Outcomes after carotid endarterectomy among elderly dual Medicare-Medicaid–eligible patients

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Abstract

Objective

To determine whether patients who are dual eligible for Medicare and Medicaid benefits have outcomes after carotid endarterectomy (CEA) that are comparable to the outcomes of those eligible for Medicare alone.

Methods

The study cohort included fee-for-service Medicare beneficiaries ≥ 65 years of age who underwent CEA (ICD-9-CM code 38.12) between 2003 and 2010. Beneficiaries with ≥ 1 month of Medicaid coverage were considered dual eligible. We fit mixed models to assess the relationship between coverage (dual eligible vs Medicare only) and outcomes over time after adjustment for demographic and clinical characteristics.

Results

There were 53,773 dual-eligible and 452,182 Medicare-only beneficiaries hospitalized for CEA. The percentage of dual-eligible patients receiving CEA increased from 10.1% in 2003 to 11.5% in 2010, with no change in geographic distribution across the country. In adjusted analyses, dual-eligible vs Medicare-only beneficiaries had a higher rate of 30-day ischemic stroke or death; higher in-hospital, 30-day, and 1-year all-cause mortality; and higher 30-day all-cause readmission. Relative annual reductions in outcomes from 2003 to 2010 ranged from 2% to 5%, but there was no significant interaction between dual-eligible status and time.

Conclusions

Dual-eligible beneficiaries had worse outcomes than those eligible for Medicare alone. Additional work is necessary to understand the reasons for this difference.

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Glossary

CEA = carotid endarterectomy; CMS = Centers for Medicare & Medicaid Services; ICD-9-CM = *International Classification of Diseases, 9th Revision, Clinical Modification*.

Medicaid serves as a fiscal safety net for low-income Americans and those with specific conditions or disabilities. In 2015, >6.7 million US adults ≥ 65 years of age relied on both Medicaid and Medicare coverage (called dual-eligible beneficiaries) to obtain critical medical services.¹ Dual-eligible beneficiaries have lower socioeconomic status and a higher prevalence and total number of chronic conditions compared with those eligible for Medicare alone.^{2,3} They also account for a disproportionate amount of Medicare spending.³ Although lower socioeconomic status is associated with higher rates of vascular risk factors, stroke incidence and mortality, and poor outcomes after certain vascular procedures,^{4,5} information on the outcomes of dual-eligible patients after carotid endarterectomy (CEA) remains limited. We compared 30-day and 1-year post-CEA outcomes for dual Medicare-Medicaid-eligible and Medicare-only beneficiaries. Because CEA outcomes have improved over time,⁶ we also assessed outcome trends by coverage status from 2003 to 2010.

Methods

Study population

The study included all fee-for-service Medicare beneficiaries ≥ 65 years of age who underwent CEA (ICD-9-CM code 38.12) at US acute care hospitals between January 1, 2003, and December 31, 2010. For patients who underwent multiple CEAs during the study, only the first procedure was included. We excluded patients with concomitant major interventions (e.g., coronary artery bypass grafting) during the index admission and those who underwent both CEA and carotid stenting.⁶ Patients enrolled in both Medicaid and Medicare for ≥ 1 month during follow-up were considered dual eligible.

Standard protocol approvals, registrations, and patient consents

Data were obtained from the Medicare Inpatient and Denominator files under a data use agreement with the Centers for Medicare & Medicaid Services (CMS). Institutional review board approval was obtained through Rutgers University and Yale University.

Outcomes

Outcomes included in-hospital, 30-day, and 1-year all-cause mortality; the composite of 30-day ischemic stroke or death; and 30-day all-cause readmission. Death was determined from the index CEA hospital admission date, and readmission and ischemic stroke (ICD-9-CM principal discharge diagnosis code 433.xx, 434.xx, or 436.xx) were calculated from the

discharge date. We also assessed discharge disposition, length of stay, and Medicare payment for the index hospitalization (adjusted for inflation with the Consumer Price Index⁷ with 2010 as the reference year).

