The Relationship Between Insurance and Health Outcomes of Diabetes Mellitus Patients in Maryland: A Retrospective Archival Record Study

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Research Article

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Abstract

Background: Past studies examining the health outcomes of diabetes mellitus (DM) patients found that social determinants of health disparities were associated with variabilities in health outcomes. However, improving access to healthcare, such as health insurance, should mitigate negative health outcomes. The aim of the study was to explore the association between four types of health insurance, namely, Medicare fee-for-service (FFS), Medicare managed care (MC), private FFS, and private MC plans, on the health outcomes of DM patients, controlling for patients’ social determinants of health.

Methods: This is a retrospective cross-sectional archival record study to explore the relationships between types of health insurance and health outcomes of DM patients. Data was drawn from the 2012 Maryland Clinical Public Use Data and was exempt from our Institutional Review Board. Maryland residents who were at least 65 years old, with chronic DM were included in the study, resulting in a sample size of 43,519 individuals. Predictor variables were four types of insurance and health outcome variables were length of hospital stay (LOS), 30-day readmission rates, and end-stage renal disease (ESRD). Control variables included hospital characteristics, patient characteristics, and social determinants of health. Multiple hierarchical regression analysis was applied to test the association between insurance plans and LOS, while logistic regression analyses were applied to test the association between insurance plans with 30-day readmission and ESRD. Statistical significance was set at p < 0.05.

Results: After factoring out confounds from hospital characteristics, patient characteristics, and social determinants of health, Medicare FFS patients had the worst outcome for LOS, 30-day readmission, and ESRD rates. Although patients on Medicare MC plans had lower LOS, 30-day readmission, and ESRD rates compared to those on Medicare FFS, patients enrolled in private MC plans had the lowest odds of 30-day readmission and patients enrolled in private FFS had the lowest odds of ESRD.

Conclusions: The data suggests that insurance plans influence health outcomes of DM patients after considering their social determinants of health. Specifically, DM patients enrolled in managed care and private insurance plans had better health outcomes compared to those on Medicare FFS plans.

Introduction

Diabetes mellitus (DM) is a chronic illness in which there is no cure and patients require constant access to healthcare. Worldwide, the number of people with DM increased from 108 million in 1980 to 422 million in 2014, [1] with this number being projected to increase to 552 million by 2030 due to population growth, aging, urbanization, and the increased prevalence of obesity and physical inactivity.[2]

Although DM patients represented 9.4% of the US population in 2017, they accounted for 24.8% of hospitalizations.[3] Likewise, while the overall 30-day readmission rate of hospitalized patients in the US was 13.9%, the readmission rate for DM patients was 20.5% in 2014.[4] The social determinants of health among DM patients have been associated with health outcomes. Social determinants, such as socioeconomic status (SES), ethnicity, and other non-medical factors, such as physical and social environments, access to medical services, and social and health policies, influence health and mortality outcomes because benefits of medical advances may be more likely to flow to those with resources that enable them to avoid health risks or adopt protective strategies.[5-7] For example, DM patients who have lower SES are more likely to experience 30-day readmissions...
than other populations of DM patients. Improving access to healthcare would mitigate negative health outcomes. Hence, having health insurance provides DM patients with access to care to control their disease progression. We explored the association between types of insurance and health outcomes for a sample of DM patients.

In 2018, 91.5% of the U.S. population have health insurance. Private health insurance covered two-thirds, whereas public insurance, administered by the Centers for Medicare and Medicaid Services, covered the remaining one-third of the insured. Within public insurance, Medicare, a federal program, provides health coverage for the disabled and individuals 65 years or older. Medicaid, in contrast, is a state and federal program that provides health coverage for low-income individuals.

Between government and private insurance plans, Davis et al. found that Medicare beneficiaries under the age of 65 years were generally more satisfied with their healthcare coverage vis-à-vis those who were covered by private insurance. Medicare beneficiaries reported fewer problems obtaining access to care, greater confidence in their access, and fewer instances of financial hardship due to medical bills. Little is known about differences between Medicare beneficiaries over 65 years old with a chronic illness and those with private insurance. This study seeks to explore health outcome differences.

