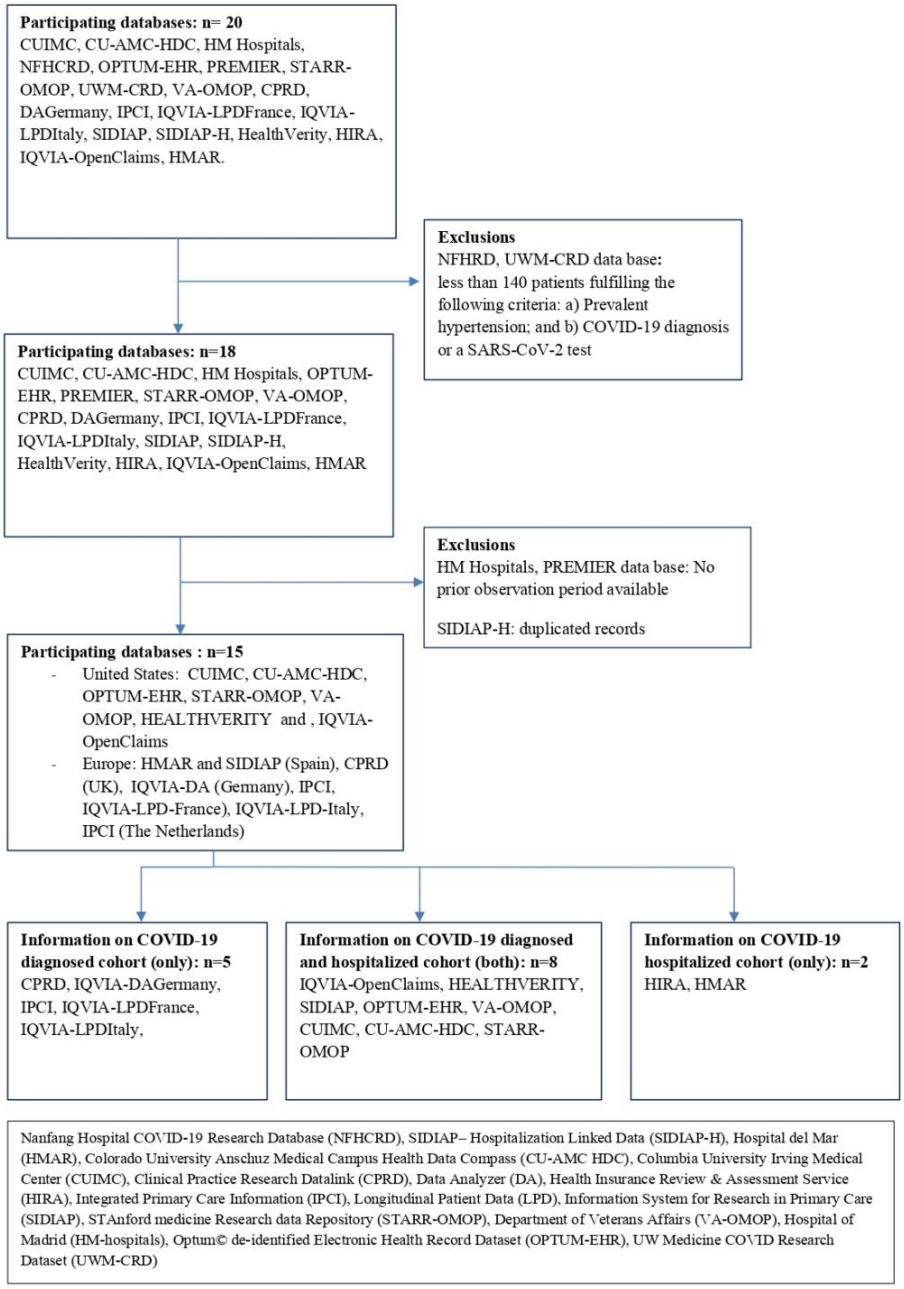
# Supporting Figure 1. Flowchart showing the selection of databases included in the analyses



