



Lung Cancer Treatment in COVID-19 Era

충남대학교병원
강 다 현

중국서 원인불명 폐렴 잇따라... '사스' 우려 확산

송고시간 2019-12-31 21:16:16



중국서 원인불명 폐렴 잇따라... '사스' 우려 확산

중국 중부 후베이성 우한에서 원인 불명의 폐렴 환자가 잇따라 사스, 즉 중증급성호흡기증후군 우려가 확산하고 있습니다.

한시 위생건강위원회는 현지 한 수산시장에서 원인 불명의 폐렴 환자가 현재까지 총 27명 발견됐고, 이 가운데 7명은 중태라고 밝혔다고 현지 언론이 보도했습니다.

이들 환자는 모두 발열과 호흡 곤란 증세를 호소했으며 폐 질환 등도 동반한 것으로 전해졌습니다.

중국 당국은 긴급히 조사에 착수했으며 현재로선 바이러스성 폐렴으로 보고 있으며 다른 사람에게 전염되는 사례가 발견되지는 않았고 환자와 접촉한 의료진도 전염되지 않았다고 밝혔습니다.

'우한 폐렴' 국내 첫 확진...35세 중국인 공항서 바로 격리

중앙일보 | 입력 2020.01.21 00:04 업데이트 2020.01.21 08:29

지면보기

유상철 기자 이예스터 기자 황수연 기자

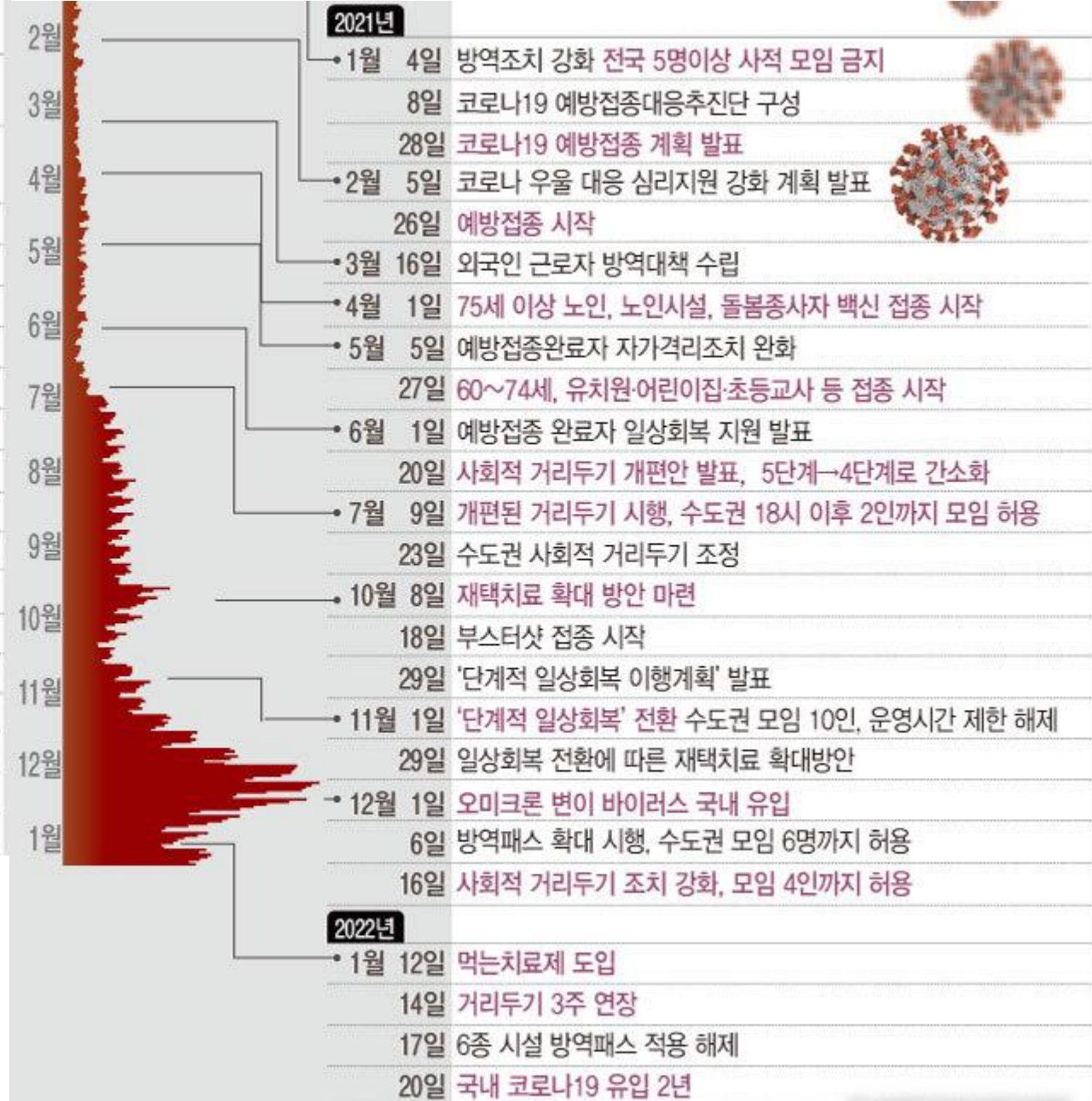
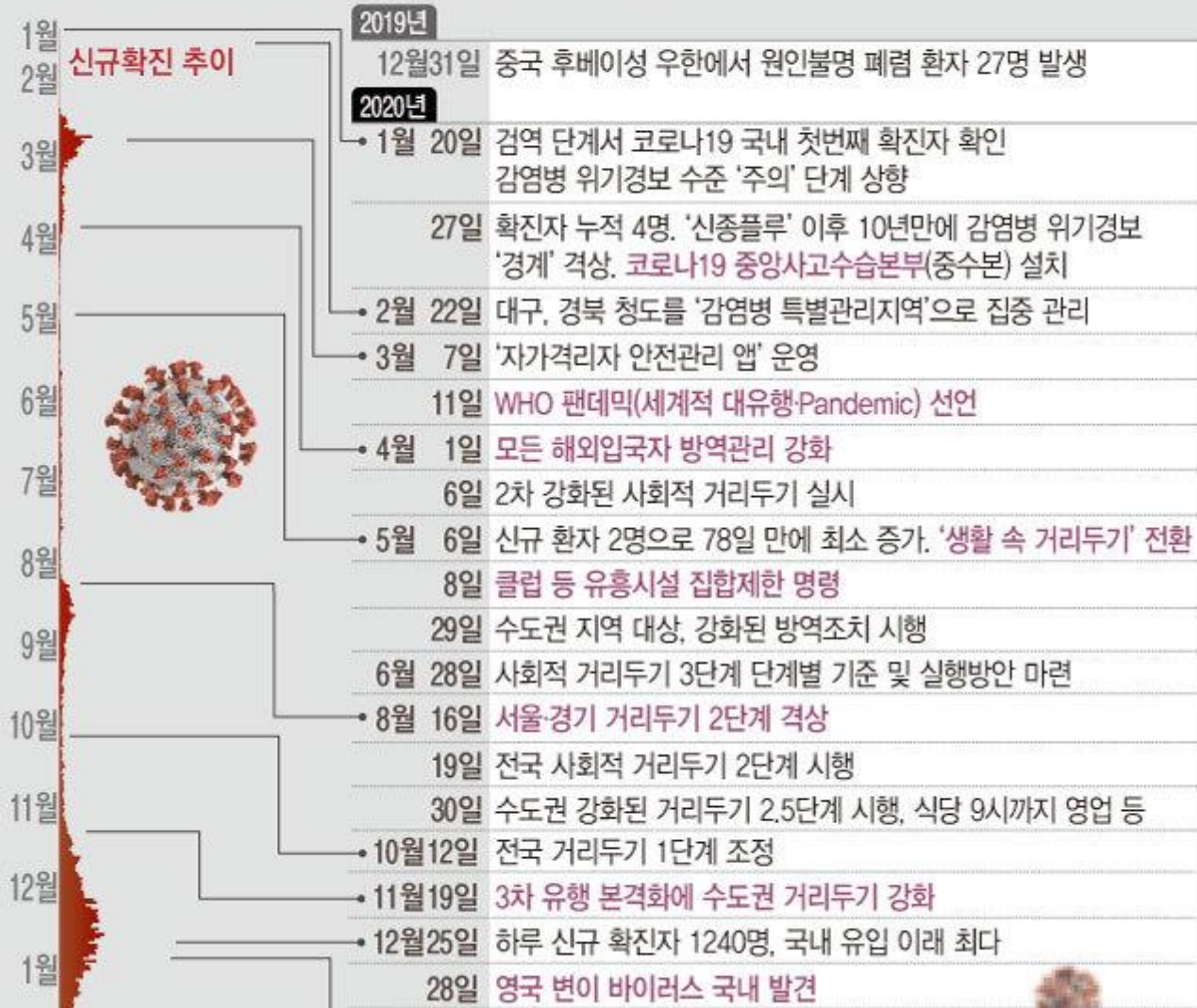
구독



