

Effect of Care Coordination on Patients With Alzheimer Disease and Their Caregivers

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Alzheimer disease and related dementias (ADRD), or degenerative diseases of the brain, are collectively the sixth leading cause of mortality in the United States.¹ These diseases exact a pronounced economic burden on society. In 2019, 5.8 million individuals lived with ADRD in the United States, with ADRD-attributed care costs exceeding \$290 billion and projected to increase to \$1.1 trillion by 2050.²

Caregivers of patients with ADRD also experience a significant financial and health burden. Approximately 16 million Americans provide uncompensated care valued at more than \$234 billion.³ In addition, depression among ADRD care partners is as high as 50%,⁴ with mortality rates for elderly spousal care partners approximately 63% higher than average.⁵

These challenges require care model innovations that address both caregiver support and care coordination.⁶⁻⁹ Although no consensus definition exists,¹⁰ the Agency for Healthcare Research and Quality defines care coordination as "...the deliberate organization of patient care activities between [2] or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services."¹¹ Presently, patients and caregivers face fragmented care delivery, and caregivers are often overwhelmed by the dual burden of navigating a complex health care landscape and providing direct care to patients with ADRD. Several studies over the past decade that evaluated care coordination programs provided strong evidence for feasibility and acceptability,¹²⁻¹⁸ caregiver satisfaction and improved quality of life,¹⁹⁻²⁶ and delayed placement of patients with ADRD into nursing home facilities.²⁷⁻²⁹ However, the literature is mixed with respect to the relationship between care coordination and acute medical service use. One study reported a positive effect on reduced health care utilization,³⁰ whereas others reported no effect.^{27,29} Moreover, many of the existing studies focused on care coordination-only models, without caregiver support.^{12,19,22,31} Thus, it remains unclear whether care coordination and care support in concert can reduce acute medical services use among patients with ADRD. Furthermore, we know of no study assessing the impact of a cognitive intervention program on health care utilization and costs among caregivers.

ABSTRACT

OBJECTIVES: To assess whether a care coordination and caregiver support intervention reduced use of acute medical services for both patients with Alzheimer disease (AD) and their caregivers.

STUDY DESIGN: Data were collected from patients with AD (n = 101) and their caregivers (n = 63) at Greenville Health System (now Prisma Health) in late 2012. Their data were linked to secondary all-payer claims data in South Carolina between 2011 and 2014.

METHODS: We conducted both a difference-in-differences regression and segmented regression analysis on the patients' health care utilization patterns pre- and post intervention. Propensity score matching identified a control group composed of nonintervention patients with AD in South Carolina (n = 928). We examined caregiver differences via *t* tests of differences in means.

RESULTS: Overall, the Memory Program did not reduce acute medical services. However, program participants experienced increases in total charges (\$5243; 95% CI, \$977-\$9510) and in inpatient admissions with AD as a diagnosis (0.15; 95% CI, 0.029-0.272) but no increase in total all-cause charges. Intervention patients also had fewer emergency department (ED) visits (-0.0538; 95% CI, -0.102 to -0.0052) in some analyses. Finally, results suggest that post intervention, caregivers had half as many acute visits with depression as a diagnosis (from 0.22 to 0.11, difference of 0.11; 95% CI, -0.242 to 0.0198).

CONCLUSIONS: Although care coordination did not decrease overall acute health services use, coordination improved clinical documentation of patients' memory impairment. ED visits may have begun to decrease among patients. Finally, stress levels may have fallen among caregivers.

Am J Manag Care. 2020;26(11):e369-e375. doi:10.37765/ajmc.2020.88532

TAKEAWAY POINTS

Care coordination and caregiver support remain the primary intervention to meet the growing challenge of caring for patients with Alzheimer disease and related dementias (ADRD). Few studies, however, assessed their impact on objective measures of health care utilization. We studied patients and caregivers enrolled in the Memory Program in Greenville, South Carolina, and found strong evidence that the program led to better documentation of patients' AD diagnosis. We also found evidence suggestive of a reduction in emergency department (ED) utilization among patients with AD and a potential reduction in urgent medical utilization for depression among caregivers.

- ▶ Existing literature on ADRD interventions often focused on feasibility and self-reported outcomes.
- ▶ Our studies assessed the impact of the Memory Program on objective measures of health care utilization for patients with AD.
- ▶ The immediate impact may be better clinical documentation of AD even when patients seek care for other medical conditions.
- ▶ There is suggestive evidence that the intervention reduced ED utilization among patients and acute medical service use for depressive symptoms among caregivers.

