# **Supplementary Table S1: Studies comparing outcomes among SARS-COV-2 infected patients with cancer and those without cancer.**

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| **Publication Date** | **Study Timeline** | **Patients Cohort**  | **Sample Size**  | **Cancer Types** | **Main Findings** | **Notes** | **Journal** | **DOI/Article Link** | **Citations** |
| 12/10/2020 | Until Aug 14, 2020 | Across 50 US states | EHR of 73.4 million patients from 360 hospitals & 317000 clinicians. 2523920 had at least 1 of 13 cancers (diagnosed within last year). Among 16570 COVID-19 patients, 1200 had cancer (690 diagnosed within last year) | Any | Recently diagnosed cancer patients were at significant risk for COVID-19 (adjusted odds ratio-AOR, 7.14). Strongest aOR was observed for leukemia (12.16), lymphoma (8.54) and lung cancer (7.99) patients. COVID-19 patients with cancer exhibited significantly high mortality compared to those without cancer (14.93% & 5.26%, respectively; p < 0.001) and compared to cancer patients without COVID-19 (4.03%; p<0.001). Study also identifies African American cancer patients at higher risk for COVID-19 compared to White cancer patients. | **Strength:** Even after adjusting for COVID-19 risk factors, cancer patients showed increased risk of SARS-CoV2 infection and death from COVID-19. **Limitations:** EHR variability can over-represent or under-represent certain aspects/findings of the study. Authors also acknowledge that COVID-19 infection rates in the US are much higher that are represented in this study, likely because COVID-19 testing done at drive-up/pop-up sites may not be captured by EHR diagnostic codes.  | JAMA Oncology | [10.1001/jamaoncol.2020.6178](https://jamanetwork.com/journals/jamaoncology/fullarticle/2773500) {Wang, 2020 #6970} | 0 |
| 11/20/2020 | Mar 1-May 31 2020 | Data from EHR of the University College London Hospitals NHS Foundation Trust | 94 COVID-19 patients with cancer (median age: 71 years). 226 age- and sex matched patients with COVID-19 without cancer (median age: 70.5 years) | Solid tumors | All-cause mortality was higher in the cancer vs non-cancer cohort (44% vs 34%). A multivariate survival analysis was performed to evaluate the independent contribution of cancer to mortality risk following SARS-CoV-2 infection, adjusting for age, ethnicity, and co-morbidities which were significant in the univariate analysis. A history of cancer was an independent risk factor for mortality (HR 1.57). Active cancer (defined as a cancer diagnosis or anti-cancer treatment within the last 12 months or radiological or biochemical evidence of active or recurrent cancer) was associated with a similar risk for mortality (HR 1.64). Patients with primary thoracic malignancies did not have an increased risk of COVID-19 mortality compared to all cancers. | **Strength**: The cohort design allowed for a direct comparison of COVID-19 patients with cancer to a matched group of patients without cancer at a single institution. **Of Note:** The mortality rates for both cancer (44%) and non-cancer (34%) patients reported here are much higher than what has been reported by the UKCCMP (28%) or CCC19 (13%). It is possible that SES or racial/ethnic composition of this cohort (~50% non-white) could explain the high death rate. | Frontiers in Oncology | [10.3389/fonc.2020.595804](https://www.frontiersin.org/articles/10.3389/fonc.2020.595804/full) {Sng, 2020 #6971} | 0 |
| 11/9/2020 | Until Sep 1 2020 | EHR data collected by the IBM Watson Health Explorys (from 360hospitals and 317,000 providers across the 50 states of U.S.) | 17,130 diagnosed with COVID-19; 420 with both COVID-19 and hematological cancer | Hematological cancers | After adjusting for age, race, gender and comorbidities, patients with hematologic malignancies had increased odds of COVID-19 infection compared with patients without hematologic malignancies for both all-time diagnosis (malignancy diagnosed in the past year or prior) (adjusted Odds Ratio: 2.27) and recent diagnosis (malignancy diagnosed in the past year) (AOR: 11.91). After adjusting for the same variables as before, COVID-19 patients with recently diagnosed hematological cancer had significantly worse outcomes (death rate: 15%) than COVID-19 patients without hematological cancer (death rate: 5%) and