Patient characteristics

Demographic information included age, sex, and race-ethnicity. Clinical variables and comorbid conditions (table 1) were identified from the index admission secondary diagnoses and the diagnosis and procedure codes from the 12-month pre-index Inpatient claims with the use of the Hierarchical Condition Categories.⁸ We used a proxy for symptomatic status using administrative codes.⁶

Statistical analysis

We fit spatial mixed models with a logit link function, Poisson distribution, and county-specific random intercepts to model dual-eligible status as a function of age, sex, and race-ethnicity and accounting for geographic differences between counties. Models included the county-specific number of Medicare beneficiaries as an offset and used a spherical covariate structure to account for spatial autocorrelation. We used these models to calculate the risk-standardized percentage of beneficiaries with dual eligibility for each county in the first and last study years. We obtained smoothed risk-standardized percentages of dual-eligible beneficiaries to account for county-neighboring group effects. We grouped counties into 25 quantiles based on their adjusted dual-eligible percentage and mapped them with a gradient from green to red (lowest to highest percentage). We used a *t* test to assess change in the age-sex-race-standardized percentage of dual-eligible beneficiaries over time.

We fit longitudinal mixed models with a logit link function and hospital-specific random intercepts to model in-hospital, 30-day, and 1-year mortality as a function of dual-eligible status, an interval time variable (years 2003 [time = 0] through 2010 [time = 7]; represents the annual change in outcome), and the interaction between dual-eligible status and time. We constructed Cox proportional hazards models to assess the 30-day ischemic stroke or death composite outcome and 30-day all-cause readmissions; the all-cause readmissions model accounted for death as a censoring event. All models were adjusted for patient demographics (age, sex, and race-ethnicity) and all medical history/comorbidity variables listed in table 1. Analyses were conducted with SAS version 9.4 (SAS Institute Inc, Cary, NC), and statistical tests were 2 sided with $\alpha = 0.05$. For efficient data presentation, we report data for the first and last study years.

Table 1 Patient characteristics and outcomes by dual-eligible status in 2003 and 2010

	2003		2010	
	Dual eligible (n = 8,210)	Medicare only (n = 73,393)	Dual eligible (n = 5,457)	Medicare only (n = 42,138)
Demographic characteristics				
Age, mean (SD), y	74.3 (6.3)	75.4 (6.2)	74.0 (6.5)	75.5 (6.6)
Women, %	62.7	41.0	57.4	40.2
White race, %	79.6	96.2	78.3	95.4
Black race, %	10.5	2.3	10.6	2.8
Other race-ethnicity, %	10.0	1.5	11.1	1.7
Medical history/comorbid conditions, %				
Symptomatic carotid stenosis	14.0	11.6	16.0	12.7
Congestive heart failure	12.4	7.1	11.5	6.4
Prior myocardial infarction	3.4	2.4	3.3	2.2
Unstable angina	5.1	3.4	2.7	1.9
Chronic atherosclerosis	50.9	47.4	49.8	46.7
Hypertension	76.7	73.4	81.6	81.0
Diabetes mellitus	39.2	29.1	42.9	32.9
Peripheral vascular disease	11.5	8.0	10.1	7.0
Prior stroke	8.4	5.8	10.3	7.4
Cerebrovascular disease	21.8	15.9	19.9	15.0
Renal failure	4.9	2.7	12.2	7.4
COPD	29.1	19.5	30.5	19.2
Asthma	2.6	1.9	3.0	2.6
Pneumonia	6.0	3.4	6.7	4.1
Cardiopulmonary respiratory failure	2.0	1.3	3.9	2.5
Dementia	4.8	2.4	6.4	3.5
Parkinson or Huntington disease	1.3	0.8	1.4	0.8
Trauma	4.5	3.1	6.3	4.0
Anemia	16.7	11.0	20.4	14.5
Functional disability	6.6	3.8	7.8	4.5
Protein-calorie malnutrition	1.3	0.6	2.9	1.3
Depression	6.1	3.4	7.5	5.2
Other psychiatric disorder	2.1	0.8	2.9	1.0
Hospital stay, mean (SD)				
Length of stay, d	4.5 (5.8)	3.2 (4.6)	3.9 (4.9)	2.8 (3.9)
Medicare payment, \$ ^a	10,250 (11,086)	8,867 (9,155)	10,291 (11,521)	8,135 (9,127)
Discharge disposition, % (95% CI)				
In-hospital death	0.9 (0.73–1.16)	0.6 (0.57–0.68)	0.6 (0.40–0.83)	0.4 (0.33–0.45)
Home	78.0 (77.1–78.9)	87.3 (87.1–87.6)	72.5 (71.3–73.7)	84.5 (84.2–84.9)

