Comparison of mortality, morbidities & healthcare resources utilisation between patients with and without a diagnosis of Covid-19

Version: 1.4

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1 Table of contents

1 Table of contents 2
2 List of abbreviations 3
3 Abstract 3
4 Amendment and Updates 3
5 Milestones 3
6 Rationale and Background 4
6.1 Objectives 5
7 Research methods 5
7.1 Study Design 5
7.2 Data Source(s) 5
7.3 Study population 6
7.4 Baseline characteristics 7
7.5 Outcomes 7
7.6 Covariates 10
7.6.1 Propensity score covariates 10
8 Data Analysis Plan 10
8.1 Calculation of time-at risk 10
8.2 Model Specification 10
8.2.1 Comparative analyses 11
8.2.2 Descriptive analyses 11
8.3 Output 11
9 Strengths and Limitations of the Research Methods 12
10 Plans for Disseminating and Communicating Study Results 12
11 References 12

2 List of abbreviations

OHDSI Observational Health Data Sciences and Informatics

3 Abstract

There are increasing reports of persistent and prolonged effects after coronavirus disease (Covid-19), but there is a lack of comprehensive information on the short-term and long-term sequelae of Covid-19. This study addresses the evidence gap and research question of the potential short- and long-term morbidities (adverse outcomes) of COVID-19 post-infection in whole populations and specific groups as well as healthcare resources utilisation of COVID-19 in the post-infection stage.

4 Amendment and Updates

Version	Date	Person	Changes
1.0	1 Jun 2021	EW, IL	Initial draft
1.1	21 Jan 2022	IL	Analysis plan updated
1.2	12 May 2022	IL	Definition of COVID-19 and control cohorts updated Inclusion period of COVID-19 and control subjects updated
1.3.2	20 June 2022	IL	Outcome cohorts updated Subgroup analysis updated Definition of COVID-19 cohort and non-COVID-19 (comparator) cohort updated
1.3.3	28 June 2022	IL	Outcome cohorts updated Details on subgroup analysis (multi-morbidities and severe COVID-19 condition included
1.3.4	21 Sept 2022	IL	Revision on the definitions of outcome cohorts Revision on the definition of comparator cohort
1.4	1 Jun 2023	IL, YC	Study protocol finalised

5 Milestones

Milestone	
Start cohort definition and cohort diagnosis	1 March 2022
Start of analysis	1 June 2023

End of analysis	20 February 2024
Presentation of results	30 April 2024

6 Rationale and Background

Since the beginning of the COVID-19 pandemic in late 2019, the epidemiology, clinical characteristics, pathogenesis, and complications of patients with COVID-19 during the acute phase have been explicitly studied. However, given the limited duration of follow-up of less than 6 months in previous studies, the medium- (up to 1 year after diagnosis) and long-term outcomes of COVID-19 (after 1 year of post-infection) remained largely unclear. More specifically, long-term follow-up studies on persistent symptoms, lung function, physical problems of discharged patients are urgently required.[1] Apart from the potential long-term adverse effect of COVID-19 on health outcomes, post-infection care for COVID-19 survivors is likely to create extra burden to the healthcare system. [2] Early statistics indicated that around 1 in 5 infected individuals hospitalized with around 1 in 10 admitted to an intensive care unit (ICU). Critically ill patients are also prone to experience acute respiratory distress syndrome (ARDS) and require mechanical ventilation. Up to 80% of patients surviving acute respiratory failure after receiving mechanical ventilation in the ICU experience new or worsened physical, cognitive and/or mental health impairments that persist beyond hospital discharge, collectively known as the post-intensive care syndrome. The success of critical care medicine in reducing mortality will result in a large number of survivors of COVID-19.

There is a lack of comprehensive information on the impact of COVID-19 on the additional healthcare resources required for providing care to COVID-19 survivors following the acute infection. Healthcare utilisation by one thousand Severe Acute Respiratory Syndrome (SARS) survivors in HK during the first year after hospital discharge was reported to be substantial, with over 5,000 attendances for consultations in primary care clinics and diagnostic tests. [3] A small study in the US reported a higher rate of hospitalization and mortality in older aged. [4] Disease outcomes in specific populations might be of particular interest. There is documented evidence that certain population, for example, those with multimorbidities, elderlies are at greater -risk of poor prognosis following COVID-19 infection. [5] Given the increasing numbers of recovered COVID-19 patients and aging of the general population compared to the time of the SARS outbreak. It is likely that the extent to which follow-up healthcare services adopted for COVID-19 survivors will be much greater than for SARS globally. [6] A timely evaluation of the post-COVID-19 healthcare resources utilisation would be of public health significance.

It is clear that methodologically, clinical trials can not be conducted to investigate the long-term clinical outcomes of patients with COVID-19. Therefore, the application of epidemiological and statistical techniques using large clinical and administrative records databases is the most appropriate option to evaluate the long-term health outcomes of COVID-19. Multinational Healthcare Big data analytics will enable us to generate robust findings on the long-term effect

of COVID-19 It also provide sufficient power to detect rare outcomes that may otherwise remain undetected and outcomes in specific populations.

6.1 Objectives

6.1.1 To monitor and evaluate the short- (six months), medium- (six months to one year), and long-term (one to two years) morbidities of COVID-19 post-infection.

6.1.2 To investigate morbidities of COVID-19 post-infection in specific populations, including children, older adults, male and female.

7 Research methods

7.1 Study Design

The study will be an observational cohort study based on routinely-collected healthcare data which has been mapped to the Observational Medical Outcomes Partnership (OMOP) Common Data Model (CDM). The study period will commence in 1 Dec 2019 (the outbreak of COVID-19 pandemic) and will end in 01 December 2022 (subject to data availability). Comparison will be conducted between subjects with a positive COVID-19 diagnosis will be matched with controls and followed for any adverse outcome. Differences in baseline confounders between two study cohorts will be accounted for by propensity score modelling.

7.2 Data Source(s)

The study will aim to be conducted using multiple databases in the OHDSI network.

