GE Healthcare

Mac-Lab/CardioLab to GE X-Ray Interface Overview and System Configuration

Mac-Lab/CardioLab Version 6.9

Introduction

Document Use

This document provides an overview of the Mac-Lab/CardioLab to GE X-Ray interface and explains how to configure the interface.

Revision History

Revision	Date	Comments
A	15 August 2011	Initial release of document.

Overview of Modality Worklist and Exam Data Export Interface

The bi-directional interface between the Mac-Lab/CardioLab Acquisition system and the Innova/Advantx X-Ray system uses the Modality Worklist (MWL) and Exam Data Export interface functions. Demographic information is queried from the Mac-Lab/CardioLab system to the X-Ray system prior to the examination using Modality Worklist, while X-Ray information is sent to the Mac-Lab/CardioLab system once the examination is completed using Exam Data Export.

Benefits

The customer benefits of a bi-directional interface are:

- Eliminate duplicate entry of patient demographics to reduce the likelihood of manual data entry errors and increase staff efficiency.
- Allows the Mac-Lab/CardioLab and X-Ray system to share a unique patient identifier to avoid patient mismatches.
- Provides comprehensive X-Ray documentation within the Mac-Lab/CardioLab system automatically. X-Ray information is saved as part of the patient record and can be printed as part of the case report on the Mac-Lab/CardioLab system.

Configurations

Network Configuration

The X-Ray system must be connected to the Mac-Lab/CardioLab system through the network via 100BaseT Ethernet (TCP/IP).

Product Configurations

The X-Ray system must have the MWL and Exam Data Export options to communicate bi-directionally with the Mac-Lab/CardioLab system.

Innova

Innova System	Required Components
4100	Modality Worklist: All new systems ship with Modality Worklist Exam Data Export: Innova 4100 M4 release (for installed base and new systems)
3100	Modality Worklist: All new systems ship with Modality Worklist Exam Data Export: Innova 3100 M3 release (for installed base and new systems)
2000	Modality Worklist: ■ Heroic2 M3 FMI 11491 (for installed base up to Q1 2003) ■ Modality Worklist Option part number S18721AW (for new systems) Exam Data Export: ■ Heroic Service Pack FMI 11495 release (for installed base through 2003) ■ Heroic VCP M3 release (for new systems)

Advantx

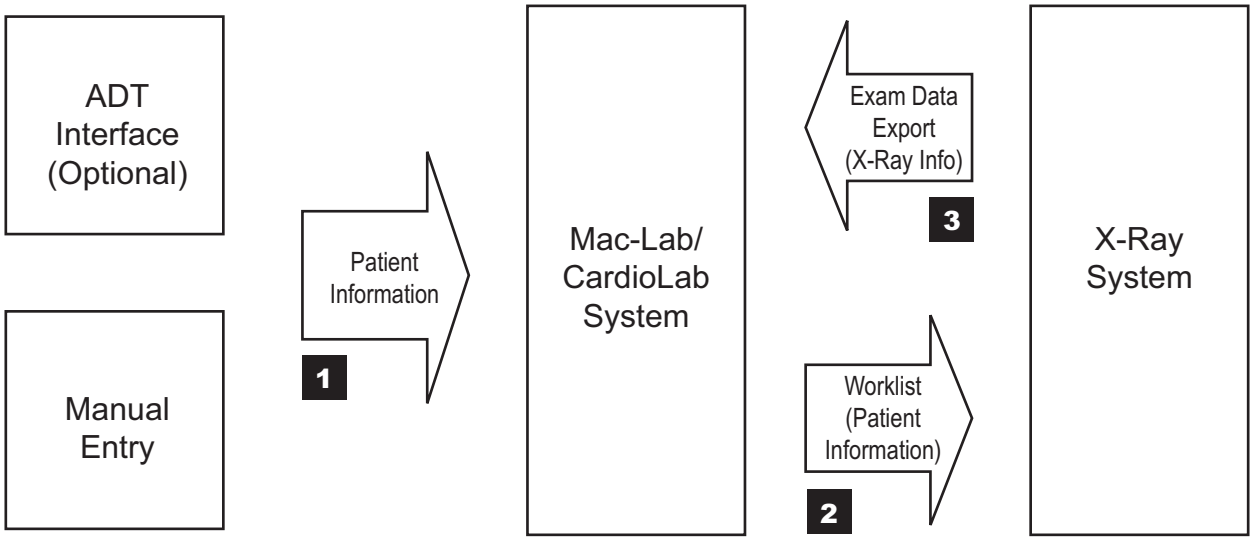
Advantx System	Required Components
2000	Advantx DLX Software version C21 or greater Modality Worklist: Advantx DLX HIS/RIS Option PN S18411HS Exam Data Export: Advantx DLX MPPS Option PN S18411PP

Mac-Lab/CardioLab

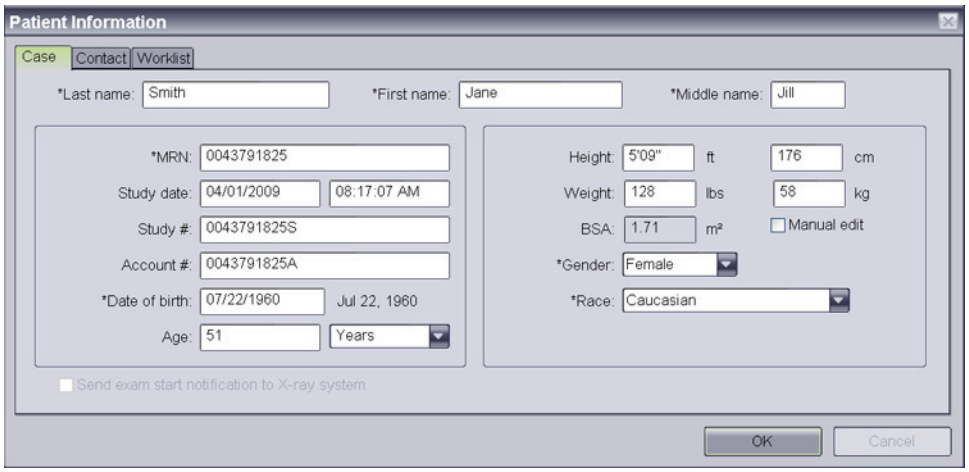
The GE X-Ray Interface Software Option is standard on all Mac-Lab/CardioLab v6.9 Acquisition systems.

