

# Economic and Health Care Resource Utilization Burden of Acute Myocardial Infarction With or Without Systemic Inflammation in US Hospitals: A Real-World Study

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### Plain Language Summary

- Why does it matter?** Acute myocardial infarction (AMI), or heart attack, is common in the United States and requires urgent medical attention, creating a burden on both people with AMI and the health care system. Inflammation throughout the whole body, also known as systemic inflammation, can increase the risk of AMI, subsequent AMI, and AMI-related death, as well as associated health-related factors
- What did we do?** This study investigated the medical resources and costs of the initial hospitalization and any readmissions of patients who experienced AMI. These outcomes were also compared among patients with or without evidence of systemic inflammation
- What did we find?** The cost of care and the use of medical resources were high for all patients with AMI. Use of medical resources was especially high for those with evidence of systemic inflammation

### Introduction

- Annually in the US, approximately 605,000 people experience an acute myocardial infarction (AMI), which is a leading cause of death in adults<sup>1,2</sup>
- The risk of experiencing cardiovascular diseases, including AMI, is increased by the development of systemic inflammation<sup>3,4</sup>
- The cost of treatment and health care resource utilization (HCRU) of patients with AMI with evidence of systemic inflammation are unknown
- This study evaluated the cost and HCRU of patients hospitalized for AMI and further investigated these endpoints among patients with or without evidence of systemic inflammation before hospitalization

### Methods

- Data from the Premier Healthcare Database were retrospectively evaluated, including data from patients with the following characteristics:
  - Aged ≥18 years
  - ≥1 inpatient hospitalization for AMI (type 1; ICD-10 code I21, excluding I21.A and I21.A9) recorded between January 1, 2017, and August 31, 2023 (index)
- For exploratory analyses, patients with evidence of systemic inflammation were defined by recorded high-sensitivity C-reactive protein (hsCRP)/CRP levels ≥2 and ≤10 mg/L in the year before index
  - Of all patients with AMI, 1997 patients received an hsCRP and/or CRP test
  - Of the patients who received an hsCRP/CRP test, 1673 patients had results ≥2 and ≤10 mg/L
- Patients with hsCRP/CRP levels <2 mg/L or without any recorded hsCRP/CRP levels were considered to have no evidence of systemic inflammation
  - As many patients in this group never received testing, there is a possibility that some were miscategorized
- Comorbidities were assessed in the year before index
- HCRU-related outcomes were assessed during index and during 30- and 90-day readmissions after index
- Cost was assessed at index and across all visits, including index and any follow-up visits

