

# Relationships between Zip Code Level Social Determinants of Health and Diabetes Medication Adherence

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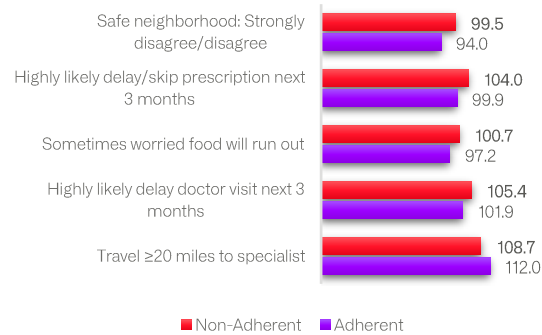
## Study Summary

**Study Question:** How are geographic location-based social determinants of health (SDoH) related to patient adherence to oral antidiabetic medications?

**Study Design:** Diabetic patients who were adherent and non-adherent to oral antidiabetic drugs were identified from 2017-2021 Merative™ MarketScan® Commercial and Medicare Databases. SDoH data obtained from Merative™ PULSE® Healthcare Survey were linked to study patients by 5-digit zip code and compared between two treatment adherence groups.

### Study Results

#### Top 5 Zip Code Level SDoH Differentiators



**Conclusion:** Zip code level SDoH data adds insight into the differences in medication adherence for chronic conditions like diabetes.

## Background

- Treatment adherence is important for effectiveness in maintaining glycemic control in diabetes<sup>1</sup>. However, failure to maintain adequate adherence to treatment is common among diabetic patients<sup>1, 2</sup>.
- Social and environmental factors are possible factors affecting treatment adherence<sup>3</sup>. However, SDoH are often absent in commonly used real-world data sources.

## Objective

- To compare zip code level SDoH between diabetic patients who are adherent and non-adherent to oral antidiabetic medications.

## Methods

### Study Design and DataSource

- Diabetic patients and their medication adherence were captured from 2017-2021 MarketScan® Commercial and Medicare Databases. The databases included fully adjudicated medical claims for inpatient and outpatient healthcare services along with outpatient pharmacy claims and enrollment data.
- SDoH data was obtained from Merative™ PULSE® Healthcare Survey, which examines more than 80 healthcare utilization and attitude topics and has been conducted with an average of 80,000 consumers in the United States each year since 1988<sup>4</sup>.

## Methods

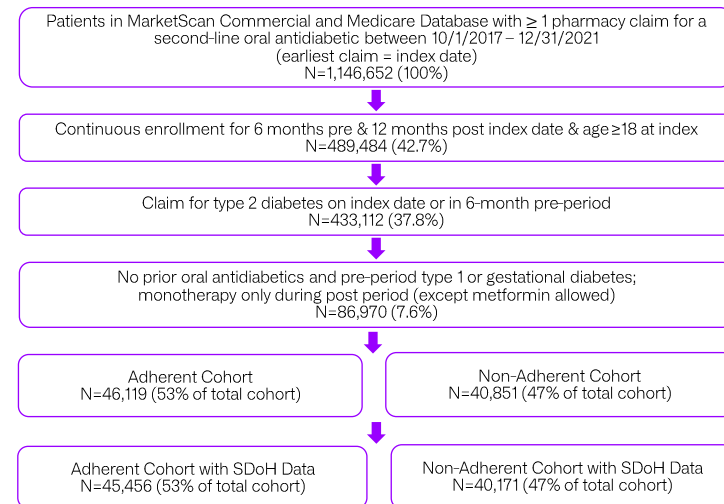
### Study Design and DataSource, Cont.

- SDoH data was summarized at the 5-digit zip code level and linked to study patients based on zip code information available in the internal version of MarketScan.

### Patient Selection

- Type 2 diabetes patients who newly initiated oral antidiabetic monotherapy between 10/1/2017 and 12/31/2021 and met all inclusion/exclusion criteria were selected.
- Patients were stratified into adherent versus non-adherent cohorts based on the medication possession ratio during 12-month post-period ( $\geq 0.8$  = adherent,  $< 0.8$  = non-adherent) (Figure 1).

Figure 1. Patient Selection



### Outcomes

- Mean relative scores for SDoH measures based on the PULSE Survey were calculated at the zip code level (Table 2)
  - Survey results were mapped onto PRIZM block groups<sup>5</sup> → Census tract → Zip code (using HUD USPS Crosswalk files<sup>6</sup>).
  - Zip code level SDoH score was normalized where 100 represented the national average.
- Zip code level scores derived from the PULSE/PRIZM survey results were assigned to study patients based on their 5-digit zip code in MarketScan.

### Analysis

- Bivariate analyses were conducted. Categorical variables were presented as the count and percentage; continuous variables were summarized by mean and standard deviation.
- Chi-square tests and t-tests were used to evaluate the statistical significance of differences for categorical and continuous variables, respectively.
- Cohen's d was employed to assess the effect size and 0.2, 0.5, and  $\geq 0.8$  were considered as having small, medium, and large effect.

## Results

- 86,970 patients met the study selection criteria, 85,627 lived in zip codes with available SDoH data. Sample included 53% treatment adherent and 47% non-adherent patients (Figure 1).
- Compared to the non-adherent cohort, the adherent patients were slightly older, more likely to be male. Pre-period Charlson comorbidity index and healthcare costs were similar between two cohorts (Table 1).

