

Title: Real-World treatment patterns of glucose-lowering agents among patients with type 2 diabetes mellitus and cardiovascular disease or at risk for cardiovascular disease – an observational, cross-sectional, retrospective study

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SUPPLEMENTARY MATERIAL

Table S1: Diagnoses, Procedure and CPT/HCPCS Codes

	ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
Inclusion/Exclusion Criteria				
Type 2 diabetes	250.x0, 250.x2	E11		No
Type 1 diabetes	250.x1, 250.x3	E10		No
Kidney failure (stage V)	585.5	N18.5		No
	403.01	I12.0		
	403.11	I13.11		
	403.91	I13.2		
	404.02			
	404.03			
	404.12			
	404.13			
	404.92			
	404.93			
ESRD	585.6	N18.6	HCPCS/CPT: 90960-90962	No
Dialysis	V45.11	Z49.0*	HCPCS/CPT:	No
	V45.12	Z49.3*	90935, 90937,	
	V56.0	Z99.2	90940, 90945,	
	V56.1	Z91.15	90947, 90989,	
	V56.2		90993, 90921,	
	V56.3*		90925, 90966,	
	E87.91		90970	
	39.96 (procedure code) 54.98 (procedure code)			
Kidney transplant	996.81	Z94	HCPCS/CPT:	No
	V42.0	T86.10	BT29*	
	55.6* (proc)	T86.11	BT39*	
	00.91	T86.12	BT49*	
	00.92	T86.13	G9750	
	00.93	T86.19	G9748	
		Z48.22		
		0TY00Z0 (proc)		
		0TY00Z1 (proc)		
		0TY00Z2 (proc)		
		0TY10Z0 (proc)		
		0TY10Z1 (proc)		
		0TY10Z2 (proc)		
ASCVD and Heart Failure				
Myocardial infarction	410.xx Acute myocardial infarction	I21.xx Acute MI		Yes
	412.xx Old myocardial infarction	I22.xx Subsequent ST elevation and non-ST elevation MI		No

	ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
		I23.xx Certain complications following ST elevation and non-ST elevation MI (within the 28-day period)		No
Acute coronary syndromes (excluding myocardial infarction)	413.xx Angina Pectoris	I20.xx Angina pectoris		Yes
	411.xx Other acute and subacute forms of ischemic heart disease	I24.xx Other acute ischemic heart diseases		No
	414.xx Other forms of chronic ischemic heart disease	I25.xx Chronic ischemic heart disease		No
Carotid Arterial Disease	433.1x Occlusion or stenosis of precerebral arteries, carotid artery	I65.2x Occlusion and stenosis of carotid artery		No
	434.1x Occlusion of cerebral arteries; cerebral infarction	I63.13 Cerebral infarction due to embolism of carotid artery		No
		I63.23 Cerebral infarction due to unspecified occlusion or stenosis of carotid arteries		No
	437.3x Cerebral aneurysm, non-ruptured	I67.1x Cerebral aneurysm, non-ruptured		No
	442.81 Other aneurysm of other specified artery; artery of neck	I72.0x Aneurysm of carotid artery		No
Transient ischemic attack	435.xx Transient cerebral ischemia	G45.xx Transient cerebral ischemic attack and related syndromes		Yes
Coronary artery disease	414.01 Coronary atherosclerosis of native coronary artery	I25.10 Atherosclerotic heart disease of native coronary artery		No
Heart failure	428.xx Heart failure	I50.xx Heart failure		No
Unstable angina	411.xx Other acute and subacute forms of ischemic heart disease	I20.0x Unstable angina		No
Ischemic stroke	433.01 Occlusion and stenosis of basilar artery with cerebral infarction	I63.xx Cerebral infarction		Yes
	433.11 Occlusion and stenosis of carotid artery with cerebral infarction			
	433.21 Occlusion and stenosis of vertebral			

	ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
	artery with cerebral infarction			
	433.31 Occlusion and stenosis of multiple and bilateral precerebral arteries with cerebral infarction			
	433.81 Occlusion and stenosis of other specified precerebral artery with cerebral infarction			
	433.91 Occlusion and stenosis of unspecified precerebral artery with cerebral infarction			
	434.01 Cerebral thrombosis with cerebral infarction			
	434.11 Cerebral embolism with cerebral infarction			
	434.91 Cerebral artery occlusion, unspecified with cerebral infarction			
Peripheral artery disease	250.7 Diabetes mellitus with peripheral circulatory disorders	E11.51 T2D with diabetic peripheral angiopathy without gangrene		No
		E11.52 T2D with diabetic peripheral angiopathy with gangrene		No
		E13.51 Other specified diabetes mellitus with diabetic peripheral angiopathy without gangrene		No
		E13.52 Other specified diabetes mellitus with diabetic peripheral angiopathy with gangrene		No
	443.29 Dissection of other artery	I67.0 Dissection of cerebral arteries, non-ruptured		No
	440.xx Atherosclerosis	I70.xx Atherosclerosis		No
	441.xx Aortic aneurysm and dissection	I71.xx Aortic aneurysm and dissection		No
	442.xx Other aneurysm	I72.xx Other aneurysm		No

	ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
	443.xx Other peripheral vascular disease	I73.xx Other peripheral vascular diseases		No
	444.xx Arterial embolism and thrombosis	I74.xx Arterial embolism and thrombosis		No
	447.xx Other disorders of arteries and arterioles	I77.xx Other disorders of arteries and arterioles		No
		I79.xx Disorders of arteries, arterioles, and capillaries in diseases classified elsewhere		No
	557.0 Acute vascular insufficiency of intestine	K55.0x Acute vascular disorders of intestine		No
	557.1 Chronic vascular insufficiency of intestine	K55.1 Chronic vascular disorders of intestine		No
	557.9 Other vascular insufficiency of intestine	K55.8 Other vascular disorders of intestine		No
		K55.9 Vascular disorders of intestine, unspecified		No
		M31.8 Other specified necrotizing vasculopathies		No
		M31.9 Necrotizing vasculopathy, unspecified		No
Coronary artery bypass graft	36.1x, 36.2x	ICD-10-PS 0212088, 0212089, 021208C, 0212098, 212099, 021209C, 02120A8, 02120A9, 02120AC, 02120J8, 02120J9, 02120JC, 02120K8, 02120K9, 02120KC, 02120Z8, 02120Z9, 02120ZC, 0212488, 0212489, 021248C, 0212498, 0212499, 021249C, 02124A8, 02124A9, 02124AC, 02124J8, 02124J9, 02124JC, 02124K8, 02124K9, 02124KC, 02124Z8, 02124Z9, 02124ZC, 0213088, 0213089, 021308C, 0213098, 0213099, 021309C, 02130A8,	33545, 33510 – 33536	Yes

ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
	02130A9, 02130AC, 02130J8, 02130J9, 02130JC, 02130K8, 02130K9, 02130KC 02130Z8, 02130Z9, 02130ZC, 0213488, 0213489, 021348C, 0213498, 0213499, 021349C, 02134A8, 02134A9, 02134AC 02134J8, 02134J9, 02134JC, 02134K8, 02134K9, 02134KC, 02134Z8, 02134Z9, 02134ZC, 021008F, 021009F, 02100AF, 02100JF, 02100KF, 02100ZF, 021048F, 021049F, 02104AF, 02104JF, 02104KF, 02104ZF, 021108F, 021109F, 02110AF, 02110JF, 02110KF, 02110ZF, 021148F, 021149F, 02114AF, 02114JF, 02114KF, 02114ZF, 021208F, 021209F, 02120AF, 02120JF, 02120KF, 02120ZF, 021248F, 021249F, 02124AF, 02124JF, 02124KF, 02124ZF, 021308F, 021309F, 02130AF, 02130JF, 02130KF, 02130ZF, 021348F, 021349F, 02134AF, 02134JF, 02134KF, 02134ZF, 0210083, 0210093, 02100A3, 02100J3, 02100K3, 02100Z3,0 210483, 0210493, 02104A3, 02104J3, 02104K3, 02104Z3,0 211083, 211093, 02110A3, 02110J3, 02110K3, 02110Z3, 0211483, 0211493, 02114A3, 02114J3, 02114K3, 02114Z3, 0212083,		

ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
	0212093, 02120A3, 02120J3, 02120K3, 02120Z3, 0212483, 0212493, 02124A3, 02124J3, 02124K3, 02124Z3,0 213083, 0213093, 02130A3, 02130J3, 02130K3, 02130Z3, 0213483, 0213493, 02134A3, 02134J3, 02134K3, 02134Z3, 021008W, 021009W, 02100AW, 02100JW, 02100KW, 021048W, 021049W, 02104AW, 02104JW, 02104KW, 021108W, 021109W, 02110AW, 02110JW, 02110KW, 021148W, 021149W, 02114AW, 02114JW, 02114KW, 021208W, 021209W, 02120AW, 02120JW, 02120KW, 021248W, 021249W, 02124AW, 02124JW, 02124KW, 021308W, 021309W, 02130AW, 02130JW, 02130KW, 021348W, 021349W, 02134AW, 02134JW, 02134KW, 210088, 0210089, 021008C, 0210098, 0210099 021009C, 02100A8, 02100A9, 02100AC, 02100J8, 02100J9 02100JC, 02100K8, 02100K9, 02100KC, 02100Z8, 02100Z9 02100ZC, 0210488, 0210489, 021048C, 0210498, 0210499 021049C, 02104A8, 02104A9, 02104AC, 02104J8, 02104J9 02104JC, 02104K8, 02104K9, 02104KC, 02104Z8, 02104Z9 02104ZC, 021K0Z8, 021K0Z9, 021K0ZC,		

	ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
		021K0ZF, 021K0ZW, 021K4Z8, 021K4Z9, 021K4ZC, 021K4ZF, 021K4ZW, 021L08P, 021L08Q, 021L08R, 021L09P, 021L09Q, 021L09R, 021L0AP, 021L0AQ, 021L0AR, 021L0JP, 021L0JQ, 021L0JR, 021L0KP, 021L0KQ, 021L0KR, 021L0Z8, 021L0Z9, 021L0ZC, 021L0ZF, 021L0ZP, 021L0ZQ, 021L0ZR, 021L48P, 021L48Q, 021L48R, 021L49P, 021L49Q, 021L49R, 021L4AP, 021L4AQ, 021L4AR, 021L4JP, 021L4JQ, 021L4JR, 021L4KP, 021L4KQ, 021L4KR, 021L4Z8, 021L4Z9, 021L4ZC, 021L4ZF, 021L4ZP, 021L4ZQ, 021L4ZR		
Percutaneous coronary intervention (requires hospitalization)	ICD-9-PS 1755, 3606, 3607, 0040-0048, 0066	ICD-10-PS 0270346, 027034Z, 0270356, 027035Z, 0270366, 027036Z, 0270376, 027037Z, 02703D6, 02703DZ, 02703E6, 02703EZ, 02703F6, 02703FZ, 02703G6, 02703GZ, 02703T6, 02703TZ, 02703Z6, 02703ZZ, 0270446, 027044Z, 0270456, 027045Z, 0270466, 027046Z, 0270476, 027047Z, 02704D6, 02704DZ, 02704E6, 02704EZ, 02704F6, 02704FZ, 02704G6, 02704GZ, 02704T6, 02704TZ, 02704Z6, 02704ZZ, 0271346, 027134Z, 0271356, 027135Z, 0271366, 027136Z, 0271376, 027137Z, 02713D6,	92920, 92921, 92924, 92925, 92928, 92929, 92933, 92934, 92937, 92938, 92941, 92943, 92944, 92973, 92975, 92977, 92980, 92981, 92982, 92984, 92995, 92996, C9600-C9608, G0290, G0291	Yes

ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
	02713DZ, 02713E6, 02713EZ, 02713F6, 02713FZ, 02713G6, 02713GZ, 02713T6, 02713TZ, 02713Z6, 02713ZZ, 0271446, 027144Z, 0271456, 027145Z, 0271466, 027146Z, 0271476, 027147Z, 02714D6, 02714DZ, 02714E6, 02714EZ, 02714F6, 02714FZ, 02714G6, 02714GZ, 02714T6, 02714TZ, 02714Z6, 02714ZZ, 0272346, 027234Z, 0272356, 027235Z, 0272366, 027236Z, 0272376, 027237Z, 02723D6, 02723DZ, 02723E6, 02723EZ, 02723F6, 02723FZ, 02723G6, 02723GZ, 02723T6, 02723TZ, 02723Z6, 02723ZZ, 0272446, 027244Z, 0272456, 027245Z, 0272466, 027246Z, 0272476, 027247Z, 02724D6, 02724DZ, 02724E6, 02724EZ, 02724F6, 02724FZ, 02724G6, 02724GZ, 02724T6, 02724TZ, 02724Z6, 02724ZZ, 0273346, 027334Z, 0273356, 027335Z, 0273366, 027336Z, 0273376, 027337Z, 02733D6, 02733DZ, 02733E6, 02733EZ, 02733F6, 02733FZ, 02733G6, 02733GZ, 02733T6, 02733TZ, 02733Z6, 02733ZZ, 0273446, 027344Z, 0273456, 027345Z, 0273466, 027346Z, 0273476, 027347Z, 02734D6, 02734DZ, 02734E6,		

ICD9 diagnosis or procedure codes	ICD10 diagnosis or procedure codes	CPT/HCPCS	Inpatient claim required
	02734EZ, 02734F6, 02734FZ, 02734G6, 02734GZ, 02734T6, 02734TZ, 02734Z6, 02734ZZ, 02C03ZZ, 02C04ZZ, 02C13ZZ, 02C14ZZ, 02C23ZZ, 02C24ZZ, 02C33ZZ, 02C34ZZ, X2C0361, X2C1361, X2C2361, X2C3361		

Abbreviations: ASCVD – Atherosclerotic Cardiovascular Disease; CPT – Current Procedural Terminology; ESRD – End-stage Renal Disease; GPI – Generic Product Identifier; HCPCS – Healthcare Common Procedure Coding System; ICD – International Classification of Diseases; LOINC - Logical Observation Identifiers, Names, and Codes; MI – Myocardial Infarction; T2D – Type 2 Diabetes

Table S2: Codes for Risk Factors for ASCVD/Heart Failure

	ICD-9/ICD-9 CM Codes	ICD-10 Code	GPI Codes/LOINC Codes/CPT Codes/HCPCS Codes
Chronic kidney disease: Diagnosis	585.1-585.4	N18.1, N18.2, N18.3, N18.4,	
Serum creatinine to calculate eGFR			LOINC: 2160-0
Hypertension	401.xx Essential hypertension 402.xx Hypertensive heart disease 403.xx Hypertensive chronic kidney disease 404.xx Hypertensive heart and chronic kidney disease 405.xx Secondary hypertension	I10.xx Essential hypertension I11.xx Hypertension and hypertensive heart disease I12.xx Hypertension and chronic kidney disease I13.xx Hypertensive heart and chronic kidney disease I15.xx Secondary hypertension I16.xx Hypertensive crisis	
Antihypertensives			GPI Codes
Angiotensin Converting Enzyme Inhibitors,			3610, 3615, 3617
Angiotensin II Receptor Blockers,			
Renin inhibitors			33*
Beta blockers			34*
Calcium channel blockers			
Diuretics			37*
Other antihypertensives			3620* - 3699* (anything in 36* that is not 3610, 3615, 3617)
Vasopressors			38*
Hyperlipidemia	272.x Hyperlipidemia	E78.0x Pure hypercholesterolemia E78.1 Pure hyperglyceridemia E78.2 Mixed hyperlipidemia E78.3 Hyperchylomicronemia E78.4 Other hyperlipidemia E78.5 Hyperlipidemia, unspecified	
Statins			GPI: 3940, 39940 (combinations with statin and ezetimibe)

