

HDR Q.A.: Physicist responsibilities

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Patient advocacy week?

TOP 10 TECHNOLOGY HAZARDS FOR 2011

1. Radiation Overdose and
Other Dose Errors during
Radiation Therapy

Source: ECRI Institute PSO
(Patient Safety Organization)

Wake up call!!

They Check the Medical Equipment, but Who Is Checking Up on Them?

By WALT BOGDANICH and KRISTINA REBELO; ROB HARRIS CONTRIBUTED REPORTING.
Loose regulation of medical physicists has allowed problems to enter a part of the process meant to make health care safer.

January 27, 2010

As Technology Surges, Radiation Safeguards Lag

By WALT BOGDANICH; REPORTING WAS CONTRIBUTED BY SIMON AKAM, RENEE FELTZ, ANDREW LEHREN, KRISTINA REBELO and REBECCA R. RUIZ.

While new treatments are more accurate, errors in software and operation are more difficult to detect.

January 27, 2010

Case Studies: When Medical Radiation Goes Awry

By WALT BOGDANICH

Patients often know little about the harm that can result when safety rules are violated and ever more powerful and technologically complex machines go awry.

January 27, 2010

V.A. Is Fined Over Errors in Radiation at Hospital

By WALT BOGDANICH

The Nuclear Regulatory Commission cited an "unprecedented number" of mistakes by the Philadelphia Veterans Affairs Medical Center in treating prostate cancer patients.

March 18, 2010

Purpose of Q.A?

- Pass an inspection? **I hope so!!**
- Make the administrator happy? **Could use it!**
- Justify the physicist's job? **Might need to!!**
- Protect your job/yourself? **Hope so!!**
- Protect the patient/others? **Definitely!!**
- Protect the hospital/physicians? **Sure!!**
- Exercise to evaluate system and discover/prevent a potential problem? **intent!!**
- Ensure a consistent and safe dose delivery to the intended target and surrounding tissues? **That might be the best answer!!**

Reasons for a *good executed Q.A.*

- Ethical: principles I, V, and XII from the Code of Ethics (TG109)

I: members shall strive to provide the best quality patient care with competent and professional service

V: members shall respect the law and regulatory requirements for the safe and effective practice of their profession

X: members shall strive to protect the safety and welfare of patients.

- Recommendations of TG-56 and TG-59

TG56: “part of the objective of this report is educational and the other is to recommend a standard of practice for brachytherapy”

- Regulatory requirement: State or NRC
- *Might be part of your best defense in the courtroom in case of lawsuit*

Education: Physicist

Responsibilities

- Quit Assuming concept (Q.A.)
- Reports AAPM TG43, TG-56 and TG-59
- AAPM Monograph # 31 (Brachy. summer school)
- “Achieving Quality in Brachytherapy” by B. R. Thomadsen
- Request in writing appropriate training/Q.A. equipment
- Avoid short cuts
- Be aware of current and new regulations: It is your responsibility.

Items in mind when drafting Q.A. program

- Tools
- Immediate entourage
- Extended entourage
- Create *reasonable* and *executable* Q.A.
- Effective program you can manage/deliver (unless you have 20 Med. Phys. at your institution then write a book!)
- To make errors “impossible”, you have to understand the system/procedure/process first

Tools

- HDR unit/transfer tubes/source
- HDR applicators
- Treatment planning system
- HDR room
- Imaging (will not be addressed here)

Immediate entourage

- Patient/family
- Physician
- Dosimetrist (s)
- Therapists
- Nurse
- Physicist colleague (s)

Extended entourage

- Regulators
- Administrators/Med. Director
- Radiation safety officer
- Attorneys

Tools...

HDR Unit

- Acceptance testing: prior to use
- Commissioning (source, TT, applicators, TCS)
- Calibration protocol (standard method)
- Daily/monthly/quarterly/annual Q.A. program (Q1)

Responsibilities

- Acceptance/commissioning: Q.M.
- Daily: RTT/QM
- Monthly/Quarterly/Annual: Q.M.
- Treatment Q.A.: RTT/QM
- Written plan of action and training for emergency situation: Natural (hurricane, earthquake, fire, flood or tornado), minor (HDR system faults) and major (source stuck, medical condition of patient)
- Appropriate training of all staff involved in HDR patient care (RTT, Nurse, Physician, Dosimetrist, other Physicist)