hematologic malignancy patients without COVID-19 (death rate: 4%). | **Strength**: Since they used EHR data the cohort represents a nationwide sample. **Limitations:** They do not report the mortality rates for COVID-19 patients with an all-time diagnosis of hematological cancers. From supplemental figure 3 which is stratified by race it looks like this value is about 13%while mortality in COVID-19 patients with no hematological cancer or all-time hematological cancer patients with no COVID-19 are significantly less. | Blood Reviews | [10.1016/j.blre.2020.100775](https://www.sciencedirect.com/science/article/pii/S0268960X20301259?via%3Dihub) {Wang, 2020 #6972} | 0 |
| 11/7/2020 | Mar 16-Aug- 31 2020 | Lean European Open Survey on SARS-CoV-2 Infected Patients (LEOSS) registry; Germany | Retrospective analysis of a cohort of 435 cancer patients and 2636 non-cancer patients with confirmed COVID-19 | Any |  Mortality attributed to COVID-19 was significantly higher in cancer patients compared with non-cancer patients (14% vs 22.5%) (mortality was comparable for patients with solid tumors and hematological cancer). however, after adjusting for age, sex, and comorbidity there was no difference in overall mortality between cancer and non-cancer patients. Of note, most patients in this study were hospitalized; the most common age category was 76–85; | Unlike data published in the earlier phase of the pandemic, both mortality and survival of cancer and non-cancer patients were comparable after adjustments for age, sex, and comorbidity. Could be because care for the severely ill patients have improved over the course of the past 9 months. **Of note:** This study is from Germany which has done extremely well in terms of mortality/survival throughout the course of the pandemic (has one of the lowest mortality rates of all countries). | Annals of Hematology | [10.1007/s00277-020-04328-4](https://link.springer.com/article/10.1007/s00277-020-04328-4) {Rüthrich, 2020 #6973} | 0 |
| 10/28/2020 | Mar 1-Apr 30, 2020 | USA/Ochsner Health System in the state of Louisiana | COVID-19+ Cancer+ (312); COVID-19+Cancer-(4833) | Any | In this retrospective observational analysis, a direct comparison of patients with and without cancer who were infected with SARS-CoV-2 showed that all-cause mortality was significantly higher among patients with cancer (21% vs 8.7%; in a multivariate analysis OR was 2.03 when adjusted for demographics and comorbidities). Hospitalized patients with cancer, however, have similar mortality risk once admitted. Patients with hematological cancers were shown to have significantly increased mortality when compared with patients with solid tumors (31.1% vs 18.7%; OR, 2.25). Those with a recent diagnosis (<1 yr. ago) were more likely to die than those with a distant history (10-15 yrs. ago) of cancer (32.8% vs 12%).  | **Strength:** The authors claim that this is the largest and at the time of publication the only multivariate study evaluating the difference in mortality from coronavirus disease 2019 (COVID-19) between patients with cancer and patients without cancer in the United States. | Cancer  | [10.1002/cncr.33243](https://acsjournals.onlinelibrary.wiley.com/doi/10.1002/cncr.33243) {Lunski, 2020 #6974} | 0 |
| 9/28/2020 | Mar 3-May 15, 2020  |  Adult patients who were COVID-19 positive and were admitted to two NY hospitals | 585 COVID-19 patients of whom 117 had active malignancy and 468 were matched controls without cancer (median age: 71 years) | Any | This retrospective observational study found no differences in death and composite outcome (death, intubation, or ICU admission) among COVID-19 patients with or without cancer. In addition, there were no differences in composite outcome between hematologic and solid cancers in terms of ICU admissions, intubation, or death. In the multivariate analysis none of the known comorbidities (COPD, hypertension, obesity) were associated with higher mortality. | **Limitations:** The non-cancer patients have a much higher mortality rate (21.4%) compared with other reports. That maybe the reason why there aren’t any differences between the two groups. Also, all patients are hospitalized. It is possible (as reported in other studies) once hospitalized the course of disease is similar among COVID-19 patients with and without cancer. The median age (71 years) is higher than most other reports.  | Journal of Clinical Oncology | [10.1200/JCO.20.01580](https://ascopubs.org/doi/full/10.1200/JCO.20.01580) {Brar, 2020 #6975} | 0 |
