PHARMACY SYSTEMS OUTCOMES AND POLICY COLLEGE OF PHARMACY

UIC

Switching Patterns of Antidiabetic Medication Use and HbA1c Trajectory in Patients with Type 2 Diabetes across Healthplan Types

Sodam Kim[1] , Kibum Kim[1]

1 Department of Pharmacy Systems and Outcomes and Policy, University of Illinois Chicago, Chicago, IL, United States

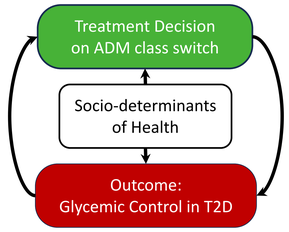
HSD125

UIC

INTRODUCTION

- Difference in healthcare access across various socio-determinants of health (SDoH) has been a concern for US public health. In patients with a progressive chronic condition, such as Type 2 diabetes (T2D), cyclical causal process between treatment decision and outcome influenced by SDoH can continue over the lifetime.[1-3] (Figure 1)
- The impact of SDoH on antidiabetic medication (ADM) class switch, a use of drug in a different therapeutic class, and glycated hemoglobin (HbA1c) control in patients with T2D was well studied.[4,5] However, overarching association over the long-term trajectory is underexplored.

Figure 1. Conceptual Framework: Socio-determinant of health on treatment decision and outcome



OBJECTIVE

- The aim of this study was to compare patterns of use of glucagon-like peptide-1 receptor agonists (GLP1Ra) and sodium-glucose co-transporter 2 inhibitors (SGLT2i), advanced non-insulin ADM options emerged over the last decade. The study examined patterns of switching ADM classes for second to fourth-line treatments among patients covered by various types of health plans.
- Longitudinal changes in HbA1c following each line of ADM class switching were compared across the insurance type.

METHOD

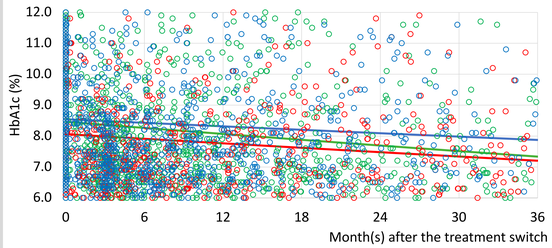
- **Study Design and Population**: We conducted a retrospective observational research using electronic healthcare records from the University of Illinois Hospital and Health Sciences System. Eligible patients were adults with T2D who had received first-line metformin between January 2016 and December 2023.
- ADM class switching was defined by change in a therapeutic class that was different from the class of previous line of ADM. We excluded patients who received insulin for ADM switching.
- ADM class switchings were grouped into two; advanced class that consists of SGLT2i and GLP1Ra, and traditional post first-line classes including all non-insulin, non-SGLT2i and non-GLP1Ra agents.
- Using bivariate analysis and Chi-square test, we compared switching patterns across three insurance types, commercial healthplan, Medicare, and underinsured group (Medicaid, self-pay or no healthcare coverage), one of the major indicators of SDoH.
- To summarize glycemic control over time, we abstracted all HbA1c (%) up to 3 years following each ADM class switching and before next ADM class switching or until the end of follow up, whichever happened first.
- A longitudinal data analysis was performed using a mixed-effect linear regression model with a Gamma error distribution with a log-link function. The population mean, variance across individuals and random error associated with HbA1c trends were factored into the model.[6] We compared the influence of health plan type using the estimates and statistical significance of each regression coefficient.