Interface Operation

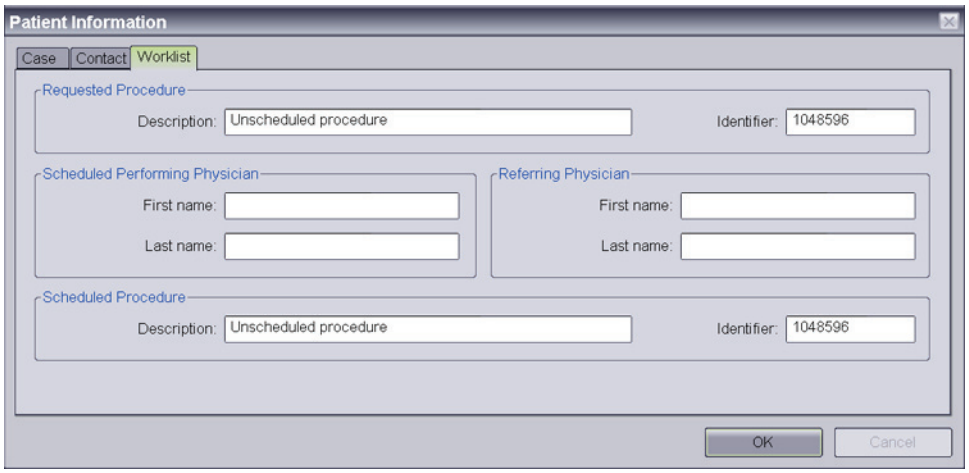
The following block diagram shows the flow of information between the Mac-Lab/CardioLab and X-Ray systems.



Patient demographic information is entered directly into the Mac-Lab/CardioLab system either manually or imported via an optional ADT interface (1 on block diagram). On the Mac-Lab/ CardioLab system, patient information is entered on the screen below.



The Mac-Lab/CardioLab operator enters patient data in the ***Case***, ***Contact*** and ***Worklist*** tabs of the ***Patient Information*** window. Procedure information that is to be provided to the X-Ray system is entered on the ***Worklist*** tab. When this data entry is complete, the operator clicks ***OK*** to close the ***Patient Information*** window. Be sure to make all required changes to the ***Patient Information*** data before clicking ***OK*** to ensure that those changes are sent to the x-ray system.



The procedure information on the ***Worklist*** tab includes the ***Requested Procedure***, ***Scheduled Procedure***, ***Scheduled Performing Physician*** and ***Referring Physician***. When a study is started using data from a Modality Worklist provider, these fields are pre-populated with the data from the provider. All of the ***Requested Procedure*** and ***Scheduled Procedure*** fields must be populated, and so each of these fields is given a default value as needed. All of these fields may be modified, except that if the study was started from a Modality Worklist provider, the two ***Identifier*** fields are fixed and cannot be changed.

The Mac-Lab/CardioLab exam is now ready to begin. At this moment, the Mac-Lab/CardioLab system becomes a “Modality Worklist provider” and is ready to send the information of the active patient upon a Worklist Query from the X-Ray system.

On the X-Ray system, a “Worklist Query” to Mac-Lab/CardioLab system is performed to obtain the information of the active patient. The demographic information is automatically exported to the X-Ray system via the network connection.

The patient information from the Mac-Lab/CardioLab system is automatically populated in a new patient and exam on the X-Ray system (2 on block diagram).

The following patient and exam information is transferred from Mac-Lab/CardioLab system to the X-Ray system:

Innova Field	Advantx Field	Mac-Lab/CardioLab Field	Mac-Lab/CardioLab 6.9
Patient ID#	Patient ID#	MRN (Medical Record Number)	X
Patient First Name	Patient First Name	First Name	X
Patient Last Name	Patient Last Name	Last Name	X
Patient Birthdate	Patient Birthdate	Date of Birth	X
Patient Gender	Patient Gender	Gender	X
Patient Height*		Height	X
Patient Weight*		Weight	X
Accession Number*	Accession Number**	Accession Number	X
Physician Name*	Admitting Physician**	Admitting Physician	
Exam Type*		Procedure Type	
Study ID Number*		Study Number	
	Phone Number	Home Phone	X
		Requested Procedure Description	X
		Requested Procedure Identifier	X
		Scheduled Performing Physician	X
		Referring Physician	X
		Scheduled Procedure Description	X
		Scheduled Procedure Identifier	X
* Fields manually editable at the Innova system.			
** Fields sent from the ***Orders*** window on the Mac-Lab/CardioLab system			

The exam on the X-Ray system is started manually by selecting the exam previously retrieved from the Mac-Lab/CardioLab system and pressing the **Start Exam** button. The exam started on the X-Ray system must always be the same exam that is active on the Mac-Lab/CardioLab system. If a different exam is started, the exam data export will fail.

The patient remains active on Mac-Lab/CardioLab throughout the examination. Any changes made to the Mac-Lab/CardioLab patient demographics during the examination will not update the X-Ray patient information.

The fluoro time and the dose information of the X-Ray acquisitions performed on the X-Ray system are stored in the X-Ray database along with the exam information. The dose information is characterized by the Total Dose and the Total/Fluoro/Record Dose Area Product (DAP).

This information is displayed on the Exam Browser at the end of the exam. After each record acquisition (Cine run) performed on the X-Ray system, the run information is stored in the X-Ray database along with the exam information, and displayed on the X-Ray Sequence Browser.

After closing the X-Ray exam by pressing **End Exam**, the information of the exam is sent automatically to the Mac-Lab/CardioLab system (3 on block diagram). It is displayed on the ***Radiology*** window, in the ***Study*** menu.

The X-Ray information passed from the X-Ray system to Mac-Lab/CardioLab includes the following fields. Abbreviations used in the ***Radiology*** dialog window are shown in brackets.

X-Ray Parameter	Mac-Lab/CardioLab 6.9
Exam Fluoro DAP* ($cGycm^2$)	X
Exam Total DAP* ($cGycm^2$)	X
Exam Cine DAP* ($cGycm^2$)	X
Total Runs	X
Total Fluoro Time (minutes)	X
Run time [TIME]	X
Run number [RUN]	X
Plane [PL] or [Plane]	X
Angulation [ANG] or [RAO/LAO]	X
Rotation [ROT] or [CRA/CAU]	X
Number of frames [FRAMES]	X
Frames per second [FPS]	X
Kilo-volts [KV]	X
Milliamps [MA]	X
Milliseconds [MS]	X
Focal Distance [SID (cm)]	X
Image Intensifier mode [FOV (cm)]	X
*DAP = Dose Area Product	

Worklist Limitations

- The ***Admitting Physician***, ***Reading Physician***, ***Referring Physician*** and ***Operator Name*** fields are not filled by the Mac-Lab/CardioLab system.
- The Mac-Lab/CardioLab system uses default values for the Requested Procedure Description, Requested Procedure Identifier, Scheduled Procedure Description and Scheduled Procedure Identifier. To send different values for these fields to the X-Ray system, enter those values into the ***Worklist*** tab of the ***Patient Information*** window before retrieving the worklist on the X-Ray system.

Exam Data Export Limitations

- The Cine Frames field in the ***Radiology*** Window of Mac-Lab/CardioLab system does not get auto-populated from the Innova. It displays as a blank but is editable.
- The Milliamps (MA) field may not be populated by Innova in some of the Innova2000 versions, and shows up as “0” on the Mac-Lab/CardioLab system ***Radiology*** Window.
- The dose information sent from Innova is estimated from the X-Ray acquisition parameters. The estimation model is accurate at ±30%.
- The angles are displayed as signed in the Mac-Lab/CardioLab system, while in Innova they are always positive and followed by the indication of LAO, RAO or CRA, CAU. In the Mac-Lab/CardioLab system, LAO and CRA angles are displayed as positive values, while RAO and CAU angles are displayed as negative values. For example, if the primary angle is displayed in Innova as 30 RAO, it is displayed in Mac-Lab/CardioLab as -30.
- If there is a Dose Measurement Device connected to Innova, the display and storage of the estimated dose may be disabled and the dose data will not be sent to the Mac-Lab/CardioLab system.
- If some sequences are deleted on the Innova system before the end of the examination (that is, before pressing the **End Exam** button), the information related to the deleted sequences will not be transferred to the Mac-Lab/CardioLab system. However:
  - The number of Total Runs will contain all the runs acquired during the examination, including the deleted runs.
  - The Cine Dose and Total Dose information will contain the dose delivered during the examination, including the dose of the deleted sequences.