Our study addresses this knowledge gap by evaluating the impact of a continuum of care and caregiver support model on the health care expenditures and utilization patterns of both patients with AD and their caregivers. We leveraged data generated by a Memory Program implemented in 2012 at Prisma Health (then known as Greenville Health System) in Greenville, South Carolina. Modeled after the MemoryCare program in Asheville, North Carolina,³² the Memory Program prioritizes meeting both caregiver and patient needs by assisting with communication with the patients' primary care physicians; providing licensed social worker services and other health care professionals for support, coaching, education, and referrals; creating a Caregiver Resource Library, an information source to learn about caregiving, managing stress, giving care, and topics related to memory health and self-care; and disseminating educational and supportive events led by experts in memory and geriatric care. This intervention afforded us an opportunity to examine the impact of a dual patient-caregiver support program on health care utilization and spending.

METHODS

Data

The study population consists of 101 patients with Alzheimer disease (AD) and 63 caregivers admitted to the 2012 Memory Program pilot program. Using a probabilistic matching algorithm, the South Carolina Revenues and Fiscal Affairs office (SC RFA) linked Memory Program patients and caregivers to all of their South Carolina emergency department (ED) and inpatient care claims between 2011 and 2014. Additionally, we obtained data on all nonintervention patients with AD (any individual with an *International Classification of Diseases, Ninth Revision [ICD-9]* code of 331.0 in South Carolina other than patients at Prisma Health) between 2011 and 2014.

SC RFA deidentified the analytical sample and assigned a unique random identifier number to each patient and caregiver to track

subjects over time. The deidentified data were then released to the research team for analysis.

Outcome Variables

We evaluated the impact of the Memory Program on 4 outcome variables of interest: total medical expenditures (charges), ED encounters, inpatient admissions, and discharge to a skilled nursing facility (SNF), aggregated at the patient-quarter level. We also created the same 4 outcome variables for AD-specific medical utilization by identifying only those visits associated with an *ICD-9* diagnosis code of 331.0. Finally, solely for caregivers, we used whether they had acute medical services for 6 comorbidities (diabetes, heart disease, cancer, depression, hypertension, and psychoses) as dependent variables to assess the impact of

the Memory Program on caregiver health.

Construction of the Control Group

Propensity score matching was used to select non-Prisma patients with AD observably similar to patients in the Memory Program. Specifically, we matched patients on baseline (2012) age, gender, race, rural residence, type of insurance coverage, and 5 comorbidity indicators (diabetes, cancer, hypertension, depression, and congestive heart failure), as well as numbers of ED, outpatient, and inpatient visits. We used nearest neighbor matching, selecting 5 patients to serve as control for each patient with AD admitted to the Memory Program. Caregivers do not have a control group, as it is not possible to identify persons serving as caregivers from a medical claims database.

Statistical Analysis

We employed the following difference-in-differences analyses to test the impact of the Memory Program on AD health care utilization and charges, using propensity score-matched non-Memory Program patients with AD as controls.

$$y_{it} = \beta_0 + \beta_1 post_{it} + \beta_2 treatment_{it} + \beta_3 post \times treatment_{it} + \alpha_i + \epsilon_{it}$$

Above, y_{it} represents the various outcomes of interest for individual i at time t , $post_{it}$ identifies whether the observation is in the postintervention period (2013 and 2014), and $treatment_{it}$ indicates participation in the Memory Program. The key coefficient is β_3 (for the interaction term $post \times treatment_{it}$), which represents the impact of the Memory Program relative to the control group. We chose to include patient-level fixed effects (α_i) to control for unobserved time-invariant characteristics. Doing so causes the treatment variable to drop out of the estimation because it is time-invariant. However, we are still able to estimate the primary coefficient of interest, or β_3 .

