



COMPASS-ND Phase 3

MR Data Acquisition Manual v1.0

The purpose of this guide for MRI of the Brain is to standardize Magnetic Resonance Image (MRI) acquisition procedures among the MR imaging facilities participating in the COMPASS-ND Phase 3. All technologists contributing to this study are expected to have received appropriate theoretical and practical training in MRI. Study personnel should also satisfy all local requirements for radiology licensing and registration. For the safety of participants and technologists alike, an understanding of risks and safety procedures related to MRI scanning is also required. Utilizing qualified radiology personnel is the first step toward the successful use of MRI in this study.

The guide is designed for the MRI technologists involved in this study. All new personnel who join the study after initiation of the study are also required to read and understand the guide. This guide, taken alone, should not be considered as sufficient training in the proper technique for acquiring MR images. The goal of the guide is to define a standard procedural approach for acquiring MR images of sufficient quality for achieving the study goals. Each investigator site or other locally licensed, qualified physicians shall be solely responsible for all medical decision making with respect to the provision of health care services to study participants. Questions regarding this document should be directed to: Dr. Rosanna Olsen (rolsen@research.baycrest.org)

This guide provides general procedures for scanning COMPASS-ND participants and contains detailed information regarding the slice positioning and MR acquisition parameters. Information regarding data transfer to LORIS can be found in the [Data Transfer Manual](#).

A. Overview of MR Protocol

MR imaging should take approximately 45 minutes, allowing time for participant screening and positioning. Slices should be contiguous, with no slice gaps.

Loc/ Scout	3D T1w sagittal	3D FLAIR sagittal	PDw/T2w ob. axial	T2* ob. axial	DTI (AP & PA) ob. axial	EPI resting ob. axial	fmaps ob. axial	SWI axial	Hires T2w ob. coronal
	5.5 min	6 min	3 min	3 min	4 min AP 17 s PA	8.5 min	4 s AP 4 s PA	4 min	3.5 min

Sequence	TR (ms)	TE (ms)	Voxel size (mm ³)	Acquisition Time* (min)	Additional details
Localizer	3.2	1.37	1.6 x 1.6 x 1.6	0.23	
3D T1w	2300	2.98	1.0 x 1.0 x 1.0	5.30	Phase encoding direction A >> P
FLAIR	6500	123	0.9 x 0.9 x 1.0	6.00	Phase encoding direction A >> P
PD/T2 dual echo FSE	4910	9/116	0.9 x 0.9 x 3.5	3.20	
T2*	650	20	0.9 x 0.9 x 3.0	3.00	Magnitude and phase
Diffusion tensor imaging (DTI-AP & PA)	3200	71	2.0 x 2.0 x 2.0	3.90 AP 0.20 PA	64 Directions b-val1 = 0 b-val2 = 1000 Allow Copy Reference to copy FOV position to avoid re-shim between dwi_dir-AP and dwi_dir-PA
Eyes open resting fMRI (EPI)	1850	13.8 34.02 54.24	3.0 x 3.0 x 3.0	8.50	MB = 3 Acceleration Factor = 2
Phase reverse scans (fmaps; AP & PA)	4210	44	3.0 x 3.0 x 3.0	0.07 AP 0.07 PA	Allow Copy Reference to copy FOV position to avoid re-shim between func_task-rest, fmap-epi_dir-AP, and fmap-epi_dir-PA
SWI	31	4.73, 9.23, 13.73, 18.23, 22.73, 27.23	0.8 x 0.8 x 2.0	3.65	Magnitude and phase
T2w-hippocampal subfields	5960	105	0.4 x 0.4 x 2	3.5	Oblique coronal acquisition, perpendicular to hippocampus

* Note: Acquisition time is based on Siemens Platform. Scan times may vary across platforms

B. Participant Screening

Participants must be screened for any MRI contraindications as per their institutional protocols and clinical guidelines. This includes, but is not limited to the following:

- Pregnancy for females of child-bearing age
- Pacemaker, pacing wires for ICD (Implantable cardioverter defibrillator)
- Brain aneurysm clip(s), deep brain stimulator
- Cochlear implant or other ear implant/surgery

Patients deemed not suitable to receive an MRI at admission cannot be included in the COMPASS-ND study. However, participants who are originally able to undergo MRI but later are unable, for example because of pacemaker implantation, will not receive an MRI at the follow-up but will remain enrolled in the substudy.

