

Division of Nuclear Medicine Procedure / Protocol University Hospital

DOSIMETRIC METASTATIC SURVEY and POST THYROID ABLATION SCAN
DECEMBER 2020

CPT CODE: 78018 and 78830

Indications: Thyroid carcinoma patients, post ablation of thyroid remnant, to determine whether a thyroid remnant and/or functioning thyroid carcinoma metastases are present, and to quantitate uptake in identified regions or lesions.

Patient Prep: Patient should be off all thyroid medication: l-thyroxine for one month and Cytomel® for at least 10 days. Note the length of time for which the patient has been off replacement thyroid hormone. The patient should have a TSH measurement in excess of 30 IU/ml prior to scanning. The patient might be put on a low iodine diet for 10 days prior to the scan, (avoid fish, seaweed, sushi, shrimp, iodized salt, dairy products, eggs, and sometimes restaurant food in general). The dosimetric questionnaire should be completed by a Nuclear Medicine Technologist upon communications with patient prior to exam.

The patient may also receive two (2) Thyrogen injections, instead of not taking their thyroid replacement medications, prior to receiving the iodine dose (this may vary between three different procedures). The advantage of the Thyrogen injections is that the patient will not become hypothyroid for an extended period of time. Most patients prefer this method for this procedure. The patient should follow the low iodine diet recommended by their physician. See the scheduling section for the three different protocols and their timing.

Scheduling: Some patients may receive Thyrogen injections, starting two days prior on Monday.

All patient regardless of receiving Thyrogen injections day one will be Wednesday. Patient will be scheduled for the following post I-131 administration

- Day 1 (2 HR): 60 min of scanner time
- Day 2 (24 HR): 60 min of scanner time
- Day 3 (48HR): 2.5 hours of scanner time
- Day 6 (144 HR): 60 min of scanner time
- Day 8 (192 HR): consult/ablation
- Day 13-15: post ablation scan for 2 hours of scanner time

Quality Control, Calibration Verification and Competencies:

Daily Quality control of the wipe counter must be performed and pass before starting any test.

The QC Nuclear Medicine Technologist of the day or any Nuclear Medicine Technologist completes the following checks and their associated logs. See the protocols listed below for specific instructions and pass/fail details.

- Daily Background Check
- Daily Efficiency/Constancy Check
 - Uses the QC labeled set of Co-57 matched sources/calibrators

Calibration verification must be performed and pass before starting any clinical testing.

The calibration verification check is only required on days of when clinical testing is being performed in Nuclear Medicine. This check verifies that the counter is accurate when counting a second Co-57 source, which has a known calibration coefficient to convert from counts/s to activity. This is performed with the verification labeled set of Co-57 matched sources/calibrators by those Nuclear Medicine Technologists qualified to perform these lab tests. See the protocols listed below for specific instructions and pass/fail details.

- Calibrator Verification Protocol
 - Uses the Verify Set labeled set of Co-57 matched sources.

Prior to counting, it should be confirmed that the I-131 calibration coefficient, which is determined through dilution, was performed within the last year.

Biannual Competency/Accuracy for Dosimetric Blood Draw Testing

All Nuclear Medicine Technologists must be in good standing with the bi-annual competency/accuracy before starting dosimetric blood draws.

- See Appendix for Biannual Competency/Accuracy for details on the performance of this competency.

Radiopharmaceutical & Dose:

4 mCi +/- 20% (3.2-4.8 mCi) I-131 NaI
Ablation doses will vary per patient

Imaging Source Standards:

On day one, a 50 uCi standard will be prepared by nuclear pharmacy in a 10 mL glass vial. The same standard will be scanned with the patient for each of the dosimetric scans. The source will be labeled with activity, date, and patient ID

Peaking source for I-131 (between 50-200uci), found in the nuclear pharmacy

Imaging Device:

GE OPTIMA 640 camera with HEGP collimators (preferred)
GE Infinia 2/Hawkeye 4 camera with HEGP collimators (when Optima not available)
Note: The same camera must be used for all dosimetric scans (non-diagnostic scans)

Data Acquisition:

Dosimetry Scans

Protocols - User - UWH Met Survey- I 131 Dosimetric. For whole-body images as outlined below. Be sure to name each file with the scan delay time.

