9 Renal

The Renal application allows you to analyze and display dynamic single- and multi-phase planar renal studies.

NOTICE

The application uses the Pre Injection Syringe and Post Injection Syringe images, if loaded, to compute the injected dose. Use the following guidelines when acquiring pre- and post-injection syringe images:

- Place the syringe on the table 30 cm from the collimator face. Under the syringe, include all other items typically used between a patient and the table (e.g., sheet, pad, restraining strap).
- If the radiopharmaceutical activity of the pre-injection syringe is greater than 3 mCi, use a syringe shield when acquiring images for both the pre- and the post-injection syringes. Pre-injection syringe activity less than 3 mCi does not require shielding.
- If you typically image patients in the supine position, position the detector under the table. If you use a different patient position, position the detector accordingly.
- Acquire a one-minute static image of each syringe, using a 256 x 256 matrix to avoid pixel overflow.

This application allows you to process and analyze planar renal studies of 1, 2, or 3 phases. You can use this application to:

- Load and process dynamic images from a renal study for display and processing. You can limit the set of frames in the loaded dynamic sets to a consecutive subset of frames for use in processing.
- Create your own predefined default sets and define the rules for matching the default sets to study types and protocols (with the appropriate system permissions). By default, the application uses predefined parameter values based on the protocol name of the selected study.
- Choose a processing algorithm. Choices include: ERPF (plasma and camera-based); GFR (plasma and camera-based); Lasix; Transplant; and Gates. The application takes the algorithm you choose as a default chosen based on exam name, and uses the algorithm to determine which ROIs are required.
- Inspect, define and modify input values for the analysis, such as injection times, doses, patient height and weight.
- Create composite images from the dynamic and use them for defining ROIs.
- Define pre- and post-injection syringe images and pre- and post-void bladder images.
- Perform automated organ segmentation, including identification of right and left kidneys, right and left background regions, and aorta as required by the processing algorithm chosen. You can choose the shape of the background ROIs.

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- Manually define the required regions and modify any system-generated regions. After reviewing the curve plots of the specified regions, you can adjust the scale and displayed range of the plots.
- Perform Patlak corrections.
- Adjust the time interval for update calculations.
- Display a differential renogram.
- Compute and display the Hilson index for a transplant.
- View post-miction displays as applicable for the selected study.

The application has these methods:

- Simple Renogram
- Pre Post Lasix
- Post Renogram Lasix
- GFR Gates
- GFR Plasma
- ERPF Schlegel
- ERPF Schlegel with Void
- ERPF: MAG 3
- Renal Deconvolution
- DMSA Static Ratio
- Hilson Index
- Patlak
- Cortical Analysis
- Renal Washout

The methods are used to create these Preferences:

- SR Transplant
- Simple Renogram
- Renal Washout
- Renal Deconvolution
- Pre Post Lasix
- Post Renogram Lasix
- Patlak
- Hilson Index
- GFR Gates
- GFR Plasma
- ERPF Schlegel with Void
- ERPF Schlegel

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- ERPF MAG3
- DMSA Static Ratio
- Cortical Analysis

For information on loading requirements, and on calculations and algorithms used in this application, see the appropriate section in the *NM Application Suite Reference Manual*.

NOTICE

For the Time Activity Curves displayed in this application, the first point is the time for the end of the first frame. For example, if the first frame is 60 sec., the first point in the curve is not 0, but 60 (if seconds are the units; it would be 1 if the units were minutes). This reflects the fact that the frame completion is at the end of the time span.

Using ROIs in Renal

The Renal application has some unique ROI functionality. While other applications may allow you to draw ROIs semi-automatically, manually, or by using a template, Renal also provides completely automatic ROI definition in some instances. To use this, click **Expand** in the Control Panel:

Then in the ROI pull-down menu for the ROI you need to set, select the pink area icon in.

In the Define Regions workstep of some Preferences, this application draws a preliminary bounding region around one or more regions. You must then take these steps to create ROIs:

1. Move and adjust the bounding regions so they just enclose the appropriate areas. Drag a line to move a bounding region; drag a handle to reshape it.
2. Click the **Detect All Regions** icon to create isocontours for all the regions at once.

This creates ROIs for the areas and for any required backgrounds. To start over, click the Detect All Regions icon again; to draw the ROI by hand, click the eraser icon (**Draw Region**) in the ROI control. It turns into a pencil, indicating that you can draw manually.

Some background ROIs are drawn automatically. Typically the background is a band swept out around the lower portion of a kidney. You can set parameters that control the shape and distance of the ROI. Refer to the “Preferences” section below for details.