Continued

Table 1 Patient characteristics and outcomes by dual-eligible status in 2003 and 2010 (continued)

	2003		2010	
	Dual eligible (n = 8,210)	Medicare only (n = 73,393)	Dual eligible (n = 5,457)	Medicare only (n = 42,138)
Home care	8.6 (8.01–9.24)	5.8 (5.63–5.96)	12.4 (11.5–13.3)	8.2 (7.90–8.42)
SNF/ICF	8.1 (7.47–8.66)	3.2 (3.06–3.32)	9.9 (9.08–10.7)	3.8 (3.64–4.01)
Transferred	0.4 (0.30–0.59)	0.3 (0.28–0.36)	0.2 (0.10–0.36)	0.2 (0.18–0.28)
Observed outcomes, % (95% CI)				
30-d ischemic stroke or death	3.8 (3.41–4.23)	3.2 (3.09–3.35)	3.2 (2.73–3.67)	2.6 (2.47–2.77)
30-d all-cause readmission	14.9 (14.1–15.6)	10.8 (10.6–11.0)	13.1 (12.1–14.0)	10.0 (9.68–10.3)
30-d all-cause mortality	1.6 (1.32–1.88)	1.1 (1.06–1.21)	1.6 (1.25–1.92)	0.9 (0.85–1.04)
1-y all-cause mortality	9.7 (9.03–10.3)	6.7 (6.48–6.85)	9.0 (8.25–9.79)	5.8 (5.62–6.07)

Abbreviations: CI = confidence interval; COPD = chronic obstructive pulmonary disease; ICF = intermediate care facility; SNF = skilled nursing facility.

^a Adjusted for inflation with the annual Consumer Price Index with 2010 as the reference.

Data availability

The data are owned by CMS, and the authors are not authorized to make these data publicly available. Data may be obtained directly through CMS.

Results

There were 53,773 dual-eligible and 452,182 Medicare-only beneficiaries hospitalized for CEA between 2003 and 2010.

Although the percentage of dual-eligible beneficiaries increased from 10.1% in 2003 to 11.5% in 2010, the risk-standardized distribution of dual-eligible beneficiaries by county remained stable over time ($p = 0.455$ for difference over time; figure 1). Dual-eligible patients were more likely to be women, of nonwhite race, and living with comorbid conditions (e.g., heart failure, renal failure, diabetes mellitus) and symptomatic carotid disease compared with Medicare-only patients (table 1). For each study year, dual-eligible vs Medicare-only patients had a longer mean length of

Figure 1 County-level risk-standardized percentage of dual eligible among Medicare beneficiaries in 2003 and 2010

Spatial mixed models with county-specific random intercepts and adjustment for age, sex, and race-ethnicity were fit to calculate and map the smoothed risk-standardized percentage of beneficiaries who were dual eligible for each county in 2003 and 2010. The risk-standardized percentage of dual-eligible individuals in US counties ranged from 1.3% to 61.8%. The counties were grouped into 25 equal quantiles based on the data and shaded according to a gradient from green (lowest percentage of dual eligible) to red (highest percentage of dual eligible). Areas shaded white indicate insufficient data that precluded calculations (not calculable).

hospitalization and a higher inflation-adjusted mean Medicare payment. Dual-eligible patients were also more frequently discharged to home care and skilled nursing/intermediate care facilities, and they had higher observed mortality and readmission rates. Both dual-eligible and Medicare-only patients with symptomatic carotid stenosis had worse outcomes than their asymptomatic counterparts; 1-year mortality was higher for dual-eligible patients regardless of symptomatic status (table e-1, links.lww.com/WNL/A709).

