

# Diabetes Medication Adherence Association with Hospitalizations and Total Cost of Care

## Background

- Diabetes medication non-adherence has been associated with substantial morbidity and mortality.<sup>1</sup>
- Prime's 2010 commercial book of business diabetes drug cost trends identified the following:<sup>2</sup>
  - Diabetes was 7.8% of all pharmacy benefit expenditures;
  - Generic utilization rate was 42.8%, relatively unchanged compared to 2009 (42.1%);
  - Overall 2010 ingredient costs per Rx were \$87.26 (brand \$145.93 and generic \$8.96);
  - Brand ingredient per Rx annual growth rate has been 8.8% over the last three years increasing from \$115 in 4Q2007 to \$150 in 4Q2010, one of the fastest growing categories excluding specialty.
- A 2005 study using 1997 to 1999 medical and pharmacy claims administrative data from a single employer found that individuals who were ≥80% adherent with their diabetes medication were significantly less likely to be hospitalized and had lower medical costs compared to individuals with lower levels of adherence.<sup>3</sup>
- In 2011, CVS Caremark published a study utilizing 2005 to 2008 medical and pharmacy data examining the relationships of adherence on hospitalizations and medical costs among individuals with an average age of ≥65. The authors concluded that despite higher adherence to diabetes medications resulting in higher pharmacy costs, the reductions in hospitalizations and emergency department use were associated with lower medical costs.<sup>4</sup>

- The cost analyses presented above are limited in their generalizability because data were from a single employer<sup>2</sup> or representative of a retiree population.<sup>4</sup>

## Objective

- To compare one year all cause hospitalization rates, medical costs and pharmacy costs among individuals adherent and non-adherent to their diabetes medications.

## Methods

- This retrospective concurrent cohort study utilized integrated administrative medical and pharmacy claims data from a commercial Blue Cross and Blue Shield (BCBS) Plan in the Central US with approximately 1.3 million lives with Prime Therapeutics pharmacy benefit coverage.
- Members were required to be continuously enrolled from January 1, 2007 to December 31, 2009.
- Medical claims were first queried for the presence of a primary or secondary field coded claim for diabetes (ICD-9-CM 250.xx) at any time in 2007 through 2009.
- Figure 1 shows the study timeline and an example member with a medical index date found in 2008.
- The index date was determined by the presence of two separate office visits for diabetes at least 30 days apart in 2008 (using the later visit of the two) or if they had a hospitalization for diabetes in 2008.
- On their index date, a member was required to have diabetes medication supply or be considered a high risk diabetes member. High risk was defined as the presence of a primary field coded medical claim in the year prior to

## Results

- 667,589 members were continuously enrolled January 1, 2007 to December 31, 2009 and 15,043 members met inclusion and exclusion criteria. Figure 2 shows the flow of members in the study.
- The mean total medical and pharmacy costs were \$11,628 for all 15,043 members.
- 11,108 (73.8%) members had a diabetes medication PDC of ≥80%, 3,935 had a PDC of <80%:
  - 552 (3.7%) PDC 0% to 19%, 520 (3.5%) PDC 20% to 39%, 984 (6.5%) PDC 40% to 59%, 1,879 (12.5%) PDC 60% to 79%

### Cost Analyses (Figure 3)

- Overall average total one year costs were \$571 higher in the adherent group (\$11,777, standard deviation [SD] \$14,216) compared to the non-adherent group (\$11,206, SD \$15,096).

their index date for any of the following diabetes associated microvascular diseases: renal manifestations, ophthalmic manifestations, neurological manifestations, peripheral circulatory disorders (ICD-9-CM 250.4x through 250.79).

The presence of a primary or secondary field coded medical claim for depression or bipolar disorder (ICD-9-CM 296.xx, 311.xx) was identified in the pre period (365 days before the index date) for each member and used as a control variable in the analysis.

The following member characteristics were derived and used as covariates: Charlson Comorbidity Index score<sup>5</sup>, count of unique non-diabetes medications on index date calculated using generic product identifier (Medi-Span), and income using ZIP code-level census data.

