

Separate Appendix:

Score-Driven Interactions for “Disease X” Using COVID and Non-COVID Mortality

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Abstract: The COVID-19 (coronavirus disease of 2019) pandemic is over; however, the probability of such a pandemic is about 2% in any year. There are international negotiations among almost 200 countries at the World Health Organization (WHO) concerning a global plan to deal with the next pandemic on the scale of COVID-19, known as “Disease X”. We develop a nonlinear panel quasi-vector autoregressive (PQVAR) model for the multivariate t -distribution with dynamic unobserved effects, which can be used for out-of-sample forecasts of causes of death counts in the United States (US) when a new global pandemic starts. We use panel data from the Centers for Disease Control and Prevention (CDC) for the cross section of all states of the United States (US) from March 2020 to September 2022 regarding all death counts of (i) COVID-19 deaths, (ii) deaths that medically may be related to COVID-19, and (iii) the remaining causes of death. We compare the t -PQVAR model with its special cases, the PVAR moving average (PVARMA), and PVAR. The t -PQVAR model provides robust evidence on dynamic interactions among (i), (ii), and (iii). The t -PQVAR model may be used for out-of-sample forecasting purposes at the outbreak of a future “Disease X” pandemic.

Keywords: score-driven time series models; dynamic conditional score (DCS); generalized autoregressive score (GAS); panel data models; coronavirus disease of 2019 (COVID-19)

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Table S1: Classification of the underlying cause of death codes.

(i) COVID-19 mortality	
Death code	Underlying cause of death
U07.1	COVID-19
B34.2	Coronavirus infection, unspecified
(ii) Casues of death medically related to COVID-19	
Death code	Underlying cause of death
C34.9	Bronchus or lung, unspecified—Malignant neoplasms
C61	Malignant neoplasm of prostate
C64	Malignant neoplasm of kidney, except renal pelvis
C80	Malignant neoplasm without specification of the site
C85.9	Non-Hodgkin lymphoma, unspecified type
C90.0	Multiple myeloma—Malignant neoplasms
E11.9	Non-insulin-dependent diabetes mellitus, without complications
E14.9	Unspecified diabetes mellitus, without complications
I10	Essential (primary) hypertension
I11.0	Hypertensive heart disease with (congestive) heart failure
I11.9	Hypertensive heart disease without (congestive) heart failure
I12.0	Hypertensive renal disease with renal failure
I13.2	Hypertensive heart and renal disease with both (congestive) heart failure and renal failure
I21.4	Acute subendocardial myocardial infarction
I21.9	Acute myocardial infarction, unspecified
I25.0	Atherosclerotic cardiovascular disease, so described
I25.1	Atherosclerotic heart disease
I25.5	Ischaemic cardiomyopathy
I25.9	Chronic ischaemic heart disease, unspecified
I26.9	Pulmonary embolism without mention of acute cor pulmonale
I42.9	Cardiomyopathy, unspecified
I46.1	Sudden cardiac death, so described
I46.9	Cardiac arrest, unspecified
I48	Atrial fibrillation and flutter
I49.9	Cardiac arrhythmia, unspecified
I50.0	Congestive heart failure
I50.9	Heart failure, unspecified
I51.6	Cardiovascular disease, unspecified
I51.9	Heart disease, unspecified
I61.9	Intracerebral haemorrhage, unspecified
I62.9	Intracranial haemorrhage (nontraumatic), unspecified
I63.9	Cerebral infarction, unspecified
I64	Stroke, not specified as haemorrhage or infarction
I67.2	Cerebral atherosclerosis
I67.9	Cerebrovascular disease, unspecified
J18.9	Pneumonia, unspecified
J43.9	Emphysema, unspecified
J44.0	Chronic obstructive pulmonary disease with acute lower respiratory infection
J44.9	Chronic obstructive pulmonary disease, unspecified
J69.0	Pneumonitis due to food and vomit
J84.1	Other interstitial pulmonary diseases with fibrosis
J84.9	Interstitial pulmonary disease, unspecified
J96.9	Respiratory failure, unspecified
K74.6	Other and unspecified cirrhosis of liver
N17.9	Acute renal failure, unspecified
N18.5	Chronic kidney disease, stage 5

Table S2: Classification of the underlying cause of death codes.