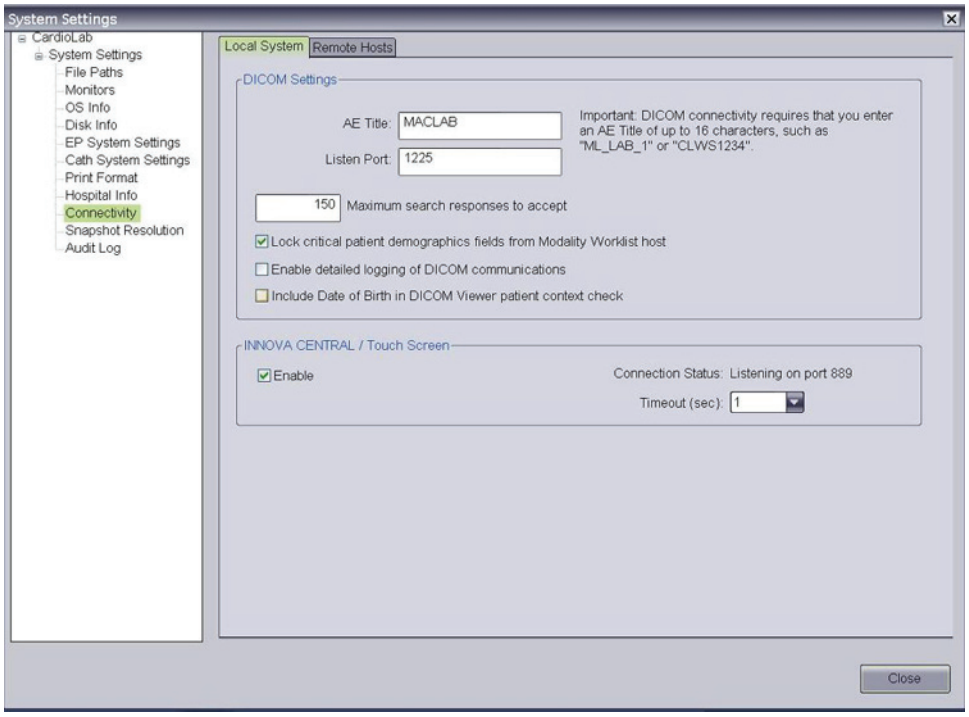
Procedures

Configure Mac-Lab/CardioLab System

1. Log on to the Acquisition system as an Administrator.
   a. Press **Ctrl** + **Action** + **Del** and click ***Log Off***.
   b. Click ***OK*** at the log off message and immediately hold down the **Shift** key to stop the auto-logon sequence.
   c. Log on to the Windows XP operating system locally as **mlcltechuser**.

      To log on locally, select the computer name in the ***Domain*** field.
   d. Log on to the Mac-Lab/CardioLab Custom shell locally as **mlcltechuser**.
2. Put the Mac-Lab/CardioLab system into either ***Overwrite*** mode or ***Append*** mode. This setting controls whether the Mac-Lab/CardioLab system will discard and replace previously received dosage and run information when new dosage and run information is received (***Overwrite*** mode), or the Mac-Lab/CardioLab system will add to any previously received dosage and run information when new dosage and run information is received (***Append*** mode). The default is ***Overwrite*** mode. If the Mac-Lab/CardioLab system will connect to an Innova system with the “MPPS” feature, the Mac-Lab/CardioLab system should be put into ***Append*** mode. For any other X-ray system, including an Innova with the “Exam Data Export” feature, the system should be put into ***Overwrite*** mode.

   To set the mode to ***Overwrite*** or ***Append***, do the following:
   a. Click ***Start*** and select ***Run***. Type **regedit**, then press **Enter**.
   b. Browse to the path ***HKEY_LOCAL_MACHINE\SOFTWARE\GEMS\DICOM\MWL_MPPS.***
   c. Double-click ***MPPS SCP Append Mode***.
   d. To put the system into ***Overwrite*** mode, enter a Value of **0** (which is the default value). To put the system into ***Append*** mode, enter a Value of **1**.
   e. Click ***OK*** to accept the new Value.
   f. Close the ***Registry Editor*** window.
3. Double-click ***Mac-Lab CardioLab*** on the desktop to launch the Mac-Lab/CardioLab application.
4. Select ***System Settings*** from the ***Administration*** menu.
5. Click ***Connectivity*** in the ***System Settings*** window. The following window is displayed:



6. On the ***Local System*** tab, enter the following settings:

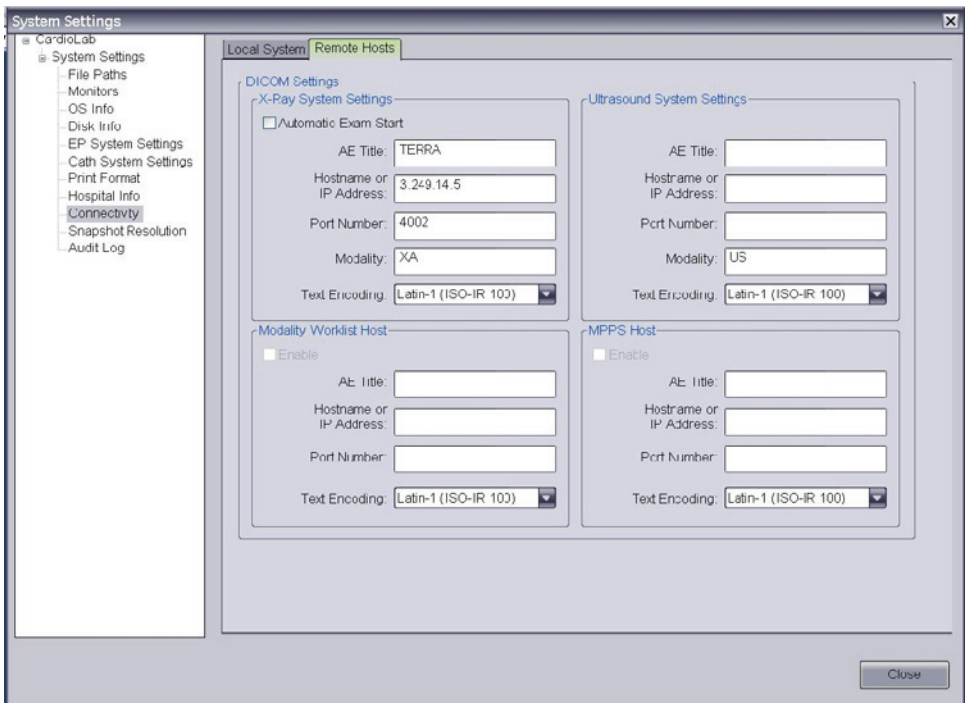
   DICOM settings: These settings are for this Mac-Lab/CardioLab system.