Acceptance testing

- Manufacturers recommended protocol
- AAPM TG40, TG43, TG-56 and TG-59
- HDR Unit, applicators, TCS, TPS
- Perform end-to-end test

Commissioning

- AAPM recommendations (TG56)
- HDR, applicators, source, TPS, TCS

Daily

- *Source positioning accuracy with film ($<1\text{mm}$)*
- *Transfer tubes condition (avoid surprises with source stuck)*
- *Timer termination (reasonable)*
- *Console*
- *Console source position indicator*
- *Catheter attachment lock system*
- *Emergency stop (inside and outside the room)*
- *Treatment interrupt system*
- *Date and time on control unit (incorrect decay)*
- *Warning light outside the room*
- *Door interlock system*
- *Emergency plan in place with proper tools (forceps, lead container, surgical supplies, syringes)(Q2)*
- *Radiation monitor inside and outside the room*
- *Communication system: camera and intercom (backup plan for both)*
- *Survey meter/hand held radiation monitor*
- *Catheter with/without connected applicator: force the system to fail.*
- *Verification of treatment time (calc.)(Q3)*

Monthly (optional)

- All of daily
- Constancy check for your calibration system (source AKS measurement)
- check wire in source position simulator (Q3)
- Source strength Calibration
- Timer accuracy, linearity

Quarterly

- Source exchange (wipe test, log book and records, calibration, safety checks, TPS, TCS, Decay tables, independent calc system)
- All of daily checks
- Backup batteries (radiation monitor, HDR unit, HDR Computer)
- Evaluate all transfer tubes
- TG 56 Recommendations

Annually

- Repeat acceptance testing
- Review and update/revise all documentation, procedure checklists and forms
- Perform a dry run to evaluate the emergency plan/response in place (Q5)
- Evaluate system and have a plan after power outage during Tx (Q6)

Treatment Q.A (part of the Q.M.)

- Review all documents: before, during and after treatment.

Treatment Q.A....Before

- Daily checks
- Written directive completed and signed
- Patient consent form signed and dated
- Patient identification
- Prescription verification
- Plan signed by Q.M. and AU
- Patient survey

Treatment Q.A....during

- Presence of AU and QM during treatment
- Indication of any system faults

Treatment Q.A...after

- Treatment completed as prescribed?
- Survey: patient, catheters, transfer tubes
- Patient treatment documentation

Additional items to consider: HDR as a new responsibility/job

- Perform radiation survey. (Q7)
- Perform acceptance testing as soon as possible
- Perform commissioning as soon as possible
- If you detect discrepancies, refer to the Ethics recommendations for resolutions

Tools...

HDR applicators

- Visual inspection prior to use by staff (look for defects)
- Read and understand manufacturer recommendations (usage, sterilization, expected life of device (Q8)...))
- Inform appropriate people about potential issues
- Appropriate applicator used and planned for (small, med ovoid etc...).

Tools...

Treatment planning system

- Correct data and matches Delivery unit (AKS, date and time)
- Repeat standard cases (single and multiple catheters) for comparison after a major upgrade (software/hardware) (Q9)
- Call manufacturer and ask about any reported problems with upgrade.
- Inform everyone (Therapists, dosimetrists, physicists) about the upgrade to be on the alert)

Tools...

Treatment planning system

- Dose prescription in plan vs. written directives (within department/published protocols)
- Reasonable dwell time (single and total)(Q9).
- Critical organ(s) dose is acceptable
- Independent second person check
- Independent check confirmed (Q10)

Remember: “garbage in => garbage out”

Q.A. for planning (part of...)

- Correct source decay
- Correct step size used
- Correct Source Index/total length used/offset
- Correct catheters identification
- Correct catheter (s) orientation
- Correct start and end dwell positions
- Correct optimization (Q11)

Source position simulator



Tools...

HDR Room (backup plan)

- Communication system: camera and intercom
- Door interlock system
- Radiation monitor inside and outside the room

Physicist: immediate entourage

Physician

- Possible issues with case (curvature of the catheter)
- Prescription and method (avoid verbal directives)
- Possible deviations from standard of practice
- Easier to correct problems in OR than during sim (be involved directly in OR for complex cases).
- Avoid “I thought he/she/you...” or “I assumed that he/she/you...” instead ask direct/specific questions “did you...what is...?”