### Results

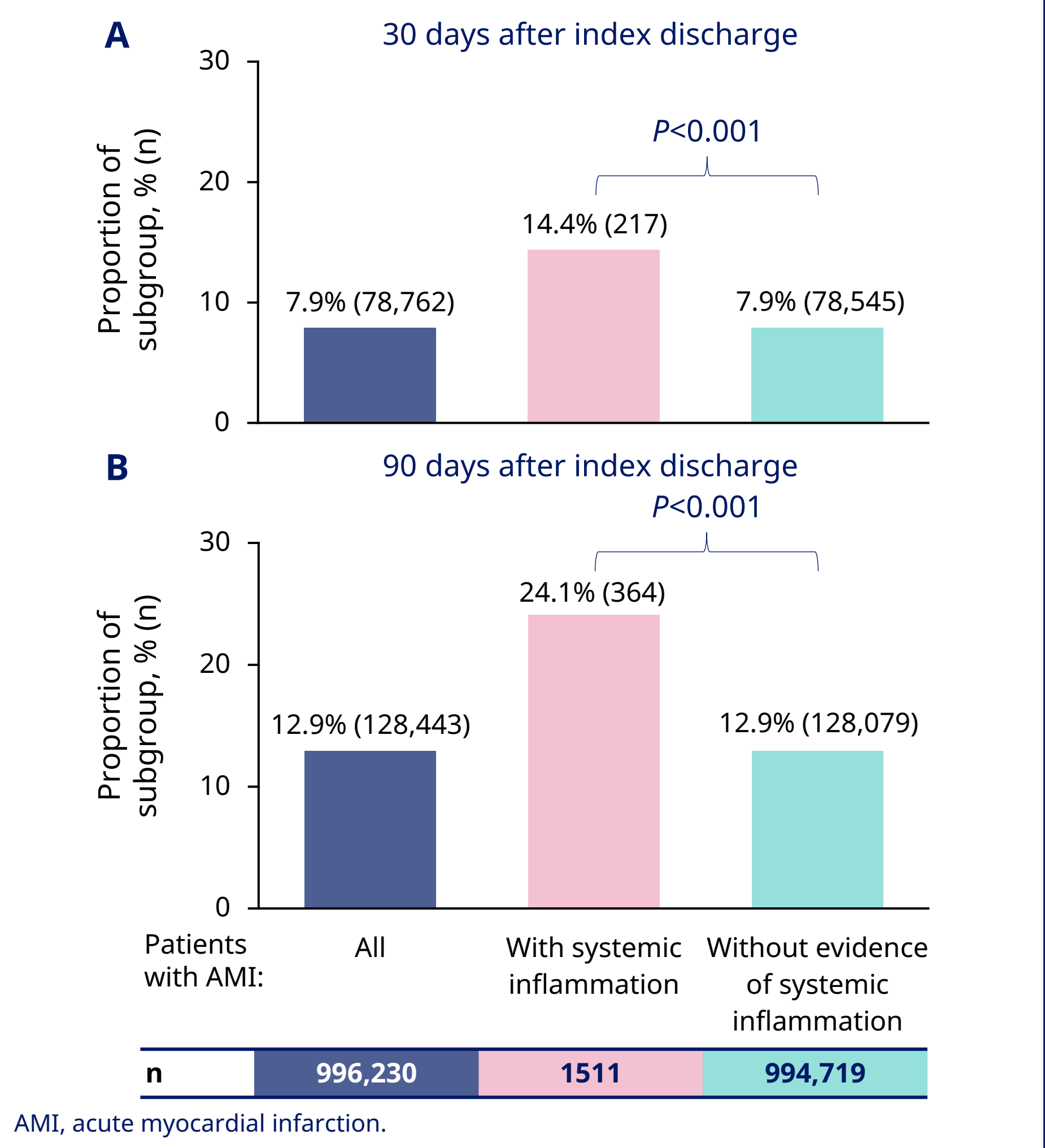
- In the total cohort (N=1,078,572), the mean age was 67.0 years, and more than half of the total cohort was male (**Table 1**)
- Patients with systemic inflammation were slightly older, with a higher proportion of patients who were female, white, and used Medicare insurance (all *P*<0.01)
- Patients with systemic inflammation were less likely to use commercial insurance and had a higher mean Quan-Charlson Comorbidity Index (*P*<0.001)
- Within 30 and 90 days of index discharge, the rate of readmission for all patients with AMI was 7.9% and 12.9%, respectively (**Figure 1**)
  - Patients with systemic inflammation had higher readmission rates vs patients without evidence of systemic inflammation (*P*<0.001)

Table 1. Baseline Demographics and Characteristics

Patients with AMI				
	All	With evidence of systemic inflammation	Without evidence of systemic inflammation	P value <sup>a</sup>
Patients, n	1,078,572	1673	1,076,899	–
Hospitals, n	1102	200	1102	–
Mean age (SD), y	67.0 (13.6)	68.0 (13.4)	67.0 (13.6)	0.005
Sex, n (%)				<0.001
Female	421,163 (39.0)	881 (52.7)	420,282 (39.0)	–
Male	657,160 (60.9)	792 (47.3)	656,368 (60.9)	–
Unknown	249 (<0.1)	0	249 (<0.1)	–
Race, n (%)				<0.001
Asian	24,679 (2.3)	16 (1.0)	24,663 (2.3)	–
Black	106,434 (9.9)	172 (10.3)	106,262 (9.9)	–
White	846,527 (78.5)	1373 (82.1)	845,154 (78.5)	–
Other/unknown	100,932 (9.4)	112 (6.7)	100,820 (9.4)	–
Ethnicity, n (%)				<0.001
Hispanic	77,890 (7.2)	87 (5.2)	77,803 (7.2)	–
Non-Hispanic	843,352 (78.2)	1415 (84.6)	841,937 (78.2)	–
Unknown	157,330 (14.6)	171 (10.2)	157,159 (14.6)	–
Mean (SD) Quan-CCI	1.0 (2.0)	3.0 (3.0)	1.0 (2.0)	<0.001
Health care coverage, n (%)				<0.001
Commercial insurance	256,794 (23.8)	238 (14.2)	256,556 (23.8)	–
Medicaid	104,360 (9.7)	208 (12.4)	104,152 (9.7)	–
Medicare	624,883 (57.9)	1110 (66.3)	623,773 (57.9)	–
Uninsured	54,352 (5.0)	43 (2.6)	54,309 (5.0)	–
Other/unknown	38,183 (3.5)	74 (4.4)	38,109 (3.5)	–

