



An Interactive, Real-time Data Visualization Tool for ADC Data

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Outline

1. Indiana Alzheimer's Disease Center
 - Background and history of the IADC Data Core
2. Database redesign - 2017
3. Data visualization tool
4. Future Work



Indiana ADC

- The IADC was established in 1991
 - A faculty statistician and one data manager were funded in the admin core
 - Databases were built in FoxPro and Access on desktop computers.
- Data and Statistics Core was added in 2004
 - Developed a web-based data management system using ASP .Net 2.0
 - SQL database
 - Paper based data collection
 - Double data entry



Indiana ADC

- Presently Comprised of 8 Cores
 - Administrative
 - Clinical
 - Neuropathology
 - Education
 - Data Management and Statistics (est. 2004)
 - Neuroimaging
 - Genetics, Biomarker, and Bioinformatics
 - Outreach and Recruitment



Database System – Previous State

- Web-based application
 - Developed in 2004 using ASP.NET 2.0 and its functionality has evolved over the years
- SQL Server Database
 - 146 tables, 200-300 data elements
 - Roughly 15-20 tables contain the bulk of the data
 - Some tables contain data that are no longer being captured
 - Database procedures/functions
- Application and database servers
 - Administered by CAITS (Clinical Affairs IT Services) at Indiana University
- Add-ons: REDCap Databases
 - Support ancillary/operational data needs for the cores.
- SAS programs
 - Data consolidation, data import/export, scheduler algorithm, QC, reporting, analysis



Issues

- Challenging programming platform (ASP.NET 2.0), time consuming to enhance/evolve, accommodate new data elements
- Does not support responsive web design
- Browser compatibility issues
- Outdated data components/tables
- Not tied into CAS authentication
- Time lapse from patient visit to data report



IADC Data Hub Main Components

1. Electronic Data Capture (*new*)
 - REDCap
 - Will replace current legacy web-based application
 - REDCap ETL Tool
 - Use REDCap application programming interface (API) which will extract, transform, and load data from REDCap into the MS SQL Server database
2. Database: MS SQL Server (*re-design*)
 - Relational, consolidated database environment
3. Integrated Web Portal (*re-design*)
 - Re-design using latest technology to enhance functionality
4. Tableau Reports/Visualizations (*new*)



IADC Data Hub Functionality

- Direct data entry;
- Scheduling Tool (tracking all contacts and scheduling results)
- Real Time Reports (enrollment, biosamples, user-defined)
- Real Time Data Visualization (longitudinal, multi-panel)
- Real Time Data Download



Tableau Functionality

Data analytic and visualization software

- Publish data dashboard with ease
 - Tables
 - Graphics
- Allow a great degree of user-defined reports
- Real Time Reporting



Alternatives

- R Shiny:
 - Pros: Advanced analytics; Automation of data manipulation; Reusability of code and template scripts
 - Cons: Limited traffic (and other feature restrictions) in free version, open source (possible package support issues)
 - Cost: No University supported infrastructure in place
- Tableau
 - Pros: Established company, detailed documentation and support training from one source; Security/permission controls; Regular maintenance and updates
 - Cons: Advanced analytics require integration with R or other platform, cost may be substantial without organizational support.
 - IU Consideration: Large IU investment in Tableau from Business Analytics side. We utilized IU instance of Tableau Server and existing licenses for zero or minor cost



IADC Data Dashboard

Major Features:

- User-defined real-time data summary
 - NIH enrollment table
 - Genetic biomarker sample table
- Operation Report (completed visits, recruitment tracking)
- Consensus diagnosis data reporting tool
 - Visualizing longitudinal neuropsych testing data
 - Summary of patient, informant and health data



IADC Data Hub

Reporting Live Demo

<https://iadc.webhost.iu.edu/index.html>





IADC Web Portal

HELLO SGAO! / LOG OFF

SCHEDULING

REPORTS

RESTRICTED REPORTS

PROFILES

Welcome to the IADC Web Portal!

This portal is designed to allow Indiana Alzheimer Disease Center (IADC) investigators and staff access to Center data, reporting, and scheduling modules in an effort to further the mission of the Center. Ideas for reports or additional data access, as well as any technical issues with this site should be sent to the IADC data manager, Steve Brown (brownstev@iu.edu). To learn more about the IADC and see upcoming events, refer to the IADC main webpage below.

[IADC External Webpage](#)



IADC NIA Enrollment Table

Racial Categories	Not Hispanic		Hispanic		Missing		Grand Total
	Female	Male	Female	Male	Female	Male	
American Indian	1						1
Asian	3	1					4
Pacific Islander							
African American	211	74					285
White	930	805	10	9	2		1,756
More than one Race							
Missing & Unknown	1	2		1	6	4	14
Grand Total	1,146	882	10	10	8	4	2,060

Use the filters on the right to update the enrollment table data as necessary.

Select Enrollment Date Range

2/6/1990

4/1/2019



Select Patient Status(es)

(All) ▼



IADC GBB Sample Availability

Click on images below to generate counts of IADC subjects per sample type. (Hover over images to view icon meaning, click icon again to clear selection).