REFERENCES

1. Liu L, Wang F, Gracely EJ, et al. Burden of Uncontrolled Hyperglycemia and Its Association with Patients Characteristics and Socioeconomic Status in Philadelphia, USA. Health Equity. 2020;4(1):525-532. doi:10.1089/heq.2020.0076
2. Collier A, Ghosh S, Hair M, Waugh N. Impact of socioeconomic status and gender on glycaemic control, cardiovascular risk factors and diabetes complications in type 1 and 2 diabetes: a population based analysis from a Scottish region. Diabetes Metab. Apr 2015;41(2):145-51. doi:10.1016/j.diabet.2014.09.004
3. Kim SH, Lee SY, Kim CW, et al. Impact of Socioeconomic Status on Health Behaviors, Metabolic Control, and Chronic Complications in Type 2 Diabetes Mellitus. Diabetes Metab J. Oct 2018;42(5):380-393. doi:10.4093/dmj.2017.0102
4. O'Connor PJ, Sperl-Hillen JA, Johnson PE, Rush WA, Biltz G. Clinical inertia and outpatient medical errors. In: Henriksen K, Battles JB, Marks ES, Lewin DI, eds. Research to Implementation (Volume 2: Concepts and Methodology). Agency for Healthcare Research and Quality; 2005.
5. Lewing B, Abughosh SM, Lal LS, Essien EJ, Sansgiry S, Sansgiry SS. Patient, physician, and health system factors associated with five types of inadequate care during management of type-2 diabetes mellitus in the United States. Diabetes Epidemiology and Management. 2022/04/01/ 2022;6:100046. doi:https://doi.org/10.1016/j.deman.2021.100046
6. Kim K, Unni S, McAdam-Marx C, et al. Influence of Treatment Intensification on A1c in Patients with Suboptimally Controlled Type 2 Diabetes After 2 Oral Antidiabetic Agents. J Manag Care Spec Pharm. Mar 2019;25(3):314-322. doi:10.18553/jmcp.2019.25.3.314

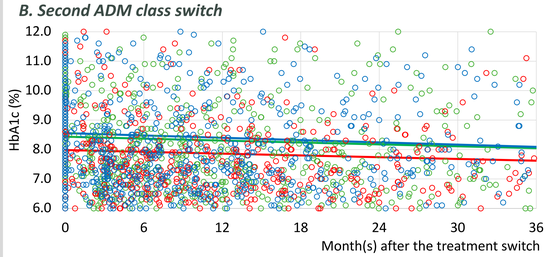
Figure 2. Longitudinal HbA1c Trends Following ADM Class Switch

A. First ADM class switch



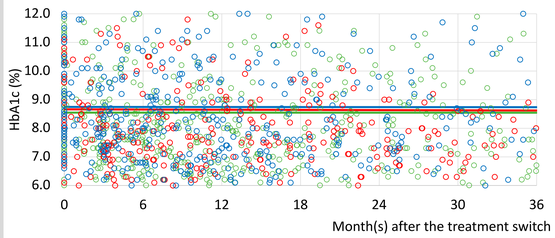
$$Eq\ 1.\ HbA1c_t = exp[(2.1358^{*}-0.0040^{*}t) + (-0.04838^{*}+0.0008t)\cdot MDCR + (0.0095+0.0017^{\dagger}t)\cdot UNDR]$$

B. Second ADM class switch



$$Eq\ 2.\ HbA1c_t = exp[(2.1325^{*}-0.0013^{*}t) + (-0.0551^{*}+0.00002t)\cdot MDCR + (0.0144-0.0003t)\cdot UNDR\ ]$$

C. Third ADM class switch



$$Eq\ 3.HbA1c_t = exp[(2.1455^{*}-0.00001t) + (0.0133-0.00012^{*}t)\cdot MDCR + (0.0230-0.00002t)\cdot UNDR\ ]$$

Scatter Plots: HbA1c records of commercially insured, underinsured and Medicare patients on or after each ADM class switching
Straight lines and equations: Population mean estimates from mixed effect model for commercially insured, underinsured and Medicare patients
Equations: HbA1c at time t in month, *p<0.05, †p<0.10

CONCLUSION

We observed the less frequent use of the recently advanced GLP1Ra or SGLT2i among the underinsured group of T2D patients. Glycemic control was, in general, better in patients covered by commercial insurance or Medicare health plan, compared to the underinsured or Medicaid covered group. Research is warranted into the systemic difference and disparity in the use of antidiabetic agent over the lifetime trajectory of T2D management and outcomes.