Data source	Country	Patient Count	History	Patient Type	Data collection
IQVIA PharMetrics Plus	United States	170.7M	2013 –	Outpatient / General population/Public and private insurance	Insurance claim record
IQVIA LPD France EMR	France	30.9 M	2009 -	Outpatient / General population/ Patients seen in the primary care setting	Electronic health records in ambulatory setting
IQVIA Disease Analyser Germany EMR	Germany	39.2 M	1992 -	Outpatient only / General population/Public and private insurance	Electronic health records in ambulatory setting
IQVIA UK IMRD	United Kingdom	12.7 M	1994 -	General population / Primary care	Pseudonymised Electronic Medical Records collected from Patient Management

				records with hospitalisation / referral information	software used within UK Primary Care
IQVIA LPD Italy	Italy	2.2 M	2011 -	Outpatient / General population/ Patients seen in the primary care setting	Electronic health records in ambulatory setting

The study will be conducted using data from real world data sources that have been mapped to the OMOP Common Data Model in collaboration with the Observational Health Data Sciences and Informatics (OHDSI) and European Health Data and Evidence Network (EHDEN) initiatives. The OMOP Common Data Model (https://github.com/OHDSI/CommonDataModel/wiki) includes a standard representation of health care experiences (such as information related to drug utilization and condition occurrence), as well as common vocabularies for coding clinical concepts and enables consistent application of analyses across multiple disparate data sources.

7.3 Study population

COVID-19 cohorts

Target Cohort: persons in the *tested positive for COVID-19 cohort* will:

- Have a record of a test for COVID-19 with positive results (with value of “detected”, “positive”, “present”, "abnormal", "outside reference range", "potentially abnormal" or "high") between 1 December 2019 and 1 December 2020.

  OR

- Have a record of a diagnosis of COVID-19 between 1 December 2019 and 1 December 2020; having no test for COVID-19 with negative results (with value of “negative”, “not detected”, “not detected in pooled specimen”, “absent” or "normal") within 3 days after COVID-19 condition
- The index date will be defined at the date of the first positive diagnosis either by a positive test or diagnosis code
- Have a continuous observation of at least 365 days before index date

Non-COVID-19 (Comparator) cohort

Target Cohort: persons in the non-COVID-19 *(Comparator) cohort* will:

- Do not have any diagnosis of a COVID-19 nor a test for COVID-19 with positive results (with value of “detected”, “positive”, “present”, "abnormal", "outside reference range", "potentially abnormal" or "high") throughout the study period.

- Subjects eligible will be matched to patients from the COVID-19 cohort based on date of birth, sex and observation period start date in the database, index date of the matched person in target cohort will be assigned as his/her pseudo index date.
- Subjects with a similar propensity score will be assigned as controls for the analysis of separate clinical outcomes. Detailed description on the methodology and covariates of the propensity score procedures are described in **section 7.6.1**.

7.4 Baseline characteristics

Demographics:
- Age: calculated as year of cohort start date – year of birth
- Sex
- Race (if available)
- History of chronic morbidities
- Drug history

7.5 Outcomes

Target Cohort: persons with specified outcome will:

- Have a first diagnosis of the following conditions over the short (0-6 months), medium (6-12 months) and long-term (1-2 years) periods following COVID-19 infection.
- All persons are followed from the index date until the end of continuous enrolment or the last healthcare encounter.
- Cardiovascular Diseases (11)
    - Hypertensive disorder
    - Hypotension
    - Angina pectoris
    - Cardiac arrhythmia
    - Myocardial infarction
    - Cardiac arrest
    - Heart Failure
    - Myocarditis and Pericarditis
    - Endocarditis
    - Cardiomyopathy
    - Arteriosclerosis
- Haematology diseases (3)
    - Deep vein thrombosis
    - Thromboembolism
    - Immune and Idiopathic thrombocytopenia
- Respiratory Diseases (14)
    - Chronic obstructive pulmonary disease (COPD)

  - Asthma
  - Acute Respiratory Distress syndrome (ARDS)
  - Dyspnea
  - Pneumonia episodes
  - Pulmonary embolism
  - Tuberculosis
  - Bronchiectasis
  - Fibrosis of lung
  - Empyema
  - Pleural effusion
  - Air leaking from lung
  - Pneumothorax
  - Pulmonary Hypertension

- Renal and Hepatic Diseases (7)
  - Acute kidney injury (AKI)
  - Chronic kidney disease
  - End-stage renal disease
  - Chronic hepatic disease
  - Pancreatitis
  - Hepatitis B
  - Hepatitis C

- Endocrine Disease (5)
  - Type-II Diabetes
  - Hypothyroidism
  - Hyperthyroidism
  - Thyroiditis
  - Sexual disorder

- Immunological (5)
  - Multi-system inflammatory syndrome (Kawasaki disease or toxic shock syndrome)
  - Sepsis
  - Multiple Sclerosis
  - Guillain-Barré syndrome
  - Myasthenia Gravis

- Neurological diseases (12)
  - Olfactory and gustatory disorder
  - Encephalitis and encephalomyelitis
  - Epilepsy and Seizure disorder
  - Alzheimer disease

    - Migraine
    - Parkinson's Disease
    - Ischaemic stroke events
    - Hemorrhagic stroke events
    - Transient cerebral ischemia
    - Impaired cognition
    - Bell’s Palsy

- Psychiatric diseases (7)
    - Psychosis
    - Dementia
    - Depression
    - Suicide and suicidal ideation
    - Schizophrenia
    - Insomnia
    - Sleep disorder
    - Anxiety disorder
    - Bipolar disorder
    - Personality disorder
    - Neurodevelopmental disorder

- Malignant diseases (5)
    - Malignant neoplastic disease
    - Lung cancer
    - Liver Cancer
    - Endometrial cancer
    - Colorectal cancer

- Dermatological diseases (6)
    - Alopecia and hair loss
    - Skin eruption
    - Atopic dermatitis
    - Chilblains
    - Urticaria
    - Purpura

- Gastrointestinal diseases (3)
    - Gastrointestinal bleeding
    - Irritable bowel syndrome
    - Inflammatory Bowel Disease