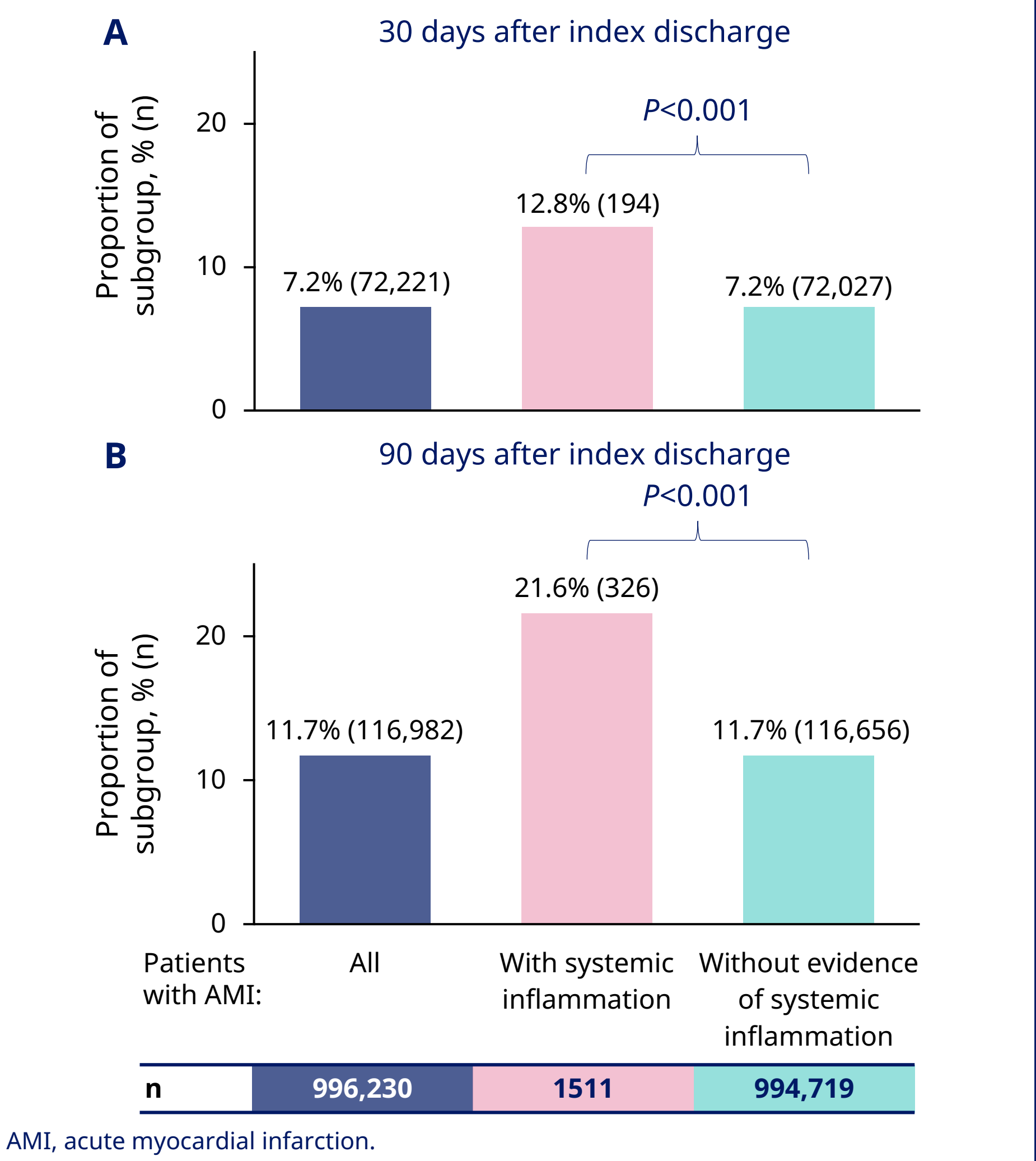
<sup>a</sup>Compared across groups with or without evidence of systemic inflammation. AMI, acute myocardial infarction; CCI, Charlson Comorbidity Index.

