Standard Operating Procedures for Siemens MRI Acquisition

Accelerating Medicines Partnership® SCHIZOPHRENIA

An observational study examining clinical trajectories and predictors of outcomes in the clinical high risk population.

Version 1.2, 21 SEP 2024

Procedure	Visit 1	Visit 2	Visit 3	Visit 4	Visit 5	Visit 6	Visit 7	Visit 8	Visit 9	Visit 10	Visit 11	Visit 12	Visit 13	Visit 14	Visit 15	Visit 16	Conversion
Month	-3 to -1	0	1	2	3	4	5	6	7	8	9	10	11	12	18	24	-
Consent Form	✓																
Interview/ Questionnaire	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cognitive Tasks		✓		✓				✓						✓		✓	✓
MRI*		✓		✓													
EEG*		✓		✓													
Blood and Saliva Samples*		✓		✓													
Actigraphy (daily)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Digital Data (daily passive sensing, EMA, audio diary)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Free Speech Sampling (audio and facial recording)		✓		✓													
PSYCHS (audio recording)		✓	✓	✓	✓			✓						✓	✓	✓	✓

** In-person visit*

AMP SCZ MRI Acquisition – Siemens Details

Standard Operating Procedure (SOP)

Version 1.2; Effective Date 2024-09-18

I. Scope

This SOP is an adjunct to the general AMP SCZ MRI Acquisition SOP, with specifics related to the Siemens platform. It should only be read after first reading and understanding the general MRI Acquisition SOP. The output of a Siemens imaging session will be the scan data and the completion of an online "MRI Run Sheet" (with annotations on the imaging session) in the appropriate network (PRESCIENT or ProNET) database.

II. Responsibilities

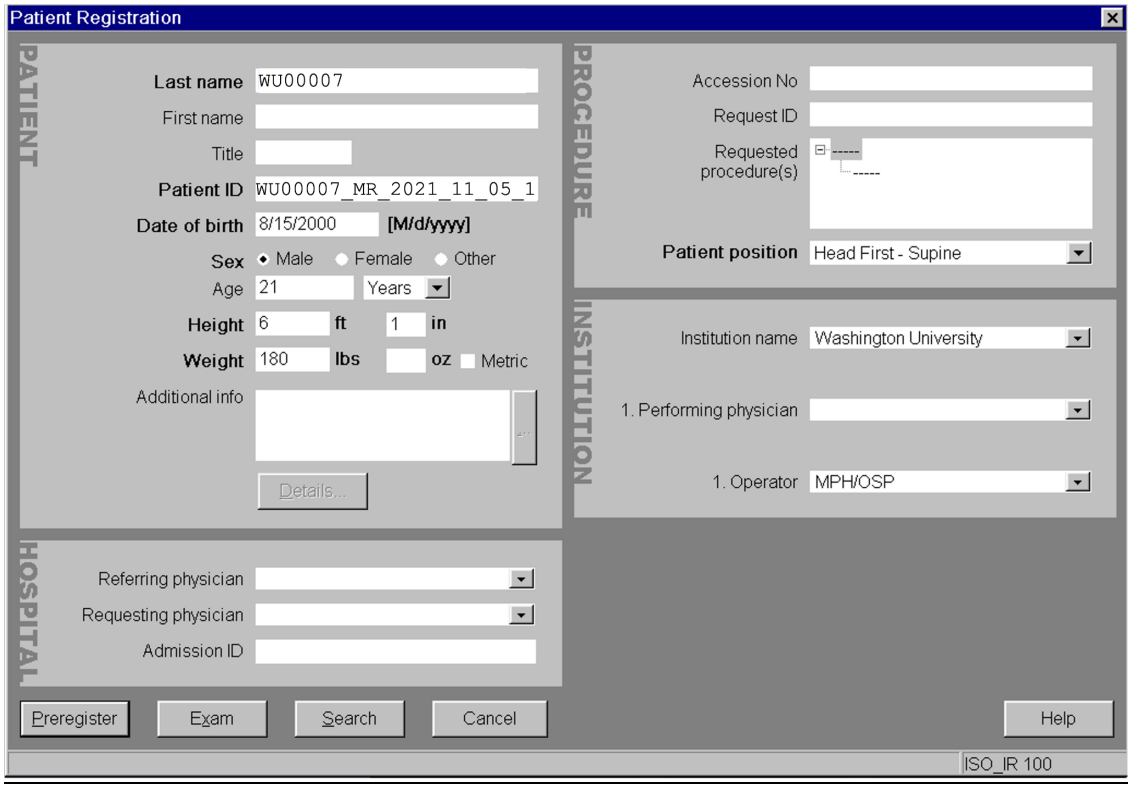
Scans should be operated by trained imaging technologists or trained study personnel that are familiar with the study and with all of the relevant SOPs. During the scan session two study personnel should be present. One person is tasked with operating the MRI console; the second person is tasked with maintaining documentation and assuring quality control. It is the responsibility of the site PI to make sure that all those who operate the scanner are trained to do so, and are also trained for the requirements of the AMP SCZ study. Imaging SOPs should be readily available for the study personnel.

