

Jackson Heart Study (JHS)

MRI Procedures Manual

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CONTACT INFORMATION FOR THE JHS STUDY

If you have any questions or concerns regarding MRI imaging, please contact the Mayo Clinic Aging and Dementia Imaging Research (ADIR) Laboratory:

JHSmri@mayo.edu

1. BACKGROUND AND SIGNIFICANCE OF THE JHS STUDY

<https://www.nhlbi.nih.gov/science/jackson-heart-study-jhs>

The Jackson Heart Study (JHS) study is the largest investigation of causes of cardiovascular disease in African-Americans, involving more than 5,300 men and women in Jackson, Mississippi. The goal of the JHS is to investigate genetic and environmental factors to understand how African Americans are disproportionately affected by cardiovascular diseases, especially high blood pressure, coronary heart disease, heart failure, stroke, and peripheral arterial disease. The NHLBI and the [National Institute on Minority Health and Health Disparities](#) co-sponsor this study.

2. SITE QUALIFICATION

2.1. Overview

Prior to any JHS subjects being scanned, the site's scanner must complete MRI Site Qualification. In most cases, site qualification will only involve scanning a phantom with the electronically provided JHS sequences which will be provided by the Mayo Clinic ADIR Lab and loaded by the local service engineer.

Once the scan is received, the ADIR Lab QC team will review the scanned protocols for correct parameters, good image quality and scanner performance. If the scans do not pass ADIR Lab QC, you will be asked to re-scan after making the suggested changes by the ADIR Lab QC team.

NOTE: Only the scanner qualified for the JHS study at your site should be used for ALL subsequent subject scans during the study. If the same MRI scanner is not used, the scan will not be reimbursed.

2.2. Phantom Scan Instructions

For site qualification, the MR Technologist must scan a phantom using the electronically loaded JHS Human Scan protocols.

*NOTE: This can be done prior to IRB approval.

2.3. Phantom Qualification Protocol

- In most cases, done on a phantom
- No adjustments should be made to these protocols

2.4. Data Transfer of Qualification Scans

Please archive all sequences acquired for site certification using your site's standard practice and upload via VPN ([Section 9](#)).

2.5. Site Certification Scan Results

The ADIR Lab QC team will perform a quality control check on the phantom and/or volunteer scan data. ADIR Lab QC team will determine if the correct parameters have been met and assure there are no other underlying problems seen during the scanning of these sessions. After successful qualification scanning, an official Site Certification e-mail will be sent to the JHS study contacts notifying them their site has been approved and is ready to scan subjects.

3. MRI SUBJECT PRE-SCAN PROCEDURES

3.1. Subject Pre-screening

All subjects should have been screened by the consenting study coordinator for standard MRI contraindications. However, subjects must be screened for MRI contraindications immediately before the MRI scan using your local standard protocol. Contraindications include, but are not limited to:

- The presence of non-removable ferrous metal objects
- Aneurysm clips
- Pacemakers
- Other contraindications such as defibrillators, etc.

3.2. Subject Safety and Monitoring

1. All sites should follow the standard subject consent protocols as approved by your local IRB.
2. Explain the scan procedure to the subject so that they know what to expect during the MRI.
3. Provide the subject with the opportunity to use the restroom before the scan begins.
4. Please use universal MRI safety precautions. Make sure that subject does not have any large ferrous metal on or inside of him/her such as shrapnel, a metal fragment in the eye, aneurysm clips, ear implants, spinal nerve stimulators, permanent makeup, or a pacemaker. Make sure that all loose metal objects are removed.
5. Offer the subject hearing protection.
6. Please use standard local practice for monitoring the subject during the scan. These may include MRI safe devices to monitor pulse and O₂ levels.

3.3. Subject Positioning

1. Proper subject positioning is crucial for successful reproduction of serial MRI exams. Therefore, it is important that each subject is positioned in the same manner for each and every MRI exam.
2. Please follow the procedures below for positioning the subject in the head coil:
 - Place clean sheet on scanner table and coil cradle.
 - Besides standard room exclusions, ensure the subject has removed their dentures as well as any hair clips, combs, earrings, necklaces, etc.
 - Remove all upper body clothing with metallic trim, such as zippers, buttons or embroideries that may cause artifacts in the MRI images.
 - Provide each subject with ear protection.
 - Position the subject so their head and neck are relaxed, but without rotation in either plane. Proper placement in the head coil is crucial because scans are acquired straight, not in an oblique orientation. The subject should also be well supported in the head coil to minimize movement. Motion artifacts may result in data rejection and request for a re-scan in many cases.
 - Support under the back and/or legs can help to decrease strain on the knees and back as well as assisting in the stabilization of motion in the lower body.
 - Once subject has been positioned, place sponges along the sides of head and a Velcro strap across forehead (if available) for stabilizing support and reduction of motion.
 - **Align the centering crosshairs on the subject's nasion (*directly between the***

eyebrows) at every scanning session.

