

Association of Clinical Factors and Recent Anti-Cancer Therapy with COVID-19 Severity among Patients with Cancer: A Report from the COVID-19 and Cancer Consortium

Supplemental Material

Alphabetical list of participants by institution that contributed at least one record to the analysis.

Supplementary Figure 1. COVID-19 Severity by Age.

Supplementary Figure 2. CONSORT Flow Diagram.

Supplementary Table 1. Metrics for Data Quality.

Supplementary Table 2. Anti-cancer Therapy by Drug Name, Class, and Modality.

Supplementary Table 3. Anti-COVID-19 Treatments Classified as 'Other.'

Supplementary Table 4. Type of Malignancy Among All Patients and Hospitalized Patients.

Supplementary Table 5. Baseline Prognostic Factors Stratified by Levels of COVID-19 Severity Among Hospitalized Patients.

Supplementary Table 6. Adjusted Associations of Baseline Prognostic Factors, Including Anti-COVID-19 Treatments, with COVID-19 Severity Among All Patients.

Supplementary Table 7. Adjusted Odds Ratios for COVID-19 Severity by Modality of Active Anti-cancer Therapy and Timing of Anti-cancer Therapy.

Supplementary Table 8. Adjusted Associations of Baseline Prognostic Factors and Laboratory Measurements with COVID-19 Severity and 30-day All-cause Mortality Among Hospitalized Patients.

Supplementary Table 9. Summary of the Most Prevalent Anti-cancer Therapies and Associated 30-day All-cause Mortality (Tabular Format of Figure 2).

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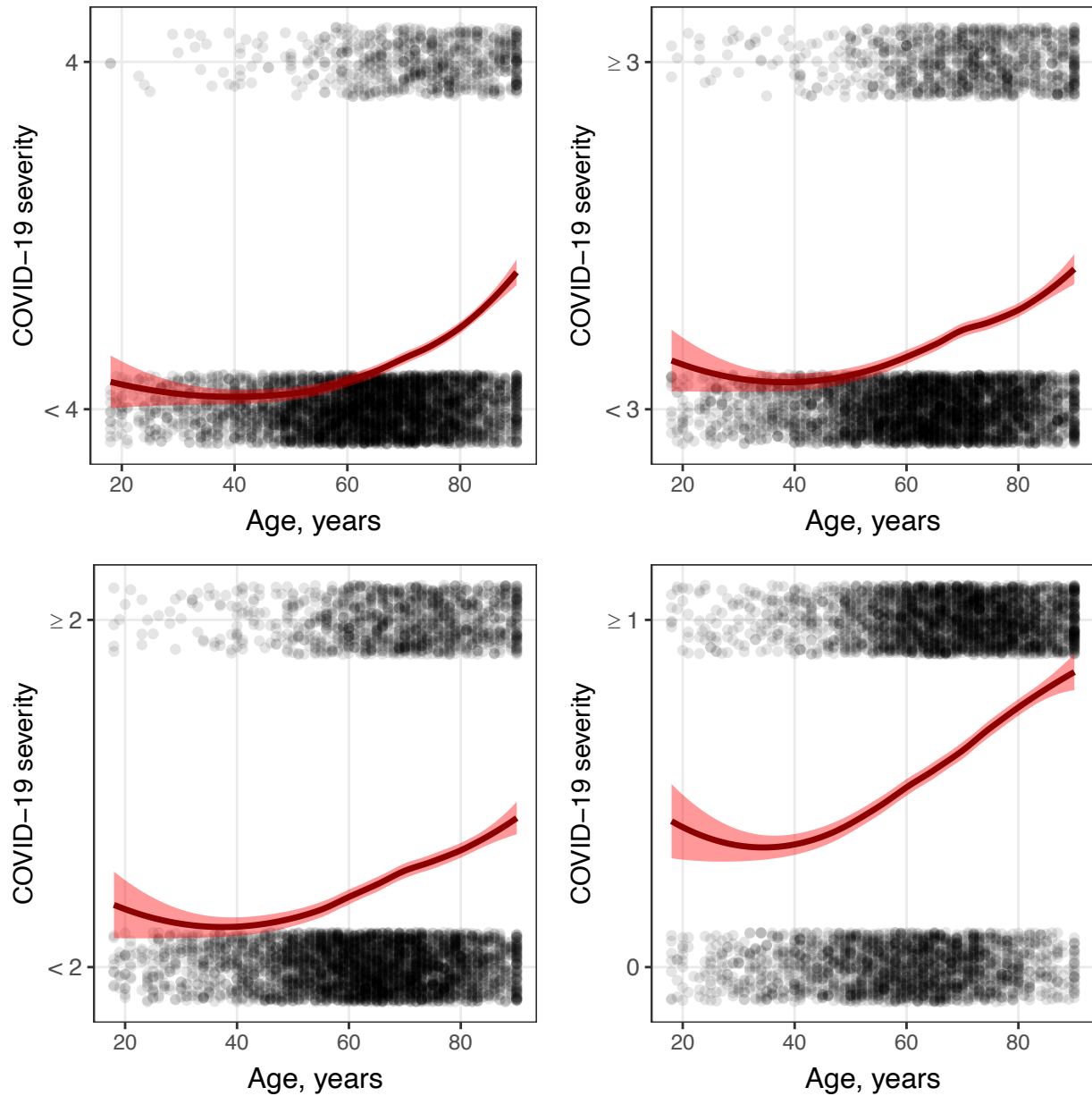
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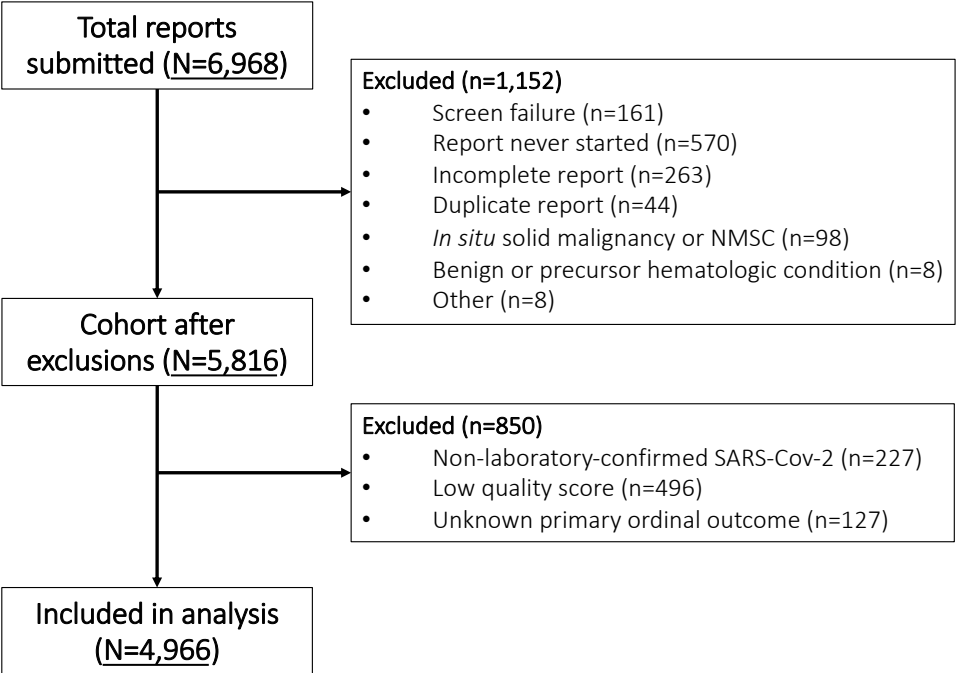
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Supplementary Figure 1. COVID-19 Severity by Age.