Figure 1. Rate of Readmission After Index Discharge



- Stroke/AMI-related readmission rates for all patients with AMI were 7.2% and 11.7% within 30 and 90 days of index discharge, respectively (**Figure 2**)
  - Patients with evidence of systemic inflammation had higher stroke/AMI-related readmission rates compared with patients without evidence of systemic inflammation (*P*<0.001)

Figure 2. Rate of Stroke/AMI-Related Readmission After Index Discharge



- Among all patients with AMI, the mean index visit length of stay was almost 5 days (**Table 2**)
  - Patients with evidence of systemic inflammation stayed longer during the index visit compared with patients without evidence of systemic inflammation (*P*<0.001)
- Within 30 and 90 days of index discharge, the mean number of outpatient visits for a patient with AMI was 1.5 and 2.4 visits, respectively
  - Patients with evidence of systemic inflammation had more outpatient visits vs patients without evidence of systemic inflammation (*P*<0.001)
- Among the total cohort, admission through the emergency room (ER) was most common (**Table 3**)
  - Compared with patients without systemic inflammation, patients with evidence of systemic inflammation were more likely to be admitted via the ER (*P*<0.001)
- The mean index cost for all patients with AMI exceeded \$23,000 (**Table 4**)
- The mean total inpatient cost across all visits was \$50,172
- Patients with systemic inflammation had higher mean outpatient visit costs but similar median outpatient costs and lower mean index costs compared with those without evidence of systemic inflammation

Table 2. HCRU Outcomes at Index and Within 30 and 90 Days of Index Discharge

Patients with AMI				
	All	With evidence of systemic inflammation	Without evidence of systemic inflammation	P value <sup>a</sup>
Patients, n	1,078,572	1673	1,076,899	–
Mean (SD) index LOS, days	4.9 (5.0)	5.2 (5.1)	4.9 (5.0)	<0.001
Mean (SD) index ICU LOS, days	3.2 (3.6)	3.4 (3.8)	3.2 (3.6)	0.5
Additional care within 30 days of index discharge, n (%)				
Visits after discharge	208,605 (19.0)	624 (37.0)	207,981 (19.0)	<0.001
ER visits	121,192 (11.0)	371 (22.0)	120,821 (11.0)	<0.001
Additional care within 90 days of index discharge, n (%)				
Visits after discharge	325,724 (30.0)	869 (52.0)	324,855 (30.0)	<0.001
ER visits	190,576 (18.0)	577 (34.0)	189,999 (18.0)	<0.001
Mean (SD) visits within 30 days of index				
Readmissions	1.1 (0.3)	1.1 (0.4)	1.1 (0.3)	0.2
Outpatient revisits	1.5 (1.1)	2.0 (1.5)	1.5 (1.1)	<0.001
ER visits	1.2 (0.5)	1.3 (0.9)	1.2 (0.5)	<0.001
Mean (SD) visits within 90 days of index				
Readmissions	1.3 (0.6)	1.4 (0.8)	1.3 (0.6)	0.002
Outpatient revisits	2.4 (2.9)	3.7 (3.9)	2.4 (2.9)	<0.001
ER visits	1.4 (1.0)	1.8 (1.6)	1.4 (0.9)	<0.001

<sup>a</sup>Compared across all groups. AMI, acute myocardial infarction; ER, emergency room; HCRU, health care resource utilization; ICU, intensive care unit; LOS, length of stay.