7.6 Covariates

7.6.1 Propensity score covariates

To address potential bias due to the discrepancy in the baseline characteristics of subjects, propensity scores matching will be used to construct a cohort of patients who differed with respect to COVID-19 test results but were similar with respect to other measured characteristics. The propensity score is defined as the probability of receiving a COVID-19 diagnosis vs the comparator cohort, given the observed patient characteristics. The Cyclops package (https://ohdsi.github.io/Cyclops) will be used to construct the propensity score based on a range of baseline covariates derived from the data, including all drugs, condition, procedures, and summary scores such as Charlson Comorbidity Index. LASSO (least absolute shrinkage and selection operator) logistic regression will be applied to estimate the propensity score for all the subjects. Subjects with COVID-19 will be matched with non-COVID-19 controls using the propensity score matching, using the caliper width of 0.05. Subjects will be matched on the following criteria:

- Demographics
    - Gender
    - Age group (<18; 18-24;25-44; 45-64; >=65 years old)
- Conditions, procedures, and device exposure records
    - In 365d prior to and including index date
- Recent drugs use
    - In 365d prior to and including index date

8 Data Analysis Plan

8.1 Calculation of time-at risk

- Time-at risk commences from the index date and ends on the date of incidence of outcome, date of death or study end (01 December 2022), whichever came first.

8.2 Model Specification

The occurrence of outcomes will be captured among the target cohort and comparator cohorts during the time-at-risk periods as specified in **section 7.1.** The hazards of the outcomes will be compared between the cohorts using Cox proportional hazards regression model. The number of outcome events and incidences of the outcome events will be calculated within the first six months (short-term), six months to one year (medium-term), and one to two years (long-term) post-infection.

Propensity score matching with variable target-to-comparator ratio[7] will be used to address the potential baseline differences in characteristics between comparison groups. A caliper of 0.05 standard deviations of the propensity score on the logit scale will be used for matching. Propensity score will be estimated for each patient using a data-driven, regularized logistic regression model available in OHDSI. The covariates to be included in the propensity score model fitting are listed in **section 7.6.1**.

8.2.1 Comparative analyses

The following comparative analyses will be performed if sufficient data is present (e.g. if at least 1,000 subjects are observed in both target and comparator cohort):

Clinical Outcome

- N=89 outcomes of interest
- N=1 models: Cox proportional hazards regression model
- N=7 subgroup analyses (age groups (18-24, 25-44, 45-64; >=65 years old), sex (male, female). The total number of analyses is therefore 89*1*7 = 623 analyses per database.

Cox regression will be conducted to evaluate the effect of COVID-19 on morbidities, where hazard ratios will be reported. If the data is over-dispersed, negative binomial regression will be used. The results from individual databases will be pooled meta-analytically if there is no substantial heterogeneity.

8.2.2 Descriptive analyses

Baseline characteristics, including age (mean and standard deviation), sex, disease history, and recent drug use will be reported for each drug cohorts of interest. The number of outcome events and incidences of the outcome events will be calculated within the first six months (short-term), six months to one year (medium-term), and one to two years (long-term) post-infection.

8.3 Output

Summary statistics on baseline characteristics and incidence rate of adverse outcomes will be reported. Hazards ratios of outcomes between subject with and without COVID-19 diagnosis will be reported.

9 Strengths and Limitations of the Research Methods

Strengths

To our knowledge, this will be the largest study that include collaborators from countries and regions with different levels of COVID-19 infection officially reported and covered by media. Clinical trials will not be sufficient to answer the questions on the medium- and long-term outcomes of patients with COVID-19 and specified patient population. The application of epidemiological and statistical techniques using large clinical and administrative records is the only viable option. The study will be able to generate a spectrum of evidence addressing the COVID-19 related impact on mental health from a global perspective.

Limitations

Due to the observational nature of the study, we cannot exclude the possibility of residual confounding factors. To overcome this potential limitation, all known confounding variables for which there is adequate information available will be included in the study.

10 Plans for Disseminating and Communicating Study Results

The study results will be made available in the OHDSI website after completion of the study. We intend to publish our findings in a peer reviewed journal as well as to present them at relevant scientific conferences.

11 References

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3. Tansey CM, Louie M, Loeb M, et al. One-year outcomes and health care utilization in survivors of severe acute respiratory syndrome. *Arch Intern Med* 2007; **167**(12): 1312-20.
4. Salerno S, Sun Y, Morris EL, et al. Comprehensive evaluation of COVID-19 patient short- and long-term outcomes: Disparities in healthcare utilization and post-hospitalization outcomes. *PLoS One* 2021; **16**(10): e0258278.
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6. Leung TYM, Chan AYL, Chan EW, et al. Short- and potential long-term adverse health outcomes of COVID-19: a rapid review. *Emerg Microbes Infect* 2020; **9**(1): 2190-9.
7. Rassen JA, Shelat AA, Myers J, Glynn RJ, Rothman KJ, Schneeweiss S. One-to-many propensity score matching in cohort studies. *Pharmacoepidemiol Drug Saf* 2012; **21 Suppl 2**: 69-80.

12 Appendices

Table 1. COVID-19 diagnosis and screening tests

Concept Id	Concept Name	Domain	Vocabulary	Excluded	Descendants	Mapped
439676	Coronavirus infection	Condition	SNOMED	NO	YES	NO
37310282	Severe acute respiratory syndrome coronavirus 2 detected	Condition	SNOMED	NO	YES	NO
3548094	SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) antigen detection result positive	Condition	SNOMED	NO	YES	NO
37310281	Severe acute respiratory syndrome coronavirus 2 **not** detected	Condition	SNOMED	YES	YES	NO
37311061	COVID-19	Clinical Findings	SNOMED	NO	YES	NO
756055	Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)	Measurement	OMOP Extension	NO	YES	NO
37310258	Measurement of Severe acute respiratory syndrome coronavirus 2 antibody	Measurement	SNOMED	YES	YES	NO
704059	Infectious agent detection by nucleic acid (DNA or RNA); severe acute respiratory syndrome	Measurement	HCPCS	NO	YES	NO

