Prognostic Survival Model

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The Cox proportional hazard (PH) model was used to predict the risk of being put on warfarin or clopidogrel or statin for patients at some specific time point (e.g., 3 years after entering medical home). The predictors include patient demographics (age, weight, BMI, gender, race) and clinical variables (diabetes, coronary disease, afib, hypertension, atherosclerosis, CHF, previous clot, and dialysis). All data were collected at baseline (t0: time medical home being established).

For each diagnostic part of the equation, the variable was instantiated with 2 instances of the relevant ICD9 code.

**Steps:**

1. Calculate linear predictor (lp.bmi or lp.wei)
2. Convert to exposure risk for 1-5 years

**Step 1**: BMI model when patient weight and height (BMI) are available (**lp.bmi**)

The linear predictor function estimated from this Cox PH model using BMI as a predictor can be written as

lp.bmi ← function (baseline.age = 51, BMI = 28.051752, gender = ”F”, race3 = ”White”, diabetes = 0, coronary.disease = 0, afib = 0, hypertension = 0, atherosclerosis = 0, chf = 0, previous.clot = 0, dialysis = 0)   
{ -4.7305438 + 0.065459713 \* baseline.age   
  
- 3.0194841e-05 \* pmax(baseline.age - 24, 0)3 + 0.0001037356 ∗ pmax(baseline.age−41,0)3−0.00015032806∗pmax(baseline.age−51,0)3+0.0001060992∗pmax(baseline.age− 60, 0)3 - 2.9311903e-05 ∗ pmax(baseline.age − 76, 0)3   
  
+ 0.065024817 ∗ BMI − 0.00010665707 ∗ pmax(BMI − 20.07749,0)3 + 0.00012222854 ∗ pmax(BMI − 24.578615,0)3 − 0.00010824019 ∗ pmax(BMI − 28.051752,0) 3 + 0.00016694303 ∗ pmax(BMI − 32.435083,0)3 − 7.4274303e-05 ∗ pmax(BMI − 43.639397,0) 3   
  
+ 0.23279775 ∗ (gender == ”M”)   
  
+ 0.0860601 ∗ (race3 == ”Other”) + 0.049906138 ∗ (race3 == ”White”)   
+ 0.58213821 ∗ diabetes   
+ 0.21707034 ∗ coronary.disease   
+ 0.4003414 ∗ afib   
− 0.0013109944 ∗ hypertension   
+ 0.036763009 ∗ atherosclerosis   
+ 0.19367406 ∗ chf   
+ 0.11672828 ∗ previous.clot   
+ 0.67819823 ∗ dialysis}







**Step 1:** Weight model when only patient weight is available (**lp.wei**)

lp.wei ← function (baseline.age = 51, weight = 81.215, gender = ”F”, race3 = ”White”, diabetes = 0, coro- nary.disease = 0, afib = 0, hypertension = 0, atherosclerosis = 0, chf = 0, previous.clot = 0, dialysis = 0)   
  
{ -4.093934   
+ 0.062887454 \* baseline.age - 2.7663616e-05 \* pmax(baseline.age - 25, 0)3 + 8.704417e-05 ∗ pmax(baseline.age−41, 0)3 −0.00012894443∗pmax(baseline.age−51, 0)3 +9.7498419e−05∗pmax(baseline.age− 60, 0) 3 − 2.7934541e − 05 ∗ pmax(baseline.age − 77, 0) 3   
  
+ 0.014879719 ∗ weight + 4.7831395e-06 ∗ pmax(weight − 53.52, 0) 3 − 2.5301908e-05 ∗ pmax(weight − 69, 0) 3 + 3.0660501e-05 ∗ pmax(weight − 81.215, 0) 3 − 9.0792408e-06 ∗ pmax(weight − 95.28, 0) 3 − 1.062491e-06 ∗ pmax(weight − 127.2335, 0) 3   
  
