Katanic, Janine

From: Schippers, Dale <dschippers@Queens.Org>
Sent: Tuesday, June 25, 2019 10:48 PM
To: Katanic, Janine
Cc: Goerner, Frank; Chadwick, Darlena
Subject: [External_Sender] FW: RE: NRC reported medical event
Attachments: Radiation Safety Plan June 18, 2019.pdf

Follow Up Flag: Follow up
Flag Status: Completed

After I sent the email I see that it was rejected due to size. This is part one with only the Radiation Safety Plan.

From: Schippers, Dale
Sent: Tuesday, June 25, 2019 5:44 PM
To: 'Katanic, Janine' <Janine.Katanic@nrc.gov>
Cc: Goerner, Frank <fgoerner@Queens.Org>; Chadwick, Darlena <dchadwick@queens.org>
Subject: RE: RE: NRC reported medical event

Janine,
Attached are additional documents, as requested, as additional information related to your inspection on May 28 – 30.

Y-90 Medical Event, May8, 2019 NRC Report revised 5-30-2019 signed (with corrective action)
This PDF includes:

- Y-90 initial training for Neal Viradia
- JP Colon Pons_RadioEmbol Training 6_5_2019
- IR Physicians PB General Radiation Safety Training, 2019 (Dr. Chan was trained by BTG on 5/15/2019, Dr. Yamada will be trained when available)
- TheraSphere Vendor training, May15-16, 2019 with roles
- TheraSphere Customer Complaint PR46327, BTG Initial report – Initial BTG report dated June 7, 2019
- BTG Destructive Catheter Testing results, Jun13, 2019
- TheraSphere NM policy with updated checklist

Radiation Safety Minutes Q2, May 8, 2019
Radiation Safety Minutes Q2, Jun17, 2019
Radiation Safety Plan June 18, 2019 – includes revision history and previous plan from 2014
RSO-19-101_All Radiation Badge Monitoring Responsibilities
Estimated Dose Memo, Queen's Medical Center

Frank and I discussed the infusion set/catheter reports from BTG with them and they are pretty convinced that an air bubble is not the cause of the high resistance in the catheter. It appears to be an isolated case and we don't really have any conclusive evidence in regards to the cause.

Let me know if we missed anything or if you have additional questions.
Thank you,
Dale

From: Katanic, Janine <Janine.Katanic@nrc.gov>
Sent: Friday, June 14, 2019 11:52 AM
To: Schippers, Dale <dschippers@Queens.Org>

Cc: Goerner, Frank <fgoerner@Queens.Org>; Chadwick, Darlena <dchadwick@queens.org>
Subject: RE: RE: NRC reported medical event

Aloha Dale,

Thanks for the update.

I think that when discussing the issues we need to make clear separation between the medical event and the dosimetry issue.

For the medical event, regarding the 15 day report, you sent the original to us prior to the inspection. It was not on letterhead, and it was not signed. During the inspection, we talked about some inconsistencies in the report, and clarifications that needed to be made, and you made some changes, put it on letterhead, printed it, and handed it to me, but it was not signed. When I returned to the office, I stamped it as received on May 30, 2019. In talking with my management, they still want a letterhead and SIGNED copy of the report. Since the Therasphere policy and checklist you noted in Item 2 below are part of your corrective actions, when you revise the 15 day report, you can include those as an attachment to the report. You can also include the BTG report (item 6) as an attachment to the revised report. I still need the training for the IR referenced docs as you noted in Item 4 below. If item 9, Therasphere training for the MP techs, and Item 10, documentation of Therasphere refresher training, are also part of your corrective actions, they can also be an attachment to the 15 day report.

For Item 1, Radiation Safety Program changes, I understand that you are going to take that to the RSC for approval.

Then for the dosimetry issue, which covers Items 3, 5, 7, and 8 below: Were any of these items going to address the 10 CFR 19.12 training that Darlena noted at the preliminary exit meeting was given to the IR docs? You were going to check whether they were previously getting that training. Also, I wanted to point out that although Drs. [redacted] and [redacted] are the most egregious, several other IR docs had months with M's or missing dosimeters. Also, I was only able to see records from 2017 forward, and don't know the full extent of the situation, how many years back, so it needs to be part of your evaluation.
[redacted] – I did not see his dosimetry report to see if he had M's. He may have done Y-90 cases, you would need to evaluate.
[redacted] – all M's
[redacted] – December 2018 was M – did he not wear it or was he not doing any procedures that month?
[redacted] – mostly M's, also a missing dosimeter in December 2018, needs to be evaluated
[redacted] – one anomalous looking reading in August 2018, and a missing dosimeter in April 2017, needs to be evaluated
[redacted] – several months with M's in 2017, 2018, and 2019, needs to be evaluated
[redacted] – I did not see his dosimetry report to see if he had M's.
[redacted] – I did not see his dosimetry report to see if he had M's.
So what I'm saying is that your evaluation needs to be comprehensive for all of the Y-90 IR docs, not just [redacted] and [redacted].

I am out of the office next week but will be checking email.

Regards,
Janine

Janine F. Katanic, PhD, CHP
Senior Health Physicist
Division of Nuclear Materials Safety
Materials Inspection Branch
US Nuclear Regulatory Commission
Region IV
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email: Janine.Katanic@nrc.gov

From: Schippers, Dale <dschippers@Queens.Org>
Sent: Friday, June 14, 2019 3:20 PM
To: Katanic, Janine <Janine.Katanic@nrc.gov>
Cc: Goerner, Frank <fgoerner@Queens.Org>; Chadwick, Darlena <dchadwick@queens.org>
Subject: [External_Sender] RE: NRC reported medical event

Janine,
Want to give you an update since it's been a couple of weeks. Frank and I have been working on the dosimetry estimate for Drs. [redacted] and [redacted] and also on our Radiation Safety Program. We have a special RSC meeting scheduled for Monday to get approval for the changes to the RS Program and to approve your recommended changes to the TheraSphere checklist.
We are planning to submit the following documents to you next week:

1. Radiation Safety Program
2. TheraSphere policy including the checklist
3. Dosimetry estimate for Drs. [redacted] and [redacted]
4. Initial TheraSphere training for Drs. Viradia and JP.
5. Memo to staff re: film badge requirements
6. Report from BTG regarding the catheter/infusion set (Don't hold your breath. It's not very conclusive.)
7. Film badge request form indicating that they received a copy of our policy for radiation monitoring and RS plan
8. Training and requirements for staff when we issue them a film badge.
9. TheraSphere training for medical physics techs.
10. Documentation for TheraSphere refresher training for IR physicians and Authorized Users

I think that should cover it but if you have further suggestions or items in your inspection notes, please let us know.

Mahalo,
Dale

RADIATION SAFETY PLAN

THE QUEEN'S MEDICAL CENTER

June 2019

Contents

I. Approvals

A. Management Approval: _____ 06/25/2019
Darlena Chadwick, VP, Patient Care — Date

B. RSO Approval: _____ 6/25/2019
Dale Schippers, Medical Physicist / RSO — Date

C. RSC Approval: _____ 6/17/2019
Frank Goerner, PhD Medical Physicist — Date

D. Effective Date: 7/15/2019

E. Date(s) when staff were trained in the new plan:

PET, Punchbowl (PB)	_____	Cyclotron	_____
Nuclear Medicine, PB	_____	QET 7 Nursing	_____
Nuclear Medicine, West	_____	Angiography	_____
Nuclear Medicine, NHCH	_____		

Must include a copy of previous plan and the changes to this plan.

II. Revision History:

Original plan: most recent plan available appears to be a draft plan and was dated July 2014. It is attached as Appendix C.

This update includes reformatting for clarity with only minor changes or revisions to radiation safety practices. The revisions include:

1. The table of contents added.
2. Frequency of types of audits were added for clarity
3. The introduction now contains a section on how to change the radiation safety plan.
4. Management commitment to ALARA program section was modified. Two paragraphs were removed.
5. High Exposure Level was added to the ALARA levels and each ALARA level was clarified with what actions will be taken.
6. Radiation Safety Officer and Authorized User sections under ALARA were deleted.
7. Dosimetry section was added to clarify the use of radiation badge monitors.
8. Item 17, under Rules for Safe Use of Radiopharmaceuticals was removed.
9. Radiation survey instrument capabilities were clarified in Area survey procedures
10. The training program section was changed to reflect the training that new employees and nursing staff receive. The article that was photocopied into the manual after the training section was deleted.
11. The Radiological Rooms, Radiation Safety Guidelines for Portable x-rays, Lead Apron Evaluation Program and Radioactive Trash In-service sections were removed because these are all addressed in QMC policies.
12. The Radiation Accident Protocol section was removed since the Spill Procedures section was added and covers most of this information.
13. The policies at the end of the radiation safety program were removed since these have all been revised.
14. Survey instrument calibration section was added.
15. Waste disposal section was added.

III. Purpose

A. Providing safe and effective use of radiation for patients, employees, medical staff, and visitors.

IV. Responsibilities

A. Radiation Safety Committee (RSC) – Administers the plan, meets quarterly.
B. Radiation Safety Officer (RSO) – Manages the program, conducts Compliance Audits.
C. Management – Evaluate Annual Review of Program.
D. Employees – Reports any unsafe conditions or events to the RSO.

V. Audits

A. Personnel Monitoring - Quarterly.
B. Radiation Therapy – Quarterly.
C. Nuclear Medicine – Quarterly.
D. Cyclotron - Quarterly
E. Radiology – Annually.

VI. Radiation Safety Program

A. Introduction
    1. It is the policy of The Queen's Medical Center (QMC) that exposures to ionizing radiation are to be kept as low as reasonably achievable (ALARA) to all employees, patients, and visitors to QMC. Toward that end, QMC has established the Radiation Safety Committee (RSC) to oversee the radiation safety practices at QMC. Furthermore, the committee has appointed a Radiation Safety Officer (RSO) to ensure the safe use of radiation. He/she will be responsible for managing the Radiation Safety Program, identifying radiation safety problems, and implementing corrective action when needed. He/she will also be responsible to ensure compliance with the United States Nuclear Regulatory Commission (NRC), State of Hawaii, and The Joint Commission (TJC) requirements.
    2. Sources of radiation include x-ray machines in Radiology, Surgery, and the Dental Clinic, as well as linear accelerators in Radiation Therapy. In Nuclear Medicine, radioactive drugs are used for imaging and treatment. Finally, certain patients on the nursing floors and in angiography are treated with radioactive sources for cancer therapy. The benefits of using

radiation in medicine are great, and this program is designed to minimize the risks.

3. If you have any questions or concerns regarding radiation, please call the RSO at 691-4884 during normal working hours. For urgent requests, he/she can also be contacted through the QMC operator.
4. Changes to Radiation Safety Program
    a) All changes to the Radiation Safety Program must be reviewed and approved in writing by the RSO and management.
    b) Individuals affected by changes to the Radiation Safety Program will be instructed on the revised program before the changes are implemented.
    c) A record of each change to the Radiation Safety Program will be maintained for 5 years. The record will include a copy of the old and new procedures, the effective date of the change, and the signatures of the RSO and management representative that reviewed and approved the change (§ 35.2026).
    d) Any change requiring a license amendment according to 10 CFR 35.13 must be submitted to the Nuclear Regulatory Commission for approval.

B. Duties of the Radiation Safety Committee/Radiation Safety Officer
1. The Radiation Safety Committee shall:
    a) Ensure that licensed material will be used safety. This includes review, as necessary, of training programs, equipment, facility, supplies, and procedures.
    b) Ensure that licensed material is used in compliance with NRC regulations and the institutional license.
    c) Ensure that the use of licensed material is consistent with the ALARA philosophy and program.
    d) Establish a table of investigational levels for individual occupational radiation exposures.
    e) Identify program problems and solutions.
2. Responsibilities of the Radiation Safety Committee include:
    a) Be familiar with all pertinent NRC regulations, the license application, the license, and any and all amendments.
    b) Review the training and experience of the proposed authorized users, the RSO, and the Authorized Medical Physicist to determine that their qualifications are sufficient to enable the individuals to perform their

duties safely and are in accordance with the regulations and the license.

c) Review of the basis of safety and approve or deny, consistent with the limitations of the regulations, the license and the ALARA philosophy, all requests for authorization to use radioactive material within the institution.

d) Prescribe special conditions that will be required during a proposed method of use of radioactive material, such as requirements for bioassays, physical examinations of users, and special monitoring procedures.

e) Review quarterly the RSO's summary report of the occupational radiation exposure records of all personnel, giving attention to individuals or groups of workers whose occupational exposure appears excessive.

f) Establish a program to ensure that all persons whose duties may require them to work in or frequent areas where radioactive materials are used (e.g., Nursing, Security, Housekeeping) are appropriately instructed as required in 19.12 of 10 CFR Part 19.

g) Review at least annually the RSO's summary report of the entire Radiation Safety Program (RSP) to determine that all activities are being conducted safely, in accordance with NRC regulations and the conditions of the license, and consistent with the ALARA program and philosophy. The review must include an examination of records, reports from the RSO, and results of NRC inspections, written safety procedures, and the adequacy of the management control system.

h) Recommend remedial action to correct any deficiencies identified in the RSP.

i) Maintain written minutes of all Committee meetings, including members in attendance and members absent, discussions, actions, recommendations, decisions, and numerical results of all votes taken.

j) Ensure that the byproduct material license is amended, if required, prior to any changes in facilities, equipment, policies and procedures, and personnel.

3. Administrative Information:

a) The Committee shall meet as often as necessary to conduct its business, but not less than once in each calendar quarter (four times yearly).

b) Membership must include one authorized user of each type of use authorized by the license, the RSO, a nursing representative and a

representative of management who is neither an authorized user nor an RSO. Management, and the RSO, may appoint alternate members to participate in meetings in the case of absence of principal members.

c) To establish a quorum, one-half of the Committee's membership, including the RSO and the management representative, must be present.

d) To the extent that they do not interfere with the mission of the Committee, management may assign other responsibilities, such as x-ray radiation safety, quality assurance (QA) oversight, and research project review and approval.

C. ALARA Program

1. Management Commitment

a) We, the management of QMC, are committed to the program described herein for keeping individual and collective doses of radiation as low as reasonably achievable (ALARA). In accordance with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policies, procedures, and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC) and Radiation Safety Officer (RSO).

b) We will perform a formal annual review of the RSP, including ALARA considerations. This will include reviews of operating procedures and past dose records, inspections, etc., and consultations with the Radiation Safety Staff or outside consultants.

2. Radiation Safety Committee

a) Review of Proposed Users and Uses

(1) The RSC will thoroughly review the qualifications of each applicant with respect to the types and quantities of materials and methods of use for which application has been made to ensure that the applicant will be able to take appropriate measure to maintain exposure ALARA.

(2) When considering a new use of byproduct material, the RSC will review the efforts of the applicant to maintain exposure ALARA.

(3) The RSC will ensure that the users justify their procedures and that individual and collective doses of radiation will be ALARA.

(4) The RSC will perform a quarterly review of occupational radiation exposure with particular attention to instances in which the ALARA levels are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an

index of the ALARA Program's quality and to decide if action is warranted when investigational levels are exceeded.

(5) ALARA Levels

	ALARA Level I 10% of MPD	ALARA Level II 30% of MPD	High Exposure Level 1/12 of MPD	Annual Limit (MPD)
Body Dose (DDE /EDE2)	125 mrem/qtr.	375 mrem/qtr.	400 mrem/mth	5 rem
Lens of Eye (LDE)	375 mrem/qtr.	1125 mrem/qtr	1250 mrem/mth	15 rem
Extremities (SDE)	1875 mrem/qtr.	5625 mrem/qtr.	4000 mrem/mth	50 rem
LDE limits per ICRP		150 mrem/qtr		2 rem

(a) ALARA Level I: No investigation is required but the RSO will watch for a trend.

(b) ALARA Level II: The RSO will ask the individual to reply to a High Exposure memo.

(c) High Exposure Level: The RSO will ask the individual to reply to a High Exposure memo.

(6) The RSO will review and record, on NRC Form 5 or equivalent, a summary of personnel monitoring on an annual basis.

VII. Quality Management Program

A. Objective

1. To provide high confidence that byproduct material will be administered as directed by the Authorized User (AU).

B. Requirements

1. Prior to administration, a Written Directive (WD) will be completed and signed by an AU for the following procedures:
   a) Any therapeutic administration of a radiopharmaceutical
   b) Any administration of I-125 or I-131 greater than 30 □Ci
   c) Brachytherapy and High Dose Rate (HDR) procedures
2. Annual Audit to include:
   a) The compliance rate of having a WD prior to administration of a radiopharmaceutical or radiation in those cases where WD is required.
   b) The content of the written directive is as required.
   c) A comparison of what was administered versus what was prescribed in the WD.

VIII. Dosimetry (Personnel Radiation Monitoring).

1. Monitoring of occupational exposure to radiation from licensed and unlicensed radiation sources under licensee control will be supplied and require the use of individual monitoring devices by:
   a) Adults likely to receive greater than 10% of the annual limits in § 20.1201(a) [10% of annual limit is 500 mrem].
   b) Minors likely to receive, in 1 year, from radiation sources external to the body, a deep dose equivalent in excess of 0.1 rem (1 mSv), a lens dose equivalent in excess of 0.15 rem (1.5 mSv), or a shallow dose equivalent to the skin or to the extremities in excess of 0.5 rem (5 mSv);
   c) Declared pregnant women likely to receive during the entire pregnancy, from radiation sources external to the body, a deep dose equivalent in excess of 0.1 rem (1 mSv); and
   d) Individuals entering a high or very high radiation area.
2. All individuals who are likely to receive greater than 5 rem skin dose (10% of skin dose limit) from handling radioactive material will be issued, and are required to wear, a film, TLD, or OSL extremity dosimeter.
3. Prior exposure history will be requested from the most recent employer, when applicable.
4. Staff shall report any lost, damaged, or accidentally exposed badges to the Radiation Safety Officer.
5. Employees and contractors (including physicians) must wear a dosimeter when performing procedures that involve ionizing radiation unless they have documentation to verify that they are not likely to receive greater than 10% of the annual dose limits.
6. In the event that your dosimeter is lost or temporarily displaced you may participate in a procedure involving ionizing radiation but you must report your lost dosimeter and/or lack of dosimeter use to Radiation Safety. The form for this report is included in appendix A.
7. Failure to wear your assigned radiation dosimeter will result in the following disciplinary actions:
   a) Consistent neglect in wearing your dosimeter, as indicated by an unusually low reported exposure relative to your workload, will result in the loss of privileges to work with ionizing radiation. For more information, please see policy *Radiation Badge Monitoring Responsibilities* (RSO-19-101-All).

IX. Procedures for Radiopharmaceuticals and Sealed Sources

A. Rules for Safe Use of Radiopharmaceuticals

1. Wear laboratory coats or other protective clothing at all times in areas where radioactive material is used.
2. Wear disposable gloves at all times while handling radioactive materials.
3. Monitor your hands for contamination in a low-background area with a survey meter either after each procedure or before leaving the area.
4. Use syringe shields for routine preparation of multi-dose vials and administration of radiopharmaceuticals to patients, except in those circumstances in which their use is contraindicated (e.g., recessed veins, infants). In these exceptional cases, consider the use of other protective methods such as remote delivery of the dose (.e.g., through use of a butterfly valve).
5. Do not eat, drink, smoke, or apply cosmetics in any area where radioactive material is stored or used.
6. Do not store food, drink, or personal effects in areas where radioactive material is stored or used.
7. Wear personnel monitoring devices at all times while in areas where radioactive materials are used or stored. These devices should be worn as prescribed by the RSO. When not being worn to monitor occupational exposures, personnel monitoring devices should be stored in the work place in a designated low-background area.
8. Wear a finger exposure monitor during the elution of generators; during the preparation, assay, and injection of radiopharmaceuticals.
9. Dispose of radioactive waste only in designated, labeled, and properly shielded receptacles.
10. Never pipette by mouth.
11. Wipe test by-product storage, preparation, and administration areas weekly for contamination. If necessary, decontaminate or secure the area for decay.
12. With a radiation detection survey meter, survey the generator storage (if applicable), kit preparation, injection areas and trash daily for contamination. If necessary, decontaminate or secure the area for decay, as appropriate.
13. Confine radioactive solutions in shielded containers that are clearly labeled. Radiopharmaceutical multi-dose diagnostic vials and therapy vials should be labeled with the isotope, the amount of the compound, and the date and time of receipt or preparation. A log book or computer software should be used to record the preceding information and total

prepared activity, specific activity as mCi/cc at a specified time, total volume prepared, the measured activity or each patient dosage, and any other appropriate information.

14. Each syringe and vial that contains unsealed byproduct material must be labeled to identify the radioactive drug. Each syringe shield and vial shield must also be labeled unless the label on the syringe or vial is visible when shielded.
15. Assay each patient dosage in the dose calibrator before administering it. Do not use a dosage if it is more than 20 percent off from the prescribed dosage, except for prescribed dosages of less than 1 mCi. When measuring the dosage, you need not consider the radioactivity that adheres to the syringe wall or remains in the needle. Check the patient's name and identification number and the prescribed radionuclide, chemical form, and dosage before administering.
16. Always keep flood sources, syringes, waste, and other radioactive material(s) in shielded containers.

B. Radiation Surveys.

1. Surveys will be performed at the end of each day of use for all radiopharmaceutical elution, preparation, assay and administration areas (except patient rooms should be surveyed at the end of the therapy instead of on the day of administration) when using radiopharmaceuticals requiring a written directive (e.g., all therapy dosages and any iodine-131 dosage exceeding 30 µCi). Special care will be taken to remove all paraphernalia from patient rooms where diagnostic administrations are occasionally made. Patient rooms will not be surveyed.
   Surveys of ambient radiation exposure rates should be performed at the end of each day of use for all radiopharmaceutical elution, preparation, assay and administration areas (excluding patient rooms). Daily surveys are consistent with our ALARA philosophy, Part 20 requirements and will ensure that radioactive material is not inadvertently disposed in the normal trash.
2. All areas where radiopharmaceuticals are eluted, prepared, assayed and administered will be surveyed weekly for ambient radiation exposure rates and for removable contamination.
3. All radiopharmaceutical use, storage and waste storage areas will be surveyed weekly for ambient radiation exposure rates and for removable contamination.