# Supporting Table 1. Description of included databases

| Institution Name/ Database | Database Description | Country |
|---|---|---|
| Janssen Research & Development<br>The Clinical Practice Research Datalink (CPRD) | The Clinical Practice Research Datalink (CPRD) is a governmental not-for-profit research service jointly funded by the NHS National Institute for Health Research (NIHR) and the Medicines and Healthcare products Regulatory Agency (MHRA) a part of the Department of Health United Kingdom (UK). CPRD consists of data collected from UK primary care for all ages. This includes conditions observations measurements and procedures that the general practitioner is made aware of in addition to any prescriptions as prescribed by the general practitioner. In addition to primary care there are also linked secondary care records for a small number of people. The major data elements contained within this database are outpatient prescriptions given by the general practitioner (coded with Multilex codes) and outpatient clinical referral immunization or test events that the general practitioner knows about (coded in Read or ICD10 or LOINC codes). The database also contains the patients' year of births and any date of deaths. | United Kingdom |
| IDIAPJGol<br>The Information System for Research in Primary Care (SIDIAP) | The Information System for Research in Primary Care (SIDIAP; www.sidiap.org) is a primary care records database that covers approximately 80% of the population of Catalonia North-East Spain. Healthcare is universal and tax-payer funded in the region and primary care physicians are gatekeepers for all care and responsible for repeat prescriptions. | Spain |
| Stanford Medicine Research Data Repository (STARR-OMOP) | A clinical data warehouse containing live Epic data from Stanford Health Care the Stanford Children's Hospital | United States |

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|---|---|---|
| | the University Healthcare Alliance and Packard Children's Health Alliance clinics.<br>Reference: Datta S Posada J Olson G *et al.* A new paradigm for accelerating clinical data science at Stanford Medicine. *arXiv* 2020; published online March 17. http://arxiv.org/abs/2003.10534 (accessed Aug 20 2020). | |
| Columbia University Irving Medical Center (CUIMC) | The clinical data warehouse of New York-Presbyterian Hospital/Columbia University Irving Medical Center New York NY based on its current and previous electronic health record systems with data spanning over 30 years and including over 6 million patients | United States |
| IQVIA<br>Open Claims | Pre-adjudicated claims covering over 300 Million lives (~80% of the US) collected from office-based physicians and specialists via office management software and clearinghouse switch sources for the purpose of reimbursement. | United States |
| HIRA<br>Health Insurance Review & Assessment Service | National claim data from a single insurance service from South Korea, It contains the observational medical records (including both inpatient and outpatient) of a patient while they are qualified to get the national medical insurance. | South Korea |
| HMAR<br>Hospital del mar | Anonymized data from the Electronic Medical Records from Hospital del Mar (Barcelona, Spain). Hospital belonging to the Spanish National Health System (public), attending the Eastern area of Barcelona City. Includes hospital data collected routinely in the clinical practice, both structured and unstructured information, extracted using a free text analysis tool (with natural language processing): Inpatient (hospital) care, Outpatient specialist care, Emergency Room Visits and partial information from other settings like primary care and pharmacy care present in free text notes from EMRs. All subjects with at least one healthcare encounter with the Hospital within approximately last 20 years are included (approximately 0.6 M subjects, with more than | Spain |