TABLE 1. Summary Statistics at Baseline

Variable	Cases (n = 101)		Matched controls (n = 928)		All controls (n = 60,410)		Caregivers (n = 63)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age in years in 2012	76.67	10.78	76.40	16.47	64.02	24.30	61.83	12.84
White	0.70		0.72		0.66		0.76	
Black	0.21		0.18		0.25		0.16	
Other	0.09		0.10		0.09		0.08	
Female	0.60		0.64		0.58		0.76	
Rural	0.02		0.02		0.24		0.02	
Medicare	0.81		0.79		0.63		0.37	
Medicaid	0.03		0.05		0.09		0.03	
Commercial	0.10		0.11		0.16		0.46	
Other insurance	0.06		0.05		0.13		0.14	
At baseline								
Total charges	\$58,286.08	\$73,388.75	\$66,016.81	\$233,493.20	\$65,549.85	\$108,589.90	\$24,293.14	\$37,704.19
Number inpatient visits	0.95	1.52	1.01	1.29	1.24	1.66	0.29	0.52
Number ED visits	2.11	2.85	1.98	7.89	2.17	4.36	0.71	0.87
Number SNF visits	4.95	4.26	4.59	8.74	4.60	5.35	2.43	1.74
Diabetes	0.21		0.22		0.25		0.14	
Cancer	0.07		0.07		0.06		0.02	
Hypertension	0.78		0.80		0.61		0.57	
Depression	0.23		0.26		0.21		0.22	
Heart disease	0.16		0.18		0.17		0.02	
First date ^a	February 11, 2012	159.5372	January 16, 2012	121.68	November 16, 2011	101.09	January 13, 2012	145.09

ED, emergency department; SNF, skilled nursing facility.

^aFirst date refers to the date of the patient or caregiver's first observation in the data set. The SD for this variable is given in days.

In addition, we also used a segmented regression model for patients. This procedure compared the outcome variables for the subjects before and after joining the Memory Program, as follows:

$$y_{it} = \beta_0 + \beta_1 \text{preperiod counter}_t + \beta_2 \text{post}_{it} + \beta_3 \text{postperiod counter}_t + \alpha_i + \varepsilon_{it}$$

Here, all the variables are identical to the difference-in-differences, except the following: The *preperiod counter* simply counts the number of quarters that have elapsed since the beginning of the study period. The *postperiod counter* remains 0 until Memory Program enrollment, and then counts the number of quarters that have passed after enrollment. The main coefficients of interest are β_2 and β_3 , which, respectively, represent any discontinuity in the outcome variable at enrollment and postperiod changes in outcome trends relative to the preperiod trends.

Owing to the lower frequency of acute events among caregivers, a segmented regression model would likely estimate inaccurate trends using highly stochastic data. We therefore conducted simple *t* tests comparing the pre- and post-Memory Program outcomes for caregivers.

RESULTS

Overall Results

Our results reveal 3 primary patterns. First, Memory Program patients had a significant increase in AD-related charges and inpatient admissions compared with controls, but there was no increase in all-cause charges and inpatient admissions. Second, some analyses show that Memory Program patients may have had a decrease in all-cause and AD-related ED visits. Finally, caregivers did not experience a reduction in serious health outcomes, as measured by inpatient and ED utilization. However, caregivers may have experienced a reduction in depression-related acute services.

Descriptive Statistics

Patients' baseline characteristics suggest that Prisma Memory Program patients differed from the general population with AD in South Carolina (Table 1). Memory Program patients were older (76.67 vs 64.02 years), less likely to be Black (21% vs 25%), less likely to have rural residence (2% vs 24%), more likely to have Medicare (81% vs 63%), and less likely to have Medicaid (3% vs 9%). At baseline,

TABLE 2. Effect of the Memory Program on Health Care Utilization and Spending: Regression Results*

