Medicare Annual Wellness Visit Association With Healthcare Quality and Costs

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ABSTRACT

OBJECTIVES: Although use of the Medicare Annual Wellness Visit (AWV) is increasing nationally, it remains unclear whether it can help contain healthcare costs and improve quality. In the context of 2 primary care physician–led accountable care organizations (ACOs), we tested the hypothesis that AWVs can improve healthcare costs and clinical quality.

STUDY DESIGN: A retrospective cohort study using propensity score matching and quasi-experimental difference-in-differences regression models comparing the differential changes in cost, emergency department (ED) visits, and hospitalizations for those who received an AWV versus those who did not from before until after the AWV. Logistic regressions were used for quality measures.

METHODS: Between 2014 and 2016, we examined the association of an AWV with healthcare costs, ED visits, hospitalizations, and clinical quality measures. The sample included Medicare beneficiaries attributed to providers across 44 primary care clinics participating in 2 ACOs.

RESULTS: Among 8917 Medicare beneficiaries, an AWV was associated with significantly reduced spending on hospital acute care and outpatient services. Patients who received an AWV in the index month experienced a 5.7% reduction in adjusted total healthcare costs over the ensuing 11 months, with the greatest effect seen for patients in the highest hierarchical condition category risk quartile. AWVs were not associated with ED visits or hospitalizations. Beneficiaries who had an AWV were also more likely to receive recommended preventive clinical services.

CONCLUSIONS: In a setting that prioritizes care coordination and utilization management, AWVs have the potential to improve healthcare quality and reduce cost.

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The Annual Wellness Visit (AWV) was introduced in 2011 by Medicare and made available to all eligible beneficiaries without deductibles or co-payments. Unlike a traditional periodic health examination or annual physical, which may be performed without a specified protocol,[1-4] the AWV includes a list of required components[5] that prioritize preventive care and investing in the relationship with the patient rather than addressing acute complaints or chronic disease (**Table 1**). It includes assessing risk factors, inquiring about care support, creating a personalized care plan, and educating beneficiaries on how to maintain their health outside of an acute illness episode.[6-8] Notably, the only physical examinations required of the visit are blood pressure measurement and height/weight measurement for body mass index (BMI), reflecting the US Preventive Services Task Force's recommendation against routine physical examinations for asymptomatic adults 65 years or older.[9]

Previous work has demonstrated growing adoption of AWVs since their introduction, but modest use overall,[10-12] with 7% of Medicare beneficiaries receiving an AWV in 2011, increasing to 16% in 2014.[13] More than 90% of AWVs nationally in 2014 were performed by a primary care physician (PCP).[13] Although utilization of the service is increasing, the benefits of an AWV for improving patient outcomes and controlling healthcare costs continue to be debated.[14-16] This lack of evidence regarding the possible impact of AWVs on important outcomes restrains providers and policy makers from optimally using the service.

In order to address these gaps, we examined the association of an AWV with healthcare costs, utilization, and measures of clinical quality among beneficiaries cared for by 2 PCP-led accountable care organizations (ACOs). We focused on beneficiaries cared for by PCPs in the ACOs formed in 2015 by Aledade, a national network of independent practices.[17-21] Aledade has prioritized AWVs to improve quality and focus a primary care relationship on preventing adverse health events. It has supported its partners in performing AWVs by identifying high-risk beneficiaries, building user-friendly technology to schedule AWVs with these beneficiaries, providing face-to-face practice transformation support to optimize workflows,

implementing templates in the electronic health record (EHR), providing data tools to support performance monitoring, and facilitating best practice sharing across a network of doctors.[22] Evaluating the AWV in the context of a highly motivated and supported physician network leads to greater understanding of how AWVs can contribute to improving healthcare quality and reducing costs under optimal conditions.

TAKEAWAY POINTS

In the context of 2 primary care physician (PCP)–led accountable care organizations, Medicare Annual Wellness Visits (AWVs) were associated with lower healthcare costs and improved clinical care quality for beneficiaries.

- Our findings suggest that an AWV can achieve meaningful improvements in cost and quality, lending support that policy makers and payers should further facilitate the adoption of high-quality AWVs by PCPs.
- Because Medicare reimburses $175 for an AWV per member per year and the AWV was associated with a $38 per member per month ($456 per member per year) decrease in costs, these data suggest that the additional expenditure on primary care can be worth the costs, particularly for a higher-risk population.
- Future research can help guide policy with respect to whether AWVs should be billable only by the patient's PCP and whether payment should be higher for higher-risk patients.

METHODS

Study Design and Sample

Primary data source. We used insurance claims from the CMS Claim and Claim Line Feed[23] as our primary data source to assess the association of an AWV with cost and utilization. These data include services provided under Medicare parts A and B for patients assigned to 2 PCP-led ACOs. Data from these specific ACOs were used because they were the first ACOs that Aledade partnered with that had complete follow-up data. The observation period was from January 1, 2014, to December 31, 2016. Permission to use data for the study was granted through the Medicare Shared Savings Program data use agreement, and institutional review board (IRB) approval was granted by Hummingbird IRB (IRB #2017-278).

Intervention and control groups in primary data source. Among patients attributed to ACOs 1 and 2 at the start of 2015, we identified intervention beneficiaries who had an AWV in 2015 (Current Procedural Terminology codes G0402, G0438, or G0439). We excluded beneficiaries who had missing data, died during the study period, or had received an AWV in 2014 (we wanted to focus on the effects from a first-time AWV, assuming that patients who did not receive an AWV in 2014 did not receive one in 2011-2013). To identify a control group, we matched the intervention beneficiaries to beneficiaries who did not have an AWV in 2015 and who met the same inclusion and exclusion criteria as the intervention group (for additional information about the matching process, see the **eAppendix** [available at **ajmc.com**]). Control patients were assigned the AWV month of the intervention patient to whom they matched. We removed the month that the AWV was done (and thus the cost of the AWV itself, because we wanted to focus on the subsequent AWV impact), which allowed us to define the 11 calendar months before the AWV as the pre-AWV period and the 11 calendar months after the AWV as the post-AWV period. Because Medicare only bills AWVs once every 12 months per patient, the intervention group by definition did not have any AWVs in the post-AWV period. After matching, we excluded all control patients who had an AWV in the post-AWV period, as well as all patients with outlier spend (to reduce skewness). For a visual definition of this cohort, see **eAppendix Figure 1**.