- Center the head coil over the subject’s head, making sure the subject is high enough in the coil to prevent signal loss at the inferior aspect of the brain.
- Offer each subject a panic button in case of emergencies or claustrophobia if common local practice at your facility (for example, a squeeze ball alarm).
- Remind subject to hold as still as possible and advance subject to the iso-center of the scanning bore.

NOTE

- If a deviation from these instructions is required to accommodate a subject, the MRI technologist should notify the ADIR Lab QC team (JHSmri@mayo.edu).

4. MRI ACQUISITION SEQUENCES

4.1. MRI Brain Scan Sequences

JHS Subject Scanning Sessions: (ALL SCANS SHOULD BE STRAIGHT - NON OBLIQUE)

4.1.1. JHS Brain Scan Protocol

1. 3 Plane/Tri-Planar Scout
2. Accelerated Sagittal MPRAGE
3. Sagittal 3D FLAIR
4. Axial 3TE T2 Star
5. Axial MB DTI (Straight Axial – Not Oblique)
6. Axial MB DTI A-P
7. Sagittal 3D T2 SPACE
8. Axial Multi PLD 3D PASL

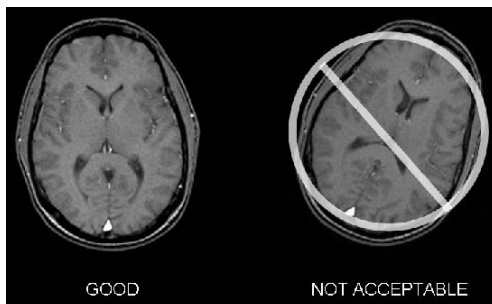
The ADIR Lab QC team will check all imaging parameters to assure the correct sequences were used. If the electronically loaded JHS sequences were not used to scan a subject, the scan will be rejected and a rescan will be requested.

4.2. MRI Example Images

4.2.1. Human Scan Sequences - Image Examples

The following pages are example images of what will be acquired for the JHS study, as well as positioning recommendations.

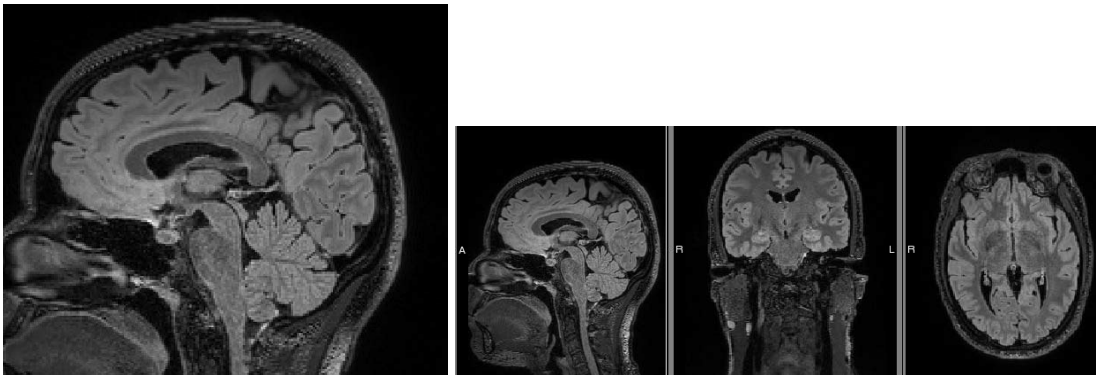
- If the subject is not positioned properly, please adjust the subject in the head coil and re-scout. Continue repositioning and scouting until the subject is correctly centered in the head coil.