+ 0.10159946 ∗ (gender == ”M”)   
+ 0.12720848 ∗ (race3 == ”Other”)   
+ 0.047369679 ∗ (race3 == ”White”)   
+ 0.59062019 ∗ diabetes   
+ 0.26573081 ∗ coronary.disease   
+ 0.78302641 ∗ afib   
− 0.03548041 ∗ hypertension   
+ 0.050988742 ∗ atherosclerosis   
+ 0.24422313 ∗ chf   
+ 0.14582975 ∗ previous.clot   
+ 0.70935756 ∗ dialysis}

**Step 2:** Converting linear predictor to exposure risk at Time X

|  |  |  |
| --- | --- | --- |
| time (days) | S0,bmi | S0,wei |
| 0 | 1 | 1 |
| 365 | 0.926 | 0.927 |
| 730 | 0.863 | 0.865 |
| 1095 | 0.797 | 0.795 |
| 1460 | 0.725 | 0.714 |
| 1825 | 0.68 | 0.662 |

-or-

Example patients, with the **lp.bmi** predictor:



**Variables**

|  |  |
| --- | --- |
| **Variable** | **How defined** |
| 1. **Demographics/other** |  |
| * 1. Age | Age in years: numeric value (include only 18 and up) |
| * 1. Gender | Male/Female/Unknown |
| * 1. Race | Caucasian/African American/Other/Unknown |
| * 1. Weight | Numeric value (xx-yy) |
| * 1. BMI | numeric value (15-50) |
| 1. **Diseases and conditions** |  |
| * 1. Diabetes | Two instances of 250.\* |
| * 1. Coronary disease | 2 or more ICD-9 codes (see below) |
| * 1. A-fib | 2 instances of 427.3\* |
| * 1. Hypertension | 2 instances of ICD 9 codes: 401.\* - 405.\* |
| * 1. Atherosclerosis | 2 or more ICD-9 codes (see below) |
| * 1. Congestive Heart Failure | 2 or more ICD-9 codes (see below) |
| * 1. Previous clot | 1 ICD9 code (see below) |
| * 1. Dialysis | 1 ICD 9 or CPT code (from below) |