Concept Id	Concept Name	Domain	Vocabulary	Excluded	Descendants	Mapped
	coronavirus 2 (SARS-CoV-2) (Coronavirus disease [COVID-19]), amplified probe technique, making use of high throughput technologies as described by CMS-2020-01-R					
704058	2019-nCoV Coronavirus, SARS-CoV-2/2019-nCoV (COVID-19), any technique, multiple types or subtypes (includes all targets), non-CDC, making use of high throughput technologies as described by CMS-2020-01-R	Measurement	HCPCS	NO	YES	NO

Table 2. Concept set definitions for study outcomes

Name	Concept Id	Concept Name	Domain	Vocabulary	Excluded	Descendants	Mapped
Cardiovascular disease							
Hypertensive disorder	316866	Hypertensive disorder	Condition	SNOMED	NO	YES	NO
	44783643	Intermittent hypertension	Condition	SNOMED	YES	YES	NO
	4167493	Pregnancy-induced hypertension	Condition	SNOMED	YES	YES	NO
Hypotension	317002	Low blood pressure	Condition	SNOMED	NO	YES	NO
	314432	Maternal hypotension syndrome	Condition	SNOMED	YES	YES	NO
	313232	Haemodialysis-associated hypotension	Observation	SNOMED	YES	YES	NO
Angina pectoris	321318	Angina pectoris	Condition	SNOMED	NO	YES	NO
Cardiac arrhythmia	44784217	Cardiac arrhythmia	Condition	SNOMED	NO	YES	NO
Myocardial infarction	4329847	Myocardial infarction	Condition	SNOMED	NO	YES	NO
	314666	Old myocardial	Condition	SNOMED	YES	YES	NO

		infarction					
	4108680	Thrombosis of atrium, auricular appendage, and ventricle due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
	4108678	Hemopericardium due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
	438172	Atrial septal defect due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
	4124687	Cardiac rupture due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
	45766212	Mitral valve regurgitation due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
	37109910	Ventricular aneurysm due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
	37109911	Pulmonary embolism due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
	37109912	Arrhythmia due to and following acute myocardial infarction	Condition	SNOMED	NO	YES	NO
Cardiac arrest	321042	Cardiac arrest	Condition	SNOMED	NO	YES	NO
Heart Failure	316139	Heart failure	Condition	SNOMED	NO	YES	NO
	315295	Congestive rheumatic heart failure	Condition	SNOMED	YES	YES	NO
Myocarditis and pericarditis	314383	Myocarditis	Condition	SNOMED	NO	YES	NO
	4138837	Pericarditis	Condition	SNOMED	NO	YES	NO
	4289908	Viral pericarditis	Condition	SNOMED	NO	YES	NO
	4149913	Systemic lupus erythematosus with pericarditis	Condition	SNOMED	NO	YES	NO
	318072	Histoplasmosis with pericarditis	Condition	SNOMED	NO	YES	NO
	44782774	Chest pain due to pericarditis	Condition	SNOMED	NO	YES	NO
Endocarditis	441589	Endocarditis	Condition	SNOMED	NO	YES	NO
Cardiomyopathy	321319	Cardiomyopathy	Condition	SNOMED	NO	YES	NO
Atherosclerosis	318443	Arteriosclerotic	Condition	SNOMED	NO	YES	NO

		vascular disease					
Haematological disease							
Deep vein thrombosis	4133004	Deep vein thrombosis	Condition	SNOMED	NO	YES	NO
	4149782	Thrombosis of vein of lower limb	Condition	SNOMED	NO	NO	NO
	444247	Venous thrombosis	Condition	SNOMED	NO	NO	NO
	77310	Deep vein phlebitis and thrombophlebitis of the leg	Condition	SNOMED	YES	YES	NO
	40481089	Embolism from thrombosis of vein of lower extremity	Condition	SNOMED	NO	YES	NO
	435565	Embolism and thrombosis of the vena cava	Condition	SNOMED	NO	YES	NO
	193512	Embolism and thrombosis of the renal vein	Condition	SNOMED	NO	YES	NO
	36712971	Chronic deep venous thrombosis	Condition	SNOMED	YES	YES	NO
	435887	Antepartum deep vein thrombosis	Condition	SNOMED	YES	YES	NO
	438820	Postpartum deep phlebothrombosis	Condition	SNOMED	YES	YES	NO
	44782752	Acute deep venous thrombosis of internal jugular vein	Condition	SNOMED	NO	YES	NO
	44782751	Acute deep venous thrombosis of axillary vein	Condition	SNOMED	NO	YES	NO
	4179911	Axillary vein thrombosis	Condition	SNOMED	YES	NO	NO
Thromboembolism	4159647	Thromboembolic disorder	Condition	SNOMED	NO	YES	NO
Immune and Idiopathic Thrombocytopenia	4119134	Thrombocytopenic purpura	Condition	SNOMED	NO	YES	NO
	4103532	Immune thrombocytopenia	Condition	SNOMED	NO	YES	NO
	4159749	Idiopathic maternal thrombocytopenia	Condition	SNOMED	NO	YES	NO
Respiratory Disease							
Chronic obstructive pulmonary disease (COPD)	255573	Chronic obstructive lung disease	Condition	SNOMED	NO	YES	NO
Asthma	317009	Asthma	Condition	SNOMED	NO	YES	NO
Acute Respiratory Distress syndrome (ARDS)	4195694	Acute respiratory distress syndrome	Condition	SNOMED	NO	YES	NO
Dyspnea	312437	Dyspnea	Condition	SNOMED	NO	YES	NO
Pneumonia episodes	255848	Pneumonia	Condition	SNOMED	NO	YES	NO

