Subject: The Impact of Depression on Medicare Inpatient Spending, Utilization, and Patient Cost Burden

**Abstract:**

In the literature, depression has been linked to increased overall patient healthcare costs and increased healthcare utilization. The goal of this study was to investigate how Medicare beneficiaries’ diagnosis of depression influences their medical costs, utilization, and Medicare's overall inpatient medical expenditure. To accomplish the aforementioned goal, I conducted an exploratory analysis of a sample of CMS's 2008–2010 Medicare Data Entrepreneurs' Synthetic Public Use File (DE-SynPUF). Throughout 2008-2010, Medicare's average inpatient payment for Medicare beneficiaries that did not have depression was more than their counterparts with depression ($9,892 vs $9,391, respectively). The difference in beneficiaries' healthcare costs without depression and those with depression was also negligibly different ($1,146 vs $1,142). The study also assessed the associations between sending and depression, as well as other variables that might impact Medicare's expenditure or members' inpatient utilization and cost. Interestingly, members with depression will utilize 0.37 (p<0.00) more inpatient days than those without depression. However, contrary to the literature, depression was negatively associated with Medicare spending (p<0.00) and members' healthcare costs. However, the results were not statistically significant for members' spending on healthcare costs.

**Background:**

Of older adults, about 15% suffer from clinically significant depressive symptoms (Fiske, et al., 2010). The prevalence of mental health issues over the years has increased staggeringly. Moreover, older adults are more likely to have depression along with other chronic conditions which also influence health expenditure (Fiske, et al., 2010; Klein & Hostetter, 2014). Due to increased knowledge about the negative effects of mental health on not only individual well-being but healthcare outcomes and expenditure, depression has become an increasing topic of focus in the literature (Figueroa, et al., 2020; Gauthier, et al., 2019; McCall, et al., 2002). In a study by Himelhoch et al. (2004), on depressive syndrome and chronic conditions among Medicare beneficiaries, older, white, and female beneficiaries were more likely to use medical inpatient hospital services as compared with those without depressive syndrome. Additionally, those with depressive syndrome and at least one other chronic condition increased the odds of using healthcare services altogether.

To address the issue described above, I investigated the differences in Medicare spending and members' personal healthcare between beneficiaries with depression and those without utilizing Medicare inpatient claims data from 2008 to 2010. Additionally, I will be investigating the differences in spending between individuals with depression only versus those members with depression and other chronic conditions. Finally, I will be conducting regression analyses to understand the relationships between depression and spending and costs; as well as to test the hypothesis that depression is associated with higher spending and utilization. This exploratory analysis can add to the existing literature on depression's impact on Medicare's expenditure and individual healthcare costs.

**Data and Variables:**

*Data:*

I began this analysis by utilizing publicly available data sets from 2008–2010 Medicare Data Entrepreneurs’ Synthetic Public Use File (DE-SynPUF). I utilized the Beneficiary Summary DE-SynPUF file with 112,754 synthesized beneficiary records and with 32 variables. Additionally, since I will only be utilizing inpatient claims for this analysis, I only utilized Inpatient Claims SynPUF data containing 66,773 beneficiary claims with 81 variables. To create a comprehensive data set both files were modified and joined using R statistical software. The data set utilized contained a total of 66,773 beneficiary records with 124 total variables. Within the variables of interest "N/A" observations were dropped, and variables of interest were re-coded from the original coding scheme (1= yes, 2= no) into a standard coding scheme for statistical analysis (1=yes, 0= no).

*Variables:*

To conduct a thorough exploratory analysis of the data set, various variables were created with the existing data. New race variables “WHTIE\_MEM”, “BLAC\_MEM”, “OTHER\_MEM”, and “HISPANIC\_MEM” were created from the existing variable “BENE\_RACE\_CD” to assess racial and ethnic differences more readily in regression analyses. Additionally, new variables for members with two (“CHRONIC\_CNT2”), three (“CHRONIC\_CNT3”), or more than four chronic conditions (“CHRONIC\_CNT4PLUS”) were created to investigate how chronic conditions were associated with spending. Similarly, a new variable was created to indicate if the member had depression and at least one other chronic condition named "CHRONIC\_CNT\_W\_DEPRESS\_YN". Finally, spending variables were created using different variables from inpatient claims with the direction of the Research and Data Assistance Center (Frank). To indicate the amount spent by Medicare on a beneficiary “Medicare\_Pay” was created for each beneficiary. beneficiary “Medicare\_Pay” was created by adding the inpatient claim payment amount (“CLM\_PMT\_AMT”) to claim pass through per diem amount (“CLM\_PASS\_THUR\_PER\_DIEM\_AMT”) multiplied by inpatient days (“CLM\_UTLZTN\_DAY\_CNT”). To indicate the amount spent by the member on healthcare “Person\_Cost” was created for each beneficiary. “Person\_Cost” was created by adding together the inpatient deductible (“NCH\_BENE\_IP\_DDCTBL\_AMT”), coinsurance liability amount (“NCH\_BENE\_PTA\_COINSRNC\_LBLTY\_AM”), and blood deductible liability amount (“NCH\_BENE\_BLOOD\_DDCTBL\_LBLTY\_AM”). Finally, to analyze differences between different years, inpatient claims data per year was separated and calculated by the variable “CLM\_THRU\_DT”.

