

Alzheimer's Disease Neuro Imaging MRI Overview

The Alzheimer's Disease Neuroimaging Initiative (ADNI) is a longitudinal natural history study whose primary purpose is informing the design of therapeutic trials in Alzheimer's disease (AD). Along with longitudinal clinical, PET, biofluid and genetic information, MRI data is one component of the comprehensive data set collected in participants.

ADNI began in 2004 and to date 3 different phases of ADNI have been undertaken. These are named ADNI 1, ADNI GO/2 and now ADNI 3. These roughly correspond to typical 5 year NIA grant cycles. The MR protocol evolved over these 3 phases. The MRI protocol for ADNI1 (2004-2009) focused on consistent longitudinal structural imaging on 1.5T scanners using T1- and dual echoT2-weighted sequences. One-fourth of ADNI 1 subjects were also scanned using essentially the same protocol on 3T scanners.

In ADNI-GO/ADNI2 (2010-2016), imaging was performed at 3T with T1-weighted imaging parameters similar to ADNI1. In place of the dual echo T2-weighted image from ADNI1, 2D FLAIR and T2*-weighted imaging was added at all sites. Both fully sampled and accelerated T1-weighted images were acquired in each imaging session. Advanced imaging was included depending on scanner manufacturer: diffusion imaging on GE scanners, resting state functional MRI on Philips scanners and arterial spin labeling on Siemens scanners.

ADNI 3 imaging is being done exclusively on 3T scanners. Nearly all of the imaging sequences from ADNI2 have been updated for inclusion in ADNI 3. Each of the ADNI 2 "advanced imaging" sequences is now included in the "basic" ADNI 3 protocol with a few site-wise exceptions related to sequence license issues. In order to create imaging protocols that can be used to support drug studies, it is necessary to restrict the sequences employed to those commercially available on scanners.

ADNI users should be aware that there is a broad gap between older MRI systems and the state-of-the-art systems within each vendor's product line. Thus, the ADNI MR data set includes a wide range of scanner platforms. A two-tiered approach is taken to accommodate the range of variability in scanners in ADNI 3. "ADNI 3 Basic" and "ADNI 3 Advanced" protocols have been created.

Both images and quantitative numeric ADNI MR data are available publically.

Each series in each exam undergoes quality control at Mayo Clinic. Two levels of quality control are performed; adherence to the protocol parameters and series-specific quality (i.e., subject motion, anatomic coverage, etc.). Scan quality is graded subjectively by trained analysts: 1-3 is acceptable and 4 is failure (unusable). This QC information will eventually be available for each series on LONI. Thus, users will be able to easily employ exam level QC information as filters in data collections.

MR scanners routinely undergo upgrades. These can be relatively minor (SW version) or major (hardware changes, e.g. head coil). In some cases, the scanner itself will be replaced at an ADNI site. We advise the following approach to the issue of scanner changes:

1. Assume that longitudinal within subject data is not compatible before vs after a change in scanner.

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2. Assume that longitudinal within subject data is not compatible before vs after a major hardware change – e.g., change in head coil.
3. Assume that longitudinal within subject data maybe compatible before vs after a SW version change, but be advised that this may not be shown to be true eventually for some types of SW changes.