(ii) Casues of death medically related to COVID-19	
Death code	Underlying cause of death
N19	Unspecified renal failure
R99	Other ill-defined and unspecified causes of mortality
F01.9	Vascular dementia, unspecified
G31.8	Other specified degenerative diseases of nervous system
K55.9	Vascular disorder of the intestine, unspecified
K92.2	Gastrointestinal haemorrhage, unspecified
N28.9	Disorder of kidney and ureter, unspecified
N39.0	Urinary tract infection, site not specified
C92.0	Acute myeloid leukaemia—Malignant neoplasms
C97	Malignant neoplasms of independent (primary) multiple sites
E11.2	Non-insulin-dependent diabetes mellitus, with renal complications
E14.2	Unspecified diabetes mellitus, with renal complications
I27.2	Other secondary pulmonary hypertension
I35.0	Aortic (valve) stenosis
I38	Endocarditis, valve unspecified
I69.8	Sequelae of other and unspecified cerebrovascular diseases
E78.5	Hyperlipidaemia, unspecified
G12.2	Motor neuron disease
K72.9	Hepatic failure, unspecified
J44.1	Chronic obstructive pulmonary disease with acute exacerbation, unspecified
A09.9	Gastroenteritis and colitis of unspecified origin
C17.0	Duodenum—Malignant neoplasms
C34.1	Upper lobe, bronchus or lung—Malignant neoplasms
C45.9	Mesothelioma, unspecified—Malignant neoplasms
C79.8	Secondary malignant neoplasm of other specified sites—Malignant neoplasms
C81.9	Hodgkin disease, unspecified
C83.1	Non-Hodgkin lymphoma small cleaved cell (diffuse)
C83.3	Non-Hodgkin lymphoma large cell (diffuse)
C85.1	B-cell lymphoma, unspecified—Malignant neoplasms
C91.0	Acute lymphoblastic leukaemia—Malignant neoplasms
C91.1	Chronic lymphocytic leukaemia—Malignant neoplasms
C92.1	Chronic myeloid leukaemia—Malignant neoplasms
C95.9	Leukaemia, unspecified—Malignant neoplasms
D47.1	Chronic myeloproliferative disease—Uncertain neoplasms
D64.9	Anaemia, unspecified
E11.1	Non-insulin-dependent diabetes mellitus, with ketoacidosis
E11.5	Non-insulin-dependent diabetes mellitus, with peripheral circulatory complications
E11.7	Non-insulin-dependent diabetes mellitus, with multiple complications
E14.1	Unspecified diabetes mellitus, with ketoacidosis
E14.7	Unspecified diabetes mellitus, with multiple complications
I13.1	Hypertensive heart and renal disease with renal failure
I24.9	Acute ischaemic heart disease, unspecified
I25.8	Other forms of chronic ischaemic heart disease
I33.0	Acute and subacute infective endocarditis
I34.0	Mitral (valve) insufficiency
I42.0	Dilated cardiomyopathy
I42.2	Other hypertrophic cardiomyopathy
I51.7	Cardiomegaly
I60.9	Subarachnoid haemorrhage, unspecified
I62.0	Subdural haemorrhage (acute)(nontraumatic)
I63.4	Cerebral infarction due to embolism of cerebral arteries

Table S3: Classification of the underlying cause of death codes.