   - ***AE Title***: The DICOM name for the Mac-Lab/CardioLab system. An AE Title may only contain letters, numbers and the underscore character, and must be 16 characters or less.

NOTE: AE Titles are case sensitive.

   - ***Listen Port***: This is the port number that the Mac-Lab/CardioLab system listens for connections from the X-Ray system. The default is 1225, and should not be changed.

7. Select the ***Remote Hosts*** tab.



8. On the ***Remote Hosts*** tab, enter the following settings:

   X-Ray System Settings: These settings apply to the GE X-Ray system.

   - ***Automatic Exam Start***: Check this option only if the x-ray system supports the Automatic Exam Start feature and you want Mac-Lab/CardioLab to trigger the automatic start of the x-ray exam when starting a new Mac-Lab/CardioLab study.
   - ***AE Title***: The DICOM name for the X-Ray system. This is found in the X-Ray system's configuration settings (the default is “dlx_root” for DLX systems and “TERRA” for the Innova systems).
   - ***Host Name or IP Address***: This is the network name or IP address of the X-Ray system.
   - ***Port Number***: This is the port number on which the X-Ray system listens for connections from the Mac-Lab/CardioLab system.
   - ***Modality***: This is the imaging system's modality. The default is XA, and should not be changed.
   - ***Text Encoding***: This is how text sent to the X-Ray system is coded. The default is Latin-1, and should not be changed.

NOTE: ***Ultrasound System Settings***, ***Modality Worklist Host*** and ***MPPS Host*** settings refer to other systems and do not need to be modified for the GE X-Ray interface configuration.

9. Click ***Close*** to save the new settings.

10. Restart the Mac-Lab/CardioLab system to initialize the system with the new configuration.

11. Allow the system to auto log on to the Windows XP operating system. At the Mac-Lab/CardioLab custom shell, log on as the local **mlcluser**.

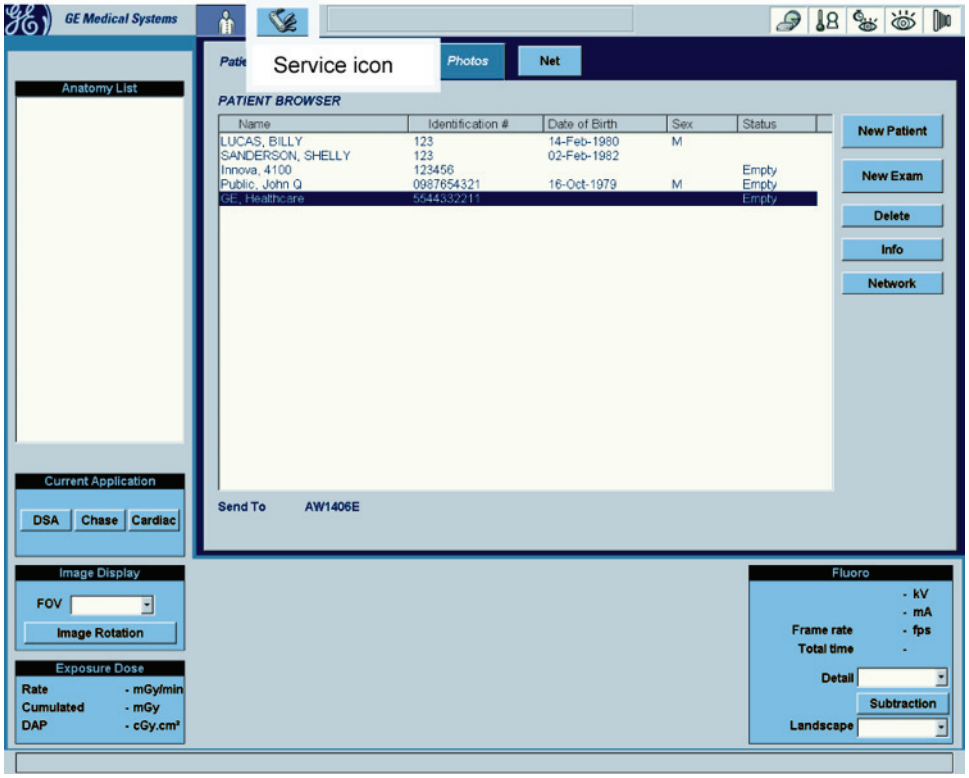
12. Proceed to either Configure the Innova X-Ray System on page 11 or to Configure the AdvantxE DLX X-Ray System on page 16.

Configure the Innova X-Ray System

This setup procedure applies to the Innova 2000/3100/4100 DL.

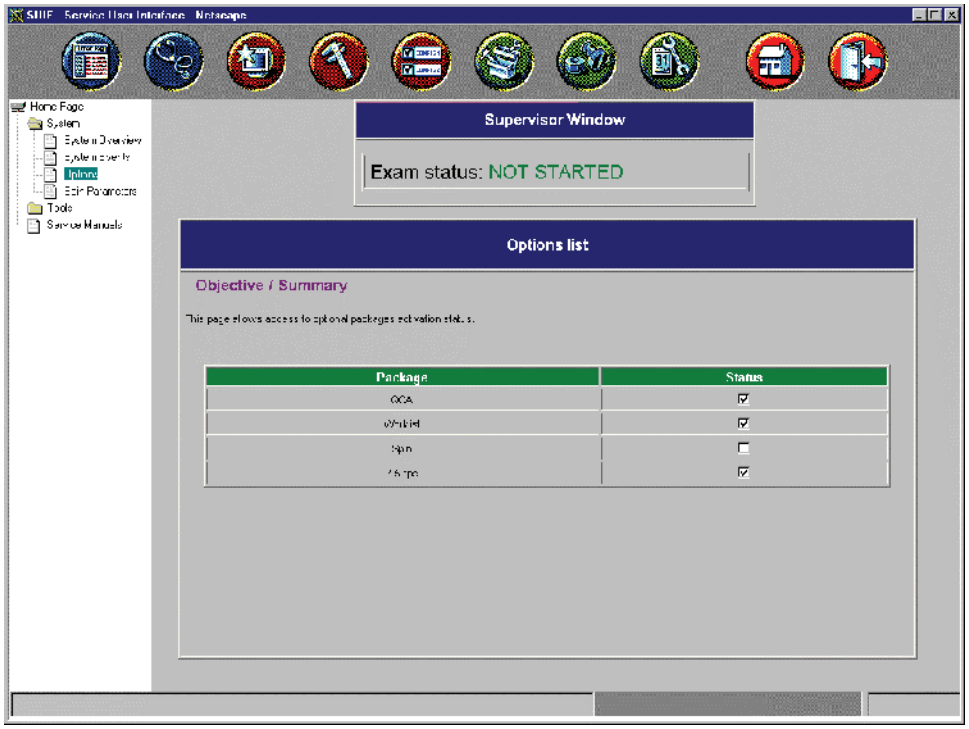
1. Log on to the DL box using **DIservice** account. If necessary:
   a. Select ***Start*** > ***Shutdown***.
   b. Select ***Close all programs and log on as a different user*** and click ***Yes***.
   c. Hold down the **Shift** key to stop the auto logon process.
   d. Log on as **DIservice** (password **HEROIC**), at the windows logon screen.
2. Rick-click ***Network Neighborhood*** and select ***Properties***.
3. Record the computer name at the Identification tab.
4. Highlight ***TCP/IP*** and select ***Properties*** from the ***Protocols*** tab.
5. Select ***adapter #2*** in the adapter drop-down box.
6. Record the X-Ray system IP information.
7. Click ***OK*** to the ***Microsoft TCP/IP Properties*** window.
8. Click ***OK*** to the ***Network Properties*** window.
9. Log off and log on to Windows as **DL** (password **innova**).