Table 1. Patient Characteristics\*

Patient Characteristics	Adherent		Non-Adherent		P-value
	N/Mean	%/SD	N/Mean	%/SD	
Age (Mean, SD)	54.7	9.6	53.3	11.3	<0.001
Male (N, %)	28,017	60.7%	22,970	56.2%	<0.001
<b>Top 3 Geographic regions (N, %)</b>					<0.001
South	23,729	51.5%	22,637	55.4%	
North Central	10,797	23.4%	8,986	22.0%	
West	5,973	13.0%	4,928	12.1%	
<b>Top 3 Insurance plan types (N, %)</b>					<0.001
EPO/PPO	22,841	49.5%	21,302	52.1%	
CDHP/HDHP	10,118	21.9%	8,258	20.2%	
HMO	7,316	15.9%	5,943	14.5%	
<b>Payer, Commercial (N, %)</b>	43,142	93.5%	36,960	90.5%	<0.001
<b>Charlson Comorbidity Index (Mean, SD)</b>	1.6	1.3	1.6	1.4	0.273
<b>Pre-period healthcare costs (Mean, SD)</b>	\$6,676	\$22,417	\$6,706	\$22,332	0.844

\*Based on study samples before linking to SDoH database.

†EPO: Exclusive provider organization; HMO: Health maintenance organization; PPO: Preferred provider organization; CDHP: Consumer-driven health plan; HDHP: High deductible health plan.

- Table 2 presents scores of top 20 SDoH differentiators between adherent and non-adherent patients. The top 5 were measures representing access to healthcare and economic indicators.
- The adherent cohort reported lower scores than non-adherent counterparts for:
  - Neighborhood safety (94.0 vs 99.5,  $p < 0.001$ )
  - Food insecurity (97.2 vs 100.7,  $p < 0.001$ )
  - Likelihood of delaying/skipping a prescription (99.9 vs 104.0,  $p < 0.001$ )
  - Likelihood of delaying doctor visit (101.9 vs 105.4,  $p < 0.001$ )
- The adherent patients scored higher for travel distance to specialist than non-adherent patients (112.0 vs 108.7,  $p < 0.001$ ).
- All SDoH measures had  $p$ -value  $< 0.05$ , although effect sizes were small,  $< 0.2$ .

## Limitations

- Some SDoH factors may not be causative but instead may be correlated with personal factors that may more directly affect adherence (e.g., household income) while others may represent true environmental and social determinants. However, for many commonly used sources, personal factors may not be available regardless.
- ZIP codes are postal delivery areas and are not based on homogeneous demographics. However, they are often the most convenient or the only geographic data available in many healthcare databases.

Table 2. Zip Code Level SDoH Scores

SDoH Measures	Adherent Mean (SD)	Non-Adherent Mean (SD)	P-value	Effect Size
<b>Access to Healthcare</b>				
Highly likely delay/skip a prescription next 3 months	99.9 (33.6)	104.0 (34.3)	<0.001	0.121
Highly likely delay doctor visit next 3 months	101.9 (29.7)	105.4 (30.2)	<0.001	0.115
Travel ≥20 miles to specialist	112 (67.6)	108.7 (68.1)	<0.001	-0.050
Lack of transportation caused delay in healthcare	95.3 (20.3)	98.2 (20.4)	<0.001	0.140
Usual place: urgent care/walk-in	99.7 (16.8)	100.9 (17.6)	<0.001	0.073
Self-treat illness w OTC medications	101.3 (10.6)	100.2 (11.1)	<0.001	-0.095
Travel ≥10 miles to PCP	107.4 (46.9)	106.4 (45.7)	0.002	-0.021
Will pay additional \$40 to continue to see PCP	96.0 (17.9)	95.1 (17.5)	<0.001	-0.047
<b>Economic Indicators</b>				
Safe neighborhood: Strongly disagree/disagree	94.0 (31.7)	99.5 (35.7)	<0.001	0.163
Sometimes worried food will run out	97.2 (21.9)	100.7 (22.6)	<0.001	0.158
Spend more savings than monthly income	94.7 (21.4)	97.1 (21.3)	<0.001	0.117
Somewhat hard to pay for basic needs	99.4 (14.1)	101.3 (13.9)	<0.001	0.135
Primary cause of stress: money	100.5 (15.8)	102.2 (15.8)	<0.001	0.107
Living situation: worried about losing it in future	99.8 (20.1)	98.9 (20.6)	<0.001	-0.045
<b>Health Conditions/Behaviors</b>				
Depressed all/most time	94.5 (23)	97.3 (23.7)	<0.001	0.121
Cigarette use	97.7 (18.1)	100.3 (18.3)	<0.001	0.140
Emotional wellbeing: fair-poor	100.0 (17.3)	102.2 (17.6)	<0.001	0.127
Mental wellbeing: fair-poor	101.9 (19.6)	103.9 (19.6)	<0.001	0.101
Stress: extremely	98.5 (15.4)	99.7 (14.9)	<0.001	0.082
Anxiety	100.0 (10.8)	101.1 (11)	<0.001	0.098

## Conclusions

- Zip code level SDoH data adds insight into the differences in medication adherence for chronic conditions like diabetes.

## References

- Int J Clin Pract. 2008 Jan;62(1):76-87.
- Diabet Med. 2015 Jun;32(6):725-37
- J Gen Intern Med. 2021 May;36(5):1359-1370
- <https://www.ibm.com/watson-health/learn/pulse-health-polls>
- <https://claritas360.claritas.com/mybestsegments/#segDetails>
- [https://www.huduser.gov/portal/datasets/usps\\_crosswalk.html](https://www.huduser.gov/portal/datasets/usps_crosswalk.html)

## Disclosure

Liisa Palmer is employee of Merative. James Nelson, Ellen Thiel, and Taylor Marlin were former employees of Merative. This study was funded by Merative.