III. Participant Registration in Siemens Syngo

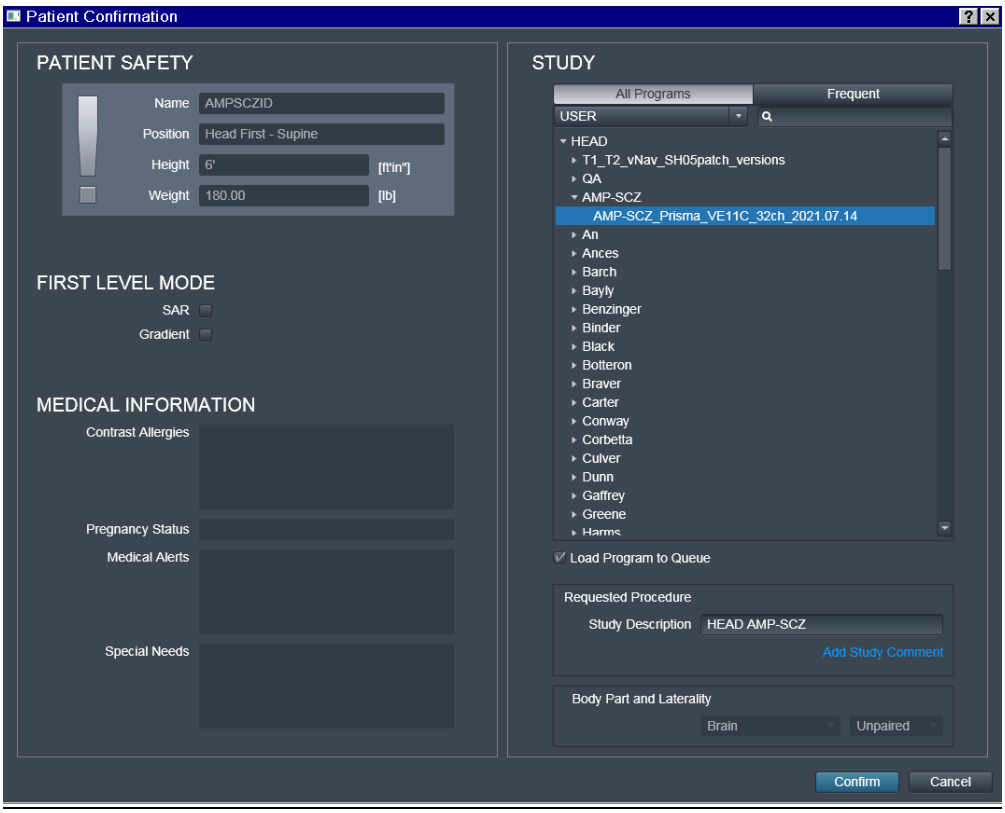
Note: The Syngo 'Patient Registration' can be completed in advance, either before the participant is in the scanner room, or by one individual while the other is setting up the participant. However, **do not click "Confirm" until the head coil is fully connected, the participant is at Isocenter and both study personnel are back in the control room.**

1. Register New Patient, as appropriate for VE11 or XA30.
2. Complete fields for Patient Registration.
    a. See general MRI Acquisition SOP ("Participant Registration" section) for instructions and naming conventions.