NOTE. Levels of ordinal COVID-19 severity are: 0, none of the following complications; 1, admitted to the hospital; 2, admitted to the intensive care unit; 3, received mechanical ventilation; 4, died within 30 days. Points are jittered vertically to enhance legibility. Red lines and shaded regions represent LOESS smoothers and 95% confidence bands, respectively.

Supplementary Figure 2. CONSORT Flow Diagram.



Abbreviation: NMSC, non-melanoma skin cancer.

Supplementary Table 1. Metrics for Data Quality.

Quality score	Definition
0	No problems identified
1	1 minor problem
2	2 minor problems
3	3 minor problems or 1 moderate problem
4	4 minor problems or 1 moderate problem and 1 minor problem
5	5 minor problems or 1 moderate problem and 2 minor problems or 1 major problem
≥6	5 or more additional problems

NOTE. Minor problems were valued at 1 point, moderate problems at 3 points, and major problems at 5 points. Reports with a quality score of >4 were excluded.

Supplementary Table 2. Anti-cancer Therapy by Drug Name, Class, and Modality.

Drug	Class ^a	Modality
9-ING-41		Targeted therapy
Abemaciclib	CDK4/6i	Targeted therapy
Abiraterone		Endocrine therapy
Abraxane		Chemotherapy
Acalabrutinib	BTKi	Targeted therapy
Afatinib	EGFRi	Targeted therapy
Alectinib	ALKi	Targeted therapy
All-trans retinoic acid		Targeted therapy
*	Allogeneic HSCT	Immunotherapy
Alpelisib		Targeted therapy
Anastrozole	Aromatase inhibitor	Endocrine therapy
Apalutamide	Nonsteroidal antiandrogen	Endocrine therapy
Arsenic trioxide		Targeted therapy
Asparaginase <i>Erwinia chrysanthemi</i>	Asparaginase	Chemotherapy
Atezolizumab	PD-1/PD-L1 antibody	Immunotherapy
Avelumab	PD-1/PD-L1 antibody	Immunotherapy
Axicabtagene ciloleucel		Immunotherapy
Axitinib	VEGFRi	Targeted therapy
Azacitidine	DNMTi	Chemotherapy
Bendamustine		Chemotherapy
Bevacizumab		Targeted therapy
Bexarotene		Targeted therapy
Bicalutamide	Nonsteroidal antiandrogen	Endocrine therapy
Binimetinib	MEKi	Targeted therapy
Bleomycin		Chemotherapy
Blinatumomab	BiTE antibody	Immunotherapy
Bortezomib	Proteasome inhibitor	Targeted therapy
Bosutinib	BCR-ABLi	Targeted therapy
Brentuximab vedotin		Targeted therapy
Brigatinib	ALKi	Targeted therapy
Busulfan		Chemotherapy
Cabazitaxel	Taxane	Chemotherapy
Cabozantinib		Targeted therapy
Capecitabine	Fluoropyrimidine	Chemotherapy
Carboplatin	Cisplatin/Carboplatin	Chemotherapy
Carfilzomib	Proteasome inhibitor	Targeted therapy
Carmustine		Chemotherapy
*	CD47 antibody	Immunotherapy
Cemiplimab	PD-1/PD-L1 antibody	Immunotherapy

Cerdulatinib		Targeted therapy
Ceritinib	ALKi	Targeted therapy
Cetuximab	EGFR antibody	Targeted therapy
Chlorambucil		Chemotherapy
Cisplatin	Cisplatin/Carboplatin	Chemotherapy
Crizotinib	ALKi	Targeted therapy
Cyclophosphamide		Chemotherapy
Cytarabine		Chemotherapy
Dabrafenib	BRAFi	Targeted therapy
Dacarbazine		Chemotherapy
Daratumumab		Targeted therapy
Darolutamide	Nonsteroidal antiandrogen	Endocrine therapy
Dasatinib	BCR-ABLi	Targeted therapy
Daunorubicin	Anthracycline	Chemotherapy
Decitabine	DNMTi	Chemotherapy
Degarelix	ADT/OFS	Endocrine therapy
Devimistat		Targeted therapy
Dexamethasone	Corticosteroid	Chemotherapy
Docetaxel	Taxane	Chemotherapy
Doxorubicin	Anthracycline	Chemotherapy
Durvalumab	PD-1/PD-L1 antibody	Immunotherapy
Dutasteride		Endocrine therapy
Duvelisib	PI3K delta inhibitor	Targeted therapy
Elotuzumab		Targeted therapy
Enasidenib		Targeted therapy
Encorafenib	BRAFi	Targeted therapy
Enfortumab vedotin		Targeted therapy
Entrectinib		Targeted therapy
Enzalutamide	Nonsteroidal antiandrogen	Endocrine therapy
Eribulin		Chemotherapy
Erlotinib	EGFRi	Targeted therapy
Etoposide		Chemotherapy
Everolimus		Targeted therapy
Exemestane	Aromatase inhibitor	Endocrine therapy
Fedratinib	JAKi	Targeted therapy
Fludarabine		Chemotherapy
Fluorouracil	Fluoropyrimidine	Chemotherapy
Flutamide	Nonsteroidal antiandrogen	Endocrine therapy
Folinic acid		Chemotherapy
Fulvestrant		Endocrine therapy
Futibatinib		Targeted therapy