Physicist: immediate entourage

Dosimetrist

- Good communication and allow double check.
- E factor: if you have it leave it in the parking lot or at home (Q12)
- Listen to their feedback
- Double check all work (Source index, prescription, etc...) regardless who did it!
- Ask the questions, do not assume the answers.

Physicist: immediate entourage

Nurses/Therapist

- Good communication and allow double check.
- Path report for APBI, Size of cylinder or ovoid used etc...
- Ask the questions, do not assume the answers.
- Listen to their feedback regarding patients under Tx: possible indication of a potential problem
- APBI patient with skin reaction: is it infection or poor Q.A.?

Physicist: extended entourage

Patient

- Poor Q.A. : could lead to poor outcome and possible Medical Event
- Pain and suffering for patient and family: “**Inept team**”, “**Horrible way to die**”
- Financial consequences
- Pay attention to their feedback: pain, discomfort, redness etc...=> possible hidden error=> review everything

Physicist: extended entourage

Regulators

- Poor Q.A. : could lead to citations
- Poor Q.A with medical events could lead to serious citations.

Physicist: extended entourage

Attorneys

- Medical events could lead to some legal issues
- Interviews and depositions
- Actions
- Could have an impact on you future

Physicist: extended entourage

Medical director/administrators

- Effect on the program
- Hospital or practice reputation
- Financial loss
- Could affect you future

Impact on the modality in general and patients might not be able to benefit from it

Case discussion: breast

- Therapist/Nurse/patient/rad. Onc. communications?
- Source indexer length q.a
- Independent check
- Poor setup (avoid transfer tubes sitting on contra-lat breast)

Event Text

AGREEMENT STATE REPORT - DOSE TO UNINTENDED TISSUES

The State of Florida was notified on 10/17/2008 by the licensee's Medical Physicist regarding a dose of 3400 cGy (3400 rad) administered to unintended tissues during several breast cancer therapy treatments over the period of September 10 - 17, 2008. The apparent unintended dose was identified on 10/16/2008 when the patient reported to the licensee symptoms of erythma (skin reddening) to the breast not intended to be treated.

Specifically, the patient was being treated for breast cancer with an Ir-192 High Dose Rate (HDR) Afterloader unit (source strength, manufacturer, and model unknown at the time of this report). When the erythema was reported by the patient, the Medical Physicist reviewed the records and determined that the HDR Afterloader was mis-programmed such that the source stopped 10 centimeters short of the intended tumor bed in the right breast. As a result, the entire dose intended for the tumor bed was administered to the left breast that was not intended to be treated.

The State of Florida did not currently have information regarding any potential long term effects for the patient due to this event. The State of Florida will dispatch an inspector to the facility early next week to follow-up on this event. A written report of this event will be provide by the State at that time.

A "Medical Event" may indicate potential problems in a medical facility's use of radioactive materials. It does not necessarily result in harm to the patient.

Breast case

AGREEMENT STATE REPORT - MEDICAL EVENT DUE TO DOSE LESS THAN PRESCRIBED DOSE

The following report was received from the State of Wisconsin via facsimile:

"On 7/14/2008, a patient was simulated and treatment planning performed for High Dose Rate (Ir-192) partial breast irradiation to the right breast using a Contura (SenoRx) balloon. The authorized user prescribed a dose of 3.65 Gy per fraction x 9 fractions for a total dose of 32.85 Gy to the Planning Target Volume. After the planning was done, the length of each of the five catheters was measured by the Nucletron Source Position Simulator. The readings were found to be 1154 each. The treatment file in the High Dose Rate treatment console was modified from its default value of 1500 to 1154 and patient was treated. The patient was treated in the High Dose Rate machine located in Room 'A'.

"On 7/15/08, the patient was scheduled to be treated in the High Dose Rate machine located in Room 'B'. Since the sources are different in activity, total time check was performed, at which time, the medical physicists also compared the measured lengths with a second patient under treatment with the Contura balloon in Room 'B'. At this point they noted the difference in the measured lengths between the two cases. The medical physicist checked the Source Position Simulator and noticed that there was an obstruction at the 1154 reading. The review of the actual delivered dose during the first fraction revealed that the source did not enter the patient's body and thus the negative impact was mitigated. A small region of the skin surface received some radiation dose, but the clinical impact is insignificant. The incident was immediately reported to the primary Radiation Oncologist and the Authorized User. The licensee states that no long-term, permanent side effects are anticipated as a result of the medical event.