| 9/10/2020 | Mar 1-Mar 31, 2020  | Lombardy, Italy | COVID-19+ Hematological cancer Patients (102; mean age 68.3); COVID-19– Hematological cancer Patients (101; mean age 68.7); COVID-19+ Non-hematological Patients (102; mean age 68.5) | Hematological cancers | This retrospective study reports mortality of 39.2% among COVID-19 patients with hematological cancers and 3% among matched uninfected hematological controls 30 days after the documentation of SARS-CoV-2 (P < .001). The cause of death was attributable to COVID-19 in all cases. The mortality of patients with COVID-19 who did not have cancer was 23.5%; p=0.02, which was significantly lower than the mortality rate of hematological cancer patients with COVID-19 when they were matched for sex, age, comorbidities, and respiratory failure at presentation. |   | Cancer | [10.1002/cncr.33160](https://acsjournals.onlinelibrary.wiley.com/doi/full/10.1002/cncr.33160){Cattaneo, 2020 #6976} | 7 |
| 7/8/2020 | Feb 1-May 6, 2020 | UK | 17,278,392 adults | Any | COVID-19 patients with a recent (<5 years) history of hematological cancer had a ≥2.5-fold increased risk of death (HR 2.80 for those diagnosed <1 year ago; HR 2.46 for those diagnosed 1-4.9 years ago); risks decreased slightly after 5 years (HR 1.61 for those diagnosed >5 years ago). For COVID-19 patients with non-hematological cancers, increased risks of death were smaller and mainly with recent diagnoses (HR 1.72 for those diagnosed < 1 year ago; HR 1.15 for those diagnosed 1-4.9 years ago). HRs were calculated using a multivariate model which adjusted for age, sex, BMI, and several comorbidities. | **Strength:** Compared risk of death from COVID-19 in cancer patients with those without a history of cancer. Of note, this study reports percentage of COVID-19 deaths among the general population rather than in a population infected with SARS-COV-2. Therefore, all patients were included irrespective of any SARS-COV-2test results and there is no analysis of case fatality rates. | Nature | [10.1038/s41586-020-2521-4](https://www.nature.com/articles/s41586-020-2521-4) {Williamson, 2020 #6977} | 126 |
| 6/10/2020 | Jan 18-Mar 27 2020 | Tongji Hospital, a designated hospital for severe COVID-19 patients in Wuhan, China.  | 109 COVID-19 patients with cancer; 327 matched controls (COVID-19 patients without cancer); (median age for patients with cancer and noncancer controls are 61.7 yrs. and 57.9 yrs., respectively) | Any | The retrospective analysis showed that COVID-19 patients with cancer exhibited a significant increase in mortality rate (29.4% vs. 10.2%, P < 0.0001). Furthermore, the clinical outcomes of patients with hematological cancers were worse, with a mortality rate twice that of patients with solid tumors (50% vs. 26.1%). A propensity score matched analysis demonstrated that cancer patients have a higher risk of mortality than the matched noncancer patients (OR 2.98);  | **Strength**: Outcomes for COVID-19 patients with cancer are compared with those without cancer from the same healthcare system | Journal of Hematology & Oncology | [10.1186/s13045-020-00907-0](https://jhoonline.biomedcentral.com/articles/10.1186/s13045-020-00907-0) {Meng, 2020 #6979} | 10 |
| 5/29/2020 | Jan 13-Mar 18 2020 | Nine hospitals in Wuhan, China | 232 COVID-19 patients with cancer and 519 statistically matched patients without cancer (median age, 64) | Any | In this multicenter, retrospective, cohort study, mortality was higher among patients with COVID-19 and cancer vs patients with COVID-19 without cancer (20% vs 11%). Patients with cancer were more likely to have severe COVID-19 than patients without cancer (odds ratio, 3·61) (patients without cancer were statistically matched to those with cancer, which helped to minimize the effects of common confounders such as age, sex, and other comorbidities on the severity of COVID-19).  | **Limitations:** They do not present any adjusted HR, RR, or OR for a comparison of mortality risks in COVID-19 patients with cancer vs those without cancer. | Lancet Oncology | [10.1016/S1470-2045(20)30309-0](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045%2820%2930309-0/fulltext) {Tian, 2020 #6962} | 41 |