1,270 Subjects with available samples

Cohort Characteristics - Use the filters below to explore sample availability along various demographic characteristics.

Gender

(All) ▼

Subject Status

(All) ▼

Age at last visit

(All) ▼

Race

(All) ▼

Hispanic Ethnicity

(All) ▼

Education Years

(All) ▼

Status: All

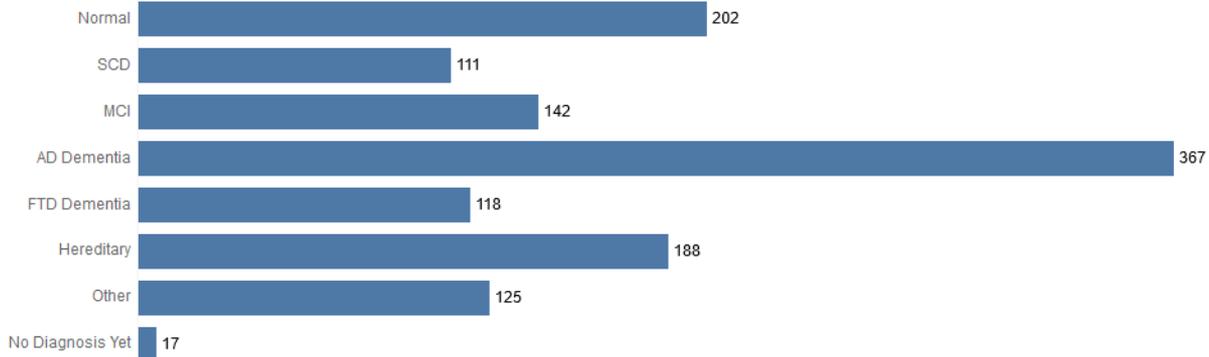
Gender: All

Age: All

Race: All

Ethnicity: All

Education: All



IADC GBB Sample Availability

Click images below to generate counts of IADC subjects per sample type by current diagnosis. Hover over icons to view meaning, click icon again to clear selection.



552 Subjects with available samples

Cohort Characteristics - Use the filters below to explore sample availability along various demographic characteristics.

Gender

(All)

Race

(All)

Status: All

Gender: All

Age: All

Race: All

Ethnicity: All

Education: All

Subject Status

(All)

- (All)
- Null
- Active: Followed Autopsy Only
- Active: In-Person
- Active: Telephone
- Deceased
- Discontinued
- Lost to follow-up
- Refused

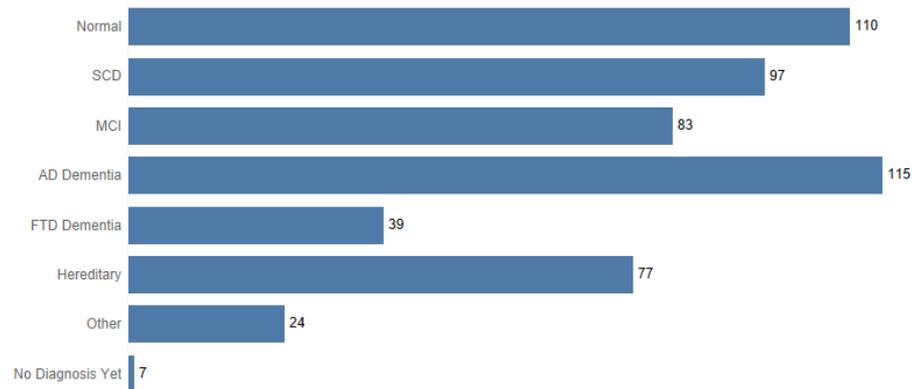
Age at last visit

(All)

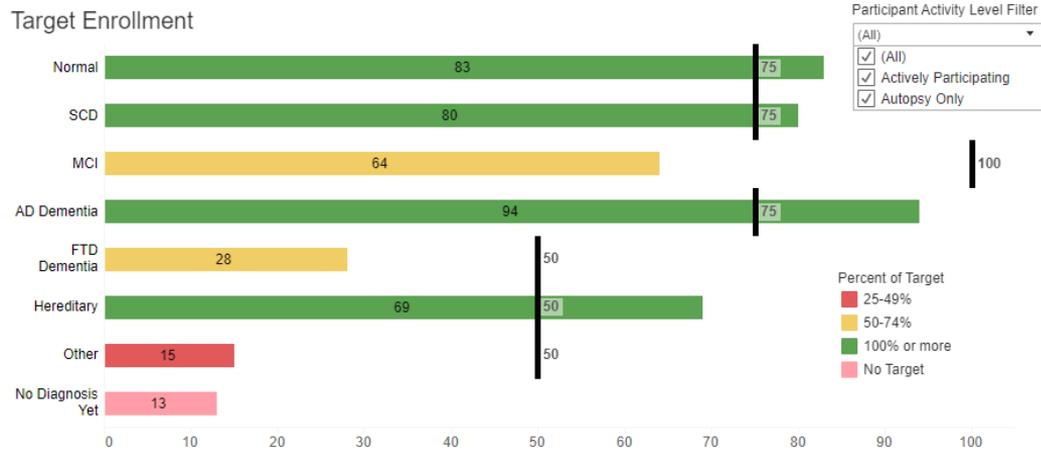
Education Years

(All)