"Due to the licensee's investigation of the Source Position Simulator revealing that a welded junction in the cable of this measuring device was kinked, it was immediately replaced with a new one. The licensee has also developed a new Quality Assurance form which will be exclusively used for Contura balloons and which incorporates the expected length for the five catheters. Department of Health Services (DHS) staff have been dispatched to investigate this incident."

Wisconsin Report Number: WI080017

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Breast case

- Q.A. on source position simulator
- Q.A. on expected readings for SIL for specific device
- Independent check

Hypothetical case

- Case 1: Source Indexer length for patient A are supposed to be (MLB old 4-5 cm balloon”): 1244, 1244, 1242, 1242 and 1243. Read and confirmed
- Let’s assume they were all either read or entered incorrectly. The actual numbers used were 1204, 1204, 1202, 1202 and 1203.
- Source indexer length used are 40 mm less
- What will happen to the dose distribution?

Plan with incorrect Source Indexer length viewed on the treatment planning station



GYN case

Event Text

AGREEMENT STATE REPORT - MEDICAL EVENT RADIATION TREATMENT NOT ADMINISTERED PER INTENTION

The following report was made by e-mail:

"In Radiation Oncology, a treatment was ordered for an HDR cylinder gynecological treatment of 2 fractions of 600 cGy to 5 mm past the surface of the cylinder. The treatment form was most likely filled out by a resident and was signed by both the resident and the attending radiation oncologist as stated by Environmental Health & Safety staff. When the radiation oncologist typed the official written directive into the IMPAC system, (Information for Management, Planning, Analysis and Coordination System), her intention was to treat 2 fractions of 600 cGy to the surface of the cylinder. ~~The treatment was planned according to the written form to 5 mm past the surface of the cylinder. This plan was checked and signed off by the treating physician and was the treatment given to the patient.~~ The radiation oncologist states that there should be no medical impact to the patient, as prescription to 5 mm past the surface of the cylinder is also an acceptable and standard treatment. The radiation oncologist has changed the prescription in IMPAC to reflect the dose that was given. The treating physician has notified both the referring physician and the patient."

A 'medical event' indicates potential problems in a medical facility's use of radioactive materials. It does not result in harm to the patient.

- Protocol
- Verbal written directives
- Confirmation of written directives
- Independent check

GYN

Event Text

AGREEMENT STATE REPORT - MISSISSIPPI - MISADMINISTRATION INVOLVING AN HDR TREATMENT

The State provided the following information via email:

"On 3-26-08, licensee's RSO notified DRH [Mississippi Division of Radiation Health] of a Iridium-192 HDR treatment misadministration. The reportable event involves the administration of 3 separate fractions for one (1) patient over a six (6) day period. The misadministration was caused by not measuring the catheters. Measurements taken on 3-25-08 of the tandem and ovoid applicators connected to the Varion Varisource HDR indicated that the length of the source wire entered in the treatment planning system should be 128 cm instead of 120 cm. Further inspection of the catheters revealed that the ovoid catheters were correct but the tandem catheter should have been used with a different applicator. The error resulted in the dose being delivered approximately 86 mm inferior to the desired location. The prescribed treatment was for 5 fractional treatments for 600 cGy each (3000 cGy total); however, due to the error only 470 cGy was administered in 3 treatments (26% of the prescribed dose). It was noted during the investigation by DRH that for other problems not associated with the HDR treatments, the patient did not return for the final 2 fractional doses. The dose to the vaginal region inferior to the treatment area received a 1300 cGy overexposure as a result of the error. The Radiation Oncologist does not foresee this patient experiencing adverse health effects as a result of this misadministration. The referring physician and the patient have been notified. "

MS Report No. MS-08004

A "Medical Event" may indicate potential problems in a medical facility's use of radioactive materials. It does not necessarily result in harm to the patient.

- Total length issue
- Independent check

References

- AAPM TG 56 med. Phys. 24(10) October 1997
- AAPM TG 59 med. phys. 25 (4) April 1998
- B. R. Thomadsen “Achieving quality in Brachytherapy”
- AAPM med. phys. Monograph N0. 31: Brachytherapy Physics, Second Edition.



Proud to be a golfer:

Stand proud you noble swingers of clubs and losers of balls...

Recent study: average golfer

- 1) Walks about 900 miles/year
- 2) Drinks about 22 gallons of alcohol/year
- 3) That means, on average golfers get about 41 miles to the gallon

That is really hybrid !!