Pulmonary embolism	440417	Pulmonary embolism	Condition	SNOMED	NO	YES	NO
	254662	Pulmonary infarction	Condition	SNOMED	NO	YES	NO
	36713113	Saddle embolus of pulmonary artery	Condition	SNOMED	NO	YES	NO
	435616	Amniotic fluid embolism	Condition	SNOMED	YES	YES	NO
	435887	Antepartum deep vein thrombosis	Condition	SNOMED	YES	YES	NO
	196715	Budd-Chiari syndrome	Condition	SNOMED	YES	YES	NO
	4062269	Cerebral venous thrombosis in pregnancy	Condition	SNOMED	YES	YES	NO
	442055	Obstetric air pulmonary embolism	Condition	SNOMED	YES	YES	NO
	433832	Obstetric blood-clot pulmonary embolism	Condition	SNOMED	YES	YES	NO
	435026	Obstetric pulmonary embolism	Condition	SNOMED	YES	YES	NO
	440477	Obstetric pyemic and septic pulmonary embolism	Condition	SNOMED	YES	YES	NO
	318137	Phlebitis and thrombophlebitis of intracranial sinuses	Condition	SNOMED	YES	YES	NO
	199837	Portal vein thrombosis	Condition	SNOMED	YES	YES	NO
	438820	Postpartum deep phlebothrombosis	Condition	SNOMED	YES	YES	NO
	4235812	Septic thrombophlebitis	Condition	SNOMED	YES	YES	NO
	195294	Thrombosed hemorrhoids	Condition	SNOMED	YES	YES	NO
	4187790	Thrombosis of retinal vein	Condition	SNOMED	YES	YES	NO
	444247	Venous thrombosis	Condition	SNOMED	YES	YES	NO
	44782732	Chronic pulmonary embolism	Condition	SNOMED	YES	YES	NO
	40479606	Septic pulmonary embolism	Condition	SNOMED	YES	YES	NO
Tuberculosis	434557	Tuberculosis	Condition	SNOMED	NO	YES	NO
	258675	Tuberculous pleurisy in primary progressive tuberculosis	Condition	SNOMED	NO	YES	NO
	432541	Primary tuberculosis	Condition	SNOMED	NO	YES	NO
	4090539	Tuberculous pleurisy, confirmed bacteriologically and histologically	Condition	SNOMED	NO	YES	NO
	4112923	Pleurisy without effusion or active	Condition	SNOMED	NO	YES	NO

		tuberculosis					
	45771090	Respiratory tuberculosis	Condition	SNOMED	NO	YES	NO
Bronchiectasis	256449	Bronchiectasis	Condition	SNOMED	NO	YES	NO
Fibrosis of lung	4197819	Fibrosis of lung	Condition	SNOMED	NO	YES	NO
Empyema	4209859	Empyema	Condition	SNOMED	NO	YES	NO
Pleural effusion	254061	Pleural effusion	Condition	SNOMED	NO	YES	NO
Air leaking from lung	43020567	Air leaking from lung	Condition	SNOMED	NO	YES	NO
Pneumothorax	253796	Pneumothorax	Condition	SNOMED	NO	YES	NO
Pulmonary hypertension	4322024	Pulmonary hypertension	Condition	SNOMED	NO	YES	NO
Renal and Hepatic disorder							
Acute kidney injury (AKI)	197320	Acute renal failure syndrome	Condition	SNOMED	NO	YES	NO
	444044	Acute tubular necrosis	Condition	SNOMED	NO	YES	NO
	432961	Acute renal papillary necrosis with renal failure	Condition	SNOMED	NO	YES	NO
Chronic kidney disease	46271022	Chronic kidney disease	Condition	SNOMED	NO	YES	NO
End-stage renal disease	193782	End-stage renal disease	Condition	SNOMED	NO	YES	NO
	443919	Hypertensive renal failure	Condition	SNOMED	NO	YES	NO
	45887996	End-Stage Renal Disease Services	Observation	CPT4	NO	YES	NO
	2617402	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES LESS THAN FULL MONTH, PER DAY; FOR PATIENTS UNDER TWO YEARS OF AGE	Observation	HCPCS	NO	YES	NO
	2617405	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES LESS THAN FULL MONTH, PER DAY; FOR PATIENTS TWENTY YEARS OF AGE AND OVER	Observation	HCPCS	NO	YES	NO
	2617403	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES LESS THAN FULL MONTH, PER DAY; FOR PATIENTS BETWEEN TWO AND ELEVEN YEARS OF AGE	Observation	HCPCS	NO	YES	NO

	2617404	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES LESS THAN FULL MONTH, PER DAY; FOR PATIENTS BETWEEN TWELVE AND NINETEEN YEARS OF AGE	Observation	HCPCS	NO	YES	NO
	2617398	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES FOR HOME DIALYSIS PATIENTS PER FULL MONTH; FOR PATIENTS UNDER TWO YEARS OF AGE TO INCLUDE MONITORING FOR ADEQUACY OF NUTRITION, ASSESSMENT OF GROWTH AND DEVELOPMENT, AND COUNSELING OF PARENTS	Observation	HCPCS	NO	YES	NO
	2617399	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES FOR HOME DIALYSIS PATIENTS PER FULL MONTH; FOR PATIENTS TWO TO ELEVEN YEARS OF AGE TO INCLUDE MONITORING FOR ADEQUACY OF NUTRITION, ASSESSMENT OF GROWTH AND DEVELOPMENT, AND COUNSELING OF PARENTS	Observation	HCPCS	NO	YES	NO
	2617401	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES FOR HOME DIALYSIS PATIENTS PER FULL MONTH; FOR PATIENTS TWENTY YEARS OF AGE AND OLDER	Observation	HCPCS	NO	YES	NO

2617400	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES FOR HOME DIALYSIS PATIENTS PER FULL MONTH; FOR PATIENTS TWELVE TO NINETEEN YEARS OF AGE TO INCLUDE MONITORING FOR ADEQUACY OF NUTRITION, ASSESSMENT OF GROWTH AND DEVELOPMENT, AND COUNSELING OF PARENTS	Observation	HCPCS	NO	YES	NO
2617395	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES DURING THE COURSE OF TREATMENT, FOR PATIENTS 20 YEARS OF AGE AND OVER; WITH 4 OR MORE FACE-TO-FACE PHYSICIAN VISITS PER MONTH	Observation	HCPCS	NO	YES	NO
2617396	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES DURING THE COURSE OF TREATMENT, FOR PATIENTS 20 YEARS OF AGE AND OVER; WITH 2 OR 3 FACE-TO-FACE PHYSICIAN VISITS PER MONTH	Observation	HCPCS	NO	YES	NO
2617397	END STAGE RENAL DISEASE (ESRD) RELATED SERVICES DURING THE COURSE OF TREATMENT, FOR PATIENTS 20 YEARS OF AGE AND OVER; WITH 1 FACE-TO-FACE PHYSICIAN VISIT PER MONTH	Observation	HCPCS	NO	YES	NO
44786436	Documentation of	Observation	HCPCS	NO	YES	NO

