

Healthcare Resource Utilization and Costs of Secondary Strokes in Medicare Fee-For-Service Beneficiaries in the United States

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Aim

To assess healthcare resource utilization (HCRU) and costs associated with secondary ischemic strokes among Medicare beneficiaries with primary non-cardioembolic ischemic stroke (NCIS) or transient ischemic attack (TIA).

Introduction

- Over 795,000 individuals have a stroke every year in the United States (US). Of these, roughly 77% are incident strokes and about 23% are secondary strokes.¹
- Ischemic strokes account for approximately 87% of all stroke cases. More than 70% of ischemic strokes are NCIS.²⁻³
- After the initial occurrence of a NCIS or a TIA, a brief stroke-like episode caused by temporary interruption of blood flow to the brain, patients often experience secondary strokes.¹
- Strokes impose substantial economic burden with healthcare costs of \$45,000 among Medicare beneficiaries and \$61,000 among commercially-insured patients in the first year following an acute ischemic stroke.⁴
- Secondary strokes are more likely to be fatal, disabling, and more costly than initial events.⁵
- However, contemporary evidence differentiating economic burden of secondary strokes from primary events is limited.

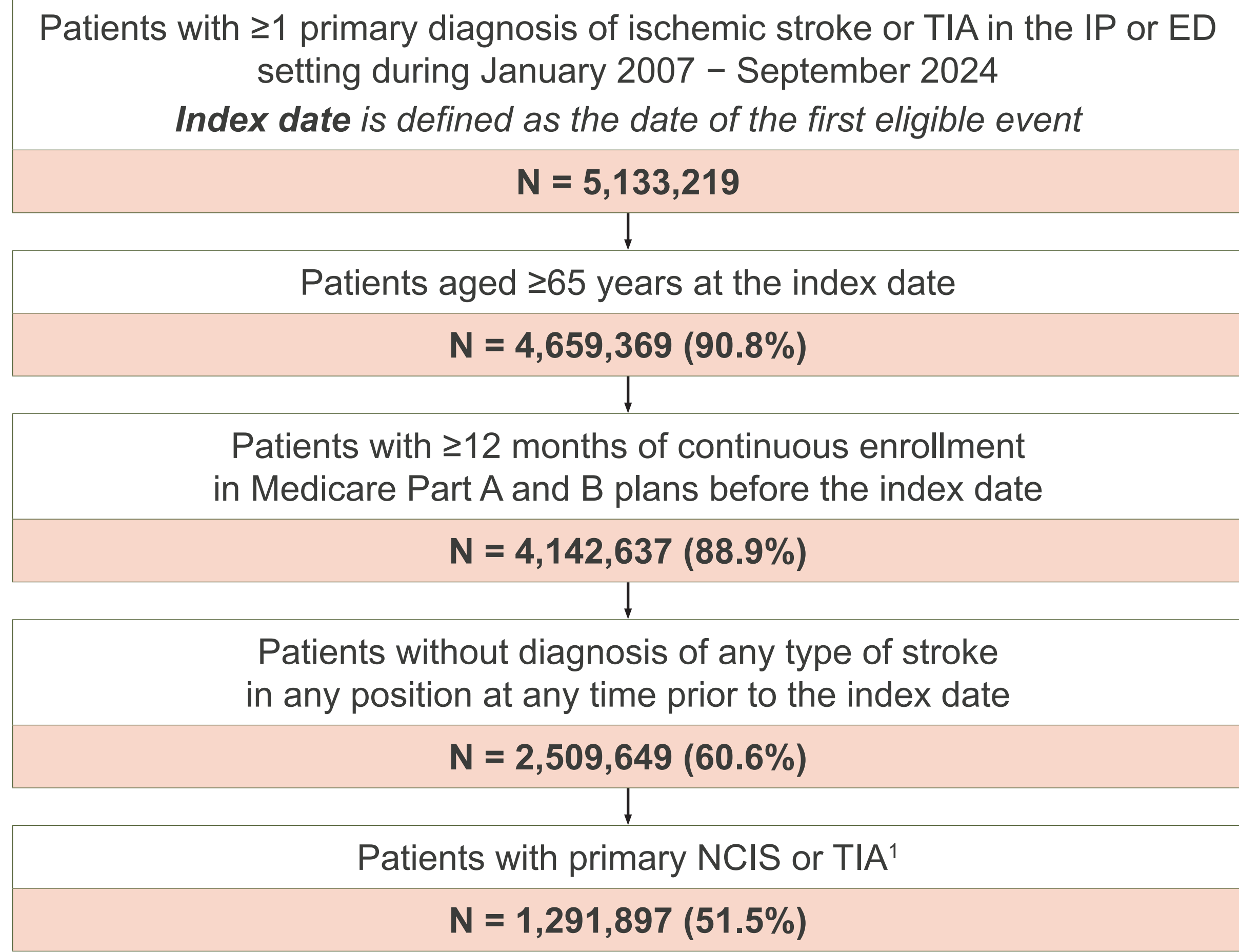
Methods

- This US-based, retrospective study used Medicare fee-for-service (FFS) data for the period January 2007 through September 2024, and included adults ≥65 years of age with a primary diagnosis of ischemic stroke or TIA during an inpatient stay or emergency room visit, and without prior history of stroke (full selection criteria shown in **Figure 1**).
 - To identify patients with NCIS, patients with history of atrial fibrillation, atrial flutter, left ventricular thrombus, mechanical valve replacement, left atrial appendage occlusion, and rheumatic heart disease prior to the index date or up to 30 days after the index date were excluded.
- The index date was defined as the date of the first observed NCIS or TIA event.
- Baseline characteristics were assessed during the 12 months prior to the index date.
- Patients were followed from the primary NCIS or TIA event until disenrollment, death, or the end of data availability.