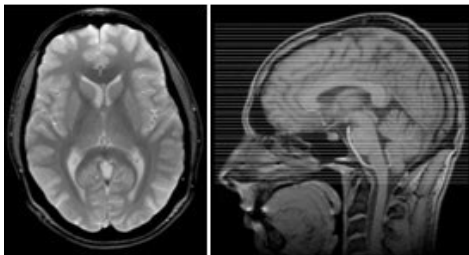
- Once the subject is positioned correctly, the following sequences are to be run.
- **NOTE: Entire brain must be covered for all series.**


Prescription of Accelerated Sagittal MPRAGE

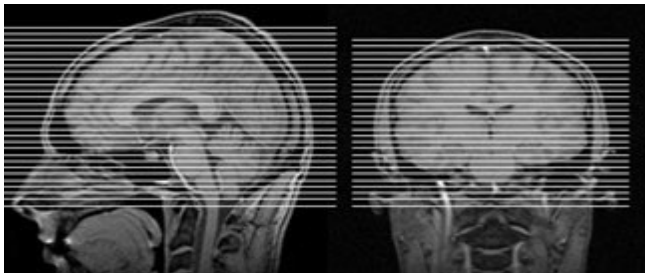
- **Do Not Angle or change any parameters**
- Box A – Axial image. FOV placed in center to avoid side-to-side wrap.
- Box B – Sagittal image. FOV placed anterior to avoid nose wrap.
- Box C – Coronal image. FOV placed to assure top of the brain is covered.


Prescription of Sagittal 3D FLAIR

- **Do Not Angle or change any parameters**
- Box A – Axial image. FOV placed in center to avoid side-to-side wrap.
- Box B – Sagittal image. FOV placed anterior to avoid nose wrap.
- Box C – Coronal image. FOV placed to assure top of the brain is covered.

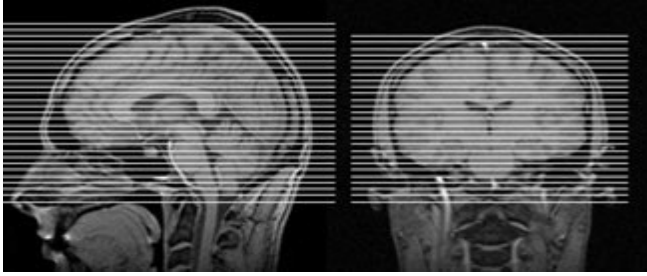

Prescription of Axial 3TE T2 Star

- **Straight Axial, do not oblique/angle the slices**
- Ensure total brain coverage position from inferior to superior


Prescription of Axial DTI P-A

- **Straight Axial, do not oblique/angle the slices**

- Position from inferior to superior



Prescription of Axial DTI A-P

- **Straight Axial, do not oblique/angle the slices**
- Position from inferior to superior



Prescription of Sagittal 3D T2 SPACE

- **Do Not Angle or change any parameters**
- Box A – Axial image. FOV placed in center to avoid side-to-side wrap.
- Box B – Sagittal image. FOV placed anterior to avoid nose wrap.
- Box C – Coronal image. FOV placed to assure top of the brain is covered.



Prescription of 3D PASL

- The inferior edge of the ASL volume must be positioned at the bottom of the cerebellum
- Place box close enough to the back of the skull to minimize the chance for nose wrap
 - Minimal nose wrap is ok, if there is significant nose wrap and it is obstructing the brain tissue/anatomy, re-position and run the series again

Use only the electronically imported JHS sequences.

5. MRI SUBJECT SCAN PROCEDURES

5.1. Entering Subject Information into the Scanner

The MRI Technologist should enter the subject information into the scanner per the local site's standard. The scan header will be de-identified and rendered HIPAA compliant as part of the upload process via VPN ([Section 9](#)).

5.2. Scan Discontinuation

If the subject elects to discontinue the MRI because of discomfort, every effort should be made to adjust the table, head coil, etc. and finish acquiring the scan. However, if the subject still does not want to complete the scan, then the MRI should be abandoned and an email should be sent to JHSmri@mayo.edu including the reason the subject was unable to complete the MRI.

5.3. On-Site Clinical Reads

Every subject must receive a clinical read by an on-site radiologist at the MRI facility. The handling of the MR interpretation should follow standard local practice at the referral site. Scan interpretations for diagnostic clinical purposes will **not** be provided by the ADIR Lab (MRI Core) for JHS.

5.4. Archive Procedures

Every MRI scan for the JHS study must be archived following your site's standard practice. Additional data transfers or copies may be requested in the event that a data transfer is interrupted or incomplete. Possible MRI archive mediums include:

- PACS
- CD or DVD

5.5. Request for Repeat/Additional MRI Scans

A request for a re-scan may be required in the event that the MPRAGE is found to be unacceptable due to subject motion or an incomplete/incorrect MRI acquisition.

The ADIR Lab QC team will check all JHS scans to be sure that the exam was conducted on the site's scanner qualified for the JHS study, and that the correct, electronically loaded sequences have been used to scan each subject. Repeat exams may also be required if the incorrect scan sequence, orientation, or angulations were used. It is imperative to use the JHS approved acquisition sequence with every JHS subject. Scans with image degradation due to the incorrect scan sequence, orientation, or angulations will **NOT** be reimbursed nor will scans acquired on any scanner other than the one qualified for JHS. Re-scans will be reimbursed if the correct scan sequence, orientation, and angulations were used.