4. All sealed source and brachytherapy source storage areas will be surveyed quarterly for ambient radiation exposure rates.
5. Surveys for ambient exposure rates will be performed with a radiation detection survey instrument able to detect at least 0.05 mR/hour.
6. Surveys for removable contamination will consist of a series of wipes which will be assayed using a procedure sufficiently sensitive to detect 2000 dpm (200 dpm for isotopes of iodine).
7. Survey results greater than the trigger levels (Table R.1 from NUREG 1556 vol9, rev2) will result in decontamination or shielding procedures necessary to reduce the exposure or contamination levels to less than the trigger levels on repeat surveys.

Type of Survey	Area Surveyed	Trigger Level
Ambient Dose Rate	Unrestricted	0.1 mR/hr
Ambient Dose Rate	Restricted	5.0 mR/hr
All trash	All areas	Background

8. A record shall be kept of all survey results. The record will include:
   a) Location, date, and type of equipment used;
   b) Initials of the person conducting the survey;
   c) Drawing of the area surveyed;
   d) Trigger levels keyed to the location on the drawing;
   e) Measured dose rates in mR/hr or contamination levels in dpm/100 cm^2, as appropriate;
   f) Corrective actions taken in case of contamination or excessive exposure rates and reduced contamination levels after corrective action.
9. The RSO will be notified immediately if the trigger levels are exceeded.

C. Procedure for Receiving and Opening Radioactive Packages

1. Packages must be delivered directly to NM or Radiation Therapy and not left in Receiving Department.
2. For all packages containing radioactive materials licensed per 10 CFR 35, the following procedure will be performed.
   a) Put on gloves to prevent hand contamination
   b) Visually inspect the package for any sign of damage (e.g., wet or crushed). If damage is noted, stop the procedure and notify the Radiation Safety Officer (RSO).
   c) Measure the exposure rate at the package surface. The surface exposure rate should not exceed 0.5, 50 and 200 mR/hr for "White I", "Yellow II" and "Yellow III" packages, respectively. If it is higher than

expected, stop and notify the RSO. The Transportation Index (TI) is the radiation level, measured at 1 meter, in Sieverts (TI:

d) Determine the removable contamination level on the exterior of the package. Wipe an area of 300 cm^2 with an absorbent material. The contamination cannot exceed or 173.443:
   (1) 240 dpm/cm^2 for beta and gamma emitters.
   (2) Contamination (in dpm) = cpm / (300 cm^2 x efficiency)
   (3) Use the measured efficiency or 0.10 if unknown.

e) Open the package with the following precautionary steps:
   (1) Remove the packing slip.
   (2) Open the outer package following the supplier's instructions, if provided.
   (3) Open the inner package and verify that the contents agree with the packing slip.
   (4) Check the integrity of the final source container. Look for broken seals or vials, loss of liquids, condensation, or discoloration of the packing material.

f) If there is any reason to suspect contamination, wipe the external surface of the final source container and remove the wipe sample to a low-background area. Assay the wipe sample to determine if there is any removable radioactivity. (It is required that the sample be assayed using a Nal Well Counter, and the results recorded in disintegrations per minute). Take precautions against the potential spread of contamination.

g) Check the user request to ensure that the material received is the material that was ordered.

h) Monitor the packing material and the empty packages for contamination with a radiation detection survey meter before discarding.
   (1) If contaminated, treat this material as radioactive waste.
   (2) If not contaminated, remove or obliterate the radiation labels before discarding in normal trash.

i) Make a record of the receipt. The receipt survey records must be kept on file for three years. The record of receipt (i.e. bill of lading, radiopharmaceutical incoming labels) must be kept as long as the licensee retains possession of the material and for three years following the transfer or disposal of the material.

3. The monitoring required by paragraph (2) shall be performed as soon as practical after receipt of the package, but not later than 3 hours after the package is received at the licensee's facility if it is received during normal working hours, or not later than 3 hours from the beginning of the next working day if it is received after working hours.

D. Survey Instrument Calibration

1. General Requirements

a) Survey instruments, for example GM survey meters, ionization chambers and NaI(Tl) scintillator probes, are required for performing various surveys (see Radiation Surveys). NUREG-1556, Volume 9, Section 8.17, states that the "instruments should be available for use at all times when byproduct material is in use. The licensee should possess survey instruments sufficiently sensitive to measure the type and energy of radiation used, including survey instruments used to locate low-energy or low-activity seeds [e.g., iodine-125 (I-125), palladium-103 (Pd-103)] if they become dislodged in the operating room or patient's room. The Radiation Protection Program that licensees are required to develop, document, and implement in accordance with NRC 10 CFR 20.1101 must include provisions for survey instrument calibration. Instruments used for quantitative radiation measurements must be calibrated for the radiation measured." The NRC in NRC 10 CFR 35.61 requires the "calibration of survey instruments used to show compliance with NRC 10 CFR 35 and NRC 10 CFR 20 before first use, annually, and following a repair that affects the calibration." (Battery changes are not considered "servicing.")

2. Calibrating Survey Instruments

a) Survey meters used for quantitative measurements will be calibrated on an annual basis using the services provided by calibration laboratories, a survey instrument vendor or a consultant.

b) An alternative method to perform calibration of our own survey instruments, may be used, as discussed by Pat Zanzonico in a 2008 Journal of Nuclear Medicine review article. Further information is available in NUREG-1556, Volume 9, Section 8.17 and Appendix K. Note that the NRC states that, as an operational check, each day before use perform a check (with a dedicated check source) as well as a battery check. A record of each survey instrument calibration must be retained for three years in accordance with NRC 10 CFR 35.2061.

E. Waste Disposal

1. The purpose of this procedure is to assure that all radioactive waste is disposed of within the guidelines of the Nuclear Regulatory Commission and State rules and standards.
2. Radioactive Waste will include the following items:
-radiopharmaceutical vials, syringes, needles, tubing, connectors, pipettes, and any other items that may be contaminated.
3. Radioactive waste storage and disposal must include the following documentation:
    a) Date item or container was placed in storage
    b) Date of the disposal, the survey instrument used, the background radiation level, the radiation level measured at the surface of each waste container, and the name of the individual who performed the survey.
4. Sharps containers will be used to collect the radioactive waste. Large items that cannot be placed into a Sharp's container will be placed into a doubled lined plastic (biohazard for human byproducts) bag.
5. When the Sharp's container is filled to the recommended limit (biohazard bags are full), the container (bag) will be closed securely. Each container will be labeled with a "radioactive materials" tag, which will have survey date, type of isotope, and initials of the surveyor. Report all abnormal/hazardous situations immediately to the RSO and manager of the nuclear medicine department.
6. All containers will be placed into a holding Pb (lead) lined box in the Waste Storage room. Report all abnormal/hazardous material to the RSO and Senior Nuclear Medicine Technologist.
7. All byproduct material with a physical half-life of less than or equal to 120 days can be disposed in the normal trash following decay-in-storage if:
    a) Survey at the surface demonstrates that its radioactivity cannot be distinguished from the background radiation level when monitored with an appropriate radiation detection survey meter set on its most sensitive scale and with no interposed shielding; and
    b) All radiation labels, except for radiation labels on materials that are within containers and that will be managed as biomedical are removed or obliterated.
8. Storage and disposal records of all radioactive waste will be maintained for 3 years following disposal.

F. Spill Procedures

1. Contamination control is the responsibility of every individual using radioactive material. Proper preparation based on its physical state, drip pans, splash guards, backed absorbent paper and similar inexpensive provisions greatly reduce the need for decontamination. Well-channeled ventilation, good housekeeping, and frequent use of survey meters are investments which will be well repaid.
2. Minor Contamination Events
   a) Minor contamination events are those events typically identified through routine surveys that involve removable contamination levels greater than the action limit, but less than ten times the action limit.
   b) Minor contamination events can be easily decontaminated without the need for strict adherence to a step-by-step procedure.
   c) Minor contamination events require judgment on the part of the individuals responding to determine the scope and extent of the contamination and to assess their ability to respond effectively.
   d) In order to prevent the spread of contamination, coworkers should be notified if decontamination of the area will be delayed.
   e) Notification of the RSO is not required.
3. Spilled activity that exceeds the values listed in this table should be considered a Major Spill (NUREG 1556 vol 9 rev 2 & draft rev 3).

F-18	100 mCi		In-111	10 mCi		Lu-177	1 mCi
Ga-67	10 mCi		Lu-177	1 mCi		Ra-223	*
I-123	10 mCi		P-32	1 mCi		Y-90	10 mCi
I-125	1 mCi		Tc-99m	100 mCi			
I-131	1 mCi		Tl-201	100 mCi			

* any spill of isotopes that are primarily alpha emitters should be major

4. The Radiation Safety Office should be notified as soon as possible whenever a spill (major or minor) occurs.
   Meanwhile, the primary considerations are:
   a) Prevent spread of contamination. If liquid spill, use absorbent material to prevent flow and seal cracks in floor, workbench, etc. Use decontamination solution (e.g. radiac wash) and wipe the contaminated area with absorbent material. If airborne, close windows, doors, vents, turn off ventilation, seal doors with masking tape.
   b) Post radiation warning signs and allow no one to enter contaminated area unaware.
   c) Decontaminate personnel using the following steps:

(1) Surface contamination - Persons splashed with active solutions should wash immediately with ample quantities of water. A mild soap should be used for a "surgical scrub" with light brushing. If the body contamination after this scrubbing remains more than two times background, the laboratory supervisor and the Radiation Safety Officer must be notified so that further steps can be taken.

(2) Internal contamination (ingestion) - Any radioactive material swallowed should be evaluated immediately by the Radiation Safety Officer and a physician knowledgeable in radiation safety, e.g., a nuclear medicine physician.

d) The Radiation Safety Office must be notified and may render assistance in decontamination. All personnel affected will be monitored and shall follow the recommendations regarding decontamination.

5. A complete history of the spill and subsequent remedial or protective measures must be submitted to the Radiation Safety Office via a Spill Report (Appendix B).

X. Personnel Protection

See the following policies available at The Queen's Medical Center intranet, eww.queens.org/RadTx/policies.html

A. Radiation Safety Guidelines Regarding Personnel Monitoring. RSO-19-101-All

B. Radiation Safety Guidelines for Fetal Protection

XI. Training

A. Annual General In-service to QMC Staff.

B. Initial Training for New Employees working with radiation may include the following as applicable

1. Review Dosimetry Requirements as listed in section VII.
2. Review policies for procedures that require a Written Directive
3. Review Personnel Protection policies listed in section IX.
4. A training checklist will be used to document initial radiation safety training. The checklist must be signed by the employee and approved by the RSO.

C. Specific Instructions

1. Nursing

a) Initial and annual radiation safety instruction will be provided to personnel caring for patients who cannot be released under § 35.75. The instruction will be commensurate with the nurse's duties and include (§ 35.310):
   (1) Patient or human research subject control;
   (2) Visitor control, including—
      (a) Visitation to hospitalized individuals will be limited in an effort to maintain the public dose to < 100 mrem (§ 20.1301)
      (b) In special cases, the dose to the public may exceed 100 mrem, but must be < 500 mrem. The Authorized User must determine that the visit is appropriate;
   (3) Contamination control;
   (4) Waste control; and
   (5) Notification of the Radiation Safety Officer, or his or her designee, and an authorized user if the patient or the human research subject has a medical emergency or dies.

2. Nuclear Medicine
   a) Initial and annual radiation safety instruction will be provided and cover the training requirements in 10 CFR 19.12, 20 and 35.
3. Radiation Therapy
   a) Emergency procedures for High Dose Rate brachytherapy
   b) Radiation Safety for brachytherapy

In the event that your dosimeter is lost or temporarily displaced you may participate in a procedure involving ionizing radiation only if another person is unable to take your place and you report the details of the procedure to the RSO within 3 days.

Also, if your dosimeter is not returned to Radiation Safety within 60 days of the end wear date, the RSO will estimate your exposure from your, or similar users, dose history. To properly assign the dose, we need the information requested below. If you have any questions contact the RSO at 691-4884.
Complete this form and return via email or inter-department mail to:

Dale Schippers, RSO
Nae'a - Radiation Therapy Department or dschippers@queens.org

Last Name	First Name

Department/Series Code:	phone / ext.

Begin Wear Date: _____ (or first use date)

End Wear Date: _____ (date badge was lost)

Type of badge: [Body]  [Ring]  [Other] _____

Briefly describe your duties around radiation sources.

Were there any circumstances during the period which might have caused an increase or decrease in your typical reading? (i.e. Unusually high workload, vacation/sick days off)

_____ _____
Signature Date

Radiation Safety Use Only Date:

Name: _____ Series Code: _____ Badge # _____

Previous exposure reading (mrem)

MONTH					
DDE					
LDE					
SDE					

Spare Badge Assigned?
Yes / No

millirem to be assigned: DDE _____ LDE _____ SDE _____

_____ _____
Radiation Safety Officer Date

QUEEN'S MEDICAL CENTER

INFORMATION AND RESPONSIBILITIES FOR BADGED RADIATION WORKERS

(Do not return with badge application – please keep for your record.)

Radiation Monitoring Badges Are Required to be worn if you are exposed to more than 10% of the annual dose limit for radiation workers. The Radiation Safety Officer (RSO) will help you determine whether or not you are required to wear a radiation monitoring badge.

If the RSO determines that you are required to wear a radiation monitoring badge, it is MANDATORY that you wear the badge when you work with or around radiation. If the RSO determines that you are not regularly wearing your radiation badge when working with or around radiation, the following disciplinary action will result:

- Consistent neglect in wearing your dosimeter, as indicated by an unusually low reported exposure relative to your workload, will result in the loss of privileges to work with ionizing radiation. Consistent neglect is defined as 3 months of unexplained low exposures, relative to workload, in a 12 month period.

It is important that you wear your radiation monitoring badge for the following reasons:

1. **For your own safety related to radiation.**
   Exposure data will help the radiation safety office to better determine if the work environment you are in protects you from unnecessary radiation and if you are using radiation safely and adhering to ALARA.
2. **For the safety of your co-workers.**
   Your radiation exposure data can be helpful in estimating the exposure for other staff in the room.
3. **For the safety of patients.**
   Your radiation exposure can be an indication of the radiation the patient received and if the user is consistently using radiation in the safest manner possible.
4. **It's a requirement of Federal, State and regulatory agencies.**

Radiation Badge Monitoring Wearer's Responsibility Code:

I understand that in conjunction with my application submission for and issuance of a personnel radiation monitoring badge, I will comply with the following:

- Wear my badge whenever I am working in the vicinity of radiation or with radioactive material
- Return my old badge at the end of the wear period
- Wear my badge according to the appropriate type:
  1. Collar Badge – wear on collar, outside of lead apron (if a lead apron is worn)
  2. Waist Badge – wear on waist, underneath lead apron (if a lead apron is worn)
     If assigned a collar and waist badge, the waist badge must be worn underneath lead apron
  3. Fetal Badge – wear low in center of abdomen, underneath lead apron
     The fetal badge will be exchanged monthly, even if your chest badge is exchanged quarterly
     Note: Pregnant radiation workers should review the Declared Pregnant Worker information.
  4. Ring Badge – wear on dominant hand, under gloves, facing source of radiation
- The badge reading is a legal record and must reflect occupational exposure only:
  - Badge shall be worn only by the person to whom it was assigned
  - Badge shall not be worn during exposure I receive as a medical patient
  - Badge shall not be worn at institutions outside of The Queen's Medical Center
- If I lose my badge, I will report it on the Lost Dosimeter Form and request a replacement
- Failure to return my badge when it is due may result in disciplinary action
- Know and adhere to the Radiation Safety Program Manual and any associated policies and procedures specific to radiation safety that are applicable to my work, including 10 CFR 19.12 training requirements.

Radioactive Spill Report

Enter values in all red cells

THE QUEEN'S MEDICAL CENTER
HONOLULU, HAWAII

Date of spill:	
Time of spill:	

Personnel Present	contamination results (items)

Radioisotopes present or suspected in spill		
Isotope: F-18	Activity:	Minor Spill

Description of the event

Follow up actions taken

Person recording form:	

Contamination Results

Meter used:	Select a counter from dropdown

Location description	Pre-clean survey	Post clean		
		survey	wipe test	
			cpm	dpm
			cpm	dpm
			cpm	dpm
			cpm	dpm
			cpm	dpm
			cpm	dpm
			cpm	dpm
			cpm	dpm
			cpm	dpm

RADIATION SAFETY PLAN

THE QUEEN'S MEDICAL CENTER

1301 Punchbowl Street

Honolulu, HI 96813

and

91-2135 Fort Weaver Road

Ewa Beach, HI 96706

July 2014

RADIATION SAFETY PLAN

1. Purpose

   Providing safe and effective use of radiation for patients, employees, medical/dental staff, and visitors.

2. Responsibilities

   2.1. Radiation Safety Committee (RSC) – Administers the plan, meets quarterly.

   2.2. Radiation Safety Officer (RSO) – Manages the program, conducts Compliance Audits.

   2.3. Management – Conducts Annual Review of Program.

   2.4. Employees – Reports any unsafe conditions or events to the RSO.

3. Compliance Audit Frequency

   3.1. Personnel Monitoring - Monthly.
   3.2. Radiation Therapy – Monthly.
   3.3. Nuclear Medicine – Quarterly.
   3.4. Brachytherapy – Quarterly.
   3.5. Radiology – Annually.

4. Records

   4.1. Audits, Records, References, RSC Meeting Minutes.
   4.2. Aforementioned records maintained in Radiation Safety Office.

5. The Queen's Medical Center's (QMC's) References

   5.1. Nuclear Regulatory Commission (NCR) License No. 52-16533-02.
   5.2. Quality Assurance Plan for Radiation Oncology.
   5.3. Quality Assurance Plan for Radiology.
   5.4. Quality Assurance Plan for Nuclear Medicine.
   5.5. QMC's Radiation Safety Manual.

6. Published References

6.1. 10 CFR Parts 19, 20, and 35.

6.2. National Council on Radiation Protection & Measurements (NCRP) Report Nos. 49, 51, 102, and 147.

6.3. The Joint Commission, *Hospital Accreditation Standards* (most recent edition).

7. Plan Features

7.1. Radiation Safety Program

7.1.1. QMC Policy.
7.1.2. Radiation Safety Committee Charter dated September 1994 (attached).
7.1.3. ALARA Program.
7.1.4. Reporting.

7.2. Radiology

7.2.1. Annual Calibration of X-ray-producing Equipment.
7.2.2. Annual Evaluation of Patient Dosimetry.
7.2.3. Acceptance Testing of New Equipment.

7.3. Nuclear Medicine

7.3.1. Radioisotope Management.
7.3.2. Radiation Control Surveys.

7.4. Teletherapy

7.4.1. Initial and Weekly Verification of Patient Dosimetry.
7.4.2. Monthly Evaluation of Radiation-producing Equipment.
7.4.3. Annual Calibration of Radiation-producing Equipment.

7.5. Brachytherapy

7.5.1. Sealed Source Maintenance.
7.5.2. Monitoring of Radiation Levels.
7.5.3. Guidelines for Visitors.

7.6. Emergency

7.6.1. Radiation Accident Protocol.
7.6.2. Radiation Exposure/Emergency Procedures.

7.7. Personnel Protection

7.7.1. Guidelines for Personnel Monitoring.
7.7.2. Guidelines for Fetal Protection.
7.7.3. Guidelines for Portable X-rays.

7.8. Training

7.8.1. Annual General Inservice to QMC Staff.
7.8.2. Specific Instructions for Departments: Nursing, Radiation Therapy, Imaging.

7.9. Facilities

7.9.1. Shielding Design for New Installations.
7.9.2. Barrier Surveys for New Installations.
7.9.3. Nuclear Medicine Ventilation Surveys.

7.10. Ancillary Departments

7.10.1. Surgery.
7.10.2. Dental Clinic.

7.11. Waste Management

RADIATION SAFETY PROGRAM

It is the policy of The Queen's Medical Center (QMC) that exposures to ionizing radiation are to be kept as low as reasonably achievable (ALARA) to all employees, patients, and visitors to QMC. Toward that end, QMC has established the Radiation Safety Committee (RSC) to oversee the radiation safety practices at QMC. Furthermore, the committee has appointed a Radiation Safety Officer (RSO) to ensure the safe use of radiation. The RSO will be responsible for managing the Radiation Safety Program, identifying radiation safety problems, and implementing corrective action when needed. The RSO will also be responsible to ensure compliance with the United States Nuclear Regulatory Commission (NRC), State of Hawaii, and The Joint Commission (TJC) requirements.

Sources of radiation include x-ray machines in Radiology, Surgery, and the Dental Clinic, as well as higher x-ray machines in Radiation Therapy. In Nuclear Medicine, radioactive drugs are used to image the body. Finally, certain patients on the nursing floors are treated with radioactive sources for cancer therapy. The benefits of using radiation in medicine are great, and the risk associated with the low doses now possible is minimal.

If you have any questions or concerns regarding radiation, please call the RSO at 691-4884 during normal working hours; the RSO is always "on call" through the QMC operator.

Duties of the Radiation Safety Committee/Radiation Safety Officer

1. Radiation Safety Committee Charter

    1.1. Charge – The Committee shall:

        1.1.1. Ensure that licensed material will be used safety. This includes review, as necessary, of training programs, equipment, facility, supplies, and procedures.

        1.1.2. Ensure that licensed material is used in compliance with NRC regulations and the institutional license.

        1.1.3. Ensure that the use of licensed material is consistent with the ALARA philosophy and program.

        1.1.4. Establish a table of investigational levels for individual occupational radiation exposures.

        1.1.5. Identify program problems and solutions.

    1.2. Responsibilities – The Committee shall:

        1.2.1. Be familiar with all pertinent NRC regulations, the license application, the license, and any and all amendments.

        1.2.2. Review the training and experience of the proposed authorized users, the RSO, and the teletherapy physicist to determine that their qualifications are sufficient to enable the individuals to perform their duties safely and are in accordance with the regulations and the license.