   Wait until the application has fully loaded.
10. Click ***Service*** and select ***Service*** from the list in the main application screen.



11. Click ***Configuration*** in the ***Service User Interface (SUIF)***

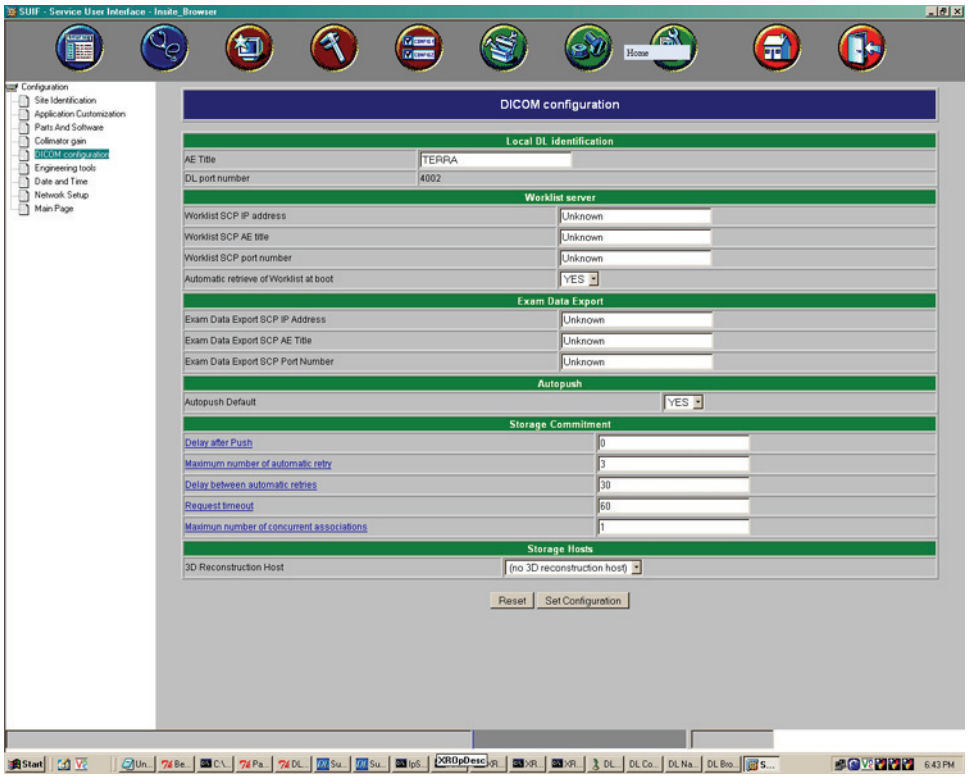
12. If the system is an Innova 2000, click ***System*** > ***Options*** from the left pane and check the ***Worklist Option*** check box from the list.



13. Select ***DICOM Configuration*** from the list on the left.

NOTE: If the system is an Innova 2000 Pre SVC Pack, the following screen will be displayed: ***Exam Data Export not enabled*** (below).

NOTE: All other systems will display a screen similar to the ***Exam Data Export enabled*** screen (below).



14. Record the system's AE title and port number as listed under Local DL Identification.
15. Record the following under the ***Worklist server***:
    - Select ***TRUE*** from the list in the ***Enable worklist*** field.
    - Enter the Mac-Lab/CardioLab system IP address in the ***Worklist SCP IP address*** field.
    - Enter the Mac-Lab/CardioLab system ***AE Title*** in the ***Worklist SCP AE Title*** field.
    - Enter the Mac-Lab/CardioLab listening port (1225) in the ***Worklist SCP port number*** field.
    - Select ***YES*** from the list in the ***Automatic retrieve of Worklist at boot***.
16. Enter the following in the Exam Data Export section:
    - Select ***TRUE*** from the list in the ***Enable Exam Data Export*** field.
    - Enter the Mac-Lab/CardioLab system IP address in the ***Exam Data Export SCP IP address*** field.
    - Enter the Mac-Lab/CardioLab system ***AE Title*** in the ***Exam Data Export SCP AE Title*** field.
    - Enter the Mac-Lab/CardioLab listening port (1225) in the ***Exam Data Export SCP port number*** field.
17. Click ***Set Configuration*** when complete.
18. Click ***Exit***.
19. Restart the Innova system.

    The system will reboot, auto-logon, and begin loading the application. Wait until the application is fully loaded.