Specimen List



Target Enrollment



Actively Participating: **364** + Autopsy Only: **82** = Total Cohort: **446**

Active Subjects

Active: In-Person	Normal	68
	SCD	66
	MCI	58
	AD Dementia	63
	FTD Dementia	18
	Hereditary	56
	Other	11
	No Diagnosis Yet	13
	Total	353
Active: Telephone	SCD	1
	AD Dementia	8
	FTD Dementia	1
	Hereditary	1
	Total	11
Grand Total	364	

Followed for Autopsy Only

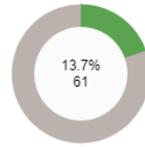
Normal	15
SCD	13
MCI	6
AD Dementia	23
FTD Dementia	9
Hereditary	12
Other	4
Grand Total	82

Active Hereditary Details

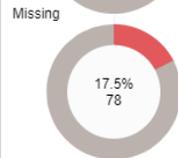
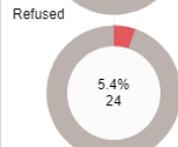
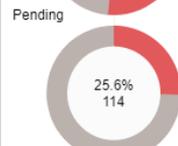
(Included in Active Subject Counts to the left)

Normal	26
SCD	13
MCI	9
AD Dementia	3
FTD Dementia	4
Other	2
Grand Total	57

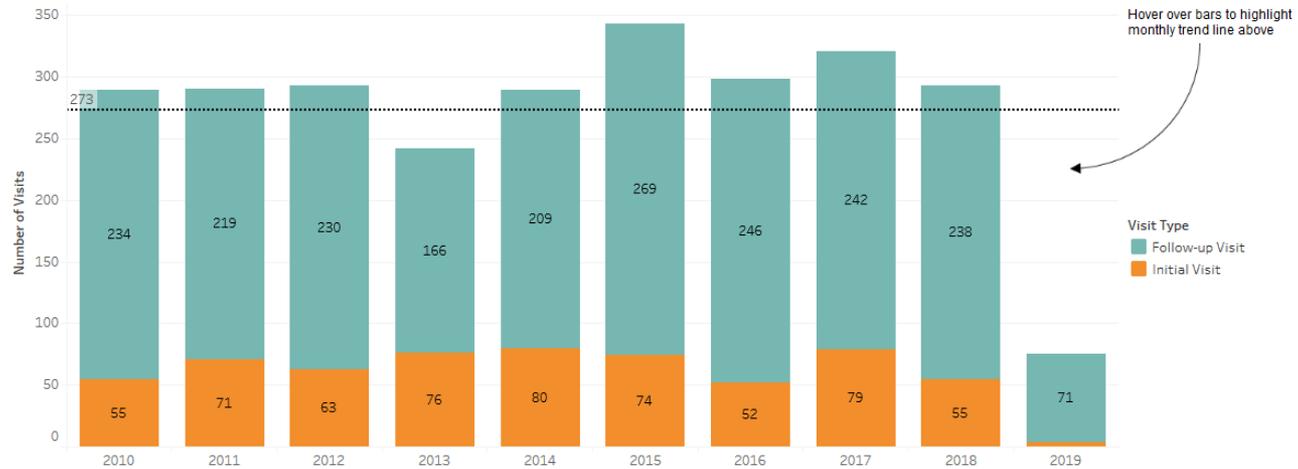
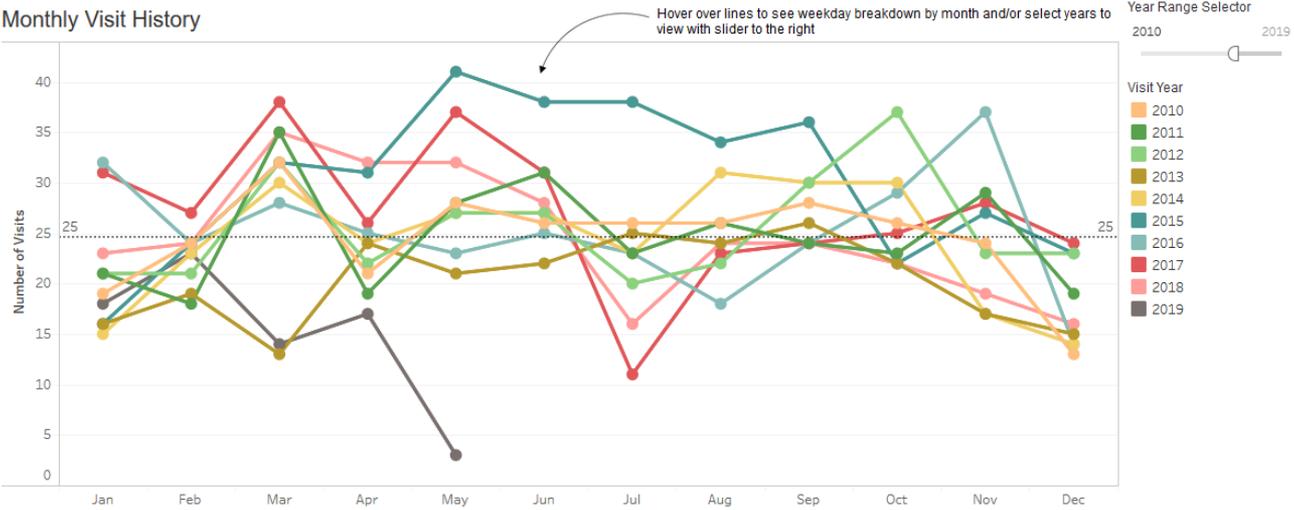
African American Participation