Post Ablation Scan

Protocols - User - UWH Met Survey. Select the appropriate protocol for I-131

Acquisition Parameters:

Phantom & Neck Statics (same for additional extra statics as requested)	I-131
Static Key Parameters	
Detector Settings	
Detector 1	Phantom, Neck (extra views)
Detector 2	Not used
Termination Criteria	
Check	Stop on time
Time in Sec	300
Reached On	Each detector independently
For Energy Set:	I-131 364
For Scatter Correction	
Scan Location	
Mode	H
Start Angle	0
Patient Location	Feet first supine
Body Part	Chest
Use Body Contour	No
Image Settings	
Matrix	128x128
Rotation	0
Zoom	1
Pan X (may change if not centered)	0
Pan Y (may change if not centered)	0
Static Corrections	
Energy Session	I-131
Collimator	HEGP
Static Location Parameters	
Scan Location	
Mode	H
Start Angle	0
Patient Location	Feet First Supine
Body Part	Chest
Use Body Contour	No
Table Height	
Check	Absolute
CM	73
Static Admin Parameters	
Workflow (Inf 2/Hwk4)	
Check	Auto Apply
Ignite Settings (Inf 2/Hwk4)	
NM	None
Image Orientation	
Body Part	Chest
Body Side	Other

Whole Body Parameters Infinia or Optima, Diagnostic Planar	I-131	I-131
<u>Whole Body Key Parameters</u>	Diagnostic	Dosimetric
Detector Settings	Auto filled	Auto filled
Start Position	H	H
Use Body Contour	Yes	Yes
Patient Location	Feet First Supine	Feet First Supine
Location From:	Max scan length	Max scan length
Location To:	0	0
Scan Mode		
Check	Continuous	Continuous
Exposure Time per Pixel	360	200
Speed	6¹	12
<u>Whole Body Corrections</u>		
Energy session	I-131	I-131
Energy Window	364 keV	364 keV
Collimator	HEGP	HEGP
<u>Whole Body Location Parameters</u>		
Table Height		
Check	Absolute	Absolute
Height in CM	73 (Infinia) 90 (Optima)	73 (Infinia) 90 (Optima)
<u>Whole Body Admin Parameters</u>		
<u>Workflow</u>		
Check	Auto Apply	Auto Apply
<u>Ignite Settings</u>		
NM	None	None
<u>Image Orientation</u>		
Body Part	Chest	Chest
Body Side	Other	Other

Note 1: Scan speed is the slowest the system allows for continuous acquisition.

Infinia 2 or 3 / Optima	I-131
Tomo Key Parameters	
Mode	H
Start Angle	0
Patient Location	Must Choose
Body Part	Chest
Use Body Contour	Yes
Acquire CT/AC	Check
Select	Table In
Select	Emission First
CT/AC Range	Full
Select On	Emission
Zoom	1
Matrix	128x128
Pan Y	0
Select	Step & Shoot
Seconds	30
Tomo Corrections	
Energy session	I131 SC [364 and 446 and 297]. I131T
Collimator	HEGP
COR Correction	Check
Tomo CT/AC Parameters	
Scan Type	Helical
Pitch	1.9
Voltage	140 (Infinia) / 120 (Optima)
Current	2.5
Velocity	2.6
Matrix	512x512
Filter	Std
Extended FOV	Check
Tomo Location Parameters	
Mode	H
Start Angle	0
Patient Location	Must Choose
Body Part	Chest
Use Body Contour	Yes
Detectors 1 and 2	Check
Total Angular Range	360
View Angle	5
Direction	CW
Number of FOVs	1
FOV Time Multiplier	1
Rough Overlap	4
Direction	Table In
Select	Default
Motorized Pallet Support	Check
Tomo Admin Parameters	
Auto Apply	No
Release at End of Scan	Check
NM	None
CT/AC	None
FOV	None
Body Part	Chest
Acquisition Context	Unknown
Body Side	Other

