

SUPPLEMENTAL MATERIAL

Appendix A. ICD-9 Codes Used for Diagnosis of AF or Stroke.

Atrial fibrillation

ICD-9	Code Description
427.31	Atrial fibrillation

Stroke

ICD-9	Type of Stroke	Code Description
430	Hemorrhagic	Subarachnoid hemorrhage
431	Hemorrhagic	Intracerebral hemorrhage
432.0	Hemorrhagic	Nontraumatic extradural hemorrhage
432.1	Hemorrhagic	Subdural hemorrhage
432.9	Hemorrhagic	Unspecified intracranial hemorrhage
433.01	Ischemic	Occlusion and stenosis, basilar artery, with cerebral infarction
433.11	Ischemic	Occlusion and stenosis, carotid artery, with cerebral infarction
433.21	Ischemic	Occlusion and stenosis, vertebral artery, with cerebral infarction
433.31	Ischemic	Occlusion and stenosis, multiple and bilateral precerebral arteries, with cerebral infarction
433.81	Ischemic	Occlusion and stenosis, other specified precerebral artery, with cerebral infarction
433.91	Ischemic	Occlusion and stenosis, unspecified precerebral artery, with cerebral infarction
434.01	Ischemic	Cerebral thrombosis, with cerebral infarction
434.11	Ischemic	Cerebral embolism, with cerebral infarction
434.91	Ischemic	Cerebral artery occlusion, unspecified, with cerebral infarction
997.02	Ischemic	Iatrogenic cerebrovascular infarction or hemorrhage
435.8	Transient ischemic attack	Other specified transient cerebral ischemia
435.9	Transient ischemic attack	Unspecified transient cerebral ischemia

Appendix B. ICD-9 Codes and Drug Classes Used for Risk Factor Identification

Heart Failure

ICD-9	Code Description
402.11	Benign hypertensive heart disease with heart failure
402.91	Unspecified hypertensive heart disease with heart failure
404.01	Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.03	Hypertensive heart disease and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage V or end stage renal disease
404.11	Hypertensive heart and chronic kidney disease, benign, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.13	Hypertensive heart disease and chronic kidney disease, benign, with heart failure and with chronic kidney disease stage V or end stage renal disease
404.91	Hypertensive heart and chronic kidney disease, unspecified, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified
404.93	Hypertensive heart disease and chronic kidney disease, unspecified, with heart failure and with chronic kidney disease stage V or end stage renal disease
428.0	Congestive heart failure, unspecified
428.1	Left heart failure
428.2	Systolic heart failure, unspecified
428.21	Acute systolic heart failure
428.22	Chronic systolic heart failure
428.23	Acute on chronic systolic heart failure
428.3	Diastolic heart failure, unspecified
428.31	Acute diastolic heart failure
428.32	Chronic diastolic heart failure
428.33	Acute on chronic diastolic heart failure
428.4	Combined systolic and diastolic heart failure, unspecified
428.41	Acute combined systolic and diastolic heart failure
428.42	Chronic combined systolic and diastolic heart failure
428.43	Acute on chronic combined systolic and diastolic heart failure
428.9	Heart failure, unspecified

Hypertension

ICD-9	Code Description
401.0	Malignant essential hypertension
401.1	Benign essential hypertension
401.9	Unspecified essential hypertension
402.0	Malignant hypertensive heart disease without heart failure
402.1	Benign essential hypertension without heart failure
402.9	Unspecified essential hypertension without heart failure
405.01	Malignant renovascular hypertension
405.09	Other malignant secondary hypertension

405.11	Benign renovascular hypertension
405.19	Other benign secondary hypertension
405.91	Unspecified renovascular hypertension
405.99	Other unspecified secondary hypertension

Therapeutic Classes for Hypertension

Drug Class	Description
50	Cardiac, alpha-beta blockers
51	Cardiac, beta-blockers
52	Cardiac, calcium channel blockers
121	Diuretics, miscellaneous
122	Diuretics, osmotic
123	Diuretics, potassium sparing
124	Diuretics, thiazide and related
125	Diuretics, carbonic anhydrase inhibitors

