Increased Persistency in Medication Use by U.S. Medicare Beneficiaries With Diabetes Is Associated With Lower Hospitalization Rates and Cost Savings

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OBJECTIVE — To assess the relationship between annual fills for antidiabetes medications, ACE inhibitors, angiotensin II receptor blockers (ARBs), and lipid-lowering agents on hospitalization and Medicare spending for beneficiaries with diabetes.

RESEARCH DESIGN AND METHODS — Using Medicare Current Beneficiary Survey data from 1997 to 2004, we identified 7,411 community-dwelling beneficiaries with diabetes, who contributed 14,317 person-years of data for the analysis. We used multivariate regression analysis to estimate the effect of persistency in medication fills on hospitalization risk, hospital days, and Medicare spending.

RESULTS — For users of older oral antidiabetes agents, ACE inhibitors, ARBs, and statins, each additional prescription fill was associated with significantly lower risk of hospitalization, fewer hospital days, and lower Medicare spending.

CONCLUSIONS — These results suggest an economic case for promoting greater persistency in use of drugs with approved indications by Medicare beneficiaries with diabetes; however, additional research is needed to corroborate the study’s cross-sectional findings.

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Approximately 25% of Medicare beneficiaries have diabetes (1). In 2002, the average beneficiary with diabetes spent $15,292 on medical services including $2,349 for prescription medications (1). The economic burden of diabetes is huge—$27 billion in 2007 (2) rising to possibly $190 billion by 2020 (3).

Recent studies suggest that better medication management for older individuals with diabetes not only improves health (4) and reduces mortality (5), but also has the potential to reduce future medical care costs (6) and may be cost saving to the Medicare program (4–5, 7–9).

In this article, we examine annual prescription fill rates for antidiabetes medications, ACE inhibitors, angiotensin II receptor blockers (ARBs), and lipid-lowering agents among Medicare beneficiaries with diabetes between 1997 and 2004. We then test to determine whether increased utilization is associated with lower hospitalization rates and savings in traditional Medicare services.

RESEARCH DESIGN AND METHODS — The study uses Medicare Current Beneficiary Survey (MCBS) data. Cases were selected based on self-reported diabetes or the presence of an ICD-9 code for diabetes and complications (250.xx), polyneuropathy in diabetes (357.2), diabetic retinopathy (362.01, 362.02), or diabetic cataract (366.41) on one hospital, skilled nursing facility, or home health claim or any of these codes on two outpatient or physician claims following a validated protocol (10,11). These selection criteria resulted in a sample of 7,411 individuals with diabetes who contributed 14,317 annual observations for the analysis.

We used MCBS prescription medication files to identify users of the following seven drug classes: older oral antidiabetes drugs (metformin and sulfonylureas), newer oral agents (thiazolidinediones, meglitinides, and α-glucosidase inhibitors), insulins, ACE inhibitors, ARBs, statins, and other lipid-lowering medications (ezetimibe, fibrates, niacin, and others). The primary explanatory variable in our analysis is the annual number of prescription fills per class per year.

We assessed the effect of prescription fill rates for users of each drug class on the risk of hospitalization, total annual hospital days, and spending on Medicare services measured in constant 2006 dollars, using the Consumer Price Index (12). Covariates included an extensive list of demographic, socioeconomic, and health status indicators (see Table A1 in the online appendix available at http://care.diabetesjournals.org/cgi/content/full/dc08-1311/DC1).

We estimated seven regression models, one per drug class, for each of the three dependent variables using person-year as the unit of analysis and the full set of covariates listed in the online appendix. Because the study subjects frequently used medications in two or more drug classes, we included fill rates for all seven drug classes in each equation. This procedure assured that the parameter coefficient on prescription fills for the subset of users of a particular drug class was conditioned on utilization of the other medication classes.

We used logistic regression for the hospitalization models and Poisson regression for the hospital day equations. For the Medicare spending models, we used a generalized linear equation with a
The regression results are summarized in Table 1. Overall, we found a consistent inverse relationship between prescription fills and the dependent variables for older oral antidiabetes drug use was statistically significant in every case. Each added fill for ARB users reduced hospitalization risk by 1.3%, reduced the number of hospital days by 0.04 days, and reduced Medicare spending by $159. User rates varied widely across the seven drug classes. Annual prevalence of older oral antidiabetes agents reduced user rates ranging from 27.4% for users of older oral antidiabetes medication users and 47.1% compared with 13.3% for ARBs (8.5), with annual fills hovering around 6.1%. The highest average annual fill was for older antidiabetes drug classes ranging from 5.6 to 28.6. The marginal effects of prescription fills on the change in inpatient days ranged from 0.02 to 0.10 days, with all other variables held at their mean values.