Brain Donation Program Status (Last Status Recorded)



Monthly Visit History





Indiana Alzheimer's Disease Center Consensus Diagnosis Information Portal

Welcome to the Consensus Diagnosis Information Portal, comprising data displays for IADC participants including neuropsychological testing, specific UDS battery forms, and other IADC specific measures.

Select a Clinical Core ID below then launch the Consensus data pages by clicking selection on the left navigation panel.

Select ID

6008



ID	Gender	Age	Grade	Last Diagnosis	Subtype	Contributing	Visits	Last Visit
6008	Female	71.9	18	Dementia	AD - Probable	Null	5	10/2/2009

Hereditary Information
(hover over image)



DiagDate	Diagnosis	Etiology
11/24/2009	Dementia	AD - Probable
10/7/2008	Dementia	AD - Probable
6/22/2007	Dementia	AD - Probable
4/21/2006	Dementia	AD - Probable



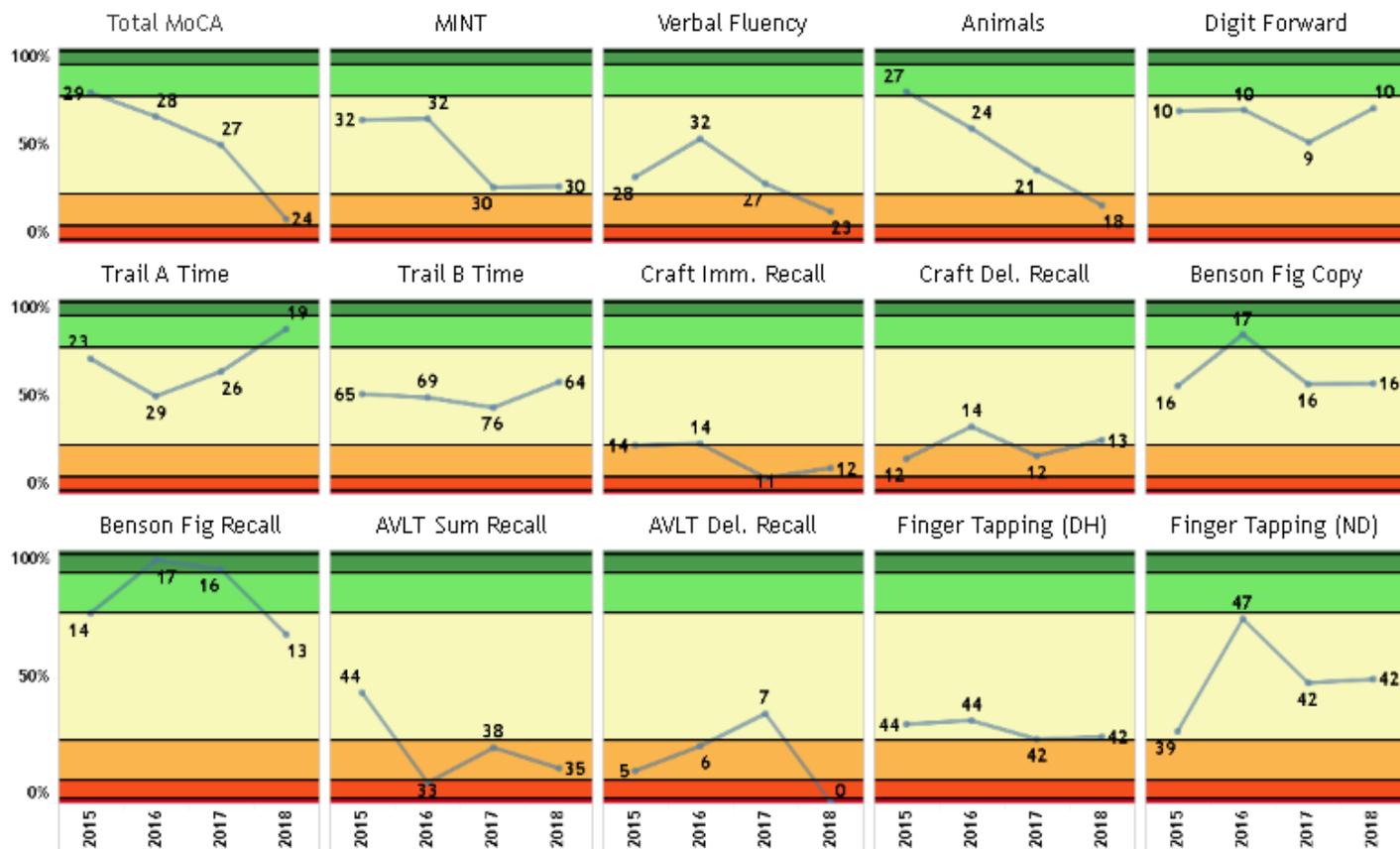
Developed by Steven Brown, Lead Data Manager, IU School of Medicine Department of Biostatistics
Contact: browstev@iu.edu