Variables	(1) Total charges	(2) Total AD charges	(3) Inpatient admission	(4) AD inpatient admission	(5) ED visits	(6) AD ED visits	(7) SNF discharges	(8) AD SNF discharges
Panel A: difference-in-differences with matched cases and controls								
Post	4463* (1781)	205.6 (809.7)	0.0815** (0.0273)	0.0206 (0.0124)	-0.0602 (0.0853)	-0.00709 (0.0118)	0.0534** (0.0170)	0.00950 (0.00890)
Post*treat	-6392 (4020)	5243* (2174)	-0.000900 (0.0977)	0.150* (0.0617)	0.0847 (0.142)	0.106 (0.0605)	0.0232 (0.0721)	0.0511 (0.0449)
Observations	3675	3675	3675	3675	3675	3675	3675	3675
R ²	0.002	0.002	0.004	0.011	0	0.005	0.004	0.003
Number of patients	1029	1029	1029	1029	1029	1029	1029	1029
Panel B: difference-in-differences with matched cases and all available controls								
Post	728.6** (242.4)	-428.7** (91.98)	-0.0208** (0.00334)	-0.00171 (0.00130)	-0.0194** (0.00700)	-0.00715** (0.00117)	0.0273** (0.00192)	0.00620** (0.000857)
Post*treat	-2658 (3610)	5877** (2018)	0.101 (0.0938)	0.173** (0.0604)	0.0438 (0.114)	0.106 (0.0594)	0.0493 (0.0700)	0.0544 (0.0440)
Observations	229,825	229,825	229,825	229,825	229,825	229,825	229,825	229,825
R ²	0	0	0	0	0	0	0.001	0
Number of patients	60,511	60,511	60,511	60,511	60,511	60,511	60,511	60,511
Panel C: segmented regressions with matched cases only								
Preenrollment trend	351.8 (1439)	131.0 (528.5)	0.0197 (0.0314)	-0.00176 (0.0187)	0.0322 (0.0298)	0.0253 (0.0201)	0.000877 (0.0194)	0.0113 (0.0113)
Post	-3735 (5559)	4310** (2172)	-0.137 (0.151)	0.130 (0.0815)	0.219 (0.229)	0.130 (0.0971)	0.00169 (0.131)	-0.00735 (0.0767)
Change in trend post enrollment	30.71 (2240)	173.6 (744.8)	0.0422 (0.0421)	0.0174 (0.0235)	-0.122* (0.0680)	-0.0538** (0.0245)	0.0246 (0.0206)	0.00438 (0.0121)
Observations	419	419	419	419	419	419	419	419
R ²	0.001	0.044	0.013	0.043	0.011	0.025	0.008	0.015
Number of patients	101	101	101	101	101	101	101	101

AD, Alzheimer disease; ED, emergency department; SNF, skilled nursing facility.
*P < .05; **P < .01.
*Robust standard errors in parentheses.

Prisma patients had slightly lower average total health care charges (\$58,286.08 vs \$65,549.85) and similar health care utilization but fewer inpatient admissions (0.95 vs 1.24). Prisma patients were less likely to have diabetes (21% vs 25%) but more likely to have hypertension (78% vs 61%).

Caregivers were, on average, 15 years younger than care recipients (61.83 vs 76.67 years) and were more likely to have commercial health insurance (46%) than Medicare (37%). Not surprisingly, caregivers were younger and healthier than patients, although it is noteworthy that they had the same rate of depression as patients.

Propensity Score Matching

Table 1 (see “Matched Controls”) provides the results of matching patients based on patient and clinical characteristics. Matched patients have better covariate balance, particularly for age, rural residence, number of inpatient admissions at baseline, Medicare coverage, and commercial insurance. (See the **eAppendix Table** [available at ajmc.com] for additional analyses on bias reduction through propensity score matching.) Overall, our nearest-neighbor

propensity score matching reduced the likelihood ratio χ^2 value from 157.7 to 2.23 and the mean bias from 22.4 to 5.1.

Difference-in-Differences Results for Patients With AD

Table 2 (panel A) describes our difference-in-differences results using our matched patients with AD as controls. Enrollment in the Prisma Memory Program was associated with little or no change in all-cause charges, inpatient and ED utilization, or the likelihood of posthospitalization discharge to an SNF. However, Prisma patients were more likely to have their charges and inpatient admissions ascribed to an AD-related cause than control patients. Prisma patients had an average of \$5243 (95% CI, \$77-\$9510) more in AD-related charges and 0.15 (95% CI, 0.0293-0.272) more inpatient admissions per quarter than non-Prisma controls with AD.

Robustness Checks for Patients With AD

The difference-in-differences results are subject to bias if the control group is not properly selected. We conducted 2 alternative analyses to assess the robustness of our results. First, we simply

TABLE 3. Caregiver Outcomes^a

Variables	(1) Total charges	(2) Any inpatient admission	(3) Any ED	(4) Diabetes	(5) Depression	(6) Cancer	(7) Hypertension	(8) Heart disease	(9) Psychoses
Post	-6820 (5745)	-0.111 (0.0709)	-0.111 (0.0881)	-0.0159 (0.0613)	-0.111* (0.0662)	0.0159 (0.0273)	-0.143 (0.0889)	0.0476 (0.0348)	-0.0159 (0.0159)
Constant	24,293*** (4750)	0.254*** (0.0553)	0.476*** (0.0634)	0.143*** (0.0444)	0.222*** (0.0528)	0.0159 (0.0159)	0.571*** (0.0628)	0.0159 (0.0159)	0.0159 (0.0159)
Observations	126	126	126	126	126	126	126	126	126
R ²	0.011	0.019	0.013	0.001	0.022	0.003	0.02	0.015	0.008

ED, emergency department.

