The Cost burden of Metastatic Bone Disease in the US from 2016 to 2022

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INTRODUCTION: The burden of cancer continues to rise, with approximately 18.8 cases per 100,000 of metastatic bone disease (MBD) diagnosed each year. Treatment can have notable financial impacts on individual patients, from hospitalizations, surgeries, systemic treatment, to rehabilitation. Our study aims to evaluate the current economic burden of MBD in the U.S.

METHODS: Patient-level and cost data were obtained from the IBM Marketscan Commercial Claims Database for patients diagnosed with MBD between 2016 and 2022. MBD patients were identified using ICD-10 codes C79.51 and C79.52, with a requirement of 12 months of continuous enrollment before the first MBD diagnosis; patients with a prior MBD diagnosis were excluded. Controls were defined as patients newly diagnosed with cancer within the same period and were extracted using ICD-10 codes. MBD patients and controls were matched based on propensity scores using nearest neighbor matching according to age, sex, region, plan type, and cancer type. Costs were winsorized to minimize the influence of outliers and adjusted to 2024 dollars using the Bureau of Labor Statistics' Consumer Price Index. Demographics, clinical characteristics, and healthcare expenditures (inpatient, outpatient, and pharmacy) were compared. Unadjusted comparisons were conducted for costs between cases and controls, as well as between MBD patients who underwent orthopedic oncologic surgeries and those who did not. Multivariable analyses using a Gamma-log regression model, adjusting for age, Charlson comorbidity index (CCI), cancer type, region, and plan type, were performed to derive adjusted mean expenditures and expenditure differences. The national cost burden of MBD in the U.S. for 2025 was estimated using population estimates, incidence rate, and an annual 5.6% increase in cost per case based on CMS health expenditure projections.

RESULTS: The study included a total of 20,521 patients, comprising 10,312 patients with MBD and 10,209 matched controls without MBD. The overall cohort had a mean age of 52.30 ± 9.4, with 42.1% males and 57.9% females. MBD patients had a significantly shorter follow-up period compared with controls (15.13 ± 14.98 vs. 27.24 ± 22.79 months; $p < 0.0001$) and exhibited a higher CCI (1.21 ± 0.44 vs. 1.03 ± 0.19; $p < 0.0001$). Incremental healthcare expenditures were markedly elevated in the MBD cohort across cancer types, with adjusted differences ranging from approximately $106,021 for lung cancer to $371,124 for thyroid cancer (all $p < 0.0001$). Overall, MBD patients incurred markedly greater total expenditures, with mean inpatient costs of $87,596 ± 115,369 compared to $57,105 ± 78,360 in controls ($p < 0.001$). Of the MBD patients, unadjusted analyses showed that those patients who underwent orthopedic oncologic surgery (n =401) had significantly higher overall expenditures compared to those who did not (n = 9,911) ($376,437.50 vs. $290,580.20; $p < 0.001$). After adjustment, the predicted mean total expenditure was $397,136 for surgical patients versus $314,364 for non-surgical patients, yielding an adjusted absolute difference of $82,772 (26.3% higher; $p < 0.0001$). The projected national cost burden of MBD in 2025 was estimated at $18.7 billion.

DISCUSSION AND CONCLUSION: Our findings demonstrate that MBD significantly amplifies healthcare expenditures, with affected patients incurring markedly higher costs than their non MBD counterparts. These elevated expenses were consistently observed across cancer subtypes, underscoring the substantial economic burden posed by advanced disease. Furthermore, the subgroup analysis revealed that MBD patients undergoing orthopedic oncologic surgery experience even greater financial impact, independent of other demographic and clinical factors highlighting the profound importance of orthopedic care and early diagnosis of MBD. These findings emphasize the urgent need for cost-effective treatment strategies and policy reforms to mitigate financial strain on healthcare systems.

Figure 1a: Incremental Expenditures graphically represented for patients without MBD.

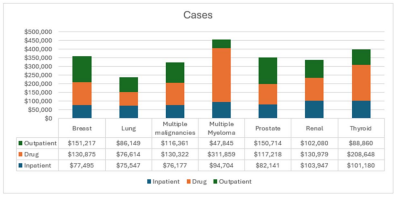

Figure 1b: Incremental Expenditures graphically represented for patients with MBD.

