

# Effects of SARS-COV-2 Viral Infection on Cancer Patients: A Biological and Statistical Study during the COVID-19 Outbreak

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## Abstract

The novel COVID-19 Pandemic has affected the World terribly causing death of more than 500,000 people, affecting over 200 countries and demolishing the World Economy. As prior studies and researches suggest, cancer patients are generally considered more prone to the viral infections owing to various relevant reasons. Therefore, a systematic analysis of cancer patients affected by COVID-19 is highly required. In this paper, data from several performed experiments in many multi-centred studies are included and evaluated to draw conclusions, specifically focusing on the age-matched non-cancer patients confirmed with COVID-19. The results suggests

that COVID-19 patients with cancer had higher risks in all severe outcomes [1]. Patients with hematologic cancer, lung cancer, or with metastatic cancer (stage IV) had minimum survival chances. Patients with non-metastatic cancer also showed similar results to those observed in patients without cancer. Patients who received surgery had low mortality rates. Again, patients undergoing radiotherapy did not possess any differences which is significant [2]. These results clearly suggest that patients with cancer are more prone to SARS-CoV-2 viral infection.

**Keywords:** COVID-19, SARS-CoV-2, Cancer, Corona Virus

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## 1.1 introduction

The recent emergence of the novel, pathogenic SARS-coronavirus 2 (SARS-CoV-2) in China and its rapid national and international spread pose a global health emergency.

There has been a number of coronavirus outbreaks noted till date, such as the severe acute respiratory syndrome coronavirus (SARS-CoV) and MERS-CoV. In December 2019, the third pathogenic HCoV, named 2019 novel coronavirus (2019-nCoV/SARS-CoV2) shuddered the whole world.

The World is going through a deadly phase of a Viral Pandemic, caused by the new acute respiratory syndrome SARS-COV-2. The current pandemic of COVID-19 (Coronavirus Disease-2019) has led to over 6. 27 Million Confirmed cases in the world and more than 199,000 in the Indian subcontinent as of June 2020. The SARS-COV-2 has already affected 213 countries and territories around the world and 2 international conveyances. The first recognised case of COVID

Continent names	Total confirmed cases	Total number of deaths	Total number of recovered	Total cases in 1 million population	Total deaths in 1 million population
World	6,220,978	372,395	2,777,366	798	47.8
Europe	2,019,482	173,692	986,884	4,032	404
South America	853,879	39,42	348,816	3,098	117
North America	2,055,280	124,210	675,429	2,021	179
Asia	1,136,426	30,767	694,239	1,029	79
Africa	146,386	4,164	63,151	203	6
Oceania	8,804	8,804	8,196	101	2

Table 1: Statistical Data Analysis of CoVID-19 Patients in the different Continents of the World. [\*The latest data is updated till June].

infection was documented as “a pneumonia of unknown cause”, reported to the WHO Country Office in China on 31 December 2019. The reported case of this viral infection was at Wuhan, China; the epicentre of the viral outbreak. Most people who are infected with the COVID-19 virus experience moderate respiratory problems.

[3]. Aged people, especially those with existing medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop this disease.

Over 18 million new individuals per year globally, is affected by Cancer. Individuals affected by cancer have more chances to get the infection owing to weak heart and lung conditions and due to the already existing chronic diseases [4]. Also, the cancer patients become immunologically weak due to the side effects caused by anti-cancer treatments, especially chemo-therapy. Naturally, the patients who are COVID positive and also possess cancer, have decreased life expectancy and they may suffer more terrible outcomes.