        1.2.3. Review of the basis of safety and approve or deny, consistent with the limitations of the regulations, the license, and the ALARA philosophy, all requests for authorization to use radioactive material within the institution.

        1.2.4. Prescribe special conditions that will be required during a proposed method of use of radioactive material, such as requirements for bioassays, physical examinations of users, and special monitoring procedures.

        1.2.5. Review quarterly the RSO's summary report of the occupational radiation exposure records of all personnel, giving attention to individuals or groups of workers whose occupational exposure appears excessive.

1.2.6. Establish a program to ensure that all persons whose duties may require them to work in or frequent areas where radioactive materials are used (*e.g.*, Nursing, Security, Housekeeping) are appropriately instructed as required in 19.12 of 10 CFR Part 19.

1.2.7. Review, at least annually, the RSO's summary report of the entire Radiation Safety Program (RSP) to determine that all activities are being conducted safely, in accordance with NRC regulations and the conditions of the license, and consistent with the ALARA program and philosophy. The review must include an examination of records, reports from the RSO, and results of NRC inspections, written safety procedures, and the adequacy of the management control system.

1.2.8. Recommend remedial action to correct any deficiencies identified in the RSP.

1.2.9. Maintain written minutes of all Committee meetings, including members in attendance and members absent, discussions, actions, recommendations, decisions, and numerical results of all votes taken.

1.2.10. Ensure that the byproduct material license is amended, if required, prior to any changes in facilities, equipment, policies and procedures, and personnel.

2. Radiation Safety Committee Administrative Information:

2.1. The Committee shall meet as often as necessary to conduct its business, but not less than once in each calendar quarter (four times yearly).

2.2. Membership must include one authorized user of each type of use authorized by the license, the RSO, a representative of the Nursing service, and a representative of management who is neither an authorized user nor the RSO. Management may appoint alternate members to participate in meetings in the case of absence of principal members, and should consider appointing as adjunct members representatives from Security, Housekeeping, and other departments. (Adjunct members should abstain from balloting on radiation safety technical questions, such as Items 2 through 5 in the "Responsibilities" section above.)

2.3. To establish a quorum, one-half of the Committee's membership, including the RSO and the management representative, must be present.

2.4. To the extent that they do not interfere with the mission of the Committee, management may assign other responsibilities, such as x-ray radiation safety, quality assurance (QA) oversight, and research project review and approval.

ALARA PROGRAM

1. Management Commitment

    1.1. We, the management of QMC, are committed to the program described herein for keeping individual and collective doses of radiation as low as reasonably achievable (ALARA). In accordance with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policies, procedures, and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC) and Radiation Safety Officer (RSO).

    1.2. We will perform a formal annual review of the RSP, including ALARA considerations. This will include reviews of operating procedures and past dose records, inspections, etc., and consultations with the Radiation Safety Staff or outside consultants.

    1.3. Modifications to operating and maintenance procedures and to equipment and facilities will be made if they will reduce exposures unless the cost, in our judgment, is considered to be unjustified. We will be able to demonstrate, if necessary, which improvements have been sought, that modifications have been considered, and that they have been implemented when reasonable. If modifications have been recommended, but not implemented, we will be prepared to describe the reasons for not implementing them.

    1.4. In addition to maintaining doses to individuals as far below the limits as is reasonably achievable, the sum of the doses to individuals received by all exposed individuals will also be maintained at the lowest practicable level. It would not be desirable, for example, to hold the highest doses to individuals to some fraction of the applicable limit if this involved exposing additional people and significantly increasing the sum of radiation doses received by all involved individuals.

2. Radiation Safety Committee

    2.1. Review of Proposed Users and Uses

        2.1.1. The RSC will thoroughly review the qualifications of each applicant with respect to the types and quantities of materials and methods of use for which application has been made to ensure that the applicant will be able to take appropriate measure to maintain exposure ALARA.

2.1.2. When considering a new use of byproduct material, the RSC will review the efforts of the applicant to maintain exposure ALARA.

2.1.3. The RSC will ensure that the users justify their procedures and that individual and collective doses of radiation will be ALARA.

2.2. Delegation of Authority

(The judicious delegation of the RSC authority is essential to the enforcement of an ALARA Program.)

2.2.1. The RSC will delegate authority to the RSO for enforcement of the ALARA concept.

2.2.2. The RSC will support the RSO when it is necessary for the RSO to assert authority. If the RSC has overruled the RSO, it will record the basis of its action in the minutes of the quarterly meeting.

2.3. Review of the ALARA Program

2.3.1. The RSC will encourage all users to review current policies and procedures and initiate any revisions, as appropriate, to support the ALARA principle.

2.3.2. The RSC will perform a quarterly review of occupational radiation exposure with particular attention to instances in which the investigational levels in Table 1 (below) are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA Program's quality and to decide if action is warranted when investigational levels are exceeded (see Item #6, "Establishment of Investigational Levels in Order to Monitor Individual Occupational External Radiation Doses," below).

TABLE 1
INVESTIGATIONAL LEVELS

	Investigational Levels (mrems per calendar quarter)	
	Level I	**Level II**
1. Whole body, head and trunk	125	375
2. Hands and forearms; feet and ankles	1250	3750

2.3.3. The RSC will evaluate our institution's overall efforts for maintaining doses ALARA on an annual basis. This review will include the efforts of the RSO, authorized users, and workers as well as those of management.

3. Radiation Safety Officer

3.1. Annual and Quarterly Review

3.1.1. Annual Review of the RSP – The RSO will perform an annual review of the RSP for adherence to the ALARA concept. Reviews of specific methods of use may be conducted on a more frequent basis.

3.1.2. Quarterly Review of Occupational Exposures – The RSO will review, at least quarterly, the external radiation doses of authorized users and workers to determine that their doses are ALARA in accordance with the provisions of Item #6, "Establishment of Investigational Levels in Order to Monitor Individual Occupational External Radiation Doses," (below) of this program and will prepare a summary report for the RSC.

3.1.3. Quarterly Review of Records of Radiation Surveys – The RSO will review radiation surveys in unrestricted and restricted areas to determine that dose rates and amounts of contamination were at ALARA levels during the previous quarter and will prepare a summary report for the RSC.

3.2. Education Responsibilities for the ALARA Program

3.2.1. As needed, the RSO will schedule briefings and educational sessions to inform workers of the ALARA Program efforts.

3.2.2. The RSO will ensure that authorized users, workers, and ancillary personnel who may be exposed to radiation be instructed in the ALARA philosophy and informed that management, the RSC, and the RSO are committed to implementing the ALARA concept.

3.3. Cooperative Efforts for Development of ALARA Procedures

Radiation workers will be given opportunities to participate in formulating the procedures that they will be required to follow.

3.3.1. The RSO will be available to all users and workers in order to discuss, develop, or review ALARA procedures for working with radioactive materials.

3.3.2. As needed, the RSO will establish procedures for receiving and evaluating the suggestions of individual workers for improving health physics practices and will encourage the use of those procedures.

4. Authorized Users

4.1. New Methods of Use Involving Potential Radiation Doses

4.1.1. The authorized user will consult with the RSO and/or RSC during the planning stage before using radioactive material for new uses.

4.1.2. The authorized user will review each planned use of radioactive materials to ensure that doses will be kept ALARA. Trials runs may be helpful.

4.2. Authorized User's Responsibility to Supervised Individuals

4.2.1. The authorized user will explain the ALARA concept and the need to maintain exposures ALARA to all supervised individuals.

4.2.2. The authorized user will ensure that supervised individuals who are subjects to occupational radiation exposure are trained and educated in good health physics practices and in maintaining ALARA.

5. Individuals Who Receive Occupational Radiation Doses

5.1. Workers will be instructed in the ALARA concept and its relationship to work procedures and work conditions.

5.2. Workers will be instructed in recourses available if they feel that ALARA is not being promoted on the job.

6. Establishment of Investigational Trigger Levels in Order to Monitor Individual Occupational External Radiation Doses

This institution hereby establishes investigational levels for occupational external radiation doses, which, when exceeded, will initiate review or investigation by the RSC and/or RSO. The investigational levels that we have adopted are listed in Table 1 (above). These levels apply to the occupational exposure of individual workers.

The RSO will review and record, on Form NRC-5, "Current Occupational External Radiation Exposures," or an equivalent form (*e.g.*, dosimeter processor's report) results of personnel monitoring not less than once in any calendar quarter as required by 10 CFR Part 20. The following actions will be taken at the investigational levels as stated in Table 1.

6.1. Personnel Dose Less Than ALARA Level 1

Except where deemed appropriate by the RSO, no further action will be taken in those cases where an individual's occupational dose is less than Table 1 values for ALARA Level 1.

6.2. Personnel Dose Equal To or Greater Than ALARA Level 1, But Less Than ALARA Level 2

The RSO will review the dose of each occupational quarterly dose that equals or exceeds the ALARA Level 1 trigger and will report the results of the reviews at the first RSC meeting following the quarter when the dose was recorded. If the dose does not equal or exceed ALARA Level 2, no action related specifically to the exposure is required unless deemed appropriate by the RSC. The RSC will, however, review each such dose in comparison with those of others performing similar tasks as an index of ALARA program quality and will record the review in the RSC meeting minutes.

6.3. Personnel Doses Equal To or Greater Than ALARA Trigger Level 2

The RSO will investigate in a timely manner the causes of all occupational doses equaling or exceeding Investigational Level II and, if warranted, will take action. A report of the investigation, any actions taken, and a copy of the individual's Form NRC-5, or its equivalent, will be presented to the RSC at its first meeting following completion of the investigation. The details of these reports will be included in the RSC meeting minutes.

6.4. Re-Establishment of ALARA Trigger Levels Above Those Listed In Table 1

In cases where a worker's or a new group of workers' doses need to exceed an investigational trigger level, a new, higher trigger level may be established for that individual or group on the basis that it is consistent with good ALARA practices. Justification for new trigger levels will be documented.

The RSC will review the justification for and must approve or disapprove all revisions of investigational trigger levels.

ORDERING AND RECEIVING RADIOACTIVE MATERIALS

1. The Radiation Safety Officer (RSO), Radiological Physicist, Medical Dosimetrist, or Nuclear Medicine Technologist must authorize each order for radioactive materials and ensure that the requested materials and quantities are authorized by the license for use by the requesting authorized user and that possession limits are not exceeded.

2. The RSO will establish and maintain a system for ordering and receiving radioactive materials. The system must contain the following information:

    2.1. For Routinely Used Materials

        2.1.1. Written records that identify the authorized user or department, isotope, chemical form, activity, and supplier will be made.

        2.1.2. The above records will be checked to confirm that material(s) received was ordered through proper channels.

    2.2. For Occasionally Used Materials (*e.g.*, therapeutic dosages)

        2.2.1. The authorized user who will perform the procedure will make a written request that indicates the isotope, radiopharmaceutical, activity, and supplier.

        2.2.2. The person who receives the material will check the physician's written request to confirm that the material received is what was ordered.

3. For deliveries during normal working hours, the RSO will tell carriers to deliver radioactive packages directly to a specified area.

4. For deliveries during off-duty hours, the RSO will tell Security personnel to accept delivery of radioactive packages in accordance with procedures outlined in the sample memorandum (attached).

Model Procedures for Ordering and Receiving Packages

This model provides acceptable procedures for ordering and receiving packages containing licensed material. As a result of the EPAct, licensed materials now include accelerator-produced radioactive materials and discrete sources of radium-226. A medical use applicant that requests authorization for the production and noncommercial transfer of PET radioactive drugs may need to supplement these model procedures by developing procedures for filling orders for these drugs from other consortium members, to meet the requirements in 10 CFR 30.41, 30.32(j), and 30.34(j).

Applicants may either adopt this model or develop alternative procedures.

Model Guidance

- Authorize, through a designee (e.g., RSO), each order of radioactive materials, including orders of accelerator-produced radioactive materials and discrete sources of radium-226, and ensure that the requested materials and quantities are authorized by the license for use by the requesting AU and that possession limits are not exceeded.
- Establish and maintain a system for ordering and receiving radioactive material; include the following information:
  - Records that identify the AU or department, radionuclide, physical and/or chemical form, activity, and supplier;
  - Confirmation, through the above records, that material received was ordered through proper channels.
  - When ordering PET radioactive drugs produced under 10 CFR 30.32(j), confirm that the medical use licensee is a member of the consortium.
- For deliveries during normal working hours, tell carriers to deliver radioactive packages directly to a specified area.
- For deliveries during off-duty hours, tell security personnel or other designated persons to accept delivery of radioactive packages in accordance with procedures outlined in the sample memorandum for delivery of packages to the Nuclear Medicine Division, provided below. Develop a similar memorandum for delivery of packages to other divisions.

(on QMC memorandum form)

Date

TO: Chief of Security

FROM: Radiation Safety Officer

SUBJECT: Receipt of Packages Containing Radioactive Material

The security guard on duty will accept delivery of radioactive material that arrives outside normal working hours. Packages will be taken immediately to the Nuclear Medicine Division, Room _____. Unlock the door, place the package on top of the counter, and relock the door.

crichards 4/18/14 1:53 PM
Comment [1]: Location for West Oahu deliveries?

If the package appears to be damaged, immediately contact one of the individuals identified below. Ask the carrier to remain at QMC until it can be determined that neither the driver nor the delivery vehicle is contaminated.

If you have any questions concerning this memorandum, please call our Radiation Safety Officer at 691-4884.

	Name	**Cell/Home Telephone**
Radiation Safety Officer		
Director, Nuclear Medicine		
Nuclear Medicine Technologist Supervisor		
Nuclear Medicine Technologist On Call (call/page Operator at ext. _____)		
Nuclear Medicine Physician On Call (call/page Operator at ext. _____)		

RULES FOR SAFE USE OF RADIOPHARMACEUTICALS

1. Wear laboratory coats or other protective clothing at all times when working with radioactive materials.

2. Wear disposable gloves at all times while handling radioactive materials.

3. Monitor your hands for contamination in a low-background area with a radiation survey meter, crystal probe or camera either after each procedure or before leaving the area.

4. Use syringe shields for routine preparation of multi-dose vials and administration of radiopharmaceuticals to patients, except in those circumstances in which their use is contraindicated (*e.g.*, recessed veins, infants). In these exceptional cases, consider the use of other protective methods such as remote delivery of the dose (*.e.g.*, through use of a butterfly infusion set).

5. **Do not** eat, drink, smoke, or apply cosmetics in any area where radioactive material is stored or used.

6. **Do not** store food, drinks, or personal effects in areas where radioactive material is stored or used.

7. Wear personnel monitoring devices at all times while in areas where radioactive materials are used or stored. These devices should be worn as prescribed by the Radiation Safety Officer. When not being worn to monitor occupational exposures, personnel monitoring devices should be stored in the work place in a designated low-background area.

8. Wear a finger exposure monitor during the elution of generators; during the preparation, assay, and injection of radiopharmaceuticals; and when holding patients during procedures.

9. Dispose of radioactive waste only in designated, labeled, and properly shielded receptacles.

10. Never pipette by mouth.

11. Wipe test radioactive materials storage, preparation, and administration areas weekly for contamination. If necessary, decontaminate or secure the area for decay.

12. On a daily basis, use a radiation detection survey meter to survey generator storage, kit preparation, and radiopharmaceutical injection areas for contamination. If necessary, decontaminate or secure the area for decay, as appropriate.

13. Confine radioactive solutions in shielded containers that are clearly labeled. Radiopharmaceutical multi-dose diagnostic vials and therapy vials should be labeled with the isotope, the amount of the compound, and the date and time of receipt or preparation. A log book should be used to record the preceding information and total prepared activity, specific activity as mCi/cc at a specified time, total volume prepared, the measured activity or each patient dosage, and any other appropriate information.

14. Each syringe or its shield shall be labeled with the radiopharmaceutical name (or its abbreviation) and the clinical procedure to be performed, OR the patient's name.

15. Assay each patient dosage in the dose calibrator before administering it. Do not use a dosage if it is more than 10 percent off from the prescribed dosage, except for prescribed dosages of less than 10 mCi. When measuring the dosage, you need not consider the radioactivity that adheres to the syringe wall or remains in the needle. Check the patient's name and identification number and the prescribed radionuclide, chemical form, and dosage before administering.

16. Always keep flood sources, syringes, waste, and other radioactive material(s) in shielded containers.

17. Because even sources with small amounts of radioactivity exhibit a high dose rate on contact, you should use a cart or wheelchair to move flood sources, waste, and other radioactive material(s).

REFERENCES

1. Policy & Procedure #RSO-xx-101-B, *Radiation Safety Guidelines Regarding Personnel Monitoring*.

2. Policy & Procedure #RSO-xx-115-B, *Radiation Badge Report Action Levels*.

3. Policy & Procedure #RSO-xx-300-B, *Radioactive Materials Disposal Procedures*.

AREA SURVEY PROCEDURES

1. Ambient Dose Rate Surveys

    1.1. Survey Areas and Schedule

        1.1.1. At the end of each day of use, perform an ambient radiation dose level survey with a radiation detection meter in all areas of radiopharmaceutical elution, preparation, and administration. If diagnostic administrations are occasionally made in patients' rooms and special care is taken to remove all paraphernalia, those rooms need not be surveyed.

        1.1.2. On a weekly basis, perform an ambient radiation dose level survey with a radiation detection meter in all areas of radiopharmaceutical dose storage and radioactive waste.

        1.1.3. On a monthly basis, perform an ambient radiation dose level survey with a radiation detection meter in laboratory areas where gamma-emitting radioactive materials are processed (less than 200 microcuries at any single time).

        1.1.4. On a quarterly basis, perform an ambient radiation dose level survey with a radiation detection meter in sealed source and brachytherapy storage areas.

    1.2. Immediately notify the RSO in those cases in which the trigger level is exceeded.

2. Removable Contamination Surveys

    2.1. Survey Areas and Schedule

        2.1.1. On a weekly basis, perform removable contamination surveys by wipe sample assay in all areas of radiopharmaceutical use and storage (e.g. elution, dose preparation, dose administration, and waste storage). If diagnostic administrations are occasionally done in patients' rooms and special care is taken to remove all paraphernalia, those rooms need not be surveyed.

        2.1.2. On a monthly basis, perform removable contamination surveys by wipe sample assay in laboratory areas where gamma-emitting radioactive materials are processed (less than 200 microcuries at any single time).

2.2. The wipe sample assay procedure should be sufficiently sensitive to detect the presence of 200 dpm/100 sq cm of removable contamination. A radioactive reference source with a known amount of activity must be used to convert sample assays (usually in counts per minute or cpm) to disintegrations per minute or dpm.

2.3. Immediately notify the RSO in those cases in which the removable contamination trigger level is exceeded.

3. Records

3.1. Keep a record of dose rate and contamination survey results. It must include the following information:

3.1.1. The date, area surveyed, and equipment used.

3.1.2. The name or initials of the person who made the survey.

3.1.3. A drawing of the areas surveyed with contamination and the trigger levels as established by the RSO.

3.1.4. Measured dose rates in mR/hr or contamination levels in dpm/100 sq cm, as appropriate.

3.1.5. Actions taken in the case of excessive dose rates or contamination as follow up survey information.

3.2. As per the ALARA Program, the RSO will perform quarterly reviews of the records and also promptly upon notification that the trigger levels were exceeded.

TRAINING PROGRAM

1. Site-specific radiation safety instruction shall be provided to all identified groups of workers. All training shall be tailored to meet the needs of the individuals in attendance and may include the following subjects:

    1.1. Applicable regulations and license conditions.

    1.2. Areas where radioactive material is used or stored.

    1.3. Potential hazards associated with radioactive material in each area where the employees will work.

    1.4. Appropriate radiation safety procedures.

    1.5. Licensee's in-house work rules.

    1.6. Each individual's obligation to report unsafe conditions to the RSO.

    1.7. Appropriate response to emergencies or unsafe conditions.

    1.8. Worker's right to be informed of occupational radiation exposure and bioassay results.

    1.9. Locations where the licensee has posted or made available notices, copies of pertinent regulations, and copies of pertinent licenses and license conditions (including application and applicable correspondence), as required by 10 CFR Part 19.

    1.10. Question-and-answer period.

2. The following groups of workers have been identified for radiation safety training:

    2.1. Nuclear Medicine Department staff.

    2.2. Radiation Therapy Department staff.

    2.3. Nurses attending to Radiopharmaceutical Therapy and Implant Therapy patients.

    2.4. Housekeepers attending to Radiopharmaceutical Therapy and Implant Therapy patients.

2.5. Security Officers.

3. Depending on the needs of the group, the following methods of training may be utilized: lectures, videotaped presentations, required reading, and demonstrations.

4. Personnel will be instructed:

   4.1. Before assuming duties with, or in the vicinity of, radioactive materials.

   4.2. During annual refresher training.

   4.3. Whenever there is a significant change in duties, regulations, or the terms of the license.

REFERENCES

1. Policies & Procedures:

   1.1. #RSO-xx-105-B, *Eye Protection Policy*.

   1.2. #RSO-xx-205-B, *Gonadal Shielding for Radiology Patients*.

   1.3. #RSO-xx-220-B, *Pregnant Patients and Imaging Examinations*.

   1.4. #RSO-xx-221-B, *Radiation Safety Policy for Fetal Protection*.

   1.5. #RSO-xx-222-B, *Radiation Safety Guidelines for Fetal Protection*.

   1.6. #RSO-xx-300-B, *Radioactive Materials Disposal Procedures*.

2. Hedrick, Wayne R., *et.al. Radiology Management*, “Managing the Pregnant Radiation Worker: A Realistic Policy for Hospital Today,” Summer 1986, (attached).

Managing the Pregnant Radiation Worker: A Realistic Policy for Hospitals Today

By Wayne R. Hedrick, Ph.D.; Joseph J. Feltes, J.D.; Dale E. Starchman, Ph.D.; and Gary C. Berry

Abstract

Effective, fair management of pregnant employees exposed to radiation requires the balancing of three factions: (1) the rights of the expectant mother to pursue her career without discrimination based on sex;[1] (2) the protection of the fetus;[2] and (3) the needs of the employer.[3] Each hospital should establish a realistic policy which addresses these three concerns, by clearly articulating the expectations of the employer and the options available to the employee. Successful implementation of the policy depends on the means by which this information is communicated to all female employees exposed to radiation, so that they have a fair opportunity to exercise their options within the hospital's general employment policies.