(ii) Casues of death medically related to COVID-19	
Death code	Underlying cause of death
I69.3	Sequelae of cerebral infarction
I69.4	Sequelae of stroke, not specified as haemorrhage or infarction
I70.9	Generalized and unspecified atherosclerosis
I71.0	Dissection of the aorta [any part]
I71.3	Abdominal aortic aneurysm, ruptured
I71.4	Abdominal aortic aneurysm, without mention of rupture
I73.9	Peripheral vascular disease, unspecified
I80.2	Phlebitis and thrombophlebitis of other deep vessels of lower extremities
J10.0	Influenza with pneumonia, influenza virus identified
J10.1	Influenza with other respiratory manifestations, influenza virus identified
J11.0	Influenza with pneumonia, virus not identified
J15.2	Pneumonia due to staphylococcus
J15.9	Bacterial pneumonia, unspecified
J44.8	Other specified chronic obstructive pulmonary disease
J45.9	Asthma, unspecified
J96.1	Chronic respiratory failure
J98.4	Other disorders of lung
K27.4	Peptic ulcer, site unspecified, chronic or unspecified with haemorrhage
K81.0	Acute cholecystitis
N18.4	Chronic kidney disease, stage 4
N18.9	Chronic renal failure, unspecified
N12	Tubulointerstitial nephritis, not specified as acute or chronic
N40	Hyperplasia of prostate
Q24.9	Congenital malformation of heart, unspecified
E03.9	Hypothyroidism, unspecified
E88.9	Metabolic disorder, unspecified
G40.9	Epilepsy, unspecified
G93.4	Encephalopathy, unspecified
K57.8	Diverticular disease of the intestine, part unspecified, with perforation and abscess
K57.9	Diverticular disease of the intestine, part unspecified, without perforation or abscess
K63.1	Perforation of the intestine (nontraumatic)
K65.0	Acute peritonitis
K76.0	Fatty (change of) liver, not elsewhere classified
K76.9	Liver disease, unspecified
K85.9	Acute pancreatitis, unspecified
M06.9	Rheumatoid arthritis, unspecified
M32.1	Systemic lupus erythematosus with organ or system involvement
C95.0	Acute leukaemia of unspecified cell type—Malignant neoplasms
E10.9	Insulin-dependent diabetes mellitus, without complications
E14.5	Unspecified diabetes mellitus, with peripheral circulatory complications
I27.9	Pulmonary heart disease, unspecified
I63.3	Cerebral infarction due to thrombosis of cerebral arteries
I67.8	Other specified cerebrovascular diseases
J47	Bronchiectasis
J96.0	Acute respiratory failure
R68.8	Other specified general symptoms and signs
D68.9	Coagulation defect, unspecified
E78.0	Pure hypercholesterolaemia
E78.9	Disorder of lipoprotein metabolism, unspecified
F05.9	Delirium, unspecified
G31.0	Circumscribed brain atrophy

Table S4: Classification of the underlying cause of death codes.

(ii) Casues of death medically related to COVID-19	
Death code	Underlying cause of death
N28.8	Other specified disorders of kidney and ureter
W80	Inhalation and ingestion of other objects obstructing respiratory tract
E87.2	Acidosis
I13.0	Hypertensive heart and renal disease with (congestive) heart failure
I28.9	Disease of pulmonary vessels, unspecified
E10.2	Insulin-dependent diabetes mellitus, with renal complications
I08.0	Disorders of both mitral and aortic valves
I35.9	Aortic valve disorder, unspecified
I61.5	Intracerebral haemorrhage, intraventricular
I70.0	Atherosclerosis of aorta
J18.1	Lobar pneumonia, unspecified
K44.9	Diaphragmatic hernia without obstruction or gangrene
P01.1	Newborn affected by premature rupture of membranes
E85.4	Organ-limited amyloidosis
G71.0	Muscular dystrophy
K55.0	Acute vascular disorders of intestine
K83.0	Cholangitis
B34.8	Other viral infections of unspecified site
I45.8	Other specified conduction disorders
I49.0	Ventricular fibrillation and flutter
I63.2	Cerebral infarction due to unspecified occlusion or stenosis of precerebral arteries
I71.8	Aortic aneurysm of unspecified site, ruptured
J80	Adult respiratory distress syndrome
G70.0	Myasthenia gravis
J98.9	Respiratory disorder, unspecified
I05.9	Mitral valve disease, unspecified
J12.9	Viral pneumonia, unspecified
J18.0	Bronchopneumonia, unspecified
I24.8	Other forms of acute ischaemic heart disease
I99	Other and unspecified disorders of circulatory system
E11.6	Non-insulin-dependent diabetes mellitus, with other specified complications
I61.3	Intracerebral haemorrhage in brain stem
E66.2	Extreme obesity with alveolar hypoventilation
G41.9	Status epilepticus, unspecified
I12.9	Hypertensive renal disease without renal failure
E11.4	Non-insulin-dependent diabetes mellitus, with neurological complications
I05.0	Mitral stenosis
I72.9	Aneurysm of unspecified site
N18.3	Chronic kidney disease, stage 3
M34.8	Other forms of systemic sclerosis
D62	Acute posthaemorrhagic anaemia
J90	Pleural effusion, not elsewhere classified
K65.9	Peritonitis, unspecified
K81.9	Cholecystitis, unspecified
K72.0	Acute and subacute hepatic failure
I63.5	Cerebral infarction due to unspecified occlusion or stenosis of cerebral arteries
R57.9	Shock, unspecified
C34.3	Lower lobe, bronchus or lung—Malignant neoplasms
I51.8	Other ill-defined heart diseases
R57.0	Cardiogenic shock
I69.1	Sequelae of intracerebral haemorrhage

