

# **<sup>177</sup>Lu Anonymized Patient Datasets**

## **Multi-time point Lu-177 SPECT/CT Scans**

### **Acknowledgement Request for Published Use:**

We ask that anyone using this data for publications/presentations acknowledge this as follows:

“We acknowledge Yuni Dewaraja at the University of Michigan for providing access to Lu-177 patient imaging data and segmentations obtained with support from R01EB022075 awarded by NIBIB and R01CA240706 awarded by NCI, NIH. Data were shared via the University of Michigan Deep Blue Data sharing repository.”

The patient data shared is to be used for purposes of research only as indicated in the License file. Any use for commercial purposes is not permitted at this time.

### **Introduction:**

Internally administered targeted radionuclide therapy (TRT) with radio-labelled targeting molecules that deliver cytotoxic radiation to tumor has been used successfully to treat multiple cancers. Lu-177, used increasingly in TRT, emits both beta particles that deliver the therapeutic effect and gamma-rays that are suitable for SPECT imaging.

The FDA recently approved a fixed activity regimen (4 cycles of 7.4 GBq/cycle as in NETTER -1 administered every 8 weeks) Lu177 DOTATATE TRT for neuroendocrine tumor. For patients under this standard treatment at University of Michigan, we performed SPECT/CT imaging at 4 time points after Cycle 1 or 2 with the goal of performing highly patient specific dosimetry to establish dose-response relationships.

Corresponding volume of interest (organs, lesions) contours were defined manually by a radiologist (lesions) or a technologist (organs) using semi-automatic tools. For 2 patients we share here baseline diagnostic imaging scans, multi-time point planar and SPECT/CT imaging data, time-integrated activity images and segmented VOIs.

### **File Descriptions:**

This publication contains anonymized diagnostic imaging scans of two patients who have liver cancer. The images provided are all taken within 8 days of the patients receiving a therapeutic dose of Lutathera. These post-therapy single-photon emission computed tomography (SPECT) scans are used clinically by the physician to identify the radionuclide dose distribution throughout the body and acquired on a Siemens Intevo system and reconstructed using xSPECT Quant.

The publication is divided into 2 main folders, one for each patient. Both patients have had scans taken 4 times after treatment. Patient 4 was imaged on the day of treatment, as well as 1, 4, and 5 days after treatment. Patient 6 was imaged on the day of treatment, as well as 1, 4, and 8 days after treatment.

There are slice-by-slice SPECT and co-registered CT DICOM files provided for each day of imaging for a patient. All scans are windowed around the abdominal region to include the entire liver and any other metastatic disease the patient had at the time of treatment. Units for the SPECT images are Bq/mL.

## **Collection Information:**

This collection is comprised of a number of works that collectively represent the imaging studies and information necessary for dosimetric analysis of a patient treated with Lutathera. All works may be used as standalone datasets or in conjunction with the others in this collection depending on the analysis performed.

Files are stored using the DICOM standard widely accepted for storage and transmission of medical images and related information. All patient private information has been anonymized using MIM commercial software (MIM Software Inc.).

Data from 2 patients, referred to as patient 4 and patient 6, has been provided in this collection and is divided among 6 works as outlined below:

### **1) Pre-therapy Diagnostic Images**

#### **Description:**

Patient diagnostic scans performed prior to Lutathera treatment. Used for identifying lesions and measuring progression. Note that the date of the baseline scan may be several months before the Lutathera treatment and changes in the anatomy are possible.

#### **Files:**

(1) Ga68 Dotatate PET/CT

Either:

(1) MRI

(1) standalone diagnostic CT

### **2) Multi-Time Point Lu-177 Planar Whole Body Scans**

#### **Description:**

Planar whole body Lu-177 scans taken at 4 time points within the 8 days after treatment. Two views (Anterior and Posterior) and 3 energy windows (one main window at 208 keV and 2 adjacent scatter windows) are available for each time point. The units of this image is counts. Energy window information, acquisition data/time and duration can be found in DICOM header.

#### **Files:**

(6) individual images at each time point (24 total images per patient)

### **3) Multi-Time Point Lu-177 SPECT/CT Scans**

Lu-177 SPECT/CT scans at 4 time points within the 8 days after treatment (same time points as the planar scans). Images were acquired on a Siemens Intevo system and reconstructed using xSPECT Quant. The units of this image is Bq/mL. Information on the reconstruction, acquisition date/time, duration, Lu-177 administration time and activity can be found in the DICOM header.

