Costs Associated with Productivity Loss Among U.S. Patients Newly Diagnosed with Multiple Myeloma Receiving Oral Versus Injectable Chemotherapy

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ABSTRACT

BACKGROUND: The use of novel drug agents in the treatment of multiple myeloma (MM) has been associated with improved therapeutic outcomes and survival; however, MM continues to pose a significant economic burden on patients and health care systems. Evaluating economic implications of therapies can provide key points of distinctions between available treatment options. Patients with MM may experience productivity loss, including lost days from work or inability to work due to MM symptoms or to undergoing treatment. Although direct costs of illness have been well described in the literature, indirect costs associated with MM are understudied.

OBJECTIVE: To compare the extent of disability benefit use and resultant workplace productivity loss among U.S. adult patients with newly diagnosed MM who received oral versus injectable MM therapy.

METHODS: A retrospective cohort study was conducted using the Truven Health Analytics MarketScan Commercial Claims and Encounters, Medicare Supplemental Coordination of Benefits, and Health and Productivity Management databases (2008-2015). Workplace absenteeism, as measured by disability benefit use, was evaluated 1 year before and 1 year after first MM diagnosis. Patients receiving only oral chemotherapy were compared with those who received injectable therapy. Absenteeism days and associated costs were compared among study groups using multivariable zero-inflated Poisson regression.

RESULTS: The final study cohort included 299 patients with newly diagnosed MM, of whom 73 received oral therapy only and 226 received injectable therapy. Treatment type was a significant predictor of disability benefit use. Patients who received injectable therapy missed an average of 110 work days in the 1 year after diagnosis, compared with 87 for patients receiving only oral therapy (difference of 23 days, 95% CI=19-26, $P<0.001$). Treatment type was also a significant predictor of costs associated with lost productivity. Patients who received injectable therapy experienced productivity loss valued at \$18,315, compared with patients who only received oral drug therapy (\$14,429). The difference between these estimates was statistically significant (\$3,886, 95% CI=\$3,540-\$4,231, $P<0.001$).

CONCLUSIONS: Patients newly diagnosed with MM face significant losses in productivity. Patients receiving injectable MM therapy use significantly more disability benefits and incur higher productivity costs, compared with those receiving oral MM therapy. Further studies elucidating the nature of the differences between injectable and noninjectable chemotherapy users are needed.

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What is already known about this subject

- Cancer as a whole may be one of the costliest health conditions for employers and patients.
- Multiple myeloma poses a significant economic burden on patients and the health care system.
- Direct costs related to treatment and medical care of myeloma have been well described in the literature; however, indirect costs are understudied.

What this study adds

- This study compared the extent of workplace productivity loss in patients newly diagnosed with multiple myeloma receiving oral versus injectable chemotherapy.
- In the year following initial diagnosis with multiple myeloma, patients experience significant productivity loss, particularly those receiving injectable chemotherapy.

Multiple myeloma (MM) is a hematologic malignancy that arises from plasma cells and is the 14th most common type of cancer in the United States.¹ Treatment of MM has markedly improved in recent years with the introduction of novel agents, which possess immunomodulatory, antiangiogenesis, and antitumor properties.² The use of these agents has been associated with improved therapeutic outcomes and survival rates, which are likely to continue improving as optimal therapeutic regimens become established and novel agents continue to emerge in the marketplace.³⁻⁵

Despite advancements in treatment, MM poses a significant economic burden on patients and health care systems.⁶ Among several domains of patients' livelihood affected by the illness, employment and disability have been described to be particularly affected in recent literature.⁷ Cancer as a whole is among the costliest health conditions, with a projected cost of \$173 billion in the year 2020.⁸ Annual productivity costs associated with malignancies have been estimated to be approximately \$1,601 per patient in those at high risk for health conditions.⁹

Understanding the scope of financial burden due to disease is important to multiple health care stakeholders. Direct costs related to treatment and medical care of MM

have been well described.¹⁰⁻¹⁴ However, indirect costs associated with this particular cancer are understudied.¹⁵ The extent of productivity loss may vary across treatment modalities: a study by Petrucci et al. (2013) showed that the highest and lowest work-related, annual productivity costs per patient were reported by those who underwent autologous stem cell transplant (ASCT; €9,538±€17,612, equivalent to \$7,963±\$14,700 in 2015 U.S. dollars) and asymptomatic patients (€22±€95, equivalent to \$18.36±\$79.29 in 2015 U.S. dollars), equivalent to 16.1% and 2.3% of the total cost of illness, respectively.¹⁶ As well, patients receiving intravenous or subcutaneous therapies may experience additional treatment burden and productivity loss due to the frequent trips to the clinic for treatment administration.^{17,18}