We choose a state with capitation funding to rule out limitations to healthcare access due to financial considerations. We contribute to the literature by clarifying results on the association between types of insurance plans and health outcomes of DM patients where the payment rate is the same to healthcare providers, which controls for financial considerations. We hope that our study will provide a clearer understanding of how different types of insurance are associated with the health outcomes for a sample of patients with a chronic illness who need constant access to healthcare for which financial considerations are controlled.

In both private and public insurance programs, enrollees can choose between fee-for-service (FFS) and managed care (MC) plans. In FFS plans, enrollees face no restrictions in their choice of healthcare providers, whereas those who choose MC plans are restricted to healthcare provider in specific networks. In FFS plans, healthcare providers are paid directly by the insurer for each individual service rendered to a patient. Concerns have been raised that this system has resulted in excessive prescriptions and test ordering. Over-diagnosis has been associated with poorer health outcomes from overtreatment, unnecessary therapies, or psychological suffering during invasive tests. Additionally, since patients can choose multiple healthcare providers for the same illness, fragmentation of care occurs because different healthcare providers may prescribe different care plans, which negatively impacts the patient’s health outcomes. In the MC plan, a specific amount is established for each insured person regardless of the number of procedures undertaken when the enrollee receives care from approved providers. To minimize the number of procedures, the healthcare provider actively manages the enrollee’s health. When enrollees receive care from approved providers, there is also a continuity of care and a single-point access of care, which prevent fragmentation of care and improve health outcomes. Health maintenance organizations, which provide MC plans, generally report lower overall rates of hospitalization, shorter LOS, and fewer repeated stays. Since MC enrollees with chronic diseases are required to participate in regular preventive visits and the single-point access provides continuity of care, it can be expected that DM patients will have better health outcomes compared to those who are enrolled in FFS plans.

Methods
Study Design, Data, and Sample

This was a retrospective, cross-sectional archival record study. Data was obtained from the 2012 Maryland Clinical Public Use Data.[1] Because this is a public data source containing no personal identifiers, no Institutional Review Board application was necessary to access the data for research purposes.

We choose Maryland as the site for our study because this state applies the same capitation model for all enrollees in government insurance plans. Past studies that include variables on social determinants of health were confounded by financial considerations, which influence the access to and level of care due to costs. In Maryland, a federal waiver exempts hospitals in the state from the national Medicare fee schedule. As a result, Maryland hospitals are placed under the same payer system to contain cost growth, improve access to care, and implement payment innovations. Consequently, confounds in utilization rates and differences in the restriction of care between Medicare FFS and Medicare MC patients are minimized because the payment rate to healthcare providers in Maryland is the same for both groups of patients.[16]

The data included 694,488 patients who were hospitalized in Maryland hospitals in 2012. Among these patients, 85,712 (12.3%) were diagnosed with DM. We limit the DM sample to those who were at least 65 years old who had the opportunity to choose between Medicare and private insurance. We excluded Medicaid enrollees because it is not a federal-only insurance program but involves state partnership. The final sample for analysis included 43,519 DM patients comprising 37,825 Medicare FFS, 1,926 private FFS, 2,736 Medicare MC, and 1,032 private MC patients.

Outcome Variables

Three health outcomes were examined in this study. The first was hospital length of stay (LOS) measured in days, which indicates the efficiency and quality of hospital care.[17] Related to quality of care is the 30-day readmission from the indexed DM-related discharge, which was coded as 1 for yes and 0 for no. The third outcome was whether the patient was hospitalized as having end-stage renal disease (ESRD), which was coded as 1 for yes and 0 for no. ESRD is a costly and disabling condition associated with DM.[18]

Control and Predictor Variables

Three groups of control variables were included in the analysis as they have influence on health outcomes even though they were not the focus of this study. The first group of control variables were related to hospital characteristics where the patient received care. Specifically, hospital size and teaching status have been associated with access to specialists and resources, which influence health outcomes.[11] Hospital size was coded as 1 if the hospital had more than 400 beds and as 0 otherwise. Operating costs increase for hospitals with over 400 beds due to diseconomies of scale.[19] The teaching status of the hospital was coded as 1 if the hospital is an academic teaching hospital and as 0 otherwise. 30-day mortality rate was found to be lower in teaching hospitals compared to non-teaching hospitals.[20]