Secondary data source for quality of care. To assess impact of an AWV on clinical quality, we used data on clinical quality measures reported to CMS as part of the ACO program.[24] These data are reported to CMS for a different randomly selected sample of beneficiaries for each measure. Beneficiaries met exclusion/inclusion criteria as defined by each measure definition in accordance with Medicare specifications.[25] Each sample was then divided into 2 groups: The control group included beneficiaries who did not receive a first-time AWV in 2015 (but could have received one in 2014 or 2016) and the intervention group included beneficiaries who did receive a first-time AWV in 2015 (including the "Welcome to Medicare" visit). We included all beneficiaries who were reported on by CMS regardless of whether they were in our final primary analytic sample.

Outcome Measures

The primary outcome was the differential change in healthcare cost (in the post-AWV period compared with the pre-AWV period) between those who did and did not receive an AWV. Costs in the month that the AWV was performed, including the approximately $175 cost of the AWV itself, were excluded. Cost was evaluated in separate analyses as total Medicare cost (all parts A and B Medicare spending) and category-specific costs within Part A (hospital acute care; hospital outpatient; hospital outpatient non–emergency department [ED]; skilled nursing facility, home health, other outpatient facility spending) and Part B (provider/supplier, durable medical equipment). The secondary outcomes included counts of ED visits and hospitalizations in the pre- and post-AWV periods. The outcomes for the quality measures analysis were 16 clinical quality measures with definitions specified by Medicare in 3 domains: preventive health, clinical care for at-risk populations, and care coordination.[25]

Statistical Analysis

Similar to other observational studies using real-world evidence, this study's approach accounted for the likelihood that individuals who received AWVs differed from other patients in substantial ways that might affect the outcomes measured. In particular, issues may include that practices did not reach out to all patients with equal likelihood, practices succeeded in reaching patients at different rates, and patients who were willing and able to come in for a primary care visit differed from patients who were not.

TABLE 1. Minimum Components of an AWV

AWV Element	Notes
Administer health risk assessment	• Demographic data • Self-assessment of health status • Psychosocial risks • Behavioral risks • ADLs, including dressing, bathing, and walking • Instrumental ADLs, including shopping, housekeeping, managing own medications, and handling finances
Establish a list of current providers and suppliers	Those providing regular care to the beneficiary
Establish medical and family history	• Use of medications/supplements • Past medical and surgical history • Medical history of beneficiary's parents, siblings, and children
Assess for depression	Assess for patient risk factors for depression, including current and past experiences with depression or other mood disorders, using validated screening tool
Evaluate functional status and level of safety	Use direct observation or use validated tool to screen for the following: • Ability to successfully perform ADLs • Fall risk • Hearing impairment • Home safety
Assess cognition	Assess cognitive status based on direct observation and reports by beneficiary's family, friends, caretakers, and others
Collect vital signs	• Height, weight, and body mass index • Blood pressure
Perform other assessments	Other routine assessments based on beneficiary's medical and family history
Create written screening schedule for the beneficiary	Use recommended screenings based on evidence-based guidelines
Create list of risk factors and conditions, and indicate plan for intervention	Include the following: • Mental health conditions • Risk factors identified • Treatment options and their associated risks and benefits
Educate, counsel, and refer based on previous components	The aim of these interventions should be community-based lifestyle interventions
Deliver advanced care planning services	This should be voluntary on the part of the beneficiary and include the following: • Future care decisions that may be necessary to make • How the beneficiary can let others know of decisions • Information about advance directives and help completing necessary forms

ADL indicates activity of daily living; AWV, Annual Wellness Visit.

We used several analytic methods to explore the impact of such selection bias and account for it. We employed propensity score matching to identify control subjects who were similar to patients who received AWVs in key respects, including level of engagement with primary care in the pre-AWV period. We estimated the impact of AWVs by specifying a series of difference-in-differences (DID) regression models.

Specifically, for the primary data source, we checked the parallel trends assumptions and used a DID study design to assess changes in subsequent 11-month healthcare costs, ED visits, and hospitalizations between beneficiaries who did and did not receive an AWV in the index month. We used a mixed-effects negative binomial model for total cost and mixed-effects zero-inflated negative binomial (ZINB) models for category-specific costs and utilization. For the secondary data source, we used mixed-effects logistic regression models to assess the association between receiving an AWV and quality measures. In order to account for multiple comparisons, the Hochberg sequential procedure was used.[26,27] For additional details on the modeling approach, see the eAppendix.

We also conducted a series of sensitivity analyses to evaluate the robustness of our results. First, we evaluated whether the intervention effect differed among those patients who received outreach using the Aledade app in 2015 versus those patients who did not receive outreach in 2015. Second, we used coarsened exact matching instead of propensity score matching to identify the comparison group. Third, we repeated our primary analysis (including the matching) only among beneficiaries who were continuously attributed throughout the entire pre- and post-AWV period. Fourth, we excluded intervention patients who matched to controls who had an AWV in the post-AWV period. Finally, we evaluated whether the AWV associations were different for "early" (January 2015–July 2015) versus "late" AWVs (August 2015–December 2015). (See eAppendix for additional details.)

All statistical analyses were conducted using R version 3.3.3 (R Foundation for Statistical Computing; Vienna, Austria). Propensity score and coarsened exact matching were conducted using the *MatchIt* package, mixed-effects logistic models were fit using the *lme4* package, and the mixed-effects negative binomial and ZINB models were fit using the *glmmTMB* package.[28-30] Graphics and plots were generated using the *ggplot2* package.[31]

RESULTS

Baseline Characteristics by AWV Status

The primary analysis sample of matched intervention and control beneficiaries included 8917 beneficiaries, of whom 4789 (54%) received a first-time AWV in 2015 (**Table 2**[23]). Differences in clinical and sociodemographic characteristics between the matched intervention and control groups were small. (For characteristics of the population of beneficiaries who entered the matching process, see the eAppendix.) The only covariate that was significantly different between those who did and did not receive an AWV in the final

analytic sample was the specific ACO of the patient, and thus it was adjusted for in final regression models.