| | | |
|---|---|---|
| | 5 M hospitalizations/visits). Hospital del Mar data are made available through collaboration with TFS / IOMED. | |
| OPTUM-EHR<br>Optum® de-identified Electronic Health Record Dataset | Optum ® de-identified Electronic Health Record Dataset is derived from dozens of healthcare provider organizations in the United States (that include more than 700 hospitals and 7,000 Clinics treating more than 103 million patients) receiving care in the United States. The medical record data includes clinical information, inclusive of prescriptions as prescribed and administered, lab results, vital signs, body measurements, diagnoses, procedures, and information derived from clinical Notes using Natural Language Processing (NLP) | United States |
| IPCI<br>Integrated Primary Care Information | The Integrated Primary Care Information (IPCI) database is collected from EHR records of patients registered with 391 GPs throughout the Netherlands. The database contains records from approximately 2.6 million patients out of a Dutch population of 17M (8.2%) starting in 1996. | The Netherlands |
| DA Germany<br>IQVIA Disease Analyser Germany | IQVIA DA Germany is collected from extracts of patient management software used by GPs and specialists practicing in ambulatory care settings. Data coverage includes more than 34M distinct person records out of at total population of 80M (42.5%) in the country and collected from 2,734 providers. Dates of service include from 1992 through March 2020 | Germany |
| LPD-Italy<br>IQVIA LPD Italy | LPD Italy is comprised of anonymised patient records collected from software used by GPs during an office visit to document patients' clinical records. Data coverage includes over 2M patient records with at least one visit and 119.5M prescription orders across 900 GP practices. Dates of service include from 2004 through | Italy |

| | | |
|---|---|---|
| | present. Observation time is defined by the first and last consultation dates. Drugs are captured as prescription records with product, quantity, dosing directions, strength, indication and date of consultation. | |
| LPD-France | LPD France is a computerised network of physicians including GPs who contribute to a centralised database of anonymised patient EMR. Currently, >1200 GPs from 400 practices are contributing to the database covering 7.8M patients in France. The database covers a time period from 1994 through the present. Observation time is defined by the first and last consultation dates. Drug information is derived from GP prescriptions. Drugs obtained over the counter by the patient outside the prescription system are not reported | France |
| HEALTHVERITY | This HealthVerity derived data set contains de-identified patient information with an antibody and/or diagnostic test for COVID-19 linked to all available Medical Claims and Pharmacy Data from select private data providers participating in the HealthVerity marketplace. | United States |
| University of Colorado Anschuz Medical Campus Health Data Compass (CU-AMC HDC) | Health Data Compass (HDC) is a multi-institutional data warehouse. HDC contains inpatient and outpatient electronic medical data including patient, encounter, diagnosis, procedures, medications, laboratory results from two electronic medical record systems (UCHealth and Children's Hospital of Colorado), state-level all-payers claims data, and the Colorado death registry. Acknowledgement statement: Supported by the Health Data Compass Data Warehouse project (healthdatacompass.org) | |
| Department of Veterans Affairs<br>VA- OMOP | VA-OMOP data reflects the national Department of Veterans Affairs health care system which is the largest integrated provider of medical and mental health services | United States |

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|---|---|---|
| | in the United States. Care is provided at 170 VA Medical Centers and 1 063 outpatient sites serving more than 9 million enrolled Veterans each year. | |

# Supporting Table 2. Definitions and codes used to identify COVID-19 cases

The below tables summarises the concepts used to identify patients diagnosed with COVID-19 . The full description of the logic used to identify patients diagnosed and hospitalized is provided at https://atlas.ohdsi.org/#/cohortdefinition/200 and https://atlas.ohdsi.org/#/cohortdefinition/197 respectively.

| **COVID-19 condition codes** | | |
|---|---|---|
| **Id** | **Name** | **Vocabulary** |
| 756023 | Acute bronchitis due to COVID-19 | OMOP Extension |
| 756044 | Acute respiratory distress syndrome (ARDS) due to COVID-19 | OMOP Extension |
| 756061 | Asymptomatic COVID-19 | OMOP Extension |
| 756031 | Bronchitis due to COVID-19 | OMOP Extension |
| 439676 | Coronavirus infection | SNOMED |
| 37311061 | Disease caused by 2019-nCoV | SNOMED |
| 4100065 | Disease due to Coronaviridae | SNOMED |
| 37310284 | Encephalopathy caused by 2019 novel coronavirus | SNOMED |