Here is a visual example from a Siemens VE11 system:



3. Proceed to select the AMP SCZ imaging protocol
    a. On VE11, you will need to click ‘Exam’ on the Patient Registration window (shown above), which will take you to the Patient Confirmation window, where you will select the AMP SCZ protocol in the “STUDY” section (shown below).



    b. On XA30, you will select the AMP SCZ protocol in the “Program Selection” section (not shown).
    c. The location of the protocol in the Study/Program tree will be site specific.
        i. Make sure that the Study/Program you select is the currently approved (up-to-date) protocol (and that you are not accidentally selecting a deprecated version of the protocol that was left on the scanner).
    d. “Body Part and Laterality” field: Should be pre-selected to “Brain”. If not, select “Brain”.
    e. “Patient position” (VE11) or “Patient Orientation” (XA30) field
        i. Make sure you have selected “Head First Supine”
    f. Click “Confirm” (VE11) or “Exam” (XA30) to proceed
        i. Warning: Do not proceed to the actual exam until the head coil is fully connected, the participant is at Isocenter and both study personnel are back in the control room. This avoids (at least) two potential problems: (i) Proceeding to the exam while the scanner bed is moving can reset the landmark and cause the bed to go too far into the bore; (ii) Opening scans in the exam queue when part of the head coil isn’t connected can disable the intended coil elements for those scans, which would render those scans unusable if not caught and corrected.

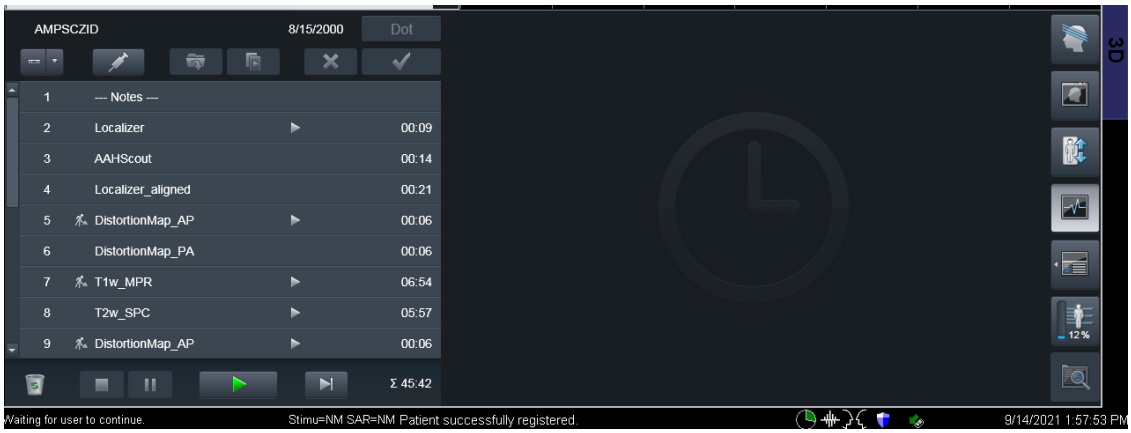
IV. Imaging Protocol – Siemens details

Important: See general MRI Acquisition SOP ("Imaging Protocol" section) for the overall structure of the imaging session, and instructions that are applicable across all vendors.

Reminder: Do NOT make any changes to the protocol without first consulting the Imaging Core.

The following details apply to the Siemens protocol:

1. **The Siemens protocol is fully automated**, including automatic setting of the desired field-of-view (FOV) and slice positioning/angulation using Siemens "AutoAlign" (AAHScout scan, combined with appropriate settings in the other scans).
2. Once successfully loaded, scan queue should look like this (VE11):

