

Radiation Safety for ¹³¹Iodine MIBG

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MIBG Therapy

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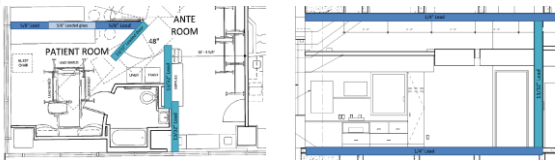
- ▶ Treatment targets primary and metastatic neuroblastoma
- ▶ Most common extracranial solid tumor in children
- ▶ Often the last resort for these patients
- ▶ Patients receive 18 mCi per kilogram
- ▶ Patients can receive therapy twice in their lifetime
- ▶ Infused over ~2 hour time period by Nuclear Medicine Technologist
- ▶ Majority of patient care is performed by family
- ▶ Minimal patient care is performed by the bedside nurse

Shielding Design

Source Assumptions

- ▶ Maximum patient dose assumed to be 1.5 Ci (~83 kg patient)
- ▶ Patient transmission of 71%
- ▶ Average "patient activity" over first 3 days equals 800 mCi
- ▶ One week of occupancy in adjacent areas
- ▶ Parent dose limited to 50 mrem for the year
- ▶ Floor to floor height of 14'6"
- ▶ Concrete floors (140 lb per cubic foot) and 5" thick
- ▶ Every 20", 6" beam is present to support 5" thick slab

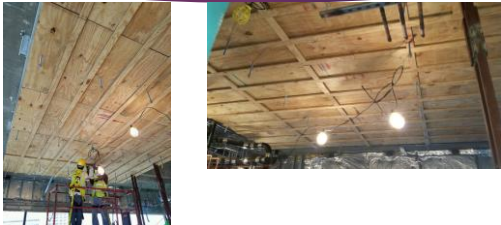
Lead Shielded Floor



Lead Shielded Floor



Lead Shielded Ceiling



Lead Shielded Wall

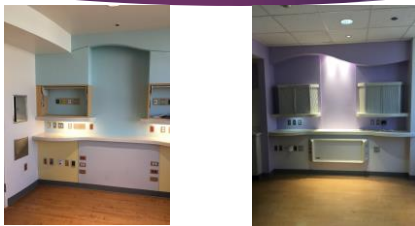


Room Design

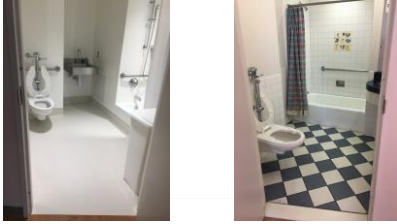
Room Design

- ▶ Flat surfaces – seamless and impervious to water
- ▶ Flooring – sealed and impervious to water, no tile, no grout
- ▶ Walls – washable and impervious to water
- ▶ Coved baseboards and corners – 4" - 6" up the wall
- ▶ Porcelain vs. Stainless Steel
- ▶ Lay-in ceiling vs. hard deck
- ▶ Negative pressure room – once through – no recirculation

West Tower 9 – Isolation Rooms



West Tower 9 – Isolation Rooms



View from Ante Room



Window Closed



Window Open



Lead Shielded Door



Portable Shielding at Bedside

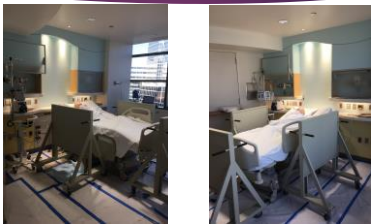


Care Team Training

Training and Simulation

- ▶ 2-hr classroom radiation safety training
- ▶ Hands on training
 - ▶ Donning/doffing PPE
 - ▶ Using GM survey meter
 - ▶ Wearing electronic dosimeter (and passive dosimeter)
 - ▶ Operating urine pump
- ▶ Simulation
 - ▶ Code/Respiratory Arrest
 - ▶ Urine spill

