

**Table S1** LOINC laboratory codes considered indicative of SARS-CoV-2 infection

LOINC code	Description
41458-1	SARS coronavirus RNA [Presence] in Unspecified specimen by NAA with probe detection
94309-2	SARS coronavirus 2 RNA [Presence] in Unspecified specimen by NAA with probe detection
94500-6	SARS coronavirus 2 RNA [Presence] in Respiratory specimen by NAA with probe detection
94533-7	SARS coronavirus 2 N gene [Presence] in Respiratory specimen by NAA with probe detection
94534-5	SARS coronavirus 2 RdRp gene [Presence] in Respiratory specimen by NAA with probe detection
94646-7	SARS coronavirus 2 RdRp gene [Cycle Threshold #] in Respiratory specimen by NAA with probe detection

These codes exclude antibody tests and older, ambiguous LOINC codes that may be less definitively consistent with true, unambiguous cases of SARS-CoV-2 infection. LOINC, Logical Observation Identifiers Names and Codes; NAA, nucleic acid amplification; RdRp, RNA (ribonucleic acid)-dependent RNA polymerase; RNA, ribonucleic acid; SARS, severe acute respiratory syndrome; SARS-CoV-2, SARS coronavirus 2.

**Table S2** LOINC laboratory codes for liver chemistries

Laboratory test	LOINC codes
Alkaline phosphatase	1783-0, 6768-6
Aspartate aminotransferase	1920-8, 30239-8
Alanine aminotransferase	1742-6, 1743-4, 1744-2
Total bilirubin	1975-2, 14631-6, 42719-5
Albumin	1751-7, 2862-1, 61151-7, 61152-5

LOINC, Logical Observation Identifiers Names and Codes.

**Table S3** Comorbidity case definitions and codes

Variable	ICD-9-CM codes (X is a wildcard character)	ICD-10-CM codes (X is a wildcard character)
Diabetes mellitus	250.X, 357.2, 362.0X, 366.41	E08, E08.X, E09, E09.X, E10, E10.X, E11, E11.X, E13, E13.X
Chronic obstructive pulmonary disease	491.20, 491.21, 491.22, 493.20, 493.21, 493.22, 496	J44.0, J44.1, J44.9
Coronary artery disease	410.01, 410.11, 410.21, 410.31, 410.41, 410.51, 410.61, 410.71, 410.81, 410.91, 411.1, 412, 413.9, 414.01, 414.02, 414.03, 414.04, 414.05, 414.06, 414.07, 414.10, 414.2, 414.3, 414.4, 414.8, 414.9, 429.2, 429.5, 429.6, 429.71, 429.79, V12.50, V12.50, V12.59, V45.82	I21, I21.X, I22, I22.X, I23, I23.X, I25, I25.1X, I25.2X, I25.5X, I25.6X, I25.7X, I25.8X, I25.9X, Z86.74, Z86.79, Z98.6, Z98.61,
Liver disease	070.0, 070.1, 070.20, 070.30, 070.31, 070.32, 070.41, 070.44, 070.54, 070.6, 070.7X, 070.9, 155.0, 155.2, 197.7, 211.5, 273.4, 275.01, 275.1, 570, 571.0, 571.1, 571.2, 571.3, 571.40, 571.41, 571.42, 571.49, 571.5, 571.6, 571.8, 571.9, 572.2, 572.3, 572.8, 573.0, 573.3, 573.8, 573.9, 646.70, 751.62, V10.07, V42.7	K70X, K71.0, K71.10, K71.11, K71.2, K71.3, K71.51, K71.6, K71.7, K71.8, K71.9, K72X, K73X, K74X, K75.2, K75.3, K75.4, K75.81, K75.89, K75.9, K76.0, K76.1, K76.6, K76.89, K76.9, K77, K83.01, C7B.02, C22.0, C22.4, C22.7, C22.8, C22.9, B00.81, B15.9, B16.9, B17.10, B17.11, B17.2, B17.8, B17.9, B18.0, B18.1, B18.2, B18.8, B18.9, B19X, B25.1, B94.2, E83.01, E83.110, E88.01, Z20.5, Z22.51, Z22.52, Z85.05, O26.611, O26.612, O26.613, O26.619, O26.62, O26.63, O98.411, O98.412, O98.413, O98.419, O98.41, O98.42, O98.43, Q44.6, Q44.7, T86.42, T86.43, V02.62, P78.81
History of nicotine dependence or exposure to environmental tobacco smoke	305.1, 649.00, 649.01, 649.02, 649.03, 649.04, V15.82	Z57.31, Z72.0, Z77.22, Z87.891, O99.33X, F17X
Malignancy	V10X, 140X, 141X, 142X, 143X, 144X, 145X, 146X, 147X, 148X, 149X, 150X, 151X, 152X, 153X, 154X, 155X, 156X, 157X, 158X, 159X, 160X, 161X, 162X, 163X, 164X, 165X, 170X, 171X, 172X, 173X, 174X, 175X, 176X, 179X, 180X, 181X, 182X, 183X, 184X, 185X, 186X, 187X, 188X, 189X, 190X, 191, 192XX, 193X, 194X, 195X, 196X, 197X, 19X8, 199X, 200X, 201X, 202X, 203X, 204X, 205X, 206X, 207X, 208X, 209X	Z85X, Z08X, C00X, C01X, C02X, C03X, C04X, C05X, C06X, C07X, C08X, C09X, C10X, C11X, C12X, C13X, C14X, C15X, C16X, C17X, C18X, C19X, C20X, C21X, C22X, C23X, C24X, C25X, C26X, C30X, C31X, C32X, C33X, C34X, C37X, C38X, C39X, C40X, C41X, C43X, C44X, C4AX, C45X, C46X, C47X, C48X, C49X, C50X, C51X, C52X, C53X, C54X, C55X, C56X, C57X, C58X, C60X, C61X, C62X, C63X, C64X, C65X, C66X, C67X, C68X, C69X, C70X, C71X, C72X, C73X, C74X, C75X, C76X, C77X, C78X, C79X, C80X, C7AX, C7BX, C82X, C83X, C84X, C85X, C86X, C88X, C90X, C91X, C92X, C93X, C94X, C95X, C96X
Heart failure	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 429.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, 428.9	I09.81, I11.0, I13.0, I13.2, I50, I50.X, I97.13X, P29.0
Chronic kidney disease or end-stage renal failure	585X, 586X, 403X, 404X, 249.40, 250.41, 250.41, 285.21X, E87.91X, V56.1X, V56.2X, V56.31X, V56.32X, V45.11X, V45.12X, 996.56X, 996.68X, 996.81X	N18X, N19X, I12X, I13X, E08.22X, E09.22X, E10.22X, E11.22X, E13.22X, D63.1X, O10.2X, O10.3X, Y84.1X, Z49X, Z99.2X, Z91.15X, T85.611X, T85.621, T85.631, T85.71X, T86.12X