CONTACT INFORMATION

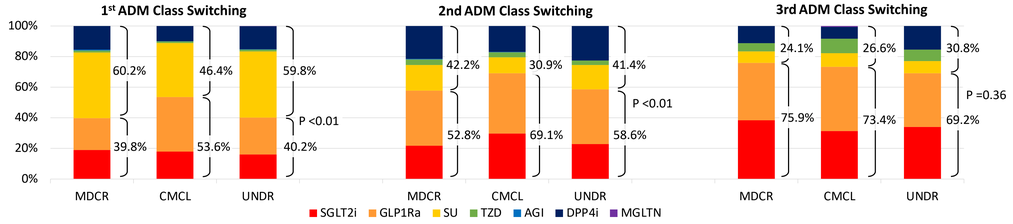
Sodam Kim, PharmD, University of Illinois Chicago (skim656@uic.edu)
Kibum Kim, PhD, Assistant Professor, University of Illinois Chicago (kkim204@uic.edu)

Table 1. Baseline Characteristics at 1st, 2nd and 3rd Treatment Switching

	1st ADM class switch				2nd ADM class switch				3rd ADM class switch			
	Medicare	Commercially Insured	Under-insured	P-value	Medicare	Commercially Insured	Under-insured	P-value	Medicare	Commercially Insured	Under-insured	P-value
N	543	703	916		275	343	478		133	169	214	
Age, Mean (SD)	62.41 (11.29)	48.67 (9.75)	48.89 (11.53)		62.39 (10.82)	49.85 (9.14)	50.00 (11.17)		62.91 (10.54)	50.16 (9.34)	49.30 (10.56)	
Age group, N(%)				<0.01				<0.01				<0.01
>=65	259 (47.70%)	23 (3.27%)	52 (5.68%)		138 (50.18%)	12 (3.50%)	27 (5.65%)		65 (48.87%)	6 (3.55%)	7 (3.27%)	
45-64	241 (44.38%)	454 (64.58%)	564 (61.57%)		116 (42.18%)	241 (70.26%)	318 (66.53%)		59 (44.36%)	119 (70.41%)	139 (64.95%)	
18-44	43 (7.92%)	226 (32.15%)	300 (32.75%)		21 (7.64%)	90 (26.24%)	133 (27.82%)		9 (6.77%)	44 (26.04%)	68 (31.78%)	
SEX (MALE)	223 (41.07%)	308 (43.81%)	346 (37.77%)	0.05	114 (41.45%)	139 (40.52%)	179 (37.45%)	0.49	64 (48.12%)	66 (39.05%)	79 (36.92%)	0.11
Race, N(%)				0.02				0.20				0.16
AIAN	3 (0.55%)	2 (0.28%)	6 (0.66%)		1 (0.36%)	1 (0.29%)	4 (0.84%)		0 (0.00%)	0 (0.00%)	2 (0.93%)	
Asian	14 (2.58%)	25 (3.56%)	12 (1.31%)		4 (1.45%)	9 (2.62%)	4 (0.84%)		1 (0.75%)	2 (1.18%)	3 (1.40%)	
NHPI	1 (0.18%)	0 (0.00%)	0 (0.00%)		0 (0.00%)	0 (0.00%)	0 (0.00%)		0 (0.00%)	0 (0.00%)	0 (0.00%)	
AFAM	269 (49.54%)	345 (49.08%)	472 (51.53%)		136 (49.45%)	167 (48.69%)	252 (52.72%)		61 (45.86%)	86 (50.89%)	103 (48.13%)	
White	81 (14.92%)	97 (13.80%)	90 (9.83%)		44 (16.00%)	42 (12.24%)	51 (10.67%)		24 (18.05%)	16 (9.47%)	22 (10.28%)	
Other	164 (30.20%)	223 (31.72%)	317 (34.61%)		85 (30.91%)	119 (34.69%)	164 (34.31%)		45 (33.83%)	61 (36.09%)	84 (39.25%)	
Declined	0 (0.00%)	1 (0.14%)	0 (0.00%)		0 (0.00%)	0 (0.00%)	0 (0.00%)		0 (0.00%)	0 (0.00%)	0 (0.00%)	
No info.	11 (2.03%)	10 (1.42%)	19 (2.07%)		5 (1.82%)	5 (1.46%)	3 (0.63%)		2 (1.50%)	4 (2.37%)	0 (0.00%)	
Ethnicity, N(%)				<0.01				0.26				0.56
Non Hispanic	374 (68.88%)	456 (64.86%)	564 (61.57%)		176 (64.00%)	207 (60.35%)	293 (61.30%)		79 (59.40%)	102 (60.36%)	120 (56.07%)	
Hispanic	155 (28.55%)	235 (33.43%)	317 (34.61%)		88 (32.00%)	126 (36.73%)	175 (36.61%)		49 (36.84%)	64 (37.87%)	89 (41.59%)	
Declined	6 (1.10%)	9 (1.28%)	23 (2.51%)		6 (2.18%)	9 (2.62%)	7 (1.46%)		2 (1.50%)	3 (1.78%)	3 (1.40%)	
No info.	8 (1.47%)	3 (0.43%)	12 (1.31%)		5 (1.82%)	1 (0.29%)	3 (0.63%)		3 (2.26%)	0 (0.00%)	2 (0.93%)	
Baseline HbA1c*, N(%)				<0.01				<0.01				0.23
< 8.0 %	274 (50.46%)	291 (41.39%)	406 (44.32%)		108 (39.27%)	109 (31.78%)	162 (33.89%)		39 (29.32%)	44 (26.04%)	73 (34.11%)	
8.0 – 8.9%	82 (15.10%)	99 (14.08%)	122 (13.32%)		64 (23.27%)	59 (17.20%)	71 (14.85%)		32 (24.06%)	32 (18.93%)	31 (14.49%)	
≥9.0%	126 (23.20%)	255 (36.27%)	293 (31.99%)		84 (30.55%)	153 (44.61%)	217 (45.40%)		58 (43.61%)	86 (50.89%)	105 (49.07%)	
missing	61 (11.23%)	58 (8.25%)	95 (10.37%)		19 (6.91%)	22 (6.41%)	28 (5.86%)		4 (3.01%)	7 (4.14%)	5 (2.34%)	

* HbA1c data nearest to the switching date on or before the AMD class switching date.
Abbreviations: AFAM, African American; AIAN, American Indian/Alaska Native; NHPI, Native Hawaiian or Other Pacific Islander

Figure 3. Therapeutic Classes at ADM Class Switching



Abbreviations: AGI, Alpha-glucosidase inhibitors; CMCL, Commercially insured; DPP4i, Dipeptidyl peptidase-4 inhibitor; GLP1Ra, Glucagon-like peptide-1 receptor agonist; MDCR, Medicare enrollees; MGLTN, Meglitinide; SGLT2i, Sodium-glucose cotransporter-2 inhibitor; SU, Sulfonylureas; TZD, Thiazolidinedione; UNDR, Underinsured or Medicaid;

RESULTS AND DISCUSSION

- The proportion of African American was higher among the underinsured group than commercially insured patients at the 1st and 2nd ADM class switching, which was not observed at the 3rd ADM switch. We suspected that patients at a lower socioeconomic status were not be followed up until the 3rd ADM class switching within the institution and affiliated clinics.
- The proportions of SGLT2i/GLP1Ra out of the commercially insured group were higher than out of Medicare beneficiaries or underinsured patients. The differences in ADM treatment patterns were significant at the 1st and 2nd ADM class switching (Figure 3).
- We estimated monthly changes in HbA1c after each ADM switching and the differences in the monthly changes (Medicare vs. Commercial and Medicaid/Underinsured vs. Commercial; Figure 2). The monthly HbA1c reduction after the 1st ADM class switching was less in the underinsured group than the commercially insured patients, and the estimate was marginally significant (β=0.0017, p=0.06). The coefficient estimates showed that the trajectory of HbA1c among the underinsured after the 2nd and 3rd ADM class switching is non-inferior to the glycemic control among the commercially insured group. However, the difference in the monthly change after the 2nd and 3rd ADM class switching may not offset the inferior glycemic control in the underinsured population after the 1st ADM switching.
- The major limitation should be considered when interpreting the findings. First, we excluded patients who received insulin, which limits the generalizability of our findings. Second, clinical justification and rationale for the ADM class switching were not considered, which significant limits the interpretation and application of our findings. Further, dose escalation or within-class ADM switching in response to adverse events or suboptimal glycemic control were not explained in our study.