Using SARS-COV-2 affected patient criteria, who are also having cancer, information was collected

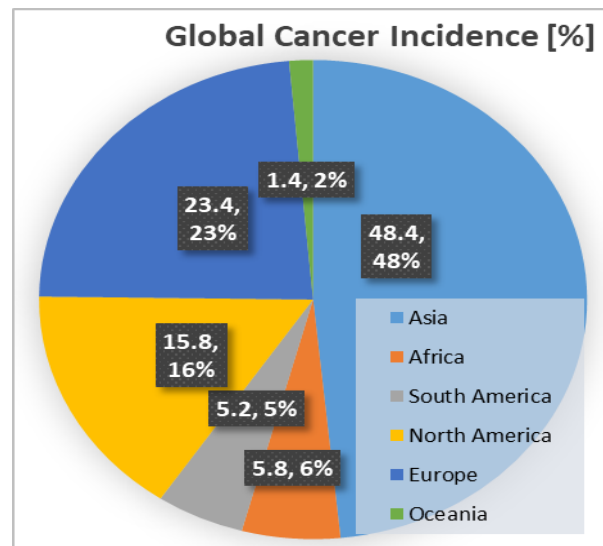


Figure 1: Global Cancer Incidence Percentages in Different Continents throughout the World.

from research papers and medical records all around the world [5]. We describe the clinical conditions and the probable results that is the death percentage, intensive care unit (ICU) records, critical symptom analysis and the ventilation. The findings for different cancer types and stages has been shown.

## 1.2. Results and discussions

### 1.2.1. Conditions of patients suffering from both covid-19 and cancer

<b>SL no.</b>	<b>All Possible Factors</b>	<b>P</b>	<b>COVID-19 patients with cancer (IQR Percentage)</b>	<b>COVID-19 patients without cancer (IQR Percentage)</b>
1.	Age (years)	0.25	14.00%	14.00%
2.	Male	0.11	54.72%	45.71%
3.	Female	0.11	45.28%	54.29%
4.	In-hospital infection	0.01	19.04%	1.49%
5.	Smoking	0.01	34.28%	8.58%
6.	Cardiovascular disease	0.17	11.43%	7.28%
7.	Diabetes	0.64	6.67%	5.41%
8.	Cerebrovascular disease	0.60	4.76%	3.92%
9.	Chronic kidney disease	0.44	5.71%	4.10%
10.	Chronic liver disease	1.00	6.67%	6.53%
11.	Fever	0.04	64.76%	74.81%
12.	Dry cough	0.45	52.29%	58.40%
13.	Sputum production	0.24	15.24%	10.82%
14.	Fatigue	0.36	28.57%	33.40%
15.	Myalgia	0.83	5.71%	7.09%
16.	Nausea or vomiting	0.68	5.71%	7.65%
17.	Chest distress	0.02	14.29%	6.16%
18.	Headache	0.49	6.67%	5.22%
19.	Sore throat	0.44	10.48%	8.02%
20.	Antibiotic treatments	NA	77.14%	67.35%
21.	Antiviral treatments	0.05	71.43%	69.40%
22.	Systemic glucocorticoids	0.68	18.10%	14.55%
23.	Oxygen therapy	0.35	45.71%	42.02%
24.	Non-invasive mechanical ventilation	0.48	10.48%	8.77%
25.	Invasive mechanical ventilation	0.58	10.48%	2.79%
26.	Metastatic cancer	NA	16.19%	NA
27.	Radiotherapy	NA	12.38%	NA
28.	Chemotherapy	NA	16.19%	NA
29.	Targeted therapy	NA	3.81%	NA
30.	Immunotherapy	NA	5.71%	NA

Table 2: Significant Results and Data Analysis of CoVID-19 Patients with and without Cancer. The different values of P which are denoted in the Comparison of SARS-COV-2 Patients with and without Cancer. ABBREVIATION: NA – Not Applicable.