Association of AWV With Healthcare Costs and Utilization

In the pre-AWV period, average trends in healthcare cost were similar for the intervention and control groups (**eAppendix Figure 2**). In 2015, a first-time AWV was associated with a 5.7% (95% CI, 0.3%-11.4%) reduction in total healthcare costs in the post-AWV period (excluding the cost of the AWV itself). This association translated to a $38 (95% CI, $9-$67) per-member-per-month (PMPM) reduction over 11 months of follow-up, or approximately $418 per beneficiary (**Figure 1**[23]). The association between a first-time AWV and reduced costs was stronger among beneficiaries in the top hierarchical condition category (HCC) risk quartile. In this population, the adjusted differential change in total healthcare cost between the intervention and control groups was 6.3%, a PMPM decrease of $81 (95% CI, $12-$150) over 11 months of follow-up (Figure 1[23]).

Analysis of category-specific costs suggested that the primary drivers of this impact were reductions in hospital acute care costs (incidence rate ratio [IRR], 0.88; 95% CI, 0.80-0.97) and hospital outpatient non-ED costs (IRR, 0.93; 95% CI, 0.89-0.97). **Table 3**[23] reports the differential change in each category-specific cost between the intervention and control groups. With respect to healthcare utilization, first-time AWVs were not associated with a statistically significant change in the total number of ED visits (IRR, 0.97; 95% CI, 0.83-1.15) or hospitalizations (IRR, 0.95; 95% CI, 0.78-1.11).

Results of the sensitivity analyses were consistent with the main findings. Of note, the AWV association from the main analysis was not systematically different among beneficiaries who were invited by phone or email to schedule an AWV by the PCP practice (defined as receiving outreach) and beneficiaries who were not invited. In addition, using an alternative matching method to identify the comparison group and limiting the sample to those who were continuously attributed were consistent with a robust association between receipt of an AWV and reduced healthcare costs. Additionally, results were consistent with the main analysis when intervention patients who matched to controls who had an AWV in the post-AWV period were excluded. Finally, the effect of the AWV was not different between AWVs conducted in the early versus late part of the calendar year (See eAppendix for additional details.)

Association of AWV With Clinical Quality

Of 16 quality measures evaluated (**Figure 2**[24]), a first-time AWV in 2015 was significantly associated with greater performance on 7 measures in adjusted analyses (all $P < .01$): fall risk screening (94% vs 15%), pneumococcal vaccination (86% vs 69%), tobacco screening and cessation (91% vs 77%), depression screening and follow-up planning (87% vs 18%), colorectal cancer screening (69% vs 60%), breast cancer screening (81% vs 66%), and controlled glycated hemoglobin (A1C) (77% vs 65%). AWVs were not statistically significantly associated with diabetes eye exams, use of aspirin,

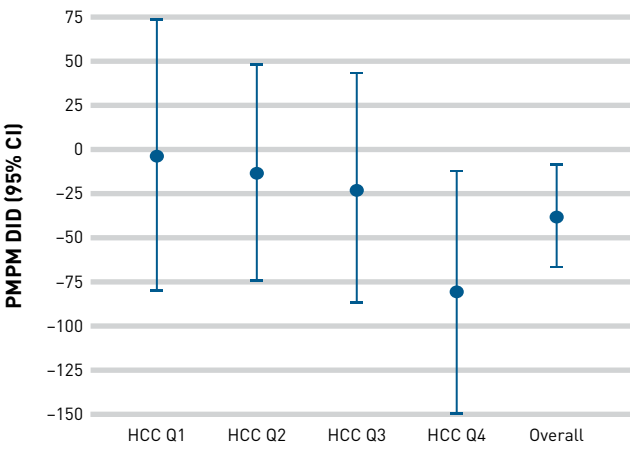
TABLE 2. Characteristics of Patients Who Received an AWV and Matched Controls

	Total Population N = 8917 (100%)	AWV n = 4789 (54%)	No AWV n = 4128 (46%)
Age in years, mean (SD)	73.3 (13.6)	72.9 (14.0)	74.8 (12.9)
Gender, n (%)			
Male	3941 (44)	2176 (45)	1765 (43)
Female	4976 (56)	2613 (55)	2363 (57)
Race, n (%)			
White	7857 (88)	4208 (88)	3649 (88)
African American	877 (10)	493 (10)	384 (9)
Other	183 (2)	88 (2)	95 (2)
HCC quartile, n (%)			
1	1433 (16)	796 (16)	637 (15)
2	2258 (25)	1205 (25)	1053 (26)
3	2588 (29)	1348 (28)	1240 (30)
4	2638 (30)	1440 (31)	1198 (29)
Beneficiary eligibility criteria, n (%)			
ESRD	9 (0.2)	7 (0.2)	2 (0.2)
Disabled	1677 (19)	874 (18)	803 (19)
Aged/dual	415 (5)	215 (5)	200 (5)
Aged/nondual	6816 (76)	3693 (77)	3123 (76)
ACO, n (%)			
ACO 1 ("Delaware ACO")	5072 (57)	3209 (67)	1863 (55)
ACO 2 ("Primary Care ACO")	3845 (43)	1580 (33)	2265 (45)

ACO indicates accountable care organization; AWV, Annual Wellness Visit; ESRD, end-stage renal disease; HCC, hierarchical condition category.

Source: Authors' analysis of data from CMS Claim and Claim Line Feed.[23]

FIGURE 1. Association of an AWV With Total Healthcare Cost, Overall and by HCC Quartiles[a]



AWV indicates Annual Wellness Visit; DID, difference in differences; HCC, hierarchical condition category; PMPM, per member per month; Q, quartile.

[a]Highest quartile of HCC risk indicates highest risk; y-axis scale is dollars.