6. ONGOING QUALITY CONTROL AND PHANTOM SCANS

The site scanners will only be required to scan the MRI phantom at initial site certification and again if there is a scanner software and/or hardware upgrades.

Please see instructions for scanning the phantom in the MRI Site Qualification, [Section 2](#).

6.1. Hardware and Software Upgrades

To avoid any delays or mistakes in scanning, the ADIR Lab QC team requires notification at least 2 weeks **PRIOR** to any software and/or hardware upgrades for any scanner involved in the JHS imaging study so they can provide you the correct upgraded protocols if needed.

At the time of the MRI scanner upgrade, you will be required to scan a phantom prior to continue scanning study subjects.

IMPORTANT:

If a site fails to perform these phantom scans and/or they have not been performed within 2 weeks of the upgrade, JHS may not accept or reimburse the subsequent subject scans. The study coordinator and the principal investigator at the site will be notified if a phantom scan has not been received within that time frame.

If you have questions regarding this procedure, please contact: JHSmri@mayo.edu.

6.2. Phantom Results and Site Notification

The ADIR Lab QC team will examine each phantom data set to ensure that there are no underlying problems with the scanning session. When finished, if there is an issue that needs to be addressed, an email will be sent notifying you of the problem.

7. DATA TRANSFER USING VIRTUAL PRIVATE NETWORK (VPN)

Please upload all sequences acquired using your site's standard practice to the local archival system. In addition, de-identified data must be transferred to the ADIR Lab via Virtual Private Network (VPN).

7.1. Subject Anonymization Nomenclature

The site will be responsible for anonymizing all patient specific information according to local laws and regulations. At a minimum, the following DICOM fields will be replaced:

1. **Patient ID:** Must be replaced with the JHS ID provided by the JHS study coordinator.
2. **Patient Name:** Must be replaced with the JHS ID provided by JHS study coordinator.
 - Nomenclature = J5#####
 - J = Field Center identifier J (Jackson)
 - 5 = JHS Study Participant
 - 6 total numeric digits (including the leading '5')
 - Example = J501234

7.2. Data Transfer Method

See [Section 9](#). Site should transfer the data via the VPN within 24 hours of acquisition.

8. MRI CONTACT INFORMATION

ADIR Lab PI	Clifford R. Jack, M.D.
ADIR Lab Project Manager	Denise Reyes
ADIR Lab MR Specialist	Kaely Thostenson
ADIR Lab E-mail Address	JHSmri@mayo.edu

9. DATA TRANSFER INSTRUCTIONS

Data transfer must be electronic in standard DICOM format in order to meet turn around requirements, preferably within one business day of the exam.

Data transfer will occur via Virtual Private Network (VPN) authorizations assigned to your site. Your site's IT group has worked with the ADIR Lab to establish your site's connection to our VPN.

The software used to send DICOM can be any tool with the ability to send images. Please use the following information for sending it to the correct DICOM receiver.

Site	Protocol/Project	HOST	IP ADDRESS	AET TITLE	SCP PORT
Jackson, Mississippi	JHS	aric.mayo.edu	129.176.134.204	JHS	8020
Jackson, Mississippi	JHS	aric.mayo.edu	129.176.134.204	JHS_Q	8018

If you are unable to send anonymized DICOM from your image storage solution, the ADIR Lab suggests DicomBrowser as one possible solution. A user guide to its features is included in [Section 10](#).