Variable	Coefficient	Standard Error	P-value	95% CI
Surgery	0.2337	0.0535	<0.0001	[0.1288, 0.3386]
Cancer Type	0.0281	0.0067	<0.0001	[0.0150, 0.0412]
Charlson Comorbidity Index	−0.1464	0.0264	<0.0001	[−0.1980, −0.0947]
Age	−0.0168	0.0017	<0.0001	[−0.0202, −0.0134]
Region	0.0112	0.0121	0.354	[−0.0125, 0.0349]
Plan type	0.0231	0.0074	0.002	[0.0086, 0.0376]
Constant	13.4877	0.1126	<0.0001	[13.2671, 13.7084]
Surgeries	Adjusted Mean Expenditure	95% CI	Absolute Difference	% Difference
No Surgery	$314,364	[306,553, 322,175]	—	—
Surgery	$397,136	[356,569, 437,705]	$82,772	26.3%

Table 3: Coefficients from a Gamma-log model of total expenditures and the corresponding adjusted mean expenditures of patients who underwent surgeries and those who didn't. The model coefficients show log-expenditure differences, while the mean expenditure table presents the predicted cost difference between surgery and no-surgery groups.

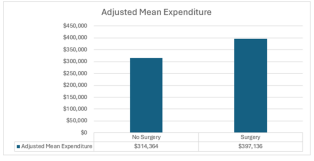

Figure 2: Adjusted mean expenditure of patients who underwent orthopedic surgical intervention versus those who didn't.

Cancer Type	Control, Mean (SD)	Case, Mean (SD)	Unadjusted Difference	Adjusted Difference	P-value
Breast	$ 63,341.5 (151,666.0)	$ 354,991.8 (345,858.9)	$ 291,650.30	$ 291,170.90	<0.0001
Lung	$ 131,308.2 (279,070.4)	$ 234,770.1 (284,867.7)	$ 103,462.00	$ 106,021.30	<0.0001
Other	$ 218,053.4 (301,922.8)	$ 317,214.5 (352,209.6)	$ 99,161.10	$ 96,286.30	<0.0001
Multiple Myeloma	$ 196,584.9 (370,813.9)	$ 447,280.2 (370,759.5)	$ 250,695.20	$ 241,825.40	<0.0001
Prostate	$ 33,782.3 (71,166.6)	$ 346,780.1 (273,497.9)	$ 312,997.90	$ 313,261.70	<0.0001
Renal	$ 72,883.2 (204,609.9)	$ 332,180.7 (381,939.3)	$ 259,297.40	$ 358,326.70	<0.0001
Thyroid	$ 21,854.9 (62,852.0)	$ 394,052.0 (326,788.0)	$ 372,197.10	$ 371,123.80	<0.0001
All Cancers	$ 63,459.22 (167,962.50)	$ 293,918.90 (321,122.0)	$ 230,459.70	$ 229,872.70	<0.0001

Table 1: Average Total Expenditure in case and control and difference in cost, unadjusted and adjusted for inflation by cancer type.

Surgery	Inpatient, Mean (SD)	Pharmacy, Mean (SD)	Outpatient, Mean (SD)	Total Expenditure, Mean (SD)
No(n=401)	$ 85,405.12 (113,914.70)	$ 103,930.50 (184,566.40)	$ 105,082.60 (203,492.40)	$ 290,580.20 (320,655.80)
Yes(n=9911)	$ 141,751.80 (136,171.20)	$ 116,519.60 (198,432.90)	$ 123,105.80 (190,466.10)	$ 376,437.50 (322,004.40)
Total	$ 87,596.26 (115,368.60)	$ 104,417.40 (185,127.20)	$ 105,783.40 (203,022.60)	$ 293,918.90 (321,122.00)
P value	<0.001	0.1914	0.0814	<0.001

Table 2: Comparing inpatient, outpatient and pharmacy costs between patients who underwent orthopedic surgical intervention and those who didn't.