Source: Authors' analysis of data from CMS Claim and Claim Line Feed.[23]

TABLE 3. Cost Category Predictions and Difference Associated With AWV in Dollars PMPM

	Intervention (AWV)		Controls (no AWV)		PMPM Association
Cost Category[a]	Pre-AWV	Post AWV	Pre-AWV	Post AWV	With AWV[b]
Hospital acute care	1901	1989	2103	2546	−30* (−52 to −9)
Home health	243	251	265	305	−3 (−26 to 20)
SNF	325	315	482	539	−2 (−22 to 16)
Hospital outpatient ED	171	190	175	220	−1 (−23 to 21)
Hospital outpatient non-ED	1232	1199	1082	1312	−20* (−38 to −2)
Other outpatient facility	125	191	121	140	4 (−24 to 26)
Provider/supplier	2552	3122	1955	2389	12 (−9 to 33)
Durable medical equipment	162	202	153	173	2 (−23 to 25)

AWV indicates Annual Wellness Visit; ED, emergency department; PMPM, per member per month; SNF, skilled nursing facility.

*P <.05.

[a]Provider/supplier and durable medical equipment are Part B and all other categories are Part A.

[b]PMPM differential change in cost (95% CI) for those who received an AWV versus those who did not from 11 months before until 11 months after the AWV.

Source: Authors' analysis of data from CMS Claim and Claim Line Feed.[23]

controlled hypertension, BMI screening, medication documentation, blood pressure control, influenza vaccination, diabetes therapy, or heart failure therapy. We speculate that AWVs had a lesser impact on these quality measures because they may already be prioritized in general primary care settings.

DISCUSSION

In this cohort of Medicare beneficiaries, first-time AWVs were associated with a significant improvement in use of preventive care and a reduction in total healthcare costs compared with matched controls. Rates of screening for fall risk and for clinical depression with follow-up plan, which are not typical components of a traditional evaluation and management visit but are components of an AWV and included in visit templates, were more than 70 percentage points higher among beneficiaries who received an AWV. These beneficiaries were also more likely to experience improved A1C control and to receive other key preventive services, including breast and colorectal cancer screening and tobacco use screening with cessation intervention. Changes in total healthcare costs were greatest among beneficiaries in the highest quartile of HCC and were driven by reductions in hospital acute care and hospital outpatient non-ED spending. Although there was a trend toward reduced hospital utilization, it was not as pronounced as that for hospital costs and did not achieve statistical significance. This would imply that the hospitalizations that did occur tended to have lower severity. These findings suggest that an AWV can be a helpful tool for improving care quality and containing costs within a primary care setting that prioritizes patient engagement, utilization management, and care coordination.

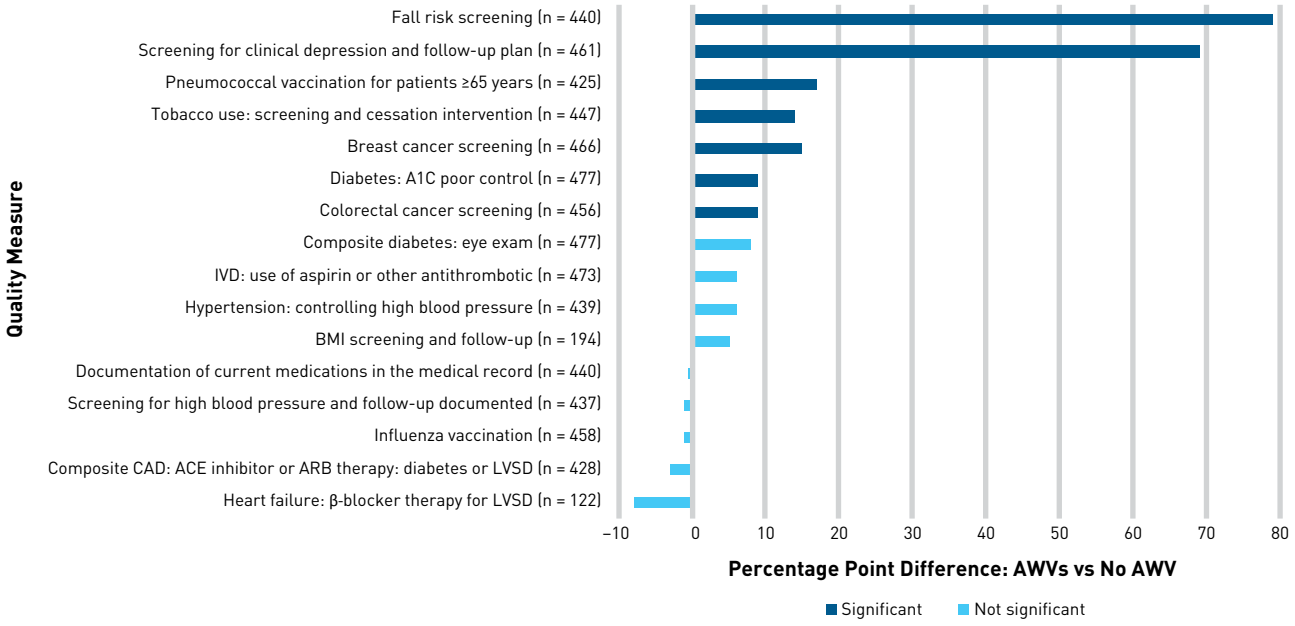
To our knowledge, this study is the first in the peer-reviewed literature to estimate the association of an AWV with measures of healthcare quality, costs, and utilization within the same study. Use of the AWV has been rising slowly since its introduction as a Medicare-reimbursable service in 2011, but there has been a paucity of evidence to guide AWV implementation into routine clinical practice in the primary care setting and to establish the potential value of this type of visit for ACOs and the Medicare program. Our findings add to a growing body of literature suggesting that the AWV can substantially improve rates of preventive services[32-36] (which may be directly related to the administration of screening tools) while providing new evidence of substantial near-term effects on total cost of care. By further delineating that the association of the AWV with healthcare costs may be most pronounced among highest-risk patients, our findings lend support to a strategy of population risk segmentation for prioritization of AWV outreach efforts to maximize savings benefits. Furthermore, although there is general consensus that strong primary care is essential to containing healthcare costs,[37-39] recent payment and delivery system innovations that intend to enhance primary care services beyond usual care have shown mixed results.[40,41] Our study results suggest that a primary care service under a system that provides the right incentives for all may contribute to cost reductions.