Diabetes Mellitus

ICD-9	Code Description
249.0	Secondary diabetes mellitus without mention of complication, not stated as uncontrolled, or unspecified
249.01	Secondary diabetes mellitus without mention of complication, uncontrolled
249.1	Secondary diabetes mellitus with ketoacidosis, not stated as uncontrolled, or unspecified
249.11	Secondary diabetes mellitus with ketoacidosis, uncontrolled
249.2	Secondary diabetes mellitus with hyperosmolarity, not stated as uncontrolled, or unspecified
249.21	Secondary diabetes mellitus with hyperosmolarity, uncontrolled
249.3	Secondary diabetes mellitus with other coma, not stated as uncontrolled, or unspecified
249.31	Secondary diabetes mellitus with other coma, uncontrolled
249.4	Secondary diabetes mellitus with renal manifestations, not stated as uncontrolled, or unspecified
249.41	Secondary diabetes mellitus with renal manifestations, uncontrolled
249.5	Secondary diabetes mellitus with ophthalmic manifestations, not stated as uncontrolled, or unspecified
249.51	Secondary diabetes mellitus with ophthalmic manifestations, uncontrolled
249.6	Secondary diabetes mellitus with neurological manifestations, not stated as uncontrolled, or unspecified
249.61	Secondary diabetes mellitus with neurological manifestations, uncontrolled
249.7	Secondary diabetes mellitus with peripheral circulatory disorders, not stated as uncontrolled, or unspecified
249.71	Secondary diabetes mellitus with peripheral circulatory disorders, uncontrolled
249.8	Secondary diabetes mellitus with other specified manifestations, not stated as uncontrolled, or unspecified
249.81	Secondary diabetes mellitus with other specified manifestations, uncontrolled
249.9	Secondary diabetes mellitus with unspecified complication, not stated as uncontrolled, or unspecified
249.91	Secondary diabetes mellitus with unspecified complication, uncontrolled

250.0	Diabetes mellitus without mention of complication, type II or unspecified type, not stated as uncontrolled
250.01	Diabetes mellitus without mention of complication, type I [juvenile type], not stated as uncontrolled
250.02	Diabetes mellitus without mention of complication, type II or unspecified type, uncontrolled
250.03	Diabetes mellitus without mention of complication, type I [juvenile type], uncontrolled
250.1	Diabetes mellitus with ketoacidosis, type II or unspecified type, not stated as uncontrolled
250.11	Diabetes mellitus with ketoacidosis, type I [juvenile type], not stated as uncontrolled
250.12	Diabetes mellitus with ketoacidosis, type II or unspecified type, uncontrolled
250.13	Diabetes mellitus with ketoacidosis, type I [juvenile type], uncontrolled
250.2	Diabetes mellitus with hyperosmolarity, type II or unspecified type, not stated as uncontrolled
250.21	Diabetes mellitus with hyperosmolarity, type I [juvenile type], not stated as uncontrolled
250.22	Diabetes mellitus with hyperosmolarity, type II or unspecified type, uncontrolled
250.23	Diabetes mellitus with hyperosmolarity, type I [juvenile type], uncontrolled
250.3	Diabetes mellitus with other coma, type II or unspecified type, not stated as uncontrolled
250.31	Diabetes mellitus with other coma, type I [juvenile type], not stated as uncontrolled
250.32	Diabetes mellitus with other coma, type II or unspecified type, uncontrolled
250.33	Diabetes mellitus with other coma, type I [juvenile type], uncontrolled
250.4	Diabetes mellitus with renal manifestations, type II or unspecified type, not stated as uncontrolled
250.41	Diabetes mellitus with renal manifestations, type I [juvenile type], not stated as uncontrolled
250.42	Diabetes mellitus with renal manifestations, type II or unspecified type, uncontrolled
250.43	Diabetes mellitus with renal manifestations, type I [juvenile type], uncontrolled
250.5	Diabetes mellitus with ophthalmic manifestations, type II or unspecified type, not stated as uncontrolled
250.51	Diabetes mellitus with ophthalmic manifestations, type I [juvenile type], not stated as uncontrolled
250.52	Diabetes mellitus with ophthalmic manifestations, type II or unspecified type, uncontrolled
250.53	Diabetes mellitus with ophthalmic manifestations, type I [juvenile type], uncontrolled
250.6	Diabetes mellitus with neurologic manifestations, type II or unspecified type, not stated as uncontrolled
250.61	Diabetes mellitus with neurologic manifestations, type I [juvenile type], not stated as uncontrolled
250.62	Diabetes mellitus with neurologic manifestations, type II or unspecified type, uncontrolled
250.63	Diabetes mellitus with neurologic manifestations, type I [juvenile type], uncontrolled
250.7	Diabetes mellitus with peripheral circulatory disorders, type II or unspecified type, not stated as uncontrolled
250.71	Diabetes mellitus with peripheral circulatory disorders, type I [juvenile type], not stated as uncontrolled
250.72	Diabetes mellitus with peripheral circulatory disorders, type II or unspecified type, uncontrolled
250.73	Diabetes mellitus with peripheral circulatory disorders, type I [juvenile type], uncontrolled
250.8	Diabetes mellitus with other specified manifestations, type II or unspecified type, not stated as uncontrolled
250.81	Diabetes mellitus with specified manifestations, type I [juvenile type], not stated as uncontrolled
250.82	Diabetes mellitus with specified manifestations, type II or unspecified type, uncontrolled
250.83	Diabetes mellitus with specified manifestations, type I [juvenile type], uncontrolled
250.9	Diabetes mellitus with unspecified complication, type II or unspecified type, not stated as uncontrolled
250.91	Diabetes mellitus with unspecified complication, type I [juvenile type], not stated as uncontrolled