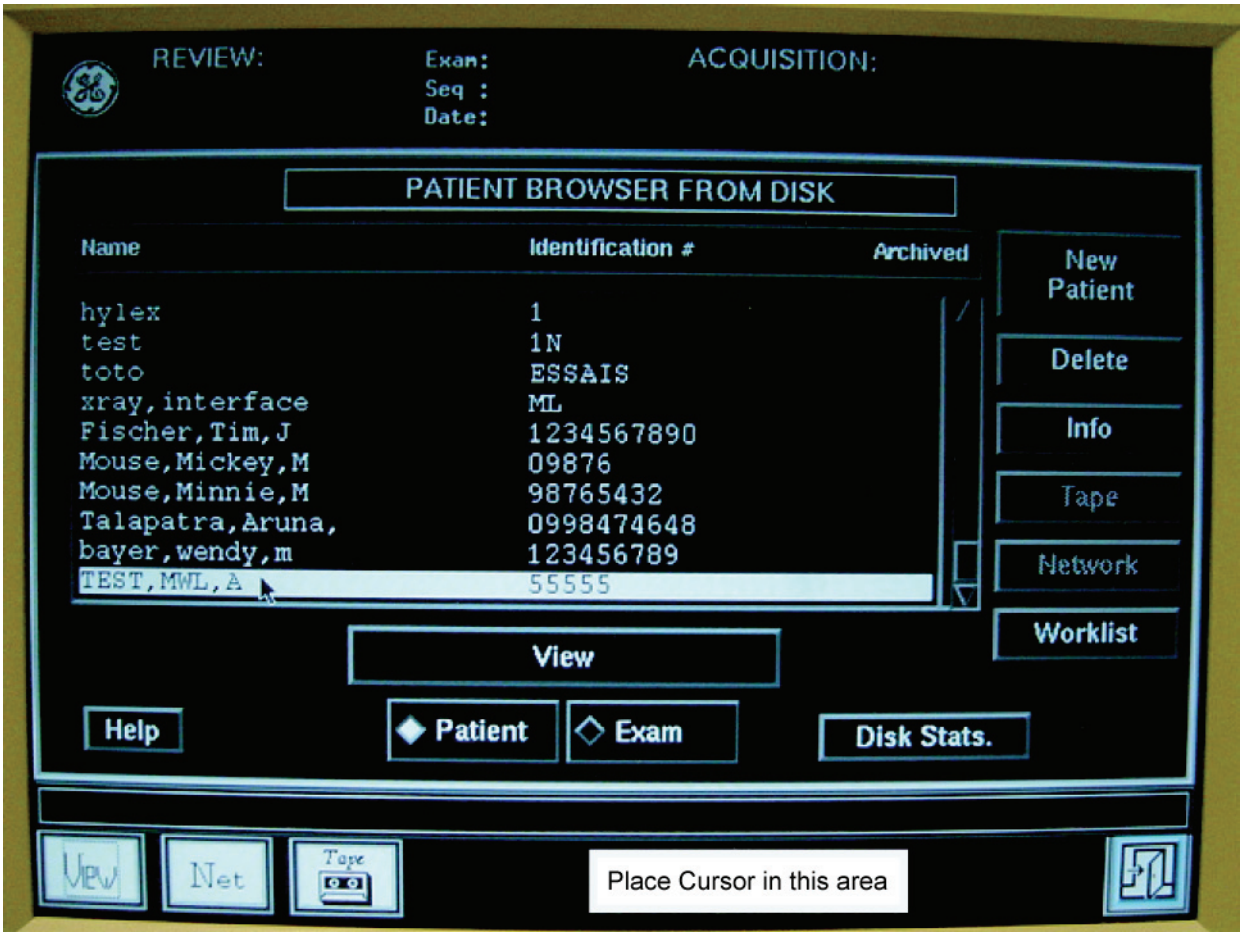
Configure the AdvantxE DLX X-Ray System

1. If the application is not started at the DLX console:
   - If a ***dlx login:*** prompt is displayed, type **dlx** and press **Return**.
   - If an ***ok:*** prompt is displayed, type **boot** and press **Return**. This will bring the system to the ***dlx login:*** prompt. At this prompt, type **dlx** and press **Return**.

   Wait for the DLX application to fully load.

2. Check the software version and IP configuration:

   a. Move the mouse into the black area at the bottom of the screen (see diagram below) and press **Control** + **Shift** + ♦ + **~** to open an xterm console.



b. At the prompt, type **tail -100 errlog** and press **Return**.

The DLX Application Version is displayed (for example, C25.60).

c. At the prompt, type **ifconfig -a** and press **Return**.

The information after ***hme1:*** are the details for the gateway NIC: flags=863 <UP, BROADCAST, NOTRAILERS, RUNNING, MULTICAST> mtu inet 3.231.48.171 netmask ff000000 broadcast 3.255.255.255).

d. Type **exit** and press **Return** to close the console.

3. Verify that the MWL and MPPS options are enabled:

a. Move the mouse into the black area at the bottom of the screen. Left-click (and hold) and select ***DLX Others*** > ***DLX INSTAL***.

Wait until the DLX INSTAL application finishes loading.

b. At the ***Enter Command Number:*** prompt, type **5** (for Other Options) and press **Return**.

c. At the ***Enter Command:*** prompt, type **5** (for Network Configuration Menu) and press **Return**.

- If ***4: Patient Worklist Management Option*** = ***YES***, the MWL option is installed.
- If ***5: Modality Performed Procedure Step Option*** = ***YES***, the MPPS option is installed.

d. Type **99** (to go back to the upper menu) at the ***Enter Command:*** prompt, and press **Return**.

e. Type **99** at the ***Enter Command:*** prompt, and press **Return**.

f. Left-click on the black screen and select DLX Application.

Wait for the Application to finish loading.

4. Configure the MWL and MPPS options:

NOTE: The application must be running in Service mode (rather than application mode).

a. Click the ***Door*** icon in the lower right corner of the screen and click ***Exit.***

b. Type **service** at the ***dlx login:*** prompt and press **Return**.

c. Type **proprietary** at the password prompt and press **Return**.

d. Left-click on the black area at the bottom of the screen, and select ***DLX Application***.

e. Configure the MPPS service:

   i. Left-click into the black area on the bottom of the screen and select ***DLX Others*** > ***Settings*** > ***MPPS***.

   ii. When prompted for ***Remote IP Address***, type the IP address of the Mac-Lab/CardioLab system and press **Return**.

   iii. When prompted for ***Application Title***, type the AE Title of the Mac-Lab/CardioLab system and press **Return**.

   iv. When prompted for ***Application Port***, type **1225** and press **Return**.

   v. Type **Y** to confirm the values entered.

f. Configure the Worklist service:

   i. Left-click on the black area on the bottom of the screen and select ***DLX Others*** > ***Settings*** > ***Worklist***.

   ii. When prompted for ***Remote IP Address***, type the IP address of the Mac-Lab/CardioLab system and press **Return**.

   iii. When prompted for ***Application Title***, type the AE Title of the Mac-Lab/CardioLab system and press **Return**.

   iv. When prompted for ***Application Port***, type **1225** and press **Return**.

   v. Type **Y** to confirm the values entered.

g. To find and set the AE title for the DLX, click in the black space at the bottom of the screen and select ***DLX Others*** > ***Settings*** > ***DLX AE-Title***.

   The ***DLX AE Title*** is displayed. If it needs to be changed, enter a new AE Title and click ***Apply***.

5. Restart the DLX application to reflect any changes to the configuration.

   a. Click the ***Door*** icon in the lower right corner of the screen and select ***Exit***.

   b. At the ***dlx login:*** prompt, type **restart** and press **Return**.

   c. At the ***dlx login:*** prompt, type **dlx** and press **Return**.