Every hospital should establish a pregnancy policy for employees exposed to ionizing radiation. Various agencies, including the Nuclear Regulatory Commission (NRC)[4] and the Joint Commission on Accreditation of Hospitals,[5] require the formulation of radiation safety policies.

More importantly, good management practice requires that the employee be informed of the potential risks associated with occupational radiation exposure, as well as her legal rights and options. This would include the opportunity, if possible, to change her work environment or to modify her responsibilities if she becomes pregnant so that the employee can make a knowing choice on her own behalf and on behalf of the fetus. Pregnancy policies should address the following issues:

- —maximum permissible dose to the fetus,
- —fetal risks associated with radiation exposure,
- —expectations of the employer,
- —employee options,
- —requirement to report pregnancy to employer,
- —availability of additional information.

Background

Studies have shown that the fetus is sensitive to high doses of ionizing radiation, especially during the first three months of gestation. A small risk of harmful effects from low doses of radiation is assumed, but not proven, to exist. That is, any radiation dose is thought to result in an increased probability of harm to the fetus. The risks from radiation should be compared with the natural incidence of adverse effects. Value judgements on both an institutional and individual level must be made regarding the amount of acceptable additional risk versus the benefits to be gained from the occupational exposure.

The major potential effects following irradiation *in utero* are considered to be the induction of leukemia and other childhood cancers during the first ten years of life and the induction of congenital anomalies. The probability of a particular effect depends on several factors including dose, stage of gestation and dose rate.

The most sensitive period for producing congenital anomalies is during organogenesis (day 14-56 post conception) when the major organs are developing. The relative risk of cancer is also highest for exposure which occurs in the first trimester. While the exact amount of risk is subject to considerable controversy, experts agree that the risk is small. The best estimates of risk are 0.0005 per rem for malformations[6] and 0.00023 per rem to 0.00058 per rem for fatal childhood cancers.[7,8] The spontaneous incidence rates of congenital anomalies and fatal childhood cancers are 4-6 per 100 births[9,10] and 4.3 per 100,000 population per year,[11] respectively.

Most hospitals have adopted the recommendation of the National Council on Radiation Protection and Measurements (NCRP) that the dose to the fetus from occupational exposure of the expectant mother should not exceed 500 mrem.[12,13] This is approximately one-tenth of the maximum permissible occupational dose limit.

In practice, many institutions have followed a more conservative informal policy of reassigning the employee to duties involving no occupational exposure when the pregnancy becomes known. Such conservativism

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Dr. Starchman is Professor of Clinical Radiation Biophysics at the Northeastern Ohio Universities College of Medicine, Adjunct Professor of Radiology at the University of Akron, and President of Medical Physics Services, Inc.

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may represent an "over-reaction" stemming from the fear of legal action by an employee who gives birth to a child with some defect.[14] This response does not fit within the realities faced by hospitals today.

The changing economic climate in health care has created a need for improved productivity by employees. In this environment, hospital management no longer can afford the luxury of retaining employees who cannot perform their jobs. Equally important is the need to protect against decreases in the level of satisfaction and performance which can occur when employees are assigned to jobs at a level lower than their abilities.[15] Highly trained technical and nursing personnel must be given the opportunity to achieve career satisfaction even though limited, temporarily, by pregnancy. These individuals should not be excluded from performing tasks for which they have been trained to do, merely because they are pregnant, so long as such performance does not place the fetus at high risk for harm or seriously affect the operation of the department.

Employee/Employer Relationship

By voluntarily accepting employment, the radiation worker knowingly agrees to perform certain duties which involve exposure to ionizing radiation. Inherent in this acceptance is the understanding that these duties are to be carried out in accordance with the established radiation safety procedures.

The employer is obligated to compensate the employee for these services and to provide a safe working environment.[16] A safe working environment is one which meets the current standards of practice as set forth by professional societies and government agencies. This includes, but is not limited to, adequately shielded x-ray rooms, properly functioning x-ray equipment, availability of protection devices such as lead aprons, the use of personnel monitoring devices, and the formation of radiation safety procedures.

When an employee becomes pregnant, she continues to have an obligation to perform job tasks within a safe working environment. Employers cannot legally terminate female employees solely because they become pregnant.[17] However, employers can formulate policies which address the issues when a female employee does become pregnant. Pregnant employees may not be prohibited from working in radiation areas, operating sources of ionizing radiation or handling radioactive materials. However, a dose limit less than that for occupationally exposed individuals should be observed for the fetus.

Formulation of Policy

Today's managerial reality is that the operation of a radiology department cannot be halted because part of the work force is pregnant. Therefore, a realistic policy must be established which satisfies the needs of the employer, respects the risks to the fetus and does not violate the civil rights of the pregnant employee.[18]

The most important feature of this policy is establishing the maximum permissible dose to the fetus from occupational exposure to the pregnant employee. A dose of 500 mrem as suggested by the NCRP and NRC is recommended. This policy also should establish expectations of the employer, the risks of radiation exposure, and realistic options available to the employee.

Although the radiation safety officer is primarily responsible for formulating the pregnancy policy, the personnel director, risk management director, and hospital attorney should also be consulted. Final approval of the policy is usually given by the hospital administrator. A sample pregnancy policy, written in "plain English," for large community hospitals is included in the appendix.

Implementation

The information contained in the pregnancy policy should be disseminated to all female radiation workers. During orientation, new female employees should sign a statement that they have read and understood the policy.[19] Current employees can be informed by posting the policy in areas where exposure to ionizing radiation occurs and by presenting inservice lectures, preferably by a medical physicist or radiation biologist. The dose levels associated with activities in each major area (diagnostic radiology, nuclear medicine, radiation therapy, laboratory and nursing) should be included in the lectures. Anticipated modifications in the work assignments for each area should also be addressed.

General guidelines for work assignments are presented in Table 1. The pregnant worker is not prohibited from performing the recommended restricted tasks given in this table. However, these tasks are considered to place the fetus at higher probability of exceeding 500 mrem or to be potentially more hazardous in terms of possible uncontrolled occurrences compared with other activities. In most cases, these restricted tasks, if performed at all, constitute a small fraction of the worker's time. Therefore, a pregnant individual could continue to work in her current capacity with no or only slight modifications in her work assignments.

Table I
General Guidelines for the Pregnant Radiation Worker

	Restrictions	Allowed Tasks
Diagnostic x-Ray	–No restrictions	–General radiography –Portable radiography –Fluoroscopy –Special Procedures
Laboratory	–Iodination of proteins	–RIA –*In-vitro* laboratory tests
Nursing	–Care of patients undergoing treatment of thyroid carcinoma with I-131 –Care of patients undergoing treatment with brachytherapy sources	–Care of patients following Nuclear Medicine diagnostic procedures –Diagnostic x-ray procedures
Radiation Therapy	–Handling of brachytherapy sources –P-32 Therapy	–External beam treatments –Simulations
Nuclear Medicine	–Treatment of thyroid carcinoma with I-131	–Preparation of radiopharmaceuticals –Injection of patients –Imaging –QA procedures

In recent years, radiation protection measures have been devised according to the principle of ALARA (as low as reasonably achievable). Radiation exposure should be maintained at the lowest practicable level. Radiation protection practices do not change because the worker becomes pregnant. Those measures which reduce the dose to the worker will also reduce the dose to the fetus. The major ways to decrease the dose further are to restrict the type of tasks performed or to limit the number of times a particular task is performed.

Fluoroscopy and Portable X-Ray

Contrary to what is generally believed, fluoroscopy and portable x-ray procedures do not result in high exposures to the fetus. Consequently, fluoroscopy and portable radiography may be included among those tasks radiation workers may continue to perform throughout pregnancy. Supporting this conclusion are the following calculations regarding the anticipated fetal dose.

The radiation monitor is worn outside the lead apron at collar level for fluoroscopic procedures. Film badge readings overestimate the abdominal surface dose by approximately a factor of 20.[20] The overlying maternal tissues will reduce the dose to the fetus by about 70 percent. Consequently, film badge readings totaling 500 mrem correspond to a fetal dose of 7.5 mrem (500 mrem X 0.05 X 0.3).

The measured output of a portable x-ray unit is approximately 5 mR/mAs at 90 kVp for a target-to-detector distance of 40 inches. For a typical abdomen technique of 75 kVp and 25 mAs, the entrance exposure corrected for distance and kVp is 175 mR [5 mR/mAs X 25 mAs X 2.0 X 0.7]. The intensity of the scattered radiation one meter from the patient is approximately 0.002 of the intensity of the useful beam.[21] Therefore, at six feet (where the technologist should be standing), the exposure is 0.088 mR [175 mR X 0.002 X 0.25]. The lead apron and attenuation by the overlying tissues will reduce the exposure by at least a factor of 20, resulting in a fetal dose of 0.0044 mrem/film. In order for the fetus to receive 500 mrem, the technologist would have to make over 110,000 portable unit exposures during the gestation period.

Reassignment

When an employee first discovers she is pregnant, it is desirable to conduct, on an individual basis, a review

of her exposure history and work assignments. If a radiologic technologist, for example, has averaged 30 mrem per month for the last several months, then a reasonable projection is that this individual, as well as her unborn child, will not receive more than 500 mrem during the period of gestation. This radiologic technologist could continue to work in her current capacity during her pregnancy. However, she should be encouraged to monitor her film badge readings and report any unusual readings to the radiation safety officer.

In the past, pregnant employees were routinely reassigned out of areas involving low level exposure to the fetus (less than 50 mrem per month). Such a policy is subject to criticism since it supports the following argument: a low dose received by the fetus during the second and third trimesters is potentially more harmful than a dose received early in the gestation period when the pregnancy is not known. Otherwise, if this were not the case, fertile women would be prevented from working in all areas involving radiation exposure. This concept can be stated in slightly different terms: if it is important to remove the pregnant employee as a radiation worker during the second and third trimesters when the pregnancy is known, then as a potentially pregnant employee she should not have been occupationally exposed at any time. There is a sense in which the removal of a worker from the radiation environment during the latter trimesters implies an admission of being responsible for permitting an unacceptable risk to that same fetus during the first trimester.

No matter how tasks are assigned, they must be performed by someone. The irrationality of removing persons from the radiation work environment during the latter trimesters is accentuated when one finds that the tasks of a technologist eight-months pregnant have been performed by another technologist who was unknowingly one-month pregnant.

A Realistic Policy

A more realistic policy for managing pregnant employees who are exposed to ionizing radiation allows both the hospital and the employee to choose among reasonable options with an emphasis on mutual accommodation.[22] If the anticipated fetal dose is less than 500 mrem over the gestation period, the employee may continue to work without restriction. If the fetal dose is expected to exceed 500 mrem, the employee may be reassigned, may continue to work with certain restrictions imposed to limit exposure to the fetus, or may voluntarily elect to continue working without restrictions.

If the employee, apprised of her options, does not want to continue performing her job tasks during her pregnancy, she may request reassignment to another area of the hospital which involves less exposure to ionizing radiation. The hospital must make a good-faith effort to accommodate the employee's request in accordance with the hospital's general policy concerning reassignment.

The hospital, because of economic and manpower realities, however, should not be forced to "create" new jobs or reassign employees to positions which are inappropriate.[23]

The employee must understand that when a temporary assignment occurs in response to her request, a commensurate change in working hours and take-home pay could occur. The employee must be apprised of any potential changes prior to the reassignment.

Occasionally, it may not be possible for the hospital to reassign a pregnant radiation employee. Where it is neither possible nor practicable to honor a reassignment request, the employee should be given the choice either to continue performing her job or take a leave of absence consistent with the hospital's general policy governing leaves. Similarly, if the pregnant employee is unwilling to continue her job responsibilities and there is no available position to which she can be reassigned (assuming, of course, that a good-faith effort was made), the hospital would be justified in laying-off the employee, in accordance with the hospital's general lay-off policy, provided that this action was not motivated by sex discrimination or had a discriminatory impact because of sex.[24]

If the hospital's actions are properly based on concern for the fetus and out of business necessity, then they will survive judicial scrutiny.[25] A hospital should not terminate a pregnant employee without first taking pains to achieve its business purpose through less drastic means.

The pregnancy policy must be applied uniformly and consistently throughout the hospital. There should not be separate standards for various groups (physicians, technologists, etc.) within the institution. Transferring one employee but not another away from all sources of ionizing radiation leaves the employer open to charges of inconsistent policy application. The process of applying for reassignment and the guidelines for granting this type of request must be well defined.

Conclusion

The management of the pregnant radiation worker is based on an assessment in which the risk of harm to the unborn child is compared with the benefits gained from occupational exposure of the expectant mother. The NCRP in evaluating the scientific data has determined that the dose to the fetus during the gestation period should be limited to 500 mrem. This dose limit does not normally interfere with the employment of fertile women as radiation workers. Health risks for the unborn child from occupational exposure of the mother are considered to be low compared with the spontaneous incidence of malformations and cancers. If it were accepted that the protection of the unborn child takes precedence over all other considerations, then any additional risk, however small, would be unacceptable. Consequently, fertile women could not be employed in a radiation work environment.

The practical implementation of the recommended dose limit has been presented for the medical work environment. An education program is essential to communicate the risks associated with radiation exposure, the options available to the pregnant employee, and the expectations of the employer. Special considerations such as a restriction of work assignments are contingent upon the notification of pregnancy by the employee to the employer. The employer should provide a monthly report of radiation exposure to the employees. In those circumstances in which the employer has not been informed of the pregnancy, the worker can monitor her exposure history to insure the dose to the fetus does not exceed 500 mrem.

Acceptance of the pregnancy policy by the worker is also facilitated by the education program. The desire to limit the dose to the fetus and the concern for unnecessary exposure to the fetus should be emphasized. New employees should be informed of the policy during orientation, so that there are no misunderstandings later. The uniform application of the policy is essential for good employee-employer relations.

Pregnant employees can maintain a high level of job satisfaction and performance in a radiation work environment. However, both the employer and employee must assume certain responsibilities to limit the dose to the fetus. □

References

1. The Pregnancy Discrimination Act of 1978 amends Title VII of the Civil Rights Act of 1964 by clarifying that the Act's proscription of sex-based employment discrimination includes discrimination based on pregnancy. 42 U.S.C. Section 2000e-(k) states "The terms 'because of sex' or 'on a basis of sex' include, but are not limited to, because of or on the basis of pregnancy, childbirth, or related medical conditions; and women affected by pregnancy, childbirth, or related medical conditions shall be treated the same for all employment-related purposes...."
2. Concern for the fetus as well as the desire to reduce liability exposure has prompted some employers to institute "fetal vulnerability policies," which restrict what jobs pregnant and, in some cases, what fertile women can do. While such policies can legally be justified if based on legitimate, non-discriminatory reasons, others have been challenged as having disparate impact on women in violation of Title VII. See discussion in *Wright v. Olin Corp.*, 697 F 2d 1172 (4th Cir. 1982).
3. The employer, unfortunately, is often caught in the midst of a clash of public policies and legal requirements. The Occupational Health and Safety Administration (OSHA) requires that "Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious harm to his employees." 29 U.S.C. Section 654(a)(1)(1976). Employers are also worried about shrinking budgets, particularly in health care where hospitals have felt the impact of declining census figures or of DRGs, and increasing exposure to litigation in tort, workers compensation and unemployment compensation claims. Despite these concerns, which may cause an employer to adopt restrictive employment policies, the employer also has a legal obligation not to discriminate based on sex. The solution of this dilemma may lie in the so-called "business necessity defense," which allows an employer to adopt employment practices that may disparately impact women, provided that the employer show that these practices are necessary to safe and efficient job performance. See *Dothard v. Rawlison,* 433 U.S. 321, 333 n. 14 (1977).
4. The NRC has promulgated workplace guidelines for pregnant women consistent with the requirements articulated in Section 19.12 CFR Part 19, which states:

   > All individuals working in or frequenting any portion of a restricted area shall be...instructed in the health protection problems associated with exposure to such radioactive materials or radiation, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed; shall be instructed in, and instructed to observe, to the extent within the worker's control, the applicable provisions of Commission regulations and licenses for the protection of personnel from exposure to radiation or radioactive materials occurring in such areas....

5. Standard 18.3 for "Radiology Services" in the JCAH 1986 *Accreditation Manual for Hospitals* requires there to be "... written policies and procedures, including safety rules, for the radiology department service."
6. International Commission on Radiological Protection. *ICRP Publication 27: Problems Involved in Developing an Index of Harm.* New York: Pergamon Press, 1977.
7. United Nations. *Report of the United Nations Scientific Committee on the Effects of Atomic Radiation, Ionizing Radiations: Levels and Effects,* Vol. 2., New York, 1972.
8. National Academy of Sciences, Committee on the Biological Effects of Ionizing Radiations. *The Effects on*

Populations of Exposure to Low Levels of Ionizing Radiation: 1980. Washington, D.C.: National Academy of Sciences Press, 1980.

9. Brent, R.L.; Gorson, R.O. Radiation exposure in pregnancy. *Curr. Probl. Radiol.* 2:5, 1972, p. 1-48.
10. Bolognese, R.J.; Corson, S.L. *Interruption of Pregnancy—A Total Patient Approach.* Baltimore: Williams and Wilkins, 1975.
11. Silverburg, E. Cancer statistics, 1985. *Ca-A Cancer Journal for Clinicians* 35:1, 1985, p. 19-35.
12. National Council on Radiation Protection and Measurements. *NCRP Report No. 39: Basic Radiation Protection Criteria.* Washington, D.C., 1971.
13. National Council on Radiation Protection and Measurements. *NCRP Report No. 53: Review of NCRP Radiation Dose Limit for Embryo and Fetus in Occupationally Exposed Women.* Washington, D.C., 1977.
14. If an employee can prove that she was injured as a direct result of being exposed to ionizing radiation at the workplace, she could prevail in a workers compensation claim against the employer. If the fetus were damaged, an action in tort may be brought on behalf of the fetus. "Bystander" claims for emotional distress may also be brought by the parents, either in the context of workers compensation or tort. Though it is undeniable that today's society is litigious, fear of lawsuits cannot paralyze the operation of radiology departments. Departments, with assistance of the hospital's risk manager and legal counsel, must strive to adopt reasonable policies that realistically assess risk to employees.
15. Chusmir, L.H. How fulfilling are healthcare jobs? *Healthcare Management Review* 2:1, 1986, p. 27-32.
16. OSHA, 29 U.S.C. Section 654(a)(1)(1976), see reference 3, above.
17. Section 703(a)(1) of the Pregnancy Discrimination Act of 1978 makes it unlawful for an employer "to fail or refuse to hire or to discharge...or otherwise to discriminate... with respect to...compensation, terms, conditions, or privileges of employment, because of...sex (including pregnancy)." 42 U.S.C. Section 2000e-2(2)(1).
18. In *Hayes v. Shelby Memorial Hospital,* 726 F 2d 1543 (1984), the United States Court of Appeals for the Eleventh Circuit, in considering a discrimination action brought by an x-ray technician who was discharged when the hospital learned she was pregnant, formulated the following analytical framework for considering employment policies:

    > ...If an employer has a fetal protection policy that applies to members of one sex only, the policy violates Title VII unless the employer shows (1) that a substantial risk of harm exists and (2) that the risk is borne only by members of one sex, and (3) the employee fails to show that there are acceptable alternative policies that would have a lesser impact on the affected sex. *Hayes* at 1554.

19. The rationale for this policy is similar to the policy requiring a patient to sign an informed consent form prior to submitting to a procedure. Liability exposure can be minimized if the employee acknowledges in writing that she understood the policy before voluntarily agreeing to be subjected to it.
20. Bushong, S.C. Management of the pregnant employee and pregnant patient. *Radiology Management* 6:3, 1984, p. 8-11.
21. National Council on Radiation Protection and Measurements. *NCRP Report No. 49: Structural Shielding Design and Evaluation for Medical Use of X-Rays and Gamma Rays of Energies up to 10 MeV.* Washington, D.C., 1976.
22. By adopting this approach, the hospital likely will satisfy the legal requirements articulated in *Hayes,* see reference 18 above, and avoid a Title VII violation. The policy also makes sense from business and employee relations standpoints.
23. Neither Title VII nor the Pregnancy Discrimination Act of 1978 was intended to have a draconian effect on employers by requiring an employer to create non-productive positions. Indeed, requiring an employer to reassign an employee to an inappropriate position violates the fairness policy underlying these laws.
24. This policy must satisfy the "business necessity" requirement. By offering the employee reasonable alternatives, an employer can avoid the result in the case of *Zuniga v. Kleberg Community Hospital,* 692 F 2d 986 (5 Cir. 1982), where the hospital, upon learning that an x-ray technician became pregnant, refused to grant her sick leave or a leave of absence and terminated her. The court held that the hospital, in asserting the "business necessity defense," had, consequently, to consider available, alternative, less discriminatory means of achieving its business purpose or else be found in violation of Title VII.
25. *Hayes,* see reference 18 above; *Zuniga,* see reference 24 above.

Pregnancy Policy for Employees Exposed to Ionizing Radiation

I. Sensitivity of Fetus to Radiation

A number of studies have suggested that the embryo/fetus may be more sensitive to ionizing radiation than an adult, especially during the first three months of gestation. The National Council on Radiation Protection and Measurements (NCRP) has recommended that special precautions be taken to limit exposure when an occupationally exposed woman could be pregnant. Specifically, the NCRP has recommended the maximum permissible dose to the fetus from occupational exposure of the expectant mother should not exceed 500 mrem. This is approximately one-tenth of the maximum permissible occupational dose limit.

II. What to do if You Become Pregnant and are Exposed to Ionizing Radiation in Your Work

When you learn you are pregnant, you must inform your supervisor immediately. There is no reason to become alarmed. We at [name of hospital] are interested in you and your baby and want you to know your options.

III. Hospital Policy

A. [Name of hospital] has adopted the conservative policy of restricting the dose of ionizing radiation to the fetus during the entire period of gestation to no more than 500 mrem.