**Statistical Analysis:**

I conducted a simple linear regression analysis between the independent variable “SP\_DEPRESS”, indicating the Medicare members with a diagnosis of depression, and the dependent variables created spending and cost variables from inpatient claims data. The dependent variables “Medicare\_Pay” and “Person\_Cost” were chosen because of the aforementioned research that depression is associated with higher out-of-pocket healthcare costs and overall economic burden. All individual regressions were conducted to see the separate relationship between them and the independent variable and the effect the independent variable has on Medicare spending and members' healthcare costs. Additionally, I also conducted a simple linear regression on the dependent variable “CLM\_UTLZTN\_DAY\_CNT”, the number of inpatient days on members' claims, and the independent variable “SP\_DEPRESS’’. This was also included in the analysis because I wanted to investigate the relationship between the diagnosis of depression and healthcare utilization.

Moreover, I conducted a multivariate regression analysis between the dependent variables, “Medicare\_Pay” and “Medicare\_Pay”, and the nineteen independent variables described above. A multivariate analysis was used to assess the relationship between each of the nineteen independent variables, while controlling for the others, and the dependent variable. This analysis controls the influence of the eighteen other variables on the number of depression visits when assessing the impact of the nineteenth, which a simple linear regression cannot account for, thereby allowing us to better predict the effect on Medicare payments and members' costs. Finally, all statistical analysis was conducted using R statistical software.

**Limitations:**

The generalizability of this study is minimal. The data utilized for the analysis are not representative of the whole U.S Medicare population. Additionally, the data utilized spanned from 2008-2010 synthetic claims data and not more recent claims data that is more representative of current healthcare costs.

**Study Results:**

*Demographics & Disease Burden:*

This sample population (n=64,914) is majority White and female (see Exhibit 1). The sample population has a high prevalence of 11 chronic conditions that were flagged within the data set. Some beneficiaries (90) suffer from all 11 chronic conditions. Within the sample population, 34 percent of Medicare Beneficiaries have depression only 1 percent have only depression while 33 percent have depression and at least one other chronic condition. This means that 97 percent of those suffering from depression also have a chronic condition. This is consistent with the literature.

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*Inpatient Medicare Payments:*

On average from, 2008 to 2010, Medicare’s inpatient payment for Medicare beneficiaries that did not have depression was $9,892 while their counterparts with depression were $9,391. From 2008 to 2010, the annual average spent by Medicare on members with depression was also not higher than with members without depression (see Exhibit 2). For members with depression and other chronic conditions, average spending was higher in 2008 and 2010. When breaking down by spending by the number of chronic conditions a beneficiary has in addition to depression, a clear trend in Medicare spending does not emerge.

Interestingly, on average from 2008 to 2010, the state with the highest average spending on members with depression was “Others” ($11,978). This category incorporates areas such as Puerto Rico and the Virgin Islands. However, when not accounting for the "Other" category, the state with the highest average spending is Vermont ($11,066), followed by North Dakota ($10,959), Maryland ($10,911), Nebraska ($10,800), and Kentucky ($10,536). For 2008, the state with the highest average spend was New Hampshire ($12,996), for 2009 Nebraska ($13,013), and in 2010 Vermont again ($20,840).

*Inpatients Patient Utilization & Cost Burden:*

When breaking down the average number of days beneficiaries spent inpatient, there seems to be no difference between members with depression versus those without (see Exhibit 2). Additionally, there is no difference in the average number of inpatient days utilized between those with depression only and those with depression and at least one other chronic condition. A difference between the average number of inpatient days utilized for chronic conditions in addition to depression does not begin to emerge until beneficiaries have seven other chronic conditions in addition to depression. Finally, there is no significant difference between the average inpatient costs of beneficiaries for those without depression, with depression, or those with depression and multiple chronic conditions.