The second group of control variables that were related to health outcomes but were not the focus of this study were the patients’ demographics, behavioral and biological factors. Age, measured in years, was included because almost 80% of US adults 65 years and older have some form of dysglycemia, which has significant implications for DM.[21] Gender, coded as 1 for male and 0 for female, was included because DM is more
common among men. Marital status, measured as 1 for married and 0 otherwise, was included because unmarried individuals tend to have higher health risks than their married counterparts. Smoking, measured as 1 for smoking and 0 otherwise, has been associated with increased risk of Type 2 DM. Asthma, measured as 1 for asthma and 0 otherwise, and tuberculosis, measured as 1 for tuberculosis and 0 otherwise, were included because DM was associated with impaired pulmonary function. Depression, measured as 1 for depression and 0 otherwise, was included because mood has been associated with adherence to medication regimens for glycemic control. Finally, obesity, measured as 1 for obesity and 0 otherwise, is associated with DM because obese individuals secrete resistin, a hormone that causes insulin resistance.

The third group of control variables were the patients’ social determinants of health. The first variable was SES. Since the 2012 Maryland Clinical Public Use Data did not provide the patients’ income data, we used the patients’ zip codes to approximate average household income in accordance with common practices in the literature. A second variable was the size of the patients’ residential neighborhood. Patients who live in metropolitan areas, with populations greater than 1 million people, were coded as living in Urban Neighborhoods and were coded as 1 to reflect the degree of congestion and access to community resources and 0 otherwise. Rural areas have fewer physicians per capita than urban areas, which indicate inequitable healthcare access. A third variable was race, measured as two dichotomous variables, White and Black, because race and ethnicity significantly affect health outcomes due to food insecurity, which can affect glycemic control. By controlling for social determinants of health disparities that has traditionally been the result of a lack of insurance access, we limit selection bias associated with financial considerations that include only healthier patients who have access to insurance and healthcare.

Our predictor variables were the four different types of insurance plans: Medicare FFS, Medicare MC, private FFS, and private MC insurance plans.

Statistical Analysis

To partial out the effects of the control variables, we used multiple hierarchical regression analysis to estimate the effects of insurance plans for LOS and logistic hierarchical regression analyses to estimate for 30-day readmission and ESRD. Hierarchical regression analysis determines whether insurance plans explained additional variance on the outcome variables, after hospital characteristics, patient demographics, behavioral and biological factors, and social determinants of health were considered. We entered the data in incremental blocks of information first by hospital characteristics, second by patient demographics, behavioral and biological factors, third by social determinants of health, and fourth by insurance to separate the various influences on the outcome variables. We report the standardized regression coefficients or beta, which considers the standard errors of the regression coefficients, for multiple regression analysis and Odds Ratio for logistic regression analyses, which indicates the likelihood that an outcome results from the influence of the predictor variable. An Odds Ratio below 1.0 indicates a likelihood of less than 100% that an outcome will occur, whereas an Odds Ratio above 1.0 indicates a likelihood greater than 100% that an outcome will occur.

[1] https://hscrc.maryland.gov/Pages/hsp-data-request.aspx

Results
Table 1 shows the descriptive statistics of the variables. The mean LOS in our sample was 4.45 days, with a standard deviation of 4.18 days, the mean percentage of patients who were readmitted within 30-days after discharge was 15.71%, and 5.09% of patients were hospitalized with ESRD.