Losses in productivity due to complications and complexity of parenteral chemotherapy administration are relevant to patient preference and treatment satisfaction, which are important considerations in determining the value of particular treatment modalities. Recent literature suggests that the mode of drug administration is an important determinant of patient preference. A study by Simchowicz et al. (2010) concluded that an all-oral drug regimen was preferred among patients with relapsed/remitting MM and that drug administration was the most important factor in determining preference.¹⁹ In a small cross-sectional study of newly diagnosed MM patients, decreased economic burden and activity impairment was observed among users of oral versus injectable MM therapy.²⁰ Workplace productivity loss is becoming an increasingly important outcome, as older adults are choosing to stay in the workforce longer.²¹ Furthermore, treatment options that enable patients to maintain greater workplace productivity can help defray direct costs of illness.

The purpose of this study was to examine the workplace productivity loss (measured by work absenteeism, short-term disability, and long-term disability days) among U.S. adult patients with an initial diagnosis of MM (IDMM) and estimate the resultant indirect costs due to productivity loss in these patients. These outcomes are compared among subjects who received oral versus injectable anticancer therapy in a retrospective cohort analysis. We hypothesized a greater indirect cost of illness posed by injectable versus oral chemotherapy agents.

Methods

Data Source

Analyses were conducted using the Truven Health Analytics MarketScan Commercial Claims and Encounters (CCAE) with Medicare Supplemental Coordination of Benefits and Health and Productivity Management (HPM) databases. These longitudinal datasets contain commercial claims from more than 100 million individual patients, including active employees, retirees, dependents of enrollees, and Medicare beneficiaries.²² Data elements include detailed information on prescription drug and

medical claims, as well as absenteeism and disability benefit utilization. Collectively, these data elements enable estimation of indirect costs among patients receiving various treatments. All observations were deidentified and validated by Truven Health Analytics to ensure completeness, accuracy, and compliance with the Health Insurance Portability and Accountability Act (HIPAA) of 1996. Consequently, approval of this research by an institutional review board was not mandated.

Sample Selection

Subjects aged at least 18 years with an IDMM between January 1, 2008, and December 31, 2014, were included in our study. MM diagnosis was identified using *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) codes 203.00, 203.01, 203.02. The date of the first claim that contained 1 of these diagnosis codes was considered the index date.²³

To enhance the specificity of selecting patients with MM, only subjects with at least 1 MM diagnosis code appearing in any inpatient claim or at least 2 MM diagnosis codes that appeared in outpatient claims and were 60-365 days apart were included. Also, subjects must have been continuously enrolled in a plan that included medical and disability benefits for 12 months before and after the index date to be included. Any evidence of another primary cancer (ICD-9-CM codes 140.xx-195.xx, 199.xx-202.xx, and 204.0x-209.xx) or metastatic disease (ICD-9-CM codes 196.xx-198.xx) before the index date warranted exclusion.

Once ascertained using these criteria, the MM study cohort was stratified according to 2 treatment types—recipients of oral chemotherapy and recipients of injectable chemotherapy only. The injectable chemotherapy stratum was selected on the basis of having at least 1 outpatient drug claim indicating a National Drug Code (NDC) number, Healthcare Common Procedure Coding System (HCPCS) code, or Current Procedural Terminology, 4th Edition (CPT-4), code corresponding to an injectable chemotherapy agent used in the treatment of MM during the study period. Consequently, this stratum contained subjects who used injectable chemotherapy, with or without oral chemotherapy agents.

The oral chemotherapy stratum was selected similarly, using NDC numbers and HCPCS codes corresponding to oral agents, but had no claims indicating injectable chemotherapy. Oral and/or injectable dosage forms of the following MM-specific chemotherapy drugs were included in our analysis: cyclophosphamide, melphalan, vincristine sulfate, doxorubicin hydrochloride, interferon alfa-2b, lenalidomide, pomalidomide, thalidomide, bortezomib, carfilzomib, ixazomib citrate, daratumumab, elotuzumab, panobinostat, bendamustine, vorinostat, and dexamethasone. HCPCS/CPT-4 codes and NDC numbers used to identify treatment type are shown in Appendix A and Appendix B, respectively (available in online article).