The mechanisms explaining the cost reductions of AWVs are not well known, but we speculate that numerous aspects of the AWV might explain its benefits. A successful AWV means that practices are not merely "checking the box." These screenings can be used to provide updates on medical history and self-reported data as an opportunity to step back from typical acute complaints and meaningfully engage in personalized conversations about risk factors, preventive needs, and a patient's long-term health goals. This attention on wellness may improve clinical quality, including the delivery of general clinical preventive services and secondary prevention among patients with chronic conditions. An optimal AWV can include medication review and regimen optimization, identification of uncoordinated use of specialty care, and discussion of social or environmental barriers to self-care that may benefit from enhanced care coordination. This up-front investment in preventive care and care coordination may avert subsequent spending. By devoting time to explore the patient's overall health status, risks, and values, the AWV may enrich the patient–provider relationship, improve patient engagement, and reinforce the core primary care tenets.

Limitations

Several factors should be considered in the interpretation of this study. First, the results should be interpreted in the context of the specific setting studied. AWVs were a key strategy of the ACOs, and rates of AWVs (54%) were substantially higher than national averages. It is possible that the results of this study would be replicable only in a

FIGURE 2. Association of AWVs With Performance on Clinical Quality Measures



A1C indicates glycated hemoglobin; ACE, angiotensin-converting enzyme; ACO, accountable care organization; ARB, angiotensin receptor blocker; AWV, Annual Wellness Visit; BMI, body mass index; CAD, coronary artery disease; IVD, ischemic vascular disease; LVSD, left ventricular systolic dysfunction.

Source: Authors' analysis of data reported for clinical quality measures as part of the ACO program.[24]

setting willing to undergo workflow optimization to accommodate a high-value visit. In addition, the cohort studied did not include beneficiaries at the end of life and those who may be less able to receive an AWV due to being homebound, institutionalized, hospitalized, or enrolled in hospice. Thus, the findings cannot be generalized to all Medicare beneficiaries. Second, as with all nonrandomized study designs, a possibility exists for selection bias and residual confounding due to unmeasured differences. However, we used propensity score matching to account for observable differences and a DID design to account for unobservable time-dependent changes in spend, as was done recently in a CMS evaluation of chronic care management.[42] A key matching variable for cases and controls was the number of baseline primary care visits, to account for the level of engagement with a PCP and the ability to come in for a visit. Furthermore, the association between receipt of AWV and healthcare cost reductions did not vary by whether or not patients received outreach, providing little evidence to suggest that the intervention effect was driven by differential outreach to patients who were predisposed to favorable cost trajectories. Finally, we were not able to ascertain whether patients had an AWV prior to 2014, although data suggest that fewer than 16% of Medicare patients were receiving them in 2013.[13]

These findings point to several priorities for payers and providers to consider. Because Medicare reimburses $175 for an AWV per member per year (PMPY), it is important to note that the true cost reduction may be smaller than the $456 PMPY effect estimate that we reported. However, given that the effect estimate is more than 2-fold the cost of the AWV itself, these data suggest that the additional expenditure on primary care can be worth the costs, particularly for a higher-risk population. It is also worth acknowledging that AWVs are one way to improve coding accuracy, and "upcoding" can be balanced by the legislatively afforded renormalization factor to account for risk inflation.[43]

Future Implications

Future research can help guide policy with respect to whether AWVs should be billable only by the patient's PCP, who may be in the best position to comprehensively assess patient risk factors and preventive care needs. Our findings show that an AWV may achieve meaningful improvements in cost and quality, lending support that policy makers should further facilitate the adoption of high-quality AWVs by PCPs. Given that underserved populations are less likely to adopt AWVs,[44,45] policies should be explored to expand access to AWVs for this important subgroup of patients.

Additional research is still needed to further understand answers to several key questions. Given the recent introduction of the AWV, it will be important to understand whether the impact of an AWV changes over a longer time horizon. Future research should also attempt to differentiate effects of specific AWV components on outcomes. Additional outcomes of interest beyond the scope of this initial study include effects on patient satisfaction, health behaviors, self-management of chronic conditions, and care continuity.

CONCLUSIONS

Among beneficiaries cared for by PCPs affiliated with 2 ACOs, the AWV was associated with delivery of greater preventive care and lower total healthcare costs, particularly for those among the highest quartile of HCC risk. The AWV may therefore be an important service for achieving the triple aim of "improving the experience of care, improving the health of populations, and reducing per capita costs of health care."[46] Future research should focus on replicating these results among other populations, given that the current study used data from 2 specific ACOs. It will be important for future studies to test the efficacy of AWVs in different geographical areas and in ACOs with different characteristics in order to provide robust evidence of AWV impact. Furthermore, identifying tactics to further facilitate adoption and optimize the effectiveness of the AWV in primary care practice will be important avenues for future research. ■

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Adam L. Beckman, BS, and Adan Z. Becerra, PhD, contributed equally to this work and are listed as co–first authors.

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Authorship Information: Concept and design (ALB, AZB, KL, EM, FM, JK); acquisition of data (JK); analysis and interpretation of data (ALB, AZB, CAD, KL, EM, FM, JK); drafting of the manuscript (ALB, AZB, AM, CAD, EM, FM); critical revision of the manuscript for important intellectual content (ALB, AZB, CAD, KL, EM, FM, JK); statistical analysis (AZB, FM, JK); administrative, technical, or logistic support (AM, KL); supervision (EM, JK); and direct work with clinics (AM).