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**Statistical Analysis Results:**

*Simple Linear Regressions:*

*Model 1:* *Medicare Payment-Depression:* The first regression with the explanatory variable depression had an R squared of 0.00, indicating the explanatory variable explains 0% of the variance in inpatient claims payment. The regression indicates that a Medicare beneficiary with depression is associated with -500.24 fewer dollars spent on inpatient claims than a beneficiary without depression. The result is statistically significant with a p-value of <.00 (see Exhibit 3).

*Model 2: Person Costs-Depression:* The explanatory variable depression was not statistically significant and explains 0% of the variation in inpatient claims payment. The regression indicates less cost to a Medicare beneficiary with depression than one without depression.

*Model 3:* *Inpatient Days (Utilization)-Depression:* The explanatory variable depression accounts for 0% of the variation in inpatient days. The regression indicates that a Medicare beneficiary with depression is associated with 0.37 more inpatient days utilized than a beneficiary without depression. The result is statistically significant with a p-value of <.00

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*Multivariate Regressions:*

*Model 4:* *Medicare Pay*: The multivariate regression with all nineteen explanatory variables had an R squared of 0.0036 indicating that our regression explains .36% of the variation in the number of depression visits (See Exhibit 4).

The explanatory variables Depression, Alzheimer's, Chronic Kidney Disease, Cancer, Chronic Obstructive Pulmonary Disease, and Osteoporosis were all statistically significant with a p-value of <0.05. The hypothesis test rejected the null, which indicated that these variables were not associated with Medicare inpatient expenditure. Chronic Kidney Disease and Cancer had positive relationships with Medicare inpatient expenditure, while variables Depression, Alzheimer, Chronic Obstructive Pulmonary Disease, and Osteoporosis had a negative relationship. The variables Diabetes, Rheumatoid Arthritis, and Osteoarthritis, White members, Black members, Other members, Chronic Condition Count =2, Chronic Condition Count =3 were all negative relationships, but were not significant with a p-value of >0.05. Congestive Heart Failure, Ischemic Heart Disease, Stroke/Transient Ischemic Attack, Sex, and Chronic Condition Count 4+, were all positive relationships but were not significant with a p-value of >0.05. The hypothesis test failed to reject the null hypothesis which indicated these variables were not associated with Medicare inpatient expenditure.

*Model 5: Person Cost:* The multivariate regression with all nineteen explanatory variables had an R squared of 0.0005 indicating that our regression explains .05% of the variation in beneficiaries' cost of healthcare.

For this model, only Chronic Kidney Disease, Chronic Obstructive Pulmonary Disease, and Black member variables were all statistically significant with a p-value of <0.05. The variables Chronic Kidney Disease and Chronic Obstructive Pulmonary Disease both had positive relationships indicating they lead to higher healthcare costs for Medicare beneficiaries. The variable Black members, however, have a negative relationship, indicating that a Medicare beneficiary who is Black has lower healthcare costs.

Depression, Alzheimer's, Congestive Heart Failure, Ischemic Heart Disease, Stroke/Transient Ischemic Attack, Diabetes, and Sex all had positive relationships but were not significant with a p-value of >0.05. Cancer, Osteoporosis, Rheumatoid Arthritis and Osteoarthritis, White members, Other members, Chronic Condition Count =2, Chronic Condition Count =3, and Chronic Condition Count 4+, were all negative relationships but were not significant with a p-value of >0.05.

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**Discussion and Conclusion:**

The analysis was consistent with the literature which demonstrated a higher prevalence of chronic conditions among those suffering from depression. However, the regressions of this analysis suggest depression might lead to less inpatient spending among Medicare beneficiaries. This goes against what was found in the literature. However, there is literature that also suggests that individuals suffering from depression are less likely to seek medical help or have a harder time accessing services. Additionally, the generated results suggested that those beneficiaries with depression will have slightly higher inpatient stays. Finally, when it comes to patient costs, Black Medicare beneficiaries are spending less on healthcare. This can be for many reasons including that they are less likely to be admitted to the hospital or seek medical help. An important thing to note, this study was unable to generate any results for Hispanic Medicaid Members during the multivariate analyses. Moving forward, the study can benefit from incorporating a larger sample of beneficiaries as well as including outpatient claims, carrier claims, and prescription drug events claims. The analyses of the different claims can bring greater insights into the differences in healthcare costs, utilization, and healthcare expenditure by incorporating other sites of care as well as the potential burden of drug costs on individuals with depression.

**Citations:**

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