- Costs of the primary NCIS or TIA and each secondary ischemic stroke were assessed during the events and for the period during and up to 1 year after each stroke or TIA event.
- If a subsequent ischemic stroke event or the end of the follow-up period (i.e., end of Part A and B enrollment, end of data availability, or death) occurred before the end of one year, the assessment period was capped at the earlier of these two events.
- Costs were inflated to 2024 United States dollars (USD).

Results

- A total of 1,291,897 patients with NCIS or TIA were included (**Figure 1**).
- Patients with NCIS or TIA had a mean age of 77.8 years and 56.3% were female. Among these patients, 62.0% had NCIS and 38.0% had TIA at index (**Table 1**).
- The mean (standard deviation [SD]) cost for the primary NCIS or TIA was \$9,366 (\$13,578) and \$13,318 (\$16,348) for the second stroke, \$13,695 (\$16,460) for the third, \$13,609 (\$14,947) for the fourth, and \$14,180 (\$16,740) for the fifth (**Figure 2**).
- The mean (SD) all-cause medical costs (per patient per month [PPPM]) during and up to 1 year after the stroke event increased with each recurrence: primary NCIS or TIA: \$6,044 (\$10,360); second stroke: \$9,937 (\$12,859); third: \$11,140 (\$13,064); fourth: \$12,001 (\$13,624); fifth: \$12,754 (\$13,976) (**Figure 3**).
- Post-acute care utilization also increased with each secondary stroke. For example, utilization of skilled nursing facility (SNF) increased from 22.6% after primary NCIS or TIA to 36.2% after second stroke, 40.8% after third, 42.2% after fourth, and 44.7% after fifth (**Figure 4**).

Figure 1. Selection of patients with primary NCIS or TIA



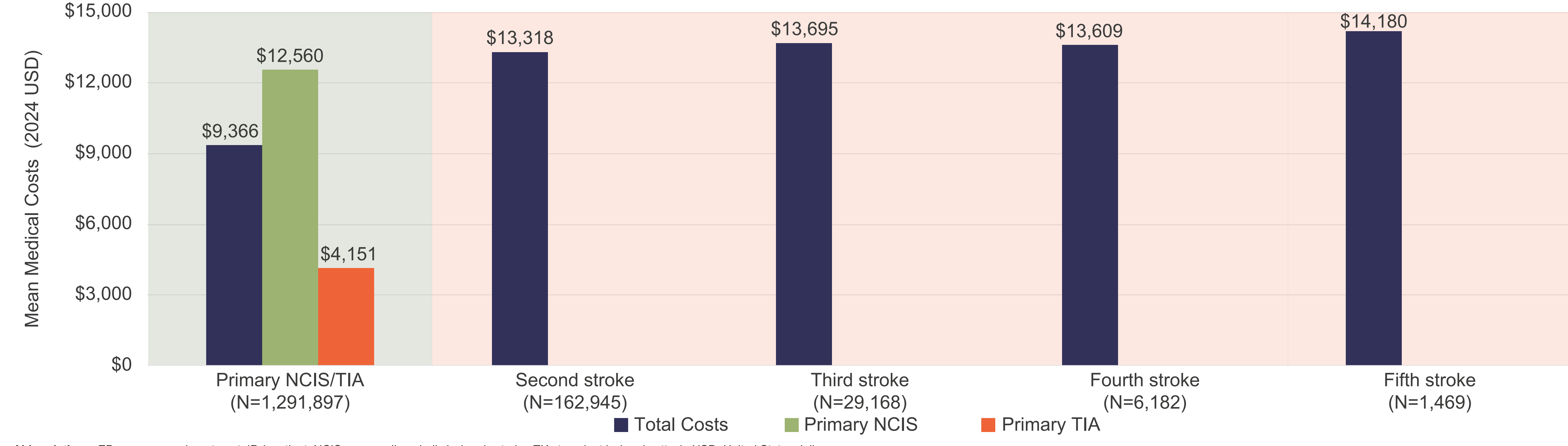
Abbreviations: ED, emergency department; IP, inpatient; NCIS, non-cardioembolic ischemic stroke; TIA, transient ischemic attack.
Note:
¹ To exclude patients with cardioembolic ischemic strokes, patients with history of atrial fibrillation, atrial flutter, left ventricular thrombus, mechanical valve replacement, left atrial appendage occlusion, and rheumatic heart disease prior to the index date or up to 30 days after the index date were excluded. Further, patients with oral anticoagulant use during the 90 days prior to the index date were excluded (except for those who had deep vein thrombosis/pulmonary embolism or hip/knee surgery).