		end stage renal disease (esrd), dialysis, renal transplant before or during the measurement period or pregnancy during the measurement period					
	443611	Chronic kidney disease stage 5	Condition	SNOMED	NO	YES	NO
Chronic hepatic disease	4340390	Chronic hepatic failure	Condition	SNOMED	NO	YES	NO
Pancreatitis	4192640	Pancreatitis	Condition	SNOMED	NO	YES	NO
Hepatitis B	4281232	Type B viral hepatitis	Condition	SNOMED	NO	YES	NO
Hepatitis C	197494	Viral hepatitis C	Condition	SNOMED	NO	YES	NO
	439672	Viral hepatitis C with coma	Condition	SNOMED	NO	YES	NO
	4196134	Hepatitis C antibody test positive	Condition	SNOMED	NO	YES	NO
	4340380	Hepatitis C carrier	Condition	SNOMED	NO	YES	NO
	44806379	Hepatitis C antigen positive	Condition	SNOMED	NO	YES	NO
	44813294	Hepatitis C viral ribonucleic acid polymerase chain reaction positive	Condition	SNOMED	NO	YES	NO
Endocrine disease							
Type-II Diabetes	443238	Diabetic - poor control	Condition	SNOMED	NO	YES	NO
	201820	Diabetes mellitus	Condition	SNOMED	NO	YES	NO
	442793	Complication due to diabetes mellitus	Condition	SNOMED	NO	YES	NO
	40484648	Type 1 diabetes mellitus uncontrolled	Condition	SNOMED	YES	YES	NO
	201254	Type 1 diabetes mellitus	Condition	SNOMED	YES	YES	NO
	435216	Disorder due to type 1 diabetes mellitus	Condition	SNOMED	YES	YES	NO
	195771	Secondary diabetes mellitus	Condition	SNOMED	YES	YES	NO
	4058243	Diabetes mellitus during pregnancy, childbirth and the puerperium	Condition	SNOMED	YES	YES	NO
	761051	Complication due to secondary diabetes mellitus	Condition	SNOMED	YES	YES	NO
Hyperthyroidism	4142479	Hyperthyroidism	Condition	SNOMED	NO	YES	NO
Hypothyroidism	140673	Hypothyroidism	Condition	SNOMED	NO	YES	NO
Thyroiditis	133444	Thyroiditis	Condition	SNOMED	NO	YES	NO

Sexual disorder	4335174	Sexual disorder	Condition	SNOMED	NO	YES	NO
Immunological disorder							
Multi-system inflammatory syndrome (Kawasaki disease and toxic shock syndrome)	434821	Systemic inflammatory response syndrome	Condition	SNOMED	NO	YES	NO
	314381	Acute febrile mucocutaneous lymph node syndrome	Condition	SNOMED	NO	YES	NO
	201214	Toxic shock syndrome	Condition	SNOMED	NO	YES	NO
Sepsis	132797	Sepsis	Condition	SNOMED	NO	YES	NO
Multiple Sclerosis	374919	Multiple sclerosis	Condition	SNOMED	NO	YES	NO
Guillain-Barré syndrome	4164770	Guillain-Barré syndrome	Condition	SNOMED	NO	YES	NO
	374925	Acute infective polyneuritis	Condition	SNOMED	NO	YES	NO
	4070552	Fisher's syndrome	Condition	SNOMED	NO	YES	NO
Myasthenia Gravis	76685	Myasthenia Gravis	Condition	SNOMED	NO	YES	NO
Neurological disorder							
Olfactory and gustatory disorder	4180629	Disorder of olfactory system	Condition	SNOMED	NO	YES	NO
	436235	Taste sense altered	Condition	SNOMED	NO	YES	NO
	4289517	Loss of taste	Condition	SNOMED	NO	YES	NO
Encephalitis and encephalomyelitis	378143	Encephalitis	Condition	SNOMED	NO	YES	NO
	4147498	Encephalitis, myelitis and encephalomyelitis	Condition	SNOMED	NO	YES	NO
	372615	Post-infectious encephalitis	Condition	SNOMED	NO	YES	NO
	373189	Encephalomyelitis	Condition	SNOMED	NO	YES	NO
	4190307	Inflammatory disease of the central nervous system	Condition	SNOMED	NO	NO	NO
	379792	Post-immunization encephalitis	Condition	SNOMED	NO	YES	NO
	4330496	Inflammation of spinal cord due to toxin	Condition	SNOMED	NO	YES	NO
	138965	Myelitis	Condition	SNOMED	NO	NO	NO
Epilepsy and Seizure disorder	4029498	Seizure disorder	Condition	SNOMED	NO	YES	NO
Epilepsy and Seizure disorder	380378	Epilepsy	Condition	SNOMED	NO	YES	NO
Alzheimer disease	378419	Alzheimer disease	Condition	SNOMED	NO	YES	NO
Migraine	318736	Migraine	Condition	SNOMED	NO	YES	NO
Parkinson's Disease	381270	Parkinson's Disease	Condition	SNOMED	NO	YES	NO
Ischaemic stroke events	4310996	Ischaemic Stroke	Condition	SNOMED	NO	YES	NO
	441874	Cerebral thrombosis	Condition	Standard	NO	NO	NO
	443454	Cerebral infarction	Condition	Standard	NO	YES	NO