Automatically detected regions will only propagate between methods specified within the preference if the ROI types match between the methods. For example, if one method is configured in the preference to use a Box ROI and a second method is configured to use a Smooth Polygon ROI, the original regions from the first preference will not be propagated to the second. You will be forced to complete the regions for the method in order to perform the analysis.

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Supplying Inputs for Renal

WARNING

All input values displayed should be confirmed or corrected prior to continuing with the analysis. Failure to do so may result in erroneous results which may lead to a possible misdiagnosis.

Some Renal Preferences require inputs in the Define Regions workstep that affect the results calculations. There are two inputs that are only displayed in the results and are not used for calculations. These are **Radionuclide** and **Radiopharmaceutical**. These are read from the DICOM header if they are present; if not, you can type any value for them.

There is one input that is also set as a parameter in the Preference: **Curves Smoothing Factor**. On startup, the input value is taken from the parameter. If you change the input value, it is not saved back to the preference unless you click **Update to Current and Save** in the Preferences panel.

Renal Results

If you do not see all the result images in the Review Results workstep, it may be that one or more viewers are hidden. If you suspect this, try using the **Show Hidden Viewers** tool in the **Utilities** Data Manager. See section “Review Results Workstep” on page 27 for details.

Preferences

To change the Preferences for this application:

1. Select the **Preferences** Data Manager.
2. Click **Open Preference Editor** at the bottom of the Preferences section (the second icon: ).
3. Make changes in the preferences window using the information in the table below.

See the section on section “Creating and Editing Preferences” on page 59 for details on editing Preferences.

You can save these parameters for this application:

Parameter	Default	Description
Review Compress Factor (Renogram)	0	Number of frames to compress for renogram review data
Review Compress Factor (Flow)	0	Number of frames to compress for flow review data

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Parameter	Default	Description
Curves Smoothing Factor	3	This sets the amount by which to smooth the results curves.
Renal Background Algorithm	PeriRenal	This sets the behavior of the background ROIs. “PeriRenal” creates a region that follows the contour of the kidney ROI. “SemiLunar” creates a 90 degree section of a ring; this ignores the Start Angle and Width parameters.
Left Kidney Outer Distance	5	Distance that separates the left kidney ROI from the left background ROI. The distance is measured along a line that passes through the center of the kidney ROI and the center of the background ROI.
Left Kidney Width	5	Width of the background ROI
Left Kidney Start Angle	90	The background ROI is drawn clockwise from this position, where 0 is at the right, 90 is at the bottom, and so on.
Left Kidney Extension	90	This is the number of degrees (clockwise) the background ROI subtends, beginning at the Start Angle.
Right Kidney Outer Distance	5	Distance that separates the right kidney ROI from the right background ROI. The distance is measured along a line that passes through the center of the kidney ROI and the center of the background ROI.
Right Kidney Width	5	Width of the background ROI
Right Kidney Start Angle	0	The background ROI is drawn clockwise from this position, where 0 is at the right, 90 is at the bottom, and so on.
Right Kidney Extension	90	This is the number of degrees (clockwise) the background ROI subtends, beginning at the Start Angle.
Composite Start Frame	1	First frame of composite image
Composite End Frame	(varies depending on the method)	Last frame of composite image

For more on compression, see section “Frame Compress” on page 46.

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Review Layouts

Below are the layouts in the Review workstep:

- Renal Dynamic
- Renal Review
- Static Review
- DMSA Static Review
- SC images
- Custom Display

Renal Tutorial

This tutorial has three parts: the first part shows how to use the Simple Renogram Preference and view its results; the second part shows how to calculate the DMSA Static Ratio; the third part shows how to combine preferences to create one that analyses Simple Renogram and GFR Gates data. The patient used for the Simple Renogram Preference contains Flow and Function data, but Multiphase data could be used equivalently.

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NOTICE

This tutorial is designed to use a particular sample patient that works well to illustrate certain features of the software. Nothing prevents you from substituting your own patient, but be aware that it may not load the same way or produce similar results.

If you try to load your own data and it fails because of automatching, see section “Editing Auto Matches” on page 27. If you would like to start this tutorial over at any time, just click Restart in the application. This reloads the data as it does in the first workstep, as long as the default Preference has not been changed.

Setup for Simple Renogram

1. In the IntelliSpace Portal Patient Directory’s Local Devices list, select the NM Demo Data folder.
2. From the list of patients, select Patient Name **NM Renal** with Patient ID **Kidney, Simple flow function**.
3. Click on the arrow in the Analysis menu and select the NM Renal application.

   The patient data automatches with the Preference by default, so you do not need to load data into buckets individually. When this happens, the application proceeds directly to the next workstep (Define Regions) automatically.

   If you wanted to load different data, you would have to go back to the Setup workstep. By way of example, we will do that next.