Table 1: Descriptive Statistics

| Variable                                      | Mean   | Std. Deviation |
|-----------------------------------------------|--------|----------------|
| Hospitals with over 400 beds (%)              | 32.97  |                |
| Teaching hospital (%)                         | 35.47  |                |
| Age (years)                                   | 76.87  | 7.813          |
| Male (%)                                      | 44.18  |                |
| White (%)                                     | 63.30  |                |
| African American (%)                          | 32.25  |                |
| Married (%)                                   | 44.85  |                |
| Income ($)                                    | $70,103.46 | $25,408.93    |
| Urban Neighborhood over 1m people (%)         | 60.41  |                |
| Smoking (%)                                   | 14.69  |                |
| Asthma (%)                                    | 16.00  |                |
| Tuberculosis (%)                              | 8.35   |                |
| Depression (%)                                | 10.22  |                |
| Obesity (%)                                   | 25.37  |                |
| Environmental Hazards (%)                     | 0.33   |                |
| Medicare Fee-for-Service (%)                  | 86.92  |                |
| Medicare Managed Care (%)                     | 6.29   |                |
| Private Fee-for-Service (%)                   | 4.43   |                |
| Private Managed Care (%)                      | 2.37   |                |
| Length of Stay (LOS) days                     | 4.45   | 4.183          |
| End Stage Renal Disease (ESRD) (%)            | 5.09   |                |
| 30-day Readmission (%)                        | 15.71  |                |

n=43,519

Table 2 shows the hierarchical linear regression results of insurance on LOS after factoring out hospital characteristics, patient demographics, behavioral, and biological factors, and social determinants of health. Table 2 shows that patients who enrolled under Medicare FFS had significantly longer LOS at p < 0.01, while patients who enrolled under Medicare MC, Private FFS, and Private MC had significantly lower LOS at p < 0.05
after factoring out hospital characteristics, patient demographics, behavioral, and biological factors, and social determinants of health.
### Table 2: Influence of Insurance on LOS