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Variables

Baseline descriptive characteristics were described for subjects in each stratum using the following variables: age; gender; plan type (health maintenance organization [HMO], point-of-service [POS], preferred provider organization [PPO], and other); employee status (i.e., full time, part time, and other); industry; and geographic region. Additionally, comorbidity burden before each subject's index date was measured using the Charlson Comorbidity Index (CCI) using ICD-9-CM diagnosis codes contained in outpatient and inpatient claims.^{24,25}

Productivity loss was evaluated using several key variables found within workplace absenteeism (WAB), short-term disability (STD), and long-term disability (LTD) claim files. A claim qualified for (a) STD, if it was for an extended period of absence, excluding weekend days, due to a particular diagnosis and was typically capped by employers at 6 months; (b) LTD, if it was for an extended period of absence, excluding weekend days, due to a particular diagnosis and typically occurred after STD benefits had ended; and (c) WAB, if it was for any days absent from work (e.g., sick, leave, recreational, other, or Family Medical Leave Act), except for those due to disability. Two variables—corresponding to the first day of missed work and first day of return to work for each patient claim—were used to obtain the number of absenteeism days for each patient. Workplace productivity loss (WPL), an aggregate of absenteeism days, was calculated using claims for WAB, STD, and LTD benefits.

Absenteeism days were captured at the month-level for each benefit type. Consequently, if patients used 2 benefits in a given month, it was not possible to discern exactly when each benefit was used within that month. When calculating WPL in these instances, absenteeism days linked to the most frequently used benefit were included in the measure; absenteeism days associated with any other benefit in that month were disregarded. For example, if a patient used 20 days of STD and 5 days of WAB in the same month, 20 days were counted for that entire month. This was done to yield a conservative measure of missed workdays (by avoiding the potential to double-count absenteeism days).

From the disease outcomes perspective, there is no evidence indicating injectable therapies (vs. oral therapies) have better outcomes beyond a 1-year period. Consequently, productivity loss is most likely better reflected in the short term following initial diagnosis. For this reason, outcomes were analyzed at the patient-month level throughout a 12-month baseline and 12-month follow-up period.

Estimated Costs of Productivity Loss

The financial burden of productivity loss was calculated in 2015 U.S. dollars for each patient-month by multiplying the number of absenteeism days (as indicated in the aggregate WPL measure) by the average daily wage for all occupations,

TABLE 1 Multipliers Used to Calculate Cost Burden of Workplace Productivity Loss

WAB	(Absenteeism days from aggregate WPL measure) $\times$ (1.3 ^a) $\times$ (23.23 ^b) $\times$ (8 ^c)
STD and LTD	(Absenteeism days from aggregate WPL measure) $\times$ (1.3 ^a) $\times$ (23.23 ^b) $\times$ (8 ^c) $\times$ (0.6 ^d)

^aAn adjustment to account for extra costs incurred by overstaffing—a measure frequently commissioned by companies to maintain company-wide productivity when employees become unavailable due to unforeseen events (e.g., illness or vacation).²¹

^bMean hourly wage across all occupations in the United States reported by the U.S. Bureau of Labor Statistics in May 2015.²⁰

^cNumber of hours in a typical work day.

^dSTD and LTD benefits generally cover 60% of the estimated value of a work day. LTD=long-term disability; STD=short-term disability; WAB=workplace absenteeism.

as reported by the U.S. Bureau of Labor Statistics.²⁶ In addition, multipliers corresponding to each benefit type, derived from a study conducted by Goetzel et al. (1999), were applied to account for extra costs incurred to maintain productivity during employee absenteeism (Table 1).²⁷ Data indicating the number of absenteeism days for each benefit were captured at the month-level. As explained above, when 2 benefits were used in a given month, the most frequently used benefit (and corresponding multiplier) was employed in our calculation, and any other benefit and its corresponding multiplier were disregarded. Monthly costs were calculated in the manner described here for each patient and subsequently summated for the 12 months following an IDMM diagnosis. The resultant figures were used in our statistical analyses to estimate differences in costs associated with productivity loss between study groups.

Statistical Analyses

The study cohort's baseline characteristics, categorical variables (e.g., gender) were described using proportions, and continuous variables (e.g., age) were described using the mean, median, and standard deviation. Student's t-tests and chi-square tests were used to evaluate differences in continuous and categorical variables between different study cohort groups, respectively. The rank sum test was used to evaluate differences in the median age across study groups.

Days of lost productivity and their associated economic value were compared using multivariable zero-inflated Poisson regression.²⁸ This model offered 2 benefits that were very important to our analysis. First, it explicitly accounted for the presence of large numbers of "zeros." Many patients actually did not use absenteeism days. The model accounted for this from a statistical perspective. Second, it allowed us to adjust for potential confounding variables, as one would do in a multivariable least squares regression. The following variables were used as covariates in the models: age, index year, gender, CCI, and plan type.