We defined comorbidity cases as cases where an ICD code for one of the following conditions was documented at or prior to the service date and time of the encounter at which a patient tested positive for SARS-CoV-2 infection. A patient who did not have an ICD code for these conditions at or prior to the service date and time of that encounter was considered a negative case for that condition. ICD, International Classification of Diseases; ICD-9-CM, International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10-CM, International Classification of Diseases, Tenth Revision, Clinical Modification.

**Table S4** Primary outcome case definitions and codes

Primary outcome	Codes/case definitions
Death	<p>A status of “deceased” (yes/no) is documented for each patient in the dataset. We defined a death case as a patient who was documented as deceased AND whose encounter noted a discharge disposition of “Expired.” We defined a non-death case as a patient who was not documented in the dataset as deceased</p> <p>Note: An adjustment was made to some encounters, to account for the fact that some health systems document ER encounters that are associated with subsequent inpatient stays as two separate encounters (i.e., an ER encounter and an inpatient encounter), even when those encounters reflect a single episode of care. If the service date of an ER encounter occurred less than or equal to 48 hours prior to the service date of an inpatient encounter, we merged the ER encounter with the subsequent inpatient encounter. Any patient who had a discharge disposition of “Expired” for one of those two “joined” encounters was considered a death case</p>
Intubation	<p>ICD-10 Procedure Codes: 0BH13EZ, 0BH17EZ, 0BH18EZ, 5A1935Z, 5A1955Z CPT codes: 31500, 94003, 94002, 94004, 33946, 33947, 33949, 33952, 33953, 33954, 33955, 33966, 33969, 36822</p> <p>ICD-10 diagnosis code: T88.4X</p> <p>Note: An adjustment was made to some encounters, to account for the fact that some health systems document ER encounters that are associated with subsequent inpatient stays as two separate encounters (i.e., an ER encounter and an inpatient encounter), even when those encounters reflect a single episode of care. If the service date of an ER encounter occurred less than or equal to 48 hours prior to the service date of an inpatient encounter, we merged the ER encounter with the subsequent inpatient encounter. Any patient who was intubated during one of those two “joined” encounters was considered an intubation case</p>
Hospital length of stay	<p>For length of stay calculations, an adjustment was made to account for the fact that some health systems document ER encounters that are associated with subsequent inpatient stays as two separate encounters (i.e., an ER encounter and an inpatient encounter), even when those encounters reflect a single episode of care. If the service date of an ER encounter occurred less than or equal to 48 hours prior to the service date of an inpatient encounter, we merged the ER encounter with the inpatient encounter. We considered the following encounter types to be inpatient encounters: (I) “admitted for observation,” (II) “inpatient,” or (III) “inpatient hospice care.”</p>

CPT, Current Procedural Terminology; ER, emergency room; ICD-10, International Classification of Diseases, Tenth Revision.