	375557	Cerebral embolism	Condition	Standard	NO	NO	NO
	372924	Cerebral artery occlusion	Condition	Standard	NO	NO	NO
Hemorrhagic stroke events	35609033	Haemorrhage Stroke	Condition	SNOMED	NO	YES	NO
	439847	Intracranial hemorrhage	Condition	SNOMED	NO	NO	NO
	432923	Subarachnoid hemorrhage	Condition	SNOMED	NO	NO	NO
	376713	Cerebral hemorrhage	Condition	SNOMED	YES	NO	NO
	4148906	Spontaneous subarachnoid hemorrhage	Condition	SNOMED	NO	NO	NO
	4144154	Non-traumatic intracerebral ventricular hemorrhage	Condition	SNOMED	NO	NO	NO
	4111709	Non-traumatic subdural hemorrhage	Condition	SNOMED	NO	NO	NO
	42535426	Acute nontraumatic subdural hemorrhage	Condition	SNOMED	NO	NO	NO
	43530728	Subacute non-traumatic intracranial subdural hemorrhage	Condition	SNOMED	NO	NO	NO
	4174299	Perinatal intracranial hemorrhage	Condition	SNOMED	YES	YES	NO
	36716544	Fetal or neonatal non-traumatic intraventricular hemorrhage	Condition	SNOMED	YES	YES	NO
	4345688	Intracerebral hemorrhage in fetus or newborn	Condition	SNOMED	YES	YES	NO
	43530727	Spontaneous cerebral hemorrhage	Condition	SNOMED	NO	NO	NO
Transient cerebral ischemia	373503	Transient cerebral ischemia	Condition	SNOMED	NO	YES	NO
Impaired cognition	443432	Impaired cognition	Condition	SNOMED	NO	YES	NO
Bells Palsy	4091559	Facial palsy	Condition	SNOMED	NO	YES	NO
	4048018	Congenital facial nerve palsy	Condition	SNOMED	YES	YES	NO
	36716396	Congenital hereditary facial paralysis with variable hearing loss syndrome	Condition	SNOMED	YES	YES	NO
Malignant diseases							
Malignant neoplastic disease	443392	Malignant neoplastic disease	Condition	SNOMED	NO	YES	NO

Lung cancer	443388	Malignant tumour of lung	Condition	SNOMED	NO	YES	NO
Liver Cancer	4246127	Malignant neoplasm of liver	Condition	SNOMED	NO	YES	NO
Endometrial cancer	4110871	Endometrial carcinoma	Condition	SNOMED	NO	YES	NO
	194286	Malignant neoplasm of corpus uteri, excluding isthmus	Condition	SNOMED	NO	YES	NO
	4162860	Primary malignant neoplasm of body of uterus	Condition	SNOMED	NO	YES	NO
Colorectal cancer	36683531	Malignant neoplasm of colon and/or rectum	Condition	SNOMED	NO	YES	NO
Dermatological diseases							
Alopecia and hair loss	133280	Alopecia	Condition	SNOMED	NO	YES	NO
	4175525	loss of hair	Condition	SNOMED	NO	YES	NO
Skin eruption	140214	Eruption	Condition	SNOMED	NO	YES	NO
Atopic dermatitis	133834	Atopic dermatitis	Condition	SNOMED	NO	YES	NO
Chilblains	141456	Chilblains	Condition	SNOMED	NO	YES	NO
Urticaria	139900	Urticaria	Condition	SNOMED	NO	YES	NO
Purpura	4309836	Purpura	Condition	SNOMED	NO	YES	NO
Gastrointestinal disorder							
Gastrointestinal bleeding	192671	Gastrointestinal hemorrhage	Condition	SNOMED	NO	YES	NO
Irritable bowel syndrome	75576	Irritable bowel syndrome	Condition	SNOMED	NO	YES	NO
Inflammatory Bowel Disease	4074815	Inflammatory Bowel Disease	Condition	SNOMED	NO	YES	NO
Psychiatric disorder							
Psychoses	436073	Psychotic disorder	Condition	SNOMED	NO	YES	NO
	4168389	Borderline schizophrenia	Condition	SNOMED	NO	YES	NO
	432590	Delusional disorder	Condition	SNOMED	NO	YES	NO
	439706	Psychosis with origin in childhood	Condition	SNOMED	NO	YES	NO
Dementia	4182210	Dementia	Condition	SNOMED	NO	YES	NO
	35610623	Dementia advance care plan agreed	Observation	SNOMED	NO	YES	NO
	46284876	Dementia care plan agreed	Observation	SNOMED	NO	YES	NO
	46284877	Dementia care plan reviewed	Observation	SNOMED	NO	YES	NO
	44790944	Dementia monitoring	Observation	SNOMED	NO	YES	NO
	44803643	Dementia monitoring first letter	Observation	SNOMED	NO	YES	NO
	44803915	Dementia	Observation	SNOMED	NO	YES	NO

		monitoring second letter					
	44803843	Dementia monitoring telephone invitation	Observation	SNOMED	NO	YES	NO
	44803781	Dementia monitoring third letter	Observation	SNOMED	NO	YES	NO
	44803706	Dementia monitoring verbal invitation	Observation	SNOMED	NO	YES	NO
	4043378	Frontotemporal dementia	Condition	SNOMED	NO	YES	NO
	42742407	Functional status for dementia assessed and results reviewed (DEM)	Observation	CPT4	NO	YES	NO
	4059191	H/O: dementia	Observation	SNOMED	NO	YES	NO
	44782763	Lewy body dementia with behavioral disturbance	Condition	SNOMED	NO	YES	NO
Depression	440383	Depressive disorder	Condition	SNOMED	NO	YES	NO
	35625752	Depression care management	Procedure	SNOMED	NO	YES	NO
	44788304	Depression - enhanced service completed	Observation	SNOMED	NO	YES	NO
	4114513	Depression - motion	Observation	SNOMED	NO	YES	NO
	4295031	Depression management program	Observation	SNOMED	NO	YES	NO
	44788282	Depression - enhanced services administration	Observation	SNOMED	NO	YES	NO
	2106310	Major depressive disorder, severe without psychotic features (MDD)	Observation	CPT4	NO	YES	NO
	2106322	Major depressive disorder, severe with psychotic features (MDD)	Observation	CPT4	NO	YES	NO
	2106305	Major depressive disorder, moderate (MDD)	Observation	CPT4	NO	YES	NO
	2106304	Major depressive disorder, mild (MDD)	Observation	CPT4	NO	YES	NO
	40756912	Plan for follow-up care for major depressive disorder, documented (MDD ADOL)	Observation	CPT4	NO	YES	NO