Table S5: Classification of the underlying cause of death codes.

(ii) Casues of death medically related to COVID-19	
Death code	Underlying cause of death
J46	Status asthmaticus
N00.9	Acute nephritic syndrome, unspecified
P29.1	Neonatal cardiac dysrhythmia
J11.1	Influenza with other respiratory manifestations, virus not identified
M62.5	Muscle wasting and atrophy, not elsewhere classified
J12.8	Other viral pneumonia
A16.2	Tuberculosis of the lung, without mention of bacteriological or histological confirmation
B94.8	Sequelae of other specified infectious and parasitic diseases
C79.3	Secondary malignant neoplasm of brain and cerebral meninges—Malignant neoplasms
D32.9	Meninges, unspecified—Benign neoplasms
E87.0	Hyperosmolality and hypernatraemia
I61.0	Intracerebral haemorrhage in hemisphere, subcortical
E87.1	Hypo-osmolality and hyponatraemia
E87.5	Hyperkalaemia
C34.0	Main bronchus—Malignant neoplasms
C92.7	Other myeloid leukaemia—Malignant neoplasms
I35.1	Aortic (valve) insufficiency
I49.5	Sick sinus syndrome
Q27.3	Peripheral arteriovenous malformation
E78.2	Mixed hyperlipidaemia
I13.9	Hypertensive heart and renal disease, unspecified
K76.7	Hepatorenal syndrome
E85.9	Amyloidosis, unspecified
R56.8	Other and unspecified convulsions
I61.4	Intracerebral haemorrhage in cerebellum
D69.6	Thrombocytopenia, unspecified
E86	Volume depletion
I71.9	Aortic aneurysm of unspecified site, without mention of rupture
K86.9	Disease of the pancreas, unspecified
I47.2	Ventricular tachycardia
Y83.9	Surgical procedure, unspecified
D86.9	Sarcoidosis, unspecified
W84	Unspecified threat to breathing
C78.0	Secondary malignant neoplasm of the lung—Malignant neoplasms
J98.8	Other specified respiratory disorders
D38.1	Trachea, bronchus and lung—Uncertain neoplasms
I60.8	Other subarachnoid haemorrhage
I07.1	Tricuspid insufficiency
I71.1	Thoracic aortic aneurysm, ruptured
I61.1	Intracerebral haemorrhage in hemisphere, cortical
B34.9	Viral infection, unspecified
I95.9	Hypotension, unspecified
R09.0	Asphyxia
J22	Unspecified acute lower respiratory infection
E87.8	Other disorders of electrolyte and fluid balance, not elsewhere classified
R53	Malaise and fatigue
B99	Other and unspecified infectious diseases
R13	Dysphagia
R58	Haemorrhage, not elsewhere classified
A49.8	Other bacterial infections of unspecified site
J86.9	Pyothorax without fistula

Table S6: Classification of the underlying cause of death codes.