* $P < .1$; ** $P < .05$, *** $P < .01$.^aRobust standard errors in parentheses.

ran an additional difference-in-differences regression using all non-Prisma patients with AD as controls. The results are broadly similar to those of the analysis using propensity-score matched controls (see Table 2, panel B). Second, we used segmented regression analyses to estimate changes in outcomes around the enrollment date using only the intervention group without using a comparison group. Analyses still reveal a statistically significant increase in total AD-related charges after Memory Program enrollment (\$4310; 95% CI, \$2-\$8618). There was also an increase in AD-related inpatient admissions of 0.130, which is similar in magnitude to other specifications, but the result is not statistically significant. However, our segmented regression analysis shows that AD-related ED utilization decreased by 0.0538 (95% CI, -0.102 to -0.00521) visits per quarter compared with preintervention trends. Because this coefficient represents the change in trends, the actual slope of the trend in postintervention AD-related ED visits is a *reduction* of 0.0285 visits (ie, 0.0253 [preintervention slope] + -0.0538 [change in postintervention slope] = -0.0285; 95% CI, -0.0564 to -0.00727) (see Table 2, panel C).

T Test of Differences in Means for Caregivers

For caregivers, the results show no statistically significant difference in means between the pre- and post-Memory Program measures for total charges, ED visits, and inpatient admissions. *T* tests on differences in means for comorbidities revealed no statistically significant comparisons at $\alpha < 0.05$. However, the proportion of caregivers using acute medical services for depression decreased from 22% to 11% (95% CI, -0.242 to 0.0198; $P < .1$) (Table 3).

DISCUSSION

Our analyses yielded 3 principal findings. First, Memory Program patients were more likely to have their AD diagnosis documented during acute medical visits. Overall ED and inpatient admissions did not increase among Memory Program patients—only the likelihood of recording AD as part of the patient's present-at-admission diagnoses increased. This superior documentation may have resulted from improved care coordination, more caregiver communication, or a

combination of these factors. Although seemingly inconsequential, comorbidity documentation improvement—a care coordination indicator—is an essential antecedent to improved health outcomes.

Theoretically, better documentation may enhance chronic disease management by reducing missing clinical information, improving diagnostic accuracy, and facilitating informational exchange necessary for efficient care coordination.³³ Accurate and centralized health information reduces medication errors³⁴ and informs root cause analysis of adverse events.^{35,36} Documentation and coding accuracy are especially critical for complex patients with multimorbidity who require coordinated care plans involving multiple clinical stakeholders and departments. Empirical data suggest that patients with ADRD have the highest levels of multimorbidity among any patient group with chronic conditions.³⁷ This observation is not accidental, as age³⁸ is a risk factor for multiple comorbidities,^{39,40} and both age and multimorbidity are risk factors for dementia.⁴¹ Superior documentation may therefore be especially important for the care of patients with ADRD.

Second, our analyses revealed no differences overall in acute health care utilization between Memory Program and control patients. This finding is consistent with those of earlier meta-analyses, including a study by Pimouguet et al²⁷ finding no evidence that care coordination reduced health care expenditures or hospitalizations. However, like ours, prior studies also found evidence suggestive of better documentation of ADRD. The MIND trial (a randomized controlled trial of an 18-month care coordination program for ADRD) reported no increase in total outpatient services but detected an increase in ADRD-related outpatient visits.⁴² The concordance of our results suggests that care coordination interventions may very well improve clinical documentation of AD patients' health care utilization, even without reducing immediate health care utilization and costs.