| 5/1/2020 | Mar 18-Apr 8 2020 | Montefiore Medical Center, NYC | 218 COVID-19 patients with a malignant diagnosis (median age of 69 years) | Any | The overall case fatality rate (CFR) among COVID-19 patients with cancer was 28%; 25% among patients with solid tumors and 37% among patients with hematological cancers. An age- and sex-matched cohort of 1,090 patients without cancer from the same time period and from the same hospital system was used as control to estimate the increased risk posed by cancer. CFR among these COVID-19 patients without cancer was 14% (OR: 2.45) and in New York, overall, was 6% (OR: 6.16). Older age was associated with increased mortality.  | **Limitations**: The cohort may be an especially vulnerable group and not representative of the overall cancer population. Many were either nursing-home or shelter residents, and/or admitted as an inpatient or presented to the emergency room within the 30 days prior to their COVID-19 positive test. The majority had a poor ECOG performance status and carried multiple comorbidities. They didn’t perform any multivariate analyses (COVID-19 patients with vs without cancer) to adjust for demographics or comorbidities | Cancer Discovery | [10.1158/2159-8290.CD-20-0516](https://cancerdiscovery.aacrjournals.org/content/10/7/935.article-info) {Mehta, 2020 #6980} | 104 |
| 4/28/2020 | Jan 1-Feb 24 2020 | 14 hospitals in Wuhan, China |  105 COVID-19 patients with Cancer and 536 age-matched non-cancer controls (median age: 64 years for COVID-19 patients with cancer) | Any | Compared with COVID-19 patients without cancer patients with cancer experienced more in-hospital infections [(19.04% vs. 1.49%); *P* < 0.01] Compared with COVID-19 patients without cancer patients with cancer had more severe disease as well as higher mortality (~5% vs 11.43%), even when adjusted for demographics and comorbidities (OR, 2.17; however, P = 0.06). Patients with hematological cancer (33%), lung cancer, and metastatic disease have relatively higher death rates. | **Strength**: Head to head comparison of outcomes among COVID-19 patients with cancer vs without cancer from the same hospital systems. **Limitations**: For some of the analyses (e.g. impact of treatments) the N is very low. This is one of the first case reports when physicians were just learning how to care for these patients and COVID-19 mortality was very high, globally. | Cancer Discovery | [10.1158/2159-8290.CD-20-0422](https://cancerdiscovery.aacrjournals.org/content/10/6/783.article-info) {Dai, 2020 #6981} | 145 |
| 4/21/2020 | Mar 1-Apr 8 2020 | Mount Sinai Health System (MSHS) in New York City | 5688 patients with COVID-19, of whom 334 patients had cancer | Any | Without adjusting for age groups, patients with cancer were intubated significantly more frequently [relative risk, RR 1.89], but the rate of death was not significantly different. After stratifying patients by age groups, patients younger than 50years with cancer had a significantly higher mortality rate [RR 5.01]. However, the mortality rates of COVID-19 in cancer patients in age groups older than 50 years,were not statistically different. | **Limitations:** The overall COVID-19 mortality risk analysis in cancer vs non-cancer patients didn’t account for other variables such as sex, comorbidities. | Annals of Oncology | [10.1016/j.annonc.2020.04.006](https://www.annalsofoncology.org/article/S0923-7534%2820%2939303-0/fulltext) {Miyashita, 2020 #6982} | 55 |

Legend: COVID-19: Coronavirus Disease 2019; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; HER: Electronic Health Records; HR: Hazard Ratio; OR: Odds Ratio; AOR: Adjusted Odds Ratio; RR: Relative Risk; CFR: Case Fatality Rate; NHS: UK National Health Service; ONS: UK Office of National Statistics; UKCCMP: UK Coronavirus Cancer Monitoring Project; CCC19: COVID-19 and Cancer Consortium; LEOSS: Lean European Open Survey on SARS-CoV-2 Infected Patients; TERAVOLT: Thoracic Cancers international COVID-19 Collaboration registry; MSKCC: Memorial Sloan-Kettering Cancer Center; NSCLC: Non-Small Cell Lung Carcinoma; SCLC: Small Cell Lung Carcinoma. “Any” in the Cancer Type column denotes a combination of multiple solid tumors and/or hematological cancers.

