation to improve quality

Typical Approach to Quality

IMRT Example

Within specifications (don’t worry about it)
- or –
Outside specifications (something is wrong, fix it, and re-measure)
  - or –
  Getting close to specifications (come back to it later)

Planning complete

Document results

End
Variations in Quality

- Quality should be universally defined
- How reproducible is IMRT QA from institution to institution?
  - Measurements and independent computer calculations
- Use control charts as the process analysis tool

Investigation of IMRT QA

- 7 institutions with active IMRT programs
  - 4 academic
  - 3 community
- Each institution followed their in-house IMRT procedures
  - Treatment planning
  - Quality assurance
    - Point dose in phantom + IMSure
What should we do?

• Efforts to improve decision-making should be focused on the process
  ✓ Errors are evaluated as process problems, not people problems

• Implement a quality program rather than a detailed prescriptive focus on capability

Two Control Charts

• Clinical specifications
  ✓ Set process requirements

• Control chart limits
  ✓ Quantify process performance

Pawlicki, Yoo, Court et al. Radiother Oncol 2008

What should we do?

• Understand the difference between clinical specifications and action levels

• Focus on understanding process performance
  ✓ It is impossible to improve a process by comparing measurements to specifications
Where do we go from here?

1. Research on modern quality techniques
2. Educate radiation oncology leadership
3. Rapid Task Group publications
4. Close collaboration with vendors
5. Use resources outside of radiation oncology
6. Adopt a patient’s (customer) view of quality