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Increasing Costs of Hospitalizations for Multiple Myeloma in the United States: A Database Analysis on Aggregate Costs and Patient Subpopulations

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INTRODUCTION

BACKGROUND

Multiple myeloma (MM) is a hematologic malignancy characterized by proliferation of clonal plasma cells in the bone marrow and a set of diverse symptoms including CRAB features (i.e., Calcium elevation, Renal dysfunction, Anemia, and Bone lesions). The incidence of MM in the United States (US) is 7.0 per 100,000 and known to vary significantly across subpopulations. For example, Non-Hispanic blacks (NHB) have at least 2.3-fold greater incidence (14.6) relative to other racial/ethnic subpopulations (range 4.1-6.2; 2021 observed SEER age-adjusted [1]) (Table below).

Multiple Myeloma US 2021 Observed Age-Adjusted Incidence Per 100,000 *				
Hispanic	Non-Hispanic Asian/Pacific Islanders	Non-Hispanic Black (NHB)	Non-Hispanic White (NHW)	All Races/Ethnicities
6.2	4.1	14.6	6.2	7.0

* SEER (Surveillance, Epidemiology, and End Results) Program database.

Treatments for MM include multi-drug regimens, innovative biologics, and bone marrow transplant (BMT)-related therapies (MMRF [2]). Numerous studies have identified disparities in access to novel therapies, stem cell transplant (SCT), time to treatment, and supportive care among MM patient subpopulations (Gasoyan 2023 [3]). For example, black MM patients are less likely to receive triplet or quadruplet therapy (Saba 2025 [4]) or SCT (Wu 2024 [5]). Despite such disparities in access, MM patients of different races/ethnicities show similar 5-year relative survival around 58% (Chen 2024 [6]) (Table below).

5-Year Relative Survival for Multiple Myeloma Diagnosed 2015–2019 (±SE) *				
Hispanic	Non-Hispanic Asian/Pacific Islanders	Non-Hispanic Black (NHB)	Non-Hispanic White (NHW)	All Races/Ethnicities
0.556 ± 0.014	0.585 ± 0.019	0.592 ± 0.013	0.586 ± 0.007	0.582 ± 0.012

* Chen 2024 analysis of SEER Program data. SE = standard error. All intersubpopulation differences not statistically significant.

OBJECTIVES

Given differences in MM incidence and treatment access, and the rise in costly treatments, we sought to examine trends in MM costs and cost-related outcomes focusing on inpatient care across patient subpopulations, including by race/ethnicity, applicable payer, and community income level. In addition, we analyzed whether changes in inpatient reimbursement rates have kept pace with changes in hospitalization costs, specifically for autologous BMT, the main SCT treatment utilized for MM.

METHODS

We analyzed National Inpatient Sample (NIS) data from the US Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUPnet) database [7] for trends in MM inpatient discharges, costs, and cost-related outcomes, and subpopulation differences. For comparison, we analyzed discharges and cost trends for other hematologic malignancies including Hodgkin lymphoma (HL), non-Hodgkin lymphoma (NHL), acute lymphocytic leukemia (ALL), acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), chronic myeloid leukemia (CML), and myelodysplastic syndrome (MDS). NIS analyses were for principal diagnoses listed above based on Clinical Classifications Software Refined (CCSR) for Diagnosis (ICD-10-CM) (NEO057–NEO062 [HL, NHL, ALL, AML, CLL, CML], NEO065 [MM], NEO068 [MDS]), which excludes malignancies in remission (CCSR for ICD-10-CM diagnoses [8]). Statistical significance of differences was evaluated using a Z-test with threshold for significance set at $p<.05$.

To assess inpatient reimbursement rates, we analyzed Medicare Acute Inpatient Prospective Payment System (IPPS) Medicare Severity Diagnosis Related Group (MS-DRG) payment rates for autologous BMT with or without complications and comorbidities (CC/MCC) (MS-DRG 016 and 017, respectively). Base payment amounts and relative weights as listed in the Medicare IPPS Final Rule files [9] were used to compute MS-DRG payment rates. MS-DRG base payment amounts were specifically the final national adjusted operating standardized amounts for hospitals that submitted quality data and were meaningful electronic health record users. To determine annual discharges for MS-DRG 016 and 017, we analyzed NIS data using the HCUPnet database. Numbers of MM-specific BMTs by year were available from the US Health Resources & Services Administration (HRSA) [10].