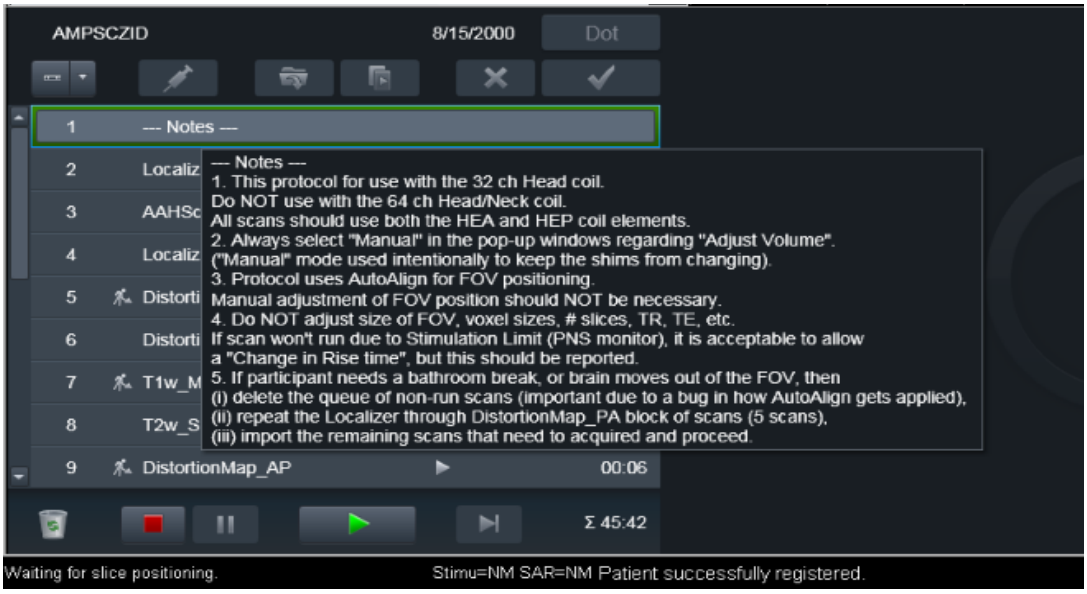


   a. The "Working/digging man" symbol (to the left of the scan name) indicates a scan that needs to be "opened" before it can be run. This is set on certain scans so that you can view the placement of the field-of-view (FOV) for that scan relative to the localizers loaded in the graphic segments at the top of the exam screen, as a visual check that AutoAlign returned a reasonable FOV. If this is not the case, see **FOV Notes** (below). *Barring a truly exceptional circumstance, the FOV should NOT be manually adjusted (and such an adjustment should only ever be implemented as a last resort, after following the guidance in* ***FOV Notes****).*

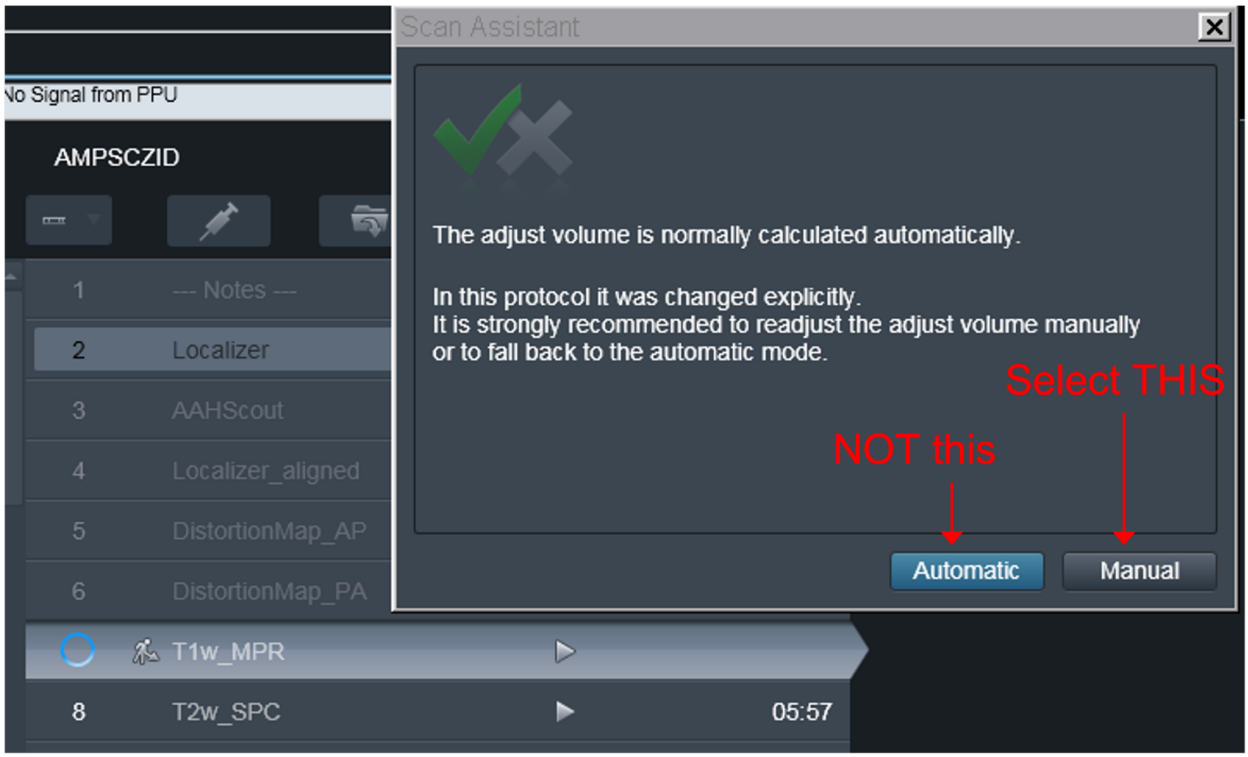
   b. Scans with a filled arrowhead (to the right of the scan name) will generate a pop-up, where you click "Continue" when you are ready for the scan to actually start.