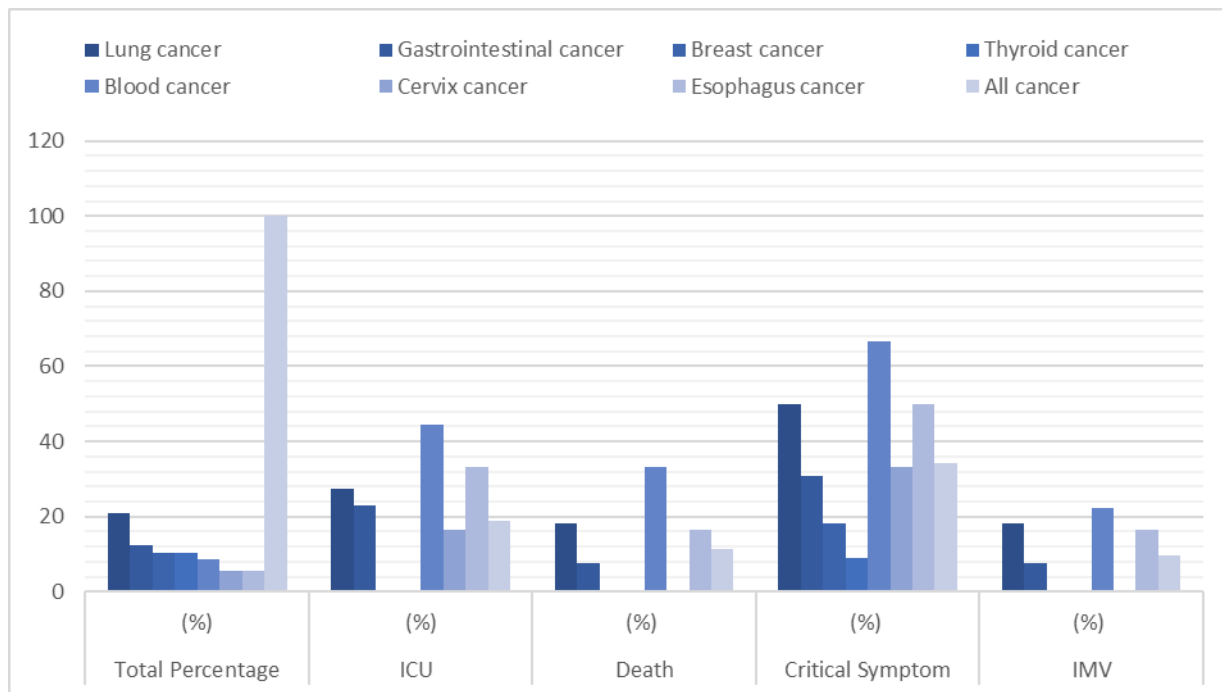


Figure 2: Death and severe conditions of CoVID patients with different types of Cancer.

18 million cancer cases around the world in which, 9.5 million cases are men and 8.5 million patients are women. In this study, a total number of cancer patients of nearly 18 million patient records were studied, from all around the world. For Calculation purposes and for the purpose of plotting different graphs, we have considered the total number of patients on a percentage scale; so we considered the total number of patients to be 100 for percentage calculation. The age group, gender, etc. were selected at random. Patients with cancer having a median of 64.00 and an interquartile range (IQR) of 14.00, when compared to patients, not having cancer, median of 63.50 and IQR of 14.00, it was seen that both had the same age distributions [6]. Naturally, patients with cancer experienced more in-hospital infections, which is nearly 19.04%. Whereas patients not having cancer experienced less in-

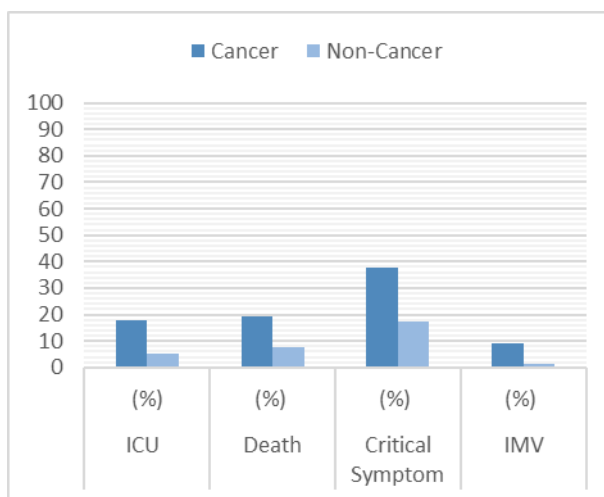


Figure 3: Death and severe conditions of CoVID patients with and without Cancer.

hospital infections, which is nearly 1.49%;  $P < 0.01$  Patients had no such differences in their sex or other baseline symptoms and other comorbidities [7]. All the detailed percentages of comparison are given in the Table 2.