4. Click the Previous Workstep button to go back to the Setup workstep.
5. Click on the Function dropdown list.
6. Scroll down to the bottom of the image list and select **Clear Bucket**.
7. Notice that the Function bucket has a red exclamation point. This indicates that it requires data.
8. Click on the Function dropdown list again and select FUNCTION. This clears the exclamation point and allows you to proceed to the next workstep.
9. Click the Next Workstep button to proceed to the Define Regions workstep:

Define Regions and Input Parameter Information for Simple Renogram

When the workstep loads, you can see that the Next Workstep button is grayed out:

This indicates that a requirement for the workstep has not been met. Different applications may have different requirements: drawing certain ROIs, setting parameters, etc. When all requirements have been met, the button becomes available.

This application provides a composite image of the data so you can be sure to enclose all the pixels in all the images at once. The composite viewer includes a slider at the bottom so you can exclude some of the beginning or ending frames. It also displays a cine so you can refer to the whole sequence of images if necessary.

This application requires some inputs for its calculations. For this patient the parameters are set by default, so you do not need to enter them yourself.

By default, there is a bounding circle around the left and right kidney in the Composite Image viewer (on the left). These define the areas in which autodetection occurs. To increase the accuracy of the autodetection, you will need to adjust the circles.

1. To improve the visibility of the image, slide the black bar in the Image Colorbar to the left to increase the contrast.
2. Adjust the slider at the bottom of the composite viewer if you would like to exclude some frames from the composite.
3. Notice that each circle could be reshaped to completely enclose its kidney.
4. Use the handles on the circles (visible when you hover over one) to adjust them so they completely enclose the kidneys.
5. Click **Detect All Regions**.

   The ROIs are drawn automatically.

6. Following the instruction at the top of the composite viewer to draw the bladder ROI, use the pencil to draw an approximate ROI (you will draw a more precise one later). When you reach the last point, double-click to end the drawing.

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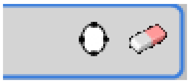
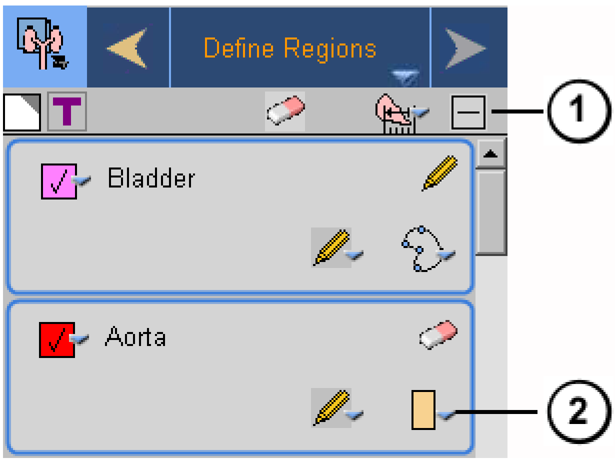
Although the Bladder is checked by default, which means that it is a required region, you are able to uncheck it so that it is optional.

Notice that the Bladder Draw Region icon is now an eraser:



7. Notice the instruction to draw the Aorta ROI. We will use a box shape for this ROI.
8. To change the ROI shape to a box, expand the ROI drawing controls (#1 below).



9. Select **Box** from the Aorta ROI Shape menu (#2 above).
10. Draw a box Aorta ROI.

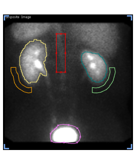
    As soon as the last ROI is drawn, background ROIs are drawn automatically, but you could adjust them if you wanted.

11. Click the eraser in the Bladder Draw Region to delete the ROI.

    The eraser changes back to a pencil, indicating that you can redraw the ROI.

12. Click the viewer's Maximize button.

    This allows you to use a larger window if that is useful. If not, click the button again to restore the default view.



13. Now draw the ROI more correctly, using whatever conventions apply in your situation.

    Here is an example of approximate ROIs:

    You can adjust the kidney ROIs in two ways: manually, using the **Nudge Tool**, and semi-automatically using a threshold value.

14. Right-click in the viewer and select **Isocontour**. This toggles the control on.
15. Select an ROI from the pull-down menu that appears and use the slider to adjust the threshold value.
16. Right-click again and uncheck **Isocontour** to remove it from the viewer.
17. Now right-click on the left kidney ROI and select **Nudge Tool** and then **Radius1** from the pull-aside menu.

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The Nudge Tool “pushes” the ROI wherever you touch it with the cursor. With this, you can make small adjustments without having to do any actual redrawing of the line.