(ii) Casues of death medically related to COVID-19	
Death code	Underlying cause of death
J93.9	Pneumothorax, unspecified
R06.8	Other and unspecified abnormalities of breathing
R06.0	Dyspnoea
N17.0	Acute renal failure with tubular necrosis
R64	Cachexia
I51.5	Myocardial degeneration
I74.9	Embolism and thrombosis of unspecified artery
D65	Disseminated intravascular coagulation [defibrination syndrome]
J81	Pulmonary oedema
P22.0	Respiratory distress syndrome of newborn
P77	Necrotizing enterocolitis of newborn
A41.9	Septicaemia, unspecified
(iii) The rest of the causes of death	
Death code	Underlying cause of death
C15.9	Oesophagus, unspecified—Malignant neoplasms
C16.9	Stomach, unspecified—Malignant neoplasms
C18.9	Colon, unspecified—Malignant neoplasms
C20	Malignant neoplasm of rectum
C22.1	Intrahepatic bile duct carcinoma—Malignant neoplasms
C22.9	Liver, unspecified—Malignant neoplasms
C25.9	Pancreas, unspecified—Malignant neoplasms
C43.9	Malignant melanoma of the skin, unspecified—Malignant neoplasms
C49.9	Connective and soft tissue, unspecified—Malignant neoplasms
C50.9	Breast, unspecified—Malignant neoplasms
C56	Malignant neoplasm of ovary
C67.9	Bladder, unspecified—Malignant neoplasms
C71.9	Brain, unspecified—Malignant neoplasms
D46.9	Myelodysplastic syndrome, unspecified—Uncertain neoplasms
E46	Unspecified protein-energy malnutrition
G20	Parkinson disease
G30.9	Alzheimer disease, unspecified
K70.3	Alcoholic cirrhosis of liver
R62.8	Other lack of expected normal physiological development
F03	Unspecified dementia
G31.1	Senile degeneration of the brain, not elsewhere classified
G93.1	Anoxic brain damage, not elsewhere classified
V87.7	Person injured in collision between other specified motor vehicles (traffic)
V89.2	Person injured in unspecified motor-vehicle accident, traffic
W19	Unspecified fall
X42	Accidental poisoning by and exposure to narcotics and psychodysleptics
X44	Accidental poisoning by and exposure to other substances
X59.9	Exposure to unspecified factor causing other and unspecified injury
X74	Intentional self-harm by other and unspecified firearm discharge
X95	Assault by other and unspecified firearm discharge
B18.2	Chronic viral hepatitis C
C22.0	Liver cell carcinoma—Malignant neoplasms
C55	Malignant neoplasm of uterus, part unspecified
E43	Unspecified severe protein-energy malnutrition
E66.8	Other obesity
F10.2	Mental and behavioral disorders due to use of alcohol, dependence syndrome

Table S7: Classification of the underlying cause of death codes.