250.92	Diabetes mellitus with unspecified complication, type II or unspecified type, uncontrolled
250.93	Diabetes mellitus with unspecified complication, type I [juvenile type], uncontrolled

Therapeutic Classes for Diabetes Mellitus

Drug Class	Description
172	Antidiabetic agents, insulin
173	Antidiabetic agents, sulfonylureas
174	Antidiabetic agents, miscellaneous

Coronary Artery Disease

ICD-9	Code Description
414.0	Coronary atherosclerosis of unspecified type of vessel, native or graft
414.01	Coronary atherosclerosis of native coronary artery
414.02	Coronary atherosclerosis of autologous vein bypass graft
414.03	Coronary atherosclerosis of nonautologous biological bypass graft
414.04	Coronary atherosclerosis of artery bypass graft
414.05	Coronary atherosclerosis of unspecified bypass graft
414.06	Coronary atherosclerosis of native coronary artery of transplanted heart
414.07	Coronary atherosclerosis of bypass graft (artery) (vein) of transplanted heart
414.2	Chronic total occlusion of coronary artery
414.3	Coronary atherosclerosis due to lipid rich plaque
414.4	Coronary atherosclerosis due to calcified coronary lesion

Chronic Kidney Disease

ICD-9	Code Description
585.1	Chronic kidney disease, Stage I
585.2	Chronic kidney disease, Stage II (mild)
585.3	Chronic kidney disease, Stage III (moderate)
585.4	Chronic kidney disease, Stage IV (severe)
585.5	Chronic kidney disease, Stage V
585.6	End stage renal disease
585.9	Chronic kidney disease, unspecified
403.0	Hypertensive chronic kidney disease, malignant, with chronic kidney disease, stage I through stage IV, or unspecified
403.01	Hypertensive chronic kidney disease, malignant, with chronic kidney disease, stage V or end stage renal disease
403.1	Hypertensive chronic kidney disease, benign, with chronic kidney disease, stage I through stage IV, or unspecified
403.11	Hypertensive chronic kidney disease, benign, with chronic kidney disease, stage V or end stage renal disease
403.9	Hypertensive chronic kidney disease, unspecified, with chronic kidney disease, stage I through stage IV, or unspecified
403.91	Hypertensive chronic kidney disease, unspecified, with chronic kidney disease, stage V or end stage renal disease

404.0	Hypertensive heart and chronic kidney disease, malignant, without heart failure and with chronic kidney disease stage I through IV, or unspecified
404.02	Hypertensive heart and chronic kidney disease, malignant, without heart failure and with chronic kidney disease stage V or end stage renal disease
404.1	Hypertensive heart and chronic kidney disease, benign, without heart failure and with chronic kidney disease stage I through IV, or unspecified
404.12	Hypertensive heart and chronic kidney disease, benign, without heart failure and with chronic kidney disease stage V or end stage renal disease
404.9	Hypertensive heart and chronic kidney disease, unspecified, without heart failure and with chronic kidney disease stage I through IV, or unspecified
404.92	Hypertensive heart and chronic kidney disease, unspecified, without heart failure and with chronic kidney disease stage V or end stage renal disease