- Members meeting inclusion criteria were followed for one year post index date and all pharmacy and medical claims during the follow-up year were identified.
- Adherence was assessed using the proportion of days covered (PDC) method for the 365 day post period. All diabetes medications were included

- Medical costs were \$1,010 lower in the adherent group (\$7,079, SD \$12,999) compared to the non-adherent group (\$8,089, SD \$13,915):
  - For ≥80% PDC: inpatient costs were \$1,719, outpatient costs were \$5,360
  - For <80% PDC: inpatient costs were \$2,141, outpatient costs were \$5,948
- Pharmacy costs were \$1,582 higher in the adherent group (\$4,699, SD \$3,528) compared to the non-adherent group (\$3,117, SD \$3,244).

### Unadjusted Analyses

- Members with a PDC <80% were significantly more likely to have a hospitalization in the year after their index date,  $p = 0.025$  for PDC ≥80% group versus 60% to 79% group, and  $p < 0.001$  for all other groups (Figure 4).
- Members with a PDC ≥80% had a significant 2.8 percentage point lower rate of at least

one hospitalization in the one year follow-up compared to members with a PDC <80%,  $p < 0.001$ .

- All medical and pharmacy claim total allowed amounts (plan and member) were summed to determine total cost of care.
- Members were excluded if their total medical costs or total pharmacy costs exceeded the 99<sup>th</sup> percentile (\$120,300 for total costs and \$22,300 for pharmacy costs).
- Members were also excluded from the analysis if they were not 18 years of age or older on their index date or if at any time in the three year study period they had a medical claim indicating a pregnancy or a nursing home stay.

### Statistical Analysis

- Statistical assessment of the relationship between adherence and all cause hospitalization was done with chi-square (unadjusted) and logistic regression adjusting for age, sex, Charlson risk score, insulin use at baseline, unique number of non-diabetes drug classes used at baseline and zip code income.
- For costs, t-test (unadjusted) and multiple linear regression were performed using the same covariates.

one hospitalization in the one year follow-up compared to members with a PDC <80%,  $p < 0.001$ .

### Multivariate Regression Results

- Using multivariate logistic regression adjusting for covariates identified in the methods, the adherent group was associated with a significantly lower hospitalization rate, odds ratio 0.69, 95% confidence interval, 0.61 to 0.78.
- Multiple linear regression costs of care comparisons also demonstrated statistically significant differences in the adherent group compared to the non-adherent group:
  - Significantly lower medical costs in the adherent group,  $p < 0.001$
  - Higher pharmacy costs in the adherent group,  $p < 0.001$
  - Higher total cost of care in the adherent group,  $p < 0.001$