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eAppendix

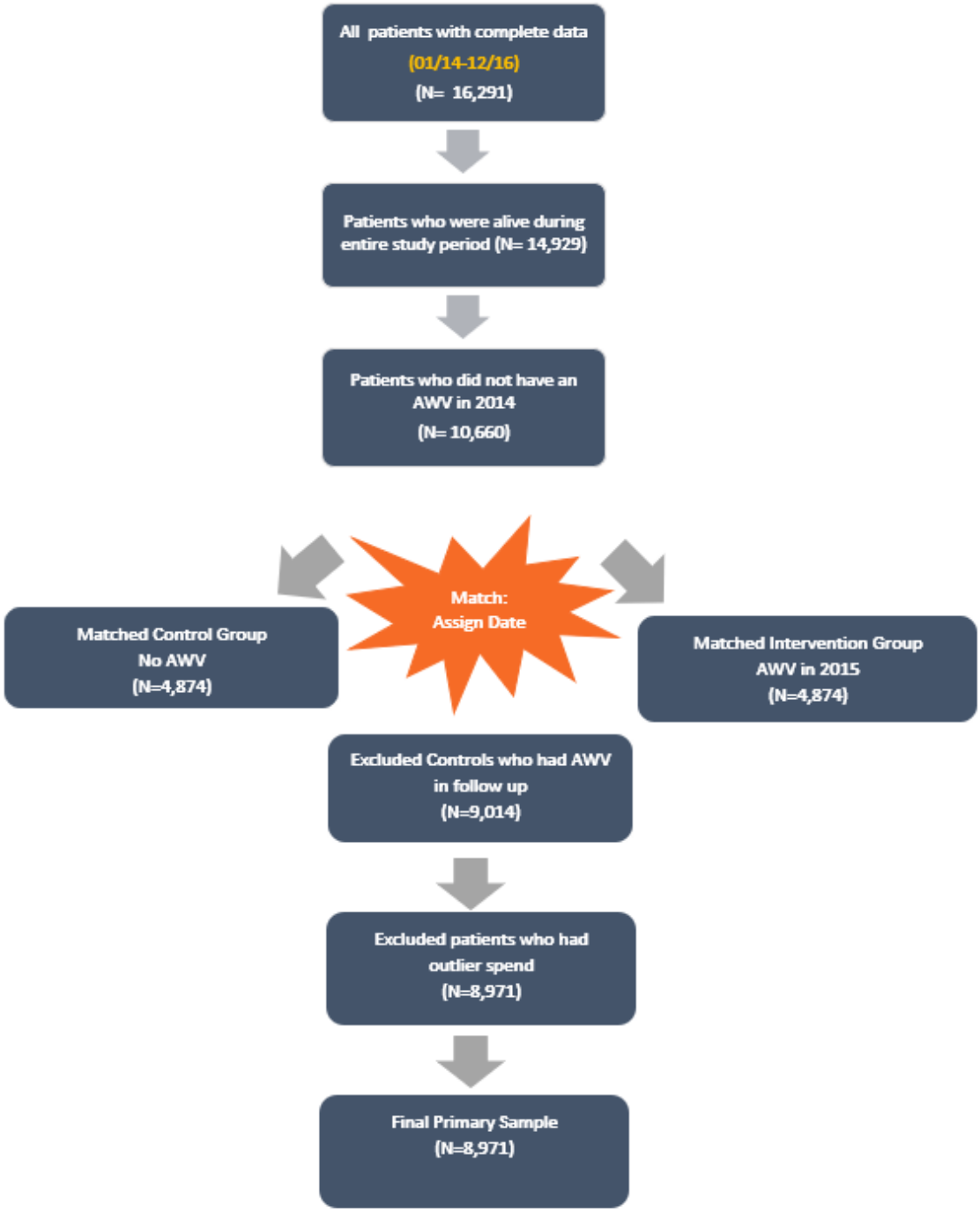
This document provides supplementary content for the manuscript entitled, "Medicare Annual Wellness Visit Association With Healthcare Quality and Costs."

Contents

Matching Algorithm to Identify Control Group

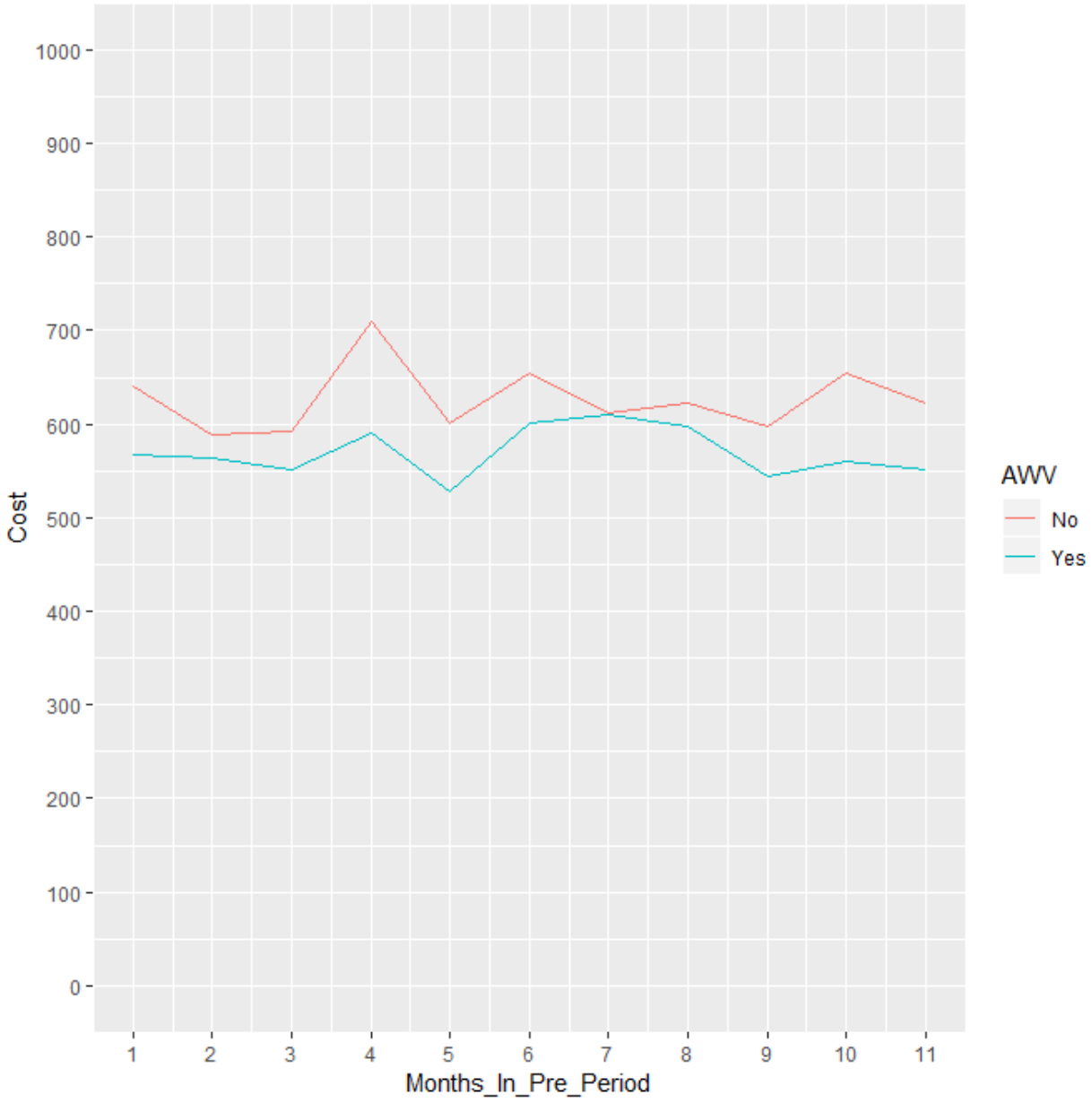
Propensity score matching was used to identify the counterfactual control group, which represents the same group of intervention beneficiaries had they not had an AWV. Candidates for the control group included beneficiaries of the ACOs who did not receive an AWV in 2015. The propensity score was estimated using a mixed-effects logistic regression model and represents each patient's probability of receiving an AWV conditional on age, sex, race, Medicare eligibility category, the number of primary care office visits in 2014, quartiles of hierarchical condition category (HCC) score based on diagnoses from 2014, and ACO. Importantly, the number of primary care office visits was included in order to account for issues of selection bias that may confound the association between AWVs and the outcomes of interest; adjusting for primary care office visits helps address the possibility that patients who receive more primary care services may be more engaged in their health care. Furthermore, the model included the unique practice identifier as a clustering variable and the caliper was set to 0.2 of the standard deviation of the logit of the propensity score as recommended by Austin 2011.[1] Matching was executed using a 1:1 nearest neighbor algorithm and controls were assigned the AWV month of the intervention beneficiary to which they matched to. This allowed us to assign the 11 calendar months before and after the AWV month as the pre and post AWV periods respectively for all beneficiaries. The calendar month that the AWV was done was excluded from the analysis (and therefore the cost of the AWV was not included in the analysis).
A total of 10,660 beneficiaries entered the matching algorithm, of which 5,292 (50%) had an index AWV in 2015. The algorithm identified 4,874 control beneficiaries who matched to 4,874 intervention beneficiaries. After we identified our matched comparison group, we conducted a series of post-matching diagnostics and found that our matching produced a comparison group that looked similar along the covariates of interest. In particular, we confirmed that the covariate distributions were not statistically different between intervention and control groups as well as visually examined the region of common support between the two groups (eAppendix Figure 3).