| | | |
|---|---|---|
| 37310283 | Gastroenteritis caused by 2019 novel coronavirus | SNOMED |
| 4248811 | Healthcare associated severe acute respiratory syndrome | SNOMED |
| 756081 | Infection of lower respiratory tract due to COVID-19 | OMOP Extension |
| 37310286 | Infection of upper respiratory tract caused by 2019 novel coronavirus | SNOMED |
| 45763594 | Middle East respiratory syndrome | SNOMED |
| 37310287 | Myocarditis caused by 2019 novel coronavirus | SNOMED |
| 37310254 | Otitis media caused by 2019 novel coronavirus | SNOMED |
| 37310285 | Pneumonia caused by 2019 novel coronavirus | SNOMED |
| 37016927 | Pneumonia caused by Human coronavirus | SNOMED |
| 40479642 | Pneumonia due to Severe acute respiratory syndrome coronavirus | SNOMED |
| 756039 | Respiratory infection due to COVID-19 | OMOP Extension |
| 320651 | Severe acute respiratory syndrome | SNOMED |
| 37396171 | Severe acute respiratory syndrome of upper respiratory tract | SNOMED |
| 37311060 | Suspected disease caused by 2019-nCoV | SNOMED |
| **COVID-19 specific testing - Positive** | | |
| 37310282 | 2019 novel coronavirus detected | SNOMED |
| **COVID-19 specific testing (note these required a corresponding value as concept of: Detected Positive or Present)** | | |

| | | |
|---|---|---|
| 37310255 | Detection of 2019 novel coronavirus using polymerase chain reaction technique | SNOMED |
| 700360 | Infectious agent detection by nucleic acid (DNA or RNA); severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Coronavirus disease [COVID-19]) amplified probe technique | CPT4 |
| 37310258 | Measurement of 2019 novel coronavirus antibody | SNOMED |
| 37310257 | Measurement of 2019 novel coronavirus antigen | SNOMED |
| 756055 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) | OMOP Extension |
| 586310 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) Genetic material using Molecular method | OMOP Extension |
| 704991 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Blood | OMOP Extension |
| 756029 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Respiratory specimen | OMOP Extension |
| 586307 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Saliva | OMOP Extension |
| 705107 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Sample from nose | OMOP Extension |
| 586309 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Specified specimen | OMOP Extension |
| 756065 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Unspecified specimen | OMOP Extension |
| 704992 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Culture method | OMOP Extension |
| 705001 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Nucleic acid amplification technique | OMOP Extension |
| 705000 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Nucleic acid amplification technique in Blood | OMOP Extension |
| 756085 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Nucleic acid amplification technique in Respiratory specimen | OMOP Extension |
| 586308 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Nucleic acid amplification technique in Saliva | OMOP Extension |
| 705106 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Nucleic acid amplification technique in Sample from nose | OMOP Extension |
| 756084 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Nucleic acid amplification technique in Unspecified specimen | OMOP Extension |
| 704993 | Measurement of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) using Sequencing | OMOP Extension |