#### **Files:**

(1) Folder with reconstructed SPECT slices per time point (4 folders total per patient)

(1) Folder containing registered CT slices per time point (4 folders total per patient)

### **4) Lesion and Organ Volumes of Interest**

#### **Description:**

DICOM RT structure files containing organ and lesion volumes of interest (VOI) that are registered to the SPECT acquisition at each of the 4 time points in **3)**. Full contour Boolean masks were created for each of the defined structures. Organs were defined using semi-automatic tools (atlas based and CNN-based) while lesions were defined manually by a radiologist guided by baseline scans. Only lesions >2 cc were defined.

#### **Files:**

(1) Folder with organ contours per time point (4 folders total per patient)

(1) Folder with lesion contours per time point (4 folders total per patient)

(1) Folder with organ Boolean masks per time point (4 folders total per patient)

(1) Folder with lesion Boolean masks per time point (4 folders total per patient)

### **5) Lu-177 SPECT Time Integrated Activity Maps**

#### **Description:**

A DICOM file containing the time-integrated activity map over all 4 time points within the 8 days after treatment. This combines the SPECT/CT scans provided in **3)** into a single integrated activity map. This map was generated via the MIM MRT Dosimetry package: The 4 time points were registered to the reference SPECT scan (time point 1) using a contour intensity based SPECT alignment and the voxel-level time-activity data was fit using exponential functions. Voxel-level integration was performed to generate the TIA map. The units of this image is Bq/mL \* sec

#### **Files:**

(1) Folder with Time-integrated activity image per patient

## 6) Lu-177 SPECT Projection Data and CT-based Attenuation Coefficient Maps

### Description:

SPECT projection data for each of the 4 Lutathera scans taken within the 8 days after treatment is provided in 3 forms: unaltered, Siemens [Reformatted], and Siemens [Advanced]. The difference between the Projections and the [Advanced] Projections is that the [Advanced] consists of uncorrected raw projection data and the other the corrected projection data (e.g. camera uniformity corrections). The [Advanced] projections are used in xSPECT reconstruction (where all corrections are done during the reconstruction), while the other is used in Flash 3D reconstruction.

CT-based attenuation coefficient maps (mumaps) are provided for each of the 4 scans taken within the 8 days after treatment. Two methods are provided for each mumap: xSPECT and F3D as the matrix size is different for the 2 cases (256 x 256 for xSPECT and 128 x 128 for Flash3D).

### Files:

- (3) Folders containing raw SPECT projections
- (2) Folders containing CT attenuation coefficient maps (mumaps)

## Additional Information:

### Patient 4:

Patient 4 is a 64 yr old male with the anonymized patient ID ANON54121

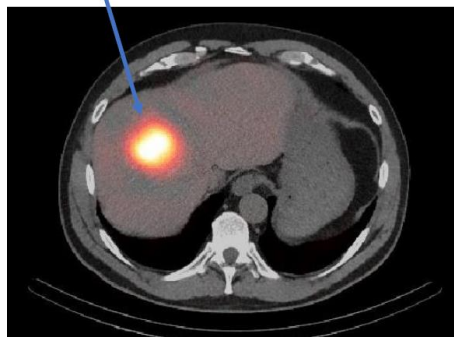
<sup>177</sup>Lu Injected Activity: 7.21 GBq

<sup>177</sup>Lu Time/date of Injection: 15NOV2018 09:22 AM

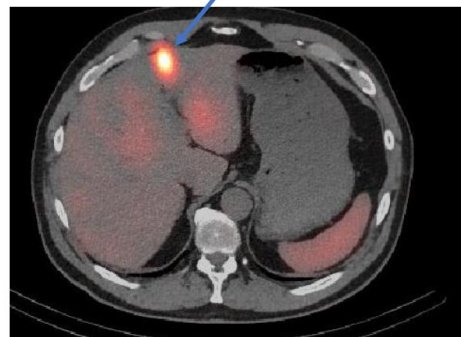
Imaging provided at 4 time points following Cycle 2 of Lutathera

Two lesions were identified and outlined by a radiologist as >2cc for this patient. These are visually identified in the images below. Other lesions may be present, but are not included in this publication.

Lesion 1  
(liver  
large)



Lesion 2  
(liver  
small)