# **Supplementary Table S2: Studies comparing outcomes among SARS-COV-2 infected patients with cancer and uninfected patients with cancer.**

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| **Publication Date** | **Study Timeline** | **Patients Cohort**  | **Sample Size** | **Cancer Types** | **Main Findings** | **Notes** | **Journal** | **DOI/Article Link** | **Citations** |
| 10/8/2020 | Until May 4, 2020 | Nationwide VA healthcare system | COVID-19+Cancer+ (n=1794); COVID-19-Cancer+(n=21120) | Any | The study compares outcomes of cancer patients with or without COVID-19. COVID-19 positivity in cancer patients was 7.8%. Positivity was higher for hematological cancers (10.9% vs 7.8%). attributable). Death rate was 14.0% in COVID-19 positive compared to 3.1% in COVID-19 negative cancer patients. COVID-19 attributable mortality, calculated as the difference between mortality among COVID-19+ cancer patients and COVID-19- cancer patients was, therefore, 10.9% overall, and 13.9% for hematological cancers.  | **Limitations:** The authors claim that the prevalence of COVID-19 in cancer patients is lower than in the general population, which contrasts with other studies. However, they do not show data on the % of COVID-19 positivity in overall VA population but cite CDC numbers (13.5%). 75% of their cohort is male which may skew the data. For mortality data, again, they claim that the rates are higher in COVID-19 infected cancer patients compared with overall COVID-19 population but cite other sources but not their own data. | Journal of National Cancer Institute | [10.1093/jnci/djaa159](https://academic.oup.com/jnci/advance-article/doi/10.1093/jnci/djaa159/5919590) {Fillmore, 2020 #6983} | 0 |
| 8/24/2020 | Mar 18-May 8 2020 | UK Coronavirus Cancer Monitoring Project(UKCCMP) | 1044 (median age: 70 years) | Any | The study compared outcomes of COVID-19 patients with cancer (UKCCMP) with cancer patients without COVID-19 [UK Office for National Statistics (ONS)]. The outcomes of interest were rate of infection and all-cause mortality (could be due to COVID-19 or from cancer or other causes) for both cohorts. Patients with hematological cancers appeared to be at significantly increased risk of COVID-19 infection since patients with leukemia, lymphoma, and myeloma were overrepresented in the UKCCMP cohort compared with ONS (OR = 2.8, 1.6, 2.03 respectively). 319 (30·6%) of 1044 patients in the UKCCMP cohort died. After a multivariable analysis (age and sex adjusted), compared with the rest of the UKCCMP cohort, patients with leukemia showed a significantly increased case–fatality rate (OR 2·25) compared with a reference group (cancers of digestive organs). | **Limitations:** The comparators for the various measures (COVID-19 prevalence and mortality) are different. For prevalence they are looking at the distribution of cancer types within UKCCMP vs ONS. However, for case fatality rates they compared each cancer type to a reference group (GI cancer) which had the median CFR. They do not show a direct comparison with cancer patients without COVID-19 (ONS) or COVID-19 patients without cancer which are the common comparators in other studies. The multivariable analysis did not adjust for comorbidities but only for age and sex. | The Lancet Oncology | [10.1016/S1470-2045(20)30442-3](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045%2820%2930442-3/fulltext) {Lee, 2020 #6991} | 0 |
| 8/14/2020 | Mar 8-Mar 31 2020 | MSKCC in NYC | 309 COVID-19 patients with cancer; 917 patients with cancer without COVID-19 | Any | Mortality rate was 10% for COVID-19 patients with cancer vs 6.2% for a time-matched cohort of cancer patients who tested negative for COVID-19. In a multivariable Cox regression analysis patient with hematological (HR: 2.1) and thoracic cancers (HR: 2.04) demonstrated a higher risk of severe or critical COVID-19.  | **Limitations:** There is no comparison with a non-cancer group of COVID-19 patients. They do not calculate the excess risk for mortality in hematological or lung cancer; HR are presented only for excess risk of severe or critical disease.  | Journal of Clinical Oncology | [10.1200/JCO.20.01307](https://ascopubs.org/doi/full/10.1200/JCO.20.01307) {Jee, 2020 #6984} | 4 |

Legend: COVID-19: Coronavirus Disease 2019; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; HER: Electronic Health Records; HR: Hazard Ratio; OR: Odds Ratio; AOR: Adjusted Odds Ratio; RR: Relative Risk; CFR: Case Fatality Rate; NHS: UK National Health Service; ONS: UK Office of National Statistics; UKCCMP: UK Coronavirus Cancer Monitoring Project; CCC19: COVID-19 and Cancer Consortium; LEOSS: Lean European Open Survey on SARS-CoV-2 Infected Patients; TERAVOLT: Thoracic Cancers international COVID-19 Collaboration registry; MSKCC: Memorial Sloan-Kettering Cancer Center; NSCLC: Non-Small Cell Lung Carcinoma; SCLC: Small Cell Lung Carcinoma. “Any” in the Cancer Type column denotes a combination of multiple solid tumors and/or hematological cancers.