Compared to COVID-19 patients without cancer, patients with cancer had higher death rates which

<b>Cancertypes</b>	<b>Total Percentage (%)</b>	<b>ICU (%)</b>	<b>Death (%)</b>	<b>Critical Symptom (%)</b>	<b>IMV (%)</b>
<b>Lung cancer</b>	<b>20.95</b>	<b>27.27</b>	<b>18.18</b>	<b>50.00</b>	<b>18.18</b>
<b>Gastrointestinal</b>	<b>12.38</b>	<b>23.08</b>	<b>7.69</b>	<b>30.77</b>	<b>7.69</b>
<b>Breast cancer</b>	<b>10.48</b>	<b>0.00</b>	<b>0.00</b>	<b>18.18</b>	<b>0.00</b>
<b>Thyroid cancer</b>	<b>10.48</b>	<b>0.00</b>	<b>0.00</b>	<b>9.09</b>	<b>0.00</b>
<b>Blood cancer</b>	<b>8.57</b>	<b>44.44</b>	<b>33.33</b>	<b>66.67</b>	<b>22.22</b>
<b>Cervix cancer</b>	<b>5.71</b>	<b>16.67</b>	<b>0.00</b>	<b>33.33</b>	<b>0.00</b>
<b>Esophagus cancer</b>	<b>5.71</b>	<b>33.33</b>	<b>16.67</b>	<b>50.00</b>	<b>16.67</b>
<b>All cancer</b>	<b>100</b>	<b>19.05</b>	<b>11.43</b>	<b>34.29</b>	<b>9.52</b>

Table 3: Significant Results and Data Analysis of CoVID-19 Patients with different Types of Cancer and patients without Cancer. [ABBREVIATION: ICU – Intensive Care Unit; IMV – Invasive Mechanical Ventilation.]

is almost 95% confidence interval (CI);  $P = 0.03$ . In case of ICU admissions also, the rates were very high, almost 95% CI;  $P < 0.01$ . In case of having at least one or two critical symptoms, the results were almost same, 95% CI;  $P < 0.01$  [8].

Also, there were higher chances of demand of mechanical ventilation. Several analysis were conducted on the occurrence of any severe conditions that is, death, ICU admission, severe symptoms, and requirement of mechanical ventilation. From these observations, it was clear that patients having cancer deteriorated on a rapid basis, compared to those without cancer [9]. These results were the same for age, sex, smoking, and comorbidities that further include diabetes, hypertension, and chronic obstructive pulmonary disease.

### 1.2.2. Analysis of different cancer types

Analysis were done on which Cancer type showed the most severe results on patients, who are also CoVID-19 positive [10]. Lung cancer is the most

severe and frequent cancer type with percentage of almost 20.95%. This was followed by gastrointestinal cancer which has a percentage of 12.38%; breast cancer which has a percentage of 10.48%; thyroid cancer which has a percentage of 10.48% and hematologic cancer having a percentage of 8.57% [11]. It was also seen that patients with hematologic cancer and with leukaemia, lymphoma, and myeloma have a higher relative death rate of 33.33%, have a higher relative ICU admission rate of 44.44%, have a higher relative critical symptoms of 66.67% and have a higher relative mechanical ventilation demand of 22.22%. Patients with lung cancer have highest risk margins accounting to death rate of 18% of patients [12]

### 1.2.3. Observation at different cancer stages

Analysis and observations of patients showed that, patients with metastatic cancer (stage IV) has the highest risks of death [13]. Again, patients with non-metastatic cancer do not characterize any statistically significant differences when they are

analysed with patients without cancer [14]. Now, when these statistical results were compared without cancer, patients having lung cancer or types of cancer apart from lung cancer with lung metastasis also resulted in high death rates, ICU admission rates, high severe symptom rates, etc.