18. Try adjusting the section of the ROI at the ureter, either to exclude it or just to improve the shape of the ROI. If you make a mistake, just redraw the whole ROI by clicking on the eraser and then on Detect Region.
19. If you have not restored the viewer to the default view, do that now by clicking on the Restore icon, formerly Maximize.
20. Notice that the Next Workstep button is now available. This indicates that there are no more ROIs to be drawn.

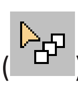
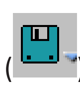
21. Confirm the input parameter values are correct.
22. Advance to the next workstep by clicking the Next Workstep button.

Review Results

In this workstep, you can review the quantification results. For a list of the results displayed, see the “Results” section later in this chapter. You can also save the page as a Secondary Capture (as you can in any workstep). Secondary Captures can be either single-frame or multi-frame. Multi-frame allows you to embed a cine.

In the Results viewer, notice that the **Radiopharmaceutical** and **Time Of Lasix Injection** paramaters have a dash for the value. This is because we did not enter values for them in the previous workstep.

Now create a Secondary Capture of the results:

1. If it is not already selected, click the **Scroll** button () and drag upward in the cine viewer to scroll to the first frame. The frame number is displayed in the lower right of the viewer.
2. In the Image Tools Manager, click the arrow on the **Save all images** button () and select **Secondary Capture**.
3. Type in a description for the Secondary Capture.
4. Check the **RGB** option.
5. Click **Save.**
6. Click on the orange IntelliSpace Portal Directory button at the top of the screen (the active button in the image below) to display the Patient Directory and notice that the saved image is listed in the Series list at the bottom, and also in the NM Images list (which is the tab next to Series).

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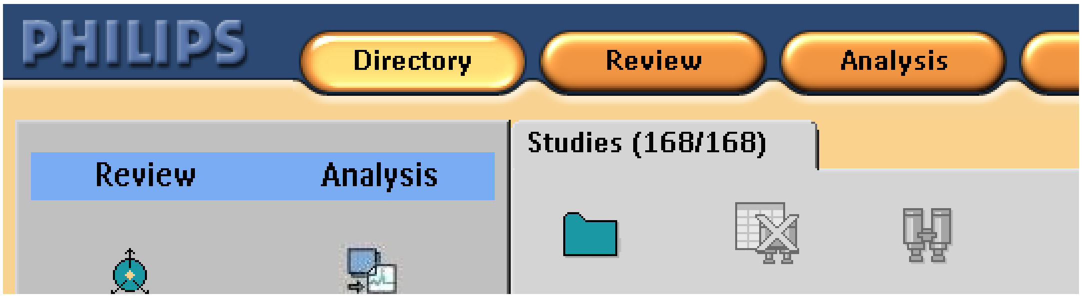


7. Return to the application by clicking on the orange IntelliSpace Portal **Analysis** button at the top.
8. Advance to the next workstep by clicking the Next Workstep button.

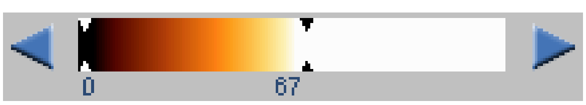
Review Images

This workstep provides multiple layouts to view the images. Click on each layout to view its contents. Layouts with a dark blue background are unavailable. You can also hide and show individual viewers:

1. Click the triangular Remove button in the upper left viewer:

   This removes the viewer from the display area.
2. From the Global Image Tools, select the **Utilities** tab.
3. Click **Show Hidden Viewers** ().

   This displays a list of all viewers that are currently hidden.
4. Select the hidden viewer to redisplay it.
5. Use the Image Colorbar in the Image Tools Manager to adjust the background (white bar) and brightness (black bar).
6. Right-click on the Image Colorbar to open a menu that lets you select Colormap, Intensity, and Pixel Values:



When you are done, click Exit to exit to the Patient Directory. If you are prompted to save images, click No unless you want to save any new images.

Setup for DMSA Data

1. In the IntelliSpace Portal Patient Directory's Local Devices list, select the NM Demo Data studies.
2. From the list of patients, select Patient Name **JETPack- DMSA Absolute Uptake** with Patient ID **Kidney**.
3. Using the arrow in the Analysis menu, select the NM Renal application.
4. In the Preferences Data Manager, scroll down the list and click the DMSA Static Ratio Preference by clicking on its **Apply Preference** icon ().

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The patient data automatches with the Preference by default, so you do not need to load data into buckets individually. When this happens, the application proceeds directly to the next workstep (Define Regions) automatically.

Define Regions for DMSA

By default, there is a bounding circle around the left and right kidney. These define the areas in which autodetection occurs. To increase the accuracy of the autodetection, you will need to increase the contrast of the kidneys and adjust the circle according to the new image information.