FIGURE 1 Application of Exclusion Criteria to Assemble Final Study Cohort

MM = multiple myeloma; SCT = stem-cell transplant.

All data management and analyses were carried out using StataMP, version 14.1 (StataCorp, College Station, TX).

Results

The attrition to the study cohort as each exclusion criterion was applied can be seen in Figure 1. A total of 90,238 individuals were aged at least 18 years and received an IDMM from 2008 to 2014 in our dataset. Of these, 299 patients met all selection criteria and were included in the final analytic cohort. In our cohort, patients who used oral chemotherapy only (n=73) had a mean age of 52 years and were mostly male (66%). Similarly, patients who used injectable chemotherapy (n=226) had a mean age of 51 years and were also mostly male (71%). Baseline characteristics of each study group are depicted in Table 2.

Of the overall cohort, 32% (n=96) used some form of disability benefit before an IDMM, compared with 63% (n=188)

after diagnosis. In the prediagnosis period, the most frequently used benefit was WAB (n=70), followed by STD (n=30) and LTD (n=1). Alternatively, in the postdiagnosis period, STD was the most frequently used benefit (n=143), followed by WAB (n=63) and LTD (n=24). Benefit use observed in each study group is summarized in Table 3. The average number of disability days used over the entire cohort was 25 days (median=0) in the year before diagnosis and 105 days (median=64) in the year after initial diagnosis ($P<0.001$ by t-test and rank sum test). Among patients who used any disability benefits, the median disability days used was 51 (mean=78) in the year before diagnosis and 154 (mean=167) in the year after initial diagnosis ($P<0.001$, rank sum test).

In the adjusted comparison of the number of missed work days, treatment type was a significant predictor of the number of missed work days per patient in the year following an IDMM

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TABLE 2 Characteristics of Multiple Myeloma Treatment Groups

	Oral Chemotherapy Users	Injectable Chemotherapy Users	P Value ^a
Sample size (n)	73	226	
Age at baseline, years			
Mean	52.0	51.4	0.579
Median	52.0	53.0	0.929
SD	5.4	7.2	
Age group, years, n (%)			0.153
18-44	7 (9.6)	40 (17.7)	
45-54	38 (52.1)	94 (41.6)	
55-64	28 (38.4)	92 (40.7)	
Sex, n (%)			0.374
Male	48 (65.8)	161 (71.4)	
Female	25 (34.3)	65 (28.6)	
Index year, n (%)			0.005
2009	13 (17.8)	14 (6.2)	
2010	11 (15.1)	28 (12.4)	
2011	15 (20.6)	31 (13.7)	
2012	13 (17.8)	46 (20.4)	
2013	15 (20.6)	57 (25.2)	
2014	6 (8.2)	50 (22.1)	
Region, n (%)			0.641
Northeast	14 (19.2)	51 (22.6)	
North Central	18 (24.7)	47 (20.8)	
South	23 (31.5)	83 (36.7)	
West	18 (24.7)	45 (19.9)	
Plan type, n (%)			0.092
HMO	12 (16.4)	26 (11.5)	
POS	2 (2.7)	24 (10.6)	
PPO	48 (65.8)	130 (57.5)	
Other	11 (15.1)	46 (20.4)	
CCI score, n (%)			0.171
0	32 (43.8)	90 (39.8)	
1	16 (21.9)	53 (23.5)	
2	7 (9.6)	44 (19.5)	
>3	18 (24.7)	39 (17.3)	

^aT-test was used to evaluate mean age and rank sum for median age; chi-square test was used for remaining categorical variables.

CCI=Charlson Comorbidity Index; HMO=health maintenance organization; POS=point-of-service; PPO=preferrred provider organization.

diagnosis. Patients who received injectable therapy missed an average of 110 work days. In contrast, patients receiving oral therapy missed an average of 87 work days. This difference was statistically significant (22.5 days, 95% CI=19-26, $P<0.001$). In the same multivariable model, older age was associated with fewer missed work days. Patients aged 45 years or older experienced an average of 26 fewer missed work days compared with individuals who were younger than 45 years (95% CI=-31-21 days, $P<0.001$). Additionally, patients with a CCI score greater than zero experienced on average 6.8 additional missed work days compared with patients whose CCI score was zero (95% CI=4.3-9.4, $P<0.001$).