Imaging Procedures:

- 1) Day 1:
 - a) Patient voids immediately prior to administration of dose.
 - i) Patient is to hold their bladder until after the 2-hour post administration image.
*Note: If patient cannot hold bladder, the scan should be done as close to 2 hours as possible.
**Note: Due to attenuation corrections for the bladder a patient cannot be catheterized.
 - b) 2 hours post dose
 - i) 1-minute single field of view blank scan of room without sources present.
 - ii) Position patient with arms at their side, feet held together.
*Be consistent between scans with regards to the use of a pillow below knees and head.
 - iii) Whole Body Planar imaging with a 50 uCi standard lateral to the right ankle. Standard should be taped to table edge, noting the cm as to where it was taped.
 - iv) Record head and feet location (cm)
 - v) Acquire dosimetric whole-body planar A/P images using protocol settings.
 - vi) Blood draw.
- 2) Day 2 (24 hours \pm 4)
 - i) Repeat day 1 procedure taking care to place patient in same location.
- 3) Day 3 (48 \pm 6) **Diagnostic** and **Dosimetric** scans acquired
 - a) 1-minute single field of view blank scan of room without sources present.
 - b) A 5-minute acquisition of the peaking source (50-200 uCi) using the neck phantom. Peaking source located in the nuclear pharmacy. Pre-measure the peaking source before the acquisition for its activity. Record this for the neck calculations later.
 - c) Position patient with arms at their side, feet held together.
*No pillow under the knees is to be used in order to keep the patient in the exact location.
 - d) **Dosimetric** whole body planar scan
Repeat day 1 procedure taking care to place patient in same location
 - e) A 5-minute acquisition of the neck is acquired with the patient supine on the bed.
 - f) **Diagnostic** Whole Body planar scan.
 - g) Have diagnostic scan reviewed before continuing to determine if 1 or 2 SPECT/CTs are needed.
 - h) SPECT/CT images acquired according to reading physician of the day
 - i) Blood draw.
- 4) Day 6 (144 \pm 6 hours)
 - a) Repeat day 1 procedure taking care to place patient in same location
 - b) Process blood samples
- 5) Day 8 - Ablation/Consult
- 6) Day 13-15 (5-8 days post ablation)
 - a) A 5-minute acquisition of the peaking source (50-200uCi) using the neck phantom. Peaking source located in the radio- pharmacy. Pre-measure the standard before the acquisition for its activity. Record this for the neck calculations later. The standard should be acquired within 10 minutes of the neck acquisition image.
 - b) A 5-minute acquisition of the neck is acquired with the patient supine on the bed.
 - c) **Diagnostic** Whole Body anterior and posterior planar scan
 - d) Have **diagnostic** scan reviewed before continuing to determine if 1 or 2 SPECT/CTs are needed.
 - e) SPECT/CT images acquired according to reading physician of the day

Blood Sample Procedure:

- A. Blood samples are drawn at the conclusion of the 2 hours, 24 hours, 48 hours, and 144 hours image appointments.
- B. Placement of 20-gauge butterfly. After placement of butterfly needle, the ability to draw back blood without resistance is to be confirmed, using an empty 3 mL syringe.
- C. Draw a 4ml blood sample with a 5 ml syringe and transfer to a Lavender top vacuette via a vacutainer blood transfer device.
 - \Rightarrow **Note:** Gently invert the blood sample after transfer to Lavender top vacuette to ensure adequate mixing of blood with the anticoagulant.
- D. Each tube must be labeled with two patient identifiers, the patient name and/or MR number and/or birth date and sampling date/time in the presence of the patient.
- E. Document all work on Dosimetric Blood Sample Worksheet.