1. Slide the black bar in the Image Colorbar to the left to increase the contrast.
2. Notice that each circle could be a little larger and tilted slightly to completely enclose its kidney.
3. Use the handles on the circles (visible when you hover over one) to adjust them so they completely enclose the kidneys.
4. Click **Detect All Regions**.

   The ROIs are drawn automatically. If you are not satisfied with the ROIs, you can either use the pencil to redraw the ROI by hand or go back and edit the size or shape of the circle and use Detect All Regions again.
5. Now follow the instruction at the top of the viewer to draw the left kidney background ROI, using the pencil icon.
6. Similarly, follow the instruction to draw the right kidney background ROI.

   After you have drawn the background ROIs you can go back and edit them, if necessary, by dragging the handles as you did the with the circles.
7. Notice that the ROI for the right kidney in the Anterior image (on the right) is displaced slightly.
8. Drag the ROI so it is positioned correctly.
9. Click Next Workstep to go to the Review Results workstep.

Review Results for DMSA

In this workstep, you can review the quantification results. For a list of the results displayed, see the “Results” section later in this chapter. You can also save the page as a Secondary Capture (as you can in any workstep). Secondary Captures can be either single-frame or multi-frame. Multi-frame allows you to embed a cine.

When you have reviewed the results, click Next Workstep to go to the Review workstep.

Review Images

This workstep provides multiple layouts to view the images. Click on each layout to view its contents. Layouts with a dark blue background are unavailable.

Setup for a Custom Preference

In this part of the tutorial, you will create a custom Preference. This will require displaying multiple layouts in the Define Regions workstep.

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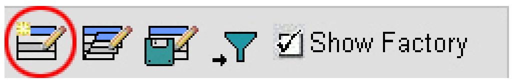
1. In the IntelliSpace Portal Patient Directory's Local Devices list, select the NM Demo Data studies.
2. From the list of patients, select Patient Name **NM Renal** with Patient ID **Kidney, MAG 3**.
3. Using the arrow in the Analysis menu, select the NM Renal application.

Now create a new custom Preference that incorporates two default Preferences.

1. Open the Preferences Data Manager.
2. Click **Create Preference** at the bottom of the Preferences section:

   The Preference Editor appears.

3. In the Preference Editor, check the Simple Renogram method and GFR Gates in the list on the right.
4. Click **Proceed.**
5. Click on **Organs** and make sure that only these items area checked:
   - Left Kidney
   - Left Kidney Bkg
   - Right Kidney
   - Right Kidney Bkg
6. In the **Name** box at the bottom, type "Simple+GFR". Click **Save**, and then **Close.**

   The new Preference is added to the top of the Preference list.

7. Select the new Preference by clicking on its light bulb icon ( ).
8. Notice that there are exclamation marks on some of the buckets, which indicate that they need assigning.
9. Click the PreSyringe bucket drop-down menu and select PRE SYR from the list.
10. Click the PostSyringe bucket drop-down menu and select POST SYR from the list.
11. Advance to the next workstep by clicking the Next Workstep button.

Define Regions and Input Parameter Information

Each of the two Preferences used to create the new one requires parameter values, and each displays different information in the viewers. For this reason, two layouts are created. You must display each layout before proceding to the next workstep.

1. In the first layout, adjust the bounding circles so they completely enclose the kidneys and click Detect All Regions to auto-detect the kidney regions.

   You can leave the parameters set as they are.

   When you create a combined Preference, there may be separate layouts in some worksteps that allow you to perform actions for the separate parts. Now that you have performed the Define Regions workstep for the Simple Renogram part of the Preference, you must also do it for the GFR Gates layout.

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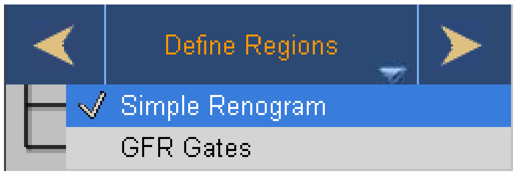
2. Click the GFR Gates layout:

   Although the two parts of the combined Preference have different layouts, any ROIs that they have in common are shared. This means that you do not have to redraw any ROIs. However, you do have to enter values for any parameters that are different.



3. Notice that two of the parameters in the Inputs table are invalid. Enter the following values:
   - Patient Weight: 70
   - Patient Height: 170
4. Click the pencil at the top right of the table to write the information.
5. Advance to the next workstep by clicking the Next Workstep button.

Review Results for Custom Preference

Results for a custom Preference are displayed in separate layouts for each Preference used to create the combined Preference. This means that you must display each layout to see all the results.

1. Review the results in the first layout (Simple Renogram).
2. Click the GFR Gates layout and review those results.
3. Advance to the next workstep by clicking the Next Workstep button.

Review Images for Custom Preference

This workstep provides multiple layouts to view the images. Click on each layout to view its contents. Layouts with a dark blue background are unavailable.