Table 1. Patient characteristics

Characteristics	Overall N = 1,291,897
Age as of index (years), mean ± SD [median]	77.8 ± 8.0 [76.8]
Female, n (%)	727,671 (56.3)
Race/ethnicity, n (%)	
White	1,052,963 (81.5)
Black	126,635 (9.8)
Hispanic	63,062 (4.9)
Asian	25,616 (2.0)
Other/unknown	23,621 (1.8)
Geographic region, n (%)	
South	526,740 (40.8)
Midwest	322,503 (25.0)
West	230,264 (17.8)
Northeast	207,922 (16.1)
Other/unknown	4,468 (0.3)
Year of index date, n (%)	
2007-2010	411,149 (31.8)
2011-2014	292,502 (22.6)
2015-2018	265,888 (20.6)
2019-2022	233,574 (18.1)
2023-2024	88,784 (6.9)
NCIS at index date, n (%)	801,176 (62.0)
TIA at index date, n (%)	490,721 (38.0)
NIHSS at index, n (%)	178,337 (13.8)
Minor (score of 0–7)	141,198 (79.2)
Moderate (score of 8–13)	18,246 (10.2)
Moderate-to-severe (score of 14–21)	11,783 (6.6)
Severe (score of 22–42)	7,110 (4.0)
Comorbidities, n (%)	
Hypertension	929,655 (72.0)
Hyperlipidemia	764,224 (59.2)
Diabetes	416,522 (32.2)
Atherosclerosis	356,291 (27.6)
Peripheral vascular disease	228,087 (17.7)
Coronary artery disease	95,358 (7.4)
Myocardial infarction	61,441 (4.8)

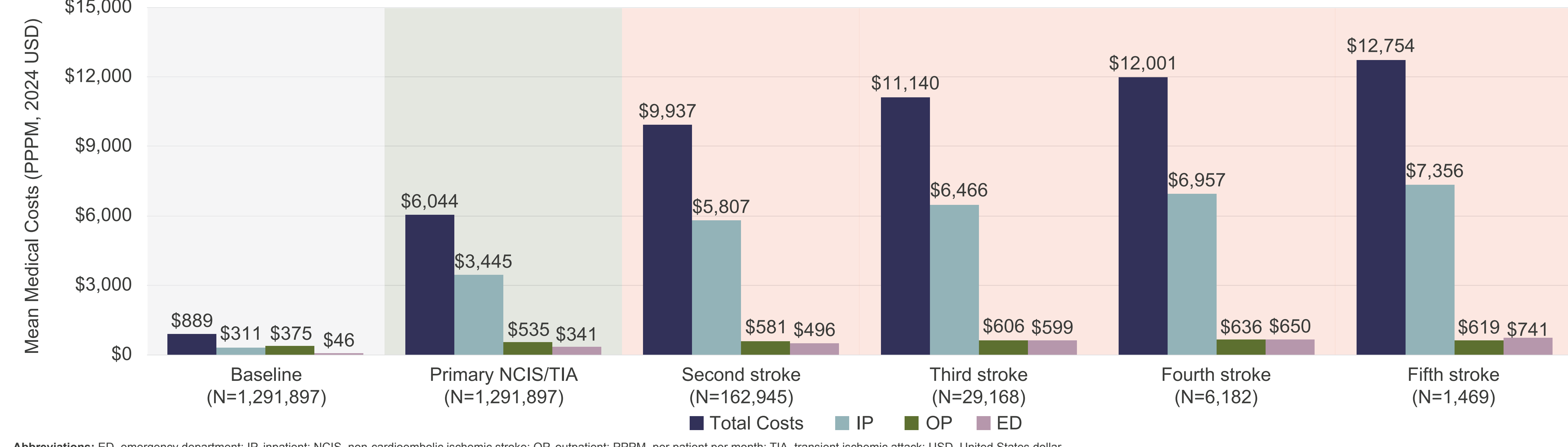
Abbreviations: NIHSS, National Institutes of Health Stroke Scale; NCIS, non-cardioembolic ischemic stroke; SD, standard deviation; TIA, transient ischemic attack.

