

Digital Cognitive Testing Assessment Associates with Expedited Care in Older Adults

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Introduction

Early diagnosis of cognitive decline is important to facilitate lifestyle interventions, initiate disease modifying therapies, and develop comprehensive care plans that align with patient needs and preferences.

Advocate Health implemented a quality improvement initiative that sought to reduce barriers to a cognitive impairment diagnosis due to limitations in Primary Care Provider (PCP) time, expertise and operational resources.

The main objective of the grant was to increase the rate of cognitive screening in patients 65 years and older. For this study we examined whether early cognitive testing influenced the frequency of making a cognitive impairment diagnosis or the associated tests that were ordered.

Methods

PCPs were offered multiple diagnostic and treatment supports as previously reported¹.

This retrospective cohort study focused on the effects of clinic-based BrainCheck² digital cognitive testing and compared the time to diagnosis and treatment between patients screened using BrainCheck (BrainCheck cohort, n=1,349) and those traditionally screened (e.g., Minicog, MoCA, etc.) (Control Cohort, n=5,635).

Digital cognitive testing is attractive for use in primary care as it can reduce the burden of test administration and provide more immediate, consistent, and automated scoring for busy primary care practices³.

Two BrainCheck tests were used during the study period. BrainCheck Screen took less than 5 min and the results were provided as (“Further Testing Recommended / Not Recommended”). BrainCheck Standard Battery took 10-15 min and the results were (“Unlikely,” “Possible,” and Likely”).

Methods (cont’d)

Cohorts included patients 65 years and older who attended at least one Annual Wellness Visit (AWV) between August 1, 2022, and July 31, 2024. Data were retrospectively extracted from the electronic medical record (Epic) and the BrainCheck database.

Inverse Probability Treatment Weighting (IPTW) was used to balance observed confounds between the cohorts⁴. Time to event for each diagnostic or treatment outcome was assessed using Cox Proportional Hazards Regression. Differences in time to event were visualized using Kaplan-Meier curves. Final time to event models included fixed effect predictors of cohort (BrainCheck or Control), existing lab data (y/n), and existing imaging data (y/n; omitted from MRI model) and were further adjusted by normalized IPTW weights and using provider name as a random effect (shared frailty term).

Post hoc Bonferroni corrected significance thresholds were used to account for multiple testing within each group of analyses. All statistical tests were run in R v4.5.1⁵.

Results

Unadjusted comparisons of demographic variables revealed significant differences between the two cohorts in age (marginal), sex, race, ethnicity, and state of residence. There were also significant differences in unadjusted proportions of existing diagnoses between the cohorts. Weighted values were balanced following IPTW normalized weight estimation with acceptably small standardized differences (< 0.1), **Table 1**.

R41 (cognitive impairment) diagnoses were more common than diagnoses of dementia or specific neurodegenerative disorders (F01-04 / G30-32), **Table 2**.

Results (cont’d)

There was strong association between undergoing a BrainCheck assessment and the time to initial R41 or F0X/G3X diagnoses in patients without prior diagnoses of these types. Initial R41 and F0X/G3X diagnoses were 83.94 and 11.22 times more likely, respectively, in the BrainCheck cohort compared to controls., **Table 3**.

The odds of these diagnoses decayed over time, suggesting the main diagnostic value of the BrainCheck assessment occurred during the AWV (time 0) and in the months immediately following (**Table 3, time interaction column**).

BrainCheck testing was associated with higher odds of all treatment and diagnostic outcomes examined in this study (**Table 3 and Figure 1**). MRI orders were 4.97 times more likely in the BrainCheck cohort. Laboratory orders of TSH, vitamin B12, and T. pallidum ranged in odds of occurrence, but were all more common in the BrainCheck cohort. Likewise, orders for memory loss medications were 13.89 times more likely in the BrainCheck group

Neuropsychology and neurology referrals were 9.23 and 4.56 times more common in the BrainCheck cohort, respectively, while gerontology referral was 62.23 times more likely in this cohort.

The odds of an R41 or F0X/G3X diagnosis was noted to vary by the type of BrainCheck test administered, **Table 4**. An R41 diagnosis was 13.27 times more likely if the BrainCheck Screen recommended further testing, but the Screen result did not increase the likelihood of an F0X/G3X diagnosis. In contrast, a “likely” BrainCheck Standard Battery result was associated with 2.47 times the increase in odds of an R41 and 15.73 times the increase in odds of F0X/G3X diagnoses.

Conclusions

Digital cognitive testing associated with more frequent cognitive impairment diagnoses, and orders for the tests, referrals and medications necessary to evaluate and treat these patients.