RESULTS

RISING COSTS OF INPATIENT HOSPITALIZATIONS IN MULTIPLE MYELOMA AND OTHER MALIGNANCIES

Rising National Costs of Multiple Myeloma Inpatient Hospitalizations Due to Increasing Costs Per Discharge

Over the period from 2017 to 2021, national costs for MM inpatient stays significantly increased by 25.9% from $686 million to $864 million ($p<.05$). For comparison, national costs for inpatient stays significantly increased for NHL from $1,355 million to $1,827 million (34.9%, $p<.01$), but not for any other hematologic malignancy analyzed (**Table 1**).

Hematologic Malignancy	National Costs of Inpatient Stay in Millions of USD By Year (±SE)		Δ 2017 → 2021	*p* Value from Z-Test
	2017	2021		
MM	**$686.0 (±$55.8)**	**$863.7 (±$71.3)**	**+25.9%**	**<.05**
HL	$155.3 (±$16.5)	$176.1 (±$20.7)	+13.5%	*ns*
NHL	**$1,354.5 (±$92.5)**	**$1,826.8 (±$157.4)**	**+34.9%**	**<.01**
ALL	$750.7 (±$77.5)	$944.6 (±$98.2)	+25.8%	*ns*
AML	$1,373.4 (±$114.6) *	$1,812.8 (±$200.5)	+32.0%	*ns*
CLL	$105.0 (±$12.1)	$115.0 (±$11.9)	+9.5%	*ns*
CML	$143.6 (±$19.8)	$158.3 (±$18.9)	+10.3%	*ns*
MDS	$252.4 (±$25.3)	$290.9 (±$30.0)	+15.2%	*ns*

* For AML, year 2016 was used for analysis given 2017 represented an outlier in that annual discharges were substantially fewer than either 2016 or 2018.

Table 1. National Costs of Inpatient Stays by Malignancy in Millions of US Dollars for Years 2017 and 2021

We evaluated whether the significant increases in national costs of inpatient hospitalizations for MM and NHL from 2017 to 2021 were attributable to increases in total number of inpatient stays or average costs per stay or both. The increase in MM costs was associated with a statistically significant increase in average costs per stay from $32,908 to $39,912 (21.3%, $p<.001$) (**Table 2**) with no significant increase in discharges (**Table 3**). Similarly, increasing NHL costs was associated with a significant increase in average costs per stay from $34,714 to $46,980 (35.3%, $p<.01$) (**Table 2**) with no significant change in discharges (**Table 3**).

Hematologic Malignancy	Average Costs Per Inpatient Stay in USD By Year (±SE)		Δ 2017 → 2021	*p* Value from Z-Test
	2017	2021		
MM	**$32,908 (±$1,288)**	**$39,912 (±$1,480)**	**+21.3%**	**<.001**
HL	$38,765 (±$2,415)	$45,812 (±$3,217)	+18.2%	*ns*
NHL	**$34,714 (±$1,294)**	**$46,980 (±$2,286)**	**+35.3%**	**<.001**
ALL	$74,180 (±$3,813)	$92,654 (±$5,180)	+24.9%	<.01
AML	$67,624 (±$2,995) *	$79,563 (±$3,973)	+17.7%	<.05
CLL	$22,490 (±$1,886)	$25,923 (±$1,615)	+15.3%	*ns*
CML	$35,503 (±$3,732)	$42,165 (±$3,772)	+18.8%	*ns*
MDS	$26,670 (±$2,219)	$35,343 (±$2,719)	+32.5%	<.05

* For AML, year 2016 was used for analysis given 2017 represented an outlier in that annual discharges were substantially fewer than either 2016 or 2018.

Table 2. Average Costs Per Inpatient Stay by Malignancy in US Dollars for Years 2017 and 2021

Hematologic Malignancy	Number of Inpatient Discharges By Year (±SE)		Δ 2017 → 2021	*p* Value from Z-Test
	2017	2021		
MM	**20,845 (±1,223)**	**21,640 (±1,066)**	**+3.8%**	***ns***
HL	4,005 (±242)	3,845 (±250)	–4.0%	*ns*
NHL	**39,020 (±1,495)**	**38,885 (±1,719)**	**–0.3%**	***ns***
ALL	10,120 (±753)	10,195 (±764)	+0.7%	*ns*
AML	20,310 (±1,033) *	22,785 (±1,740)	+12.2%	*ns*
CLL	4,670 (±215)	4,435 (±257)	–5.0%	*ns*
CML	4,045 (±204)	3,755 (±237)	–7.2%	*ns*
MDS	9,465 (±323)	8,230 (±332)	–13.0%	<.01

* For AML, year 2016 was used for analysis given 2017 represented an outlier in that annual discharges were substantially fewer than either 2016 or 2018.