Select ID	ID	Gender	Age	Grade	Last Diagnosis	Subtype	Contributing	Visits	Last Visit
10024	10024	Male	76.7	20	Amnestic MCI-memory impairment	Null	Null	4	11/16/2018

FTD
Testing
Summary



Neuropsych Testing (Normative Percentile Scores Adjusted for Age, Race, and Education)

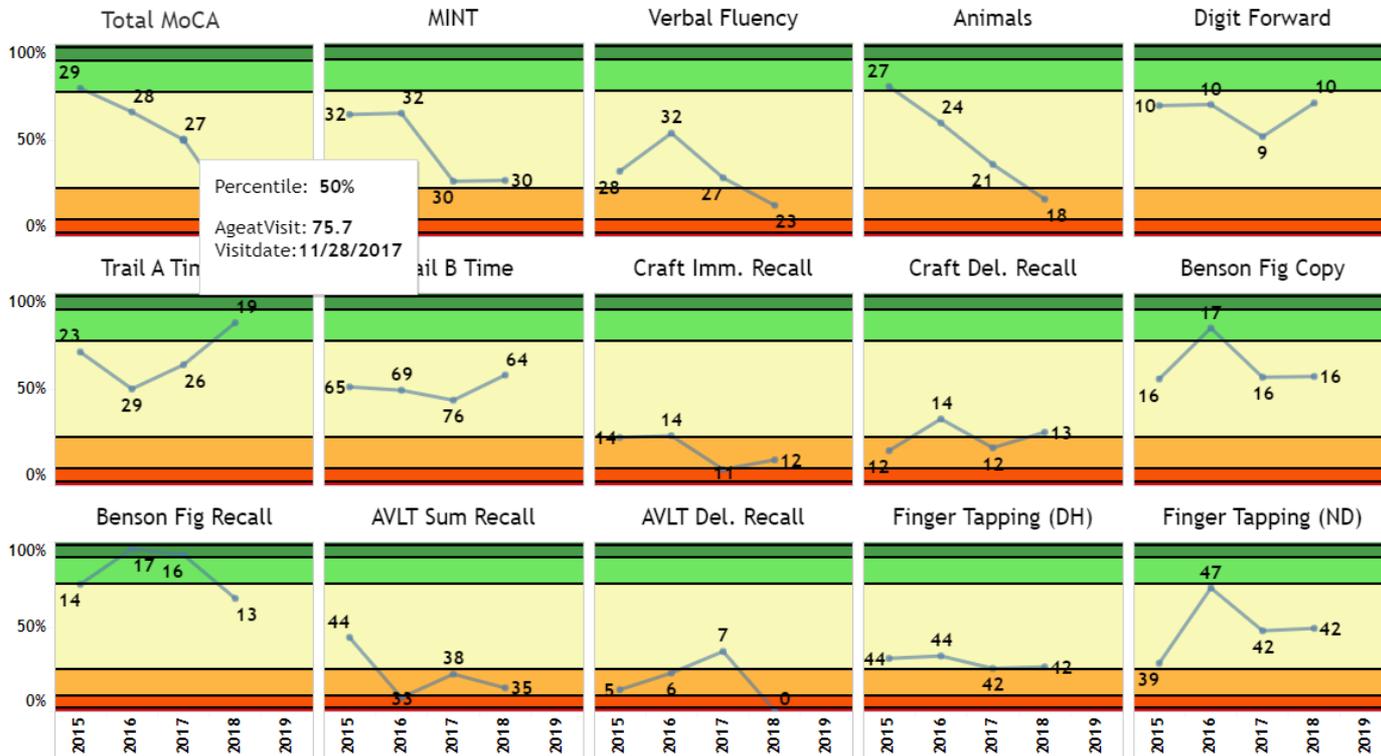
Additional Longitudinal Test Scores Can Be Viewed Here:

[Click here to view current scores by domain:](#)



ID	Gender	Age	Grade	Last Diagnosis	Subtype	Contributing	Visits	Last Visit	⋮
10024	Male	77.6	20	Amnestic MCI-memory impairment	Alzheimers disease	Null	5	10/4/2019	