(iii) The rest of the causes of death	
Death code	Underlying cause of death
K56.6	Other and unspecified intestinal obstruction
V09.2	Pedestrian injured in traffic accident involving other and unspecified motor vehicles
V29.9	Motorcycle rider [any] injured in unspecified traffic accident
W18	Other fall on the same level
X41	Accidental poisoning by antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs
X45	Accidental poisoning by and exposure to alcohol
X70	Intentional self-harm by hanging, strangulation and suffocation
X72	Intentional self-harm by handgun discharge
G30.1	Alzheimer's disease with late onset
A04.7	Enterocolitis due to <i>Clostridium difficile</i>
B24	Unspecified human immunodeficiency virus [HIV] disease
C02.9	Tongue, unspecified—Malignant neoplasms
C10.9	Oropharynx, unspecified—Malignant neoplasms
C11.9	Nasopharynx, unspecified—Malignant neoplasms
C14.0	Pharynx, unspecified—Malignant neoplasms
C19	Malignant neoplasm of rectosigmoid junction
C23	Malignant neoplasm of gallbladder
C26.9	Ill-defined sites within the digestive system—Malignant neoplasms
C32.9	Larynx, unspecified—Malignant neoplasms
C41.9	Bone and articular cartilage, unspecified—Malignant neoplasms
C44.4	Skin of scalp and neck—Malignant neoplasms
C44.9	Malignant neoplasm of skin, unspecified—Malignant neoplasms
C48.2	Peritoneum, unspecified—Malignant neoplasms
C53.9	Cervix uteri, unspecified—Malignant neoplasms
C54.1	Endometrium—Malignant neoplasms
C73	Malignant neoplasm of thyroid gland
C78.6	Secondary malignant neoplasm of retroperitoneum and peritoneum—Malignant neoplasms
C78.7	Secondary malignant neoplasm of the liver—Malignant neoplasms
K70.1	Alcoholic hepatitis
K70.4	Alcoholic hepatic failure
K70.9	Alcoholic liver disease, unspecified
P07.2	Extreme immaturity
R95	Sudden infant death syndrome—SIDS
E66.9	Obesity, unspecified
F10.1	Mental and behavioral disorders due to use of alcohol, harmful use
G10	Huntington disease
G23.1	Progressive supranuclear ophthalmoplegia [Steele-Richardson-Olszewski]
G31.9	Degenerative disease of the nervous system, unspecified
G35	Multiple sclerosis
G80.9	Infantile cerebral palsy, unspecified
L03.1	Cellulitis of other parts of limb
M86.9	Osteomyelitis, unspecified
V03.1	Pedestrian injured in collision with car, pick-up truck or van, traffic accident
V23.4	Motorcycle rider injured in collision with car, pick-up truck or van, driver injured in traffic accident
V29.4	Driver injured in collision with other and unspecified motor vehicles in traffic accident
V43.5	Car occupant injured in collision with car, pick-up truck or van, driver injured in traffic accident
W10	Fall on and from stairs and steps
W67	Drowning and submersion while in swimming-pool
W79	Inhalation and ingestion of food obstructing respiratory tract
X00	Exposure to uncontrolled fire in building or structure
X59.0	Exposure to unspecified factor causing fracture

Table S8: Classification of the underlying cause of death codes.