C. Participant Naming and de-identification compliance

It is expected that all scans uploaded into the LORIS database system are properly labeled by the **scanning site**. **It is also recommended to save scans from your system until it is uploaded in LORIS and accepted by the Quality control team.** Any scans with identifying patient names will be discarded and not accepted. The PatientName header must comply with the LORIS naming convention described below. **Therefore if validation fails, the file can/will be automatically discarded/removed.**

For study participants, de-identification will serve two purposes: 1) masking identifying information, and 2) adhering to the naming convention in the PatientName field of the DICOM header, with the goal being that after de-identification, the Patient Name field will consist of a concatenation of:

- **the PSCID:** a unique 3-digit identifier to each site participating in the study, followed by a 4-digit number representing the number of the candidate recruited at that site
- **the CandID:** a unique 6-digit random number generated by the data coordinating center
- **the VisitLabel;** which is set to **Time_3_MRI** for the follow-up Imaging Visit

i.e.: PSCID_CandID_VisitLabel of JGH0174_614401_Time_3_MRI would represent the Time_3_MRI visit (follow-up time 3) of a candidate with ID 614401 (generated by LORIS when the candidate profile is first created) from site JGH which represents the abbreviation of the Jewish General Hospital Memory Clinic. Note that the 0174 following JGH represents a *randomly* generated number by LORIS to also identify the candidate associated with that specific site.

D. MR Acquisition Instructions

1) Participant positioning

- a) Proper positioning is critical for obtaining high quality images. Correct, consistent and comfortable positioning of the participant within the MRI scanner will limit artifacts and maximize the acquisition of good quality images.

2) System set-up

- a) Coil selection: Higher channel count (32+ channels) will benefit accelerated functional and diffusion scans.
- b) The participant's head must be placed in a volumetric multi-channel head OR head/neck radio frequency (RF) coil (no surface coils are allowed).
- c) The head should be as close to the coil centre as possible, without rotation in either plane.
- d) Position the participant as comfortably as possible. Use foam inserts and/or straps across the forehead for stabilization and prevention of motion.

- e) Using the centering crosshairs, landmark the participant by aligning the light with the participant's nasion, between the eyebrows.

3) FOV Positioning Guidelines

- a) For all of the whole brain sequences ([all except the T2w hi res scan for hippocampal subfields](#)), the entire brain should be in the field of view, i.e. both, the cerebrum and cerebellum need to be covered in the inferior/superior, posterior/anterior, and left/right directions. Nose wrap into the back of the FOV is permitted, so long as it does not overlap into the skull or brain. FOV can be obliqued to near AC-PC for optimal coverage for all scans **except SWI** where it should remain true Transverse.