국내에서 중국 우한 폐렴 확진자가 발생한 가운데 20일 오후 인천국제공항 입국장에서 검역원들이 발열 검사를 하고 있다. 중국 우한에서 출발해 인천공항에 도착한 승객들이 대상이다. [뉴시스]

국내에서 신종 코로나바이러스로 인한 '우한(武漢) 폐렴' 확진자가 처음으로 확인됐다. 보건당국은 감염병 위기 경보 수준을 '관심'에서 '주의' 단계로 격상했다. 질병관리본부는 20일 "이날 오전 중국 우한시 신종코로나바이러스 감염증 해외유입 확진환자를 확인했다"며 "중앙방역대책본부와 지자체 대책반을 가동해 지역사회 감시와 대응을 강화하겠다"고 밝혔다.

코로나19 첫 확진자부터 2년경과까지



COVID-19 epidemiology

WHO Coronavirus (COVID-19) Dashboard

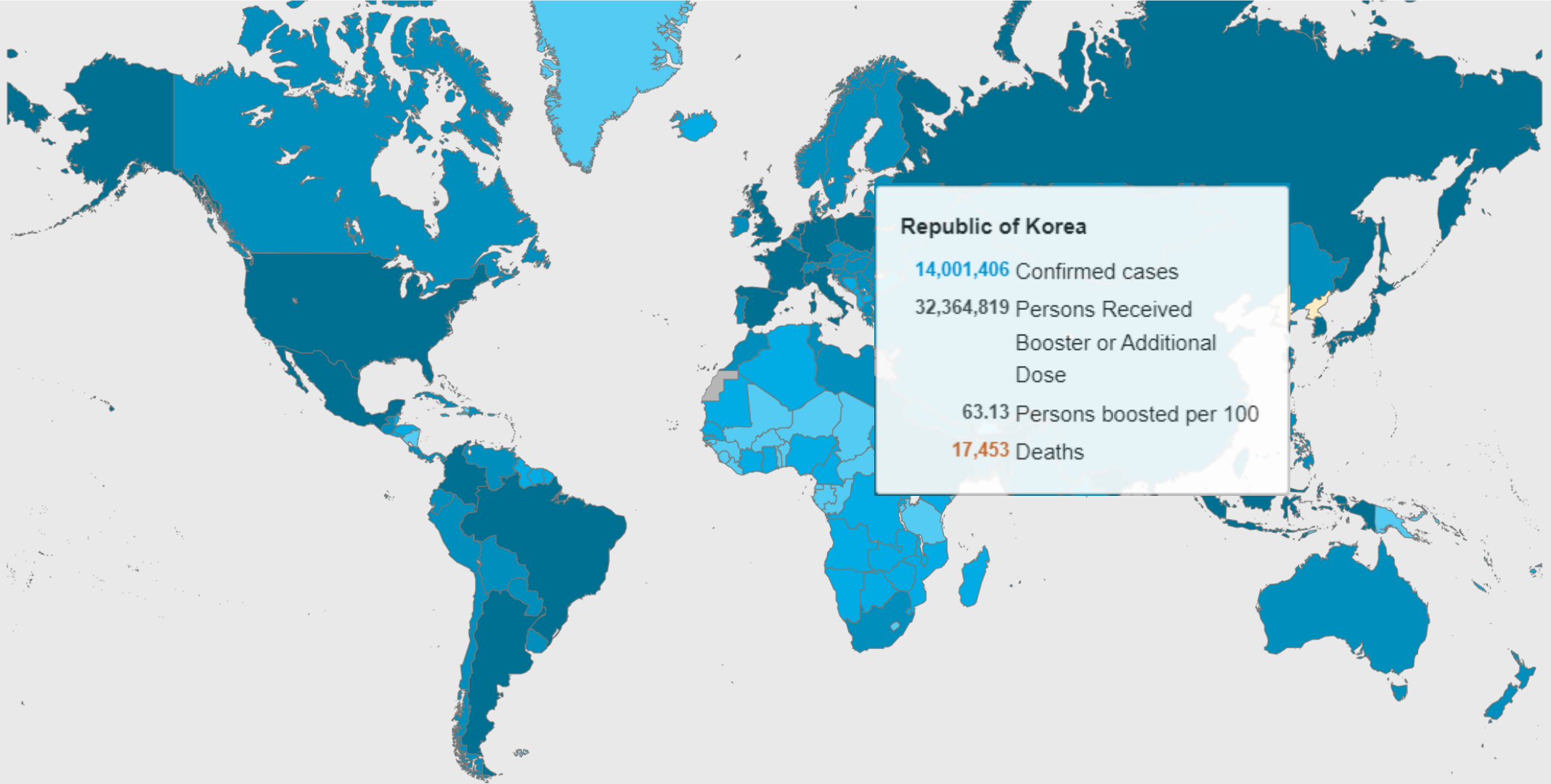
[Overview](#)

[Measures](#)

[Table View](#)

[Data](#)

[More Resources](#)



Cases
Total

718,294
new cases in last 24hrs

489,779,062
cumulative cases

6,152,095
cumulative deaths

COVID-19 epidemiology

Globally, as

Global Situation

489,77
confirmed cases

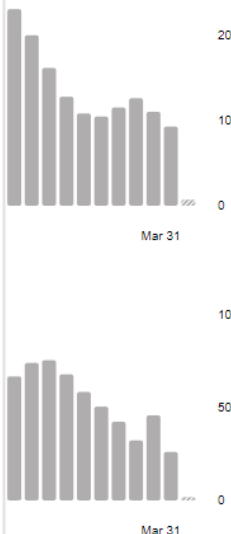
6,152,0
deaths

Source: World Health Organization
Data may be incomplete for the curr



2022, a total of

Daily Weekly





- Mortality
- Impact of cancer treatment
- Vaccination

- Impact of Covid-19 pandemic
- Diagnosis, Treatment

Lung cancer



Contents

1. Lung cancer → Covid-19

- 1) Covid-19 in patients with lung cancer
- 2) Impact of cancer treatment on Covid-19
- 3) Vaccination

2. Covid-19 → Lung cancer

- 1) Impact of Covid-19 pandemic on lung cancer
- 2) Guideline on Covid-19 pandemic
- 3) Cancer treatment in Covid-19 patients

Contents

1. Lung cancer → Covid-19

- 1) Covid-19 in patients with lung cancer
- 2) Impact of cancer treatment on Covid-19
- 3) Vaccination

2. Covid-19 → Lung cancer

- 1) Impact of Covid-19 pandemic on lung cancer
- 2) Guideline on Covid-19 pandemic
- 3) Cancer treatment in Covid-19 patients