### 1.2.4. The treatment measurements of cancer:

Analysing the cancer patients, who developed COVID-19 infection, 12. 26% of the total percentage of patients have radiotherapy, 14. 15% of the total percentage of patients have received chemotherapy, 7. 62% of the total percentage of

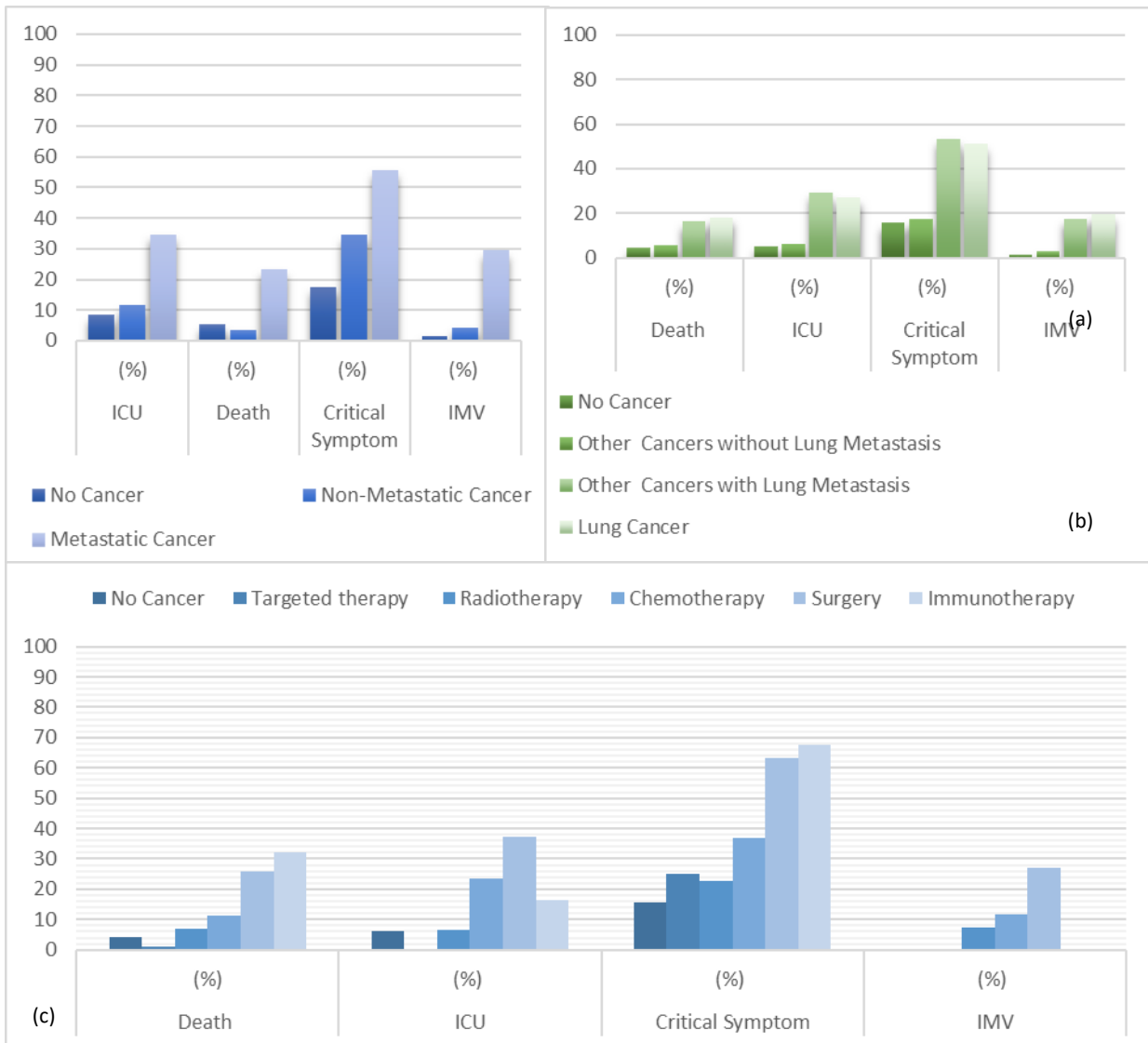


Figure 4: (a) Death and severe conditions in COVID patients with Metastatic, non-Metastatic Cancer and also without Cancer. (b) Death and severe conditions in COVID patients with Lung Cancer, Cancers with Lung Metastasis, without Lung Metastasis and also without Cancer. (c) Death and severe conditions in COVID patients with different types of Cancer Therapy and also patients without cancer.