eAppendix Figure 1. Study Population



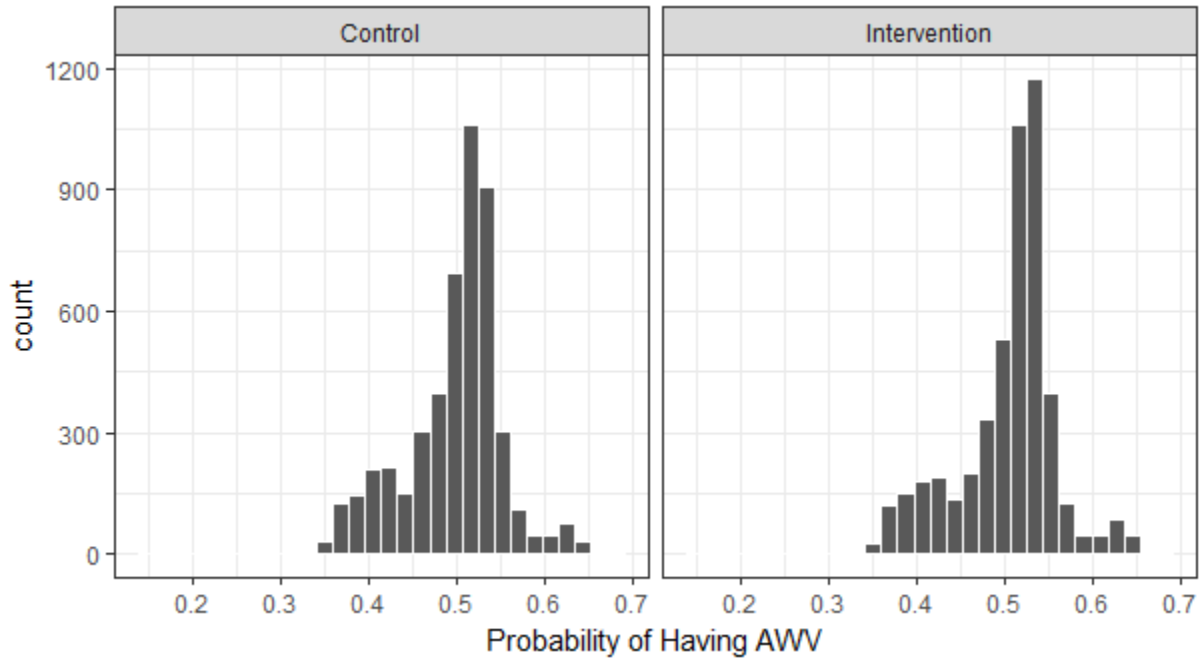
NOTES: Outliers were defined as being in the 99th percentile of the spend distribution in accordance with the Medicare Shared Savings Program.

eAppendix Figure 2. Monthly Cost Trends of Patients Who Received an AWV vs. Controls in the Pre-Period



SOURCE: Authors' analysis of data from Centers for Medicare and Medicaid Services Claim and Claim Line Feed. y-axis scale is in dollars

eAppendix Figure 3. Distribution of Propensity Scores



SOURCE: Authors' analysis of data from Centers for Medicare and Medicaid Services Claim and Claim Line Feed

Statistical Models for Main Analyses

Primary Data Source

Using our primary data source, we evaluated whether receiving an AWV was associated with health care costs and utilization using difference in differences regression models. For the cost outcomes, mixed effects negative binomial models were used to account for clustering of patient outcomes within practices. A zero-inflated version of these models was used for cost categories that had a large percentage of 0s (hospital acute care, home health, SNF, hospital outpatient ED, hospital outpatient ED, other outpatient facility, and DME) since the model fit was superior. We estimated incidence rate ratios which represent the impact of receiving an AWV on cost outcomes on a percentage scale. We also supplemented the model estimates with predicted values of cost for each patient, and used non-parametric bootstrapping in order to obtain the difference in difference estimator on the dollar scale for all of the cost outcomes. We also used mixed effects negative binomial models for counts of ED visits and hospitalizations. The only additional covariate that was included in all of these models was ACO since it was the only covariate that remained unbalanced from the matching procedure (See Exhibit 1).