Interface Testing

Enter Patient Information on the Mac-Lab/CardioLab system

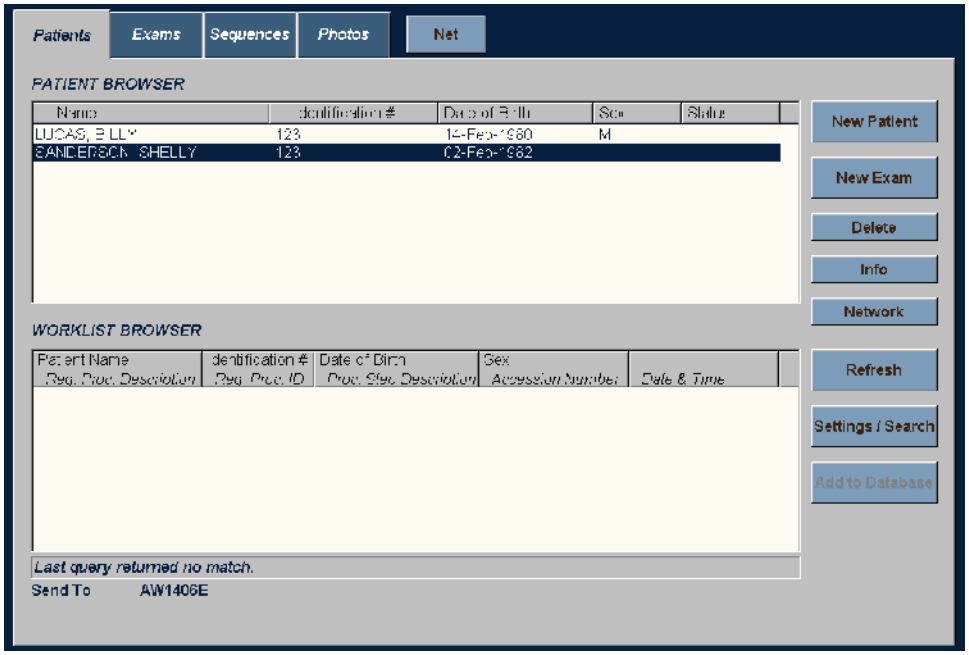
1. At the Mac-Lab/CardioLab system, double-click ***Mac-Lab CardioLab*** to launch the application.
2. Click ***New Study*** to open a Mac-Lab or CardioLab study (either may be selected).
3. Enter the appropriate patient demographic information, then click ***OK*** to close the ***Patient Information*** window

   To also transfer the Accession Number data, enter this data into the ***Orders*** dialog (under the ***Study*** menu).

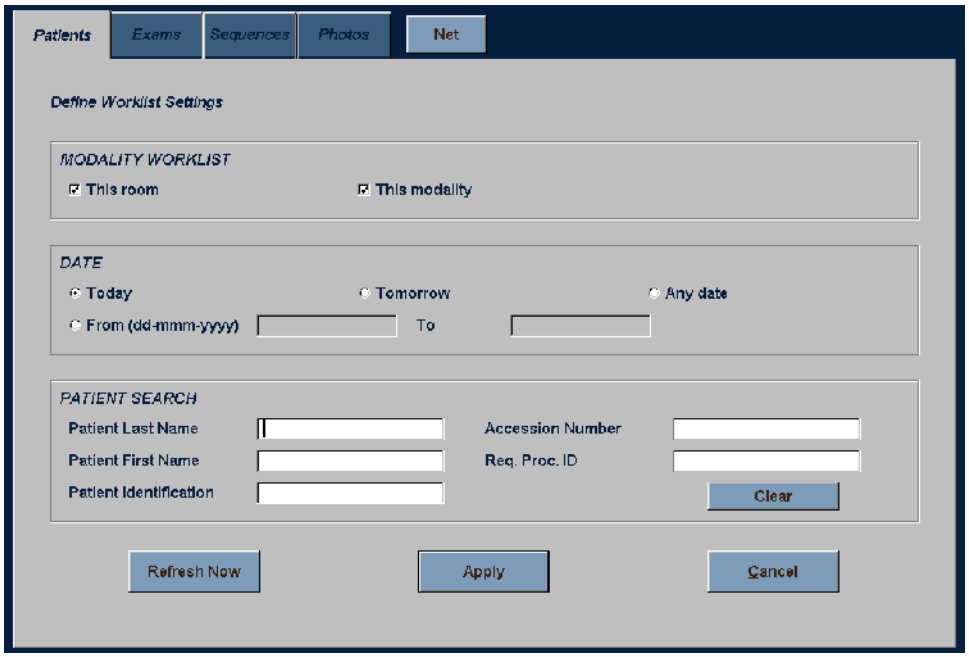
Test with the Appropriate X-Ray System

Innova DL

1. The main window displays a Patient Browser window and a Worklist browser window.



2. Click ***Settings/Search***.



3. In the ***Modality Worklist*** section, verify both the ***This room*** and ***This modality*** checkboxes are checked.
4. Verify that ***Today*** is selected in the ***Date*** field.
5. Click ***Refresh Now***. The patient will be listed in the ***Worklist*** Browser.
6. With the patient selected, click ***Add to Database***.
7. Click Start Exam at the ***Patient Information*** window.
8. Acquire X-Ray images (create a fluoro sequence).
9. Click ***End Exam***.

NOTE: Always close the study on the X-Ray system before closing the study on the Mac-Lab/CardioLab system so the run information can be transferred.

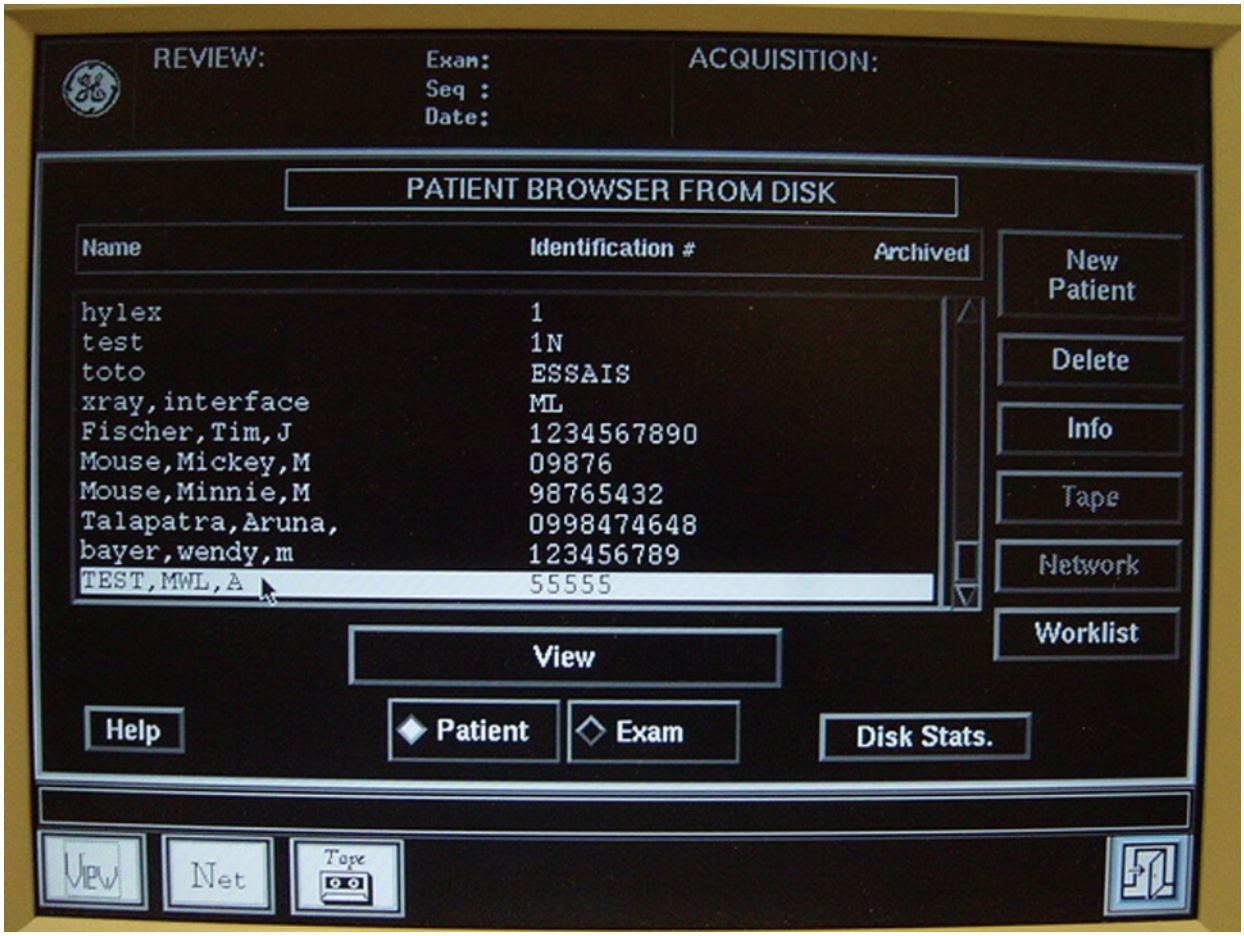
MPPS information should now be populated into the Mac-Lab/CardioLab study. At the Mac-Lab/CardioLab system, verify that the data from the X-Ray system is transferred by opening the ***Radiology*** dialog under the ***Study*** menu and clicking ***Refresh***.