Nevertheless, in the segmented regression analyses, we observed that all-cause and AD-specific ED visits began declining among Memory Program patients toward the end of the study period. Boustani et al similarly observed less frequent utilization of acute health services.³⁰ However, a comprehensive literature search revealed that these results are outliers and that few published studies reported reduced ED utilization. More commonly, studies documented that

care coordination for AD satisfied unmet needs, increased quality of life, and improved quality of care without necessarily reducing health care utilization or costs.^{20-24,43}

Future research should include extended follow-up to confirm or qualify our findings, but there are at least 2 reasons for the general lack of a finding that care coordination produces theorized benefits. First, care coordination is costly to administer and addresses both overutilization and underutilization resulting from fragmented care.⁴⁴ As such, care coordination can actually increase health care services utilization when previously unmet needs are addressed with better clinical coordination. Second, there is no consensus definition of care coordination, so it is likely inconsistently applied in clinical settings.^{10,45} In breaking down care coordination into coordination activities (eg, communication and monitoring) and interdependencies (eg, flow, shared resources, simultaneity), Kianfar et al identified at least 258 care coordination activities.⁴⁶ Petersen et al, in a meta-analysis, found at least 37 widely diverse theoretical frameworks for care coordination, likely with different theory-to-practice links.⁴⁷ With such a broad range of potential implementations of care coordination, it is possible that existing studies have evaluated multiple variations of clinical care coordination models, most of which have not yielded reductions in health care utilization and costs.

Third, our analyses did not find that caregivers experienced a statistically significant decrease in acute health services use. However, our analyses suggest that caregivers experienced reduced ED use and inpatient care for depression. This result shows that 22% of caregivers experienced an acute episode of depression requiring urgent care in the preintervention period, whereas only 11% had such an incident in the postintervention period. The results are significant only at the .10 level, and the limited number of caregivers in the preintervention period (63) potentially failed to provide sufficient power to detect a significant result at the .05 level.

These results are consistent with those of multiple published studies reporting caregiver satisfaction, stress reductions, and improvements in quality of life. For example, the investigators of the MIND trial observed that the intervention reduced the time that caregivers were required to spend with care recipients.²⁰ The Veterans Health Administration's Partners in Dementia Care program showed that intervention group caregivers experienced significant improvements in meeting previously unmet needs, alleviating 3 types of caregiver strains, as well as decreasing depression and increasing access to caregiver support services.²¹ Similarly, in the Veterans Health Administration's Resources for Enhancing Alzheimer's Caregiver Health randomized controlled trial, caregivers reported decreased burden, depression, and caregiving frustrations, all of which affected quality of life.²⁴ Other trials also observed that caregiver support reduced unmet needs,²² increased caregiver self-efficacy, and reduced caregiver burden.^{25,26} Our results affirm the findings of these prior studies and contribute to the literature by using objective health services measures in claims data, beyond caregiver self-reports.

Limitations

We acknowledge several study limitations. First, our study is not a randomized controlled trial. Existing patients with AD and their caregivers opted to enroll in the Memory Program for a fee. Our study group in fact consisted of patients with AD who were more likely to have advanced illness than the general patient population with AD, but we attempted to alleviate this selection bias by using propensity score matching to identify non-Prisma patients with AD in South Carolina observably most similar to our intervention group. Second, data deidentification resulted in losing/obscuring the exact enrollment dates for each individual AD patient and caregiver. We chose to sacrifice some precision to preserve participant protection principles, noting that we were able to identify a quarter in which a substantial majority of our subjects enrolled in the Memory Program. We designated this quarter as the intervention start period. Potential error introduced by a misassigned start date could introduce noise and reduce statistical significance. Despite this, our analyses detected statistically significant relationships in several specifications.

CONCLUSIONS

ADRD incidence and prevalence continue to increase worldwide, with significant health and economic implications for patients with ADRD, their caregivers, health systems, and policy makers. Absent a cure, optimal care coordination and caregiver support remain the prime media to improve ADRD patient and caregiver welfare. Existing literature generally considers only program feasibility and self-reported outcomes of behavior symptoms, caregiving support, and caregiver quality of life. Fewer studies have assessed program impact on health care utilization. Our study showed that Memory Program enrollment was associated with better clinical documentation of patients' AD diagnosis. Moreover, we found suggestive evidence that the program reduced ED utilization among patients with AD and possibly reduced urgent medical utilization for depression among caregivers. Future studies on the impact of care coordination and caregiver support programs should consider extended follow-up periods to assess the long-term benefits from these care delivery interventions. ■

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Source of Funding: This publication resulted from research supported by the Institute for the Advance of Health Care at the Greenville Health Systems (now Prisma Health). The content is solely the responsibility of the authors and does not necessarily represent the official views of the funding agency.