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|---|---|---|
| 586516 | SARS-CoV-2 (COVID19) [Presence] in Unspecified specimen by Organism specific culture | LOINC |
| 723480 | SARS-CoV-2 (COVID19) Ab [Interpretation] in Serum or Plasma | LOINC |
| 586515 | SARS-CoV-2 (COVID19) Ab [Presence] in Serum or Plasma by Immunoassay | LOINC |
| 586522 | SARS-CoV-2 (COVID19) Ab [Units/volume] in Serum or Plasma by Immunoassay | LOINC |
| 706179 | SARS-CoV-2 (COVID19) Ab panel - Serum or Plasma by Immunoassay | LOINC |
| 723477 | SARS-CoV-2 (COVID19) Ag [Presence] in Respiratory specimen by Rapid immunoassay | LOINC |
| 706166 | SARS-CoV-2 (COVID19) E gene [Cycle Threshold #] in Unspecified specimen by NAA with probe detection | LOINC |
| 586523 | SARS-CoV-2 (COVID19) E gene [Presence] in Respiratory specimen by NAA with probe detection | LOINC |
| 586518 | SARS-CoV-2 (COVID19) E gene [Presence] in Serum or Plasma by NAA with probe detection | LOINC |
| 706174 | SARS-CoV-2 (COVID19) E gene [Presence] in Unspecified specimen by NAA with probe detection | LOINC |
| 723473 | SARS-CoV-2 (COVID19) IgA Ab [Presence] in Serum or Plasma by Immunoassay | LOINC |
| 586521 | SARS-CoV-2 (COVID19) IgA Ab [Presence] in Serum  Plasma or Blood by Rapid immunoassay | LOINC |
| 723459 | SARS-CoV-2 (COVID19) IgA Ab [Units/volume] in Serum or Plasma by Immunoassay | LOINC |
| 757686 | SARS-CoV-2 (COVID19) IgA+IgM [Presence] in Serum or Plasma by Immunoassay | LOINC |
| 586527 | SARS-CoV-2 (COVID19) IgG Ab [Presence] in DBS by Immunoassay | LOINC |
| 723474 | SARS-CoV-2 (COVID19) IgG Ab [Presence] in Serum or Plasma by Immunoassay | LOINC |
| 706181 | SARS-CoV-2 (COVID19) IgG Ab [Presence] in Serum  Plasma or Blood by Rapid immunoassay | LOINC |
| 706177 | SARS-CoV-2 (COVID19) IgG Ab [Units/volume] in Serum or Plasma by Immunoassay | LOINC |
| 706176 | SARS-CoV-2 (COVID19) IgG and IgM panel - Serum  Plasma or Blood by Rapid immunoassay | LOINC |
| 723479 | SARS-CoV-2 (COVID19) IgG+IgM Ab [Presence] in Serum or Plasma by Immunoassay | LOINC |

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| 723475 | SARS-CoV-2 (COVID19) IgM Ab [Presence] in Serum or Plasma by Immunoassay | LOINC |
| 706180 | SARS-CoV-2 (COVID19) IgM Ab [Presence] in Serum  Plasma or Blood by Rapid immunoassay | LOINC |
| 706178 | SARS-CoV-2 (COVID19) IgM Ab [Units/volume] in Serum or Plasma by Immunoassay | LOINC |
| 706167 | SARS-CoV-2 (COVID19) N gene [Cycle Threshold #] in Unspecified specimen by NAA with probe detection | LOINC |
| 706157 | SARS-CoV-2 (COVID19) N gene [Cycle Threshold #] in Unspecified specimen by Nucleic acid amplification using CDC primer-probe set N1 | LOINC |
| 706155 | SARS-CoV-2 (COVID19) N gene [Cycle Threshold #] in Unspecified specimen by Nucleic acid amplification using CDC primer-probe set N2 | LOINC |
| 715272 | SARS-CoV-2 (COVID19) N gene [Presence] in Nasopharynx by NAA with probe detection | LOINC |
| 757678 | SARS-CoV-2 (COVID19) N gene [Presence] in Nose by NAA with probe detection | LOINC |
| 706161 | SARS-CoV-2 (COVID19) N gene [Presence] in Respiratory specimen by NAA with probe detection | LOINC |
| 586524 | SARS-CoV-2 (COVID19) N gene [Presence] in Respiratory specimen by Nucleic acid amplification using CDC primer-probe set N1 | LOINC |
| 586525 | SARS-CoV-2 (COVID19) N gene [Presence] in Respiratory specimen by Nucleic acid amplification using CDC primer-probe set N2 | LOINC |
| 586520 | SARS-CoV-2 (COVID19) N gene [Presence] in Serum or Plasma by NAA with probe detection | LOINC |
| 706175 | SARS-CoV-2 (COVID19) N gene [Presence] in Unspecified specimen by NAA with probe detection | LOINC |
| 706156 | SARS-CoV-2 (COVID19) N gene [Presence] in Unspecified specimen by Nucleic acid amplification using CDC primer-probe set N1 | LOINC |
| 706154 | SARS-CoV-2 (COVID19) N gene [Presence] in Unspecified specimen by Nucleic acid amplification using CDC primer-probe set N2 | LOINC |
| 757680 | SARS-CoV-2 (COVID19) neutralizing antibody [Presence] in Serum by pVNT | LOINC |
| 757679 | SARS-CoV-2 (COVID19) neutralizing antibody [Titer] in Serum by pVNT | LOINC |
| 723469 | SARS-CoV-2 (COVID19) ORF1ab region [Cycle Threshold #] in Respiratory specimen by NAA with probe detection | LOINC |
| 706168 | SARS-CoV-2 (COVID19) ORF1ab region [Cycle Threshold #] in Unspecified specimen by NAA with probe detection | LOINC |
| 723478 | SARS-CoV-2 (COVID19) ORF1ab region [Presence] in Respiratory specimen by NAA with probe detection | LOINC |