Simple Renogram

Simple Renogram is primarily used to analyze the acquisition data and produce statistical information about the function of the kidneys.

Using Simple Renogram

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- Differential Start Time (min)

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- Differential End Time (min)
- Residual Activity Time (min)
- Depth

Results

- Composite image with all ROIs
- Cine with all ROIs
- Peak Time (sec) for both kidneys
- T 1/2 (min) for both kidneys
- Peak Counts for both kidneys
- Diff Perfusion (%) for both kidneys
- Renal Retention (%) for both kidneys
- 20 min/3 min ratio
- 20 min/peak ratio
- Differential Calculation Time (min)
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- Splash display
- Time Activity curve for Flow data for both kidneys and aorta
- Time Activity curve for Renogram data for both kidneys and bladder

If you do not see all the result images in the Review Results workstep, it may be that one or more viewers are hidden. If you suspect this, try using the Show Hidden Viewers tool in the Utilities Data Manager. For details, see section “Review Results Workstep” on page 27.

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Pre Post Lasix

This method provides renal processing capability (analogous to Pegasys) by combining the flow and renal portions of the study into a single curve for processing.

Using Pre Post Lasix

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (0 for no Lasix)

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- Time of Post Lasix Percent Remaining (min): The Time after Lasix injection for the ratio of Counts At Lasix to the Time selected. The time of the ratio should be selected to show the success or failure of the Lasix injection to cause emptying. It should be as late as possible based on the duration of the POST Lasix phase. For example, if the kidney emptied 15 minutes after Lasix injection, the time would be 15 minutes. If the study continued 22 minutes after Lasix but showed no emptying, the time would be 22 minutes. You cannot have a time longer than the end of the study.
- Differential Start Time (min)
- Differential End Time (min)
- Residual Activity Time (min)

NOTICE

If Time of Lasix Injection is blank, it will not appear in the Review Results workstep. A negative number indicates the amount of time the Lasix is given prior to performing the flow injection.

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Results

- Composite image with all ROIs
- Cine with all ROIs
- Time Activity curves for Flow data for both kidneys and aorta
- Time Activity curves for Renogram data for both kidneys and bladder
- Splash display

Renogram Results

- Peak Time (min)
- T 1/2 (min): calculated from peak
- Peak Counts
- 20 min/3 min ratio
- 20 Min / Peak Ratio
- Differential (%)

Flow Image Timings

- Time To Max (sec)
- Max Flow Counts

Lasix Clearance Report

- Peak Post Lasix (min): Time in minutes where each kidney curve reached peak
- T 1/2 From Peak (min): Time in minutes where each kidney curve reached 1/2 count starting at the time of peak counts.

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- T 1/2 from Lasix (min)
- xM/PRE-L Clearance (%): Ratio of counts for each kidney of user-specified time in minutes compared to the frame before Lasix injection, where ‘x’ is the value of the “Time Of Post Lasix Percent Remaining” input in the Define Regions workstep.
- xM/PK-L Clearance (%): Ratio of counts for each kidney of user-specified time in minutes compared to the peak counts. This time is usually the same as the time of Lasix injection, but it can also be 1 or more frames after the value above. The ‘x’ in the name is the value of the “Time Of Post Lasix Percent Remaining” input in the Define Regions workstep.
- Aorta Peak Time (sec)
- Differential Time (min)
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)

Post Renogram Lasix

This method uses a post renogram Single Framing Rate Dynamic (Diuresis) study to create the Post-Lasix T 1/2.

Using Post Renogram Lasix

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)

Results

- Composite image with all ROIs
- Cine with all ROIs
- T 1/2 (min) for both kidneys
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- Time Activity curve for left kidney Lasix and fit
- Time Activity curve for right kidney Lasix and fit
- Splash display

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GFR Gates

This calculates the total glomerular filtration rate (GFR), individual GFR, normalized GFR, time to peak, and time to half peak for two-kidney and single-kidney patients.

Using GFR Gates

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Patient Weight
- Patient Height
- Time of Lasix Injection
- Pre Dose Multi-Factor
- Post Dose Multi-Factor
- Pre-Injection Counts
- Post-Injection Counts
- Pre-Injection Time
- Patient Injection Time
- Post-Injection Time
- Total Injected Dose

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NOTICE

You need to provide dose multi-factor parameters if you use a syringe with less activity than what you inject to acquire the pre-injection syringe. For example, if you count 3mCi of activity in a pre-injection syringe but inject 15mCi, the pre dose multi-factor will be 5 because you injected 5 times more activity than you counted for the syringe.