COVID-19 mortality rate in cancer patients

Table 1. Key studies highlighting the mortality rates in all cancers and lung cancers

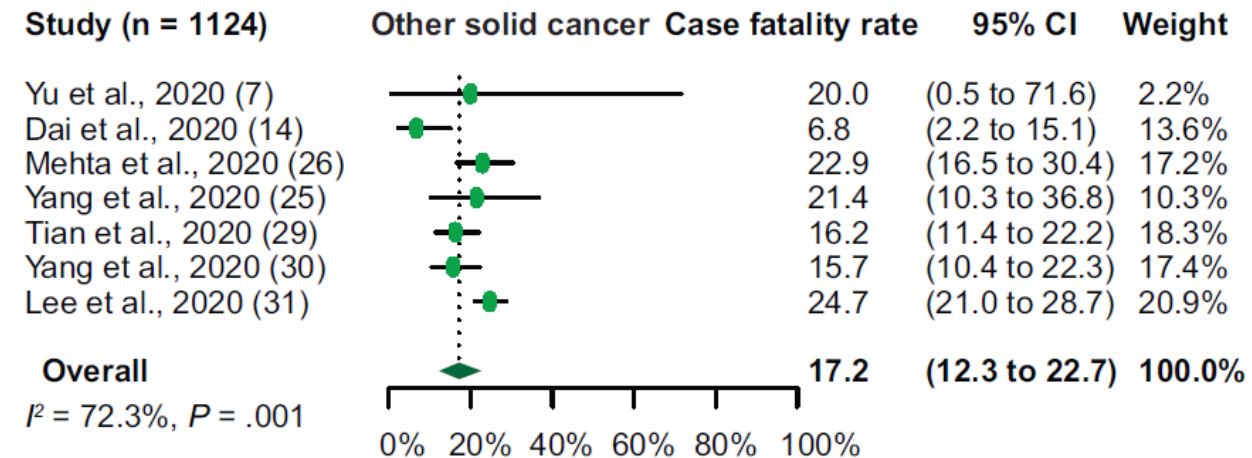
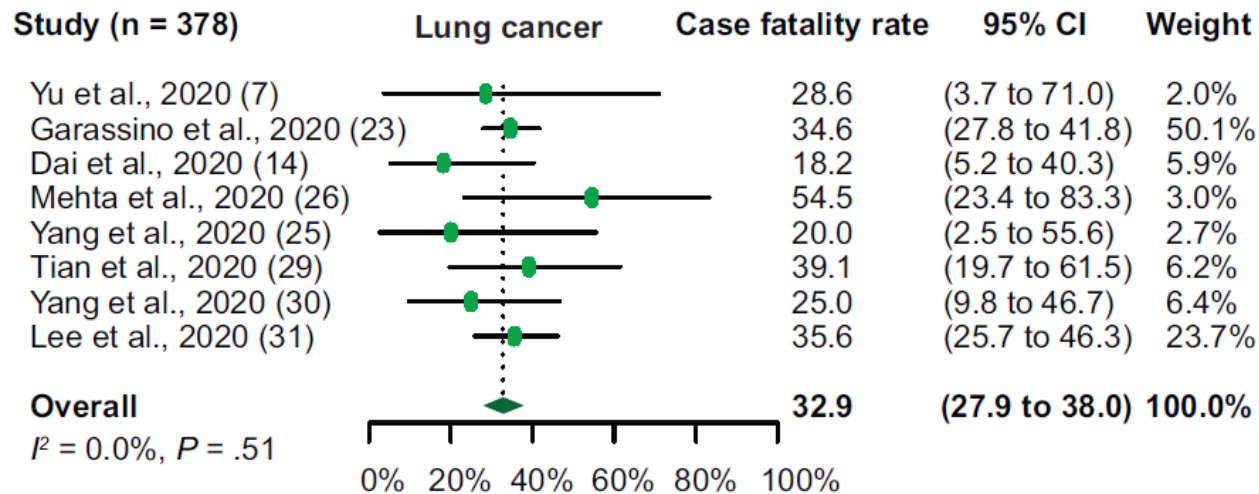
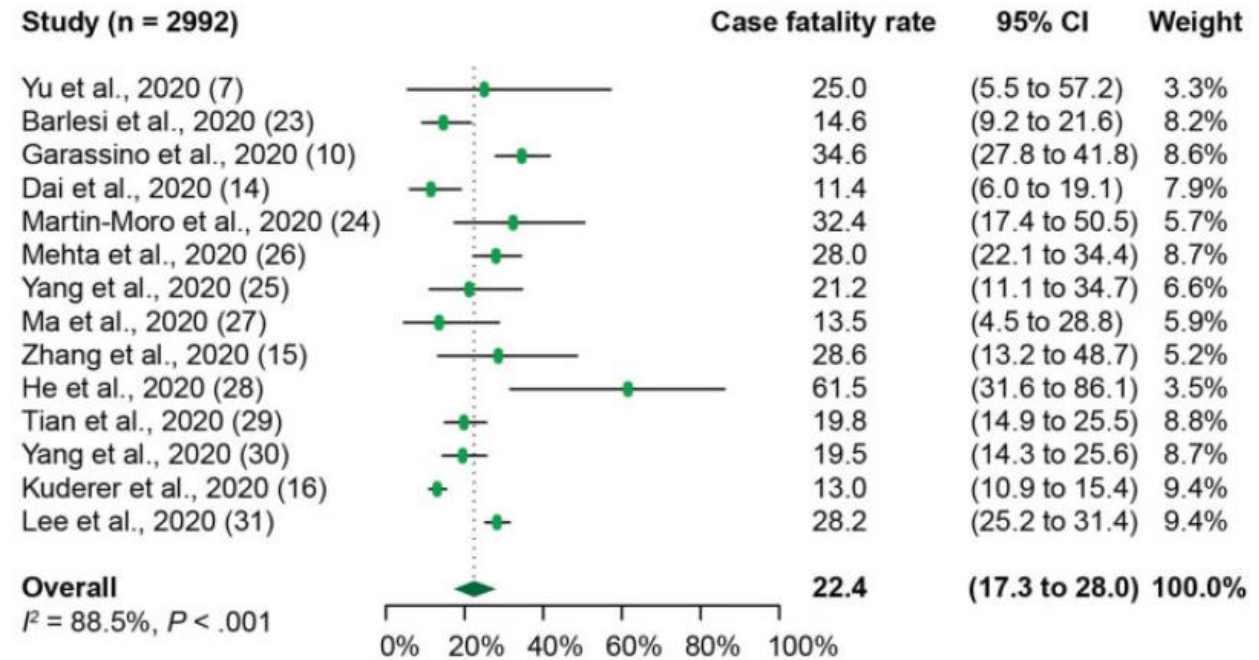
Study	Study population	Study size (N)	Mortality in patients with any cancer	Mortality in patients with lung cancer
Dai <i>et al.</i> ^[9]	Chinese	105 (All cancers) 22 (Lung cancer)	11.4%	18.1%
Yang <i>et al.</i> ^[13]	Chinese	205 (All cancers) 25 (Lung cancer)	20%	25%
Mehta <i>et al.</i> ^[10]	United States	218 (All cancers) 11 (Lung cancer)	28%	55%
Luo <i>et al.</i> ^[16]	United States	101 (Lung cancer)	NA	25%
Lee <i>et al.</i> ^[8]	United Kingdom	800 (All cancers) 90 (Lung cancer)	28%	14%
Kuderer <i>et al.</i> ^[7]	United States and Canada	928 (All cancers) 92 (Lung cancer)	13%	26%
Garassino <i>et al.</i> ^[11,20]	European	400 (Lung cancer)	NA	35%

11~28%

14~55%

COVID-19 mortality rate in cancer patient

- Overall : 11.4~61.5%
- Lung cancer : 18.2~54.5%
- Other solid cancer : 6.8~24.7%