patients have received surgery, 3. 81% of the total and there were probabilities of having critical

symptoms of 66.67% [16]. Patients undergoing surgery possessed a higher death rate of 25.00%. Furthermore, patients undergoing surgery has higher tendencies of ICU admission of almost 37.50%) of 8 patients, higher tendencies of developing critical symptoms of 62.50%, and increased use of invasive ventilation, almost about 25.00% [17]. But surprisingly, cancer patients receiving radiotherapy had not much significant differences statistically. 5.71% of the total percentage of patients received immunotherapy. All these treatments were received within 40 days' time period of the onset of the symptoms of COVID-19 viral infection. [15]. These therapeutic drugs were targeted at EGFR-tyrosine kinase inhibitors for treating lung cancer and the immunotherapy drugs were PD-1 inhibitors for the treatment of lung cancer. The results and observations suggested that the patients who received immunotherapy suffered a death rate of 33.33%

### 1.3. Conclusions

By observing and analysing all the data from the above results, it is clear that cancer patients who are also positive with the infection of SARS-CoV-2 are more prone to critical outcomes and even death, when compared to non-cancer but COVID-19 positive patients. Cancer patients, especially ones with hematologic cancer, lung cancer and metastatic cancers in their different stages have shown higher rates of critical symptoms and death rates when compared with ones who does not possess cancer. Again, patients with cancer who had to go through different types of cancer surgeries, showed higher death rates and also,

arrival of new severe effects was seen in such patients [18]

Mostly it is also suggested in several reports that elderly males who are positive from COVID-19 Viral Infection interestingly shows a higher percentage of mortality rate and severe outcome rates. [19]. Medical information which is related to Cancer is limited and especially, patients with both COVID-19 infection and cancer is not available at all. Continents like Asia, Europe, and North America have the largest rates of occurrence of cancer in the world. Though COVID-19 infected individuals with cancer may contain few epidemiologic features, all around the world with, they can have other clinical characteristics too [20]. So, mainly, the study was done to evaluate the potential effect of COVID-19 on cancer patients [21]

Though it is evident that COVID-19 has a relative lower mortality or death rate of 2% to 3% all around the world, cancer patients around the world have mortality rates of almost three times compared to that of deaths occurring due to SARS-COV-2 Viral infection [22].

In conclusion, it can be said that, mainly we can conclude four different factors throughout this study [23]. They are:

- Death rates in hospitals of patients suffering from both Cancer and COVID-19 Viral infection.
- Admission of the patients with the above mentioned criteria into the ICU
- Occurrence of severe symptoms of such patients.

- Usage and demand requirement of ventilation machines made mechanically.
- The Clinical symptoms of SARS-COV-2 or the COVID-19 Virus according to the World Health Organisation or WHO includes aches and pains, nasal congestion, headache, conjunctivitis, sore throat, diarrhoea, loss of taste or smell or a rash on skin or discoloration of fingers or toes [24].