This information can also be included in the Mac-Lab/CardioLab report by adding the “X-Ray Run Information” section to the report format. Refer to the Mac-Lab/SpecialsLab Operator’s Manual (PN 2047900-101) or the CardioLab Operator's Manual (PN 2047900-102) for additional information on Report Formats.

10. Close the study on the Mac-Lab/CardioLab system.

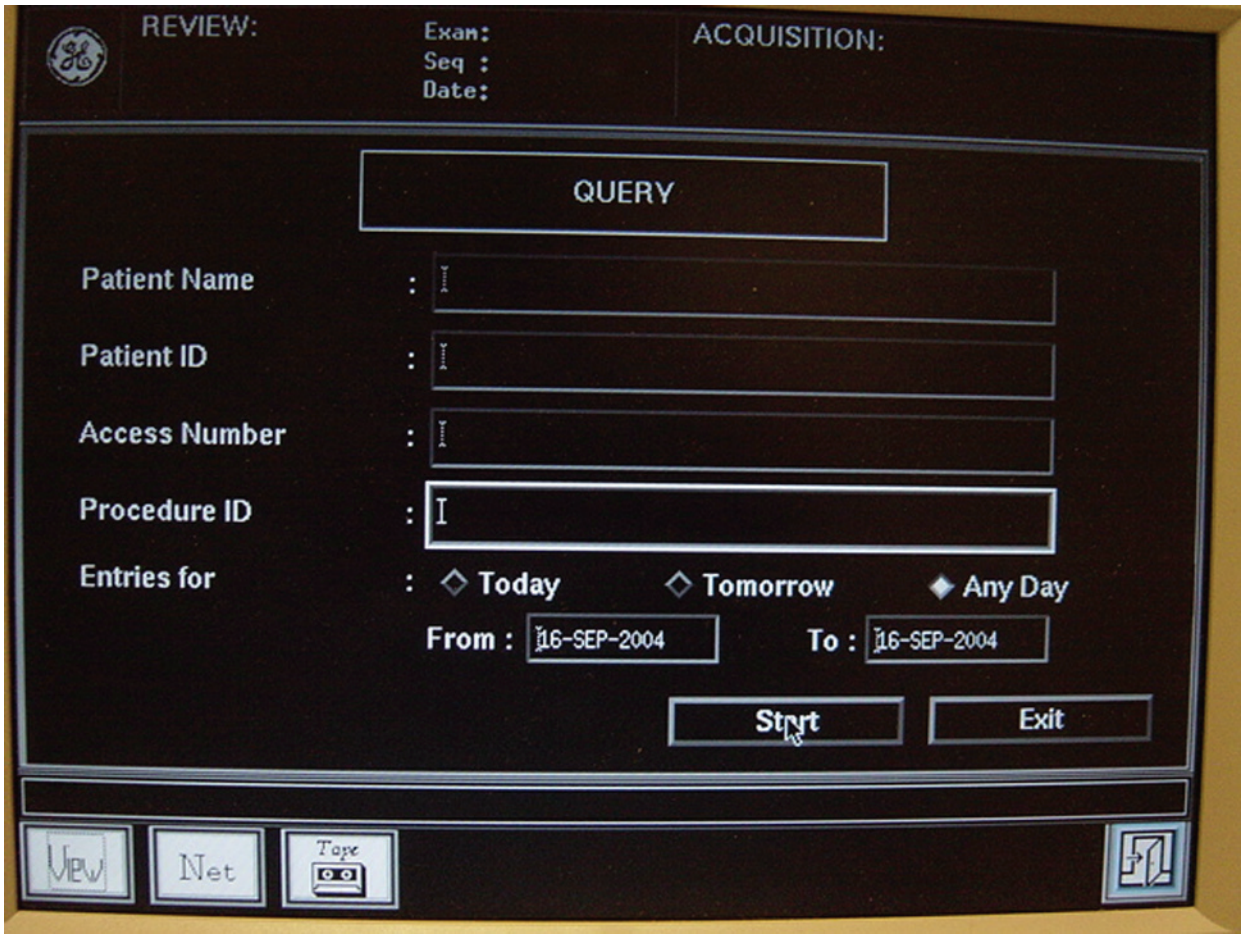
DLX system

1. From the DLX Application, click ***Worklist*** on the right side of the screen.



2. Click ***Query*** at the ***Patient Worklist Browser*** window.


REVIEW:
Exam:
Seq :
Date:
ACQUISITION:
PATIENT WORKLIST BROWSER
Last Query:
16-SEP-2004 18:36
Name
Date of Birth
Identification#
Access#
TEST,MWL,A
01-JAN-2001
55555
Query ...
Patient Info
Import
Help
Worklist Verif.
Exit
View
Net
Tape



3. Verify that ***Today*** is selected and click ***Start***.
4. Highlight the patient and click ***Import***.
5. Click ***Close*** at the ***Worklist Import Request Status*** message box.
6. Click ***Exit***.
7. Find the patient in the ***Patient Browser*** window and click ***Exam***.
8. Click ***New Exam***.
9. Click ***Start Exam***.
10. Acquire X-Ray images (create a fluoro sequence).

11. Click ***End Exam***.

NOTE: It is important to close the study on the X-Ray system prior to closing the study on the Mac-Lab/CardioLab system in order for the run information to be transferred.

MPPS information should be now populated into the Mac-Lab/CardioLab study. At the Mac-Lab/CardioLab system, verify that the data from the X-Ray system is transferred by opening the ***Radiology*** dialog under the ***Study*** menu and clicking ***Refresh***.

This information can also be included in the Mac-Lab/CardioLab report by adding the “X-Ray Run Information” section to the report format. Refer to the Mac-Lab/SpecialsLab Operator’s Manual (PN 2047900-101) or the CardioLab Operator's Manual (PN 2047900-102) for additional information on Report Formats.

12. Close the study on the Mac-Lab/CardioLab system.