Gemcitabine		Chemotherapy
Gemtuzumab ozogamicin		Targeted therapy
Gilteritinib	FLT3i	Targeted therapy
*	GITR Agonistic Antibody	Immunotherapy
Goserelin	ADT/OFS	Endocrine therapy
Hydroxyurea		Chemotherapy
Ibrutinib	BTKi	Targeted therapy
Idarubicin	Anthracycline	Chemotherapy
Idelalisib	PI3K delta inhibitor	Targeted therapy
Ifosfamide		Chemotherapy
Imatinib	BCR-ABLi	Targeted therapy
Inotuzumab ozogamicin		Targeted therapy
*	Investigational agent	
Ipilimumab	CTLA-4 antibody	Immunotherapy
Irinotecan		Chemotherapy
Ivosidenib		Targeted therapy
Ixazomib	Proteasome inhibitor	Targeted therapy
JCARH125		Immunotherapy
*	KRAS inhibitor	Targeted therapy
L-Asparaginase	Asparaginase	Chemotherapy
Lanreotide	Somatostatin analog	Endocrine therapy
Lapatinib	ERBB2i	Targeted therapy
Lenalidomide	IMiD	Targeted therapy
Lenvatinib		Targeted therapy
Letrozole	Aromatase inhibitor	Endocrine therapy
Leuprolide	ADT/OFS	Endocrine therapy
Levothyroxine		Endocrine therapy
Liothyronine		Endocrine therapy
Lomustine		Chemotherapy
Lorlatinib	ALKi	Targeted therapy
Luspatercept		Targeted therapy
Lutetium Lu 177 dotatate		Radiotherapy
MEDI5395		Immunotherapy
Megestrol		Endocrine therapy
Melphalan		Chemotherapy
Mercaptopurine		Chemotherapy
Methotrexate		Chemotherapy
Methylprednisolone	Corticosteroid	Chemotherapy
Midostaurin	FLT3i	Targeted therapy
Mosunetuzumab		Immunotherapy
Neratinib	ERBB2i	Targeted therapy

Nilotinib	BCR-ABLi	Targeted therapy
Niraparib	PARPi	Targeted therapy
Nivolumab	PD-1/PD-L1 antibody	Immunotherapy
*	NY-ESO-1 inhibitor	Immunotherapy
Obinutuzumab	CD20 antibody	Targeted therapy
Octreotide	Somatostatin analog	Endocrine therapy
Ofranergene obadenovec		Targeted therapy
Olaparib	PARPi	Targeted therapy
Osimertinib	EGFRi	Targeted therapy
Oxaliplatin		Chemotherapy
Paclitaxel	Taxane	Chemotherapy
Palbociclib	CDK4/6i	Targeted therapy
Panitumumab	EGFR antibody	Targeted therapy
Pazopanib	VEGFRi	Targeted therapy
Pegaspargase	Asparaginase	Chemotherapy
Peginterferon alfa		Immunotherapy
Pegylated liposomal doxorubicin	Anthracycline	Chemotherapy
Pembrolizumab	PD-1/PD-L1 antibody	Immunotherapy
Pemetrexed		Chemotherapy
Pertuzumab		Targeted therapy
Polatuzumab vedotin		Targeted therapy
Pomalidomide	IMiD	Targeted therapy
Ponatinib	BCR-ABLi	Targeted therapy
Pralatrexate		Chemotherapy
Pralsetinib	RETi	Targeted therapy
Prednisone	Corticosteroid	Chemotherapy
Procarbazine		Chemotherapy
Radium-223		Radiotherapy
Raltitrexed		Chemotherapy
Ramucirumab		Targeted therapy
REGN5458		Immunotherapy
Regorafenib		Targeted therapy
Ribociclib	CDK4/6i	Targeted therapy
Ripretinib		Targeted therapy
Rituximab	CD20 antibody	Targeted therapy
Romidepsin		Targeted therapy
Ruxolitinib	JAKi	Targeted therapy
Sacituzumab govotegan		Targeted therapy
Selpercatinib	RETi	Targeted therapy
Sorafenib	VEGFRi	Targeted therapy
Sunitinib	VEGFRi	Targeted therapy

TAK-659		Targeted therapy
Talazoparib	PARPi	Targeted therapy
Talimogene laherparepvec		Local therapy
Tamoxifen		Endocrine therapy
Temozolomide		Chemotherapy
Tesetaxel	Taxane	Chemotherapy
Thiotepa		Chemotherapy
Tisagenlecleucel		Immunotherapy
Topotecan		Chemotherapy
Trabectedin		Chemotherapy
Trametinib	MEKi	Targeted therapy
Trastuzumab		Targeted therapy
Trastuzumab emtansine		Targeted therapy
Trifluridine and tipiracil	Fluoropyrimidine	Chemotherapy
Tucatinib	ERBB2i	Targeted therapy
Ublituximab	CD20 antibody	Targeted therapy
Umbralisib	PI3K delta inhibitor	Targeted therapy
Vandetanib		Targeted therapy
Varlilumab		Immunotherapy
Vemurafenib	BRAFi	Targeted therapy
Venetoclax		Targeted therapy
Vinblastine	Vinca alkaloid	Chemotherapy
Vincristine	Vinca alkaloid	Chemotherapy
Vinorelbine	Vinca alkaloid	Chemotherapy
Vopratelimab		Immunotherapy