- F. Blood Processing (after all dosimetric scans are complete, day 6):
- For each blood sample, invert/mix samples, prepare three 1.0 ml whole blood aliquots by pipetting into scintillation tubes for counting in triplicate. Cap tube, label, and save for counting.
- G. Counting Procedure: Counting device used is the LTI Multi-Wiper Nuclear Medicine Counter with the following processing protocol, DMS (protocol 6) under the Wipe Set Library (protocol 1). This protocol uses an isotope setting of 364 KeV \pm 20% window.
- H. Place the sample tubes in the counting trays as follows:
- I. Tray 1
- Wells 1 & 2, Background using lab grade water in the same volume as the samples to be counted. See the lab water appendix below about lot number and validation.
 - Wells slots 3 & 4 & 5, 2-hour blood samples
 - Wells 6 & 7 & 8, 24-hour blood samples
 - Record the start time of counting of samples on the Dosimetric Blood Sample Worksheet.
- J. Tray 2
- Wells 1 & 2, Background using lab grade water in the same volume as the samples to be counted
 - Wells slots 3 & 4 & 5, 48-hour blood samples
 - Wells 6 & 7 & 8, 144-hour blood samples
 - Record the start time of counting of samples on the Dosimetric Blood Sample Worksheet.
- K. Scan and send Dosimetric Blood Sample Worksheet to PACS

L. **Verifications:**

Documentation

All blood collection tubes are labeled with two patient identifiers in the presence of the patient and documented on the **DOSIMETRIC BLOOD DRAW VERIFICATION form**.

All counting tubes are labeled with two patient identifiers and documented on the **DOSIMETRIC BLOOD DRAW VERIFICATION (PT IDENTIFIER) S/P PROCEDURE form**.

Image Processing and PACS:

Diagnostic Planar Processing: To process the neck uptake, highlight both the phantom image and neck image, and click on the Met Survey Uptake I131 icon in Xeleris.

1. Click on **Process**. This will take you to step two.
2. Center the standard region of interest (ROI) over the standard on the image, click proceed.
3. Draw the thyroid ROI on the neck image, click proceed.
4. Draw the thyroid background ROI on the neck image (this should be an area outside the neck, preferably the shoulder area or some other image without increased areas of uptake), click proceed.
5. Enter the patient dose in **micro** Curies.
6. Enter the number of hours since the dose was administered to the time of the neck image (round to the nearest quarter hour).
7. Enter the standard activity in **micro** Curies, click proceed.
8. Take a screen capture (see example below) of this results page, file, and exit.

After completion of the diagnostic whole-body imaging, highlight the anterior and posterior emission images and select the **Whole Body & Spot Bone** review icon in Xeleris. This will display dual intensity images for the physicians.

1. Click on the anterior images.
2. Select ALL under the intensity box. Adjust the intensity to suit.
3. Label the anterior and posterior images accordingly.
4. Label the anterior image with the patient dose, the type of iodine dose received, and the number of hours post-dose.
5. Take a **DatabaseStudy1024B&W** screen capture (see example below), save and exit. Check the images with the reading physician of the day to see if additional images and/or SPECT/CT are needed. Sometimes two SPECT/CT image sets are needed.