### Table 1—Descriptive statistics and regression results of the relationship between prescription fills by drug class, hospitalization, hospital days, and Medicare spending for Medicare beneficiaries with diabetes, 1997–2004

| Drug classes                          | Number of drug users | Mean ± SD annual prescription fills | Unadjusted hospitalization risk | Conditional marginal effect of an additional prescription fill on probability of hospitalization | Unadjusted mean ± SD | Conditional marginal effect of an additional prescription fill on inpatient days | Unadjusted mean ± SD | Conditional marginal effect of an additional prescription fill on Medicare spending |
|--------------------------------------|----------------------|-------------------------------------|---------------------------------|------------------------------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------|----------------------|----------------------------------------------------------------------------------|
| Older oral antidiabetes agents*      | 6,747 (47.1)         | 8.3 ± 5.6                           | 27.4                            | -0.3 (-0.5 to -0.04)*                                                                 | 2.8 ± 8.4           | -0.04 (-0.06 to -0.02)                                                     | 8,565 ± 16,937       | -71 (-114 to -28)                                                                |
| Newer oral antidiabetes agents       | 1,910 (13.3)         | 5.8 ± 4.7                           | 30.8                            | 0.1 (-0.5 to 0.7)                                                                                     | 3.5 ± 10.1          | -0.02 (-0.06 to -0.02)                                                     | 10,436 ± 19,533       | 66 (-41 to 174)                                                                  |
| Insulins                             | 875 (6.1)            | 6.0 ± 5.1                           | 34.9                            | -0.6 (-1.5 to 0.2)                                                                                   | 6.1 ± 13.9          | 0.03 (-0.03 to 0.10)                                                      | 16,950 ± 28,412       | 27 (-165 to 219)                                                                 |
| ACE inhibitors                       | 5,490 (38.4)         | 6.5 ± 4.0                           | 32.3                            | -0.9 (-1.3 to -0.5)*                                                                 | 3.6 ± 9.5           | -0.07 (-0.10 to -0.04)*                                                   | 19,533 ± 28,412       | -164 (-238 to -91)                                                                |
| ARBs                                | 1,724 (12.0)         | 5.9 ± 3.8                           | 31.3                            | -1.3 (-2.0 to 0.6)*                                                                                 | 3.6 ± 9.7           | -0.12 (-0.16 to -0.07)*                                                   | 19,847 ± 28,412       | -159 (-284 to -34)                                                                |
| Statins                              | 4,641 (32.4)         | 6.0 ± 3.8                           | 29.5                            | -0.5 (-0.9 to -0.04)*                                                                               | 3.1 ± 9.1           | -0.05 (-0.09 to -0.02)*                                                   | 20,509 ± 28,412       | -107 (-193 to -21)                                                                |
| Other lipid-lowering agents          | 936 (6.5)            | 5.3 ± 3.8                           | 28.3                            | -9‡                                                                                                   | 2.7 ± 8.0           | -0.07 (-0.14 to 0.00)                                                     | 9,828 ± 20,012        | -48 (-204 to 108)                                                                 |

*Includes metformin and sulfonylureas. †P < 0.05, significant difference; ‡P < 0.001, significant difference; §P < 0.01, significant difference.¶Includes thiazolidinediones, meglitinides, and α-glucosidase inhibitors.

Estimate failed to converge.
per drug fill measured in 2006 dollars. The average unit cost of an older oral anti-diabetes agent was $49 (in constant 2006 dollars) for our study sample or $22 less than the estimated saving associated with an additional fill. For ACE inhibitors and ARBs, the estimated unit costs were $58 and $71, significantly lower than the estimated Medicare savings per fill of $154 and $159, respectively.

CONCLUSIONS — We find consistent evidence that more persistent use of older oral antidiabetes drugs, ACE inhibitors, ARBs, and statins is associated with greater risk of hospitalization and lower spending for traditional Medicare services by beneficiaries with diabetes. These findings are consistent with previous research showing that underuse of these agents is associated with greater risk of hospitalization and higher medical costs for individuals with diabetes (5,7–9,15). The study results suggest a case for promoting greater use of drugs with approved indications by Medicare beneficiaries with diabetes; however, additional research is needed to corroborate the study’s cross-sectional findings.

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