FTD Testing Summary

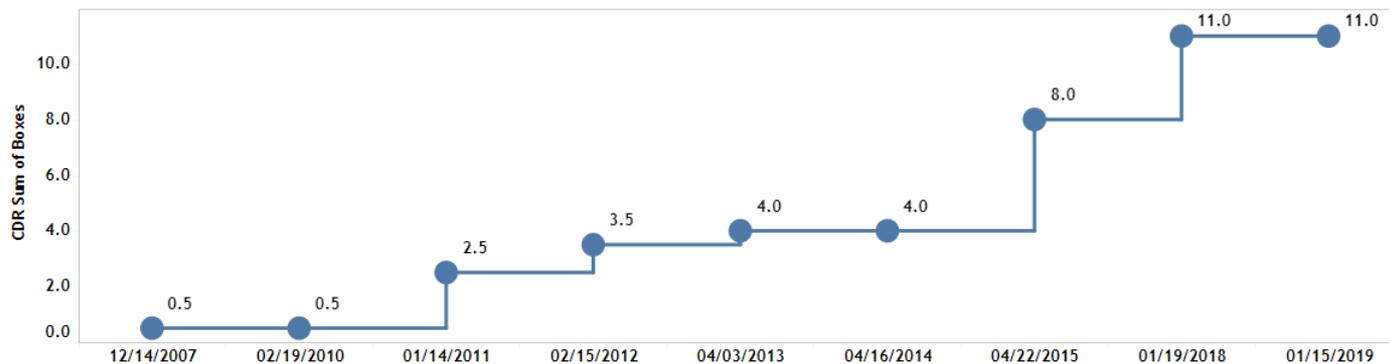


UDS B4: CDR Sum of Boxes

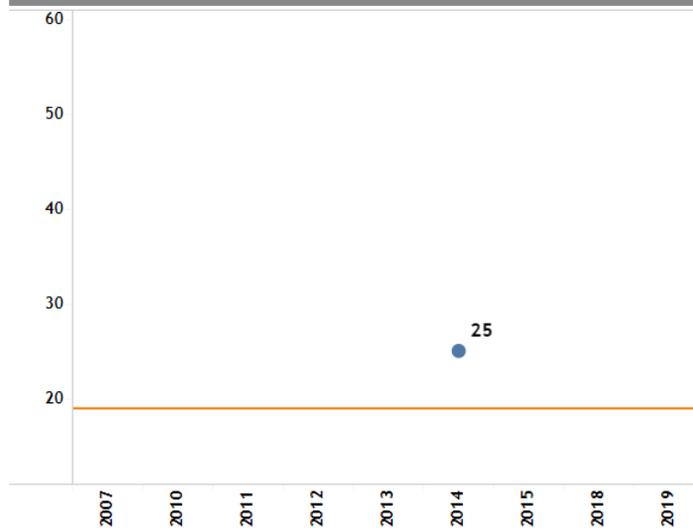
Hover over CDR sum of boxes to see global score and item-level details for that visit, or select item-level in the dropdown box to the right to see CDR items across all visits

Select CDR Sum of Boxes or Item-Level

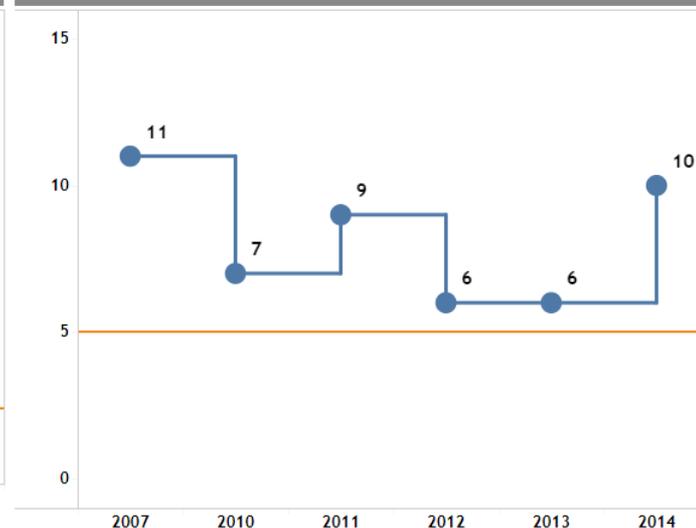
Sum of Boxes



Self Reported Measures (CCI First 12 Items)



Self Reported Measures (GDS 15-item)