Abbreviations: ADT, androgen deprivation therapy; ALKi, anaplastic lymphoma kinase inhibitor; BCR-ABLi, BCR-ABL tyrosine kinase inhibitor; BiTE antibody, bi-specific T-cell engaging antibody; BRAFi, serine/threonine-protein kinase B-Raf inhibitor; BTKi, Bruton tyrosine kinase inhibitor; CDK4/6i, cyclin-dependent kinase 4 and 6 inhibitor; DNMTi, DNA methyltransferase inhibitor; EGFRi, epidermal growth factor receptor tyrosine kinase inhibitor; ERBB2i, epidermal growth factor receptor 2 tyrosine kinase inhibitor; FLT3i, fms related receptor tyrosine kinase 3 inhibitor; HSCT, hematopoietic stem cell transplant; IMiD, immunomodulator; JAKi, Janus kinase inhibitor; MEKi, mitogen-activated protein kinase kinase inhibitor; OFS, ovarian function suppression; PARPi, poly ADP ribose polymerase inhibitor; RETi, ret proto-oncogene inhibitor; VEGFRi, vascular endothelial growth factor receptor inhibitor.

^a Drugs without a class listed were analyzed at the drug level, whereas those with class listed were combined prior to visualization and analysis.

Supplementary Table 3. Anti-COVID-19 Treatments Classified as ‘Other.’

Treatment	Number treated
Azithromycin	867
Convalescent plasma	214
Tocilizumab	161
Lopinavir/Ritonavir	28
Chloroquine	8
Atazanavir	8
Other interleukin inhibitors	6
JAK inhibitors	5
TNF alpha inhibitors	3
Total	1300

NOTE. Total is more than 1166 (the number of patients for whom anti-COVID-19 treatment was classified as ‘other’; see Table 1) because some patients received more than one ‘other’ COVID-19 treatment.

Supplementary Table 4. Unadjusted Rates of Hospital Admission and 30-day All-cause Mortality by Baseline Prognostic Factors.

	Total patients N	Admitted to hospital n (%)	Died within 30 days n (%)
Age ^a , years			
<65	2282	1024 (45)	148 (6)
65-74	1309	801 (61)	178 (14)
≥75	1375	1047 (76)	369 (27)
Sex			
Female	2527	1323 (52)	282 (11)
Male	2436	1546 (63)	413 (17)
Missing/unknown	3	3 (100)	0 (0)
Race and ethnicity ^b			
Non-Hispanic white	2485	1371 (55)	342 (14)
Non-Hispanic black	1068	697 (65)	183 (17)
Hispanic	722	390 (54)	82 (11)
Other	578	359 (62)	76 (13)
Missing/unknown	113	55 (49)	12 (11)
Smoking status			
Never	2615	1356 (52)	266 (10)
Ever	2161	1386 (64)	390 (18)
Missing/unknown	190	130 (68)	39 (21)
Obesity status			
Not obese	3220	1909 (59)	489 (15)
Obese	1704	944 (55)	203 (12)
Missing/unknown	42	19 (45)	3 (7)
Comorbidities ^b			
Cardiovascular	1582	1175 (74)	354 (22)
Pulmonary	1091	762 (70)	222 (20)
Renal disease	831	644 (77)	209 (25)
Diabetes mellitus	1385	994 (72)	265 (19)
Missing/unknown	56	26 (46)	5 (9)
ECOG performance status			
0	1731	725 (42)	90 (5)
1	1296	794 (61)	166 (13)
≥2	806	675 (84)	278 (34)
Unknown	1121	671 (60)	160 (14)
Missing	12	7 (58)	1 (8)
Type of malignancy ^b			
Solid tumors	4021	2260 (56)	536 (13)
Breast	967	433 (45)	82 (8)
Prostate	773	487 (63)	128 (17)
Thoracic	409	284 (69)	107 (26)

Lower gastrointestinal	404	253 (63)	63 (16)
Other genitourinary	403	247 (61)	61 (15)
Gynecological	322	178 (55)	37 (11)
Upper gastrointestinal	266	171 (64)	45 (17)
Endocrine	235	109 (46)	13 (6)
Skin cancer	183	86 (47)	19 (10)
Head and neck	151	93 (62)	23 (15)
Sarcoma	110	55 (50)	12 (11)
Nervous system	78	47 (60)	10 (13)
Not otherwise specified ^c	54	34 (63)	7 (13)
Hematological neoplasms	1097	717 (65)	191 (17)
Lymphoid neoplasms	641	407 (63)	111 (17)
Multiple myeloma	232	162 (70)	36 (16)
Myeloid neoplasm	220	143 (65)	40 (18)
Not otherwise specified	17	14 (82)	6 (35)
Cancer status			
Remission or no evidence of disease	2546	1366 (54)	269 (11)
Active and responding	556	293 (53)	56 (10)
Active and stable	813	467 (57)	108 (13)
Active and progressing	613	452 (74)	162 (26)
Unknown	426	283 (66)	95 (22)
Missing	12	11 (92)	5 (42)
Timing of anti-cancer therapy			
Never treated	413	252 (61)	63 (15)
0-4 weeks	1609	907 (56)	220 (14)
1-3 months	375	231 (62)	77 (21)
>3 months	2344	1324 (56)	289 (12)
Missing/unknown	225	158 (70)	46 (20)
Modality of active anti-cancer therapy ^{b,d}			
None	2807	1625 (58)	374 (13)
Cytotoxic chemotherapy	802	491 (61)	144 (18)
Immunotherapy	248	137 (55)	39 (16)
Targeted therapy	693	426 (61)	104 (15)
Endocrine therapy	483	229 (47)	47 (10)
Locoregional therapy	422	249 (59)	65 (15)
Other	33	18 (55)	7 (21)
Missing/unknown	176	110 (62)	24 (14)
Anti-COVID-19 treatment ^b			
None	2816	1048 (37)	222 (8)
Remdesivir	438	435 (99)	84 (19)
Hydroxychloroquine	829	796 (96)	238 (29)
Corticosteroids	708	634 (90)	158 (22)
Other	1166	1023 (88)	284 (24)
Missing/unknown	259	143 (55)	38 (15)

Country of patient residence			
U.S.	4739	2714 (57)	659 (14)
Outside U.S.	227	158 (70)	36 (16)
Month of COVID-19 diagnosis			
January-April	1927	1284 (67)	411 (21)
May-August	2508	1325 (53)	245 (10)
September-November	433	211 (49)	31 (7)
Missing/unknown	98	52 (53)	8 (8)

NOTE. Data presented as No. (%). The 'Missing/unknown' category indicates either missingness due to non-response for optional survey questions or a response of unknown; an unknown category was provided for all survey questions.