10. DICOMBROWSER USER GUIDE

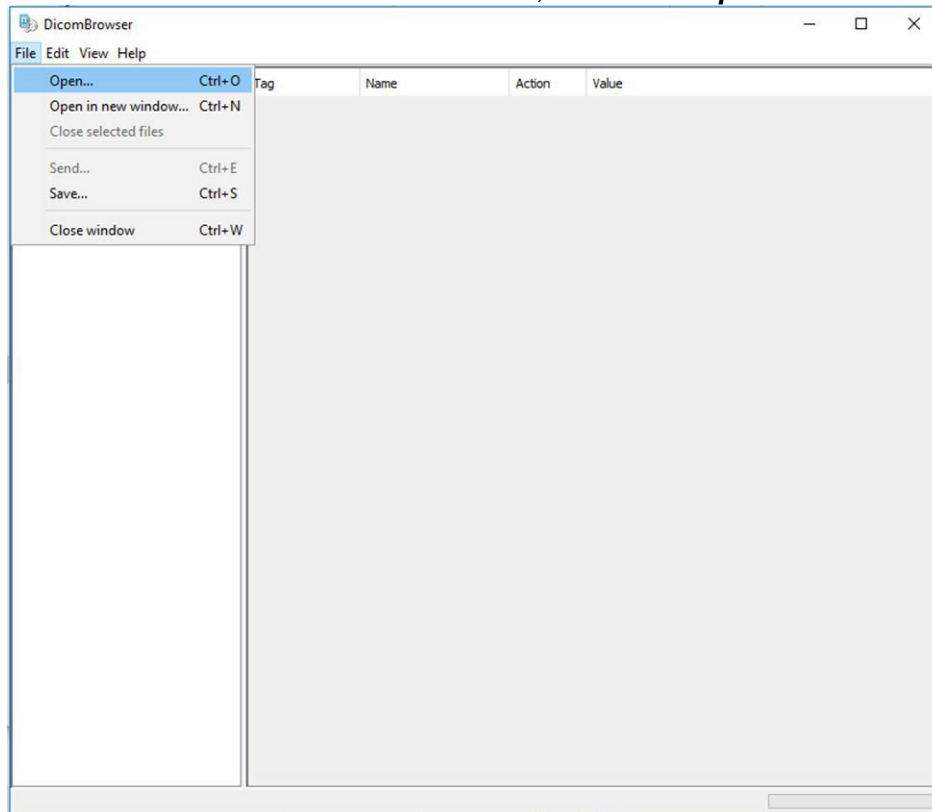
DicomBrowser is an application for inspecting and modifying DICOM metadata in many files at once. A single imaging session can produce thousands of DICOM files. DicomBrowser allows users to view and edit a whole session—or even multiple sessions—at once. Users can save the original or modified files to disk, or send them across a network to a DICOM C-STORE service class provider, such as a PACS or an XNAT.

DicomBrowser is available at the following link: <https://wiki.xnat.org/xnat-tools/dicombrowser>. This link includes a Video Tutorial on anonymizing DICOM using the application.

Users may also use the steps below or on this site to anonymize and send DICOM: <https://wiki.xnat.org/xnat-tools/dicombrowser/how-to-use-dicombrowser>:

10.1. Load DICOM into DicomBrowser

1. With DicomBrowser installed and started, select **File\Open** from the Menu Bar:

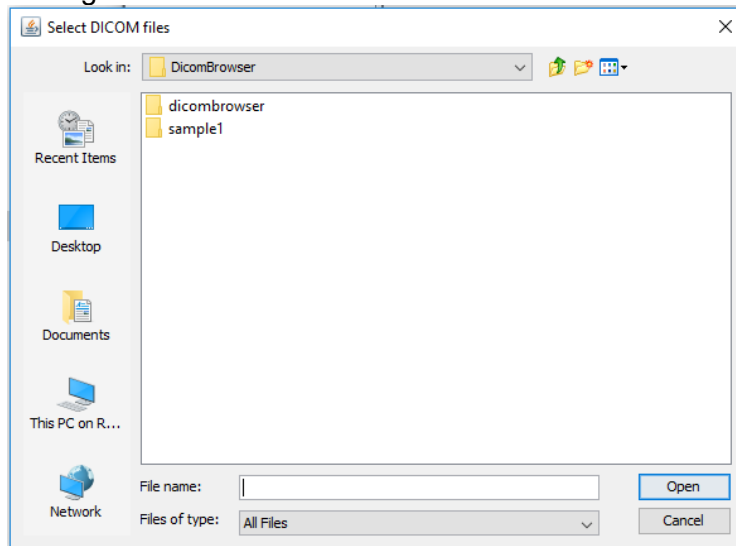


2. Using the **Select DICOM files** dialog box, navigate to the desired DICOM directory to be anonymized and/or sent and click the **Open** button:

NOTE: Select either individual DICOM files or directories. If a directory is selected, all DICOM files in that directory and its contained directories are loaded.

The browser can load thousands of files at a time, but trying to view attributes for more than a few thousand files can exceed the Java memory limit.

The memory limit can be increased, but the application may experience delays. Therefore, it is better to load only as many sessions as the machine can gracefully manage.



3. When the files have loaded, a list of Patient IDs appears on the left side of the browser window. DicomBrowser arranges data files in a hierarchy in which Patient is the top level; below Patient is Series, Study, and, at the bottom, Image (or Instance), representing a single DICOM data object. This hierarchy might or might not mirror the organization of these files in directories on disk.