Figure 1. Study Timeline and Example Member Timeline

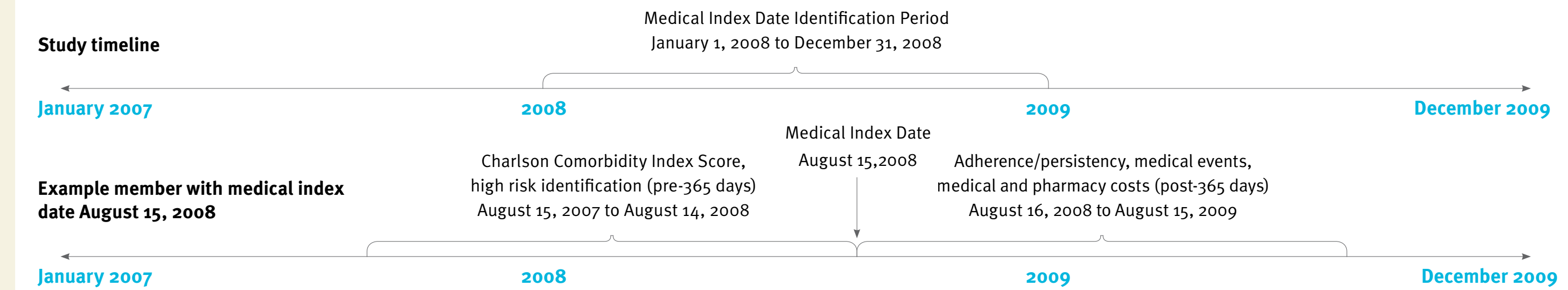


Table 1. Member Characteristics

	PDC <80% n=3,935	PDC ≥80% n=11,108	P Value*
Males (%)	2,187 (55.6%)	6,685 (60.2%)	<0.001
Average age (SD)	52 (11.4)	55 (10.0)	<0.001
Average Charlson Comorbidity Index Score (SD)	2.0 (1.7)	1.8 (1.4)	<0.001
Zip code level median household income 1999 (SD)	\$45,777 (\$14,972)	\$45,925 (\$14,227)	0.585
Insulin supply on index date (%)	1,018 (25.9%)	2,291 (20.6%)	<0.001
Medical claim for depression or bipolar disorder (%)†	281 (7.1%)	624 (5.6%)	<0.001
Average count on index date of non-diabetes drugs (SD)	6.0 (4.6)	6.5 (4.3)	<0.001
Average count on index date of diabetes drugs (SD)	1.0 (0.6)	1.6 (0.8)	<0.001
High risk members (%)‡	935 (23.8%)	1,347 (12.1%)	<0.001

PDC = proportion of days covered  
SD = standard deviation  
\* Pearson chi-square used for categorical variables and Student's t-test for continuous variables  
† medical claim found (ICD-9-CM 296.xx or 311.xx) in the 365 days before the index date  
‡ medical claim found for diabetes associated microvascular diseases: renal, ophthalmic, or neurological manifestations, or peripheral circulatory disorders (ICD-9-CM 250.4x through 250.79) in the 365 days before the index date