Abbreviations: ECOG, Eastern Cooperative Oncology Group

^a For patients younger than 18 years, age was truncated to 18 years; for patients older than 89 years, age was truncated to 90 years.

^b Counts could sum to more than 4966 (the total number of patients) because categories are not mutually exclusive.

^c Includes peritoneal cancers and germ cell tumors, which cannot be further resolved to one of the named categories.

^d Within 3 months of COVID-19 diagnosis.

Supplementary Table 5. Baseline Prognostic Factors Stratified by Levels of COVID-19 Severity^a Among Hospitalized Patients.

	Admitted to hospital (n=1675, 58%)	Admitted to ICU (n=232, 8%)	Received mechanical ventilation (n=292, 10%)	Died within 30 days (n=673, 23%)
Median age ^b , years (IQR)	69 (59-78)	66.5 (58-76)	66 (57-72.25)	75 (66-83)
Sex				
Female	832 (50)	109 (47)	111 (38)	271 (40)
Male	841 (50)	123 (53)	180 (62)	402 (60)
Missing/unknown	2 (<1)	0 (0)	1 (<1)	0 (0)
Race and ethnicity ^c				
Non-Hispanic white	802 (48)	116 (50)	125 (43)	328 (49)
Non-Hispanic black	389 (23)	51 (22)	76 (26)	181 (27)
Hispanic	239 (14)	27 (12)	46 (16)	78 (12)
Other	211 (13)	36 (16)	38 (13)	74 (11)
Missing/unknown	34 (2)	2 (1)	7 (2)	12 (2)
Smoking status				
Never	842 (50)	105 (45)	154 (53)	255 (38)
Ever	768 (46)	113 (49)	126 (43)	379 (56)
Missing/unknown	65 (4)	14 (6)	12 (4)	39 (6)
Obesity status				
Not obese	1125 (67)	148 (64)	165 (57)	471 (70)
Obese	538 (32)	82 (35)	125 (43)	199 (30)
Missing/unknown	12 (1)	2 (1)	2 (1)	3 (<1)
Comorbidities ^c				
Cardiovascular	629 (38)	96 (41)	110 (38)	340 (51)
Pulmonary	414 (25)	65 (28)	67 (23)	216 (32)
Renal disease	331 (20)	49 (21)	63 (22)	201 (30)
Diabetes mellitus	540 (32)	82 (35)	113 (39)	259 (38)
Missing/unknown	15 (1)	2 (1)	4 (1)	5 (1)
ECOG performance status				
0	476 (28)	65 (28)	96 (33)	88 (13)
1	490 (29)	62 (27)	79 (27)	163 (24)
≥2	328 (20)	50 (22)	35 (12)	262 (39)
Unknown	378 (23)	54 (23)	80 (27)	159 (24)
Missing	3 (<1)	1 (<1)	2 (1)	1 (<1)
Type of malignancy ^c				
Solid tumor	1361 (81)	167 (72)	213 (73)	519 (77)
Hematological neoplasm	368 (22)	74 (32)	91 (31)	184 (27)
Cancer status				
Remission	831 (50)	125 (54)	148 (51)	262 (39)
Active and responding	194 (12)	17 (7)	27 (9)	55 (8)
Active and stable	275 (16)	38 (16)	48 (16)	106 (16)
Active and progressing	243 (15)	23 (10)	32 (11)	154 (23)
Unknown	129 (8)	29 (12)	34 (12)	91 (14)
Missing	3 (<1)	0 (0)	3 (1)	5 (1)
Timing of anti-cancer therapy				
Never treated	144 (9)	21 (9)	26 (9)	61 (9)
0-4 weeks	530 (32)	66 (28)	96 (33)	215 (32)
1-3 months	130 (8)	14 (6)	15 (5)	72 (11)
>3 months	793 (47)	113 (49)	137 (47)	281 (42)