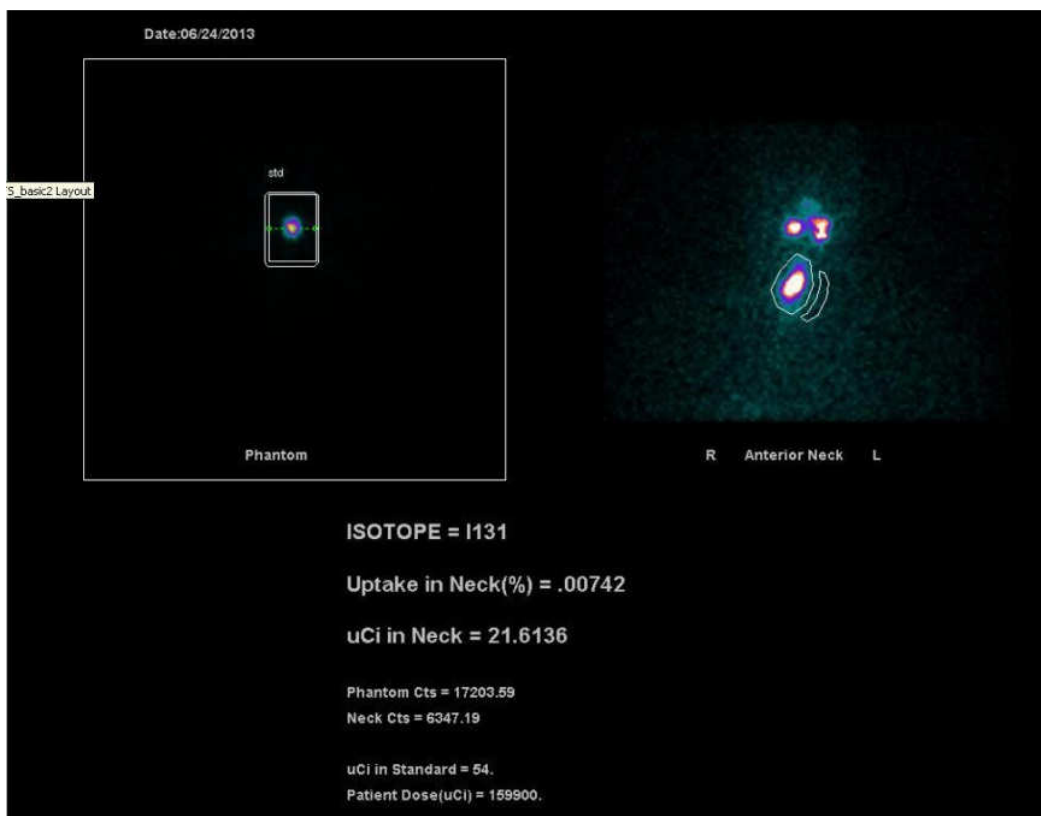
For additional static images, display them using the **Load to New** icon in Xeleris. Adjust the intensity of the images as necessary and annotate all images. Take a **DatabaseStudy1024B&W** screen capture and exit.

Screen caps below of sample images to PACS.

SPECT Processing: See **GENERAL SPECT/CT processing protocol**

Also send the entire study to the MDXCEL2.

The physicians may acquire create their own screen captures off the MDXCEL2 and ask that they be sent to PACS. The screen captures will need to be sent back from the MDXCEL2 to the processing Xeleris, and then to PACS. The MDXCEL2 is not directly linked to PACS.





Dosimetric Planar Processing: Needs to be completed on Day 6 or 7

1. Send raw dosimetric images to MIM, including A/P background scans and A/P dosimetry images (not conjugate view images)
2. Following completion of all dosimetric scans, highlight all dosimetric images in MIM, including background images, and run the workflow UW_I131_dosimetry.
3. Using contouring tools (2D brush or pen tool), create a contour around the entire body of the patient, excluding the standard.
4. Create new ROI, contour the standard
5. Run workflow to propagate contours through all time points.
6. Check contours on each time point, make corrections if needed.
7. Make ROI in background scans for each time point.
8. Create table with all counts, export to spreadsheet.
9. Send spreadsheet for full dosimetry analysis.

*Send all diagnostic and dosimetric images to PACS: All Raw Files, NM-Transaxials, NM- Coronals, NM-Sagittals, MIP, TOMO HWKY_EM_IRACRR, ...