Figure 2. Analyzable Population Identification

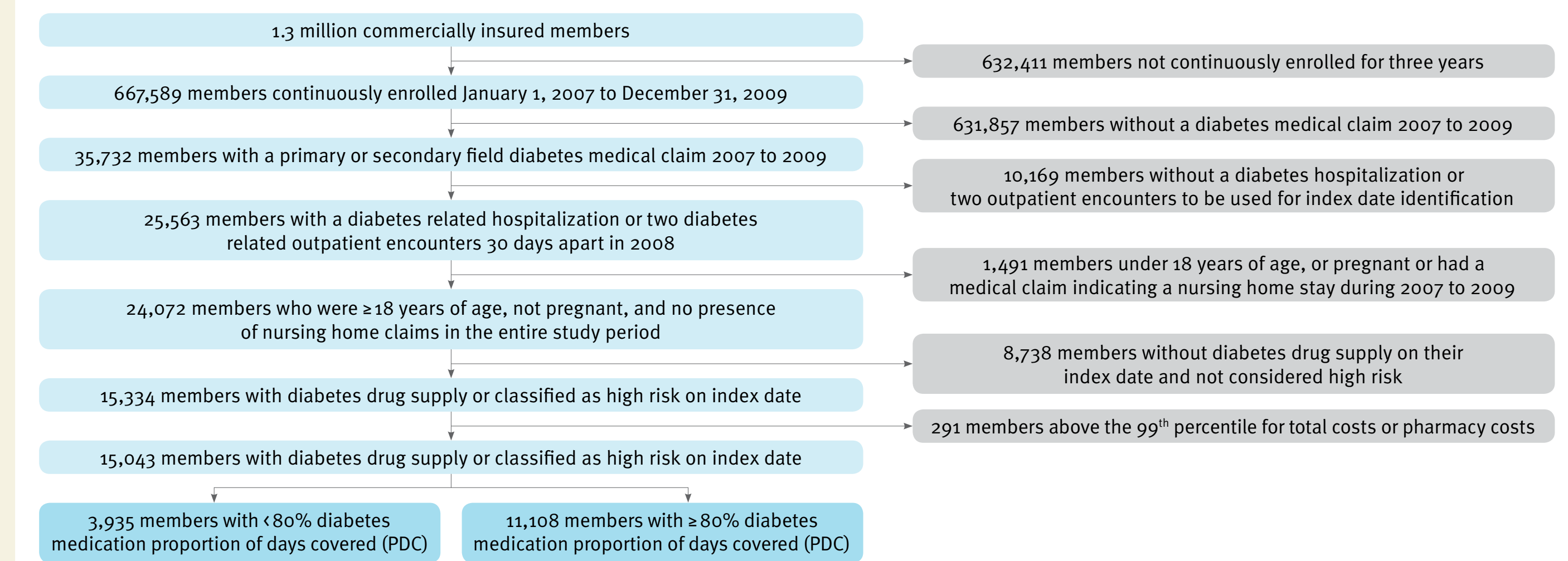


Figure 3. Total One Year Cost of Care by Diabetes Medication Adherence

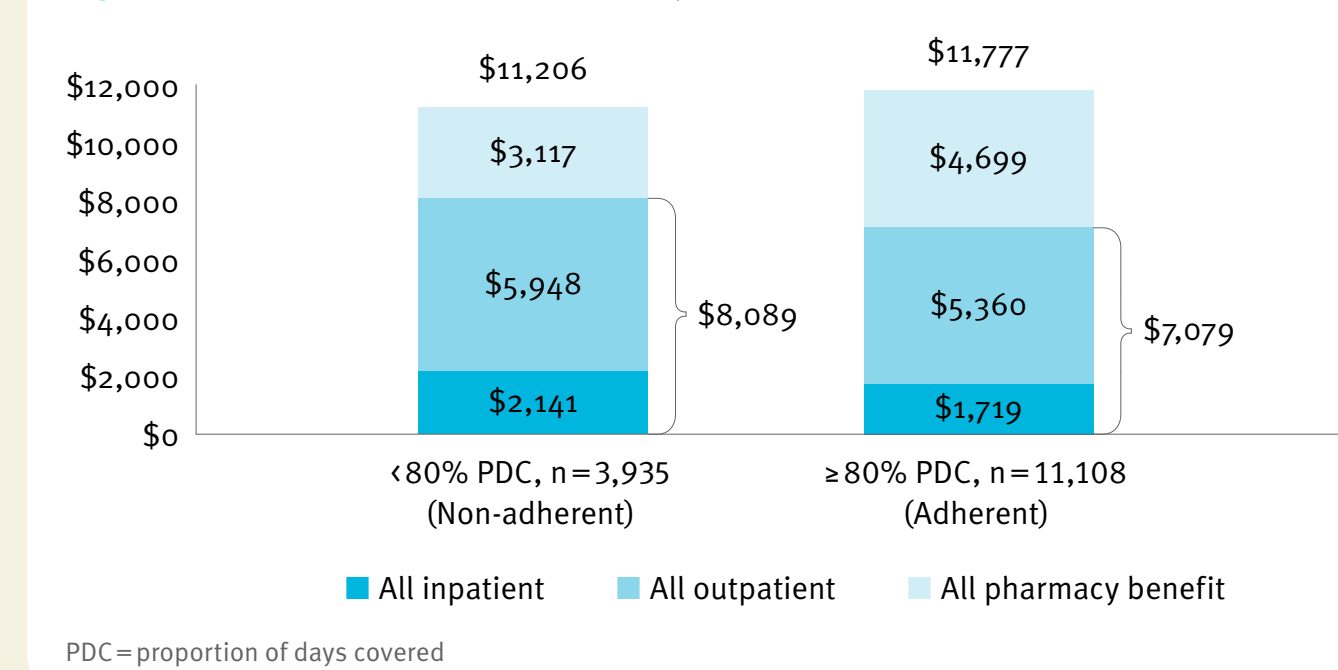
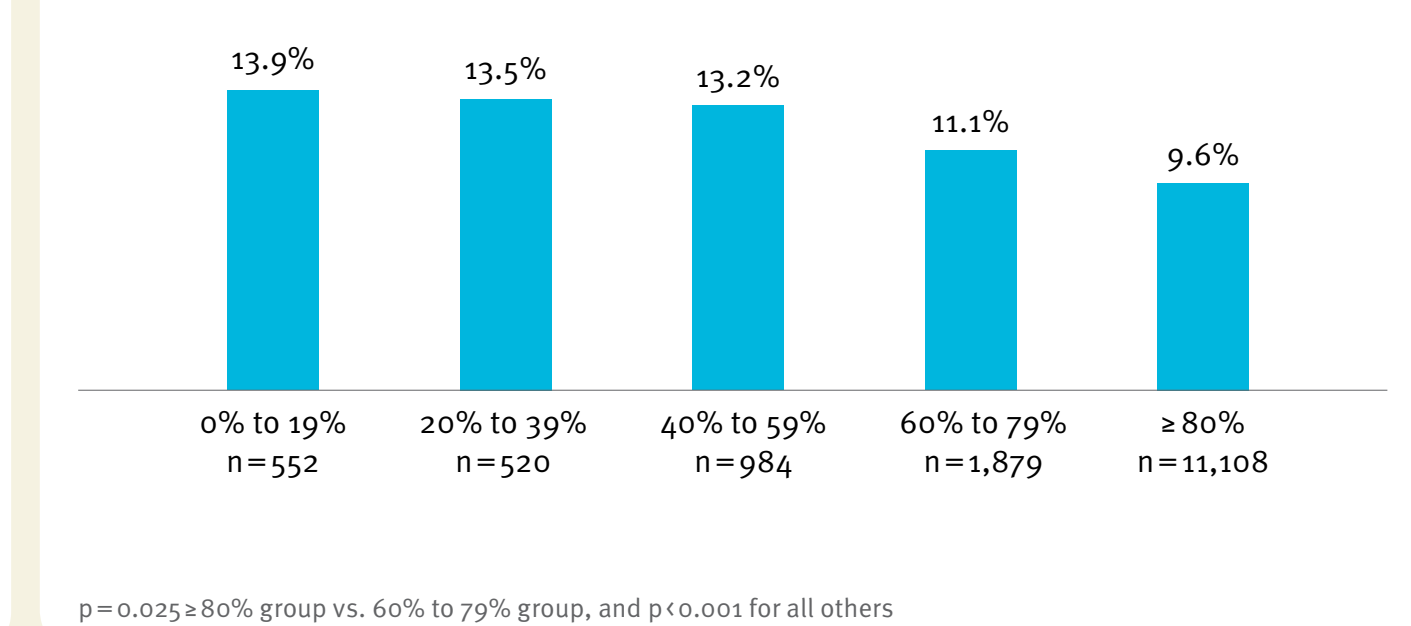