Secondary Data Source

Using our secondary data source, we used a cross-sectional design to evaluate whether receiving an AWV was associated with clinical quality measures. Because each quality measure was dichotomous, we used mixed-effects logistic regression model that controlled for clustering of patients within practices. The models also adjusted for age, sex, race, eligibility criteria, the number of primary care office visits in 2014, quartiles of 2014 hierarchical condition category (HCC) score, and ACO.

Methods for Sensitivity Analyses

Our first sensitivity analysis evaluated whether the AWV association from the main analysis was systematically different among beneficiaries who were invited by phone or email to do an AWV by the PCP practice (defined as being outreached) and beneficiaries who were not invited. There could be concern that beneficiaries who were outreached by the PCP practices already had favorable cost trajectories which could be biasing the results. For this analysis, we used data about the numbers of times a PCP practice attempted to contact a patient inviting them for an AWV (defined as an outreach attempt). These data were collected through a cloud-based platform (termed the “Aledade App”), which permits the PCP practice staff to identify high

priority beneficiaries through an AWV worklist, call or email a patient inviting them to schedule an AWV, and record the outcome of the conversation (i.e. “Appointment Made,” “Patient Refused,” “Left Message,” among others). This analysis was conducted by including a triple interaction term between the intervention indicator, time period indicator, and an indicator for whether or not the beneficiary had been outreached in 2015.

Second, we sought to assess the extent to which the matching algorithm was influencing our results. Instead of using propensity score matching, we used coarsened exact matching to identify a control group.[1] Coarsened exact matching does not estimate the probability of receiving the intervention, but matches units based on whether their covariate inputs match exactly. The comparison group identified via coarsened exact matching was used to estimate the association between receiving an AWV and total health care cost. Third, we repeated the main analysis (including the matching procedure) only among beneficiaries who were continuously attributed throughout the entire study period (2014-2016). Fourth, we excluded intervention patients who matched to controls who had an AWV in the post AWV period. Finally, we compared the effect of “early” (January 2015-July 2015) AWVs and “late” AWVs (August 2015-December 2015) to explore the impact of seasonality.

Results of Sensitivity Analyses

The first sensitivity analysis included the final analytic sample of 8,917 and evaluated whether the AWV effect was different in beneficiaries with and without outreach attempts in 2015. Among the 2,407 beneficiaries who had at least one outreach attempt during 2015, 1,805 (75%) had an AWV and 602 did not have an AWV (25%). Among the 7,112 beneficiaries who had no outreach attempts during 2015, 3,271 (46%) had an AWV and 3,841 did not have an AWV (54%). The differential change in cost between the intervention and control group for beneficiaries who were outreached was -$455 whereas it was -$383 for those who were not outreached. In order to test whether these AWV associations were different from each other, we analyzed the three way interaction term which suggested that the AWV association was not statistically significantly different between those who were and were not outreached (p for interaction = 0.33). This finding provides evidence to suggest that the results reported in the main analysis were not being driven by beneficiaries who were identified by PCP practices to have favorable cost trajectories. There would have been more evident concerns of selection bias had the intervention effect been concentrated only among beneficiaries who had been invited to come in for an AWV by the PCP practices.

In the second sensitivity analysis, a different comparison group was identified using coarsened exact matching and the final sample included a total of 8,655 beneficiaries. An index AWV was associated with a differential reduction in total health care cost of $301 (95% CI= -$548, -$54) among this sample of beneficiaries. Furthermore, in the third sensitivity analysis that restricted the analysis only to those beneficiaries who were continuously attributed, a total of 6,543 beneficiaries met inclusion criteria. An index AWV was associated with a differential reduction in total health care cost of $654 (95% CI= -$1279, -$29). In the fourth sensitivity analysis we excluded intervention patients who matched to a control that had an AWV in the post AWV period, and confirmed that the results were consistent with the primary analysis. Finally, there was no statistically significant evidence that the association between AWVs and cost was different between in early versus late months (p for interaction = 0.54).

eAppendix Table. Characteristics of patients who received an AWV and controls before matching process

Variable	**Total Population** N=10660 (100%)	**AWV** N = 5292 (50%)	**No AWV** N = 5368 (50%)
Age	73.1 ± 11.1	73.7 ± 13.0	72.3 ± 11.9
Gender			
Male	4610 (43%)	2304 (44%)	2306 (43%)
Female	6049 (57%)	2988 (56%)	3061 (57%)
Race			
White	9355 (88%)	4590 (87%)	4765 (89%)
African-American	1071 (10%)	596 (11%)	475 (9%)
Other	234 (2%)	106 (2%)	128 (2%)
HCC Quartile			
Q1	1624 (15%)	791 (15%)	833 (16%)
Q2	2519 (24%)	1308 (25%)	1211 (23%)
Q3	3146 (30%)	1632 (31%)	1514 (28%)
Q4	3371(32%)	1561 (29%)	1810 (34%)
Bene Eligibility Criteria			
ESRD	37 (0.4%)	7 (0.2%)	30 (0.1%)
Disabled	2174 (20%)	913 (17%)	1261 (23%)
Aged/Dual	503 (5%)	226 (4%)	277 (5%)
Aged/Non-Dual	7946 (75%)	4146 (79%)	3800 (71%)
ACO			
Delaware	6010 (64%)	3559 (67%)	2451 (46%)
Primary Care	4650 (44%)	1733 (33%)	2917 (54%)

SOURCE: Authors' analysis of data from Centers for Medicare and Medicaid Services (CMS) Claim and Claim Line Feed (CCLF). ABBREVIATIONS: AWV, Annual Wellness Visit; ESRD, end-stage renal disease; HCC, hierarchical condition category

eAppendix References

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