(iii) The rest of the causes of death	
Death code	Underlying cause of death
Y85.0	Sequelae of motor-vehicle accident
X64	Intentional self-poisoning by and exposure to other and unspecified drugs and biological substances
X67	Intentional self-poisoning by and exposure to other gases and vapors
X73	Intentional self-harm by rifle, shotgun and larger firearm discharge
X80	Intentional self-harm by jumping from a high place
X93	Assault by handgun discharge
X99	Assault by sharp object
Y09	Assault by unspecified means
B23.8	HIV disease resulting in other specified conditions
C51.9	Vulva, unspecified—Malignant neoplasms
C84.5	Other and unspecified T-cell lymphomas—Malignant neoplasms
R54	Senility
F19.1	Mental and behavioral disorders due to multiple drug use and use of other psychoactive substances
V43.6	Car occupant injured in collision with car, pick-up truck or van, passenger injured in traffic accident
V49.9	Car occupant [any] injured in unspecified traffic accident
W69	Drowning and submersion while in natural water
R09.2	Respiratory arrest
D43.2	Brain, unspecified—Uncertain neoplasms
C09.9	Tonsil, unspecified—Malignant neoplasms
C16.0	Cardia—Malignant neoplasms
C21.0	Anus, unspecified—Malignant neoplasms
C24.0	Extrahepatic bile duct—Malignant neoplasms
C43.7	Malignant melanoma of lower limb, including hip—Malignant neoplasms
C48.0	Retroperitoneum—Malignant neoplasms
C82.9	Follicular non-Hodgkin lymphoma, unspecified
K70.0	Alcoholic fatty liver
Q90.9	Down syndrome, unspecified
F15.1	Mental and behavioral disorders due to use of other stimulants, including caffeine, harmful use
K56.2	Volvulus
M72.6	Necrotizing fasciitis
V47.5	Car occupant injured in collision with fixed or stationary object, driver injured in traffic accident
Y86	Sequelae of other accidents
X61	Intentional self-poisoning by antiepileptic, sedative-hypnotic, antiparkinsonism and psychotropic drugs
X81	Intentional self-harm by jumping or lying before moving object
C37	Malignant neoplasm of thymus
C44.3	Skin of other and unspecified parts of the face—Malignant neoplasms
K25.4	Gastric ulcer, chronic or unspecified with haemorrhage
K26.4	Duodenal ulcer, chronic or unspecified with haemorrhage
F15.9	Mental and behavioral disorders due to use of other stimulants, including caffeine
F19.9	Mental and behavioral disorders due to multiple drug use and use of other psychoactive substances
C18.7	Sigmoid colon—Malignant neoplasms
C49.4	Connective and soft tissue of abdomen—Malignant neoplasms
I42.6	Alcoholic cardiomyopathy
V27.4	Motorcycle rider injured in collision with fixed or stationary object, driver injured in traffic accident
X71	Intentional self-harm by drowning and submersion
X78	Intentional self-harm by sharp object
C06.9	Mouth, unspecified—Malignant neoplasms
C18.0	Caecum—Malignant neoplasms
D61.9	Aplastic anaemia, unspecified
E44.0	Moderate protein-energy malnutrition
F10.9	Mental and behavioral disorders due to use of alcohol, unspecified mental and behavioral disorder

Table S9: Classification of the underlying cause of death codes.

(iii) The rest of the causes of death	
Death code	Underlying cause of death
K50.9	Crohn's disease, unspecified
X47	Accidental poisoning by and exposure to other gases and vapors
V49.4	Driver injured in collision with other and unspecified motor vehicles in traffic accident
V49.5	Passenger injured in collision with other and unspecified motor vehicles in traffic accident
X30	Exposure to excessive natural heat
C18.1	Appendix—Malignant neoplasms
C74.9	Adrenal gland, unspecified—Malignant neoplasms
C76.2	Abdomen—Malignant neoplasms
X62	Intentional self-poisoning by and exposure to narcotics and psychodysleptics
V59.9	Occupant [any] of pick-up truck or van injured in unspecified traffic accident
W75	Accidental suffocation and strangulation in bed
A41.5	Septicaemia due to other Gram-negative organisms
K85.2	Alcohol-induced acute pancreatitis
V47.6	Car occupant injured in collision with fixed or stationary object, passenger injured in traffic accident
W74	Unspecified drowning and submersion
Y35.0	Legal intervention involving firearm discharge
G47.3	Sleep apnoea
L89.9	Decubitus ulcer and pressure area, unspecified
Y84.8	Other medical procedures
K26.5	Duodenal ulcer, chronic or unspecified with perforation
Q91.3	Edwards syndrome, unspecified
V48.5	Car occupant injured in noncollision transport accident, driver injured in traffic accident
O98.5	Other viral diseases complicating pregnancy, childbirth and the puerperium
C07	Malignant neoplasm of parotid gland
C24.1	Ampulla of Vater—Malignant neoplasms
C62.9	Testis, unspecified—Malignant neoplasms
V13.9	Pedal cyclist injured in collision with a car, pick-up truck or van
J13	Pneumonia due to <i>Streptococcus pneumoniae</i>
L03.9	Cellulitis, unspecified
V05.9	Unspecified whether traffic or nontraffic accident
X31	Exposure to excessive natural cold
Y83.1	Surgical operation with an implant of artificial internal device
B20.7	HIV disease resulting in multiple infections
C57.0	Fallopian tube—Malignant neoplasms
W11	Fall on and from ladder
W01	Fall on the same level from slipping, tripping and stumbling
B49	Unspecified mycosis
C24.9	Biliary tract, unspecified—Malignant neoplasms
C25.0	Head of the pancreas—Malignant neoplasms
K25.5	Gastric ulcer, chronic or unspecified with perforation
W65	Drowning and submersion while in bath-tub
B22.7	HIV disease resulting in multiple diseases classified elsewhere
V19.4	Driver injured in collision with other and unspecified motor vehicles in traffic accident
A49.0	Staphylococcal infection, unspecified
J12.1	Respiratory syncytial virus pneumonia
F01.1	Multi-infarct dementia
F17.9	Mental and behavioral disorders due to use of tobacco, unspecified mental and behavioral disorder
C76.0	Head, face and neck—Malignant neoplasms
K80.2	Calculus of gallbladder without cholecystitis
N20.0	Calculus of kidney
V43.9	Car occupant injured in collision with a car, pick-up truck or van