|                      | Base Model | Medicare Fee-for-Service | Medicare Managed Care | Private Fee-for-Service | Private Managed Care |
|----------------------|------------|--------------------------|-----------------------|-------------------------|----------------------|
|                      | Beta       | p-value                  | Beta                  | p-value                 | Beta                 | p-value              |
| Block 1: Hospital Type |            |                          |                       |                         |                      |
| Hospital with >400 beds | 0.04       | <0.001                   | 0.04                  | <0.001                  | 0.02                 | <0.001              |
|                      |            |                          | 0.04                  | <0.001                  | 0.04                 | <0.001              |
|                      |            |                          |                       |                         |                      |
| Block 2:              |            |                          |                       |                         |                      |
| Patient Demographics, Behavioral, and Biological Factors |            |                          |                       |                         |                      |
| Age (years)           | 0.03       | <0.001                   | 0.03                  | <0.001                  | -0.04                | <0.001              |
|                      |            |                          | 0.03                  | <0.001                  | 0.03                 | <0.001              |
| Male                 | -0.01      | 0.01                     | 0.01                  | 0.92                    | 0.03                 | <0.001              |
|                      |            |                          | 0.03                  | <0.001                  | 0.01                 | 0.96                |
| Married              | -0.04      | <0.001                   | -0.04                 | <0.001                  | -0.02                | <0.001              |
|                      |            |                          | -0.02                 | <0.01                   | -0.04                | <0.001              |
| Smoking              | 0.03       | <0.001                   | 0.03                  | <0.001                  | -0.01                | 0.30                |
|                      |            |                          | 0.03                  | <0.001                  | 0.03                 | <0.001              |
| Asthma               | -0.01      | 0.12                     | -0.01                 | 0.12                    | -0.03                | <0.001              |
|                      |            |                          | -0.01                 | 0.12                    | -0.01                | 0.12                |
| Tuberculosis         | 0.09       | <0.001                   | 0.09                  | <0.001                  | -0.03                | <0.001              |
|                      |            |                          | 0.09                  | <0.001                  | 0.09                 | <0.001              |
| Depression           | -0.02      | <0.001                   | -0.02                 | <0.001                  | -0.01                | <0.01               |
|                      |            |                          | -0.01                 | <0.01                   | -0.02                | <0.001              |
| Obesity              | 0.01       | 0.13                     | 0.01                  | 0.14                    | 0.11                 | <0.001              |
|                      |            |                          | 0.01                  | 0.14                    | 0.01                 | 0.13                |
| Block 3: Social Determinants |            |                          |                       |                         |                      |
| White                | -0.02      | 0.16                     | -0.02                 | 0.15                    | -0.06                | <0.001              |
|                      |            |                          | -0.02                 | 0.15                    | -0.02                | 0.15                |
| African American     | -0.01      | 0.62                     | -0.01                 | 0.59                    | 0.07                 | <0.001              |
|                      |            |                          | -0.01                 | 0.59                    | -0.01                | 0.60                |
| Income               | -0.01      | 0.11                     | -0.01                 | 0.15                    | -0.01                | 0.84                |
|                      |            |                          | -0.01                 | 0.15                    | -0.01                | 0.12                |
| Urban Neighborhood   | -0.03      | <0.001                   | -0.03                 | <0.001                  | 0.01                 | 0.03                |
|                      |            |                          | -0.03                 | <0.001                  | 0.01                 | 0.03                |
| Environmental Hazards| 0.01       | 0.01                     | 0.01                  | 0.01                    | -0.01                | <0.01               |
|                      |            |                          | 0.01                  | <0.01                   | 0.01                 | <0.01               |
| Block 4:             |            |                          |                       |                         |                      |
|                      | 0.01       | <0.01                    | -0.01                 | 0.01                    | -0.01                | 0.03                |
|                      |            |                          | -0.01                 | 0.01                    | -0.01                | 0.02                |
Table 3 shows the hierarchical logistic regression results of insurance on 30-day readmission rate after factoring out hospital characteristics, patient demographics, behavioral, and biological factors, and social determinants of health. Table 3 shows that patients who enrolled under Medicare FFS had a significantly higher likelihood of being readmitted within 30 days (OR = 1.16, p < 0.001) while patients who enrolled under Medicare MC (OR = 0.88, p = 0.03) and Private MC (OR = 0.75, p < 0.01) had significantly lower likelihood of being readmitted within 30 days after discharge from the indexed DM admission. Patients who enrolled under Private FFS did not reach a level of significance for 30-day readmission at p < 0.05. Thus, the data indicates that DM patients who were 65 years or older who enrolled in Private MC had the lowest likelihood among the four types of insurance plans to be readmitted while those who enrolled in Medicare FFS had the highest likelihood of being readmitted within 30 days.
|                      | Base Model | Medicare Fee-for-Service | Medicare Managed Care | Private Fee-for-Service | Private Managed Care |
|----------------------|------------|--------------------------|-----------------------|-------------------------|----------------------|
|                      | Odds Ratio | p-value                  | Odds Ratio            | p-value                 | Odds Ratio           | p-value               | Odds Ratio            | p-value                 | Odds Ratio           | p-value               |
| Constant             | 0.10       | <0.001                   | 0.10                  | <0.001                  | 0.11                 | <0.001               | 0.11                 | <0.001                  | 0.11                 | <0.001               |
| Block 1: Hospital Type |           |                          |                       |                         |                      |                      |                      |                         |                      |                      |
| Hospital with >400 beds | 1.00      | 0.97                     | 1.00                  | 0.96                    | 1.00                 | 0.94                 | 1.00                 | 0.97                    | 1.00                 | 0.99                 |
| Teaching hospital    | 0.78       | <0.001                   | 0.79                  | <0.001                  | 0.79                 | <0.001               | 0.78                 | <0.001                  | 0.78                 | <0.001               |