## References

1. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020; 382:1708–20.
2. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020;323:1239–42.
3. Chen W, Zheng R, Baade PD, Zhang S, Zeng H, Bray F, et al. Cancer statistics in China, 2015. *CA Cancer J Clin* 2016;66:115–32.
4. Liang W, Guan W, Chen R, Wang W, Li J, Xu K, et al. Cancer patients in SARS-CoV-2 infection: a nationwide analysis in China. *Lancet Oncol* 2020;21:335–37.
5. Xia Y, Jin R, Zhao J, Li W, Shen H. Risk of COVID-19 for cancer patients. *Lancet Oncol* 2020;21:e180.
6. Wang HP, Zhang L. Risk of COVID-19 for patients with cancer. *Lancet Oncol* 2020;21:e181.
7. Yang X, Yu Y, Xu J, Shu H, Xia J, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *Lancet Respir Med* 2020 Feb 24 [Epub ahead of print].
8. Zhang B, Zhou X, Qiu Y, Feng F, Feng J, Jia Y, et al. Clinical characteristics of 82 death cases with COVID-19. *MedRxiv* 2020.
9. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2018;68:394–424.
10. Zheng RS, Sun KX, Zhang SW, Zeng HM, Zou XN, Chen R, et al. Report of cancer epidemiology in China, 2015. *Zhonghua Zhong Liu Za Zhi* 2019;41:19–28.
11. Ramos-Casals M, Brito-Zerón P, López-Guillermo A, Khamashta MA, Bosch X. Adult haemophagocytic syndrome. *Lancet* 2014;383:1503–16.
12. Raab MS, Podar K, Breitkreutz I, Richardson PG, Anderson KC. Multiple myeloma. *Lancet* 2009;374:324–39.
13. Albano D., Bertagna F., Bertolia M., Bosio G., Lucchini S., Motta F. Incidental findings suggestive of COVID-19 in asymptomatic patients undergoing nuclear medicine procedures in a high prevalence region. *J. Nucl. Med.* 2020;(April (1)) jnumed. 120. 246256. [PubMed]. [Google Scholar]
14. Al-Shamsi H. O., Alhazzani W., Alhurairi A., Coomes E. A., Chemaly R. F., Almuhanna M. A practical approach to the management



- of cancer patients during the novel coronavirus disease 2019 (COVID-19) pandemic: an international collaborative group. *Oncologist*. 2020;(April (3)) [PMC free article]. [PubMed]. [Google Scholar]
15. Banna G., Curioni-Fontecedro A., Friedlaender A., Addeo A. How we treat patients with lung cancer during the SARS-CoV-2 pandemic: primum non nocere. *ESMO Open*. 2020;5(2) [PMC free article]. [PubMed]. [Google Scholar]
  16. Bersanelli M. Controversies about COVID-19 and anticancer treatment with immune checkpoint inhibitors. *Immunotherapy*. 2020;(March (26)) imt-2020-0067. [PMC free article]. [PubMed]. [Google Scholar]
  17. Bhatraju P. K., Ghassemieh B. J., Nichols M., Kim R., Jerome K. R., Nalla A. K. Covid-19 in critically ill patients in the Seattle region - case series. *N. Engl. J. Med*. 2020;(March (30)) [PMC free article]. [PubMed]. [Google Scholar]
  18. Bonomi L., Ghilardi L., Arnoldi E., Tondini C. A., Bettini A. C. A rapid fatal evolution of Coronavirus Disease-19 (COVID-19) in an advanced lung cancer patient with a long time response to nivolumab. *J. Thorac. Oncol. Off. Publ. Int. Assoc. Study Lung Cancer*. 2020;(March (31)) [PMC free article]. [PubMed]. [Google Scholar]
  19. Burki T. K. Cancer care in the time of COVID-19. *Lancet Oncol*. 2020;(March (23)) [PMC free article]. [PubMed]. [Google Scholar]
  20. Burki T. K. Cancer guidelines during the COVID-19 pandemic. *Lancet Oncol*. 2020;(April (2)) [PMC free article]. [PubMed]. [Google Scholar]
  21. Cancer Labs Pivot to Battle COVID-19. *Cancer Discov*. 2020;(March (31)) [PubMed]. [Google Scholar]
  22. Cao Y., Li Q., Chen J., Guo X., Miao C., Yang H. Hospital emergency management plan during the COVID-19 epidemic. *Acad. Emerg. Med*. 2020;(March (2)) acem. 13951. [PMC free article]. [PubMed]. [Google Scholar]
  23. Chen Y. H., Peng J. S. Treatment strategy for gastrointestinal tumor under the outbreak of novel coronavirus pneumonia in China. *Zhonghua Wei Chang Wai Ke Za Zhi Chin J Gastrointest Surg*. 2020;23(2):I-IV. Feb 25. [PubMed]. [Google Scholar]
  24. Clinical Research Slows as COVID-19 Surges. *Cancer Discov*. 2020;(April (1)) [PubMed]. [Google Scholar].