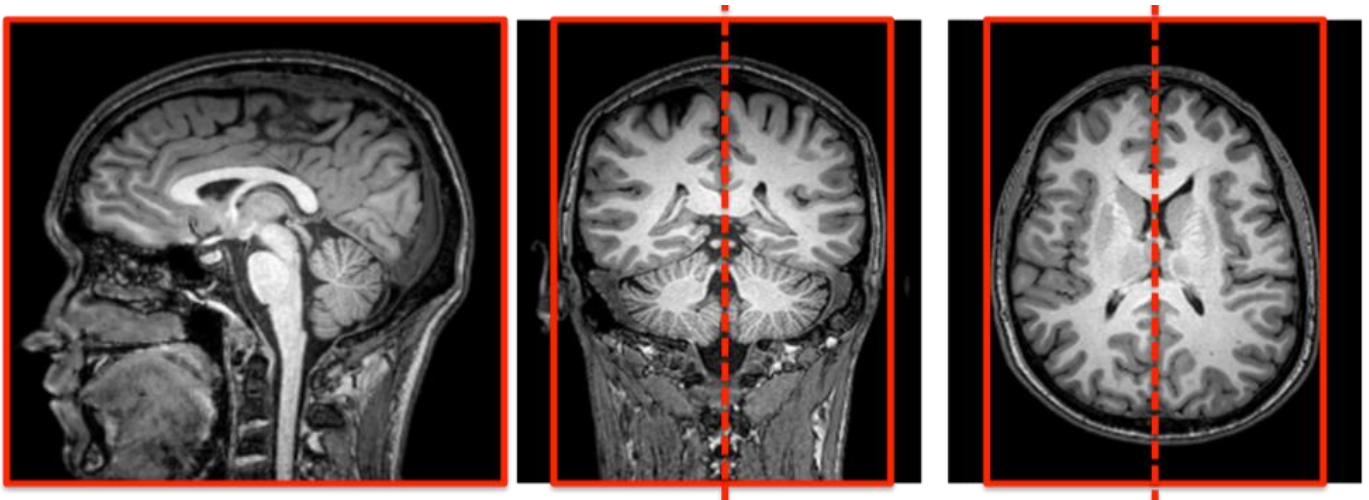
4) Auto Align Scout

- a) Standard **Siemens** Auto Align Scout sequence is used as a localizer. Most subsequent scans use AutoAlign setting "Head > Brain". The "anat-T2w" hippocampal scan uses "Head > Temporal Lobe". The "swi" scan uses no AutoAlign setting and is a true "Transversal" Orientation.

5) 3D T1 (e.g., MP-RAGE, IR-SPGR)

- Sagittal orientation
- Placement of the volume in the z-direction (inferior/superior) should be approximately centered on the thalami (*Figure 1*)
- Full head coverage including skull is necessary.

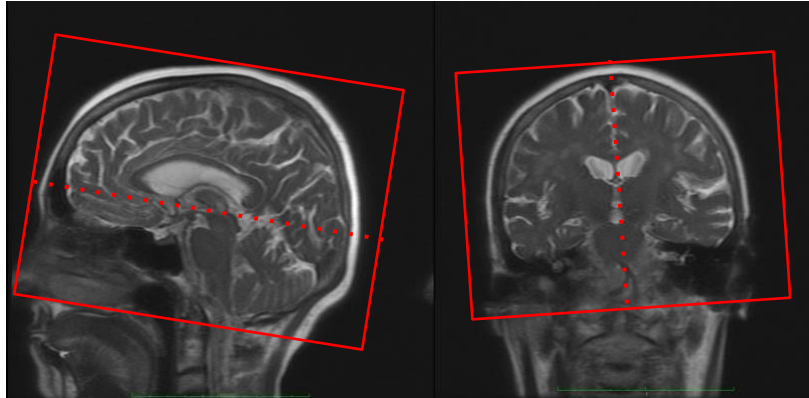
Figure 1. Positioning of 3D T1 volume shown on 3-plane localizer images. The same FOV should be used for the 3D FLAIR image



6) 3D FLAIR

- Oblique sagittal orientation.
- 1 mm contiguous slices with no gaps (ideally matching the FOV of the T1w image; *Figure 1*).
- Using the mid-coronal image, align the axial slices along the inferior temporal lobes.
- Slices should cover from the most inferior portion of the cerebellum (foramen magnum) through the most superior portion of the cerebrum (brain vertex).

Figure 2. Positioning of oblique axial slices



7) 2D PDw/T2w

- 3 mm contiguous slices with no gaps.
- Oblique axial orientation. Angulate Axial 2D sequences parallel to AC-PC line (see Figure 2). Using the mid-sagittal image, align axial slices along the line between the anterior and posterior commissure or the inferior border of the genu to splenium. Using the mid-coronal scout image, check that the axial slices are angled parallel to the inferior temporal lobes (Figure 2).
- Slices should cover from the most inferior portion of the cerebellum through the vertex
- Verify that fat saturation / suppression is turned on.

8) 2D T2* GRE

- 3 mm contiguous slices with no gaps
- Oblique axial orientation, **use the same angulation as the 2D PDw/T2w scan.**
- Slices should cover from the most inferior portion of the cerebellum through the vertex.