| | | |
|---|---|---|
| 723464 | SARS-CoV-2 (COVID19) ORF1ab region [Presence] in Unspecified specimen by NAA with probe detection | LOINC |
| 723471 | SARS-CoV-2 (COVID19) RdRp gene [Cycle Threshold #] in Respiratory specimen by NAA with probe detection | LOINC |
| 723470 | SARS-CoV-2 (COVID19) RdRp gene [Cycle Threshold #] in Unspecified specimen by NAA with probe detection | LOINC |
| 706160 | SARS-CoV-2 (COVID19) RdRp gene [Presence] in Respiratory specimen by NAA with probe detection | LOINC |
| 706173 | SARS-CoV-2 (COVID19) RdRp gene [Presence] in Unspecified specimen by NAA with probe detection | LOINC |
| 586528 | SARS-CoV-2 (COVID19) RNA [Cycle Threshold #] in Respiratory specimen by NAA with probe detection | LOINC |
| 586529 | SARS-CoV-2 (COVID19) RNA [Cycle Threshold #] in Unspecified specimen by NAA with probe detection | LOINC |
| 715262 | SARS-CoV-2 (COVID19) RNA [Log #/volume] (viral load) in Unspecified specimen by NAA with probe detection | LOINC |
| 723476 | SARS-CoV-2 (COVID19) RNA [Presence] in Nasopharynx by NAA with non-probe detection | LOINC |
| 586526 | SARS-CoV-2 (COVID19) RNA [Presence] in Nasopharynx by NAA with probe detection | LOINC |
| 757677 | SARS-CoV-2 (COVID19) RNA [Presence] in Nose by NAA with probe detection | LOINC |
| 706163 | SARS-CoV-2 (COVID19) RNA [Presence] in Respiratory specimen by NAA with probe detection | LOINC |
| 715260 | SARS-CoV-2 (COVID19) RNA [Presence] in Saliva (oral fluid) by NAA with probe detection | LOINC |
| 715261 | SARS-CoV-2 (COVID19) RNA [Presence] in Saliva (oral fluid) by Sequencing | LOINC |
| 723463 | SARS-CoV-2 (COVID19) RNA [Presence] in Serum or Plasma by NAA with probe detection | LOINC |
| 706170 | SARS-CoV-2 (COVID19) RNA [Presence] in Unspecified specimen by NAA with probe detection | LOINC |
| 706158 | SARS-CoV-2 (COVID19) RNA panel - Respiratory specimen by NAA with probe detection | LOINC |
| 706169 | SARS-CoV-2 (COVID19) RNA panel - Unspecified specimen by NAA with probe detection | LOINC |
| 723467 | SARS-CoV-2 (COVID19) S gene [Cycle Threshold #] in Respiratory specimen by NAA with probe detection | LOINC |
| 723468 | SARS-CoV-2 (COVID19) S gene [Cycle Threshold #] in Unspecified specimen by NAA with probe detection | LOINC |

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|---|---|---|
| 723465 | SARS-CoV-2 (COVID19) S gene [Presence] in Respiratory specimen by NAA with probe detection | LOINC |
| 586519 | SARS-CoV-2 (COVID19) S gene [Presence] in Serum or Plasma by NAA with probe detection | LOINC |
| 723466 | SARS-CoV-2 (COVID19) S gene [Presence] in Unspecified specimen by NAA with probe detection | LOINC |
| 586517 | SARS-CoV-2 (COVID19) whole genome [Nucleotide sequence] in Isolate by Sequencing | LOINC |
| 40218805 | Testing for SARS-CoV-2 in CDC laboratory | HCPCS |
| 40218804 | Testing for SARS-CoV-2 in non-CDC laboratory | HCPCS |