	ICD-9/ICD-9 CM Codes	ICD-10 Code	GPI Codes/LOINC Codes/CPT Codes/HCPCS Codes
Micro- or macroalbuminuria	791.0 Proteinuria	R80.xx Proteinuria	
	585.3 Chronic kidney disease, stage 3	N18.3 Chronic kidney disease, stage 3	
	585.4 Chronic kidney disease, stage 4	N18.4 Chronic kidney disease, stage 4	
	585.5 Chronic kidney disease, stage 5	N18.5 Chronic kidney disease, stage 5	
Obesity	278.00 Obesity, unspecified	E66.0x Obesity due to excess calories	
	278.01 Morbid obesity	E66.2 Morbid (severe) obesity with alveolar hypoventilation	
	278.03 Obesity hypoventilation syndrome	E66.8 Other obesity	
	V85.3x Body mass index 30-39	E66.9 Obesity, unspecified	
	V85.4x Body mass index 40 and over	Z68.3x Body mass index 30-39	
		Z68.4x Body mass index 40 or greater	
Smoking	305.1 Non-dependent tobacco use disorder		CPT: 1034F, 4000F, 99406
	649.0 Tobacco use disorder complicating pregnancy, childbirth, or the puerperium		HCPCS: C9801, C9802, D1320, G0375, G0436, G0437, G8402, G8403, G8453–G8455, S9075, S9453
	649.00–649.04 Tobacco use disorder complicating pregnancy, childbirth, or the puerperium, unspecified as to episode		
	989.84 Toxic effect of tobacco		
	E869.4 Accidental poisoning second-hand tobacco smoke		
	V15.82 Personal history of tobacco use, presenting hazards to health		
	V65.42 Counseling on substance use and abuse		

Abbreviations: CPT – Current Procedural Terminology; eGFR – Estimated Glomerular Filtration Rate; GPI – Generic Product Identifier; HCPCS – Healthcare Common Procedure Coding System; ICD – International Classification of Diseases; ICD-9 CM – International Classification of Diseases Ninth edition Clinical Modification; LOINC - Logical Observation Identifiers, Names, and Codes

Table S3: Medication Codes

Variable	Description	LOINC/CPT/GPI codes
Glucose-lowering medication classes	Drugs in class	GPI code
Biguanides	Metformin	2725*
Sulfonylureas	Chlorpropamide, glimepiride, glipizide, glyburide, glyburide, tolazamide, tolbutamide	2720*
Thiazolidinediones	Pioglitazone, rosiglitazone	2760*
Amylin agonists	Pramlintide	2715*
Meglitinides	Repaglinide, nateglinide	2723*, 2728*
Alpha-glucosidase inhibitors	Acarbose, miglitol	2750*
Glucagon-like peptide-1 receptor agonists	Exenatide, liraglutide, dulaglutide, injectable semaglutide	2717*
Dipeptidyl peptidase-4 inhibitors	Sitagliptin, saxagliptin, linagliptin	2755*
Sodium-glucose co-transporter 2 inhibitors	Canagliflozin, dapagliflozin, empagliflozin	2770*
Insulin	many	2710*
Combination oral antidiabetics	many	2799*
CV Therapies (Class-level)		GPI codes
Angiotensin Converting Enzyme Inhibitors, Angiotensin II Receptor Blockers, Renin inhibitors		3610, 3615, 3617
Beta blockers		33*
Calcium channel blockers		34*
Diuretics		37*
Other antihypertensives		3620*- 3699* (anything in 36* that is not 3610, 3615, 3617)
Vasopressors		38*
Statins		3940, 39940 (combinations with statin and ezetimibe)
Fibrates		3920
Antianginal agents		GPI 2: 32
Antiarrhythmics		GPI 3: 35
Anticoagulants		GPI 2: 83
Cardiotonics		GPI 2: 31

Abbreviations: CV – Cardiovascular; CPT – Current Procedural Terminology; GPI – Generic Product Identifier; LOINC - Logical Observation Identifiers, Names, and Codes