Missing/unknown	78 (5)	18 (8)	18 (6)	44 (7)
Modality of active anti-cancer therapy ^{c,d}				
None	953 (57)	142 (61)	167 (57)	363 (54)
Cytotoxic chemotherapy	293 (17)	29 (12)	31 (11)	138 (21)
Immunotherapy	75 (4)	15 (6)	11 (4)	36 (5)
Targeted therapy	243 (15)	34 (15)	48 (16)	101 (15)
Endocrine therapy	149 (9)	11 (5)	24 (8)	45 (7)
Locoregional therapy	140 (8)	20 (9)	24 (8)	65 (10)
Other	9 (1)	0 (0)	2 (1)	7 (1)
Missing/unknown	63 (4)	10 (4)	14 (5)	23 (3)
Anti-COVID-19 treatment ^c				
None	744 (44)	54 (23)	44 (15)	222 (33)
Remdesivir	210 (13)	72 (31)	69 (24)	84 (12)
Hydroxychloroquine	380 (23)	57 (25)	122 (42)	237 (35)
Corticosteroids	281 (17)	92 (40)	104 (36)	157 (23)
Other	465 (28)	100 (43)	175 (60)	283 (42)
Missing/unknown	84 (5)	11 (5)	14 (5)	34 (5)
Country of patient residence				
U.S.	1573 (94)	221 (95)	282 (97)	638 (95)
Outside U.S.	102 (6)	11 (5)	10 (3)	35 (5)
Month of COVID-19 diagnosis				
January-April	651 (39)	75 (32)	163 (56)	395 (59)
May-August	842 (50)	129 (56)	115 (39)	239 (36)
September-November	148 (9)	26 (11)	6 (2)	31 (5)
Missing/unknown	34 (2)	2 (1)	8 (3)	8 (1)
Absolute lymphocyte count				
Low	746 (45)	119 (51)	163 (56)	374 (56)
Normal	597 (36)	69 (30)	72 (25)	153 (23)
High	24 (1)	6 (3)	13 (4)	31 (5)
Missing/unknown	308 (18)	38 (16)	44 (15)	115 (17)
Absolute neutrophil count				
Low	130 (8)	17 (7)	15 (5)	55 (8)
Normal	1048 (63)	145 (62)	186 (64)	360 (53)
High	208 (12)	43 (19)	59 (20)	164 (24)
Missing/unknown	289 (17)	27 (12)	32 (11)	94 (14)
Platelet count				
Low	376 (22)	51 (22)	86 (29)	220 (33)
Normal	994 (59)	148 (64)	168 (58)	365 (54)
High	78 (5)	8 (3)	10 (3)	23 (3)
Missing/unknown	227 (14)	25 (11)	28 (10)	65 (10)
Creatinine				
Normal	940 (56)	131 (56)	150 (51)	277 (41)
Abnormal	513 (31)	78 (34)	121 (41)	337 (50)
Missing/unknown	222 (13)	23 (10)	21 (7)	59 (9)
D-dimer				
Normal	164 (10)	17 (7)	31 (11)	24 (4)
Abnormal	695 (41)	125 (54)	164 (56)	337 (50)
Missing/unknown	816 (49)	90 (39)	97 (33)	312 (46)
Troponin				
Normal	599 (36)	89 (38)	110 (38)	185 (27)
Abnormal	243 (15)	49 (21)	80 (27)	236 (35)
Missing/unknown	833 (50)	94 (41)	102 (35)	252 (37)
Lactate dehydrogenase				

Normal	250 (15)	25 (11)	35 (12)	48 (7)
Abnormal	569 (34)	98 (42)	155 (53)	306 (45)
Missing/unknown	856 (51)	109 (47)	102 (35)	319 (47)
C-reactive protein				
Normal	103 (6)	10 (4)	8 (3)	16 (2)
Abnormal	768 (46)	133 (57)	185 (63)	348 (52)
Missing/unknown	804 (48)	89 (38)	99 (34)	309 (46)

NOTE. Data presented as No. (%) unless otherwise indicated. The ‘Missing/unknown’ category indicates either missingness due to non-response for optional survey questions or a response of unknown; an unknown category was provided for all survey questions.

Abbreviations: ECOG, Eastern Cooperative Oncology Group; ICU, intensive care unit; IQR, interquartile range.

^a Five-level ordinal scale based on a patient’s most severe reported disease status. For example, patients who were admitted to the intensive care unit without mechanical ventilation and did not die within 30 days of COVID-19 diagnosis are classified as “admitted to intensive care unit,” while patients who were admitted to the intensive care unit with mechanical ventilation and did not die within 30 days of COVID-19 diagnosis are classified as “received mechanical ventilation.”

^b For patients younger than 18 years, age was truncated to 18 years; for patients older than 89 years, age was truncated to 90 years.

^c Percentages could sum to >100% because categories are not mutually exclusive.

^d Within 3 months of COVID-19 diagnosis.

Supplementary Table 6. Adjusted Associations of Baseline Prognostic Factors, Including Anti-COVID-19 Treatments, with COVID-19 Severity Among All Patients.

	COVID-19 Severity OR ^a (95% CI)
Age, per decade ^b	
Age<40 years	0.85 (0.66 – 1.08)
Age>40 years	1.36 (1.29 – 1.44)
Sex, male vs. female	1.31 (1.16 – 1.47)
Race and ethnicity, vs. non-Hispanic white	
Non-Hispanic black	1.48 (1.28 – 1.72)
Hispanic	1.35 (1.13 – 1.61)
Other	1.24 (1.01 – 1.51)
Smoking status, ever vs. never	1.04 (0.92 – 1.18)
Obesity status, obese vs. not obese	1.02 (0.90 – 1.16)
Cardiovascular comorbidities, yes vs. no	1.42 (1.24 – 1.62)
Pulmonary comorbidities, yes vs. no	1.22 (1.06 – 1.41)
Renal disease, yes vs. no	1.37 (1.18 – 1.61)
Diabetes mellitus, yes vs. no	1.37 (1.20 – 1.56)
ECOG performance status, vs. 0	
1	1.34 (1.15 – 1.56)
≥2	4.14 (3.44 – 4.99)
Unknown	1.58 (1.34 – 1.86)
Type of malignancy, vs. solid tumor	
Hematological neoplasm	1.35 (1.15 – 1.60)
Multiple ^c	1.22 (1.01 – 1.46)
Cancer status, vs. remission or no evidence of disease	
Active and responding	0.84 (0.67 – 1.05)
Active and stable	1.03 (0.85 – 1.24)
Active and progressing	2.17 (1.76 – 2.66)
Unknown	1.80 (1.44 – 2.26)
Timing of anti-cancer therapy, vs. >3 months	
Never treated	1.07 (0.83 – 1.36)
0-4 weeks	1.07 (0.81 – 1.42)
1-3 months	1.23 (0.89 – 1.70)
Modality of active anti-cancer therapy ^d	
Cytotoxic chemotherapy, yes vs. no	1.31 (1.06 – 1.62)
Immunotherapy, yes vs. no	0.80 (0.59 – 1.10)
Targeted therapy, yes vs. no	1.03 (0.81 – 1.30)
Endocrine therapy, yes vs. no	0.74 (0.56 – 0.97)
Locoregional therapy, yes vs. no	0.97 (0.76 – 1.25)
Other, yes vs. no	0.92 (0.43 – 1.98)
Anti-COVID-19 treatment	
Remdesivir, yes vs. no	3.75 (3.05 – 4.62)
HCQ alone, yes vs. no	4.54 (3.59 – 5.73)

Corticosteroids alone, yes vs. no	2.89 (2.38 – 3.51)
Other alone, yes vs. no	2.64 (2.22 – 3.15)
HCQ + corticosteroids, yes vs. no	6.31 (4.57 – 8.71) ^e
HCQ + other, yes vs. no	8.04 (6.51 – 9.94) ^e
Country of residence, U.S. vs. outside U.S.	1.15 (0.85 – 1.55)
Month of COVID-19 diagnosis, vs. January-April	
May-August	0.61 (0.54 – 0.70)
September-November	0.36 (0.28 – 0.45)

NOTE. Models include all variables listed.