Interpretation:

Functioning thyroid tissue in the neck requires ablation with 30 mCi doses. The minimum uptake exceeds in intensity the submandibular gland and nasal activity. This represents an uptake of > 0.03% of the administered dose. The physician should indicate pre scan TSH, plan for therapy (if any), when to restart T-4 (and dosage), and follow-up plans. If functioning metastases are seen then the patient is scheduled for therapy 100-125 mCi for lymph node mets, 125-175 for pulmonary mets, and 175-220 mCi for skeletal metastases.

NOTE: The NM physician must have the patient restart their thyroid hormone. A follow-up scan or appointment is made.

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I-131 Dosimetry Scans

Subject Name: _____

Subject MRN: _____

Subject DOB: _____

I-131 Survey Dose administered: _____

	<u>Baseline scan w/o patient</u>	<u>Baseline scan w/o patient</u>	<u>Day 1</u> 2 Hours Post Dose	<u>Day 1</u> 4-6 hrs post Dose	<u>Day 2</u> 24hrs ± 4 hours post dose	<u>Day 3</u> 48 hours (±4 hours) post dose	<u>Day 6</u> 120 hours (±4 hours) post dose	<u>Day 13-15</u> Post Ablation
Date								
Did subject void prior to imaging? (Y or N)	N/A							
Ideal Time								
Time of Scan								
Camera Used	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP	Manufacturer: GE Model: Optima 640 Computer Vendor: GE Medical Software: Xeleris 4.0 Camera Type: Dual Head Collimator: HEGP

I-131-CLR Dosimetry Scans

Subject Name: _____

Subject MRN: _____

Subject DOB: _____

	<u>Baseline scan w/o patient</u>	<u>Baseline scan w/o patient</u>	<u>Day 1</u> 2 Hours Post Dose	<u>Day 1</u> 4-6 hrs post Dose	<u>Day 2</u> 24hrs ± 4 hours post dose	<u>Day 3</u> 48 hours (±4 hours) post dose	<u>Day 6</u> 120 hours (±4 hours) post dose
Acquisition Start Time							
Acquisition End Time							
Scan speed (cm/min)							
Head location (cm)							
Feet Location (cm)							
Deviations to scanning							
Cobalt-57 peak	122 ± 20%	122 ± 20%	N/A	N/A	N/A	N/A	N/A
I-131 Peaks			<input type="checkbox"/> 297 +/- 20% <input type="checkbox"/> 364 +/- 20% <input type="checkbox"/> 446 +/- 20%	<input type="checkbox"/> 297 +/- 20% <input type="checkbox"/> 364 +/- 20% <input type="checkbox"/> 446 +/- 20%	<input type="checkbox"/> 297 +/- 20% <input type="checkbox"/> 364 +/- 20% <input type="checkbox"/> 446 +/- 20%	<input type="checkbox"/> 297 +/- 20% <input type="checkbox"/> 364 +/- 20% <input type="checkbox"/> 446 +/- 20%	<input type="checkbox"/> 297 +/- 20% <input type="checkbox"/> 364 +/- 20% <input type="checkbox"/> 446 +/- 20%
Reference standard activity			Units: _____	Units: _____	Units: _____	Units: _____	Units: _____
Time assayed							
Date assayed							

PATIENT DOSIMETRIC METASTATIC SURVEY QUESTIONNAIRE

UPDATED: February 2020

NAME _____ EXAM DOSIMETRIC METASTATIC SURVEY
MR # _____ DATE _____
TSH (>30 IUl/ ml) _____ Thyrogen Injections: _____

Is there a pregnancy Test ordered (if applicable)? YES NO

PLEASE ANSWER THE FOLLOWING QUESTIONNAIRE WHEN CALLING PATIENT PRIOR TO STUDY.