Self-harm and suicide	4219484	Suicide attempt	Condition	SNOMED	NO	YES	NO
	440925	Suicide	Observation	SNOMED	NO	YES	NO
	444362	Suicidal deliberate poisoning	Observation	SNOMED	NO	YES	NO
	4092411	Self-injurious behavior	Condition	SNOMED	NO	YES	NO
	4181216	Self-administered poisoning	Condition	SNOMED	NO	YES	NO
	439235	Self inflicted injury	Condition	SNOMED	NO	YES	NO
	435446	Late effect of self inflicted injury	Condition	SNOMED	NO	YES	NO
	4303690	Intentionally harming self	Observation	SNOMED	NO	YES	NO
Insomnia	436962	Insomnia	Condition	SNOMED	NO	YES	NO
Sleep disorder	435524	Sleep disorder	Condition	SNOMED	NO	YES	NO
Anxiety disorders	442077	Anxiety disorder	Condition	SNOMED	NO	YES	NO
	4058397	Claustrophobia	Condition	SNOMED	NO	YES	NO
	4322025	Mild anxiety	Condition	SNOMED	NO	YES	NO
	4214746	Severe anxiety	Condition	SNOMED	NO	YES	NO
	440985	Phobia	Condition	SNOMED	NO	YES	NO
	4087190	Performance anxiety	Condition	SNOMED	NO	YES	NO
	4008683	Anxiety neurosis	Condition	SNOMED	NO	YES	NO
	4263429	Moderate anxiety	Condition	SNOMED	NO	YES	NO
	4338032	Anxiety hysteria	Condition	SNOMED	NO	YES	NO
	4332995	Needle phobia	Condition	SNOMED	NO	YES	NO
	4261239	Anticipatory anxiety	Condition	SNOMED	NO	YES	NO
	4209114	Phonophobia	Condition	SNOMED	NO	YES	NO
	4155074	School phobia	Condition	SNOMED	NO	YES	NO
	4103273	Recurrent anxiety	Condition	SNOMED	NO	YES	NO
	4102977	Disturbance of anxiety and fearfulness in childhood and adolescence	Condition	SNOMED	NO	YES	NO
	4012101	Nosophobia	Condition	SNOMED	NO	YES	NO
Bipolar disorders	436665	Bipolar disorder	Condition	SNOMED	NO	YES	NO
	4128935	Bipolar	Observation	SNOMED	NO	YES	NO
Personality disorders	441838	Personality disorder	Condition	SNOMED	NO	YES	NO
Neruodevelopmental disorder	45771096	Neurodevelopmental disorder	Condition	SNOMED	NO	YES	NO
	40480225	Adult attention deficit hyperactivity disorder	Condition	SNOMED	NO	YES	NO
	4165912	On learning disability register	Observation	SNOMED	NO	YES	NO
	442335	Dyslexia	Condition	SNOMED	NO	YES	NO
	40483181	History of neurodevelopmental disorder	Observation	SNOMED	NO	YES	NO
	4136053	Learning disabilities health action plan	Observation	SNOMED	NO	YES	NO

		reviewed					
	45765570	Drug therapy for attention deficit hyperactivity disorder	Procedure	SNOMED	NO	YES	NO
	4024717	Dyslexia AND/OR speech dysfunction	Condition	SNOMED	NO	YES	NO
Alcohol misuse or dependence	433753	Alcohol abuse	Condition	SNOMED	NO	YES	NO
	435243	Alcohol dependence	Condition	SNOMED	NO	YES	NO
	44788279	Alcohol misuse - enhanced services administration	Observation	SNOMED	NO	YES	NO
	44788303	Alcohol misuse - enhanced service completed	Observation	SNOMED	NO	YES	NO
	4218106	Alcoholism	Condition	SNOMED	NO	YES	NO
	439005	Chronic alcoholism in remission	Condition	SNOMED	NO	YES	NO
	436953	Continuous chronic alcoholism	Condition	SNOMED	NO	YES	NO
	4275257	Detoxication psychiatric therapy for alcoholism	Procedure	SNOMED	NO	YES	NO
	435532	Episodic chronic alcoholism	Condition	SNOMED	NO	YES	NO
	378726	Dementia associated with alcoholism	Condition	SNOMED	NO	YES	NO
	433735	Acute alcoholic intoxication in alcoholism	Condition	SNOMED	NO	YES	NO
	432609	Acute alcoholic intoxication in remission, in alcoholism	Condition	SNOMED	NO	YES	NO
Substance misuse or dependence	4279309	Substance abuse	Condition	SNOMED	NO	YES	NO
	440069	Drug dependence	Condition	SNOMED	NO	YES	NO
	4004672	Psychoactive substance use disorder	Condition	SNOMED	NO	YES	NO
	44786481	Documentation that patient is a current tobacco user	Observation	HCPCS	NO	YES	NO
	4302387	Substance use treatment: drug withdrawal	Procedure	SNOMED	NO	YES	NO
	2796056	Substance Abuse Treatment, Pharmacotherapy	Procedure	ICD10PCS	NO	YES	NO
	440787	Drug dependence in mother complicating pregnancy, childbirth AND/OR puerperium	Condition	SNOMED	NO	YES	NO

434697	Maternal tobacco abuse	Observation	SNOMED	NO	YES	NO
443274	Psychostimulant dependence	Condition	SNOMED	NO	YES	NO
4319165	Therapeutic drug dependence	Condition	SNOMED	NO	YES	NO
37116660	Marijuana user	Condition	SNOMED	NO	YES	NO
37116661	Cocaine user	Condition	SNOMED	NO	YES	NO
4269905	Referral to drug abuse counselor	Observation	SNOMED	NO	YES	NO
4217840	Substance misuse behavior	Condition	SNOMED	NO	YES	NO
44790195	Delivery of rehabilitation for drug addiction	Procedure	SNOMED	NO	YES	NO
4151569	Drug addiction notification	Observation	SNOMED	NO	YES	NO
4219382	Persistent substance misuse	Condition	SNOMED	NO	YES	NO
44787894	Referral to community drug dependency team	Observation	SNOMED	NO	YES	NO
4149607	Drug addiction therapy - methadone	Procedure	SNOMED	NO	YES	NO