Abbreviations: CI, confidence interval; ECOG, Eastern Cooperative Oncology Group; HCQ, hydroxychloroquine; OR, odds ratio.

^a Odds ratios greater than 1 indicate higher COVID-19 severity.

^b Obtained from a linear regression spline with a knot at age 40 years, such that odds ratios for ‘Age<40 years’ correspond to the per-decade difference in age for ages less than 40 years and odds ratios for ‘Age>40 years’ correspond to the per-decade difference in age for ages greater than 40 years.

^c Includes two or more solid tumors or hematological neoplasms.

^d Within 3 months of COVID-19 diagnosis.

^e Interaction P<0.001 (2 degrees of freedom).

Supplementary Table 7. Adjusted Odds Ratios for COVID-19 Severity by Modality of Active Anti-cancer Therapy and Timing of Anti-cancer Therapy.

Modality	Treated with modality, n	Not treated with modality, n	OR ^a (95% CI)	P value ^b
Cytotoxic chemotherapy				0.54
0-4 weeks	647	961	1.29 (1.00 – 1.65)	
1-3 months	155	220	1.52 (0.96 – 2.41)	
Immunotherapy				0.33
0-4 weeks	209	1399	0.86 (0.61 – 1.21)	
1-3 months	39	336	0.58 (0.28 – 1.19)	
Targeted therapy				0.85
0-4 weeks	593	1015	1.01 (0.78 – 1.31)	
1-3 months	100	275	1.07 (0.62 – 1.85)	
Endocrine therapy				0.38
0-4 weeks	426	1182	0.79 (0.58 – 1.06)	
1-3 months	57	318	0.56 (0.28 – 1.11)	
Locoregional therapy				0.18
0-4 weeks	270	1338	1.08 (0.81 – 1.43)	
1-3 months	152	223	0.72 (0.43 – 1.20)	

NOTE. Adjusted for age, sex, race/ethnicity, smoking status, obesity, comorbidities, Eastern Cooperative Oncology Group performance status, type of malignancy, cancer status, country of patient residence, and month of COVID-19 diagnosis.

Abbreviations: CI, confidence interval; OR, odds ratio.

^a Odds ratio comparing COVID-19 severity by modality of active anti-cancer therapy (yes vs. no) within time periods.

^b P value for evaluating the null hypothesis of equality in odds ratios between time periods.

Supplementary Table 8. Adjusted Associations of Baseline Prognostic Factors and Laboratory Measurements with COVID-19 Severity and 30-day All-cause Mortality Among Hospitalized Patients.

	COVID-19 Severity OR ^a (95% CI)	30-day Mortality OR ^b (95% CI)
Age, per decade ^c		
Age<40 years	0.78 (0.54 – 1.14)	0.68 (0.37 – 1.24)
Age>40 years	1.17 (1.09 – 1.26)	1.62 (1.47 – 1.78)
Sex, male vs. female	1.22 (1.04 – 1.43)	1.22 (1.00 – 1.49)
Race and ethnicity, vs. non-Hispanic white		
Non-Hispanic black	1.15 (0.94 – 1.39)	1.26 (0.99 – 1.61)
Hispanic	1.11 (0.86 – 1.42)	1.22 (0.88 – 1.70)
Other	1.07 (0.83 – 1.40)	0.89 (0.63 – 1.27)
Type of malignancy, vs. solid tumor		
Hematological neoplasm	1.38 (1.11 – 1.71)	1.18 (0.89 – 1.57)
Multiple ^d	1.20 (0.95 – 1.53)	1.19 (0.89 – 1.58)
Cancer status, vs. remission or no evidence of disease		
Active and responding	0.80 (0.58 – 1.10)	0.96 (0.65 – 1.44)
Active and stable	1.02 (0.80 – 1.30)	1.21 (0.89 – 1.64)
Active and progressing	1.68 (1.31 – 2.15)	2.84 (2.11 – 3.83)
Unknown	2.16 (1.64 – 2.84)	2.41 (1.71 – 3.39)
Modality of active anti-cancer therapy ^e		
Cytotoxic chemotherapy, yes vs. no	1.04 (0.82 – 1.32)	1.50 (1.12 – 1.99)
Immunotherapy, yes vs. no	1.25 (0.86 – 1.82)	1.13 (0.71 – 1.80)
Targeted therapy, yes vs. no	0.92 (0.71 – 1.19)	0.89 (0.65 – 1.22)
Endocrine therapy, yes vs. no	0.86 (0.63 – 1.16)	0.78 (0.53 – 1.14)
Locoregional therapy, yes vs. no	1.27 (0.95 – 1.69)	1.35 (0.94 – 1.93)
Other, yes vs. no	1.69 (0.63 – 4.55)	2.21 (0.69 – 7.08)
Country of residence, U.S. vs. outside U.S.	0.91 (0.61 – 1.36)	1.10 (0.67 – 1.82)
Month of COVID-19 diagnosis, vs. January-April		
May-August	0.59 (0.50 – 0.70)	0.53 (0.43 – 0.65)
September-November	0.43 (0.31 – 0.60)	0.41 (0.26 – 0.64)
Absolute lymphocyte count, vs. normal		
High	2.37 (1.48 – 3.82)	2.20 (1.25 – 3.88)
Low	1.48 (1.22 – 1.78)	1.43 (1.13 – 1.80)
Absolute neutrophil count, vs. normal		
High	1.66 (1.34 – 2.05)	1.75 (1.35 – 2.27)
Low	0.81 (0.59 – 1.11)	0.98 (0.66 – 1.45)
Platelet count, vs. normal		
High	0.65 (0.42 – 1.00)	0.77 (0.45 – 1.33)
Low	1.32 (1.09 – 1.60)	1.34 (1.06 – 1.70)
Creatinine, normal vs. abnormal	1.52 (1.28 – 1.80)	1.66 (1.34 – 2.05)
D-dimer, normal vs. abnormal	1.24 (0.93 – 1.66)	1.44 (0.96 – 2.14)
Troponin, normal vs. abnormal	1.78 (1.45 – 2.19)	1.74 (1.33 – 2.28)