| Block 2: Demographics & Medical |           |                          |                       |                         |                      |                      |                      |                         |                      |                      |
| Age (years)          | 1.00       | 0.47                     | 1.00                  | 0.75                    | 1.00                 | 0.47                 | 1.00                 | 0.57                    | 1.00                 | 0.647                |
| Male                 | 1.01       | 0.77                     | 1.01                  | 0.70                    | 1.01                 | 0.77                 | 1.01                 | 0.74                    | 1.01                 | 0.74                 |
| Married              | 0.92       | <0.01                    | 0.93                  | <0.01                   | 0.92                 | <0.01                | 0.93                 | <0.01                   | 0.93                 | <0.01                |
| Smoking              | 1.11       | <0.01                    | 1.10                  | <0.01                   | 1.11                 | <0.01                | 1.10                 | <0.01                   | 1.10                 | <0.01                |
| Asthma               | 1.01       | 0.69                     | 1.02                  | 0.69                    | 1.02                 | 0.69                 | 1.01                 | 0.70                    | 1.01                 | 0.69                 |
| Tuberculosis         | 1.49       | <0.001                   | 1.49                  | <0.001                  | 1.49                 | <0.001               | 1.49                 | <0.001                  | 1.49                 | <0.001               |
| Depression           | 1.13       | <0.01                    | 1.13                  | <0.01                   | 1.13                 | <0.01                | 1.13                 | <0.01                   | 1.13                 | <0.01                |
| Obesity              | 1.02       | 0.55                     | 1.02                  | 0.58                    | 1.02                 | 0.56                 | 1.02                 | 0.56                    | 1.02                 | 0.56                 |
| Block 3: Social Determinants |           |                          |                       |                         |                      |                      |                      |                         |                      |                      |
| White                | 1.77       | <0.001                   | 1.76                  | <0.001                  | 1.76                 | <0.001               | 1.76                 | <0.001                  | 1.76                 | <0.001               |
| African American     | 1.56       | <0.001                   | 1.57                  | <0.001                  | 1.57                 | <0.001               | 1.56                 | <0.001                  | 1.56                 | <0.001               |
| Income               | 1.00       | <0.01                    | 1.00                  | <0.001                  | 1.00                 | <0.001               | 1.00                 | <0.01                   | 1.00                 | <0.01                |
| Urban Neighborhood   | 1.28       | <0.001                   | 1.28                  | <0.001                  | 1.28                 | <0.001               | 1.28                 | <0.001                  | 1.28                 | <0.001               |
| Environmental Hazards| 0.88       | 0.59                     | 0.88                  | 0.59                    | 0.88                 | 0.59                 | 0.88                 | 0.59                    | 0.88                 | 0.58                 |
| Block 4: Insurance   | 1.16       | <0.001                   | 0.88                  | 0.03                    | 0.93                 | 0.25                 | 0.75                 | <0.01                   |                      |                      |
Table 4 shows the hierarchical logistic regression results of insurance on ESRD after factoring out hospital characteristics, patient demographics, behavioral, and biological factors, and social determinants of health. Table 4 shows that patients who enrolled under Medicare FFS had significantly higher likelihood of ESRD (OR = 1.44, p < 0.001) while patients enrolled under Medicare MC (OR = 0.83, p = 0.03), Private FFS (OR = 0.28, p < 0.001), and Private MC (OR = 0.58, p < 0.01) had significantly lower likelihood of having ESRD. Thus, the data indicates that DM patients who are 65 years or older who enrolled in Private FFS had the lowest likelihood while those enrolled under Medicare FFS had the highest likelihood among the four types of insurance to be hospitalized for ESRD.
|                           | Base Model | Medicare Fee-for-Service | Medicare Managed Care | Private Fee-for-Service | Private Managed Care |
|---------------------------|------------|--------------------------|-----------------------|-------------------------|----------------------|
|                           | Odds Ratio | p-value                  | Odds Ratio p-value    | Odds Ratio p-value      | Odds Ratio p-value   |
| Constant                  | 0.25       | <0.001                   | 0.21                  | <0.001                  | 0.26                 | <0.001 |
| Block 1: Hospital Type    |            |                          |                       |                         |                      |
| Hospital with >400 beds   | 1.27       | <0.001                   | 1.27                  | <0.001                  | 1.27                 | <0.001 |
| Teaching hospital         | 0.82       | <0.01                    | 0.83                  | <0.01                   | 0.82                 | <0.01  |
| Block 2: Demographics & Medical |         |                          |                       |                         |                      |
| Age (years)               | 0.98       | <0.001                   | 0.98                  | <0.001                  | 0.98                 | <0.001 |
| Male                      | 1.33       | <0.001                   | 1.34                  | <0.001                  | 1.33                 | <0.001 |
| Married                   | 0.85       | 0.001                    | 0.85                  | 0.001                   | 0.85                 | 0.001  |
| Smoking                   | 0.94       | 0.35                     | 0.94                  | 0.36                    | 0.94                 | 0.34   |
| Asthma                    | 0.68       | <0.001                   | 0.69                  | <0.001                  | 0.68                 | <0.001 |
| Tuberculosis              | 0.48       | <0.001                   | 0.48                  | <0.001                  | 0.48                 | <0.001 |
| Depression                | 0.78       | <0.01                    | 0.77                  | <0.01                   | 0.77                 | <0.01  |
| Obesity                   | 2.58       | <0.001                   | 2.58                  | <0.001                  | 2.58                 | <0.001 |
| Block 3: Social Determinants |         |                          |                       |                         |                      |
| White                     | 0.52       | <0.001                   | 0.51                  | <0.001                  | 0.52                 | <0.001 |
| African American          | 1.53       | <0.001                   | 1.53                  | <0.001                  | 1.54                 | <0.001 |
| Income                    | 1.00       | 0.74                     | 1.00                  | 0.63                    | 1.00                 | 0.79   |
| Urban Neighborhood        | 1.12       | 0.04                     | 1.12                  | 0.04                    | 1.12                 | 0.04   |
| Environmental Hazards     | 0.57       | 0.28                     | 0.56                  | 0.27                    | 0.57                 | 0.27   |
| Block 4: Insurance        | 1.44       | <0.001                   | 0.83                  | 0.03                    | 0.28                 | <0.001 |
|                           |            |                          |                       |                         |                      |
Discussion