B. If you work in an area where the anticipated dose is less than 500 mrem to the fetus over the period of gestation, you are able to continue to work in this area with no restrictions. Your work assignments will be under the direction of your supervisor. However, the radiation safety officer may make certain recommendations regarding your work assignments to further reduce the dose to the fetus.

C. Based on past experience, no areas in [hospital] have been identified which would be considered likely to result in a dose to the fetus exceeding 500 mrem, if the established radiation safety procedures are practiced. If a situation is identified in which the anticipated dose to the fetus over the gestation period would be more than 500 mrem, the following three alternatives listed below are possible:

1. You may be assigned to another area involving less exposure to ionizing radiation.
2. You may continue to work in the area with certain restrictions to limit exposure of the fetus to less than 500 mrem (based on recommendations made by the radiation safety officer). In nearly all cases, the work environment will require slight modifications to insure that the dose to the fetus does not exceed 500 mrem.
3. You may, at your option and with the full awareness of a slight increased risk for the unborn child, decide to continue working in this area. It is likely, under these circumstances, that the fetus could receive a dose of more than 500 mrem. If you choose this option, you must sign a statement acknowledging your willingness to work in the area where the dose to the fetus might exceed 500 mrem. You are not encouraged to select this option.

D. If you are unwilling to accept the increased risk to your unborn child due to your current level of radiation exposure, you may request reassignment to an area involving less exposure to ionizing radiation. [Hospital] will make a good faith effort to accommodate your request in accordance with the hospital's general policy for reassignments. Please be aware that transfer to another area may result in a change of working hours and take-home pay. If it is not possible or practicable to grant your request, after a good-faith effort has been made, then you may be laid-off or placed on a leave of absence in accordance with the hospital's general policies.

E. Individuals who are pregnant are not prohibited from working in or frequenting radiation areas. These individuals may also operate sources of ionizing radiation (diagnostic x-ray equipment, cobalt-60 teletherapy units, and linear accelerators) and handle radioactive materials such as those that are present in the RIA laboratory and in Nuclear Medicine.

F. During your pregnancy, you are expected to perform your assigned duties as a radiation worker, unless certain restrictions are placed upon you by the radiation safety officer.

G. During your pregnancy, you are encouraged to monitor your radiation exposure via the film badge readings, which are made available to radiation workers. Contact the radiation safety officer if any unusual readings occur.

IV. What the Radiation Experts Say About Exposure to Ionizing Radiation

A. Natural background radiation levels are such that the average person in the United States receives approximately 125 mrem each year.

B. The actual dose received by the embryo/fetus is less than the dose received by the mother because some of the radiation is absorbed by the overlying maternal tissues.

C. The unborn child is most sensitive to ionizing radiation during the first three months of gestation.

D. The normal incidence of congenital abnormalities is 4-6%. It is impossible to attribute a given anomaly to a small dose of radiation received by an embryo/fetus. The estimated risk to the unborn baby is small, 0.025 percent for 500 mrem.

E. Some studies suggest a relationship between prenatal exposure and childhood leukemia. This risk is small: 1 in 8,800 for 500 mrem. The induction of other childhood cancers is considered to be at a similar level of risk.

F. The radiation dose required to produce sterility is 200,000 mrem or more. Occupational dose levels will not interfere with your ability to bear children.

V. If You Have Questions or Want Additional Information

A. The Nuclear Regulatory Guide 8.13 ("Instruction Concerning Prenatal Radiation Exposure") will be made available to you for informational purposes, if you request.

B. The radiation safety officer is available for discussion regarding levels of exposure from sources of ionizing radiation in the work environment and the risks to the developing embryo/fetus as a result of prenatal exposure. You will be asked to acknowledge in writing that the radiation safety officer gave you instruction. □

RADIOLOGICAL ROOMS

1. Shielding Design for Radiological Rooms

   1.1. All construction plans for rooms intended for radiological equipment shall be evaluated by the RSO.

   1.2. Shielding design calculations for Imaging Equipment shall follow the principles of NCRP Report Nos. 49 and 102.

   1.3. Shielding design calculations for Therapy Equipment shall follow the principles of NCRP Report Nos. 49, 51, 102, and 147.

   1.4. The RSO or appropriate Medical Physicist shall inspect the construction site during installation of the shielding to verify compliance with the design.

   1.5. All shielding calculations shall be kept on file in the Medical Physics Department.

2. Barrier Surveys of Radiological Rooms

   2.1. Upon installation of the equipment, the RSO shall perform radiation exposure level measurements to test the installed shielding.

   2.2. Barrier survey measurements shall follow the principles of NCRP Report No. 102.

   2.3. All survey reports shall be kept on file in the Medical Physics Department.

3. Nuclear Medicine Ventilation Surveys

   Surveys shall be conducted bi-annually to confirm compliance with the attached NRC license requirements.

crichards 4/17/14 10:03 AM
Comment [1]: Attachment???

RADIATION SAFETY GUIDELINES FOR PORTABLE X-RAYS

Portable x-rays play an important role in the management of the hospitalized patient. The radiation dose delivered to the patient presents an insignificant risk compared to the immediate benefit of the diagnostic examination. Sound radiation safety principles must be applied to minimize the exposure to the technologists, nurses, family, and other patients during these procedures.

Goal – In accordance with the National Council on Radiation Protection, no member of the general public shall receive in excess of 500 mrem per year. Occupationally exposed workers shall be limited to 5,000 mrem per year. In either case, all efforts will be extended to maintain ALARA.

Dosimetry – The scatter exposure at 6 feet from the patient is 4,000 times less than what the patient received. A portable radiograph may deliver 5 to 500 mrem skin dose to the patient. This will result in a maximum of 0.1 mrem at 6 feet. By comparison, the daily dose due to background radiation in Honolulu, Hawaii, is 0.3 mrem.

Technique – The x-ray field shall be collimated to the smallest dimensions required to image the anatomy. The highest kVp and shortest time appropriate for the examination will be used. The beam axis shall never be directed toward another patient or staff.

Technologists – Technologists shall wear a lead apron during the exposure and stand at a distance of 6 feet from the patient.

Nurses – Nurses shall maintain a minimum distance of 6 feet during the exposure. If it is convenient, they may be encouraged to leave the room. A lead apron is not required for nurses.

Pregnancy – Refer to Policy & Procedure 621-xx-220-B, *Pregnant Patients and Imaging Examinations*, for additional information.

Family – Family shall be asked to leave the room during the examination to maximize efficiency for the technologist during the study.

Other Patients – The exposure delivered at a distance of 6 feet is insignificant compared to the potential trauma of moving that patient. Therefore, patients shall not be required to leave the room or wear a lead apron during portable x-rays.

LEAD APRON EVALUATION PROGRAM

1. Purpose

   The Lead Apron Evaluation Program is designed to identify damaged or defected lead protective apparel with QMC and ensure that these items are removed and disposed of in accordance with the Hazardous Material/Waste Management Policy for QMC, and any federal, state, or local regulations and guidelines.

2. Procedure

   The following procedure is established for the evaluation of lead protective apparel used within QMC and the disposal of defective items.

   2.1. Annual Testing

      2.1.1. All lead protective apparel used within QMC will be inspected annually by Imaging Services.

      2.1.2. Testing of lead protective apparel will be completed by a licensed technologist, medical physicist, or alternate individual with proper training.

      2.1.3. All lead aprons, gloves, and thyroid shields will be tested using a fluoroscopic system by placing each item separately on the examination table and imaging the entire length of the apparel.

      2.1.4. The evaluation criteria for identifying defective apparel under fluoroscopic inspection are any cracks greater than 1 inch in length and ¼ inch in width, or any holes greater than ½ inch in diameter.

      2.1.5. Each defect found will be properly identified on the outside of the lead apparel with the use of a permanent marker.

      2.1.6. When necessary, the defect can be imaged and further evaluated using the spot-film radiographic system.

      2.1.7. Inspection records will be maintained for all lead protective apparel used within QMC.

3. Disposal

   3.1. The defective lead protective apparel will be immediately removed from service.

3.2. All lead protective apparel removed from service will be stored and then disposed of in accordance with the Hazardous Material/Waste Management Policy for QMC. When available, detective lead protective apparel will be shipped back to the vendor for recycling.

RADIOACTIVE TRASH INSERVICE

1. Where Does It Come From?

    1.1. Nuclear Medicine Department (vials, absorbent paper, bandages).
    1.2. T7E Patients (diapers, paper tissues, disposable dining trays).

2. What Is It?

    2.1. Tc-99m = 6-hour half life.
    2.2. I-131 = 8-day half life.
    2.3. In-111 = 3-day half life.
    2.4. Tl-201 = 3-day half life.

3. Is It Safe? – Yes, very low-level exposure rate.

4. What's the Problem?

    4.1. The United States Environmental Protection Agency (EPA) does not allow us to throw away anything radioactive.

    4.2. The Honolulu Program of Waste Energy Recovery (H-Power) transfer station has radiation detectors. They will send the truck back to QMC if it sets off alarm.

5. How Do We Stop It?

    5.1. Radiation detectors at Compactor and Biohazard Room.
    5.2. Push carts slowly past the detectors.
    5.3. Alarm is sounded when radiation is present.

6. What Do We Do With It?

    6.1. Must hold it at QMC until it decays to background levels.
    6.2. Put a "Radioactive Materials" tag on the bag.
    6.3. Keep it separated and test it the next day.
    6.4. Tell supervisor if still radioactive.
    6.5. Supervisor will contact Radiation Safety Officer (RSO) at ext. 4884.

RADIATION ACCIDENT PROTOCOL

1. Notification – Director of the Emergency Department

    1.1. Notifies the RSO via telecommunications.
    1.2. Notifies Security.
    1.3. Together with the RSO decides whether to implement Radiation Accident Plan.
    1.4. Takes charge of victim(s) or designates person(s) to do so.

2. Obtain On-Site Information

    2.1. Number and condition of **uncontaminated** victim(s).
    2.2. Number and condition of **contaminated** victim(s).
    2.3. Type of radioactive material involved.
    2.4. Type of radioactive accident:

        2.4.1. Irradiation.
        2.4.2. Contamination.
        2.4.3. Incorporation.

3. Emergency Department Preparation

    3.1. Emergency Department Patients and Personnel

        3.1.1. Move all patients or others near route from ambulance entrance to decontamination area to other areas free of possible contamination.

        3.1.2. Move all pregnant or possibly pregnant women to other areas free of possible contamination.

        3.1.3. Locate decontamination supplies for radiation safety personnel.

    3.2. Preparation for Arrival of Victim(s)

        3.2.1. Floor

            3.2.1.1. Receiving dock area and route to decontamination area will be covered with absorbent paper or plastic and secured with tape.

            3.2.1.2. Receiving area and route will be marked “**RADIOACTIVE**” until cleared by the RSO.

3.2.2. Decontamination Area

3.2.2.1. Area or room shall be covered with absorbent paper or plastic and secured with tape.

3.2.2.2. Entrance to area shall be marked "**RADIOACTIVE**."

3.2.2.3. RSO shall designate person(s) with surveying instruments to stay at entrance to monitor all personnel, equipment, and samples leaving area.

3.2.2.4. ALL non-essential equipment to be removed from area.

3.2.2.5. Charge Nurse to designate person(s) to stand outside to obtain supplies for medical and decontamination team.

3.2.2.6. Cover examination gurney with absorbent paper or plastic.

crichards 5/9/14 10:22 AM
Comment [1]: Should this be secured with tape?

3.2.2.7. Provide large red plastic bags or metal containers to receive discarded clothing, gauze, supplies, etc.

3.2.3. Decontamination Team

3.2.3.1. Physician – Takes charge of patient's medical problems.

3.2.3.2. Nurse

- Assists physician(s).
- Responsible for collecting all specimens.
  - Laboratory (blood for complete blood count, typing and cross-matching, urine for analysis).
  - Swabs for contaminated areas (see below).
- Monitors vital signs and records data.

3.2.3.3. Radiation Safety Officer (RSO)

- Directs decontamination procedure.
- Monitors patient and decontamination team during care of patient.

- Responsible for analysis of all swabs and specimens for contamination and identification thereof.

3.2.3.4. Circulating Nurse and Ancillary Radiation Personnel

- Assists team as needed.
- Labels all specimens.
- Obtains all needed supplies from outside decontamination area.
- Records areas and levels of contamination on chart as measured by RSO.

3.2.4. Decontamination Team Preparation

3.2.4.1. Use restroom.

3.2.4.2. Attach film badge to clothes.

3.2.4.3. Put on disposable gown, disposable booties, gloves (double glove), and mask.

3.2.4.4. Attach external dosimeter, if available.

3.2.4.5. Read, at intervals, during decontamination procedure and report/record readings.

4. Patient Arrival – Physician and RSO to examine patient in ambulance on arrival.

4.1. RSO decides if patient is contaminated.

4.2. Patient's Condition

4.2.1. If patient **is** critically injured, he/she goes directly to decontamination room whether or not his/her clothes have been removed.

4.2.2. If patient **is not** critically injured, his/her clothing will be removed in the ambulance or loading area in red plastic bags.

4.3. Patient is transferred to stretcher and covered with absorbent paper or plastic sheet or cloth.

4.4. Ambulance attendants stay by ambulance until they and the ambulance are monitored for contamination.

4.4.1. **If** contaminated, follow RSO's instructions for decontamination.

4.4.2. **If not** contaminated, release for duty.

5. Decontamination of Patient

5.1. Airway, breathing, and cardiovascular status must be attended to first.

5.1.1. Physical examination done by physician.

5.1.2. Required laboratory material, electrocardiogram, and radiographs obtained, as required, by patient's condition.

5.1.3. Procedures, fluids, and drug administration done, as required, to stabilize patient's condition.

5.2. Patient Evaluation

5.2.1. Remove patient's clothing if not done in ambulance area, place in red plastic bag, seal, and label.

5.2.2. Cotton swab samples of ear canals, nares, and mouth.

5.2.3. Place swabs in labeled containers as directed. RSO monitors patient completely.

5.2.4. Nurse or assistant records contamination areas and readings.

5.3. Physical Decontamination of Radioactive Areas

5.3.1. Contaminated Open Wounds (**these have first priority**)

5.3.1.1. Wash with normal saline.
5.3.1.2. Monitor, repeat 5.3.1.1.
5.3.1.3. If contamination persists, wash with 3% hydrogen peroxide.
5.3.1.4. Consider surgical debridement.
5.3.1.5. Save and monitor all removed tissue.

5.3.2. Contaminated Eyes

5.3.2.1. Rinse with water, stream should go in nose to temple direction, away from medial canthus.

5.3.2.2. Monitor patient and repeat 5.3.2.1, as needed.

5.3.3. Contaminated Ear Canals

5.3.3.1. Rinse gently with small amount of water; suction frequently.

5.3.3.2. Monitor patient and repeat 5.3.3.1, as needed.

5.3.4. Contaminated Nares and Mouth

5.3.4.1. Turn patient's head to side or down as condition permits.

5.3.4.2. Rinse gently with small amount of water; suction frequently.

5.3.4.3. Prevent water from entering stomach as much as possible.

5.3.4.4. Insert nasogastric tube into stomach; suction and monitor contents. If contents are contaminated, lavage with small amount of normal saline until contents is clear of contamination.

5.3.5. Contaminated Intact Skin

5.3.5.1. Wash with mild soap and tepid water, gently scrubbing with soft brush for 3 minutes.

5.3.5.2. Monitor patient and repeat 5.3.5.1, as needed.

5.3.5.3. Do not redden or irritate skin with hot water or harsh scrubbing.

5.3.6. Contaminated Hair

5.3.6.1. Shampoo with mild soap for 3 minutes.

5.3.6.2. Monitor patient and repeat 5.3.6.1, as needed.

5.3.6.3. If contamination persists, cut contaminated hair off.

6. Removal of Patient from Decontamination Room

6.1. Dry patient thoroughly.

6.2. Re-swab all previously contaminated areas.

6.2.1. Label all swabs and mark “Post Decontamination.”

6.2.2. Give swabs to RSO or assistant.

6.3. RSO to monitor entire body.

6.4. New covering is placed on floor from door to patient so that “clean” area(s) do not become contaminated.

7. Exit of Decontamination Team

7.1. Each team member goes to “clean” line at door and removes protective clothing and places them in red plastic bag marked “Contaminated.”

7.1.1. Remove outer gloves first, turning them inside-out as they are pulled off.

7.1.2. Give dosimeter to RSO.

7.1.3. Remove inner gloves.

7.2. Have hands and feet monitored.

8. For 24-hour assistance in dealing with radiation accidents, call:

REAC/TS
Oak Ridge National Laboratory
615.576.1004

THE QUEEN'S MEDICAL CENTER
HONOLULU, HAWAII

OPERATING ROOM/SDS
ORIGINAL DATE: 12/94
REVISED DATE:6/98, 5/05
REVIEW DATE:5/97,11/99,3/00, 4/01,5/02,9/03, 3/06
POLICY #:2301-06-545

SUBJECT:

USE OF THE FLURO SCAN (aka MINI) C-ARM/IMAGE INTENSIFIER: RADIATION SAFETY/FLUOROSCOPY

PURPOSE:

To provide guidelines for the use of the Fluro Scan image intensifiers also known as the Mini C-Arm.

POLICY:

1. The Fluro Scan may be utilized in the Operating Rooms - Main O.R. and Same Day Surgery - by Attending Surgeons who meet the criteria of authorized operator as identified in the "One Level of Care: Fluoroscopy" statement a component of the Medical Staff Policy Department regulations.

2. All personnel within a 3 foot distance from the unit during use will wear a lead apron and other protective equipment as necessary.

3. If the C-Arm is used in a free state (removed from the positioning bar) the surgeon will hold the arm, the Operating Room staff will not be required to hold the c-arm unit.

Responsibilities:

Surgeon - as Authorized Operator:

1. Will inform Surgery Scheduling/Front Desk at the time of scheduling the case that the Fluro Scan and XI-Scan/Mini C-Arm will be required for the case.

2. Will be accountable for the safety of the patient, personnel and equipment.

3. Report any unsafe procedure or incident to the Radiation Safety Officer: **telephone:** 4884 **pager:** [redacted]

Staff of the Operating Rooms:

1. Turn on C-Arm unit and take exposures as directed by attending physician/Authorized Operator.

2. Provide appropriate protection for patient and room personnel.

3. Report any unsafe procedure or incident to the Radiation Safety Officer: **telephone:** 4884 **pager:** [redacted]

4. Report any maintenance issues to Biomedical Services at ext. 4719.

Approved by Operating Room Manager:

_____ Date: _____

Approved by SDS Manager:

_____ Date: _____

Approved by Director of Perioperative Services:

_____ Date: _____

Approved by Radiation Safety Officer:

_____ Date: _____

Approved by Department of Orthopedics:

_____ Date: _____

THE QUEEN'S MEDICAL CENTER

2301-13-525-B

This policy applies to the following campuses:

- ☐ The Queen's Medical Center – Punchbowl
- ☐ The Queen's Medical Center – West Oahu
- ☒ Both

December 2013

POLICY NAME: **LEAD APRON AND COLLAR SAFETY CHECK**

POLICY TYPE:

☒ **Clinical/Nursing Departments – Requires Approval by Appropriate Manager**

☐ Behavioral Health	☐ Clinical Nursing/Mosby	☐ Decentralized Lab	☐ Emergency Dept
☐ Environmental Svc	☐ Hemodialysis (2119)	☐ Infection Prevention	☐ Imaging
☐ Laboratory	☐ Nursing Policies (502)	☐ Pharmacy	☐ Progressive Care Unit
☐ Radiation Services	☐ Respiratory Therapy	☒ Surgical Services	☐ Transplant Center
☐ Trauma Services			

PUNCHBOWL CAMPUS

Kathy Green, MBA, MSN, RN,CNOR
Vice President, Patient Care

WEST OAHU CAMPUS

Jenny A. Papacek, MSN, RN, CNOR
Director, Surgical Services

Susan R. Murray, FACHE
QHS Sr VP, West O`ahu Region
COO, The Queen's Medical Center - West O`ahu

Submitted for Revision by:	Date	Date Approved by Dept Mgr (Nursing/Clinical)	Date Approved By SLC (Admin)	Date Approved By MEC/BOT (Medical Staff)
Most Recent Revision Info				
Previous Revision Info				

Distribution: Available via the Queen's Medical Center Intranet and to Medical Staff Members upon request. The master, signed original document is located in the office of the identified guardian.

POLICY

To assure the integrity of lead aprons and thyroid collars used in the Surgical Suites, fluoroscope examination will be performed annually (Nov/Dec) by the Medical Physicist, in conjunction with:

1. Main OR: Orthopedic Service Line Manager and the evening Clinical Operations Manager.
2. SDS: Clinical Operations Manager.
3. West Oahu: OR Charge Nurse.

OUTCOME MEASUREMENT

Any aprons/collars found to be an ineffective radiation barrier by fluoroscope will be removed from service.

PROCEDURE

1. The Medical Physicist contacts the Orthopedic Service Line Manager (Main OR), Operations Manager (SDS), or OR Charge Nurse (West Oahu) to arrange a time for annual fluoroscopic examination of aprons and collars.
2. A complete inventory list of lead aprons and collars is maintained by the Medical Physicist. A copy will be forwarded to the Orthopedic Service Line Manager, SDS Clinical Operations Manager, and OR Charge Nurse West Oahu.
3. The outcome of the fluoroscopic exam for each article will be noted, dated, and initialed by the radiation technician.
4. Items that do not pass the fluoroscopic examination will be marked and removed from service. Disposal of the lead aprons and collars that are beyond repair will be arranged by the Medical Physicist (ext. 4597).
5. The Medical Physicist will forward an updated copy of the inventory list to the Orthopedic Service Line Manager, SDS Clinical Operations Manager, and OR Charge Nurse (West Oahu)..