Treatment type was also a significant predictor of costs associated with lost productivity. Patients who received injectable therapy experienced productivity loss valued at \$18,500, compared with patients who only received oral drug therapy (\$14,605). This difference was statistically significant (\$3,894, 95% CI=\$3,547-\$4,241, $P<0.001$). Patients aged between 45 and 54 years experienced \$2,302 less costs associated with productivity loss, on average (95% CI=-\$2,511-\$2,094, $P<0.001$) compared with patients aged less than 45 years. Patients aged 55 years and older experienced \$2,580 less costs associated with productivity loss (95% CI=-\$2,811-\$2,347, $P<0.001$) compared with patients aged less than 45 years. Additionally, patients with a CCI score greater than zero experienced an average of \$1,515 greater costs associated with productivity loss compared with patients whose CCI score was zero (95% CI=\$1,377-\$1,653, $P<0.001$).

Discussion

Loss of productivity is a significant contributor of financial hardship in patients with cancer. It has been estimated that up to 62% of cancer survivors report accruing debt due to their oncologic therapies, with average losses of productivity in the range of \$380 to \$8,236.²⁸ There is tremendous variability in the measurement of productivity loss in the published literature, including missed work days, limitations in housework or school, lost income, and time spent in bed.²⁹⁻³¹ Here, we present the first study to value productivity loss as measured by disability benefit use among MM patients receiving injectable versus oral chemotherapy. Although overall survival in patients with MM has significantly increased in the past decade due to improved treatments, this study demonstrates an increasing financial burden posed by MM therapies. Our findings highlight the importance of considering indirect costs alongside efficacy, safety, and direct costs during the treatment decision-making process.

The overall study cohort exhibited a use of 87-110 absenteeism days, on average, in the year following initial MM diagnosis, with higher use of absenteeism days for patients on injectable versus oral therapy. Average costs associated with these days ranged from approximately \$14,500 to \$18,000, depending on treatment type, with higher costs associated with patients on injectable therapy versus oral therapy. These results compare with a similar study conducted on breast cancer patients (60 absenteeism days valued at \$4,900) and patients with non-Hodgkin lymphoma (65 days valued at \$12,741).^{33,34} Productivity loss has also been evaluated with similar figures in patients with colorectal malignancies.³⁵

Comparisons among these studies should be interpreted with caution, however, since there is significant variability in the methodologies used to evaluate productivity loss. For example, our monetary figures were adjusted to account for overstaffing, while analogous estimations by Yu et al. (2016)

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TABLE 3 Productivity Loss and Associated Costs of Multiple Myeloma Patients Receiving Treatment

	Oral Chemotherapy Users (n = 73)	Injectable Chemotherapy Users (n = 226)	P Value ^a
Benefit users before diagnosis, n (%)			0.707
WAB	18 (24.7)	52 (23.0)	
STD	6 (8.2)	24 (10.6)	
LTD	0 (0)	1 (0.4)	
Benefit users after diagnosis, n (%)			0.830
WAB	17 (23.3)	46 (20.4)	
STD	35 (48.0)	108 (47.8)	
LTD	5 (6.9)	19 (8.4)	
Predicted number of missed work days in year after MM diagnosis, ^b days (95% CI)	87.2 (79.2-95.3)	109.7 (95.3-120.0)	<0.001
Predicted costs of missed work in year after MM diagnosis, ^b USD (95% CI)	\$14,605 (\$13,312-\$15,900)	\$18,500 (\$16,862-\$20,139)	<0.001

^aChi-square test was used to evaluate categorical variables.

^bParameter estimates from multivariable zero-inflated Poisson regression.

CI = confidence interval; LTD = long-term disability; MM = multiple myeloma STD = short-term disability; USD = U. S. dollars; WAB = workplace absenteeism.

were not.³⁴ Regardless, our findings demonstrate that an initial diagnosis with MM is related to a significant increase in absenteeism days used in the subsequent 12 months.

Consideration of the other sources of economic burden imposed by MM in the context of our findings is instructive. Several studies that evaluated the direct expenses of various MM treatments found an average monthly cost ranging from \$13,876 to \$47,417.^{36,37} These investigations demonstrate that the direct costs of treatment from the payer perspective are similar in magnitude to our estimates of indirect costs from the patient perspective.

The indirect costs associated with workplace absenteeism are significant and contribute to the overall economic burden of MM. Furthermore, our results showed that patients who received injectable therapy experienced a greater increase in lost productivity compared with patients who received oral therapy.