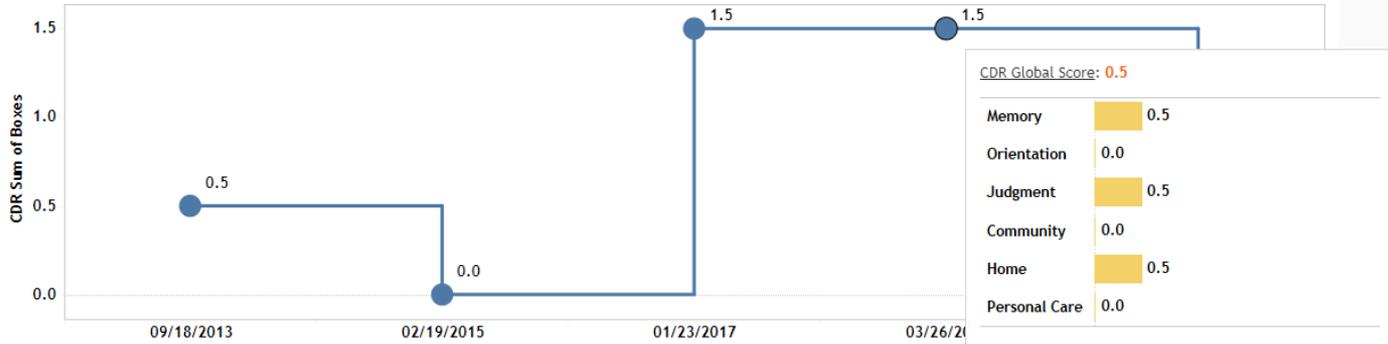


UDS B4: CDR Sum of Boxes

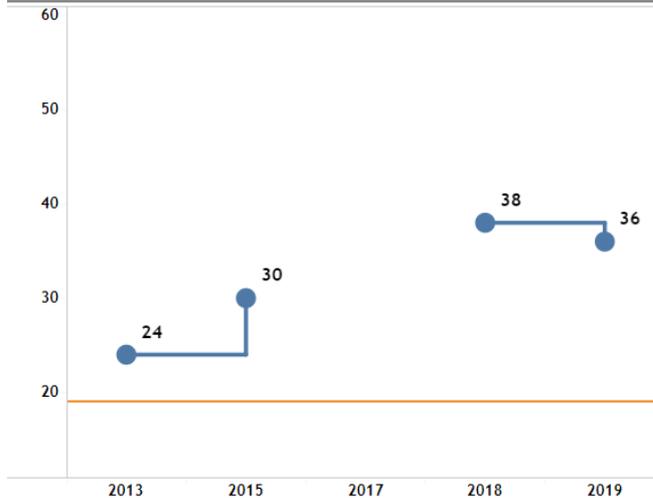
Hover over CDR sum of boxes to see global score and item-level details for that visit, or select item-level in the dropdown box to the right to see CDR items across all visits

Select CDR Sum of Boxes or Item-Level

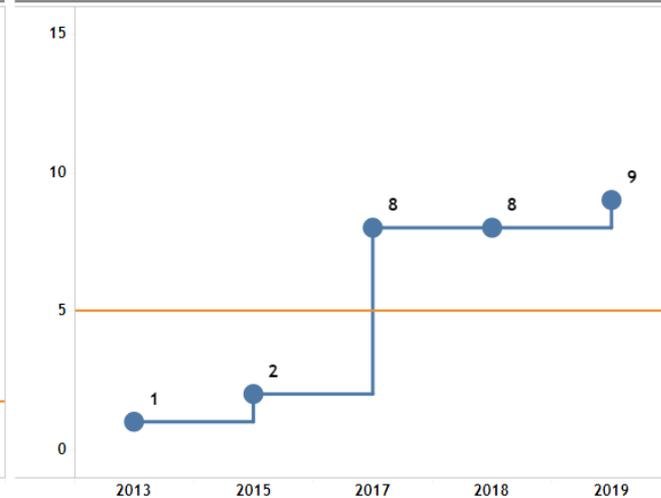
Sum of Boxes



Self Reported Measures (CCI First 12 Items)



Self Reported Measures (GDS 15-item)





Informant Interview - Does informant indicate issues in Memory, Language, Judgement, Visuospatial Function, or Attention?

Date	Memory	Language	Judgement	Visuospatial	Attention
5/15/2019	Yes	Yes	No	No	Yes
3/26/2018	Yes	No	Yes	No	Yes
1/23/2017	Yes	No	Yes	Yes	Yes

Informant Interview - Years Having Issues (From Last Date w/ Information)

Memory	Language	Judgement	Visuospatial	Attention
5.0	1.0	5/15/2019		1.0

UDS B7 (FAS)

Use the dropdown box below to view the FAS indications for all visits or the last visit only.

Visit Selection

All Visits

	2013	2015	2017	2018	2019
FAQ Sum	2	5	8	4	3
Bills					
Taxes					
Shopping					
Games					
Stove					
Meal Prep					
Events					
Paying Attention					
Remembering					
Travel					





Family History

Mutation/Cognitive Family History

May 2019 MUTATIONS: Mutation Evidence is the same as the prior visit.
PARENTS: Parental neurological history is the same as the prior visit.

March 2018 MUTATIONS: Mutation Evidence is the same as the prior visit.
PARENTS: Parental neurological history is the same as the prior visit.