This study explored the association between insurance and health outcomes among DM patients who were 65 years or older. To rule out confounds on health outcomes that arise from hospital characteristics, patient demographics, behavioral, and biological, and their social determinants of health, we factored out these confounds in the regression analyses. The data indicated that patients who enrolled in Medicare FFS had significantly worse health outcomes in terms of LOS, 30-day readmissions, and ESRD compared to those enrolled in the other three types of insurance. Patients who enrolled in Private MC had the lowest likelihood of experiencing a 30-day readmission, while patients who enrolled in Private FFS had the lowest likelihood of having ESRD.

Given the cross-sectional nature of the data from a single year, we were limited by the ability to determine causality among the factors associated with health outcomes for DM patients 65 years and older. Since the data is publicly de-identified hospital discharge data, collecting follow-up data on patients’ characteristics, such as their income and other SES data, was challenging. Public discharge data also did not record the segmentation of private health plans by socioeconomic categories, which makes it difficult to determine whether high deductible plans were selected by individuals who fall into higher socioeconomic categories because they provide access to Health Saving Accounts with tax advantages.

Nevertheless, given the data restrictions, the results indicate that the selection of insurance choices was associated with health outcomes for a sample of older patients with DM. Future research could mitigate some of these unanswered questions by utilizing longitudinal data. Additionally, a future study could validate the results by examining data for a different chronic illness for which insurance plans and patient characteristics could also play important roles on health outcomes.

Conclusion

The data suggests that Medicare fee-for-service plans where enrollees in the government insurance plan face no restrictions in their choice of healthcare providers had worse health outcomes in terms of length of hospital stay, 30-day readmission, and end-stage renal disease rates compared to those enrolled in Medicare managed care plans or private insurance plans. Public policy could be made to provide incentives for older population with DM to transfer their enrollment to Medicare managed care or private insurance plans. There could even be greater public-private health partnerships with insurance companies and healthcare providers to mitigate the health risks of those with chronic illnesses.

Abbreviations

DM = diabetes mellitus
FFS = fee-for-service
MC = managed care
LOS = length of stay
ESRD = end-stage renal disease
Declarations

- Ethics approval and consent to participate: Not applicable because data is drawn from Maryland Clinical Public Use Data
- Consent for publication: Not applicable because this public data has been deidentified
- Availability of data and materials: Data is found in this link: https://hscrc.maryland.gov/Pages/hsp-data-request.aspx
- Competing interests: The authors declare no competing interests
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- Authors’ contributions: Soo-Hoon Lee analyzed and interpreted the data and was a major contributor in writing the manuscript. Sam Brown accessed the data, contributed to the writing of the manuscript. Andrew A. Bennett coded the data for analysis. All authors read and approved the final manuscript.
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