Different types of digital tests may have differing utility across diagnoses: briefer tests increased early cognitive impairment diagnoses, while more in-depth testing increased the odds of diagnosing dementia.

The results suggest that clinic-based digital cognitive testing facilitated patient care. However, further studies are needed to understand whether this improved long-term patient outcomes.

Future studies are also needed to examine whether similar results are obtained with remote digital testing, which has the potential to further expedite care.

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Disclosures

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Contact

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Table 1: Demographic and Diagnostic Factors at Baseline

	Prior to IPTW			Following IPTW	
Variable	BrainCheck (n = 1349)	Control (n= 5635)	p-value	Standardized Difference	p-value
Age (range)	75.3 (65-102)	74.9 (65-103)	0.045	0.061	0.077
Sex			0.004	-0.063	0.065
Female	801 (60%)	3102 (55%)			
Male	548 (40%)	2533 (45%)			
Race†			<0.001	0.093	0.008
Black / African Am.	373 (28%)	984 (18%)			
White	930 (69%)	4361 (77%)			
Am Indian / AK Native	4 (<1%)	30 (<1%)			
Asian	30 (2%)	153 (3%)			
Other Pacific Islander	1 (<1%)	23 (<1%)			
Two or More Races	2 (<1%)	19 (<1%)			
Unknown	9 (<1%)	65 (1%)			
Ethnicity†			0.026	0.030	0.500
Hispanic / Latino	55 (4%)	318 (6%)			
Not Hispanic / Latino	1287 (96%)	5260 (94%)			
Refused / Unknown	7 (<1%)	57 (1%)			
State of Residence			<0.001	0.023	0.483
Illinois	792 (59%)	1847 (33%)			
Wisconsin	549 (41%)	3762 (67%)			
Other / Unknown	8 (<1%)	26 (<1%)			
Any Existing Memory-Related Diagnosis	392 (29%)	691 (12%)	<0.001	0.034	0.262

†Race and ethnicity values with counts <200 were binned for analyses into ‘Other / Unknown’ and ‘Not Hispanic / Latino / Unknown’, respectively.

Table 2. Patient Counts for On-Study Diagnoses

	BrainCheck Cohort (n = 1349)	Control Cohort (n= 5635)
	On-Study	On-Study
R41 Dx	274 (20%)	214 (4%)
F01-F04 / G30-32 Dx	82 (6%)	89 (2%)

Table 3. Time to Event Model Results

	Estimate (95% CI)§		
Outcome	Evaluable N (Events)	BrainCheck	BrainCheck x t¶
R41 Dx	5977 (487)	83.94 (58.63-120.18)**	0.65 (0.55-0.77)**
F01-F04 / G30-G32 Dx	6681 (171)	11.22 (6.14-20.50)**	0.91 (0.85-0.98) ^{MS}
Imaging Orders			
MRI	6568 (882)	4.97 (3.74-6.60)**	N/A
Laboratory Orders			
TSH	4201 (2351)	1.56 (1.28-1.88)**	1.02 (1.00-1.04)
Vitamin B12	5934 (1575)	2.97 (2.41-3.66)**	N/A
T. pallidum	6957 (47)	6.76 (2.48-18.42)*	N/A
Referrals			
Neuropsychology	6886 (230)	9.23 (5.33-15.98)**	N/A
Neurology	6649 (693)	4.56 (3.15-6.61)**	0.98 (0.95-1.01)
Gerontology	6906 (85)	62.23 (26.70-145.04)**	0.93 (0.87-0.98) ^{MS}
Memory Loss Medication Rx			
	6786 (252)	13.89 (8.87-21.75)**	N/A
Any Action	3293 (2066)	3.11 (2.49-3.87)**	0.99 (0.96-1.03)