Results

- Composite image with all ROIs
- Cine with all ROIs
- Depth (cm) for both kidneys
- Peak Time (sec) for both kidneys
- T 1/2 (min) for both kidneys
- Uptake (%) for both kidneys
- GFR (ml/min) for both kidneys
- Total GFR (ml/min)

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- Normalized GFR (ml/min)
- Total Injected Dose (MB q)
- Time of Lasix Injection (min)
- Radionuclide
- Radiopharmaceutical
- Splash display
- Time Activity curves for Flow data for both kidneys and aorta
- Time Activity curves for Renogram for both kidneys and bladder

GFR Plasma

The GFR Analysis (Plasma) application calculates total glomerular filtration rate (GFR) based on a two-plasma sample method, drawn at 60 and 180 minutes post injection of 99mTc-DTPA.

Using GFR Plasma

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs Viewer:

- Dilution factor
- Water background (cpm)
- Standard dose counts (cpm)
- Plasma background (cpm)
- First plasma sample counts
- First plasma sample time (min)
- Second plasma sample counts
- Second plasma sample time (min)
- Standard dose activit y(uCi)
- Measured patient dose (uCi)
- Measured residual activity(uCi)
- Patient Height (cm)
- Patient Weight (kg)

Results

- Composite image with all ROIs
- Cine with all ROIs
- Splash with all ROIs
- Time Activity curves for Renogram for both kidneys and bladder
- Peak Time (min) for both kidneys

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- T ½ (min) for both kidneys
- Contribution % for both kidneys
- GFR(ml/min) for both kidneys
- Normalized GFR (ml/min/1.73 m2)
- Total GFR (ml/min)

ERPF Schlegel

This method calculates the effective renal plasma flow.

Important

This method is not validated for use with MAG-3.

Using ERPF Schlegel

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Patient Weight
- Patient Height
- Time of Lasix Injection
- Total Injected Dose
- Pre-Injection Counts
- Post-Injection Counts

Results

- Composite image including all ROIs
- Cine including all ROIs
- Time Activity curve for right and left kidney values, and bladder values (if used)
- Splash display

Schlegel Results

- Peak Time (min) for both kidneys
- Uptake (%) for both kidneys
- ERPF (ml/min) for both kidneys

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- Slope1 (peak -T1/2) for both kidneys

Normal Values

- Normalized ERPF (ml/min) for both kidneys, and total

Total Values

- Total ERPF (ml/min)
- Normalized ERPF (ml/min)
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)

ERPF Schlegel with Void

This method calculates the effective renal plasma flow with additional calculation of dose return and residual urine volume.

Important

This method is not validated for MAG-3.

Using ERPF Schlegel with Void

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Patient Weight
- Patient Height
- Time of Lasix Injection
- Voided Urine Volume (ml)
- Voided Urine Activity
- Total Injected Dose
- Pre-Injection Counts
- Post-Injection Counts

Results

- Composite image including all ROIs

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- Cine including all ROIs
- Time Activity curve for right and left kidney values, and bladder values (if used)
- Splash display

Schlegel with Void Results

- Peak Time (min) for both kidneys
- Uptake (%) for both kidneys
- ERPF (ml/min) for both kidneys
- Slope1 (peak - T1/2) for both kidneys
- T ½ (min)

Normal Values

- Normalized ERPF (ml/min) for right and left kidneys

Total Values

- Total ERPF (ml/min)
- Normalized ERPF (ml/min)

Return Values

- Residual Return (%)
- Voided Return (%)
- Predicted Return (%)
- Normal Return (%)
- Total Return (%)
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)

ERPF MAG 3

The method implements calculation of effective renal plasma flow from MAG-3.

Using ERPF MAG 3

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)

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- Patient Weight
- Patient Height
- Pre-Injection Counts
- Post-Injection Counts
- Pre Dose Multi-Factor
- Post Dose Multi-Factor

NOTICE

You need to provide dose multi-factor parameters if you use a syringe with less activity than what you inject to acquire the pre-injection syringe. For example, if you count 3mCi of activity in a pre-injection syringe but inject 15mCi, the pre dose multi-factor will be 5 because you injected 5 times more activity than you counted for the syringe.

Results

- Composite image with all ROIs
- Cine with all ROIs
- Time of Lasix Injection (min)
- Peak Time (min) for both kidneys
- Uptake (%) for both kidneys
- ERPF (ml/min) for both kidneys
- Total MAG3 Clearance (ml/min)
- Total ERPF (ml/min)
- Radionuclide
- Radiopharmaceutical
- Time Activity Flow curves for both kidneys
- Time Activity Renogram curves for both kidneys
- Splash display

Deconvolution

This method allows you to generate kidney retention functions with transit calculation.