Figure 4. All Cause Hospitalization Rate During One Year Follow-up by Diabetes Medication Adherence



## Limitations

- Administrative pharmacy and medical claims have the potential for miscoding and include assumptions of member actual medication use and diagnosis, therefore the data may represent information that is false-positive or -negative.
- Data are limited to a commercial population in the Central US; therefore findings may not be generalized to Medicare or Medicaid populations or other geographic regions.
- Members with high medical or pharmacy costs (above the 99<sup>th</sup> percentile) were excluded from the analysis and as a result, our findings may not represent all actual costs.
- Individuals who adhere to medications may also have healthier lifestyle behaviors that we were unable to control. Differences found in medical events and costs between the adherent and non-adherent populations may be influenced by healthier lifestyles.
- We defined adherence using the PDC ≥80% which is an arbitrary cut point, however this cut point has frequently been used in previous research.

## Conclusions

- Our findings are consistent with previous research identifying an association between diabetes medication adherence and lower all cause hospitalization rates. In this study of a commercially insured population, diabetes medication adherence was associated with a statistically significant 31% lower hospitalization rate and lower medical costs.
- In individuals with diabetes, total annual cost of care was higher in the adherent group. These higher total costs were the result of higher pharmacy costs off-setting lower medical costs. These findings differ from previous research potentially due to population differences including younger age, recent increases in antidiabetic agent utilization and brand drug price inflation.
- Future research is needed to assess the relationship between adherence and total costs of care.

## References

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