9) Diffusion Tensor Imaging (DTI)

- Oblique axial orientation, **use the same angulation as the 2D PDw/T2w scan.**
- Slices should cover from the most inferior portion of the cerebellum through the vertex.
- Slice positioning for the second dwi_dir-PA scan should be copied exactly from the dwi_dir-AP scan, preferably automatically with a Copy Reference. Any change in FOV position will cause the scanner to re-shim, which will invalidate the second scan.
- Siemens scanners with XA software versions will properly use the Phase Encoding Dir. specified in the Routine Card. Siemens scanners on V software versions may find the second PA scan resets to AP at run time. These scanners may instead have to:
 - Set "Phase Encoding Dir." on the Routine card to "A >> P" for both scans
 - Add a note in the protocol in between the two scans indicating to manually adjust the second scan at scan time. Disable "Start measurement without further preparation" in the Execution settings of the second scan to prevent it from starting automatically.
 - When preparing the second scan during examination, in the Routine card, next to "Phase Encoding Dir." click the "..." box, and adjust the Rotation by 180 degrees. If the initial Rotation value is negative, add 180 to it (e.g. -8 becomes 172). If the initial rotation is positive, subtract 180 from it (e.g. 8 becomes -172)

10) Resting State fMRI

- Oblique axial orientation, **use the same angulation as the 2D PDw/T2w scan.**
- Slices should cover from the most inferior portion of the cerebellum through the vertex.
- If the Stimulation Monitor threshold is exceeded, the system will give an "clipped RF pulse detected" error. You can try the following options one at a time to overcome this error:

- In Sequence - Special there are a set of options you can move through with left/right arrow buttons. Turn on “MB RF phase scramble”. This will distribute the multi-band RF peaks to lower max stimulation, with minimal impact on the outcome.
- In Sequence - Special there are a set of options you can move through with left/right arrow buttons. Turn on “Opt. MB RF pulse BW”. This is less documented but can also reduce peak RF power.
- Re-register the patient, re-run the scout, and try running the remaining scans. The sequence was set up not to trip this threshold, but in one tested case when it happened, it could not be replicated.

Specific instructions for the participant:

- Pick a point to focus on either on the coil or inside the bore of the magnet.
- Keep your eyes open throughout the duration of this scan and fix your gaze on one point. *Normal blinking is fine.*
- Try not to think of anything specific and hold still.

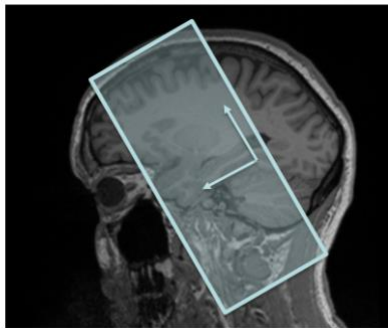
11) se-EPI phase reverse (instead of fMAPs)

- Slice positioning should be copied exactly from the resting state functional run, preferably automatically with a Copy Reference. Any change in FOV position will cause the scanner to re-shim, which will invalidate the fmap scans.
- **Siemens** scanners with XA software versions will properly use the Phase Encoding Dir. specified in the Routine Card. Siemens scanners on V software versions may find the second PA scan resets to AP at run time. These scanners can instead set “Phase Encoding Dir.” on the Routine card to “A >> P” and “Invert RO/PE polarity” on the Sequence - Special card to “On”.

12) SWI

- Axial orientation (true transverse)
- Note that true axial acquisition is important for QSM post processing and quantitative estimation of susceptibility.

Figure 3 Placement of the Hi Res T2w slices perpendicular to the longitudinal axis of the hippocampus.



13) T2w TSE for hippocampal subfields

- Prescribe oblique coronal T2 images using the higher resolution 3D T1 images to ensure proper placement of the slices (better visualization than a scout scan)
- Oblique coronal orientation. Using a sagittal image which contains the hippocampus, visualize the long axis (see Figure 3) and align the slices so that they are perpendicular to the longitudinal axis.
- See [Appendix II](#) for more information on correct slice placement.

E. MRI Scan Information and Quality

During the exam, the MR technologist will note any occurring problem or change, including if scans were not well acquired due to participant motion or non-compliance with scanning.

Every effort should be made to comply with the protocol. By virtue of experience and knowledge, it is considered the responsibility of the MR technologist, and not the psychometrist, to acquire high-quality MRIs, suitable for research purposes. Acquisitions that are clearly non-compliant with the protocol, without stated reasons, will not be reimbursed.