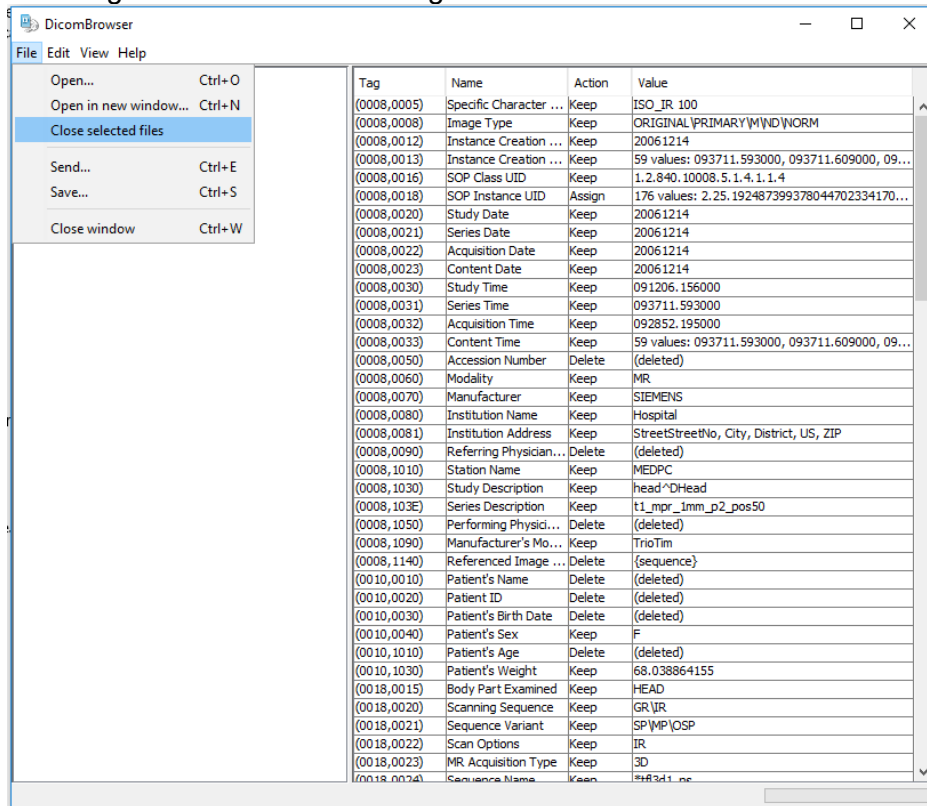
Each Patient ID label has an expander button to its left; clicking this expander shows all the Studies loaded for that patient. Clicking the expander next to a Study label shows all the contained Series, and clicking the expander next to a Series label shows all the contained Images.

Clicking on a label itself (Patient, Series, Study, or Image) selects that label, which causes the browser to load all the associated attributes. These attributes are displayed in a table on the right side of the browser window. Selecting a single Image causes just one file to be loaded; selecting a Patient may cause hundreds of files to be loaded, which could take a few minutes.

When a selection has been made on the left side, the attributes for all files associated with the selection are shown in a table on the right side. The table shows, for each attribute, its DICOM tag, the name of the attribute, a summary of whether and how the attribute has been modified, and the value(s) of that attribute, after any changes have been applied.

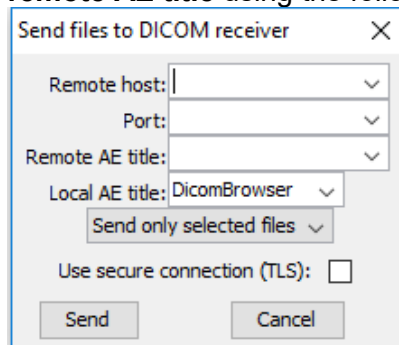
The Action column shows whether each attribute has been changed. When files are first loaded, the label in this column is **Keep**, meaning that the browser will keep the original values. Other possible values are **Clear**, if the attribute contents have been erased; **Delete**, if the attribute has been removed entirely; **Assign**, if the attribute has been set to a new value; or **Mixed**, if the current file selection includes multiple files for which different operations have been specified.