# **Supplementary Table S3: Studies reporting outcomes among SARS-COV-2 infected patients with cancer without any comparison.**

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| **Publication Date** | **Study Timeline** | **Patients Cohort**  | **Sample Size** | **Cancer Types** | **Main Findings** | **Notes** | **Journal** | **DOI/Article Link** | **Citations**  |
| 7/31/2020 | Feb 26-Apr 1 2020 | 19 centers surveyed in the United Kingdom, Italy, Spain, and Germany | 890 patients with confirmed COVID-19 (mean age: 68) | Any | As of May 11, 2020, 33.6% of patients had died. There was a worsening gradient of mortality from breast cancer to hematological cancers; male gender, older age, and number of co-morbidities identified a subset of patients with significantly worse mortality rates from COVID-19. Multi variable regression models evaluating the relationship between patient characteristics and mortality from COVID-19 demonstrated a HR of 1.81 for patients with active malignancy (those who, at the time of COVID-19 diagnosis, presented with measurable oncologic disease defined by radiologic, clinical, and hematological criteria routinely employed for clinical monitoring of the reference tumor type) vs those in remission or NED. | **Limitations:** Does not have a non-cancer or non- COVID-19 group for comparison of mortality rates. | Cancer Discovery | [10.1158/2159-8290.CD-20-0773](https://cancerdiscovery.aacrjournals.org/content/10/10/1465) {Pinato, 2020 #6985} | 7 |
| 7/30/2020 | Mar 1- Apr 30 2020 | Five academic centers in New York City  | 100 (median age, 68) | Multiple myeloma | The authors reported a 22% mortality rate among multiple myeloma patients with COVID-19 and identified race/ethnicity as the most significant risk factor for severe outcome. There was a higher risk of adverse outcome (intensive care unit admission, mechanical ventilation, or death) in Hispanics/Latinos, OR = 4.7, and African American Blacks, OR = 3.5, as compared with White patients. | **Limitations:** There is no direct comparison with outcomes from COVID-19 patients without cancer. However, they mention that in New York during the study period the overall case fatality rate from COVID-19 was 6%.  | Blood Cancer Discovery | [10.1158/2643-3230.BCD-20-0102](https://bloodcancerdiscov.aacrjournals.org/content/1/3/234) {Hultcrantz, 2020 #6986} | 0 |
| 7/30/2020 | Mar 1-Apr 22 2020 | 6 NYC-area hospital systems | 121 patients with gynecologic cancer and COVID-19 (median age, 64 years) | Gynecologic cancers | Retrospective, observational study. The overall mortality among COVID-19 infected patients with gynecologic cancer was 14.0%, whereas mortality among hospitalized patients was 25.8%.  | **Limitations:** There is no comparison with outcomes from non-cancer patients. The authors do, however, refer to some relevant data from other studies and infer that patients with gynecologic cancer who have been hospitalized with COVID-19 have a risk of death similar to the age-specific mortality risk in the overall COVID-19 population | Cancer | [10.1002/cncr.33084](https://acsjournals.onlinelibrary.wiley.com/doi/10.1002/cncr.33084) {Lara, 2020 #6987} | 1 |
| 7/22/2020 | Mar 17 -Jun 26 2020 | USA obtained through CCC19 registry | 2186 adults with invasive cancer and confirmed COVID-19 | Any | The main purpose of this study was to determine the association of several treatments with COVID-19 outcomes. They did however report all-cause mortality among patients with cancer infected by the SARS-CoV-2 virus as 16%. | **Limitations:** Looked only at COVID-19 patients with cancer. No comparator. They mention in the discussion that similar to their first analysis and other smaller series, this CCC19 updated cohort confirms significantly higher all-cause mortality among patients with cancer infected by the SARS-CoV-2 virus (16%) compared with what is reported in the general population (2-7%). | Cancer Discovery  | [10.1158/2159-8290.CD-20-0941](https://cancerdiscovery.aacrjournals.org/content/10/10/1514) {Rivera, 2020 #6988} | 4 |
| 7/22/2020 | 29 Feb-12 May 2020 | Guy's Cancer Center London, UK | 156 cancer patients with a confirmed COVID-19 diagnosis; (median age: 67) | Any | The overall case fatality rate was 22%; 25% for hematological cancers and 21% for solid tumors (however, this difference wasn’t significant after multivariate analysis). Being of Asian ethnicity [HR, 3.73], having an initial cancer diagnosis >24 months before [HR, 2.14] were positively associated with COVID-19 death.  | **Limitations**: Represents one hospital only which serves a specific catchment area with a high prevalence of low SES patient population which may skew the findings. There was no comparison with COVID-19 patients without cancer or cancer patients without COVID-19. | Frontiers in Oncology | [10.3389/fonc.2020.01279](https://www.frontiersin.org/articles/10.3389/fonc.2020.01279/full) {Russell, 2020 #6989} | 0 |