Should the MR technologist notice that some acquisitions are problematic, they should be re-acquired immediately. In particular, the following sequences **must** be acquired:

- 3D T1-weighted ; and
- T2 FLAIR.

This may mean that some later elements of the core protocol will not be performed, e.g. resting state fMRI, SWI. All of the scans should be uploaded in LORIS, alongside a description of the problem and solutions attempted in the Scan Transmittal Form. It is based on this information that the MRI Coordinator will issue the recommendation to accept/deny reimbursement.

Clinical reads

CCNA MRIs should not be locally interpreted.

Incidental findings

No diagnostic will be done by CCNA. If a life-threatening abnormality is detected, follow local institutional policies procedures for research studies. If non-threatening, please include a comment (i.e approximate size, region, shape) on the Scan Transmittal Form within LORIS. The quality control team will review images and take further actions as per Section 6 of this Manual.

F. LORIS Database Upload

1. Account Set-up (one time only):

- The individual responsible for the data transfer should create a LORIS account [here](#). If you have any questions, you can send an email to ccna@mcin.ca

2. Data Preparation

- Compress folder with all DICOM images from a single scan into a single zip file. To compress files on a Mac device, select the folder(s) containing the MR exam DICOM images, right click, select archive. To compress files on a PC device, right click, select send to and then send to compressed zip file. This should create a file with a '.zip' extension in the same directory of the original folder. Other methods such as tar or gzip are also acceptable.
- If the DICOM files are grouped by subfolders, with each subfolder housing the DICOM files for each imaging modality, do NOT use spaces in the directories' names.
- Please ensure that the zip does not contain any non-DICOM files, otherwise the insertion scripts will fail (in particular, for a folder zipped on a MAC, watch out for the .DS_Store and remove before zipping).
- The compressed file that you will upload has to be named according to the following convention: PSCID_CandID_VisitLabel.zip (or .tgz or .tar.gz; LCS0000_158003_V1.zip).

3. Upload data

- For a detailed procedure on how to upload images to LORIS using the imaging uploader, please look at [CCNA Phase III - Manual of Procedures - Imaging Data Upload](#)

Contact Information

Please contact **Dr. Rosanna Olsen** (rolsen@research.baycrest.org) with questions and additional information regarding MR parameters.

Appendix 1

MRI Parameter Form



Participant ID:

MRI Visit: ☐ Time 1 ☐ Time 3

MRI PARAMETER FORM

Page 1 of 1

MRI Dataset Name: _____ PSCID_CandID_VisitLabel	Scan Date: ____/____/____ DD MM YYYY	Type of Data: ☐ Participant ☐ Geometric Phantom ☐ Human Phantom
MRI Site Name: _____	Total Duration of Session: ____ : ____ H MM	
MRI Operator Name: _____		

Following section: To be completed by an **MR technologist**.

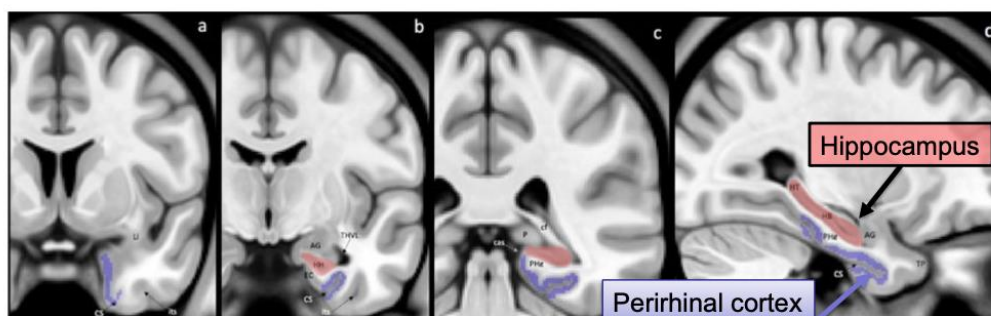
Use CDIP 2.0-approved sequences for all COMPASS-ND scans. Please review the scan for motion and artifacts. Ensure 3D T1w and FLAIR imaging has been well-acquired before scanning subsequent sequences (re-acquire if necessary). Refer to [CCNA Scan Procedure Manual](#) for detailed instructions.