Limitations

There are several limitations associated with our analyses. Importantly, there are very limited clinical data in the Truven CCAE database, which reduced our capacity to establish clinical causes and conditions that led to the observed choices of therapy and subsequent differences in productivity loss. For example, patients may have had to take time off work due to various reasons including disease-related symptoms, treatment-related toxicities, travel time to and from the clinic, and for treatment administration. Because we did not have access to this information, our analysis is silent on these and related phenomena. As demonstrated in a previous study, complications and side effects of chemotherapy, such as neutropenia, have been shown to explain differences in short-term disability use.³⁸ Other potential explanatory factors that are not represented in the Truven database include the type of occupation, complexity of chemotherapy administration, and treatment response. Socioeconomic status was also unavailable

in our dataset and may have influenced the measured outcomes. For instance, subjects with high socioeconomic status may have exhibited more confidence in taking time off work. To address this, our multivariable model was adjusted for health-plan type, which could have captured some aspect of this potential confounder.

Our small sample size was an additional limitation, especially with respect to the number of patients receiving oral chemotherapy (n = 73). Although our estimations reached statistical significance, larger sample sizes would likely allot more representative figures, as well as enable an exploration of the relative differences in outcomes of each chemotherapy agent. Furthermore, our study population was among working adults in the United States with disability benefits. These results, therefore, may not be generalizable to other populations.

The scope of our study was limited to the consideration of productivity-related losses. Although these losses are important to patients and employers, the scope is somewhat limited and falls short of a full cost-effectiveness analysis. The requisite data sources to accomplish such an analysis were unavailable to us. Nevertheless, we feel this current work is a valuable contribution.

Conclusions

Future studies are needed to elucidate the conditions that lead to greater productivity loss among injectable chemotherapy users. Data that permit a larger sample size, more clinical details, and greater follow-up times would be helpful in tracking treatment outcomes of MM therapies. A more comprehensive picture, in this regard, may empower patients and clinicians with strategies to reduce the overall economic burden imposed by MM and, in turn, promote greater quality of care. This study examined the productivity loss and associated costs in the year following a new diagnosis of MM. The greater productivity loss observed among patients treated with

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injectable therapy may continue to persist over a longer time horizon (e.g., 2 or 3 years after diagnosis) as patients increasingly receive long-term treatment.

An initial diagnosis with MM is associated with an increased use of disability benefits in the year following initial diagnosis. Injectable chemotherapy use appears related to a greater use of disability benefits than oral chemotherapy use in the setting of this particular cancer.

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DISCLOSURES

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APPENDIX A HCPCS/CPT-4 Codes of MM-Specific Anticancer Agents Analyzed

Medication	HCPCS/Procedure Codes (Route of Administration)
Cyclophosphamide	J8530 (Oral), J9070 (Injectable), J9080 (Injectable), J9090-J9097 (Injectable)
Melphalan	J8600 (Oral), J9245 (Injectable)
Vincristine sulfate	J9370 (Injectable), J9375 (Injectable), J9380 (Injectable)
Doxorubicin hydrochloride	J9000 (Injectable), J9001 (Injectable)
Liposomal doxorubicin	J9002 (Injectable)
Interferon alfa-2b	J9214 (Injectable), S0146 (Injectable), S0148 (Injectable)
Bortezomib	J9041 (Injectable)
Carfilzomib	J9047 (Injectable)
Bendamustine	J9033 (Injectable)
Dexamethasone	J1094 (Injectable), J1095 (Injectable), J1100 (Injectable), J8540 (Oral), S0173 (Oral)
Prednisone	J7506 (Oral)

CPT-4 = Current Procedural Terminology, 4th Edition; HCPCS = Healthcare Common Procedure Coding System; MM = multiple myeloma.

**Costs Associated with Productivity Loss Among U.S. Patients Newly Diagnosed
with Multiple Myeloma Receiving Oral Versus Injectable Chemotherapy**