Table 3. Total Number of Inpatient Discharges by Malignancy for Years 2017 and 2021

COSTS OF INPATIENT HOSPITALIZATIONS IN MULTIPLE MYELOMA SUBPOPULATIONS

Rising Costs of Hospitalizations and Increasing Costs in Specific Multiple Myeloma Subpopulations

Since national inpatient and average costs per inpatient stay for MM increased significantly, we examined trends in costs and cost-related outcomes for specific MM patient subpopulations to identify cost drivers. Specific findings are summarized below.

- **National costs for MM inpatient stays** significantly increased from 2018 to 2021 for:
  - NHB patients from $148.0 million to $199.5 million (34.9%, $p<.05$)
  - Hispanic patients from $70.2 million to $103.4 million (47.4%, $p<.05$)
  - Patients from low-income communities from $159.9 million to $205.8 million (28.7%, $p<.01$)
- **Average costs per inpatient stay** significantly increased from 2018 to 2021 for:
  - NHB patients from $30,166 to $41,484 (37.5%, $p<.001$)
  - NHW patients from $31,250 to $38,418 (22.9%, $p<.001$)
  - Medicare patients from $28,178 to $36,008 (27.8%, $p<.001$)
  - Patients with private insurance from $37,853 to $45,363 (19.8%, $p<.01$)
  - Patients from all community income levels:
    - Low-income from $28,839 to $36,858 (27.8%, $p<.01$)
    - Middle-income from $33,280 to $39,661 (19.2%, $p<.01$)
    - High-income from $34,164 to $43,543 (27.5%, $p<.01$)
- **Average length of inpatient stay** significantly increased for NHB patients, from 11.2 to 12.5 days (11.6%, $p<.05$).

MEDICARE PAYMENT RATES FOR DIAGNOSIS RELATED GROUPS RELEVANT TO MULTIPLE MYELOMA

Medicare Reimbursement May Not Be Keeping Pace With Rising Costs of Multiple Myeloma Inpatient Care

Medicare MS-DRG payment rates are prospective payment amounts covering Medicare inpatient episodes of care and updated each year. For MS-DRGs corresponding to autologous BMT inpatient stays with (016) or without (017) CC/MCC (including MM BMT patients), Medicare payment rates increased from 2017 to 2021 by 19.1% and 28.2%, respectively (Table below). Payment rates in 2017 for MS-DRG 016 and 017 were $33,679 and $22,453 (Table below), while average costs per stay for MM were $32,908 (**Table 2**). While 2021 payment rates for 016 and 017 increased to $28,794 and $40,097 (Table below), average costs per MM inpatient stay rose to $39,912 (**Table 2**) and were $36,008 in Medicare MM patients; $36,858, $39,661 and $43,543 for low-income, middle-income and high-income community MM patients; $38,418 and $41,484 for NHW and NHB MM patients. Interestingly, the 2025 Medicare payment rate for both MS-DRGs is $39,984 (Table below). Analysis of 016 and 017 discharges and BMT indication mix for the year 2020 revealed MM patients comprised 59.7% of the MS-DRG volume (7,722 of 12,940), and 016 represented 96.6% (12,500 of 12,940). Assuming the cost of inpatient care for MM has continued to rise, together these data suggest the reimbursement for a substantial number of Medicare MM inpatient stays, especially for BMT, is likely to be below the actual costs.

MS-DRG	MS-DRG Title	Payment Rate By Year *			Δ 2017 → 2021
		2017	2021	*2025*	
016	AUTOLOGOUS BONE MARROW TRANSPLANT WITH CC/MCC	**$33,679**	**$40,097**	*$39,984*	+19.1%
017	AUTOLOGOUS BONE MARROW TRANSPLANT WITHOUT CC/MCC	**$22,453**	**$28,794**	*$39,984*	+28.2%

* Payment rates were determined as the product of MS-DRG relative weights for the year and national adjusted standardized amounts for the year (described in Methods).