Training/Simulation

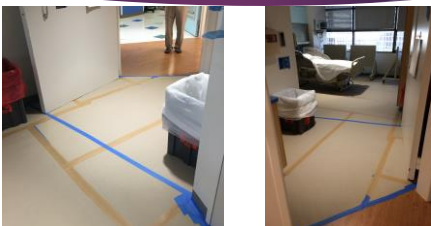


Contamination Control

Room Preparation



Room Preparation



Patient Care and Discharge

Patient Care

- ▶ Majority is performed by family caregivers
 - ▶ Routine Vital Signs
 - ▶ Oral Medication
 - ▶ Feeding
 - ▶ Changing Linens
 - ▶ Changing Diapers
 - ▶ Comforting child – time must be limited and dose must be monitored
- ▶ Parent training is provided prior to admission and on day of treatment
- ▶ Parent dose is tracked/measured using an electronic dosimeter

Caregiver Dose

- ▶ 10 CFR 20.1301(c)
 - ▶ A licensee may permit visitors to an individual who cannot be released, under 10 CFR 35.75, to receive a radiation dose greater than 100 mrem (1 mSv):
 - ▶ The radiation dose received does not exceed 500 mrem (5 mSv); and
 - ▶ The authorized user has determined before the visit that it is appropriate.
- ▶ P1 (400 mCi) – Mom = 112 mrem; Dad = 82 mrem; Adult Brother = 29 mrem
- ▶ P2 (400 mCi) – Mom = 40 mrem; Dad = 17 mrem; Adult Brother = 3 mrem
- ▶ P3 (560 mCi) – Mom = 25 mrem
- ▶ P4 (245 mCi) – Dad = 59 mrem; Mom = 31 mrem

Nurse Dose

- ▶ Administrative dose limit of 50 mrem per month, one 12-hour shift per patient, and 1 patient per month
- ▶ Patient 1 (400 mCi)
 - ▶ Day 1 = 35 mrem and 36 mrem
 - ▶ Day 2 = 15 mrem and 11 mrem
- ▶ Patient 2 (400 mCi)
 - ▶ Day 1 = 26 mrem and 18 mrem
 - ▶ Day 2 = 16 mrem and 10 mrem
- ▶ Patient 3 (560 mCi)
 - ▶ Day 1 = 17 mrem and 13 mrem
 - ▶ Day 2 = 12 mrem and 10 mrem
- ▶ EPD doses fits with passive dosimeter doses

Patient Discharge

- ▶ 10 CFR 35.75(a)
 - ▶ A licensee may authorize the release from its control of any individual who has been administered unsealed byproduct material or implants containing material if the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed 500 mrem (5 mSv).
- ▶ Discharge criteria of 7 mrem/hr at 1 meter (NUREG-1556, Vol. 9, Rev. 2, Appendix U, Table U.1)
- ▶ P1 - Monday morning dose rate of 6.3 mrem/hr at 1 meter
- ▶ P2 - Monday morning dose rate of 6.1 mrem/hr at 1 meter
- ▶ P3 - Monday morning dose rate of 6.1 mrem/hr at 1 meter
- ▶ P4 - Saturday afternoon dose rate of 5 mrem/hr at 1 meter

Patient Discharge

- ▶ Measured by Radiation Safety and record maintained for inspection
- ▶ Discharge instructions provided to parents
 - ▶ Use a different bathroom than other family members
 - ▶ Flush toilet 3 times after each use
 - ▶ Sleep in their own bed/room with no one sleeping on other side of wall
 - ▶ Use disposable utensils, cups, and plates
 - ▶ Limit time spent with small children or pregnant family members

Sewer Disposal

Sewer Disposal

- ▶ **10 CFR 20.2003, Disposal by release into sanitary sewerage**
 - ▶ (a) A licensee may discharge licensed material into sanitary sewerage if each of the following is satisfied:
 - ▶ (1) The material is readily soluble (or is readily dispersible biological material) in water; and
 - ▶ (2) The quantity of licensed or other radioactive material that the licensee releases into the sewer in 1 month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in Table 3 of appendix B to part 20; and
 - ▶ (3) If more than one radionuclide is released
 - ▶ (b) Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in paragraph (a) of this section.