APPENDIX B NDC Numbers for MM-Specific Anticancer Agents Analyzed

Medication	Route of Administration	NDC Number
Bendamustine	Injectable	63459039120, 63459039008, 63459034804, 63459039602, 63459039502
Cyclophosphamide	Injectable	10019094510, 10019095701, 00015050541, 00781324494, 10019093601, 10019093650, 10019093901, 10019094401, 10019094450, 10019095601, 10019095616, 00015050641, 00781325594, 10019093701, 10019093710, 10019094201, 10019094501, 10019094510, 10019095701, 10019095711, 00015050241, 00781323394, 10019093501, 10019093525, 10019093801, 10019094301, 10019094325, 10019095501, 10019095550, 00013563601, 00013563670, 00015054812, 00015054841, 00013560601, 00013560693, 00015053941, 00013564601, 00013564670, 00015054912, 00015054941, 00013561601, 00013561693, 00015054641, 00013562601, 00013562693, 00015054712, 00015054741
	Oral	00015050401, 00054412925, 00054808925, 54569571200, 54868521800, 54868521801, 54868521802, 00015050301, 00015050302, 00054413025, 00054813025, 54569571300, 54868500500, 54868500501, 00054038225, 00054038325
Melphalan	Oral	00173004535, 52609000105, 54868433900, 54868433901, 54868433902, 54868433903, 54868433904, 59572030250
	Injectable	00173013093, 52609300100, 59572030101, 67457019501, 67457021501, 67457057901, 68152010900
Daratumumab	Injectable	57894050205, 57894050220
Elotuzumab	Injectable	00003229111, 00003452211
Pomalidomide	Oral	59572050100, 59572050121, 59572050200, 59572050221, 59572050300, 59572050321, 59572050400, 59572050421
Doxorubicin hydrochloride	Injectable	00013108691, 00069017001, 10019092001, 53905081010, 55390023110, 55390024110, 67457047810, 00015335322, 00013111601, 00013111683, 00013109601, 00013109691, 53905081110, 55390023210, 55390024210, 00013110601, 00013110679, 00015335222, 00069017101, 10019092102, 55390023301, 55390024301, 67457043650, 00013113601, 00013114601, 00013116601, 00013117601, 00013117687, 00013123691, 00013124691, 00013125679, 00013126683, 00013128683, 00069303020, 00069303120, 00069303220, 00069303320, 00069303420, 00069400405, 00069401510, 00069402625, 00069403001, 00069403101, 00069403201, 00069403301, 00069403401, 00069403701, 00703504001, 00703504301, 00703504303, 00703504601, 25021020705, 25021020725, 25021020751, 45963073355, 45963073357, 45963073360, 45963073368, 53150031410, 53150031501, 53150031701, 53150032010, 53905081310, 53905081410, 53905081501, 53905081601, 55390023510, 55390023610, 55390023701, 55390023801, 55390024510, 55390024610, 55390024701, 55390024801, 62756082640, 62756082740, 63323010161, 63323088305, 63323088310, 63323088330, 67457039300, 67457039354, 67457039400, 67457039410, 67457039525, 67457039610, 17314960001, 17314960002, 47335004940, 47335005040, 47335008250, 47335008350, 59676096001, 59676096002
Bortezomib	Injectable	63020004901
Carfilzomib	Injectable	76075010101
Ixazomib citrate	Oral	63020007801, 63020007802, 63020007901, 63020007902, 63020008001, 63020008002
Panobinostat lactate	Oral	00078065006, 00078065106, 00078065206
Vorinostat	Oral	00006056840
Interferon alfa-2b	Injectable	00085057102, 00085435001, 00085111001, 00085435101, 00085028502, 00085064705, 54868308501, 00085012002, 00085053901, 00085435201, 54868334100, 00085113301, 00085117901, 00085116801, 00085118401, 00085125401, 00085117902, 00085124201, 00085118402, 00085119102, 00085123501
Vincristine sulfate	Injectable	00013745601, 00013745686, 00013746686, 00703440211, 00703441211, 61703030906, 61703030916, 61703030925, 61703030926, 20536032201
Lenalidomide	Oral	59572041000, 59572041028, 59572041030, 59572041500, 59572041521, 59572042000, 59572042021, 59572042500, 59572042521, 59572042525, 59572040500, 59572040528, 59572040530, 59572040200, 59572040228
Thalidomide	Oral	59572021015, 59572021095, 59572021513, 59572021593, 59572022016, 59572022096, 59572010512, 59572010513, 59572010592, 59572010593, 59572020514, 59572020517, 59572020594, 59572020597

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**Costs Associated with Productivity Loss Among U.S. Patients Newly Diagnosed
with Multiple Myeloma Receiving Oral Versus Injectable Chemotherapy**