CONCLUSIONS †

- **The cost of MM inpatient care increased in aggregate by 26% from 2017 to 2021 driven by increases in average costs per inpatient stay ranging from 19% to 38% for specific subpopulations from 2018 to 2021**, including for patients of specific races/ethnicities (NHB and NHW), those with specific types of insurance (Medicare and private insurance), and for patients across all community income levels (low, middle and high).
- Analysis of Medicare inpatient payment rates over the same period suggests that **costs of MM inpatient care – particularly for BMT – may be outpacing any increases in Medicare reimbursement**, potentially resulting in uncompensated care.
- **Further research is needed to explore reasons for increasing MM inpatient costs, whether such increases result in improved clinical outcomes, and opportunities for future cost reduction and improved reimbursement.**

ABBREVIATIONS: AHRQ = Agency for Healthcare Research and Quality; ALL = acute lymphoblastic leukemia; AML = acute myeloid leukemia; BMT = bone marrow transplant; CC = complications and comorbidities; CCSR = Clinical Classification Software Refined; CIBMTR = Center for International Blood and Marrow Transplant Research; CLL = chronic lymphocytic leukemia; CML = chronic myeloid leukemia; HCUPnet = Healthcare Cost and Utilization Project; HL = Hodgkin lymphoma; HRSA = Health Resources & Services Administration; ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification; IPPS = Inpatient Prospective Payment System; MCC = major complications and comorbidities; MDS = myelodysplastic syndrome; MM = multiple myeloma; MMRF = Multiple Myeloma Research Foundation; MS-DRG = Medicare Severity Diagnosis Related Group; NHB = non-Hispanic blacks; NHL = non-Hodgkin lymphoma; NHW = non-Hispanic whites; NIS = National Inpatient Stay; ns = not statistically significant; SCT = stem cell transplant; SE = standard error; US = United States; USD = US Dollars; SEER = Surveillance, Epidemiology, and End Results.

† **STUDY LIMITATIONS:** Example limitations that may impact the validity of study analyses and conclusions include the following: (1) HCUPnet NIS data exclude patients with primary diagnoses indicating cancer in remission [11]; (2) HCUPnet NIS costs are estimated based on facility charges and average cost-to-charge ratios from hospital accounting reports, which may either underestimate or overestimate cost for specific inpatient stays (for stays with a high proportion of ancillary charges such as major surgery, costs may tend to be overestimated using cost-to-charge ratios) [11]; (3) analysis of Medicare inpatient reimbursement does not consider either (1) outlier payments paid to hospitals when costs exceed the established fixed-loss threshold amount or (2) new technology add-on payments [12].

REFERENCES CITED: **[1]** MMRF (Multiple Myeloma Research Foundation). Treatments for Multiple Myeloma: https://themmrf.org/diagnosis-and-treatment/treatment-options/; **[2]** SEER*Explorer: An interactive website for SEER cancer statistics [Internet]. Surveillance Research Program, National Cancer Institute; 2024 Apr 17. [updated: 2024 Nov 5]. Available from: https://seer.cancer.gov/statistics-network/explorer/; **[3]** Gasoyan H, et al. Disparities in Multiple Myeloma Treatment Patterns in the United States: A Systematic Review. Clin Lymphoma Myeloma Leuk. 2023 Nov;23(11):e420-e427; **[4]** Saba L, et al. A Real-World Analysis on Access to Triplet and Quadruplet Therapy in Newly Diagnosed Multiple Myeloma Patients in the United States. Clin Lymphoma Myeloma Leuk. 2025 Jan;25(1):e1-e10; **[5]** Wu JF, et al. Racial and Ethnic Disparities in Autologous Hematopoietic Cell Transplantation Utilization in Multiple Myeloma Have Persisted Over Time Even After Referral to a Transplant Center. Transplant Cell Ther. 2024 Dec;30(12):1189.e1-1189.e10; **[6]** Chen C, et al. Trends in 5-year cancer survival disparities by race and ethnicity in the US between 2002-2006 and 2015-2019. Sci Rep. 2024 Sep 30;14(1):22715; **[7]** HCUPnet, Healthcare Cost and Utilization Project. Agency for Healthcare Research and Quality, Rockville, MD. https://datatools.ahrq.gov/hcupnet; **[8]** HCUPnet Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses. https://hcup-us.ahrq.gov/toolssoftware/ccsr/dxccsr.jsp#overview; **[9]** Acute Inpatient Prospective Payment System. Centers for Medicare & Medicaid Services. https://www.cms.gov/medicare/payment/prospective-payment-systems/acute-inpatient-pps; **[10]** HRSA. Transplant Activity Report. https://bloodstemcell.hrsa.gov/data/donation-and-transplantation-statistics/transplant-activity-report; **[11]** HCUPnet Methodology: https://datatools.ahrq.gov/hcupnet/methodology/; **[12]** New Medical Services and New Technologies. Centers for Medicare & Medicaid Services. https://www.cms.gov/medicare/payment/prospective-payment-systems/acute-inpatient-pps/new-medical-services-and-new-technologies.

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