MRI ADNI Steering committee – April 2017

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**Funded MRI Investigators**
- Charlie DeCarli – UCD
- Nick Fox – UCL
- Duygu Tosun – SFVA
- Paul Thompson – USC
- Paul Yuskevich - Penn
- Danielle Harvey – biostats

**MR company scientists**
- Dan Rettmann – GE Mayo
- Pete Kollasch/Gunnar Kruger – Siemens
- Yansong Zhao - Philips, BU
outline

- ADNI 3 protocol – description, rationale
- Changes from ADNI 2 to ADNI 3
ADNI 3 protocol
all 3T, all 8 sequences in all subjects (where possible)

- 3D T1 volume
- 3D FLAIR
- T2* GRE
- ASL – 3 possible sequences depending on model
- TF-fMRI - advanced and basic versions
- Field map
- dMRI - advanced and basic versions
- Coronal high resolution T2
ADNI 3 MRI protocol rationale

3D T1

- core for multi modality comparisons
- required for standard of care local clinical reads
- precise longitudinal measure
3D T1: Change from ADNI 2 to 3

- **ADNI 2**
  - Unaccelerated and 2x accelerated
  - all platforms

- **ADNI 3**
  - 2x accelerated
  - All platforms
  - Slight resolution change – 1mm cubed
ADNI 3 MRI protocol rationale

FLAIR: CV disease detection, safety standard for trials, required for standard of care local clinical reads
FLAIR: Change from ADNI 2 to 3

- **ADNI 2**
  - all platforms
  - 2D FLAIR
  - 1x1x5 mm

- **ADNI 3**
  - all platforms
  - 3D FLAIR
  - 1x1x2 mm
T2*GRE: MCB detection, safety standard for trials, required for standard of care local clinical reads
T2*GRE: Change from ADNI 2 to 3

- None
- All platforms
ADNI 3 MRI protocol rationale

Coronal hi res T2: Hippocampal subfields
Hi res coronal: Change from ADNI 2 to 3

- **ADNI 2**
  - One vendor

- **ADNI 3**
  - Minor tune up to parameters
  - all platforms
technical improvements since ADNI 2 – esp. SMS

Opportunity to see if advanced methods cross the diagnostic “value” threshold in clinical trials environment

Without change, 2009 methods (ADNI 2) would be carried to 2022

- do not want methods to be outmoded by end of ADNI 3 grant cycle
ASL

3D pCASL

3D PASL

2D PASL
ASL: Change from ADNI 2 to 3

- **ADNI 2**
  - One vendor – Siemens 2D PASL

- **ADNI 3**
  - all platforms (but must have license)
  - 3D pCASL (11): GE >15
  - 3D PASL (18): Siemens VD & VE
  - 2D PASL (26): Siemens VB, Philips 3X and 5.1

  **Upgrade schedule**
  - Philips 5.3 – 3D pCASL – initial roll out starting
  - Siemens 3D pCASL ?
dMRI – FA group map, ADNI CN and AD
dMRTI: change from ADNI 2 to 3

- **ADNI 2** - single vendor, single b=1000 shell
- **ADNI 3** – all platforms, advanced or basic
  - **basic** – single b=1000 shell
  - **advanced, HCP-like**: b=500, 1000, 2000; 3X SMS, 6/8 PF
    - Better FA/MD
    - Enable NODDI, tractography, cortical hub to hub connectivity, multi tissue compartments
- **Custom gradient direction set** - downloadable
- **Compatibility** – derive equivalent of basic single b=1000 shell in every subject at no time penalty
ADNI3’s Diffusion Gradient Shells

Basic* (no SMS acceleration)

*GE Basic also has 48 b=1000, but in a different, still spherical, arrangement.

7 b = 0 + 48 b = 1000

Advanced (with SMS acceleration)

13 b = 0 + 6 b = 500 + 48 b = 1000 + 60 b = 2000

TE = 56 ms,
TR = 8000 ms,
Scan duration = 7:05

TE = 71ms,
TR = 3300 ms,
Scan duration = 7:20

The given times are for a Siemens Prisma, and will vary for different scanner models. The basic set is included in the advanced one, to facilitate comparison between basic and advanced scans.
TF-fMRI
Default Mode Network subsystems - group map
TF-fMRI: change from ADNI 2 to 3

- **ADNI 2** – single vendor, ~ 3 sec TR
- **ADNI 3** – all platforms, advanced or basic
  - basic – 10 minute, ~3 sec TR
  - advanced, HCP-like – 10 min, 600msTR, 8x SMS
    - More precise measure of time series (temporal resolution)
    - Less noisy node to node, ICA, graph theory measures
    - Time varying connectivity metrics
- **Compatibly advanced and basic** ➔ derived basic equivalent
dMRI and TF-fMRI – requirements for advanced

- **multi band (SMS)**
  - Siemens product VE11C plus SMS license
  - Philips 5.3 – initial roll out
  - GE DV 2.6 – 2017, only dMRI, fMRI SMS?

- Consequently, almost all ADNI 3 have started with basic and sites will step up to advanced as systems are upgraded
MR measures – funded investigators

- Structural MRI measures
  - BSI – UCL (Fox)
  - Freesurfer – SFVA (Tosun)
  - TBM – USC (Thompson)
  - TBM-Syn – Mayo (‘Jack’)

- Cerebrovascular disease – UC Davis (DeCarli)
- AIRA H (MCB) – Mayo (‘Jack’)
- ASL – SFVA (Tosun)
- TF-fMRI – Mayo (‘Jack’)
- dMRI - USC (Thompson); DeCarli; Fox
- Hipp subfields – Penn (Paul Yushkevich)
ADNI 2 to 3 consistency: rollover subjects go to ADNI 3 protocol – i.e. no parallel ADNI 2 protocol for roll overs

- 3D T1 volume - consistent
- T2*GRE - consistent
- 3D FLAIR - break
- ASL - break
- TF-fMRI and dMRI
  - basic & derived - consistent
  - advanced break
- Coronal high res T2 - consistent
ADNI 3 MR certifications as of 4/17

- 56/57 sites sent protocol
- x have been certified
  - X basic
  - 2 advanced
Link to protocol PDFs:
http://adni.loni.usc.edu/methods/documents/mri-protocols/

**MRI Scanner Protocols**

The MRI Core developed structural MRI protocols and an MRI phantom for calibration. MRI scanner protocols are available for GE, Philips and Siemens devices.

- MRI Analysis
- MRI Acquisition
- MRI Image Data

MRI Scanner Protocols from recent models of General Electric (GE) Healthcare, Philips Medical Systems, and Siemens Medical Solutions are supported. The tables below contain active links to PDF files of scanner protocols, click to download.

**ADNI 3**

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