**Diabetes**

250.\* Diabetes mellitus

**Coronary Disease**

410.\* Acute myocardial infarction

411.\* Other acute and subacute forms of ischemic heart disease

412 Old myocardial infarction

414.\* Other acute and subacute forms of ischemic heart disease

429.7\* Certain sequelae of myocardial infarction, not elsewhere classified

**Chronic Liver Disease/Cirrohsis**

571 Chronic Liver disease/Cirrhosis

571.0 Alcoholic Fatty Liver

571.1 Acute Alcoholic Hepatitis

571.2 Alcoholic Cirrhosis Liver

571.3 Alcoholic Liver Damage NOS

571.4 Chronic Hepatitis

571.40 Chronic Hepatitis NOS

571.41 Chronic Persistent Hepatitis

571.49 Chronic Hepatitis NEC

571.5 Cirrhosis of Liver NOS

571.6 Biliary Cirrhosis

571.8 Chronic Liver Disease NEC

571.9 Chronic Liver Disease NOS

572.2 Hepatic Coma

572.3 Portal Hypertension

572.4 Hepatorenal syndrome

572.8 Other Sequela, Chronic Liver Disease

789.5 Ascites

789.51 Malignant Ascites

789.59 Ascites NEC

**Atherosclerosis (surrogate for CAD/PVD)**

440.4 Atherosclerosis of Aorta

440.1 Atherosclerosis of Renal Artery

440.2 Atherosclerosis of Native Arteries of Extremities

440.20 Atherosclerosis of Native Arteries of Extremities, Unspec

440.21 Atherosclerosis of Native Arteries of Extremities with Intermittent Claudication

440.22 Atherosclerosis of Native Arteries of Extremities with Rest Pain

440.23 Atherosclerosis of Native Arteries of Extremities with Ulceration

440.24 Atherosclerosis of Native Arteries of Extremities with Gangrene

440.29 Other Atherosclerosis of Native Arteries of The Extremities

440.30 Atherosclerosis of Unspecified Bypass Graft of the Extremities

440.31 Atherosclerosis of Autologous Vein Bypass Graft of the Extremities

440.32 Athererosclerosis of Nonautologous Biological Bypass Graft of the Extremities

440.4 Chronic Total Occlusion of Artery of the Extremities

440.8 Atherosclerosis of Other Spec Arteries

440.9 Generalized and Unspecified Atherosclerosis

414.0 Coronary Atherosclerosis

414.00 Coronary Atherosclerosis of Unspecified 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

414.10 Aneurysm of Heart

414.11 Aneurysm of Coronary Vessel

414.12 Dissection of Coronary Artery

414.19 Anuerysm of Heart NEC

414.2 Chronic Total Occlusion Cor Artery

414.8 Chronic Ischemic Heart Disease NEC

414.9 Chronic Ischemic Heart Disease NOS

414.06 Coronary Atherosclerosis of Transplanted Heart

414.07 Coronary Atherosclerosis of Bypass Graft of Transplanted Heart

413.0, 413.1, 413.9 Angina Pectoris

412 Old Myocardial Infarction

411.0, 411.1, 411.8 Other Acute Ischemic Heart Disease

410 Acute Myocardial Infarction

410.00, 410.01, 410.02 AMI Anterolateral Wall

410.10, 410.11, 410.12 AMI Anterior Wall NEC

410.20, 410.21, 410.22 AMI Inferolateral Wall

410.30, 410.31, 410.32 AMI Inferoposterior Wall

410.40, 410.41, 410.42 AMI Inferior Wall NEC

410.50, 410.51, 410.52 AMI Lateral Wall NEC

410.60, 410.61, 410.62 True Posterior Infarct

410.70, 410.71, 410.72 Subendocardial Infarc

410.80, 410.81, 410.82 Myocardial Infarct NEC

410.90, 410.91, 410.92 Myocardial Infarct NOS

437.0 Cerebral Atherosclerosis

437.1 Other Generalized Ischemic Cerebrovascular Disease

437.2 Hypertensive Encephalopathy

437.5 Moyamoya Disease

437.8 Other Ill-Defined Cerbrovascular Disease

437.9 Unspecified Cerebrovascular Disease

436 Acute But Ill-Defined, Cerebrovascular Disease

290.40, 290.41, 290.43 Vascular Dementia

434 Cerebral Artery Occlusion

434.00, 434.01 Cerebral Thrombosis

434.10, 434.11 Cerebral Embolism

434.90, 434.91 Cerebral Artery Occlusion NOS

435.0, 435.1, 435.2, 435.3, 435.8, 435.9 Transient Cerebral Ischmia

433 Precerebral Occlusion

433.00, 433.01 Basilar Artery Occlusion

433.10, 433.11 Carotid Artery Occlusion

433.20, 433.21 Vertebral Artery Occlusion

433.30, 433.31 Multiple Precerebral Occlusion

433.80, 433.81 Precerebral Occlusion NEC

433.90, 433.91 Precerebral Occlusion NOS

**Congestive Heart Failure**

402.01 Malignant hypertensive heart disease with heart failure

402.11 Benign hypertensive heart disease with heart failure

402.91 Unspecified hypertensive heart disease with heart failure

428.\* Heart Failure

**Previous Clot**

415.1 Pulmonary embolism and infarction

415.9 Pulmonary embolism and infarction

444 Arterial embolism and thrombosis

452 Portal vein thrombosis

453 Pulmonary embolus and DVT

673.\* Obstetrical pulmonary embolism

**Dialysis**

V56\* Encounter for dialysis and dialysis catheter care

V45.1 Postsurgical renal dialysis status

V45.11 Renal dialysis status

V45.12 Noncompliance with renal dialysis

458.21 Hypotension of hemodialysis

996.56 Mechanical complication due to peritoneal dialysis catheter

996.68 Infection and inflammation RXN due to peritoneal dialysis catheter

996.73 Other complications due to renal dialysis device, implant and graft

V45.11 Renal dialysis status

792.5 Cloudy (hemodialysis)(peritoneal) dialysis effluent

CPT: 90935, 90937, 90945, 90947, 90989, 90993, 90921, 90925, indicating dialysis or dialysis training