# Supporting Table 3. Definitions and codes used for hypertension and other comorbidities

| **Name** | **Included Codes** |
|---|---|
| Hyperlipidemia | https://atlas.ohdsi.org/#/concept/432867 |
| Chronic kidney disease | https://atlas.ohdsi.org/#/cohortdefinition/312 |
| Cancer | https://atlas.ohdsi.org/#/cohortdefinition/222 |
| Asthma | https://atlas.ohdsi.org/#/cohortdefinition/218 |
| Dementia | https://atlas.ohdsi.org/#/cohortdefinition/226 |
| Total cardiovascular disease | https://atlas.ohdsi.org/#/cohortdefinition/246 |
| Peripheral vascular disease | https://atlas.ohdsi.org/#/concept/321052 |

| | |
|---|---|
| Cerebrovascular disease | https://atlas.ohdsi.org/#/concept/381591 |
| Chronic liver disease | https://atlas.ohdsi.org/#/concept/4212540 |
| Chronic obstructive pulmonary disease | https://atlas.ohdsi.org/#/cohortdefinition/219 |
| Heart disease | https://atlas.ohdsi.org/#/cohortdefinition/231 |
| Hypertension | https://atlas.ohdsi.org/#/cohortdefinition/227 |
| Obesity | https://atlas.ohdsi.org/#/cohortdefinition/224 |
| Type 2 Diabetes Mellitus | https://atlas.ohdsi.org/#/cohortdefinition/311 |

## Supporting Table 4. Prevalence of hypertension among COVID-19 patients in the diagnosed and hospitalised cohorts in the CHARYBDIS Network.

| | **Diagnosed with COVID-19** | | **Hospitalized with COVID-19** | |
|---|---|---|---|---|
| | **N of prevalent cases** | **% (95%CI)** | **N of prevalent cases** | **% (95%CI)** |
| IQVIA-OpenClaims-US | 1,245,436 | 48.3 (48.2-48.4) | 384,508 | 76.5 (76.3-76.6) |
| OPTUM-EHR-US | 66,432 | 37.4 (37.2-37.7) | 18,242 | 64.1 (63.5-64.6) |
| VA-OMOP-US | 34,093 | 61.4 (61.0-61.8) | 8,996 | 85.9 (85.2-86.6) |

| | | | | |
|---|---|---|---|---|
| HEALTHVERITY-US | 25,405 | 22.3 (22.0-22.5) | 4,512 | 59.5 (58.4-60.6) |
| SIDIAP-Spain | 21,289 | 17.4 (17.2-17.6) | 5,636 | 31.0 (30.3-31.6) |
| CUIMC-US | 3,672 | 43.1 (42.1-44.2) | 1,708 | 65.7 (63.9-67.5) |
| IQVIA-LPD-France | 3,260 | 19.0 (18.4-19.6) | - | - |
| CU-AMC-HDC-US | 2,461 | 33.9 (32.8-34.9) | 904 | 63.0 (60.5-65.5) |
| IQVIA-DA-Germany | 2,418 | 30.3 (29.3-31.3) | - | - |
| HIRA-South Korea | - | - | 1943 | 25.6 (24.6-26.6) |
| IQVIA-LPD-Italy | 1,618 | 36.1 (34.6-37.5) | - | - |
| STARR-OMOP-US | 1,246 | 37.4 (35.8-39.1) | 342 | 55.6 (51.7-59.5) |
| HMAR-Spain | - | - | 594 | 29.5 (27.5-31.5) |
| CPRD-UK | 756 | 22.4 (21.0-23.8) | - | - |
| IPCI-The Netherlands | 676 | 22.2 (20.7-23.7) | - | - |