**Table S5** Medication categories and associated medication names

Medication category	Medication names (generic)
Proton pump inhibitors	esomeprazole, lansoprazole, dexlansoprazole, omeprazole, pantoprazole, rabeprazole
H2 blockers	ranitidine, famotidine, cimetidine, nizatidine
H2 blocker, histamine 2 receptor agonist.	

**Table S6** Medication names and search terms

Generic medication name	Medication Search Terms (case insensitive; asterisk = wildcard character)
Esomeprazole	*esomeprazole*, *nexium*, *vimovo*
Lansoprazole/dexlansoprazole	*lansoprazole*, *prevacid*, *prevpac*, *dexilant*, *kapidex*
Omeprazole	omeprazole*, *prilosec*, *omeclamox*, *zegerid*, *yosprala*, *talicia*
Pantoprazole	*pantoprazole*, *protonix*
Rabeprazole	*rabeprazole*, *aciphex*
Ranitidine	*ranitidine*, “acid control”, “acid control 75”, “acid reducer”, *taladine*, *wal-zan*, *zantac*, *tritec*
Famotidine	“acid controller”, *famotidine*, “heartburn prevention”, “heartburn relief”, “leader acid reducer”, *mylanta*, *pepcid*, “dual action complete”, “duo fusion”, *duexis*
Cimetidine	*cimetidine*, *tagamet*
Nizatidine	*nizatidine*, *axid* (not including *maxidex*)

These search terms were identified by using the multum\_dnum\_reference medication table. This table contains all generic and brand names from the Multum database.

**Table S7** Full-matched patient cohort: covariate means and standardized mean differences

Characteristic	Means: patients with $\geq 1$ abnormal liver chemistries	Means: patients with normal liver chemistries	Standardized mean difference
Distance	6.51E-01	6.48E-01	0.029
Age	5.87E+01	6.02E+01	-0.082
Gender, female	4.69E-01	4.65E-01	0.008
Gender, male	5.31E-01	5.35E-01	-0.008
Race/ethnicity, non-Hispanic White	3.02E-01	3.16E-01	-0.031
Race/ethnicity, non-Hispanic Black	1.63E-01	1.48E-01	0.041
Race/ethnicity, AAPI/AIAN/non-Hispanic Other	7.93E-02	8.14E-02	-0.008
Race/ethnicity, Hispanic	4.55E-01	4.54E-01	0.002
Diabetes mellitus, absent	5.30E-01	5.13E-01	0.035
Diabetes mellitus, present	4.70E-01	4.87E-01	-0.035
Chronic obstructive pulmonary disease, absent	8.72E-01	8.64E-01	0.024
Chronic obstructive pulmonary disease, present	1.28E-01	1.36E-01	-0.024
Coronary artery disease, absent	7.21E-01	7.14E-01	0.016
Coronary artery disease, present	2.79E-01	2.86E-01	-0.016
Liver disease, absent	7.96E-01	7.83E-01	0.031
Liver disease, present	2.04E-01	2.17E-01	-0.031
Body mass index	3.10E+01	3.08E+01	0.024
PPI prescription within 60 days, absent	9.78E-01	9.75E-01	0.017
PPI prescription within 60 days, present	2.24E-02	2.49E-02	-0.017
H2 blocker prescription within 60 days, absent	9.93E-01	9.95E-01	-0.029
H2 blocker prescription within 60 days, present	7.21E-03	4.73E-03	0.029
Serum albumin	3.21E+00	3.21E+00	-0.011
Blood type, O+	4.79E-01	4.83E-01	-0.008
Blood type, A+	3.03E-01	3.00E-01	0.006
Blood type, B+	1.12E-01	1.16E-01	-0.013
Blood type, O-	4.03E-02	4.29E-02	-0.013
Blood type, A-	3.47E-02	2.80E-02	0.036
Blood type, AB+	2.29E-02	2.49E-02	-0.014
Blood type, B-	7.88E-03	4.51E-03	0.038
Blood type, AB-	5.63E-04	2.25E-04	0.014
Malignancy, absent	8.61E-01	8.38E-01	0.066
Malignancy, present	1.39E-01	1.62E-01	-0.066
Heart failure, absent	7.94E-01	7.80E-01	0.034
Heart failure, present	2.06E-01	2.20E-01	-0.034
Chronic kidney disease/End-stage renal disease, absent	7.35E-01	7.35E-01	0.001
Chronic kidney disease/End-stage renal disease, present	2.65E-01	2.65E-01	-0.001
Nicotine dependence or exposure to tobacco smoke, absent	6.58E-01	6.45E-01	0.027
Nicotine dependence or exposure to tobacco smoke, present	3.42E-01	3.55E-01	-0.027

AAPI, Asian American/Pacific Islander; AIAN, American Indian/Alaska Native; H2 blocker, histamine 2 receptor agonist; PPI, proton pump inhibitor.