Lactate dehydrogenase, normal vs. abnormal	1.61 (1.25 – 2.08)	1.69 (1.18 – 2.44)
C-reactive protein, normal vs. abnormal	1.73 (1.21 – 2.47)	1.62 (0.97 – 2.71)

NOTE. Models for COVID-19 severity and 30-day all-cause mortality are adjusted for all variables listed.

Abbreviations: CI, confidence interval; OR, odds ratio.

^a Odds ratios greater than 1 indicate higher COVID-19 severity.

^b Odds ratios greater than 1 indicate higher odds of 30-day all-cause mortality.

^c Obtained from a linear regression spline with a knot at age 40 years, such that odds ratios for ‘Age<40 years’ correspond to the per-decade difference in age for ages less than 40 years and odds ratios for ‘Age>40 years’ correspond to the per-decade difference in age for ages greater than 40 years.

^d Includes two or more solid tumors or hematological neoplasms.

^e Within 3 months of COVID-19 diagnosis.

Supplementary Table 9. Summary of the Most Prevalent Anti-cancer Therapies and Associated 30-day All-cause Mortality (Tabular Format of Figure 2).

Drug exposure	30-day all-cause mortality, n/exposed (%)	Regimen exposure	30-day all-cause mortality, n/exposed (%)
DNMTi	8/22 (36)	DNMTi monotherapy	6/12 (50)
Ifosfamide	5/15 (33)	R-CHOP-like	8/22 (36)
Abraxane	6/19 (32)	Carbo/Cis-Etop	3/10 (30)
CD20 antibody	26/95 (27)	NSAA & ADT	11/40 (28)
Pemetrexed	7/26 (27)	NSAA monotherapy	3/11 (27)
Hydroxyurea	6/23 (26)	JAKi monotherapy	4/15 (27)
Etoposide	10/41 (24)	Aromatase inhibitor & CDK4/6i	3/12 (25)
NSAA	15/62 (24)	Chemo-IO	3/12 (25)
JAKi	5/21 (24)	Fluoropyrimidine monotherapy	6/26 (23)
BTKi	8/35 (23)	BTKi monotherapy	7/32 (22)
Cisplatin/Carboplatin	35/155 (23)	EGFRi monotherapy	3/14 (21)
Abiraterone	6/28 (21)	Hydroxyurea monotherapy	4/20 (20)
Gemcitabine	8/38 (21)	IMiD-Dex	3/15 (20)
EGFRi	3/15 (20)	Bevacizumab monotherapy	2/11 (18)
Venetoclax	5/25 (20)	TCHP	2/11 (18)
Vinca alkaloid	14/74 (19)	Abiraterone & ADT	3/17 (18)
ADT/OFS	28/157 (18)	Taxane monotherapy	4/23 (17)
Taxane	26/149 (17)	CD20 antibody monotherapy	4/24 (17)
Cyclophosphamide	20/116 (17)	PD-1/PD-L1 antibody monotherapy	20/135 (15)
Corticosteroids	26/152 (17)	ADT/OFS monotherapy	7/48 (15)
Bevacizumab	8/47 (17)	Gem-Cis/Carbo	2/15 (13)
Fluoropyrimidine	19/120 (16)	BCR-ABLi monotherapy	6/46 (13)
PD-1/PD-L1 antibody	33/213 (15)	FOLFOX-like	3/25 (12)
Proteasome inhibitor	11/71 (15)	IMiD monotherapy	4/35 (11)
BRAF _i	2/13 (15)	CTLA-4 antibody & PD-1/PD-L1 antibody	2/19 (11)
Folinic acid	10/65 (15)	FOLFIRI-like	1/10 (10)

Anthracycline	17/117 (15)	Carboplatin/Cisplatin & Taxane	3/31 (10)
Irinotecan	5/35 (14)	VEGFRi monotherapy	1/11 (9)
Oxaliplatin	8/56 (14)	Temozolomide monotherapy	1/11 (9)
Daratumumab	4/29 (14)	RVD-like	2/26 (8)
BCR-ABLi	7/56 (12)	PARPi monotherapy	1/14 (7)
CDK4/6i	4/34 (12)	Cisplatin/Carboplatin monotherapy	1/14 (7)
PARPi	2/17 (12)	Trastuzumab monotherapy	1/16 (6)
Cytarabine	2/18 (11)	Tamoxifen monotherapy	4/68 (6)
Methotrexate	3/29 (10)	Aromatase inhibitor monotherapy	7/130 (5)
IMiD	11/108 (10)	AC-T-like	0/17 (0)
Bleomycin	1/10 (10)	AI + OFS	0/12 (0)
Trastuzumab	5/53 (9)	Somatostatin analog monotherapy	0/12 (0)
EGFR antibody	1/11 (9)	Fulvestrant & CDK4/6i	0/10 (0)
CTLA-4 antibody	2/25 (8)	Dara-IMiD-Dex	0/10 (0)
MEKi	1/13 (8)		
Pertuzumab	2/26 (8)		
Fulvestrant	1/15 (7)		
Temozolomide	1/16 (6)		
Aromatase inhibitor	10/170 (6)		
Tamoxifen	4/74 (5)		
VEGFRi	1/19 (5)		
Brentuximab vedotin	0/10 (0)		
ERBB2i	0/10 (0)		
Everolimus	0/11 (0)		
Somatostatin analog	0/16 (0)		