Using Renal Deconvolution

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide

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- Radiopharmaceutical
- Time of Lasix Injection (min)

Results

- Composite image with all ROIs
- Cine with all ROIs
- Mean Transit Time (min) for both kidneys
- T80 (min) for both kidneys
- T20 (min) for both kidneys
- % Function (%)
- Peak Time (min) for both kidneys
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- Splash display
- Time Activity background subtracted curves for Renogram data for both kidneys and blood
- Time Activity curves for Function data for left and right retention function

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DMSA Static Ratio

This method provides 2 ROI ratio comparison (optionally with background subtraction) analogous to the Pegasys Global Q implementation.

Results

- Posterior image with ROIs
- Counts/Total Vol for both kidneys
- %Diff/Total Vol for both kidneys
- Counts/Pixel for both kidneys
- %Diff/Pixel for both kidneys
- Geometric Mean Counts for both kidneys
- Any optional images loaded

If you do not see all the result images in the Review Results workstep, it may be that one or more viewers are hidden. If you suspect this, try using the Show Hidden Viewers tool in the Utilities Data Manager. For details, see section “Review Results Workstep” on page 27.

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Hilson Index

The Hilson Index method generates a renal perfusion index based on the ratio of areas under the kidney curve and the area under the artery curve in the perfusion phase. It is typically used for kidney transplant management.

Using Hilson Index

After you have drawn the ROIs, you can optionally enter these values in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical

Results

- Composite image with all ROIs
- Cine with all ROIs
- Peak Time (min)
- T 1/2 (min)
- Iliac Peak Time (sec)
- Area Iliac Curve To Peak (cps)
- Area Renal Curve (cps)
- Hilson Perfusion Index
- Peak Counts (cps)
- Up Slope (cpm): The rising slope of the curve before the maximum count value is reached.
- Rise Time (min): The time, in minutes, that it takes for the curve to rise from 5% of the peak in the curve to 90% of the peak.
- 20 min / Peak Ratio (%)
- 20 min/ 3 min Ratio (%)
- EOS (cps): The counts at the time of end of study.
- TEOS (min): The time in which renogram actually finished.
- Total Counts (cps)
- Total Counts Range (2 to 3 mins) (cps)
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- Time Activity curve for Perfusion data for Ileac Artery and transplant kidney
- Time Activity curve for Clearance data for Ileac Artery and transplant kidney Splash display

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Statistic	Description
Upslope	The rising slope of the curve before the maximum count value is reached.
Rise Time	The time, in minutes, that it takes for the curve to rise from 5% of the peak in the curve to 90% of the peak.
EOS	The counts at the time of end of study.
TEOS	The time in which renogram actually finished.

Patlak

This method provides the capability to generate Patlak-Rutland plots and display separate tissue and vascular background regions together with a Patlak-Rutland plot (Analogous to the Odyssey Euro Custom Menu)

Using Patlak

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Patient Weight
- Time of Lasix Injection (min)
- Activity Administered

Results

- Composite image with all ROIs
- Cine with all ROIs
- Peak Time (sec) for both kidneys
- Relative Function (%) for both kidneys
- RF Time Range (sec) for both kidneys
- Two Minute Uptake (%) for both kidneys
- Three Minute Uptake (%) for both kidneys
- 20 Min/Peak Ratio (%) for both kidneys
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- Splash display
- Rutland Fit curves for each kidney
- Time Activity curves for both kidneys and bladder

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You can use the timing markers in the Time Activity graph to adjust the fit curves, which also causes the results values to change.

Cortical Analysis

This method computes and displays various results using the Cortical regions.

Using Cortical Analysis

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- RCA Calculation Time (min)

Results

- Composite image with all ROIs
- Cine with all ROIs
- Peak Time (min) for both cortexes
- Peak Counts for both cortexes
- Residual Cortical Activity (%)
- RCA Calculation Time (min)
- 20 min/3 min ratio
- 20 min/peak ratio
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection (min)
- Time Activity curve for Renogram data for both cortexes
- Splash display
- T ½ (min)
- Differential calculation time (min)

Renal Washout

This method uses a post-renogram single framing rate dynamic to create separate right and left time activity curves with associated control timing markers and appropriate curve fitting.

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Using Renal Washout

In the Define Regions workstep, you may need to provide values for the following parameters in the Inputs viewer:

- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection

In the Review Results workstep, you can use the timing markers in the curve viewer to adjust the time range represented by the results values. Drag the timing markers to update the results.

Results

- Composite image with all ROIs
- Cine with all ROIs
- T 1/2 (min) for both kidneys from the fit curve
- Radionuclide
- Radiopharmaceutical
- Time of Lasix Injection
- Time Activity curve and markers, with fit for left kidney
- Time Activity curve and markers, with fit for right kidney
- Splash display

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