	Sequence type	Protocol name	Acquired?			No. of attempts	Comments (e.g., subject woke, repeated series #, motion, name of add-on acquisition if applicable)
			Yes	Partial	No		
Standard	3D T1w	anat-T1w	☐	☐	☐		
	3D FLAIR	anat-FLAIR	☐	☐	☐		
	2D PDw/T2w	anat-PDT2w	☐	☐	☐		
	T2*	anat-T2starw	☐	☐	☐		
	Diffusion AP	dwi_dir-AP	☐	☐	☐		
	Diffusion PA	dwi_dir-PA	☐	☐	☐		
	Resting State fMRI (eyes open)	func_task-rest	☐	☐	☐		
	Field Map AP	fmap-epi_dir-AP	☐	☐	☐		
	Field Map PA	fmap-epi_dir-PA	☐	☐	☐		
	SWI / QSM	swi	☐	☐	☐		
Add-on	Hi-Res T2w TSE	anat-T2w	☐	☐	☐		
			☐	☐	☐		
			☐	☐	☐		
			☐	☐	☐		

☐ Check if form uploaded to LORIS

Version 3.1 – 23 January 2025

High Res T2-weighted scan for visualization of hippocampal subfields

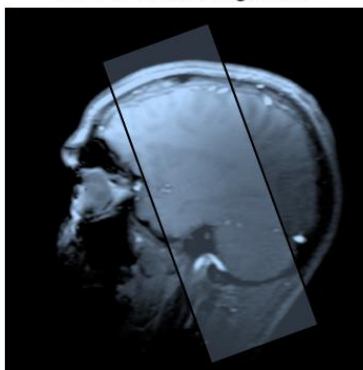


Recommendations from Dr. Rosanna Olsen
Updated February 2025

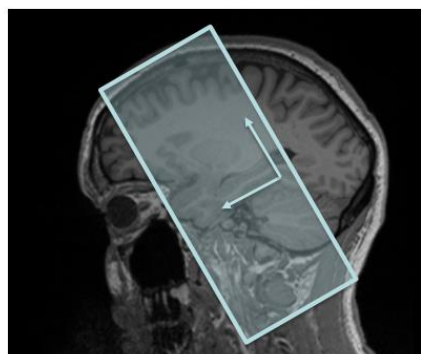
Suggested Guidelines:

- Collect T1 images prior to the oblique coronal T2 images to ensure proper placement of the slices (more useful than scout scan)
- If multiple imaging techs are working on a project, ensure the techs know the extended MTL anatomy and are cross checking for consistency

Example of slice placement on a scout scan:
Note poor visualization of the hippocampus,
hard to chose angulation

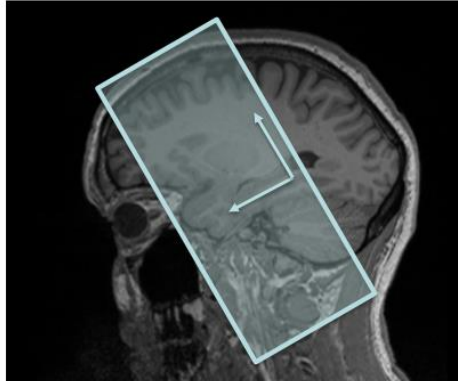


Example of slice placement on T1 image.
Note: easier to visualize the extent
hippocampus and MTL cortex, ensures full
coverage and proper alignment!



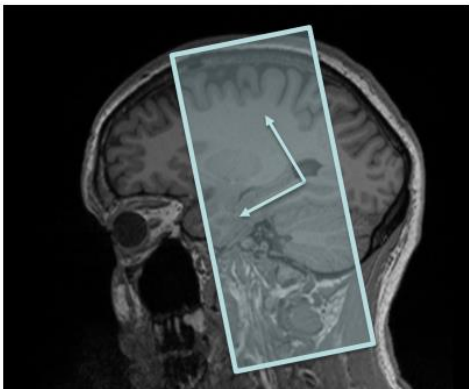
Example of **correct** placement:

Covers whole hippocampus and all of temporal pole
Slices are perpendicular to the “long axis” of the hippocampus



Examples of **incorrect** placement:

Too posterior (misses temporal pole)
& slices are not perpendicular to
hippocampus



Angle is correct but slices are too anterior
(misses hippocampal tail)