Appendix C. Codes Used for Identification of Symptoms, Additional Comorbid Condition, and External Cardiac Monitoring

Symptom Codes

ICD-9	Type of Symptom	Code Description
786.50	Chest pain	Chest pain, unspecified
786.51	Chest pain	Precordial pain
786.52	Chest pain	Painful respiration
786.59	Chest pain	Other chest pain
780.4	Dizziness	Dizziness or vertigo, not otherwise specified
785.1	Palpitations	Palpitations
785.0	Tachycardia	Tachycardia
786.00	Respiratory	Dyspnea and respiratory abnormalities
786.05	Respiratory	Shortness of breath
786.09	Respiratory	Other respiratory abnormalities

Additional Comorbid Condition Codes

ICD-9	Type of Condition	Code Description
327.2	Sleep apnea	Organic sleep apnea, not otherwise specified
327.23	Sleep apnea	Obstructive sleep apnea
780.51	Sleep apnea	Insomnia with sleep apnea, not otherwise specified
780.53	Sleep apnea	Hypersomnia with sleep apnea, not otherwise specified
780.57	Sleep apnea	Sleep apnea, not otherwise specified

External Cardiac Monitoring Codes

CPT Code	Type of Monitoring	Code Description
93228	Mobile cardiac outpatient telemetry	Wearable mobile cardiovascular telemetry with electrocardiographic recording, concurrent computerized real time data analysis and greater than 24 hours of accessible ECG data storage (retrievable with query) with ECG triggered and patient selected events transmitted to a remote attended surveillance center for up to 30 days; physician review and interpretation with report
93229	Mobile cardiac outpatient telemetry	Technical support for connection and patient instructions for use, attended surveillance, analysis and physician prescribed transmission of daily and emergent data reports
93268	Loop monitor	Wearable patient activated electrocardiographic rhythm derived multiple event recording with pre-symptom memory loop, 24-hour attended monitoring, per 30 day period of time; includes transmission, physician review and interpretation
93270	Loop monitor	Connection, recording and disconnection of an external device
93271	Loop monitor	Monitoring, receipt of transmissions, and analysis
93272	Loop monitor	Physician review and interpretation of EKG strips
93224	Holter monitor	Electrocardiographic monitoring for 24 hours by continuous original ECG waveform recording and storage, with visual superimposition scanning;

		includes recording, scanning analysis with report, physician review and interpretation
93225	Holter monitor	Electrocardiographic monitoring for 24 hours by continuous original ECG waveform recording and storage, with visual superimposition scanning; recording (includes hook-up, recording, and disconnection)
93226	Holter monitor	Electrocardiographic monitoring for 24 hours by continuous original ECG waveform recording and storage, with visual superimposition scanning; scanning analysis with report
93227	Holter monitor	Electrocardiographic monitoring for 24 hours by continuous original ECG waveform recording and storage, with visual superimposition scanning; physician review and interpretation

Appendix D. Additional Baseline Patient Characteristics

Baseline Characteristics	High-risk Subcohort (N= 1,851,653) Count (%)	Low-risk Subcohort (N= 1,156,221) Count (%)	Combined Population for Multivariable Analysis (N= 3,007,874) Count (%)
Region			
Northeast	173,774 (9.4%)	120,171 (10.4%)	293,945 (9.8%)
North Central	663,462 (35.8%)	361,661 (31.3%)	1,025,123 (34.1%)
South	710,288 (38.4%)	433,469 (37.5%)	1,143,757 (38.0%)
West	299,454 (16.2%)	236,082 (20.4%)	535,536 (17.8%)
Unknown	4,675 (0.3%)	4,838 (0.4%)	9,513 (0.3%)
External Cardiac Monitoring			
MCOT*, Loop, or Holter	27,303 (1.5%)	6,140 (0.5%)	33,443 (1.1%)

*MCOT = mobile cardiac outpatient telemetry