Figure 2. Mean IP and/or ED medical costs for ischemic stroke or TIA events



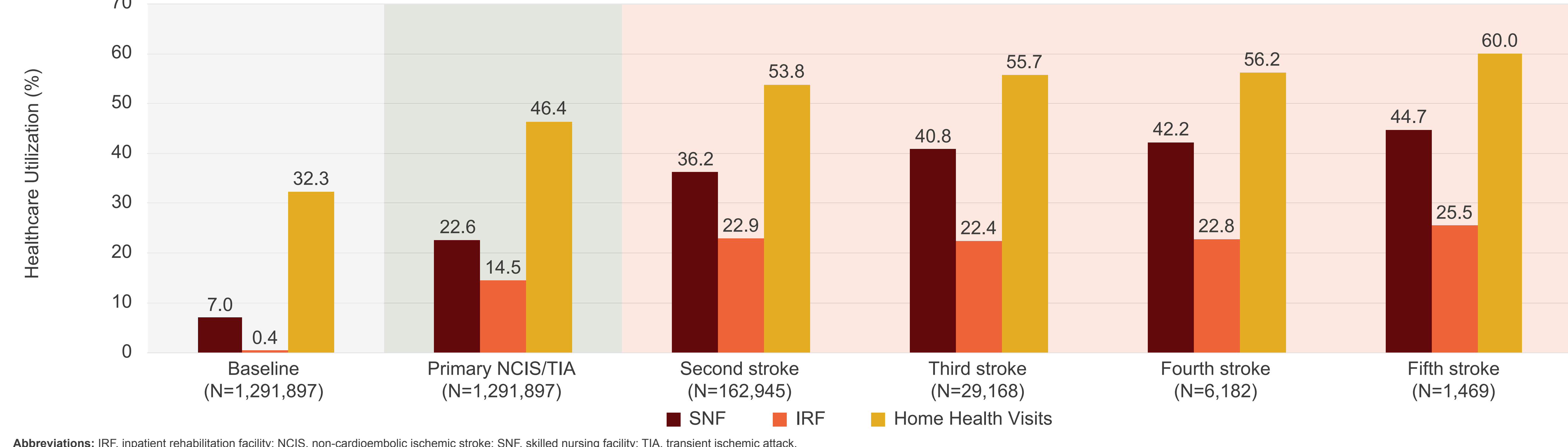
Abbreviations: ED, emergency department; IP, inpatient; NCIS, non-cardioembolic ischemic stroke; TIA, transient ischemic attack; USD, United States dollar.
Note:
¹ Medicare payer costs of the IP and/or ED visit for the ischemic stroke (or TIA, if the index event) were reported.
² TIA was only considered for the primary event. All secondary events (second through fifth) represent ischemic strokes only; therefore, costs are not stratified by NCIS vs TIA for secondary strokes.

Figure 3. Mean all-cause medical costs (PPPM) during baseline, and during and up to 1 year after the ischemic stroke or TIA event



Abbreviations: ED, emergency department; IP, inpatient; NCIS, non-cardioembolic ischemic stroke; OP, outpatient; PPPM, per patient per month; TIA, transient ischemic attack; USD, United States dollar.
Note:
¹ PPPM estimates were calculated by dividing each patient's total costs by their assessment time. For patients with less than 1 month of assessment time, the assessment period was imputed to 1 month.
² TIA was only considered for the primary event. All secondary events (second through fifth) represent ischemic strokes only.

Figure 4. Post-acute care utilization during baseline, and during and up to 1 year after the ischemic stroke or TIA event



Abbreviations: IRF, inpatient rehabilitation facility; NCIS, non-cardioembolic ischemic stroke; SNF, skilled nursing facility; TIA, transient ischemic attack.
Note:
¹ TIA was only considered for the primary event. All secondary events (second through fifth) represent ischemic strokes only.

Limitations

- Results may not be generalizable to other patient populations, including patients covered by commercial or Medicaid insurance, and patients who are uninsured.
 - Nevertheless, understanding the burden of secondary stroke among our study population is important given that approximately three-quarters of all strokes occur in individuals aged 65 or older and Medicare FFS beneficiaries represent around 45% of this demographic.
- Strokes that occurred before patients enrolled in the Medicare FFS plan were not captured in our data, which may result in misclassification of some secondary strokes as primary events.
- Medicare FFS plan does not cover SNF care beyond 100 days, nor do they include long-term care such as nursing homes and assisted living facilities. As a result, the costs associated with SNF may be underestimated, while the costs associated with long-term care are not captured.

Conclusion

Secondary ischemic strokes impose substantial economic burden. The progressive increases in monthly costs and post-acute care utilization following each secondary event underscore the need for effective secondary stroke prevention strategies.

References

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