**Patient 6:**

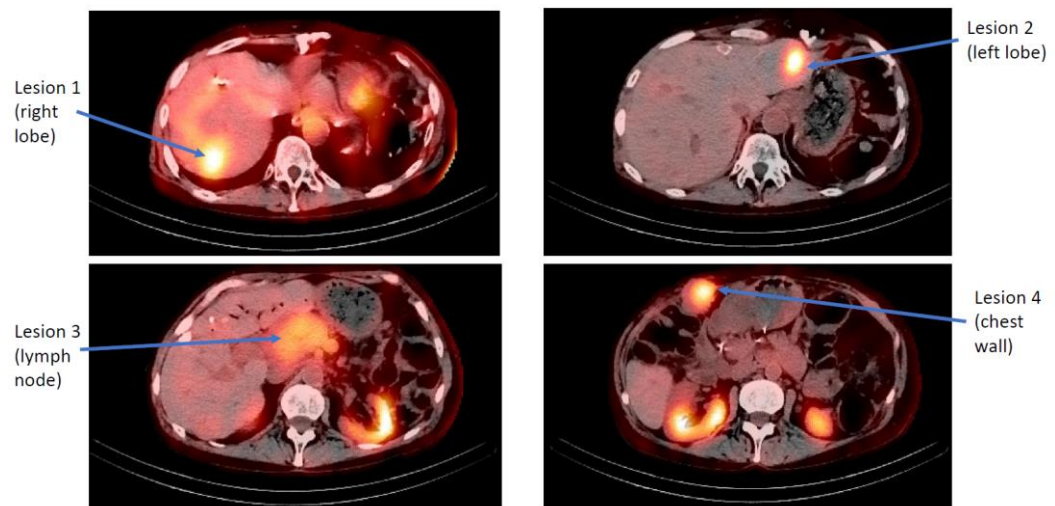
Patient 6 is a 63 yr old female with the anonymized patient ID ANON60350

$^{177}\text{Lu}$  Injected Activity: 7.31 GBq

$^{177}\text{Lu}$  Time/date of Injection: 15MAY2019 09:55 AM

Imaging provided at 4 time points following Cycle 1 of Lutathera.  
Patient has no spleen.

Four lesions were identified and outlined by a radiologist for this patient. These are visually identified in the images below. Other lesions may be present, but are not included in this publication.



Information on scan data/time, acquisition time, matrix size, pixel size, reconstruction method/parameters etc. are available on the DICOM header of these files. Only Personal Health Information (PHI) were removed during the anonymization.

## Glossary:

### DICOM Naming:

The series description for the DICOM files provided include an indexing code in their folder or file names for easy identification of which scan they belong to.

### **C[x]S[y]D[z]**

C[x] refers to the Lutathera cycle. Lutathera is administered in 4 cycles for the patients in this publication and at the moment this collection only provides scan data for a single cycle for each patient, which is cycle 1 for patient 6 and cycle 2 for patient 4.

S[y] refers to the scan number. Four scans are taken after each treatment cycle and all 4 scans are provided in this publication.

D[z] refers to the day the scan was taken on. Days are numbered from 0 (day of Lutathera treatment) to 8 (8 days after treatment).

## Related Materials:

### Publications:

Our publications related to above data that may have additional information you are looking for are listed below. However, note that in some cases in-house developed algorithms were used for reconstruction while all images in this repository were reconstructed using clinic software.

- 1) Theresa P Devasia, Yuni K Dewaraja, Kirk A Frey, Ka Kit Wong, Matthew J Schipper. A novel time-activity information sharing approach using nonlinear mixed models for patient-specific dosimetry with reduced imaging time points: application in SPECT/CT imaging post-177Lu-DOTATATE. J Nuc Med 2020  
<https://doi.org/10.2967/jnumed.120.256255>.
- 2) Mirando D, Dewaraja, YK, Cole NM, Nelson AS. In pursuit of fully automated dosimetry: evaluation of an automatic VOI propagation algorithm using contour intensity-based SPECT alignment. Eur J Nucl Med Mol Imaging. 2020;47(Suppl 1): S236.

## Datasets:

Other datasets currently referenced in this readme, or future works published in the University of Michigan Deep Blue Data repository can be located via the Deep Blue Data downloads page for this work. Look for the “Relationships” or “Citations to related material” attributes on the downloads page for documents related to this publication.

DOI's for the currently associated works are also listed below:

### **Pre-therapy Diagnostic Images**

DOI: <https://doi.org/10.7302/vqmy-g059>

### **Lesion and Organ Volumes of Interest**

DOI: <https://doi.org/10.7302/vhrh-qg23>

### **Lu-177 SPECT Time Integrated Activity Maps**

DOI: <https://doi.org/10.7302/9nct-bk44>

### **Multi-Time Point Lu-177 Planar Whole Body Scans**

DOI: <https://doi.org/10.7302/y4xd-s758>

### **Lu-177 SPECT Projection Data and CT-based Attenuation Coefficient Maps**

DOI: <https://doi.org/10.7302/ctcw-6s13>

This publication may be cited as follows:

Dewaraja, YK., Van, BJ. (2021) Lu-177 DOTATATE Anonymized Patient Datasets: Multi-Time Point Lu-177 SPECT/CT Scans [Data set]. University of Michigan - Deep Blue. <https://doi.org/10.7302/0n8e-rz46>.