THE QUEEN'S MEDICAL CENTER

2301-13-540-B

This policy applies to the following campuses:

- ☐ The Queen's Medical Center – Punchbowl
- ☐ The Queen's Medical Center – West Oahu
- ☒ Both

December 2013

POLICY NAME: **RADIATION SAFETY**

POLICY TYPE:

☒ **Clinical/Nursing Departments – Requires Approval by Appropriate Manager**

☐ Behavioral Health	☐ Clinical Nursing/Mosby	☐ Decentralized Lab	☐ Emergency Dept
☐ Environmental Svc	☐ Hemodialysis (2119)	☐ Infection Prevention	☐ Imaging
☐ Laboratory	☐ Nursing Policies (502)	☐ Pharmacy	☐ Progressive Care Unit
☐ Radiation Services	☐ Respiratory Therapy	☒ Surgical Services	☐ Transplant Center
☐ Trauma Services			

PUNCHBOWL CAMPUS

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Most Recent Revision Info				
Previous Revision Info				

Distribution: Available via the Queen's Medical Center Intranet and to Medical Staff Members upon request. The master, signed original document is located in the office of the identified guardian.

PURPOSE

1. To protect patients and personnel from the effects of ionizing radiation exposure.

2. To minimize the amount of radiation exposure of patients and personnel.

BACKGROUND INFORMATION

1. Ionizing radiation is produced naturally by the decay of radioactive elements or artificially by such devices as x-ray machines.

2. Radiation exposure usually results from scattering of x-ray beams or the emission of gamma rays by patients being treated with radioactive implants.

3. Ionizing radiation can cause biological effects such as cancer.

4. The effects of radiation exposure can be cumulative.

POLICY

1. The Radiology Department and the Radiation Safety Officer will be responsible for the radiation safety activities in Surgical Services. All equipment will be maintained and monitored by the Radiology and Biomedical Departments. OR/SDS management is responsible for compliance to radiation standards.

2. The patient will be protected from unnecessary exposure to x-rays.

    2.1. Inquire of all females of childbearing age if they are, or could be, pregnant. Refer information to radiologist/surgeon.

    2.2. Leaded shields should be used to protect the patient's gonads during x-ray studies of the hips and upper legs, unless the shield interferes with exam or treatment.

    2.3. Whenever possible, a thyroid shield should be used during upper extremities and head x-rays.

    2.4. All reasonable means of reconciling an incorrect count should be implemented prior to performing an x-ray.

3. All personnel will be protected from unnecessary x-ray exposure.

    3.1. Only staff who works within 6 feet of the patient shall be required to wear lead aprons and thyroid shields.

    3.2. Those staff members who work at a distance greater than 6 feet from the patient are not advised to wear lead aprons.

    3.3. Staff is not advised to leave the room when radiography is performed. This only compromises patient care and sterility.

3.4. No additional precautions are necessary for pregnant staff.

3.5. Inadvertent exposures shall be investigated by the Radiation Safety Officer. A dose estimate shall be calculated from the technical data provided by the radiologic technologist. No dose estimate is required if the exposed individual was located at least 6 feet away from the patient. If exposure occurs, the staff member will fill out an event form and include the patient's name, procedure, and name of the radiologic technologist.

3.6. Leaded gloves should be worn when hands are in direct exposure to fluoroscopy.

4. Radiation monitoring devices are not required for any personnel.

5. Personnel will be protected from exposure to patients who have received radioactive implants in surgery.

5.1. See safety guidelines from radioactive implants in surgery.

5.2. Notify radiation safety officer who will be present to monitor and explain.

5.3. Warning signs should be posted at doors to alert personnel entering room that radioactive materials are present.

5.4. Alert receiving unit prior to transfer to allow time to plan for protection of their personnel and other patients.

6. Leaded protective devices will be handled carefully and examined periodically to prevent damage.

6.1. Aprons should be laid flat or hung by the shoulders when not in use.

6.2. Protective devices are checked annually for cracks or damage that could diminish effectiveness and safety level.

7. All employees will have an annual radiation safety update. In addition a radiation safety, in-service will be provided for the OR staff by the Radiation Safety Officer and will include:

7.1. Review of principles of radiation safety and dose reduction techniques.

7.2. Review of the different x-ray imaging procedures and associated exposures.

7.3. Review of the proper use and evaluation of the personnel monitors.

THE QUEEN'S MEDICAL CENTER

621-13-1010-B

This policy applies to the following campuses:

- ☐ The Queen's Medical Center – Punchbowl
- ☐ The Queen's Medical Center – West Oahu
- ☒ Both

December 2013

POLICY NAME: RADIOLOGY QUALITY CONTROL PROGRAM

POLICY TYPE:

☒ **Clinical/Nursing Departments – Requires Approval by Appropriate Manager**

☐ Behavioral Health	☐ Clinical Nursing/Mosby	☐ Decentralized Lab	☐ Emergency Dept
☐ Environmental Svc	☐ Hemodialysis (2119)	☐ Infection Prevention	☒ Imaging Services
☐ Laboratory	☐ Nursing Policies (502)	☐ Pharmacy Services	☐ Progressive Care Unit
☐ Radiation Services	☐ Respiratory Therapy	☐ Surgical Services	☐ Transplant Center
☐ Trauma Services			

PUNCHBOWL CAMPUS

Garan Ito
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Darlene Chadwick
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WEST OAHU CAMPUS

Gary Ropert
Diagnostic Imaging Manager

Susan R. Murray, FACHE
QHS Sr VP, West O`ahu Region
COO, The Queen's Medical Center - West O`ahu

Submitted for Revision by:	Date	Date Approved by Dept Mgr (Nursing/Clinical)	Date Approved By SLC (Admin)	Date Approved By MEC/BOT (Medical Staff)
Most Recent Revision Info	12/2013			
Previous Revision Info	09/2012			

Distribution: Available via the Queen's Medical Center Intranet and to Medical Staff Members upon request. The master, signed original document is located in the office of the identified guardian.

Test	Frequency	Method	Performed By
Overall QC Review	Annually	Evaluation of results	Technologist
CR Review	Annually		Physicist
Mammo Film Processor	Daily	Sensitometer, Densitometer, thermometer	Technologist
Mammo Review	Quarterly	Review daily results	Physicist
Retake Analysis	Monthly	Calculation of retake rate	Technologist
Review	Annually	Evaluation of Program	Technologist
Lead Aprons	Annually	Fluoroscopic System	Physicist
Cassette Condition	Annually	Visual	Technologist
Computed Radiography:			
Cassette Uniformity	Annually	1 mR exposure	Physicist
Laser Printer	Bi-monthly	Service Program	Technologist
Laser Printer	Quarterly	Evaluation of Program	Physicist
All Systems:			
kVp Accuracy	Annually	kVp meter, cassette, or voltage divider	Physicist
Beam Quality (HVL)	Annually	Electrometer, aluminum filters	Physicist
Focal Spot Size	Annually	Star or bar pattern	Physicist
Radiographic Systems:			
Radiation Output	Annually	Electrometer	Physicist
Output Linearity	Annually	Electrometer	Physicist
Reproducibility	Annually	Electrometer	Physicist
Timer Accuracy	Annually	Digital timer	Physicist
Phototimer Operation	Annually	Electrometer, densitometer	Physicist
Patient Exposures	Annually	Electrometer	Physicist
Light/Radiation Coincidence	Annually	Phantom, Cassette	Physicist
SID, Field Size Indicator Accuracy	Annually	Phantom, Cassette	Physicist
Fluoroscopic Systems:			
High Contrast Resolution	Annually	Resolution Phantom	Physicist
Low Contrast Sensitivity	Annually	Low Contrast Phantom	Physicist
A.B.C.	Annually	Electrometer, Visual	Physicist
Fluoro Patient Exposure Levels	Annually	Electrometer, Phantoms	Physicist

Test	Frequency	Method	Performed By
Beam Collimation	Annually	Ruler Plate, Film	Physicist
Tomography Systems:			
Tomographic Motion	Annually	Tomo Uniformity Phantom	Physicist
Fulcrum Height	Annually	Tomo Accuracy Phantom	Physicist
Tomo Resolution	Annually	Tomo Resolution Phantom	Physicist
Digital Subtraction Systems:			
High Contrast Spatial Resolution	Annually	Digital Phantom	Physicist
Low Contrast Resolution	Annually	Digital Phantom	Physicist
Contrast Uniformity	Annually	Digital Phantom	Physicist
Spatial Uniformity	Annually	Digital Phantom	Physicist
Contrast Linearity	Annually	Digital Phantom	Physicist
Artifacts	Annually	Digital Phantom	Physicist
Patient Exposure	Annually	Electrometer, Phantom	Physicist

RADIOGRAPHIC TECHNICQUES AND CRITERIA

1. kVp Calibration

   A digital kVp meter is used to measure both the average kVp and the effective kVp. The kVp measurements are derived from measurement of the linear absorption coefficient of the hardened x-ray beam. The average kVp is derived from data collected solely from the peaks of the x-ray waveform while the effective kVp is obtained from the entire x-ray waveform. As the kVp increases, the linear absorption coefficient increases. The filtration can affect the accuracy of the measurement because additional filtration will harden the beam, which in turn changes the linear absorption coefficient. Errors in measurement from differences in filtration can be corrected by knowing either the total aluminum equivalent filtration or the half value layer at 80 kVp.

   Without correction, the digital kVp meter is accurate to within ± 5 percent. With correction, the meter accuracy is ± 2 percent. Should the measured kVp differ from the indicated value by more than ± 5 percent, the unit should be checked by appropriate service personnel.

   For mammography systems, the accuracy of the digital kVp meter is ± 1 kV + 2 percent, or ± 5 percent for film/screen mammography. Without correction, the measurements are accurate to within ± 10 percent. If the measurements differ from the indicated value by more than 10 percent, the unit should be checked by appropriate service personnel.

2. Beam Quality

   The half value layer (HVL) is measured using a diagnostic ion chamber and Type 1100 aluminum alloy. The ion chamber center is placed 40 inches (or the maximum allowable if 40 inches is not possible) and the aluminum is placed as near the x-ray tube as possible. The acceptance criteria for HVL is that recommended by National Council on Radiation Protection & Measurements (NCRP) Report No. 102 entitled "Medical X-ray, Electron Beam and Gamma Ray Protection for Energies up to 50 MeV (Equipment Design, Performance and Use)." The HVL at 80 kVp shall exceed 2.4-mm aluminum for single-phase systems, and 2.7-mm for three-phase, high-frequency, and constant potential systems as specified in that report.

   In accordance with NCRP Report No. 85, entitled, "Mammography - A User's Guide," the HVL must exceed 0.3mm aluminum at 30 kVp for film/screen mammography tubes and 1.5-mm aluminum at 45 kVp for xeromammography systems. A HVL for film/screen systems greater than 0.4-mm aluminum at 30 kVp indicates a probable problem with the calibration or position of the mirror and/or filtration.

3. Focal Spot Size

   A star pattern phantom is used to measure the focal spot size. Radiation from different areas of the focal spot will cause a periodic blurring of the pattern due to penumbra effects. Knowing the geometric factors and the distance from the center of the pattern to the region where blurring occurs allows calculation of the focal spot size.

   For very small focal spots, such as those for mammography, the size measured by a star pattern can be affected by the focal spot intensity distribution. The star pattern still provides a good measurement of the tube's resolution but might not correspond accurately to the focal spot size. Action regarding acceptability of focal spot size should only be based on slit camera or pinhole measurements.

   According to National Electrical Manufacturers Association (NEMA) standards, the focal spot size shall not measure more than 50 percent above the nominally stated dimension supplied by the manufacturer for less than 0.8 mm focal spots, not more than 40 percent above for nominal 0.8- through 1.5-mm focal spots and not more than 30 percent above nominal focal spots greater than 1.5 mm.

4. Time Accuracy

   Here, a digital x-ray timer is used. The timer operates in both the "time mode" and the pulse "count mode" (for single-phase systems). In the count mode, the accuracy is ± 0.1 msec or 5 percent, whichever is greater. The measured exposure time should be within 5 percent or 1 msec (whichever is greater) of the set exposure time.

5. Coefficient of Variation

   This measurement of reproducibility consists of repeated radiation measurements with an electrometer. For any specific combination of selected technique factors, the coefficient of variation, defined as the standard deviation divided by the mean, shall not exceed 0.05 (or 5 percent) for 10 consecutive measurements. For systems with automatic exposure controls, the AEC must meet the same requirements for exposures at least 0.1 second (or 12 pulses).

6. Linearity

   This requirement applies to equipment that allows a choice of x-ray tube current settings. The mA stations used are those within the range of 40 to 100 percent of the maximum rated. The coefficient of linearity is defined as the difference divided by the sum of the average mR/mA values calculated for each of 2 consecutive tube current stations. The value of this coefficient must be less than 0.10 (or 10 percent).

7. Exposure Rate

   The exposure rate for the radiographic tubes is measured using an ion chamber. At 40 inches from the focal spot of the tube, and at 80 kVp, the exposure rate in mR/mAs should be within 20 percent of 4 mR/mAs for single-phase, full-wave rectified equipment; and 6 mR/mAs for three-phase, high-frequency, and constant potential equipment. The exposure rate at other distances from the focal spot and kVp's may be estimated using inverse square dependence on distance and squared dependence on kVp. Systems with unusually high filtration will have lower mR/mAs.

8. Source Image Distance

   This is checked by exposing a film to a specific collimator-set field size at a distance determined by the SID indicator. Then, without changing the collimator setting, the tube is lowered a distance "d" and the film is re-exposed. If FS1 and FS2 represent the dimension of a radiation field before and after the tube is lowered a distance d, the SID is given by:

$$SID = \frac{d(FS1)}{(FS2 - FS1)}$$

   The accuracy of the SID indicator should be within 2 percent of the SID. At 40 inches, this means the accuracy should be ± 0.8 inches.

9. Light/Radiation Coincidence

   This is checked by comparing the light-field-defined margins with the radiation-field-defined margins. The center of the light field should correspond to the radiation field center to within ± 2 percent of the Scientific Information Database (SID). The field size indicators should provide the correct dimension of the radiation field to within ± 2 percent of the SID along either the length or width and to within ± 3 percent of the SID for the sum of both directions. The light field and radiation field should coincide to within ± 2 percent of the SID along either the length or width and to within ± 3 percent of the SID for the sum of both directions."

10. Tomographic Test

    The fulcrum position, mechanical stability, and resolving power are checked. The fulcrum position is checked with a helix of 23 lead numbers embedded in plastic. Each of the numbers is 1mm apart. The fulcrum indicator is set within this range. The phantom also contains a copper mesh consisting of 4 individual sections that tests the resolving poser. The holes per millimeter are 0.8, 1.2, 1.6, and 2.0. The stability and uniformity of exposure is checked by observation and use of an aperture plate with a 3.0-mm-diameter central hole. Large tomographic angles are used to minimize the slice thickness.

The accuracy of the fulcrum indicator should be within ± 1mm for circulator or pluridirectional systems and ± 3mm for linear systems. The trace of the 3.0-mm hole in the aperture plate should show no path or exposure non-uniformities.

FLUOROSCOPIC TECHNICQUES AND CRITERIA

1. Patient Exposure Rate

   The exposure measurements are made with a calibrated ion chamber. For systems with under table tubes, measurements are made just above the table top on the central ray. For systems with tubes above the table, measurements are made 12 inches above the table top with the tube in its closest operational position. For C-arms and L-U systems, measurements are made 12 inches from the input plane of the image intensifier with the tube in its closest operational position. Exposure measurements are taken using a child phantom (0.75-inch aluminum), and adult phantom (1.50-inch aluminum), and a lead blocker. For systems equipped with ABC (automatic brightness control) mode, the measurements will be made in this mode.

   "Acceptance criteria are based on that recommended by NCRP Report No. 102 and 21 CFR 1020.32, *Fluoroscopic Equipment.* The maximum entrance exposure rate (EER) shall not exceed 10 R/minute for systems with ABC and 5 R/minute for those with only manual control. Systems with high-level control (HLC) that can operate with EER greater than 10 R/minute must provide ABC. If available, when the HLC is activated, the maximum EER shall not exceed 20 R/minute.

   The entrance exposure rate with the child and adult phantoms is dependent upon many factors, such as field size, kVp, filtration, and specific geometry, but is should not exceed 5 R/minute for normal operation. Typically, the exposure rate is between 1 and 3 R/minute with the adult phantom."

2. Beam Quality

   This is determined from the half value layer measured with an ion chamber and Type 1100 aluminum. The method and criteria of acceptance is as described in this category under Radiographic Techniques and Criteria.

3. Limiting Resolution

   The maximum resolution of the imaging system is measured by viewing a resolution phantom placed as close as possible to the image intensifier with no additional attenuation material in the beam. If the system is equipped with ABC, it should be used. Otherwise, the lowest manual kVp (typically 60-65 kV) should be used.

   There are no specific requirements for the limiting resolution but typically a system with a 9-inch field of view will resolve at least 0.8 line pairs per mm and smaller fields of view will resolve 1.0 line pair per mm or better. Changes in limiting resolution are a good indication that the imaging system requires adjustment.

4. Low Contrast Delectability

   The low contrast performance is determined by viewing a phantom made of 3/16-inch aluminum with 3/8-inch holes of varying depths. Copper sheets totaling 2mm is also placed in the beam to provide normal attenuation levels and reduce the contrast of the phantom. If the system has automatic brightness control, that mode is used. If not, 80 or 100 kVp is selected manually. Typically a system will resolve the 3.3 percent contrast hole or better. Changes in this function indicate that the imaging system requires adjustment.

   Another phantom sometimes used for this measurement consists of 2, 0.75-inch aluminum blocks with a 1/32-inch aluminum sheet placed between them. The aluminum sheet has 5 pairs of holes ranging from 1/16 inch to 1/4 inch. All systems should resolve at least the 1/8-inch holes but most systems will resolve them all.

5. Contrast-Detail Resolution

   The phantom used for this test consists of 3 strips of copper and 3 strips of aluminum of different thicknesses. Each strip will have 8 holes ranging from 1/8-inch to 1/2-inch diameter. This provides for resolution measurement of 6 different contrast levels. The 2-mm copper is also placed in the beam as in the low contrast delectability test. If the system has ABC mode, it is used. Otherwise, 80 or 100kVp is manually selected.

   These results provide a good comparison of image quality between different systems and another method of monitoring changes. Most systems will resolve all of the 31.9 percent contrast holes and 1 or 2 of the 1.7 percent contrast holes.

6. Image Intensifier Entrance Exposure Rate

   An ion chamber is used to measure the exposure rate at the entrance to the image intensifier (or grid). Manufacturers specify what the levels should be when the system is new but the radiation levels are generally increased as the image intensifier ages in order to keep the same image quality. Higher than normal values may be an indication that adjustment or replacement of components is warranted. Sudden changes in the exposure rate indicate a problem that should be checked by appropriate service personnel.

THE QUEEN'S MEDICAL CENTER

621-13-1030-B

This policy applies to the following campuses:

- ☐ The Queen's Medical Center – Punchbowl
- ☐ The Queen's Medical Center – West Oahu
- ☒ Both

December 2013

POLICY NAME: COMPUTERIZED TOMOGRAPHY QUALITY CONTROL PROGRAM

POLICY TYPE:

☒ **Clinical/Nursing Departments – Requires Approval by Appropriate Manager**

☐ Behavioral Health	☐ Clinical Nursing/Mosby	☐ Decentralized Lab	☐ Emergency Dept
☐ Environmental Svc	☐ Hemodialysis (2119)	☐ Infection Prevention	☒ Imaging Services
☐ Laboratory	☐ Nursing Policies (502)	☐ Pharmacy Services	☐ Progressive Care Unit
☐ Radiation Services	☐ Respiratory Therapy	☐ Surgical Services	☐ Transplant Center
☐ Trauma Services			

PUNCHBOWL CAMPUS

Garan Ito
Director, Imaging/Molecular/Pathology

Darlena Chadwick
Vice President, Patient Care

WEST OAHU CAMPUS

Gary Ropert
Diagnostic Imaging Manager

Susan R. Murray, FACHE
QHS Sr VP, West O`ahu Region
COO, The Queen's Medical Center - West O`ahu

Submitted for Revision by:	Date	Date Approved by Dept Mgr (Nursing/Clinical)	Date Approved By SLC (Admin)	Date Approved By MEC/BOT (Medical Staff)
Most Recent Revision Info	12/2013			
Previous Revision Info	12/2009			

Distribution: Available via the Queen's Medical Center Intranet and to Medical Staff Members upon request. The master, signed original document is located in the office of the identified guardian.

PROCEDURE

Test	Frequency	Method	Performed by
Fast Cal	Daily	Noise phantom	Technologist
Linearity	Annually	CT test phantom	Physicist
Contrast Scale	Annually	CT test phantom	Physicist
Noise	Annually	CT test phantom	Physicist
Beam Alignment	Annually	CT test phantom	Physicist
Slice Thickness	Annually	CT test phantom	Physicist
High Contrast Spatial Resolution	Annually	CT test phantom	Physicist
Point Spread Function	Annually	CT test phantom	Physicist
Low Contrast Sensitivity	Annually	CT test phantom	Physicist
Radiation Exposure	Annually	CT test phantom	Physicist
Laser Alignment	Annually	CT test phantom	Physicist

THE QUEEN'S MEDICAL CENTER

621-14-900-B

This policy applies to the following campuses:

☐ The Queen's Medical Center – Punchbowl
☐ The Queen's Medical Center – West Oahu
☒ Both

January 2014

POLICY NAME: **RADIATION SAFETY PROGRAM**

POLICY TYPE:

☒ **Clinical/Nursing Departments – Requires Approval by Appropriate Manager**

☐ Behavioral Health	☐ Clinical Nursing/Mosby	☐ Decentralized Lab	☐ Emergency Dept
☐ Environmental Svc	☐ Hemodialysis (2119)	☐ Infection Prevention	☒ Imaging Services
☐ Laboratory	☐ Nursing Policies (502)	☐ Pharmacy Services	☐ Progressive Care Unit
☐ Radiation Services	☐ Respiratory Therapy	☐ Surgical Services	☐ Transplant Center
☐ Trauma Services			

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COO, The Queen's Medical Center - West O`ahu

Submitted for Revision by:	Date	Date Approved by Dept Mgr (Nursing/Clinical)	Date Approved By SLC (Admin)	Date Approved By MEC/BOT (Medical Staff)
Most Recent Revision Info	01/2014			
Previous Revision Info	12/09 RS Program 09/2006 Lead Apron, *et.al.*, and RS Guidelines 09/2012 RS Pregnant Patients			

Distribution: Available via the Queen's Medical Center Intranet and to Medical Staff Members upon request. The master, signed original document is located in the office of the identified guardian.