   c. Some scans are set to run automatically following the preceding scan, such as the `DistortionMap_PA` scans, and the 2nd and 3rd scans in the "dMRI block" (not shown in the above snapshot).

d. Hovering over the "--- Notes ---" scan will open a tooltip with some important reminders about the protocol:

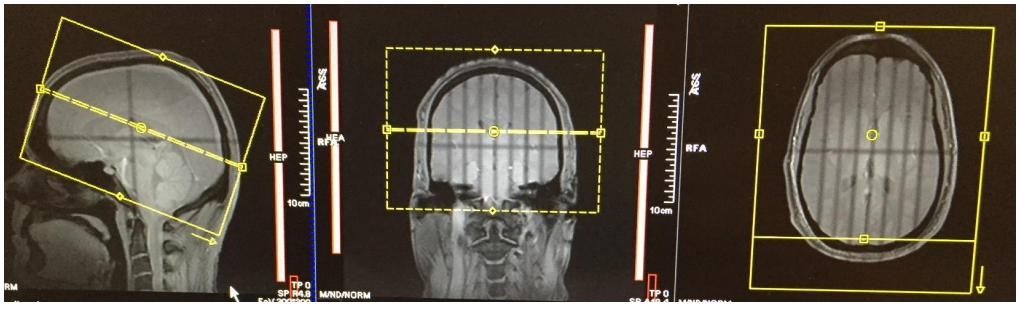


3. ***Always select "Manual"*** **in any pop-up windows regarding "adjust volume"**.
   a. "Manual" mode is used intentionally to keep the shim settings from changing between scans.