| 6/12/2020 | Mar 26-Apr 12 2020 | 42 institutions across eight countries (Italy, Spain, France, Switzerland, Netherlands, USA, UK, and China (TERAVOLT registry) | 200 (median age: 68 years) | Any thoracic cancer NSCLC, SCLC, mesothelioma, thymic epithelial tumors, and other pulmonary neuroendocrine neoplasms | 33% of patients died. Deaths were attributed to complications from COVID-19 only (26%), cancer progression, complications from COVID-19 and cancer progression, complications from cancer therapy, and other reasons. Univariable analyses revealed that being older than 65 years (OR 1·88), being a current or former smoker (4·24), and the presence of any comorbidities (2·65) were associated with increased risk of death. However, in multivariable analysis, only smoking history (OR 3·18) was associated with increased risk of death | **Limitations:** There is no direct comparison with outcomes from COVID-19 patients without cancer or from cancer patients without COVID-19. While 134 (88%) out of the 152 hospitalized patients met criteria for ICU admission, only 13 (10%) were admitted to the ICU; it is possible that lack of standard care led to the high mortality in this cohort. | Lancet Oncology | [10.1016/S1470-2045(20)30314-4](https://www.thelancet.com/journals/lanonc/article/PIIS1470-2045%2820%2930314-4/fulltext) {Garassino, 2020 #6959} | 56 |
| 6/11/2020 | 10 Mar-Apr 7, 2020 | MSKCC in NYC | 423 (median age range: 60-69) | Any | The overall case fatality rate was 12%. In a multivariate analysis, the following risk factors were independently associated with hospitalization: non-white race, hematological cancer, a composite measure of chronic lymphopenia and/or corticosteroid use and treatment with ICI therapy.  | **Limitations:** Looked only at COVID-19 patients with cancer. No comparator. The risk analysis included predictors of hospitalization and severe respiratory illness but not deaths from COVID-19. hematological cancer patients showed higher odds of hospitalization (but not severe respiratory illness) but their risk of death is not presented. | Nature Medicine | [10.1038/s41591-020-0979-0](https://www.nature.com/articles/s41591-020-0979-0) {Robilotti, 2020 #6957} | 35 |
| 5/28/2020 | Mar 17 -Apr 16 2020 | USA, Canada, and Spain from the COVID-19 and Cancer Consortium (CCC19) registry | 928 (Median age, 66) | Any | Among COVID-19 patients with cancer the all-cause mortality rate was 13%. They didn’t really see a higher all-cause mortality among patients with hematological cancers compared with those with solid tumors but there was a higher prevalence of severe illness in these patients. Older age, male sex, and 2 or more comorbidities were associated with increased mortality.  | **Limitations:** Looked only at COVID-19 patients with cancer. No comparator (COVID-19 patients without cancer, or cancer patients without COVID-19). They mention in the discussion that this rate of mortality (13%) is higher than what has been reported in COVID-19 patients without cancer (<2%) in separate studies. | The Lancet | [10.1016/S0140-6736(20)31187-9](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2820%2931187-9/fulltext) {Kuderer, 2020 #6990} | 127 |
| 5/28/2020 |  Mar 18-Apr 26 2020 | Patients with active cancer and presenting with COVID-19 to a network of 55 cancer centers affiliated with UKCCMP | 800 (median age: 69 years) | Any  | 28% of patients died (all-cause mortality). Compared with the rest of the cancercohort, patients who died were significantly older (median 73·0 years vs 66·0 years), more were male and those who died also displayed higher rates of comorbidities compared with those who did not, including cardiovascular disease and hypertension.  | **Limitations:** The authors conclude that their data are strongly indicative that COVID-19 mortality in patients with cancer is principally driven by advanced age and the presence of other non-cancer comorbidities. However, there is no multivariate analysis of mortality risks in COVID-19 patients with cancer compared with patients without cancer. | The Lancet | [10.1016/S0140-6736(20)31173-9](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736%2820%2931173-9/fulltext) {Lee, 2020 #6958} | 85 |

Legend: COVID-19: Coronavirus Disease 2019; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; HER: Electronic Health Records; HR: Hazard Ratio; OR: Odds Ratio; AOR: Adjusted Odds Ratio; RR: Relative Risk; CFR: Case Fatality Rate; NHS: UK National Health Service; ONS: UK Office of National Statistics; UKCCMP: UK Coronavirus Cancer Monitoring Project; CCC19: COVID-19 and Cancer Consortium; LEOSS: Lean European Open Survey on SARS-CoV-2 Infected Patients; TERAVOLT: Thoracic Cancers international COVID-19 Collaboration registry; MSKCC: Memorial Sloan-Kettering Cancer Center; NSCLC: Non-Small Cell Lung Carcinoma; SCLC: Small Cell Lung Carcinoma. “Any” in the Cancer Type column denotes a combination of multiple solid tumors and/or hematological cancers.