OBJECTIVE

The fundamental objective of the medical use of radiation is to obtain optimum diagnostic information or therapeutic effect with minimal exposure of the patient, the radiological personnel concerned, and the general public. Therefore, the following methods and rationale hope to achieve the above objective by utilizing technical aspects and methods of radiation safety to minimize unproductive radiation exposure of human beings.

1. For the General Public:

Methods	Rationale
Fluoroscopy checks before patient load begins.	To insure radiation output of fluoroscopy stations for optimum consistency and quality.
Ask all females of childbearing age if they are pregnant or if there is a possibility that they are pregnant. If pregnant, refer to a Radiologist before proceeding.	To optimally minimize radiation exposure during exam or if possible, postpone or cancel exam, especially during the first trimester of pregnancy.
Close all doors in room before making exposure.	Avoid unnecessary exposure to other patients and employees outside the room.
Select the appropriate size cassette for each exam and limit the useful beam to the smallest area consistent with clinical requirements. Accurately align the x-ray beam with the patient and the film. There must be evidence of a cone cut on each film.	To avoid unnecessary primary and secondary radiation exposure to body parts which do not need to be seen for clinical evaluation on the finished radiograph.
Use optimal KV and minimal MAS (time for exposure to patient).	The use of high KV and low MAS (time) results in minimum dose to the patient.
Use optimal usable distance of the individual from the source.	To minimize radiation exposure to the patient.
Use a bucky or grid for any body parts measuring 10 to 12 cms. or more.	To reduce secondary and scattered radiation to the patient due to higher exposure necessary to penetrate part.
Use a lead shield over gonadal area of all patients up to the age of 50 years, unless such devices interfere with the conditions or objectives of the exam or treatment.	To avoid radiation exposure to gonadal area in patients during organ development, cell maturation and childbearing years.
Keep fluoroscopy exposure rate to a maximum of 5 R/min.	To reduce the higher amount of radiation exposure to patient that is necessary for fluoroscopy.
Avoid unnecessary repeat films due to positioning or technique errors.	To avoid unnecessary additional radiation exposure to the patient.
Fluoroscopy should not be used as a substitute for radiography.	To avoid unnecessary additional radiation exposure to the patient.

2. For the User:

Methods	Rationale
Wear film badge on the chest or abdomen at all times during working hours.	To provide a monitoring system for whole body dose radiation.
A. During fluoroscopy, badge should be worn outside lead apron.	A. For accurate reading to eyes and thyroid.
Stand deep within the control booth during radiation exposure to patient.	To avoid unnecessary radiation exposure to the body.
Wear lead apron of at least 0.25 mm lead to cover torso and upper legs during fluoroscopy and do not turn back to source.	To minimize additional radiation of gonadal regions.
A. Avoid putting hands near or under useful beam unless covered with lead gloves, and when possible stand at 90 degrees angle and 6' distance from source.	A. To avoid unnecessary radiation to other body parts.
B. Wrap-around aprons and thyroid shields are also available for use during fluoroscopy.	B. To avoid unnecessary radiation to other body parts.
Use mechanical supporting or restraining devices when patient must be held in position for radiography. If the patient must be held by an individual, that individual shall be protected with appropriate shielding devices and he should be positioned so that no part of this body will be struck by the useful beam and as far as possible from the useful beam.	To avoid unnecessary radiation and limit radiation exposure to the gonadal areas of user.
Wear lead apron and stand at 90 degrees angle and 6' distance from the patient, tube and useful beam during portable and/or surgery exposures.	To provide optimal protection from unnecessary radiation exposure.
A pregnant technologist will wear two film badges; one outside the apron, the other under the apron at the abdomen level.	To monitor the skin close as well as the radiation dose to the fetus.

Reference: Medical X-ray & Gamma-Ray Protection for Energies up to 10 MeV. Equipment Design and Use. NCRP Report No. 102 June 30, 1989.

LEAD APRON AND SAFETY CHECK

Lead aprons and thyroid collars are labeled numerically. Once a year they are fluoroscoped by an RT to guarantee their integrity. Results are logged and inventory lists are kept in the Radiation Safety Office.

RADIATION SAFETY GUIDELINES FOR PORTABLE SYSTEMS

Portable systems using both radiography and fluoroscopy play an important role in the management of the hospitalized patient. The radiation dose delivered to the patient presents an insignificant risk compared to the immediate benefit of the diagnostic exam. Sound radiation safety principles must be applied to minimize the exposure to the technologists, nurses, family, and other patients during these procedures.

1. Goal – Hawaii Administrative Rules Title 11 Chapter 45 sets an annual limit of 100 mrem to members of the general public. Occupationally exposed workers shall be limited to 5000 mrem per year. In practice, the QMC ALARA Program reduces this limit to 500 mrem per year for radiological staff.

2. Dosimetry – The scatter exposure at 6 feet from the patient is 400 times less than what the patient received. A portable radiography may deliver a skin dose of 500 mrem to the patient. This results in 1 mrem at 6 feet. A fluoroscopy study using a mobile C-Arm may deliver 10,000 mrem to the patient or 25 mrem at 6 feet.

3. Technique – The x-ray field shall be collimated to the smallest dimensions required to image the anatomy. The highest peaked kilovolts (kVp) and shortest time appropriate for the exam shall be used. The beam axis shall never be directed toward another patient or staff. For C-arm, lead aprons are required. Other patients and visitors are not allowed in the room during C-arm procedure.

4. Technologists – The technologist and/or operator must wear a lead apron if standing within 6 feet of the examined patient. No lead apron is required beyond 6 feet.

5. Nurses – Nurses shall maintain a minimum distance of 6 feet during the exposure. At this distance, a lead apron is not required for nurses when portables are performed on the nursing units.

6. Family – Family shall be asked to leave the room during the exam to minimize their exposure and maximize efficiency for the technologist during the study.

7. Other Patients – The exposure delivered at a distance of 6 feet is insignificant compared to the potential trauma of moving that patient. Therefore, nearby patients shall not be required to leave the room or wear a lead apron during portable x-rays.

RADIATION SAFETY GUIDELINES FOR PREGNANT PATIENTS

1. Purpose – To provide appropriate guidelines for handling pregnant or possibly pregnant patients requiring diagnostic examinations that involves ionizing radiation.

2. Background

   2.1. Available scientific data shows that the health risks associated with radiation to the fetus are small for the dose levels delivered by most diagnostic procedures. No proven effects have been observed for total radiation doses to the fetus less than 5 rad.

2.2. The health risks associated with radiation to the fetus are cumulative. As a result, previous exposures to radiation during the pregnancy must be considered before new procedures are initiated.

2.3. QMC shall follow the guidelines of The American College of Obstetricians and Gynecologists (ACOG) regarding radiological imaging exams conducted on pregnant patients (International Journal of Gynecology and Obstetrics, Vol 51 (1995) 288-291).

3. Procedure

3.1. Imaging Services should be notified when a patient is known or thought to be pregnant. The information should be included on the imaging requisition or entered into the CareLink order.

3.2. Before every imaging procedure, the technologist(s) should inquire from all female patients, of the child bearing age, as to whether she is or may be pregnant. If time permits, a pregnancy test should be performed.

3.3. If a patient is or may be pregnant, the radiologist assigned to that particular service should always be contacted.

3.4. Women should be counseled that x-ray exposure from a single diagnostic procedure does not result in harmful fetal effects. Specifically, exposure to less than 5 rad has not been associated with an increase in fetal anomalies or pregnancy loss.

3.5. Concern about possible effects of high-dose ionizing radiation exposure should not prevent medically indicated diagnostic x-ray procedures from being performed on the mother. During pregnancy, other imaging procedures not associated with ionizing radiation (*e.g.,* ultrasonography, MRI) should be considered instead of x-ray, when possible.

3.6. Ultrasonography and MRI are not associated with known adverse fetal effects. However, until more information is available, **an MRI is not recommended for use in the first trimester**.

3.7. Consultation with a radiologist or physicist may be helpful in calculating estimated fetal dose when multiple diagnostic procedures are performed on a pregnant patient.

3.8. The use of radioactive isotopes of iodine is contraindicated for therapeutic use during pregnancy.

3.9. Estimated fetal dose from some common radiologic procedures:

Procedure	Fetal Exposure
Chest X-ray (2 views)	0.02-0.07 mrad
Abdominal film (single view)	100 mrad
Intravenous pyelography	≥1 rad*
Hip film (single view)	200 mrad
Mammography	7-20 mrad
Barium enema or small bowel series	2-4 rad
CT† scan of head or chest	<1 rad
CT scan of abdomen and lumbar spine	3.5 rad
CT pelvimetry	250 mrad

* Exposure depends on number of films.
† CT indicates computed tomography.

4. Shielding Techniques

4.1. The technologist should shield the abdomen and pelvis with lead aprons for procedures above the abdomen or below the hip.

4.2. Contact the radiologist who can discuss the risks versus benefits for procedures performed where the fetus is in the x-ray beam and may receive a radiation dose greater than 5 rads. Imaging techniques not involving ionizing radiation should be considered.

4.3. Coverage of procedure should be limited to area essential for a diagnosis.

4.4. Repeat exposures should not be performed without consulting the radiologist responsible for reading the exam. Every effort must be made to eliminate repeat exposures.

4.5. Low exposure techniques should be used to reduce fetal dose.

Katanic, Janine

From: Schippers, Dale <dschippers@Queens.Org>
Sent: Tuesday, June 25, 2019 10:49 PM
To: Katanic, Janine
Cc: Goerner, Frank; Chadwick, Darlena
Subject: [External_Sender] FW: RE: NRC reported medical event
Attachments: Radiation Safety Minutes Q2, May 8, 2019.pdf; Radiation Safety Minutes Q2, Jun17, 2019.pdf; RSO-19-101_All Radiation Badge Monitoring Responsibilities.pdf; Estimated Dose Memo, Queen's Medical Center.pdf; Y-90 Medical Event, May8, 2019 NRC Report revised 5-30-2019 signed (with....pdf

Follow Up Flag: Follow up
Flag Status: Completed

This is part two with the remaining documents.

THE QUEEN'S MEDICALCENTER

Radiation Safety Committee Meeting
May 8, 2019

Attendees:

Name / (Role)	**Name / (Role)**
Darlena Chadwick, RN, VP (nursing & mgmt. rep.)	Doug Prager, MD (AU 35.100, 200, 300, 1000)
Dale Schippers (RSO)	Frank Goerner, PhD (medical physicist)
Jennifer Kimbell, PhD (Cyclotron management)	Gary Ropert (West Radiology mgmt.)
Kathy Sugai (Radiology Director)	

Absent:

Marc Coel, MD (AU 35.100, 200, 300, 1000)	Dana Ast (NM technologist, NHCH)
Anthony Herrera, MD (IR radiologist)	Brad Kim (NM technologist Punchbowl)
Stuart Tsuji, MD, PhD (AU 35.400, 600)	Vince Duryee, PhD (Authorized medical physicist)

Guests: Darby Corriston (Radiology Mgmt.)

I) Minutes of the meeting of the Feb 20, 2019 were reviewed and approved.

II) OLD BUSINESS:
1) Dose Tracking software
   i) We are tracking CT doses on all campuses. Phase 2 will record patient dose from flouro procedures.
2) Radioactive trash monitoring
   i) The purchase of a second set of detectors for West, including the server software, will be charged to Medical Physics_QHS cost center.
3) CT Protocol committee update
   i) The committee will meet next week. This should conclude the protocol review.
4) Fluoro Training
   i) The training can be accessed on Queen's intranet page.
   My Info / Learning Dashboard / Find Learning (under Quick Links) / search for "Fluoroscopy."
   ii) We discussed the need to define affected staff and physicians. Del can assist for SDS and OR. Ron Kuroda, MD for West physicians. Gary Goldberg, MD for NHCH physicians. Rick Bruno, MD may be able to help with physician names for Cardiology, Ortho and ED. Kapuna Montgomery for Cath Lab staff.

III) RSO REPORTS:
1) Dosimetry
   i) Fetal doses – all well below the 500 mrem limit.
   ii) Staff exceeding ALARA Level II (DDE >375 mrem, Ext >3750 mrem) for Q1.

Name	EDE2	LDE	Lt Finger	Rt Finger
i) [redacted]	379 mrem	1,268 mrem		
ii) [redacted]	393 mrem	1,309 mrem		
iii) [redacted]	946 mrem	2,117 mrem		6,762 mrem
v) [redacted]			7,712 mrem	6,309 mrem

All of the staff that exceeded ALARA II received a memo investigating their exposure.

2) Dosimeter use
   i) [redacted], MD, [redacted], MD and [redacted], MD may not be wearing their dosimeters on a regular basis.
3) Spills, Surveys
   i) No spills
   ii) All surveys documented.
4) Events
   i) Skin Doses exceeding 500 cGy
      a) Cath Lab patient ([redacted]) received a skin dose of 5.5 Gy on 3/6/2019.
      b) IR patient ([redacted]) had a dose to the reference point of 9 Gy on 3/4/2019.
   ii) CT High-dose log
      37 patients exceeded the CT dose thresholds.
      West comment: Poor centering of a Lumber spine and Head cuased several high doses. Romeo will send an email reminding technologists to center the patients. Others were due to patient size.
   iii) Misadministrations (NRC, State)
      c) none
5) Audits
   i) All areas had satisfactory audits.
6) Radiation Safety Training:
   i) Punchbowl HDR: January 2019
   ii) NHCH Nuclear Medicine (Angie Sanford): April 2019
   iii) PET: May 2019

IV) NEW BUSINESS:
1) NRC Cyclotron Inspection, March 18
   i) No violations
   ii) Recommended annual review similar to NM
   iii) Annual effluent monitoring is recommended
   iv) Pharmacy distribution license, from the NRC, could be discontinued.
2) Membership Changes
   i) A motion was made to remove Dana Ast and add Kelly Fitzgerald. Kelly is the new imaging supervisor for NHCH. The motion was approved (7 – yes, 0 – no votes).
3) Blood Irradiator update
   i) The x-ray unit should be delivered in early June.
4) RadPad use in Cath Lab
   i) Medical physics observed several cardiac imaging exams and measured the attenuation benefits of the RadPad.
   ii) The RadPad offers limited benefit for most procedures since the overhead shield is very effective at reducing the scattered radiation to the staff. The exception would be for exams that require left radial catheter placement.
   iii) Radiation safety practices that we observed were very good.

Radiation Safety Committee Meetings
- August 14, 2019
- November 13, 2019

THE QUEEN'S MEDICALCENTER

Radiation Safety Committee Meeting
June 17, 2019

Attendees:

Name / (Role)	**Name / (Role)**
Darlena Chadwick, RN, VP (nursing & mgmt. rep.)	Marc Coel, MD (AU 35.100, 200, 300, 1000)
Dale Schippers (RSO)	Frank Goerner, PhD (medical physicist)
Jennifer Kimbell, PhD (Cyclotron management)	Gary Ropert (West Radiology mgmt.)
Kathy Sugai (Radiology Director)	Anthony Herrera, MD (IR radiologist)
Kelly Fitzgerald (NHCH Imaging Supervisor)	Brad Kim (NM technologist Punchbowl)

Absent:

Stuart Tsuji, MD, PhD (AU 35.400, 600)	Vince Duryee, PhD (Authorized medical physicist)

Guests: Erin Capps, MD (Radiologist), Darby Corriston (Radiology Mgmt.)

I) Establish Quorum
   A) Management, Nursing and RSO plus > 50% of members were present.

II) Review changes to Radiation Safety Plan
   A) The revisions and additions to the plan were discussed.
      1) The committee recommended that package receipt include the requirement to deliver directly to NM or radiation therapy.
      2) Also discussed the requirements to wear dosimeters (film badges) and the consequences for failing to wear on a consistent basis.
      3) Radiation safety training for Security will be included in the annual SOS program.
      4) Add clarification for spills, major vs minor vs contamination.
   B) A motion was made to accept the changes to the plan. The motion was carried (10 – Yes, 0 – no votes)

III) Application for Personal Dosimetry form review
   A) The updated form, including the obligations of the user, were discussed.
   B) A motion was made to accept the changes to the form. The motion was carried (10 – Yes, 0 – no votes)

IV) Review TheraSphere Checklist
   A) The updated checklist was discussed.
   B) A motion was made to accept the changes to the checklist. The motion was carried (10 – Yes, 0 – no votes)

Radiation Safety Committee Meetings

- August 14, 2019
- November 13, 2019

THE QUEEN'S MEDICAL CENTER

RSO-19-101-All

June 2019

System-Wide Radiation Services Policies and Procedures of The Queen's Health System

Subject: RADIATION BADGE MONITORING RESPONSIBILITIES

This policy applies to all employees and contractors of the following entities, (collectively "Queens"):

☒ The Queen's Health Systems	☐ Queen's Development Corporation
☒ The Queen's Medical Center	☒ Diagnostic Laboratory Services, Inc.
☒ Molokai General Hospital	☐ Queen's Insurance Exchange, Inc.
☒ North Hawaii Community Hospital, Inc.	☐ CareResource Hawaii
☐ Queen Emma Land Company	☐ All Entities, and any other current or future subsidiaries

PUNCHBOWL CAMPUS

Dale Schippers

Dale Schippers, MS DABR
Radiation Safety Officer (RSO)

Darlena Chadwick, MSN, MBA, FACHE
Vice President, Patient Care

WEST OAHU CAMPUS

Susan R. Murray, FACHE
QHS Sr VP, West O`ahu Region
COO, The Queen's Medical Center-West O`ahu

NORTH HAWAII CAMPUS

Cindy Kamikawa, RN MS
President, North Hawaii Community Hospital

MOLOKAI GENERAL HOSPITAL

Janice Kalanihuia
President, Molokai General Hospital

Submitted for Revision by:	Date	Date Approved by Dept Mgr (Nursing/Clinical)	Date Approved By SLC (Admin)	Date Approved By MEC/BOT (Medical Staff)
Most Recent Revision Info	06/2019			
Previous Revision Info	04/2014			

Distribution: Available via the Queen's Medical Center Intranet and to Medical Staff Members upon request. The master, signed original document is located in the office of the identified guardian.

SCOPE

Individuals likely to receive 10% of the annual radiation dose limit (500 mrem/year is 10%), will be provided with and **MUST WEAR** radiation dosimeters when working with or around ionizing radiation. Radiation safety staff will determine which individuals or groups require monitoring. This includes personnel (employees and contractors) who work with radioactive material or x-ray equipment at The Queen's Medical Center.

PURPOSE

1. To ensure the safety of patients, staff and contractors at Queen's Medical Center that are exposed to ionizing radiation.
2. To ensure that staff and contractors are compliant with personnel monitoring procedures.

POLICY COMPLIANCE

The Radiation Safety Officer (RSO) or a delegate will review all dosimeter reports for high level exposures which will follow guidelines listed in the Radiation Safety Program. Additionally, dosimeter reports will be reviewed to ensure that staff are compliant in wearing their radiation badge dosimeters when working with or around ionizing radiation. If the RSO determines that staff have failed to wear their radiation dosimeter(s) while working with or around radiation the following corrective actions will be taken:

1. The first offense will result in a formal notification letter to the employee or contractor requesting additional information regarding the relatively low exposure recorded on their dosimeter.
    a. If the response is unsatisfactory or no response is given their supervisor will be notified in writing and be asked to have the employee or contractor provide a response to the letter.
2. If a second offense occurs, in the subsequent monitoring period, this will result in written notification to the individual as well as the individual's supervisor. The written notification will include a warning that a subsequent offense will result in the loss of privileges to work with or around radiation unless a satisfactory explanation is given.
3. If a third offense occurs, in subsequent monitoring periods or a consistent pattern of failure to wear their dosimeter is observed, the individual will lose privileges to work with or around ionizing radiation at all Queen's Health System's facilities.

PROCESS

1. To obtain a Radiation badge for occupational dose monitoring, radiation workers must submit a completed "Application for Personal Dosimetry" form (Appendix A) to the RSO.

2. If your radiation dosimeter is lost, misplaced, damaged or contaminated you must notify the RSO within 3 days. A "Lost Dosimeter Form" (Appendix B) must be completed and submitted to the RSO.

3. To obtain a Fetal Radiation badge for occupational fetal dose monitoring, radiation workers must notify the RSO. A "Declaration of Pregnancy" form (Appendix C) must be completed and submitted to the RSO for approval.

THE QUEEN'S MEDICAL CENTER
REQUEST FOR PERSONAL DOSIMETRY
RADIATION MONITORING BADGE

Appendix A
RSO-19-101_All

Type or print legibly all information requested.

1. Full Name: _____
   Last First Middle (Maiden)

2. Last 4 digits of your Social Security Number: _____ 3. Sex: ☐ Male ☐ Female

4. Department: _____ 5. Telephone No. / ext.: _____

6. Position/Title: _____

7. a. Have you previously been issued a radiation monitoring badge by QMC? ☐ Yes ☐ No

   b. If "Yes", complete the following:

   (1) Department: _____

   (2) Dates of Employment: From _____ To _____

8. Previous exposure history - OTHER THAN AT QMC.

   a. Have you been enrolled in a dosimetry program before? ☐ Yes ☐ No

   b. Have calculations and/or analysis been made of external radiation received, and/or radioactive materials deposited in your body? ☐ Yes ☐ No

   c. If answer to "a" or "b" above is "Yes", complete the following:

Note: This section only applies to the individual who has worked with radiation-producing devices or radioisotopes in a permanent status. List only those employers for whom you worked with radiation.

NAME OF EMPLOYER **AND** DEPARTMENT	ADDRESS (Street address, city, state, zip code)	FROM Month / Year	TO Month / Year

- Under the provisions of Title 10, Code of Federal Regulations, Part 19.13 (10CFR19.13), I authorize former employers to release my history of occupational radiation exposure to The Queen's Medical Center, Radiation Safety Officer.