January 2017 MUTATIONS: There is NO family evidence of an AD mutation. There is NO family evidence of an FTD mutation. There is NO family evidence of any other mutation. PARENTS: There is NO evidence of any neurologic problems from the subjects Mother. There is NO evidence of any neurologic problems from the subjects Father.

Medication List

Visit Date	Drug Name
3/26/2018	Cyclobenzaprine
	Donepezil
	Escitalopram
	Lutein
	Tamsulosin
	Vitamin E
1/23/2017	Acetaminophen

Baseline Smoking/Alcohol Use

2/19/2015
No alcohol abuse within the past 12 months.
Subject has never been a smoker.

Health Conditions

	2017	2018	2019
Diabetes			
Cancer			
Myocardial Infarct			
Congestive Heart Fail..			
Atrial Fibrillation			
Hypertension	✓	✓	✓
Angina			
Hyper- cholesterolemia		✓	
B12 Deficiency			
Thyroid Disease			
Arthritis	✓	✓	✓
Urinary Incontinence		✓	
Bowel Incontinence			
Sleep Apnea	✓	✓	✓
REM Sleep Behavior		✓	
Hyposomnia / Insomnia			
Carotid Procedure			
Percutaneous Corona..			
Pacemaker			
Hear Valve Repair			
Antibody Mediated En..			
Other Condition			

B9 SUMMARY

2013	2015	2017	2018	2019
Subject Reported Decline: Yes Informant Reported Decline: Yes Clinician Reported Decline: Yes	Subject Reported Decline: Yes Informant Reported Decline: Yes Clinician Reported Decline: Yes	Subject Reported Decline: Yes Informant Reported Decline: Yes Clinician Reported Decline: Yes	Subject Reported Decline: Yes Informant Reported Decline: Yes Clinician Reported Decline: Yes	Subject Reported Decline: Yes Informant Reported Decline: Yes Clinician Reported Decline: Yes
Age Cognitive Decline Began: 59 Age Motor Symptoms Began: Missing Age Behavioral Symptoms Began: Missing	Age Cognitive Decline Began: 59 Age Motor Symptoms Began: Missing Age Behavioral Symptoms Began: Missing	Age Cognitive Decline Began: 59 Age Motor Symptoms Began: 63 Age Behavioral Symptoms Began: Missing	Age Cognitive Decline Began: See Prior Visit Age Motor Symptoms Began: 777 Age Behavioral Symptoms Began: Missing	Age Cognitive Decline Began: See Prior Visit Age Motor Symptoms Began: Missing Age Behavioral Symptoms Began: Missing

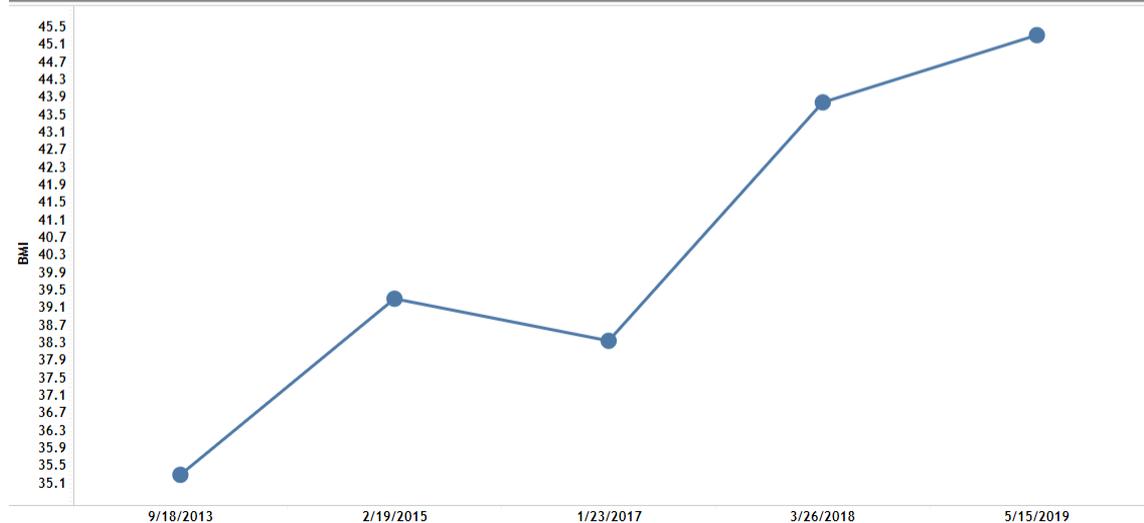


BP and Heart Rate

2013	2015	2017	2018	2019
Blood Pressure: 139/77 Heart Rate: 93	Blood Pressure: 189/85 Heart Rate: 65	Blood Pressure: Unknown Heart Rate: Unknown	Blood Pressure: 134/84 Heart Rate: 82	Blood Pressure: 157/78 Heart Rate: 55



BMI



Future Work

1. Adjust data visualization/reporting format according to investigators' feedback
2. Include imaging data and data from all IADC cores in the data dashboard.