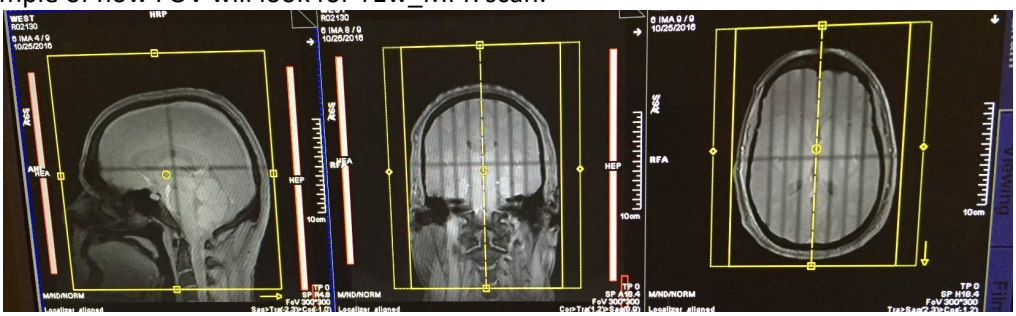


4. **Protocol uses AutoAlign** ('AAHScout' scan) **for automatic FOV placement, including both the position of the FOV box and its angulation** (~ AC/PC aligned).
    a. Based on 1000's of HCP scans, Siemens AutoAlign is highly reliable at positioning the FOV for adolescent and adult brains. Thus, manual adjustment of the FOV should NOT be necessary (see **FOV Notes**, below).
    b. In the absence of movement, the protocol settings (i.e., FOV size) should be sufficient to minimize wrap-around (due to susceptibility distortion) in both the "AP" and "PA" polarity EPI scans. If the participant moves appreciably (either enough to induce wrap-around of brain tissue, or more likely, out of the FOV in the superior/inferior direction), see the **Rescan procedures and unscheduled breaks** section of the general MRI Acquisition SOP.
5. Adjustment of FOV, voxel sizes, # slices, TR, TE, BW, echo spacing, etc at run time is NOT permitted.
6. Polarity inversion to "PA" is automatically set up in this protocol.
    a. It is accomplished in the CMRR sequences via the "Invert RO/PE polarity" option on the `Sequence:Special` tab.
    b. Thus, "Phase enc. dir." on Routine tab in the "PA" scans will still be listed as "A>>P". *Do not change that setting.*
7. Reminder: Sites with the 32 ch head coil should be using that protocol.
    a. All scans in this protocol are set up to use both the anterior and posterior coil elements ("HEA;HEP").
8. For sites with only the 64 ch head/neck coil:
    a. There is a specific protocol for that coil.
    b. All scans except for the `Localizer, AAHScout`, and `Localizer_aligned` intentionally use only the "head" (HC1-7) elements.
    i.e., the "neck" (NC1,2) elements are turned off for all but those scans and should not be activated at run time.

9. **FOV Notes**
    a. In each of the scans with the "Working/digging man" enabled (see picture of queue above), you will have an opportunity to view the FOV orientation and positioning on top of the Localizer_aligned scan in the graphic segments at the top of the screen.
    b. Verify that AutoAlign has placed FOV appropriately. It should cover the entire brain and look similar to below. If the placement is 'poor', check whether AutoAlign converged successfully (see details for AAHScout scan below). **The placement of the FOV should NOT be manually adjusted**, since a number of aspects of the protocol (such as shim consistency) are tied to the AutoAlign-derived positioning across scans. If the placement is 'poor', implement the **"Delete the queue" procedure** (see below). After that, load a fresh set of Location block scans in *from the Explorer* (not copied from an already completed scan), followed by a fresh set of the scans (again from the Explorer) that still need to be acquired. Acquiring the Location block again (which will include a new AAHScout scan) will generate a new AutoAlign calculation and FOV placement. If the FOV placement still remains poor after rerunning the Location block of scans, it is then permissible in that situation to manually set the FOV position. *Note however that this situation should be exceedingly rare.* If this occurs, take a picture of the AutoAlign Info Dialog (see details for AAHScout scan below) for the rerun of the AAHScout, take a picture of the bad positioning (prior to any manual adjustments), and report the situation along with the screenshots to the imaging team leads after the imaging session.
    c. Keep in mind that the Localizers shown in the graphic segments (on which the FOV is overlaid) reflect the participant's position in the coil/magnet at the particular moment in time that the localizer scan was acquired. Thus, if the participant moves, the FOV relative to the *ongoing acquisitions* may no longer capture the brain, *even if the FOV relative to the localizer scan looks perfectly fine.* For this reason it is important to monitor the actual achieved brain coverage as the session progresses, by reviewing real-time reconstructions in the 'inline' viewing window.
    d. Example of how FOV will look for DistortionMap, rfMRI, and dMRI scans:



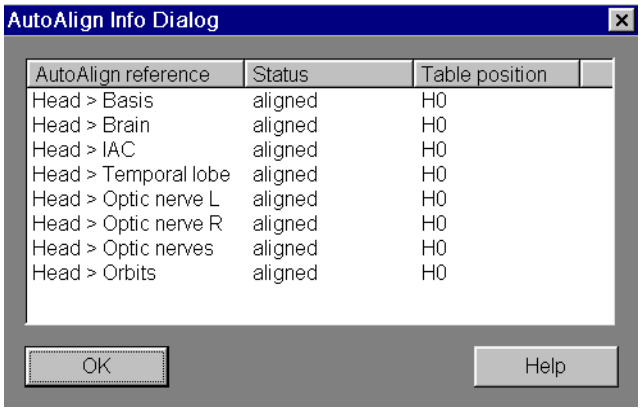
    e. Example of how FOV will look for T1w_MPR scan:



10. Details and additional notes about certain scans follows:

a. AAHScout

i. AutoAlign is typically very robust on adolescent and adult brains. If there is ever a question about whether it successfully converged, you can check the "AutoAlign Info Dialog" (available under the 'Queue' menu at the top of the screen on the VE11 platform). We want the "Head > Brain" approach to have a Status of "aligned":



(This Dialog is available on VE11, but not XA30.)

b. T1w_MPR

i. You should get a pop-up about the "adjust volume".
Select "Manual" (per above).

c. rfMRI scans

i. **Make sure music/video is turned off and fixation crosshair is projected** and approximately centered in participant's view, with the remainder of the visual field being a (predominantly) black background**.**

d. dMRI scans

i. Music/video can be turned back on.

ii. You should get a pop-up about the "adjust volume".
Select "Manual" (per above).

iii. The 3 scans will run automatically back-to-back as a consecutive block of 11 minutes.

11. **"Delete the queue" procedure**
    a. Due to an insidious bug in how repeated instances of AutoAlign get applied to downstream scans, **it is important that the following is implemented any time the "Location" block needs to be re-run**:
        i. Delete all scans that haven't yet been run from the scan queue.
        ii. Import a fresh set of the 3 "Location" block scans (`Localizer, AAHScout, Localizer_aligned`) *from the Explorer.*
        (Do NOT copy/duplicate from previously completed Location block scans already in the queue.)
        iii. Run the Location block scans.
        iv. Import the scan blocks that still need to be run, again *from the Explorer.*
        (Do NOT copy/duplicate from previously completed scans, which will have been run with the old AutoAlign parameters).
        Note that when importing replacement T1w_MPR, T2w_SPC, and rfMRI_REST scans, they should be accompanied (preceded) by a fresh pair of DistortionMap scans as well (i.e., consistent with the "block" structure of the protocol outlined in the general MRI Acquisition SOP, consider the DistortionMap scans as 'ancillary' scans that are part of the T1w_MPR, T2w_SPC, and rfMRI_REST acquisitions).
        v. Proceed to acquire the remaining scans that need to be acquired.
12. Make use of the Siemens 'Inline' viewer for real-time display and review of the rfMRI and dMRI scans.

V. Miscellaneous – Siemens

1. Nuances related to the **XA software platform**:
    a. When reviewing scans in 'Mosaic' format in the XA View&GO window, some slices can appear blank. If the slice in question is totally black (i.e., truly zero, with no background noise) then this is a display issue only. If you refresh that scan in View&GO later, the issue may be gone, or different slices may appear blank instead. This is not an issue with the 'inline' (real-time) display on XA.
    b. **Do NOT export immediately after the conclusion of the final scan in the session** because it can take several minutes for the images to get stored/indexed properly in the scanner database. *Exporting too soon on XA systems may result in incomplete export of the final scan.* To be safe, check the file count of the final scan in the session in the Patient Browser or Export window prior to exporting to ensure that the count is as expected for that scan.
    c. XA sessions should be exported as "Enhanced DICOM".
    See **DICOM export and upload** section of the general MRI Acquisition SOP.

VI. Document Control

Document location: Paper copies are valid only on the day they are printed. Refer to the author if you are in any doubt about the accuracy of any document(s).

Document approval: This SOP requires the approval of the responsible investigator, as do any changes thereto.

This SOP has been approved by: Drs. Ofer Pasternak and Michael Harms

VII. Change Log

Version	Date	Summary of Changes
1.0	2021.09.24	- First version distributed to AMP SCZ consortium members.
1.1	2021.11.16	- Updated “Patient ID”/Session ID naming convention.
1.2	2024.09.18	- Removed several sections from this Siemens-specific SOP and relocated to the general MRI Acquisition SOP, since they were appropriate/relevant for all platforms (i.e., “Before the scan session”, “Participant Registration”, “Scan Protocol”, and “Rescan procedures and unscheduled breaks”). - Added a “Miscellaneous” section. - Various other restructuring and minor edits in preparation for public release.