# **Supplementary Table S4: A compilation of studies reporting metanalyses of published studies on COVID-19-cancer connection.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Publication Date** | **Study Timeline** | **Patients Cohort**  | **Sample Size** | **Cancer Types** | **Major Findings** | **Notes** | **Journal** | **DOI/Article Link** | **Citations** |
| 11/2/2020 | Until June 9, 2020 | The most common geographical region of residence was the UK and Europe (41.0%), followed by the USA and Canada (35.7%) and Asia (China, 23.3%) | Uses data from 15 cohort studies involving 3019 patients | Any | Overall case fatality rate (CFR) among COVID-19 patients with cancer was 22.4%; Analysis of three studies that reported CFR of both populations (COVID-19 patients with and without cancer) showed that CFR of COVID-19 patients with cancer (23.4%) was higher than those without cancer (5.9%); CFR of patients from China was similar to those from Europe and USA. The CFR for COVID-19 of 10 patients with lung cancer (32.9%) is comparable to that of those with hematological cancer (34.2%), while it is lower in other types of solid cancer. The occurrence of severe events including death in cancer patients with COVID-19 appears to be primarily accentuated by age, gender and co-existing comorbidities but not active treatments. | **Limitations:** They do not calculate the increased mortality risk in cancer vs non cancer patients with COVID-19. The impact of treatments and other individual characteristics on case fatality are derived from a very small sub population of the total data cohort.  | JNCI | [10.1093/jnci/djaa168](https://academic.oup.com/jnci/advance-article/doi/10.1093/jnci/djaa168/5951181) {Zhang, 2020 #6964} | 0 |
| 9/2/2020 | Up to July 16, 2020 | Fifty-two studies (mostly from U.S., UK, Europe, and Asia) were selected for the pooled analysis.  |  Analysis included a total of 18,650 patients with both COVID-19 and cancer | Any | Pooled case mortality rate among patients with cancer and COVID-19 was 25.6%. (I2 = 48.9%). A sensitivity analysis excluding reports with less than 100 patients showed an I2 = 49.7% for studies with > 100 patients |   | European Journal of Cancer | [10.1016/j.ejca.](https://www.sciencedirect.com/science/article/pii/S0959804920304627)[2020.08.011](https://www.sciencedirect.com/science/article/pii/S0959804920304627) {Saini, 2020 #6992} | 4 |
| 4/6/2020 | Until March 14, 2020 | China | A meta-analysis of 11 articles using random-effects models to analyze the pooled prevalence of cancer among patients with COVID-19 | Any | Overall pooled prevalence of cancer in patients with COVID-19 was 2.0%  | **Limitations:** They do not mention what the overall prevalence of cancer is in the same populations. | JCO Global Oncology | [10.1200/GO.20.00097](https://ascopubs.org/doi/full/10.1200/GO.20.00097) {Desai, 2020 #6993} | 73 |

Legend: COVID-19: Coronavirus Disease 2019; SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus 2; HER: Electronic Health Records; HR: Hazard Ratio; OR: Odds Ratio; AOR: Adjusted Odds Ratio; RR: Relative Risk; CFR: Case Fatality Rate; NHS: UK National Health Service; ONS: UK Office of National Statistics; UKCCMP: UK Coronavirus Cancer Monitoring Project; CCC19: COVID-19 and Cancer Consortium; LEOSS: Lean European Open Survey on SARS-CoV-2 Infected Patients; TERAVOLT: Thoracic Cancers international COVID-19 Collaboration registry; MSKCC: Memorial Sloan-Kettering Cancer Center; NSCLC: Non-Small Cell Lung Carcinoma; SCLC: Small Cell Lung Carcinoma. “Any” in the Cancer Type column denotes a combination of multiple solid tumors and/or hematological cancers.