### Conclusions

- This study shows persistently high cost and HCRU among patients hospitalized for AMI
  - Given the variance between index, inpatient, and outpatient cost outcomes, further investigation into the costs incurred by patients with or without evidence of systemic inflammation is warranted
- In exploratory analyses, HCRU and economic burden were higher among patients with evidence of systemic inflammation compared with those without evidence of systemic inflammation
  - The exploratory analyses related to patients with systemic inflammation were limited due to the small sample size, which can be attributed to the small proportion of patients who received the hsCRP or CRP tests

Table 3. Visit Characteristics During Index

Patients with AMI				
	All	With evidence of systemic inflammation	Without evidence of systemic inflammation	P value <sup>a</sup>
Patients, n	1,078,572	1673	1,076,899	–
Admission type, n (%)				
Emergency	846,762 (78.5)	1526 (91.2)	845,236 (78.5)	<0.001
Trauma or injury center	4174 (0.4)	5 (0.3)	4169 (0.4)	–
Urgent care	215,647 (20.0)	139 (8.3)	215,508 (20.0)	–
Other/unknown	11,989 (1.1)	– <sup>b</sup>	11,986 (1.1)	–
Admission point of entry, n (%)				
Non-health care facility	784,258 (72.7)	1427 (85.3)	782,831 (72.7)	–
Clinic	48,355 (4.5)	48 (2.9)	48,307 (4.5)	–
Transfer from acute facility	224,058 (20.8)	150 (9.0)	223,908 (20.8)	–
Transfer from ICF or SNF	11,292 (1.0)	43 (2.6)	11,249 (1.0)	–
Other/unknown	10,609 (1.0)	5 (0.3)	10,604 (1.0)	–
Discharge status, n (%)				
Home/home health	760,426 (70.5)	1074 (64.2)	759,352 (70.5)	–
Transfers to other facilities <sup>c</sup>	151,255 (14.0)	303 (18.1)	150,952 (14.0)	–
Discharged to hospice <sup>d</sup>	31,542 (2.9)	80 (4.8)	31,462 (2.9)	<0.001
Deaths <sup>e</sup>	82,409 (7.6)	162 (9.7)	82,247 (7.6)	–
Other/unknown	84,482 (7.8)	134 (8.0)	84,348 (7.8)	–

<sup>a</sup>Compared across all groups. <sup>b</sup>n=5. <sup>c</sup>Discharge categories: long-term care facility, skilled nursing facility, intermediate nursing care facility, acute care facility, hospice. <sup>d</sup>While most patients discharged to hospice experience mortality, some may be readmitted to the hospital. <sup>e</sup>As recorded in Premier Healthcare Database. AMI, acute myocardial infarction; ICF, intermediate nursing care facility; SNF, skilled nursing facility.

Table 4. Cost Outcomes for Patients With AMI

Patients with AMI				
	All	With evidence of systemic inflammation	Without evidence of systemic inflammation	P value <sup>a</sup>
Index costs				
Patients, n	1,078,572	1673	1,076,899	–
Mean (SD), \$	23,648 (23,648)	21,215 (21,385)	23,651 (23,471)	<0.001
Total inpatient hospitalization costs <sup>b</sup>				
Patients, n	1,073,698	1669	1,072,029	–
Mean (SD), \$	50,172 (49,128)	46,928 (45,369)	50,178 (49,133)	0.14
Median (Q1–Q3), \$	33,122 (20,146–60,776)	33,192 (20,138–53,938)	33,122 (20,146–60,786)	–
Total outpatient visit costs <sup>b</sup>				
Patients, n	315,528	845	314,683	–
Mean (SD), \$	2887 (4495)	3188 (4824)	2886 (4494)	0.04
Median (Q1–Q3), \$	1110 (345–3353)	1192 (417–3784)	1109 (345–3352)	–

<sup>a</sup>Compared across all groups. <sup>b</sup>Including all index and follow-up visits. AMI, acute myocardial infarction.

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