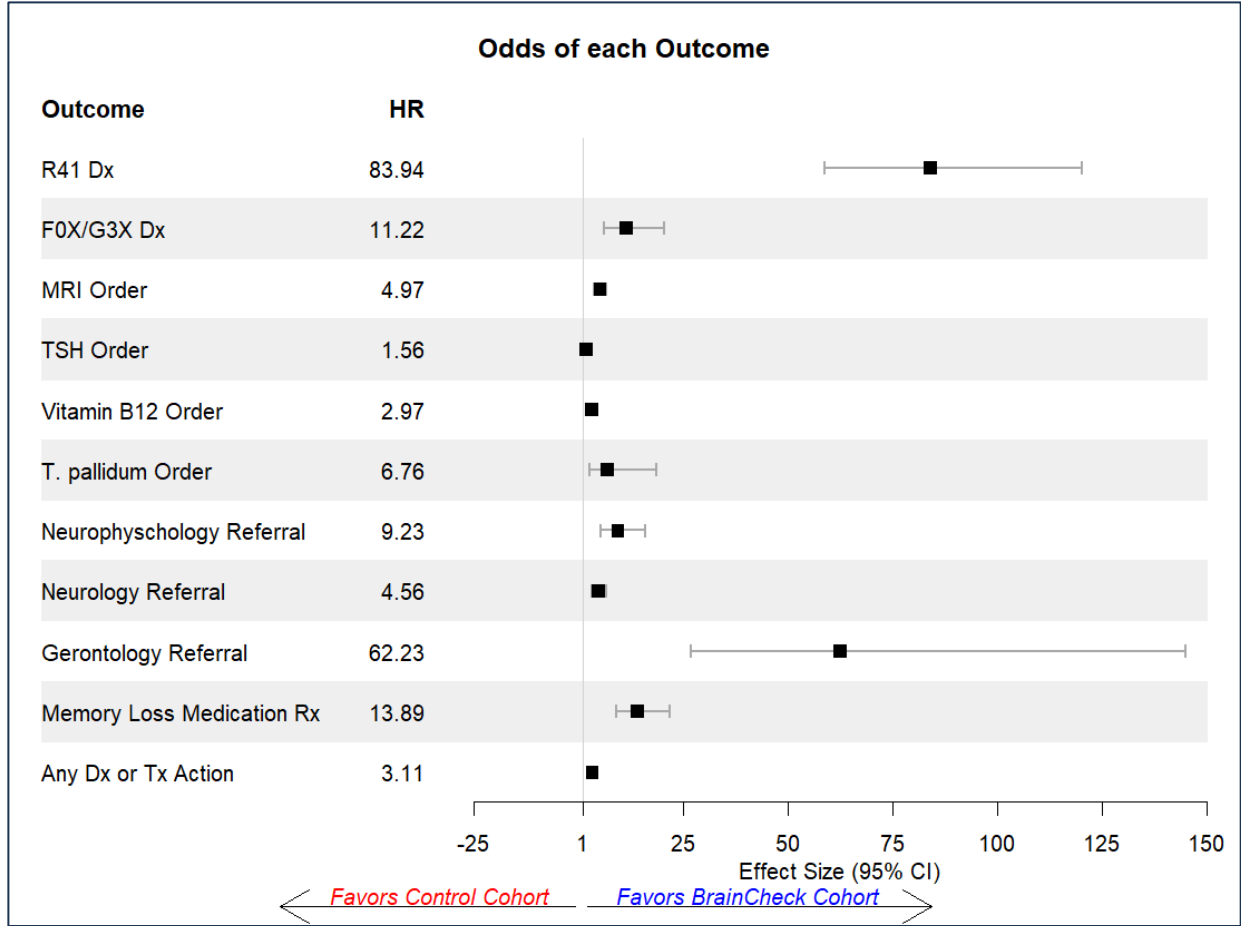
§Estimates (and CIs) are natural log back-transformed and can be interpreted as a multiplicative effect on median odds of each outcome. The control cohort and absence of existing imaging or labs serve as the reference levels of each variable in all models.
¶The time transformation interaction variable was included in models where the cohort assignment term violated assumptions of proportional hazards. This term can be interpreted as the change in median odds in the BrainCheck cohort per unit time (month). Terms labeled N/A did not violate the assumption of proportional hazards and were not included
Significance is evaluated as ^{MS}0.05< p>0.005, *p<0.005 (Bonferroni adjusted significance threshold accounting for 11 models) or **p<0.0001.

Table 4. Diagnosis Odds by BrainCheck result

Outcome	Assessment Type	Evaluable N (Events)	Impression	
R41 Dx	Screen	424 (23)	Testing Recommended	13.27 (4.61-38.20)**
	Standard Battery	515 (250)	Possible Likely	1.26 (0.86-1.84) 2.47 (1.82-3.34)**
F01-F04 / G30-G32 Dx	Screen	454 (3)	Testing Recommended	5.21 (0.45-59.90)
	Standard Battery	810 (79)	Possible Likely	1.97 (0.57-6.83) 15.73 (6.29-39.33)**

§Estimates (and CIs) are natural log back-transformed and can be interpreted as a multiplicative effect on median odds of each outcome. Further Tested Not Warranted (Screen) and Unlikely (Standard Battery) test results and absence of existing imaging or labs serve as the reference levels of each variable in all models.
Significance is evaluated as *p<0.01 (Bonferroni adjusted significance threshold accounting for 2 models) or **p<0.001

Figure 1. Forest Plot: Hazard Ratios of each Outcome.



Estimated effect sizes of BrainCheck cohort membership for each study outcome. All outcomes were positively and significantly associated with the BrainCheck assessment after multiple test correction.