Table S10: Classification of the underlying cause of death codes.

(iii) The rest of the causes of death	
Death code	Underlying cause of death
M46.2	Osteomyelitis of vertebra
B16.9	Acute hepatitis B without delta-agent and hepatic coma
C49.2	Connective and soft tissue of lower limb, including hip—Malignant neoplasms
X01	Exposure to uncontrolled fire, not in building or structure
P01.0	Newborn affected by incompetent cervix
A49.9	Bacterial infection, unspecified
W06	Fall involving bed
C79.5	Secondary malignant neoplasm of bone and bone marrow—Malignant neoplasms
K56.5	Intestinal adhesions [bands] with obstruction
B20.1	HIV disease resulting in other bacterial infections
Y12	Poisoning by and exposure to narcotics and psychodysleptics
V95.9	Unspecified aircraft accident injuring occupant
C26.0	Intestinal tract, part unspecified—Malignant neoplasms
W20	Struck by thrown, projected or falling object
K52.9	Noninfective gastroenteritis and colitis, unspecified
X37	Victim of cataclysmic storm
C17.9	Small intestine, unspecified—Malignant neoplasms
C71.1	Frontal lobe—Malignant neoplasms
W13	Fall from, out of or through building or structure
A92.3	West Nile fever
W17	Other fall from one level to another
C18.2	Ascending colon—Malignant neoplasms
M00.9	Pyogenic arthritis, unspecified
K75.4	Autoimmune hepatitis
A81.0	Creutzfeldt-Jakob disease—CJD
V91.9	Accident to watercraft causing another injury
C25.3	Pancreatic duct—Malignant neoplasms
Y14	Poisoning by and exposure to other and unspecified drugs, medicaments and biological substances
F06.9	Unspecified mental disorder due to brain damage and dysfunction and to physical disease
Y34	Unspecified event, undetermined intent
K31.9	Disease of stomach and duodenum, unspecified
L98.4	Chronic ulcer of skin, not elsewhere classified
X38	Victim of flood
L08.9	Local infection of the skin and subcutaneous tissue, unspecified
P07.3	Other preterm infants
W05	Fall involving wheelchair
M62.8	Other specified disorders of muscle
R29.8	Other and unspecified symptoms and signs involving the nervous and musculoskeletal systems
X49	Accidental poisoning by and exposure to other and unspecified chemicals and noxious substances
C71.2	Temporal lobe—Malignant neoplasms
U01.4	Terrorism involving firearms
X94	Assault by rifle, shotgun and larger firearm discharge
X85	Assault by drugs, medicaments and biological substances
A09.0	Other and unspecified gastroenteritis and colitis of infectious origin
G82.5	Tetraplegia, unspecified
Y83.2	Surgical operation with anastomosis, bypass or graft
A41.0	Septicaemia due to <i>Staphylococcus aureus</i>
X91	Assault by hanging, strangulation and suffocation
W52	Crushed, pushed, or stepped on by crowd or human stampede
P36.9	Bacterial sepsis of newborn, unspecified
Q00.0	Anencephaly