In adjusted analyses, dual-eligible status was associated with a higher rate of 30-day ischemic stroke or death; higher in-hospital, 30-day, and 1-year all-cause mortality; and higher 30-day all-cause readmission (figure 2). Outcomes improved over time, with adjusted relative annual reductions ranging from 2% to 5%, but there was no interaction between dual-eligible status and time.

Discussion

In this national study, dual Medicare-Medicaid-eligible beneficiaries had poorer 30-day and 1-year outcomes after CEA than Medicare-only beneficiaries after adjustment for

demographic and clinical characteristics. These disparities persisted between 2003 and 2010 despite an overall improvement in outcomes after CEA.

Few national studies have assessed acute events or procedural outcomes by dual-eligible status. A study of patients hospitalized for myocardial infarction found that dual-eligible beneficiaries had better medication adherence than Medicare-only beneficiaries but were less likely to receive invasive therapies and had worse outcomes.⁹ Similarly, we found that among patients hospitalized for CEA, those with dual Medicare-Medicaid coverage had worse outcomes than those with Medicare alone.

Studying patterns of care by dual-eligible status affords the opportunity to incorporate a patient-level indicator of low income. This is important and timely because dual eligibility has been proposed by CMS as a means of accounting for patient-level socioeconomic status in risk-adjusted models used to determine hospital penalties for adverse outcomes.¹⁰ Our findings are consistent with those of prior studies documenting the association between low socioeconomic status and poor vascular health.^{4,5} However, dual eligibility is more than an indicator of low income; the designation identifies

Figure 2 Adjusted association between dual-eligible status and outcomes

Longitudinal mixed models with a logit link function and hospital-specific random intercepts were used to model in-hospital, 30-day, and 1-year mortality as a function of dual-eligible status, an interval time variable representing annual change in outcome, and the interaction between dual-eligible status and time. Cox proportional hazards models were used to model the 30-day ischemic stroke or death composite outcome and 30-day all-cause readmission. All models were adjusted for patient demographics (age, sex, and race) and clinical characteristics (symptomatic carotid stenosis, congestive heart failure, prior myocardial infarction, unstable angina, chronic atherosclerosis, hypertension, diabetes mellitus, peripheral vascular disease, prior stroke, cerebrovascular disease, renal failure, chronic obstructive pulmonary disease, asthma, pneumonia, cardiopulmonary respiratory failure, dementia, Parkinson or Huntington disease, trauma, anemia, functional disability, protein-calorie malnutrition, depression, and other psychiatric disorder). ^aOdds ratios were calculated for in-hospital, 30-day, and 1-year mortality. ^bHazard ratios were calculated for 30-day ischemic stroke or death and 30-day all-cause readmission.

beneficiaries with additional health care coverage through Medicaid. The persistently poor outcomes for these beneficiaries despite the financial assistance provided for their care highlight the need for further research in this vulnerable population.

Limitations of our study include possible variation in administrative coding practices across hospitals and the lack of detailed clinical information in administrative data to completely adjust for patient medical complexity. In addition, other patient-level sociodemographic variables such as education are unavailable in Medicare data. Analyses were limited to fee-for-service Medicare beneficiaries ≥ 65 years of age, and results may not generalize to non-fee-for-service or younger populations. Medicaid eligibility and services vary by state, and we were unable to characterize the specific support provided to each patient or whether all patients who qualified for Medicaid were enrolled.

Our results indicate a need to better understand factors contributing to poorer outcomes for dual-eligible patients. Challenges may include the split accountability between the Medicare and Medicaid programs and differences in sociodemographic and clinical characteristics of these patients.

Authors Contributions

Erica C. Leifheit: conceptualized and designed the study; interpreted the data; drafted and revised the manuscript for intellectual content. Yun Wang: conceptualized and designed the study; analyzed and interpreted the data; revised the manuscript for intellectual content. George Howard, Virginia J. Howard, and Larry B. Goldstein: interpreted the data; revised the manuscript for intellectual content. Thomas G. Brott: interpreted the data; revised the manuscript for intellectual content; obtained funding. Judith H. Lichtman: conceptualized and designed the study; interpreted the data; drafted and revised the manuscript for intellectual content.

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Disclosure

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