Author Disclosures: The authors report no relationship or financial interest with any entity that would pose a conflict of interest with the subject matter of this article.

Authorship Information: Concept and design (BC, BS-L); acquisition of data (BC, BS-L); analysis and interpretation of data (BC, XC, NH); drafting of the manuscript (BC, BS-L, MFH, DJ); critical revision of the manuscript for important intellectual content (BC, XC, MFH, DJ, NH); statistical analysis (BC, XC, NH); provision of patients or study materials (BS-L); obtaining funding (BC, BS-L); administrative, technical, or logistic support (BS-L, MFH, DJ); and supervision (BC).

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eAppendix Table. Reduction in Bias After Propensity Score Matching

Variable	Unmatched	Mean		%bias	%reduct	t-test		V(T)/
	Matched	Treated	Control		bias	t	p>t	V(C)
Age (2012)	U	76.673	64.207	66.4		5.17	0	0.20*
	M	76.673	77.06	-2.1	96.9	-0.2	0.844	0.42*
Black	U	0.20792	0.25315	-10.7		-1.04	0.296	.
	M	0.20792	0.18119	6.3	40.9	0.48	0.633	.
Other race	U	0.08911	0.08828	0.3		0.03	0.977	.
	M	0.08911	0.10198	-4.5	-1453	-0.31	0.757	.
Female	U	0.60396	0.5808	4.7		0.47	0.637	.
	M	0.60396	0.64356	-8	-71	-0.58	0.564	.
Rural residence	U	0.0198	0.23645	-68.5		-5.12	0	.
	M	0.0198	0.01485	1.6	97.7	0.27	0.789	.
Diabetes	U	0.20792	0.25156	-10.4		-1.01	0.312	.
	M	0.20792	0.21089	-0.7	93.2	-0.05	0.959	.
Cancer	U	0.06931	0.06337	2.4		0.24	0.807	.
	M	0.06931	0.06436	2	16.7	0.14	0.889	.
Hypertension	U	0.78218	0.60833	38.4		3.58	0	.
	M	0.78218	0.8099	-6.1	84.1	-0.49	0.627	.
Depression	U	0.22772	0.20765	4.9		0.5	0.619	.
	M	0.22772	0.25545	-6.7	-38.1	-0.46	0.647	.
Heart disease	U	0.15842	0.17065	-3.3		-0.33	0.744	.
	M	0.15842	0.16832	-2.7	19.1	-0.19	0.85	.
Total charges	U	58286	65557	-7.7		-0.65	0.513	0.43*
	M	58286	63339	-5.4	30.5	-0.21	0.831	0.11*
Num ED	U	2.1089	2.1638	-1.5		-0.12	0.901	0.41*
	M	2.1089	2.305	-5.3	-256.8	-0.17	0.864	0.07*
Num inpat	U	0.9505	1.2411	-18.3		-1.76	0.078	0.84
	M	0.9505	0.96337	-0.8	95.6	-0.07	0.948	1.41
Num amb. surg.	U	0.87129	0.59	19.2		2.05	0.04	1.25
	M	0.87129	1.1564	-19.5	-1.4	-0.73	0.463	0.18*
Medicare	U	0.81188	0.62902	41.5		3.8	0	.
	M	0.81188	0.79802	3.1	92.4	0.25	0.805	.
Medicaid	U	0.0297	0.08575	-24.2		-2.01	0.044	.
	M	0.0297	0.04158	-5.1	78.8	-0.45	0.651	.
Comm. Ins.	U	0.09901	0.15607	-17.1		-1.58	0.114	.
	M	0.09901	0.10396	-1.5	91.3	-0.12	0.908	.
First date	U	19034	18948	64.3		8.48	0	2.46*
	M	19034	19021	10	84.4	0.66	0.512	1.52*
* if variance ratio outside [0.84; 1.19] for U and [0.84; 1.19] for M								
Sample	Ps R2	LR chi2	p>chi2	Mean Bias	Med Bias	B	R	%Var
Unmatched	0.106	157.7	0	22.4	13.9	125.7*	0.64	67
Matched	0.008	2.23	1	5.1	4.8	20.8	0.82	83