- I have read and understand the form "Information and Responsibilities for Badged Radiation Workers" and agree to wear my radiation dosimetry badge any time I am using or around radiation while performing work duties at The Queen's Medical Center.

Signature: _____ Date: _____

RADIATION SAFETY USE ONLY

Series Code: _____

a. Monitoring badge required ☐ Whole-body Type _____ ☐ Ring Size _____

b. Frequency ☐ Monthly ☐ Quarterly

Date badge ordered: _____ Begin Wear Date: _____

Issue spare badge? ☐ Yes ☐ No Spare badge date: _____ Spare badge #: _____ Date Issued: _____

QUEEN'S MEDICAL CENTER

INFORMATION AND RESPONSIBILITIES FOR BADGED RADIATION WORKERS

(Do not return with badge application – please keep for your record.)

Radiation Monitoring Badges Are Required to be worn if you are exposed to more than 10% of the annual dose limit for radiation workers. The Radiation Safety Officer (RSO) will help you determine whether or not you are required to wear a radiation monitoring badge.

If the RSO determines that you are required to wear a radiation monitoring badge, it is MANDATORY that you wear the badge when you work with or around radiation. If the RSO determines that you are not regularly wearing your radiation badge when working with or around radiation, the following disciplinary action will result:

- Consistent neglect in wearing your dosimeter, as indicated by an unusually low reported exposure relative to your workload, will result in the loss of privileges to work with ionizing radiation. Consistent neglect is defined as 3 months of unexplained low exposures, relative to workload, in a 12 month period.

It is important that you wear your radiation monitoring badge for the following reasons:

1. **For your own safety related to radiation.**
   Exposure data will help the radiation safety office to better determine if the work environment you are in protects you from unnecessary radiation and if you are using radiation safely and adhering to ALARA.
2. **For the safety of your co-workers.**
   Your radiation exposure data can be helpful in estimating the exposure for other staff in the room.
3. **For the safety of patients.**
   Your radiation exposure can be an indication of the radiation the patient received and if the user is consistently using radiation in the safest manner possible.
4. **It's a requirement of Federal, State and regulatory agencies.**

Radiation Badge Monitoring Wearer's Responsibility Code:

I understand that in conjunction with my application submission for and issuance of a personnel radiation monitoring badge, I will comply with the following:

- Wear my badge whenever I am working in the vicinity of radiation or with radioactive material
- Return my old badge at the end of the wear period
- Wear my badge according to the appropriate type:
  1. Collar Badge – wear on collar, outside of lead apron (if a lead apron is worn)
  2. Waist Badge – wear on waist, underneath lead apron (if a lead apron is worn)
     If assigned a collar and waist badge, the waist badge must be worn underneath lead apron
  3. Fetal Badge – wear low in center of abdomen, underneath lead apron
     The fetal badge will be exchanged monthly, even if your chest badge is exchanged quarterly
     Note: Pregnant radiation workers should review the Declared Pregnant Worker information.
  4. Ring Badge – wear on dominant hand, under gloves, facing source of radiation
- The badge reading is a legal record and must reflect occupational exposure only:
  - Badge shall be worn only by the person to whom it was assigned
  - Badge shall not be worn during exposure I receive as a medical patient
  - Badge shall not be worn at institutions outside of The Queen's Medical Center
- If I lose my badge, I will report it on the Lost Dosimeter Form and request a replacement
- Failure to return my badge when it is due may result in disciplinary action
- Know and adhere to the Radiation Safety Program Manual and any associated policies and procedures specific to radiation safety that are applicable to my work, including 10 CFR 19.12 training requirements.

In the event that your dosimeter is lost or temporarily displaced you may participate in a procedure involving ionizing radiation only if another person is unable to take your place and you report the details of the procedure to the RSO within 3 days.

Also, if your dosimeter is not returned to Radiation Safety within 60 days of the end wear date, the RSO will estimate your exposure from your, or similar users, dose history. To properly assign the dose, we need the information requested below. If you have any questions contact the RSO at 691-4884.
Complete this form and return via email or inter-department mail to:

Dale Schippers, RSO
Nae'a - Radiation Therapy Department or dschippers@queens.org

Last Name	First Name

Department/Series Code:	phone / ext.

Begin Wear Date: _____ (or first use date)

End Wear Date: _____ (date badge was lost)

Type of badge: [Body]  [Ring]  [Other] _____

Briefly describe your duties around radiation sources.

Were there any circumstances during the period which might have caused an increase or decrease in your typical reading? (i.e. Unusually high workload, vacation/sick days off)

_____ _____
Signature Date

Radiation Safety Use Only Date:

Name: _____ Series Code: _____ Badge # _____

Previous exposure reading (mrem)

MONTH					
DDE					
LDE					
SDE					

Spare Badge Assigned?
Yes / No

millirem to be assigned: DDE _____ LDE _____ SDE _____

_____ _____
Radiation Safety Officer Date

DECLARATION OF PREGNANCY

Employee Name: _____ Department: _____

I have declared my pregnancy and wish to continue to work in my present capacity at The Queen's Medical Center. Currently, my work involves occupational radiation exposure.

The Radiation Safety Officer has provided me the following documents:

1) Radiation and Pregnancy: A Fact Sheet for the Public
2) Radiation Safety Guidelines for Fetal Protection

I understand that the additional risk from occupational exposure during my pregnancy is less than that for most occupational groups.

The approximate date of conception is _____.

A fetal radiation badge will be issued to monitor fetal radiation exposure. **This badge is to be worn at my waist and under the lead apron when one is being worn**.
I understand that the fetal dose will not be allowed to exceed the 500 mrem limit during the entire monitoring period.

_____ _____
Employee sign Date

_____ _____
Manager sign Date

Reviewed:

_____ _____
Radiation Safety Officer / medical physicist Date

MEMORANDUM

TO: Janine Katanic, PhD

FROM: Frank Goerner, PhD

RE: Dosimetry Audit of Interventional Radiologists during period of RAM use

Date: June 24, 2019

On June 21, 2019 dose estimation calculations were made for all of the interventional radiologist at Queen's Medical Center that work with or around radioactive materials including: [redacted] MD, [redacted] MD, [redacted] MD, [redacted] MD, [redacted] MD, [redacted] MD, [redacted] MD and [redacted] MD.

We reviewed all dosimetry records starting from the beginning of the Y-90 program. The first Y-90 procedure was done in December of 2011. We reviewed the records to look for any months that an interventional radiologist had a dose of minimal or "M" or when they had an unused or absent dosimeter. For each month that this occurred for each radiologist we also determined how many interventional cases that they performed. If a radiologist performed 10 or more interventional cases, and we determined that they may not have worn there radiation badge, we estimated their dose for that month.

It is difficult to determine what the dose estimate should be or when it is appropriate for a radiologist to receive an M on their dosimeter report because the amount of radiation they use on each patient is so variable. For example some patients only receive a few mGy of dose for a straightforward case done by an experienced radiologist, while others may receive up to 8 Gy of skin dose because a case is complex. Additionally the radiologist's position during a case can greatly affect the monitored dose. If they are standing directly behind the overhead lead shield and doing a procedure on a normal sized patient the dose rate we measured to their collar is 1 mR/hr. If, with a similar sized patient, the radiologist is unable to use the overhead lead shield the dose we measured would be 24 mR/hr. Additionally these doses will vary substantially with patient size. Based on these numbers were determined that it is possible and likely for a radiologist to receive an "M" for the month if they performed fewer than 10 cases.

Radiation dose was estimated for months when the radiologist performed more than 10 exams but the reported dose was listed as M. The expected dose per case was estimated by looking at time periods for which we had the number of cases and we knew that Dr. [redacted] and Dr. [redacted] wore their badges. We eliminated the rest of the physicians for the following reasons: Dr. [redacted] is part time, Dr. [redacted] does a lot of work in the operating room with a different fluoroscopy machine, Dr. [redacted] and Dr. [redacted] both have limited dose history at Queens,

Drs. [redacted] and [redacted] had too many Ms in there dose history. We looked at the total dose from January 2013 to March 2019 for Dr. [redacted] and determined how many cases he did during that period, eliminated any months of non-dosimeter use and found his dose per case rounded up to the nearest integer to be EDE2= 2 mrem, SDE & LDE = 5 mrem. Additionally we looked at Dr. [redacted]'s doses from January 2017 to March 2019 and his total number of cases and total dose for that time period and arrived at the same dose per case. For the following dose estimates we multiplied the estimated dose per case by the number of cases that were performed during the indicated period to arrive at our estimated dose.

[redacted] **MD** has worked at Queens Medical center since August 2018 and has had one month in December of 2018 with an M in his dosimetry record in which he participated in his normal workload. He recalls wearing a badge at all times during his entire time at Queens Medical Center. Upon reviewing his dose history his dose for November 2018 was 120 mrem DDE and his doses for January, February and March of 2019 were 21, 61, 62 mrem respectively. It is likely that he wore his November badge for the month of December as well as November.

[redacted] **MD** has worked at Queens Medical center since August 2018 and it appears based on review of his dosimetry records that he has worn his badge every month.

[redacted] **MD** has worked at Queens Medical center since before the start of the Y-90 program. His dosimetry records were reviewed from December of 2011 until present. Based on this review we believe the Dr. [redacted]'s dosimetry records are accurate and he regularly wore his badge. Dr. [redacted] did have 2 months that said his dosimeter was unused but we believe based on his habitual badge use that this was likely because he wore his dosimeter for 2 months in a row so we did not estimate any doses for him.

[redacted] **MD** has worked at Queens Medical center since before the start of the Y-90 program. His dosimetry records were reviewed from December of 2011 until present. Below are estimated doses for months in which Dr. [redacted] had a dose of M and performed 10 or more cases. The table below only lists estimated doses. Even with estimated doses Dr. [redacted] annual doses were well below regulatory limits.

[redacted] **MD**		Estimated Dose mrem		
Month-Year	# Cases	EDE2	LDE	SDE
May-13	46	92	230	230
April-15	32	64	160	160
May-15	24	48	120	120
August-15	69	138	345	345
August-17	111	222	555	555
July-18	50	100	250	250
January-19	20	40	100	100

[redacted] **MD** has worked at Queens Medical center since before the start of the Y-90 program. His dosimetry records were reviewed from December of 2011 until present. Below

are estimated doses for months in which Dr. [redacted] had a dose of M and performed 10 or more cases. The table below only lists estimated doses. Even with estimated doses Dr. [redacted] annual doses were well below regulatory limits.

[redacted]		Estimated Dose mrem		
Month-Year	# Cases	EDE2	LDE	SDE
February-12	35	70	175	175
June-12	26	52	130	130
July-12	38	76	190	190
December-12	57	114	285	285
December-13	21	42	105	105
January-14	50	100	250	250
February-16	24	48	120	120
April-17	22	44	110	110
December-18	17	34	85	85

[redacted] **MD** has worked at Queens Medical center since before the start of the Y-90 program. His dosimetry records were reviewed from December of 2011 until present. Below are estimated doses for months in which Dr. [redacted] had a dose of less than 10 mrem EDE2 and performed 20 or more cases. We changed the criteria slightly for Dr. [redacted] because he had a large amount of months with doses less than 10 but greater than 0, which seemed unlikely for someone with his case load.

				Estimated or Reported Dose mrem		
[redacted] MD	Reported Dose mrem					
Month-Year	EDE2	LDE	SDE	EDE2	LDE	SDE
December-11	2	7	6	2	7	6
January-12	M	M	M	146	365	365
February-12	8	27	27	118	295	295
March-12	9	31	30	186	465	465
April-12	M	M	M	122	305	305
May-12	1	4	3	90	225	225
June-12	M	M	M	102	255	255
July-12	M	M	M	148	370	370
August-12	M	M	M	92	230	230
September-12	1	2	1	206	515	515
October-12	M	M	M	106	265	265
November-12	1	1	M	178	445	445
December-12	M	M	M	38	95	95
		Total 2012		**1532**	**3830**	**3830**
January-13	M	M	M	40	100	100

February-13	M	M	M	180	450	450
March-13	28	92	90	28	92	90
April-13		ABSENT		108	270	270
May-13	M	M	M	162	405	405
June-13	48	158	154	48	158	154
July-13	23	75	70	23	75	70
August-13		ABSENT		122	305	305
September-13	M	M	M	214	535	535
October-13	M	M	M	136	340	340
November-13	M	M	M	122	305	305
December-13	M	M	M	122	305	305
		Total 2013		**1304**	**3340**	**3329**
January-14	M	M	M	76	190	190
February-14	M	M	M	36	90	90
March-14	M	M	M	128	320	320
April-14	M	M	M	82	205	205
May-14	M	M	M	142	355	355
June-14	M	M	M	154	385	385
July-14	M	M	M	80	200	200
August-14	M	M	M	62	155	155
September-14	M	M	M	150	375	375
October-14	M	M	M	144	360	360
November-14	M	M	M	66	165	165
December-14	M	M	M	188	470	470
		Total 2014		**1308**	**3270**	**3270**
January-15	M	M	M	112	280	280
February-15	M	M	M	108	270	270
March-15	M	M	M	110	275	275
April-15	M	M	M	72	180	180
May-15	M	M	M	194	485	485
June-15	1	2	1	74	185	185
July-15	3	11	10	192	480	480
August-15	M	M	M	66	165	165
September-15	M	M	M	258	645	645
October-15	M	M	M	134	335	335
November-15	M	M	M	98	245	245
December-15	M	M	M	138	345	345
		Total 2015		**1556**	**3890**	**3890**
January-16	M	M	M	128	320	320
February-16	M	M	M	88	220	220
March-16	M	M	M	104	260	260
April-16	M	M	M	204	510	510
May-16	M	M	M	208	520	520

June-16	56	185	185	56	185	185
July-16	12	40	40	12	40	40
August-16	M	M	M	60	150	150
September-16	77	257	246	77	257	246
October-16	9	29	27	130	325	325
November-16	131	436	430	131	436	430
December-16	48	160	156	48	160	156
		Total 2016		**1246**	**3383**	**3362**
January-17	61	203	198	61	203	198
February-17	50	168	168	50	168	168
March-17	74	247	244	74	247	244
April-17		ABSENT		82	205	205
May-17	133	447	447	133	447	447
June-17	67	222	219	67	222	219
July-17	94	314	313	94	314	313
August-17	51	170	168	51	170	168
September-17	35	115	113	35	115	113
October-17	89	295	290	89	295	290
November-17	23	77	76	23	77	76
December-17	140	466	458	140	466	458
		Total 2017		**898**	**2929**	**2899**
January-18	37	124	122	37	124	122
February-18	60	200	192	60	200	192
March-18	95	315	313	95	315	313
April-18	93	311	303	93	311	303
May-18	102	347	347	102	347	347
June-18	63	210	208	63	210	208
July-18	200	672	672	200	672	672
August-18	1	2	1	116	290	290
September-18	63	209	202	63	209	202
October-18	51	171	165	51	171	165
November-18	169	564	551	169	564	551
December-18	103	342	333	103	342	333
		Total 2018		**1153**	**3755**	**3698**
January-19	56	185	183	56	185	183
February-19	41	137	136	41	137	136
March-19	296	987	943	296	987	943
April-19	86	289	289	86	289	289

[redacted] **MD** has worked at Queens Medical center since before the start of the Y-90 program. His dosimetry records were reviewed from December of 2011 until present. Below

are estimated doses for months in which Dr. [redacted] had a dose of M and performed 10 or more cases.

[redacted] MD	Reported Dose mrem			Estimated Dose mrem		
Month-Year	EDE2	LDE	SDE	EDE2	LDE	SDE
December-11	UNUSED			78	195	195
January-12	M	M	M	16	40	40
February-12	M	M	M	92	230	230
March-12	5	18	18	28	70	70
April-12	5	16	16	170	425	425
May-12	M	M	M	126	315	315
June-12	M	M	M	136	340	340
July-12	M	M	M	22	55	55
August-12	M	M	M	12	30	30
September-12	M	M	M	98	245	245
October-12	M	M	M	214	535	535
November-12	M	M	M	68	170	170
December-12	M	M	M	68	170	170
			Total 2012	**1050**	**2625**	**2625**
January-13	M	M	M	128	320	320
February-13	M	M	M	86	215	215
March-13	M	M	M	100	250	250
April-13	M	M	M	52	130	130
May-13	M	M	M	54	135	135
June-13	M	M	M	178	445	445
July-13	1	2	2	204	510	510
August-13	M	M	M	106	265	265
September-13	M	M	M	104	260	260
October-13	M	M	M	110	275	275
November-13	M	M	M	18	45	45
December-13	UNUSED			164	410	410
			Total 2013	**1304**	**3260**	**3260**
January-14	UNUSED			122	305	305
February-14	M	M	M	226	565	565
March-14	M	M	M	98	245	245
April-14	M	M	M	84	210	210
May-14	M	M	M	150	375	375
June-14	M	M	M	134	335	335
July-14	M	M	M	176	440	440
August-14	M	M	M	76	190	190
September-14	M	M	M	56	140	140
October-14	M	M	M	122	305	305
November-14	M	M	M	52	130	130

December-14	M	M	M	86	215	215
			Total 2014	**1382**	**3455**	**3455**
January-15	M	M	M	78	195	195
February-15	M	M	M	110	275	275
March-15	M	M	M	102	255	255
April-15	M	M	M	108	270	270
May-15		UNUSED		58	145	145
June-15	M	M	M	4	10	10
July-15	M	M	M	170	425	425
August-15	M	M	M	40	100	100
September-15	M	M	M	60	150	150
October-15	M	M	M	98	245	245
November-15	M	M	M	56	140	140
December-15	M	M	M	66	165	165
			Total 2015	**950**	**2375**	**2375**
January-16	M	M	M	96	240	240
February-16	M	M	M	84	210	210
March-16	M	M	M	70	175	175
April-16	M	M	M	62	155	155
May-16	M	M	M	66	165	165
June-16	M	M	M	28	70	70
July-16	M	M	M	94	235	235
August-16	M	M	M	64	160	160
September-16	M	M	M	104	260	260
October-16	M	M	M	64	160	160
November-16	M	M	M	50	125	125
December-16	M	M	M	96	240	240
			Total 2016	**878**	**2195**	**2195**
January-17	M	M	M	156	390	390
February-17	M	M	M	124	310	310
March-17	M	M	M	152	380	380
April-17	M	M	M	216	540	540
May-17	M	M	M	132	330	330
June-17	M	M	M	78	195	195
July-17	M	M	M	126	315	315
August-17	M	M	M	100	250	250
September-17	M	M	M	92	230	230
October-17	M	M	M	178	445	445
November-17	M	M	M	142	355	355
December-17	M	M	M	118	295	295
			Total 2017	**1614**	**4035**	**4035**
January-18	M	M	M	146	365	365
February-18	M	M	M	64	160	160

March-18	M	M	M	104	260	260
April-18	M	M	M	106	265	265
May-18	M	M	M	68	170	170
June-18	M	M	M	80	200	200
July-18	M	M	M	104	260	260
August-18	M	M	M	62	155	155
September-18	M	M	M	70	175	175
October-18	M	M	M	92	230	230
November-18	M	M	M	28	70	70
December-18	M	M	M	82	205	205
			Total 2018	**1006**	**2515**	**2515**
January-19	M	M	M	84	210	210
February-19	M	M	M	82	205	205
March-19	M	M	M	78	195	195
April-19	M	M	M	116	290	290

[redacted] **MD** has worked at Queens Medical center since August 2014. Below are estimated doses for months in which Dr. [redacted] had a dose of M and performed 10 or more cases.

[redacted] **MD**	Reported Dose mrem			Estimated or Reported Dose mrem		
Month-Year	EDE2	LDE	SDE	EDE2	LDE	SDE
August-14	M	M	M	208	520	520
September-14	M	M	M	130	325	325
October-14	M	M	M	62	155	155
November-14		UNUSED		240	600	600
December-14		UNUSED		120	300	300
			Total 2014	**760**	**1900**	**1900**
January-15	M	M	M	212	530	530
February-15	M	M	M	188	470	470
March-15	M	M	M	178	445	445
April-15	M	M	M	212	530	530
May-15	M	M	M	130	325	325
June-15	M	M	M	242	605	605
July-15	M	M	M	166	415	415
August-15	M	M	M	156	390	390
September-15	M	M	M	90	225	225
October-15	M	M	M	166	415	415
November-15	M	M	M	64	160	160
December-15	M	M	M	190	475	475

				Total 2015		**666**	**1665**	**1665**
January-16	M		M		M	82	205	205
February-16		49		163	163	49	163	163
March-16	M		M		M	122	305	305
April-16	M		M		M	118	295	295
May-16	M		M		M	32	80	80
June-16	M		M		M	228	570	570
July-16	M		M		M	72	180	180
August-16	M		M		M	204	510	510
September-16	M		M		M	208	520	520
October-16	M		M		M	210	525	525
November-16	M		M		M	216	540	540
December-16	M		M		M	192	480	480
				Total 2016		**1030**	**2575**	**2575**
January-17	M		M		M	60	150	150
February-17	M		M		M	112	280	280
March-17	M		M		M	208	520	520
April-17	M		M		M	148	370	370
May-17	M		M		M	184	460	460
June-17	M		M		M	196	490	490
July-17	M		M		M	110	275	275
August-17	M		M		M	134	335	335
September-17	M		M		M	82	205	205
October-17	M		M		M	122	305	305
November-17	M		M		M	188	470	470
December-17	M		M		M	86	215	215
				Total 2017		**612**	**1530**	**1530**
January-18	M		M		M	152	380	380
February-18	M		M		M	94	235	235
March-18	M		M		M	230	575	575
April-18	M		M		M	132	330	330
May-18		79		270	270	79	270	270
June-18		151		505	505	151	505	505
July-18	M		M		M	112	280	280
August-18		251		852	852	251	852	852
September-18		57		196	196	57	196	196
October-18	M		M		M	138	345	345
November-18	M		M		M	134	335	335
December-18	M		M		M	134	335	335
				Total 2018		**714**	**2063**	**2063**
January-19	M		M		M	52	130	130
February-19	M		M		M	M	M	M
March-19	M		M		M	32	80	80

April-19	M	M	M	154	385	385