- Files that have been loaded can be closed and removed from the browser view by selecting them and then choosing **File\ Close selected files** from the Main Menu:



10.2. Send Files with DicomBrowser

- In the **Send files to DICOM receiver** dialog box, enter the **remote host**, **port**, and **remote AE title** using the following screenshot and table as guides:

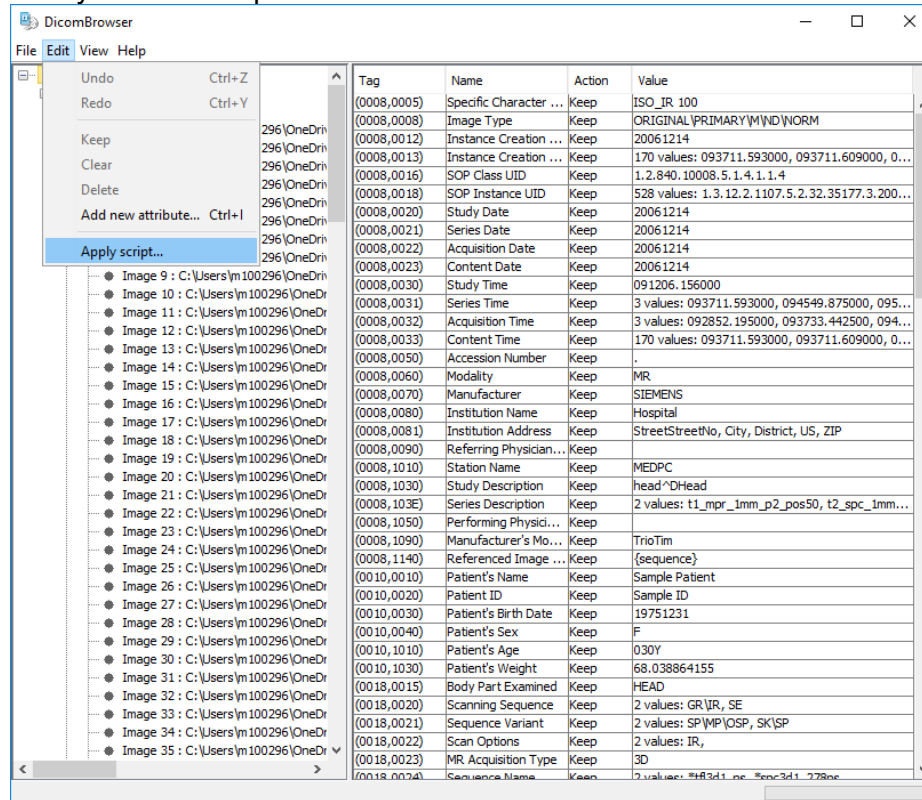


- From the drop-down menu, select one of the following options and click the **Send** button:
 - Send only selected files**
 - Send all files**

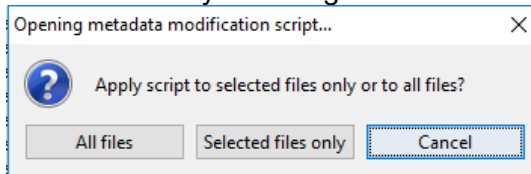
10.3. Modify DICOM in DicomBrowser

1. If the DICOM has not yet been de-identified (anonymized), from the Main Menu, select **Edit\Apply script...** and navigate to and select the desired anonymization script and select the Open button:

NOTE: Please refer to the link to the DicomBrowser application, above, for sample anonymization scripts:

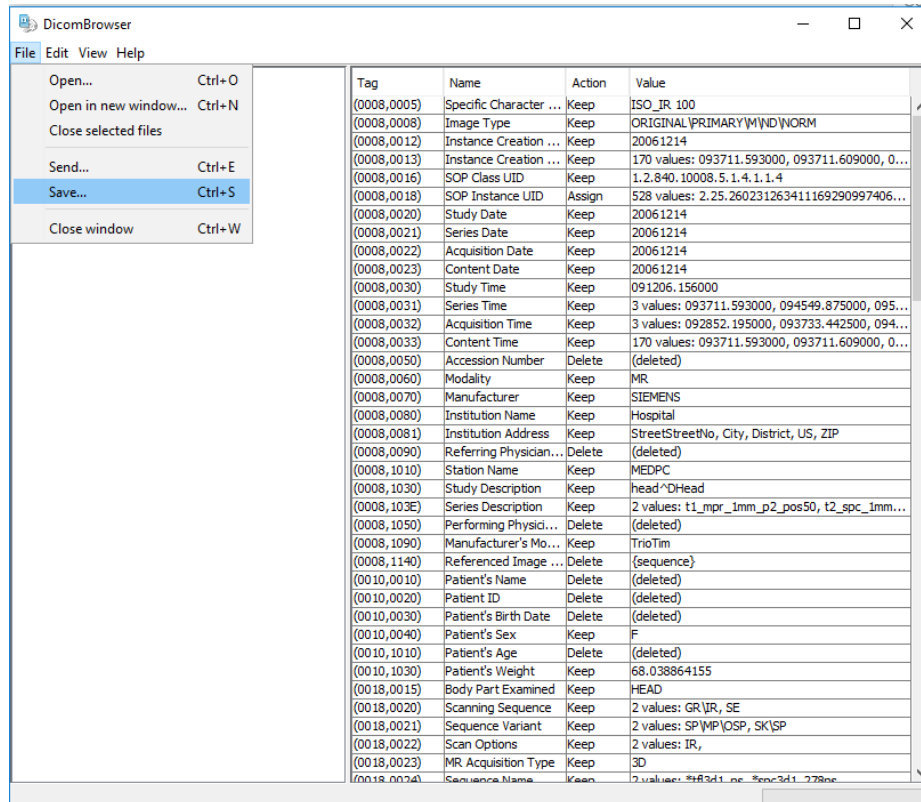


2. At the **Opening metadata modification script...** dialog box, chose to apply the script to all files by selecting the **All Files** button:

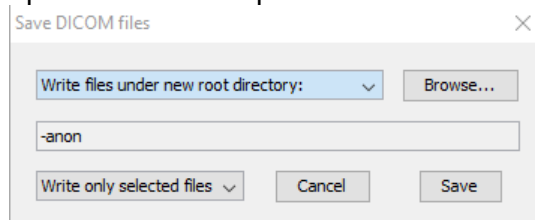


3. Scroll through the DICOM values and verify no identifying information remains.

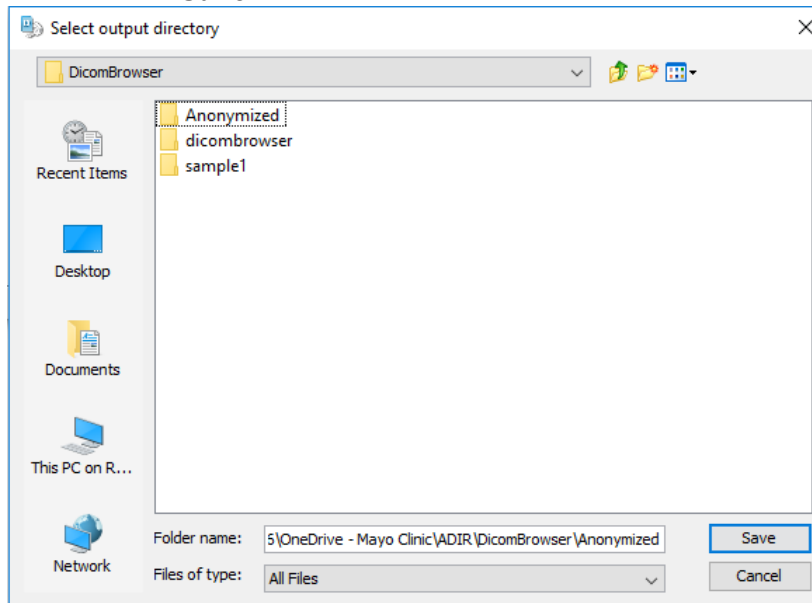
- Save the anonymized files to a different directory by selecting **File\Save...** from the Main Menu:



- In the **Save DICOM files** dialog box, select the **Write files under new root directory:** option from the drop-down menu:



6. From the **Select output directory** dialog box, navigate to the desired save-to directory and click the **Save** button:

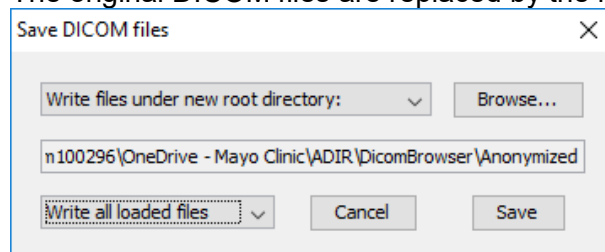


7. Back in the **Save DICOM files** dialog box, select the **Write all loaded files under** option from the Dropdown menu and click the **Save** button:

NOTE: The dialog box that appears offers several options for naming the saved files:

- Write files in adjacent directory with suffix
For each directory in the original file structure, a new directory is created with the original pathname with the given suffix appended. The new directory is filled with modified versions of the DICOM files in the original directory.
- Write files in same directory with suffix
New files are written in the same directory structure as the originals, but each new filename has the given suffix.
- Write files under new root directory
A new root directory (specified by the user) is created, and all modified files are written under that root in a directory structure that mirrors the original.
- Overwrite existing files

The original DICOM files are replaced by the modified files.



8. To send anonymized DICOM objects to a remote DICOM C-STORE receiver, select **File\Send** from the Main Menu:

