Pharmacist-driven Management of Type 2 Diabetes Improves Survival and Medical Costs in an Integrated Health System: Findings from Retrospective Analyses Utilizing Statistical Modeling of Time-dependent Variables, Difference-in-difference Evaluations, and Propensity Score Matching

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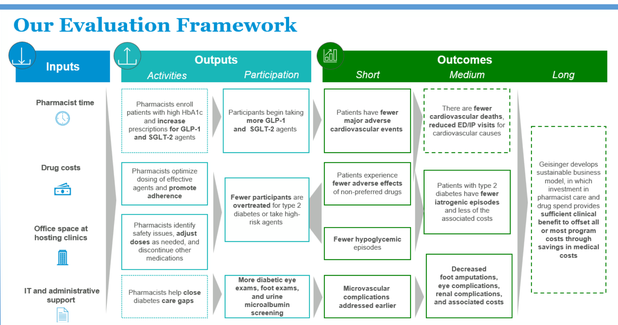
Introduction

- Latest-generation type 2 diabetes (T2DM) medications reduce severe adverse outcomes, which are associated with high medical costs and contribute to all-cause mortality
- Geisinger Health System introduced a T2DM pharmacotherapy protocol in 2016 prioritizing metformin, GLP-1 agonists, and SGLT2 inhibitors for appropriate patients
- Geisinger's pharmacy medication therapy disease management (MTDM) program aims to coordinate care and accelerate adoption of the protocol
- This quantitative analysis assessed the impact of MTDM management of T2DM on survival, cost, drug utilization, HbA1c, and diabetes care gaps

Methods

- Survival analysis: Cox proportional hazards model, with MTDM-enrollment as a time-dependent variable
- Cost of care analysis: Difference-in-differences analyses, assessing pharmacy costs, medical costs, and total healthcare costs utilizing generalized estimating equations (GEEs) assuming a gamma distribution
- HbA1c analysis: Propensity-matched score analysis (1:1 nearest-neighbor algorithm; 0.10 caliper) assessing change in HbA1c from baseline to one year (lowest subsequent HbA1c within a year)
- Medication and care gap analyses: Pre-post comparison utilizing the HbA1c cohort comparing care gap/medication status at baseline vs one year

Results



	Control	MTDM	p
n	15,632	9,138	
Age, mean (SD)	58.35 (14.78)	56.28 (13.12)	<0.001
Age 65 ≥ 1, n (%)	5,287 (33.8)	2,449 (26.8)	<0.001
Male sex, n (%)	8,958 (57.3)	5,094 (55.7)	0.017
White, n (%)	14,260 (91.2)	8,219 (89.9)	0.001
Ever smoker, n (%)	7,939 (50.8)	4,888 (53.5)	<0.001
Geisinger PCP, n (%)	2,955 (18.9)	3,342 (36.6)	<0.001
BMI category, n (%)			<0.001
Underweight (< 18.5)	63 (0.5)	11 (0.1)	
Healthy [18.5, 25)	1062 (8.3)	511 (6.3)	
Overweight [25, 30)	2,727 (21.2)	1,562 (19.2)	
Class 1 Obesity [30, 35)	3,389 (26.4)	2,172 (26.8)	
Class 2 Obesity [35, 40)	2,623 (20.4)	1,764 (21.7)	
Class 3 Obesity (>= 40)	2,974 (23.2)	2,097 (25.8)	
Baseline HbA1c, mean (SD)	10.48 (1.55)	10.62 (1.61)	<0.001
Total diabetes medication count, mean (SD)	2.00 [1.00, 2.00]	1.00 [0.00, 2.00]	0.004
Total diabetes medication category, n (%)			<0.001
0-1	7692 (49.2)	4611 (50.5)	
2-3	6792 (43.4)	4025 (44.0)	
4+	1148 (7.3)	502 (5.5)	
On insulin, n (%)	5875 (37.6)	2605 (28.5)	<0.001
On SGLT2, n (%)	1195 (7.6)	547 (6.0)	<0.001
On DPP-4, n (%)	1673 (10.7)	1115 (12.2)	<0.001
On GLP-1, n (%)	1161 (7.4)	518 (5.7)	<0.001
On metformin, n (%)	7279 (46.6)	4877 (53.4)	<0.001
CCI, mean (SD)	3.54 (2.71)	3.40 (2.56)	<0.001
Serious mental illness flag, n (%)	5,397 (34.5)	4,007 (43.8)	<0.001
Coronary artery disease, n (%)	1,625 (10.4)	835 (9.1)	0.002
Cirrhosis of the liver, n (%)	274 (1.8)	153 (1.7)	0.684
COPD, n (%)	1,735 (11.1)	993 (10.9)	0.587
Heart failure, n (%)	1,724 (11.0)	711 (7.8)	<0.001
Nephropathy, n (%)	1,747 (11.2)	957 (10.5)	0.091
Neuropathy, n (%)	2,282 (14.6)	1,331 (14.6)	0.959
Peripheral vascular disease, n (%)	1,015 (6.5)	408 (4.5)	<0.001
Retinopathy, n (%)	492 (3.1)	237 (2.6)	0.014
Amputation, n (%)	201 (1.3)	76 (0.8)	0.001
Wound complications, n (%)	205 (1.3)	118 (1.3)	0.939
Hypoglycemia, n (%)	207 (1.3)	108 (1.2)	0.365
Chronic kidney disease (% in stage)			<0.001
Early stage: 1-3	15,048 (96.2)	9,000 (98.6)	
Late stage: 4-5	584 (3.7)	138 (1.5)	
Hypertension, n (%)	9,044 (57.9)	5,869 (64.2)	<0.001
Hyperlipidemia, n (%)	7,237 (46.3)	4,828 (52.8)	<0.001
GHP flag, n (%)	5,144 (32.9)	3,847 (42.1)	<0.001
ED count category (%)			<0.001
0	8,792 (56.2)	4,874 (53.3)	
1	2,423 (15.5)	1,459 (16.0)	
2	1,302 (8.3)	787 (8.6)	
>2	3,115 (19.9)	2,018 (22.1)	
Admission count category (%)			<0.001
0	9,745 (62.3)	6,210 (68.0)	
1	3,016 (19.3)	1,471 (16.1)	
2	1,142 (7.3)	619 (6.8)	
>2	1,729 (11.1)	838 (9.2)	

Table 1: Population demographics in survival analyses

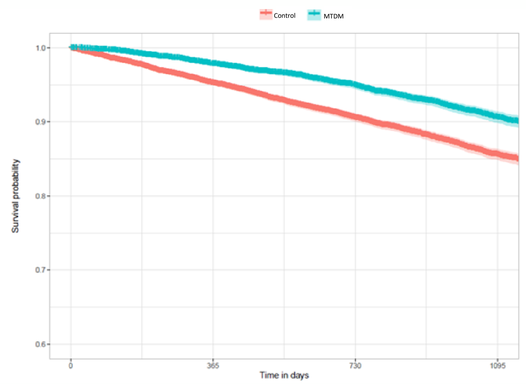


Figure 1: Kaplan-Meier curves for MTDM cases and controls, calibrating the immortal time in the control group.

Figure 2a: Pharmacy costs among MTDM patients and controls in baseline year versus years 1 and 2 after index

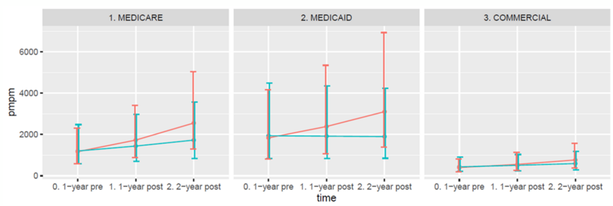


Figure 2b: Medical costs among MTDM patients and controls in baseline year versus years 1 and 2 after index

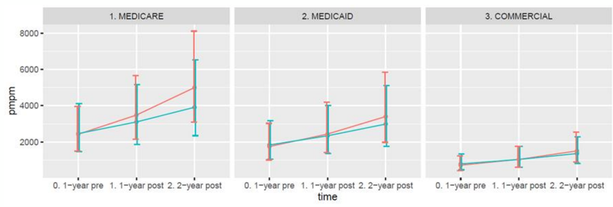


Figure 2c: Total healthcare costs among MTDM patients and controls in baseline year versus years 1 and 2 after index

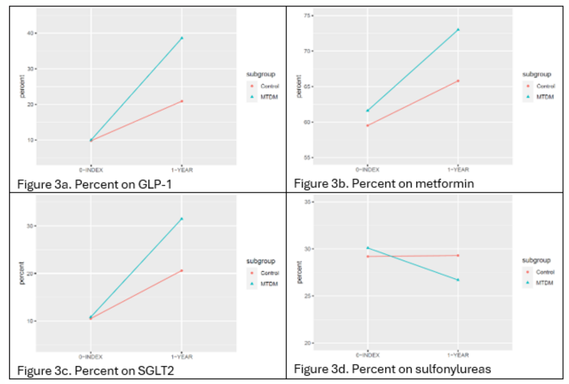


Figure 3: Percentage of MTDM patients and controls on GLP-1 agents, metformin, SGLT2 agents, and sulfonylureas at baseline and one year of follow-up

Diabetic eye exam care gap closed at baseline (%)	1036 (28.7)	1464 (39.7)	<0.001
Diabetic eye exam care gap closed after one year (%)	1586 (43.9)	2344 (63.5)	<0.001
Diabetic foot exam closed at baseline (%)	1205 (33.3)	1698 (46.0)	<0.001
Diabetic foot exam closed after one year (%)	1938 (53.6)	2683 (72.7)	<0.001
Urine microalbumin care gap closed at baseline (%)	1140 (31.5)	1400 (37.9)	<0.001
Urine microalbumin care gap closed after one year (%)	2200 (60.8)	2395 (64.9)	<0.001

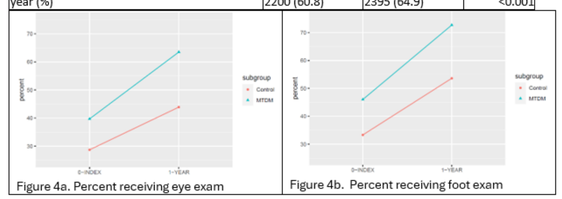


Table 2/Figure 4: Percentage of MTDM patients and controls with traditional diabetes care gaps closed at baseline and one year follow-up

Conclusions

- Pharmacist-led management of T2DM led to greater adherence to protocol-preferred medications and care gap closure
- Pharmacist-managed patients had 23% lower all-cause mortality (95% CI:16-30%); this was likely due, in part, to drug choice
- Pharmacist-led care increased pharmacy costs in Medicaid and commercial populations; this was offset by reductions in medical costs
- Total cost of care was lower among Medicare patients managed by pharmacy MTDM