1. Have you recently taken the following medications? If so, please include dose and when last taken.

- Synthroid (1 Month)
• (Levothyroxine, Levoxyl, Unithyroid)
- Cytomel (10 Days)
• (Triostat, Liothyronine)
- Kelp Supplement
- Iodine Supplement
- SSKI Drops
- Seaweed Supplement

Dose and date last taken: _____

2. Did your ordering physician place you on a Low Iodine Diet? If so, for how long? YES NO _____ Days

- Low Iodine Diet:
- No iodized salt
 - No foods from the sea
 - Limit amounts of beefs, chicken, and turkey
 - No dairy products or foods containing dairy
 - Limit grain products (i.e. noodles, pasta, pastries) - 1 slice bread, ½ cup pasta daily

3. Have you eaten any of the following items within 10 days? If, so please include when last consumed.

- Miso Soup
- Seaweed
- Sushi
- Kelp
- Fish
- Shellfish

Date last consumed: _____

4. Have you recently undergone the following: If so, please indicate when?

- Medical Imaging with Contrast
- Thyroid Radioactive Iodine Treatment

Date of Exam: _____

5. Are you claustrophobic, or have needed medications like valium for MR or CT scans? YES NO

Brief Radiation Safety Topics to be covered with patient:**Low Dose Metastatic Survey precautions:**

1. Maintain an arms' length distance from other people if you will be with them for long stretches of time. The amount of radiation exposure will decrease quickly as the distance is increased. Even an arm's distance can reduce doses that other people may receive by 10-30 fold. Maintain this for the first 24 hours.
2. Flush the toilet twice after using it. Brush once under the rim of toilet with toilet brush and flush again. If you can, use a toilet that others won't use for the first 24 hours.
3. Avoid sharing of eating utensils. After use, you can wash your utensils as usual.
4. Avoid close contact with children and pregnant women during this 24-hour period.
5. Increase fluid intake for the first 24 hours and void frequently.

High Dose Ablation Precautions:

1. Do not return to work for 2 days.
2. Limit your time in public areas
3. Do not travel by airplanes or prolonged car trips for one week.
4. Maintain an arms' length distance from other people if you will be with them for long stretches of time and double this distance for pregnant women and children. The amount of radiation will decrease quickly as the distance is increased. Maintain this for four days.
5. Flush the toilet twice after using it. Brush once under the rim of toilet with toilet brush and flush again. If you can, use a toilet that others won't use.
6. Avoid sharing of eating utensils. After use, you can wash your utensils as usual.
7. Use lemon candies to increase saliva secretion.
8. Sleep alone for 4 days unless otherwise instructed by your doctor.
9. Wash your towels, bed linens, underwear, and any clothing stained with urine or sweat separately from others for the first 2 days.

Dosimetric Blood Sample Worksheet

MRN: _____ Patient Initials: _____

Patient Weight: _____ kg Height: _____ cm

Inj. Date: _____ Inj. Time: _____

Total Inj. Activity _____ mCi Calibration Factor _____
(cpm/nCi/mL)

Imaging Reference Standard Activity

Day 1 (2 hrs)	uCi	Date:	Time:
Day 2 (24 hours ± 4)	uCi	Date:	Time:
Day 3 (48 ± 6)	uCi	Date:	Time:
Day 6 (144 ± 6 hours)	uCi	Date:	Time:

Blood Sampling Times

Please record dates and times when samples were taken below:

Time Point (post injection)	Date (Day/Month/Year)	Actual Time (24 hr clock)
Day 1 (2 hrs)		
Day 2 (24 hours ± 4)		
Day 3 (48 ± 6)		
Day 6 (144 ± 6 hours)		

Blood Counts

	Whole Blood Sample	Date Counted	Time Counted	CPM/ mL	Bkg CPM
1	Day 1 Sample 1				
2	Day 1 Sample 2				
3	Day 1 Sample 3				
4	Day 2 Sample 1				
5	Day 2 Sample 2				
6	Day 2 Sample 3				
7	Day 3 Sample 1				
8	Day 3 Sample 2				
9	Day 3 Sample 3				
10	Day 6 Sample 1				
11	Day 6 Sample 2				
12	Day 6 Sample 2				