APPENDIX B NDC Numbers for MM-Specific Anticancer Agents Analyzed *(continued)*

Medication	Route of Administration	NDC Number
Dexamethasone	Oral	00054317644, 00472097208, 00472097233, 00603114556, 00603114756, 00677060142, 00904097209, 54569103400, 54879000308, 55045142801, 55289041004, 60346097731, 60432046600, 60432046608, 64679081008, 64980050924, 68850000108, 00054317757, 00054317763, 00054817716, 63629269601, 49884008301, 49884008310, 00006004168, 00054417925, 00054817925, 49884008401, 49884008410, 51655021277, 54868092700, 55045266502, 58016029000, 58016029002, 58016029003, 58016029012, 58016029015, 58016029020, 58016029030, 58016029073, 58016029089, 00006006368, 00054418025, 00054818025, 00247062407, 00247062412, 00247062420, 00247062421, 00247101004, 00247101012, 21695029030, 23490540401, 33261055830, 33261055860, 33261055890, 49884008501, 49884008510, 52959039201, 52959039212, 52959039221, 52959039228, 52959039230, 54569032200, 54569032203, 54569032205, 54868091600, 55045130804, 55045130805, 55289090310, 55289090312, 55289090320, 58016029300, 58016029312, 58016029315, 58016029320, 58016029330, 60346055012, 60346055015, 60346055030, 60713002810, 60713002815, 63629412901, 63874044401, 63874044412, 63874044415, 63874044420, 63874044421, 63874044430, 66267006612, 66267006630, 66336055012, 66336055021, 68115009612, 68115009614, 68387017221, 00006006312, 00254266706, 00603319111, 52959150421, 54569311000, 60904008527, 00054418125, 00054817425, 21695072812, 35356035930, 00054418225, 00054818125, 00603319221, 00904024560, 49884008601, 49884008610, 54868174400, 55700026321, 55700026355, 61919026921, 61919026955, 63629412701, 68115043510, 00095008635, 00095008651, 44183050735, 44183050851, 44183050921, 00054418325, 00054817625, 21695074510, 21695074512, 43063026607, 54569033601, 54569033603, 54868315700, 54868315701, 62682500002, 63874047104, 63874047105, 63874047110, 00006009750, 00054418425, 00054817525, 00677084901, 10544021206, 16590026906, 16590026910, 16590026960, 16590026972, 21695038204, 21695038206, 21695038208, 21695038220, 21695038260, 23490540701, 23490540702, 33261062502, 33261062530, 33261062560, 33261062590, 47463020230, 49884008701, 49884008703, 49884008710, 49999005906, 49999005930, 52959054704, 52959054710, 52959054711, 52959054712, 52959054716, 52959054720, 52959054730, 52959054750, 54569032402, 54569032404, 54569032406, 54569032407, 54569032409, 54569572900, 54868021800, 54868021801, 54868021802, 54868021803, 54868021804, 54868021805, 54868021806, 54868021807, 54868021808, 54868021809, 55045197001, 55045197002, 55045197004, 55045197005, 55045197008, 55048020230, 55289058204, 55289058206, 55289058210, 55289058228, 55887037730, 57866358101, 58016078100, 58016078110, 58016078112, 58016078114, 58016078115, 58016078120, 58016078121, 58016078124, 58016078128, 58016078130, 58016078140, 58016078150, 60346047906, 60346047908, 60346047915, 60346047919, 60346047950, 63629374201, 63629374202, 63629374203, 63874079501, 63874079510, 63874079512, 63874079514, 63874079515, 63874079520, 63874079521, 63874079524, 63874079528, 63874079530, 63874079540, 63874079550, 66267006704, 66267006708, 66267006710, 66267006712, 66267006720, 66267006721, 66336047906, 66336047915, 66336047921, 66336047940, 66336047960, 68115009720, 68115009730, 00054418625, 00054818325, 49884012901, 49884012903, 54868590300, 00095008921, 00095008735, 00095008851, 54868533400
	Injectable	54569395300, 62295305807, 00314089775, 00551011005, 54569142300, 54868397700, 62295305907, 62295305706, 45861013101, 63187034801, 76420076901, 63323050601, 63323050616, 00551017410, 00641036721, 00641036725, 00703352403, 23490541401, 68258896202, 00069017701, 00069017702, 00069454101, 00069454102, 00703352401, 54868609900, 63323051610, 67457042010, 00069019201, 00069019202, 00069454501, 00069454502, 00517493025, 21695084830, 23490541300, 23490541301, 54569304000, 54868087106, 55045321203, 55150023930, 63323016530, 67457042100, 67457042130, 00069017801, 00069017802, 00069454301, 00069454302, 00517490525, 54569302700, 54569302701, 54569464800, 54569464801, 54569464802, 54868087100, 55150023805, 63323016505, 63323016526, 67457042254, 68258897201, 68258897202, 68258897205, 00006762803, 00006762825, 00069017901, 00069017902, 00069454701, 00069454702, 00314089605, 00314089610, 00314089630, 00314089670, 00314089675, 00517490125, 00551003705, 00551003730, 00703350104, 00703351304, 49999043425, 54569157500, 54569472800, 55150023701, 63323016501, 63323016516, 66758050122, 67457042300, 67457042312, 76045010610, 00006764603, 45861013301, 76420076601, 45861013401, 76420081001, 45861013201, 76420076701

MM = multiple myeloma; NDC = National Drug Code.