Sewer Disposal

- ▶ **10 CFR 20, Appendix B, Table 3, Release to Sewers**
 - ▶ Monthly average concentrations ($\mu\text{Ci}/\text{ml}$)
 - ▶ I-131 = $1 \times 10^{-5} \mu\text{Ci}/\text{ml}$
- ▶ **Bounding calculation:**
 - ▶ 2 patients per month at 1.5 Ci each
 - ▶ 100% released to sewer
 - ▶ Requires ~80,000 gallons to sewer to reach $1 \times 10^{-5} \mu\text{Ci}/\text{ml}$
 - ▶ Average monthly release from our facility is greater than 500,000 gallons

Sewer Disposal



Sewer Disposal



Waste Management

Waste Management

- ▶ Most radioactive waste will be placed in 1 of 4 containers
 - ▶ Biohazardous Waste
 - ▶ Catheters/IV lines
 - ▶ Other biomedical waste that is potentially contaminated
 - ▶ Radioactive Linen
 - ▶ Radioactive Waste
 - ▶ PPE (gloves, shoe covers, isolation gowns, face shields, etc.)
 - ▶ Food Waste
 - ▶ Styrofoam food trays, cups, utensils, napkins, etc.
 - ▶ Solid food waste
- ▶ Liquids and soft food are disposed of using the sink and toilet

Waste Management

- ▶ Limit PPE waste to just PPE and it will most likely be immediately releasable
- ▶ Biohazard waste is a source of exposure
- ▶ Food waste is a source of odor
- ▶ Limit personal items taken into the room
- ▶ Child life supplied toys
- ▶ Weekend Waste Management
 - ▶ Empty biohazard waste and food waste on Friday afternoon
 - ▶ Place full bags of PPE waste into bathtub over weekend

Room Clearance

Room Clearance

- ▶ The following are placed in the appropriate waste container
 - ▶ paper and plastic used to "protect" the room
 - ▶ remaining linen, and
 - ▶ remaining disposable items
- ▶ All flat surfaces, the sink, the toilet, and other equipment are surveyed with a Geiger counter
- ▶ All radioactive waste are removed and placed in storage
- ▶ A detailed wipe survey is performed in the room
- ▶ Room released to Environmental Services for terminal clean

I-131 NaI Thyroid Ablation

Iodine-131 NaI

- ▶ Potential contamination to facilities is biggest concern during thyroid ablation
- ▶ Contamination control practices developed for I-131 MIBG have been applied
- ▶ Corner room with anteroom for care giver use
- ▶ Treatment of special needs patients
 - ▶ 18 year old developmentally delayed male with difficulty swallowing
 - ▶ Sedation and nasogastric intubation for administration of drug
 - ▶ Catheter placed for draining of bladder while sedated
 - ▶ Evaluation of home care to determine appropriate release criteria (greater than 7 mrem per hour).
 - ▶ Autistic patients with behavior issues
 - ▶ Development of care giver questionnaire to evaluate compliance during therapy

Y-90 Microspheres

Y-90 Microspheres

- ▶ Potential contamination to facilities and personnel is biggest concern during procedure
- ▶ Contamination control practices developed for I-131 MIBG have been applied
- ▶ Loose catheter is your biggest concern
 - ▶ Catheter not secured and fell to side of table
 - ▶ Contaminated liquid spilled on floor
 - ▶ Resident focused on procedure, not catheter, and stepped on spot of contamination
 - ▶ Contaminated shoes and scrub pants
 - ▶ Very important to survey everyone as they exit the IR suite
- ▶ TCH recently completed first case with no issues

Questions?