COVID-19 patients with thoracic malignancy

Table 1 Registries and series of COVID-19 cases in patients with thoracic malignancy

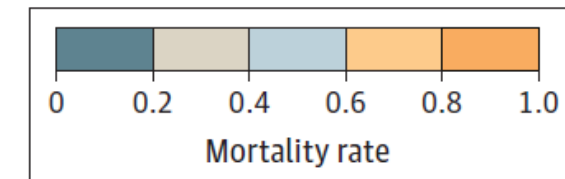
Author or group (if applicable)	Location	Study characteristics	Total number of patients with thoracic malignancies	Mortality rate	Outcomes of patients with lung cancer
Tian <i>et al</i> ¹⁹	China	Retrospective analysis 13077 total patients with COVID-19.	23 patients with lung cancer.	39% (9/23)	Severe clinical outcome: 18/23 (78%).
Dai <i>et al</i> ²⁰	China (Hubei)	Multicenter study of 14 hospitals. 641 COVID-19 positive patients, of which 105 with cancer.	22 patients with lung cancer.	18% (4/22)	<ul style="list-style-type: none"> ▶ ICU admission rate: 27% (6/22). ▶ Severe/critical symptoms: 50% (11/22). ▶ Risk of mechanical ventilation: 18.1% (4/22).
Rugge <i>et al</i> ²¹	Italy (Veneto)	Regional cancer registry 9275 patients with COVID-19, of which 723 with cancer.	21 patients with lung cancer.		
de Joode <i>et al</i> ²² ; Dutch Oncology COVID-19 Consortium	The Netherlands	Observational cohort study of cancer patients with COVID-19 409 total subjects.	47 NSCLC patients.		
Lee <i>et al</i> ²³ ; UKCCMP	UK	Observational cohort study including 1044 cancer patients with COVID-19.	111 patients with lung cancer.		
Various authors ^{5,24-26} ; CCC-19	Multicenter, primarily USA based	Cohort study of patients with COVID-19 who have cancer.	237 patients with lung cancer (based on interim 2749 patient analysis). ²⁴	26% (61/237)	Significantly higher mortality rate than the 16% (433/2749) for all patients with cancer.
Luo <i>et al</i> ²⁷ ; MSKCC	New York, USA	Monoinstitutional series of patients with lung cancer and concomitant positive SARS-CoV-2 RT-PCR.	102 patients with lung cancer.	25% (25/102)	<ul style="list-style-type: none"> ▶ Hospitalization rate: 62% (63/102). ▶ ICU admission: 21% (21/101). ▶ Risk of mechanical ventilation: 18% (18/100).
Various authors ²⁸⁻³⁰ ; TERAVOLT	Multicenter, international	Cross-sectional and longitudinal cohort study of thoracic malignancy patients diagnosed with COVID-19.	1012 patients with thoracic malignancies.	32% (326/1012)	<ul style="list-style-type: none"> ▶ Hospitalization rate: 72% (733/1012). ▶ ICU admission: 12% (118/1012). ▶ Mechanical ventilation, both tube assisted and non-invasive: 25% (248/1012).

- **Mortality rate** : 24~47%
- **Hospitalization rate** : 62~72%
- **Mechanical ventilation** : 18~25%

All-Cause Mortality Rate With COVID-19

All patients

	≤39	40-49	50-59	60-69	70-79	≥80
Myeloproliferative neoplasms and CML	<5	<5	<5	7	<5	<5
Acute leukemia or MDS	10	6	15	21	19	18
Lung	7	31	66	99	62	<5
Myeloma or plasmacytoma	<5	5	16	29	27	56
Unspecified hematological	<5	<5	<5	7	6	<5
Urinary tract	<5	<5	15	43	55	53
Prostate			9	46	94	123
Endocrine glands	<5		5	5	<5	
CNS	9	<5	9	18	10	<5
CLL		<5	7	19	25	13
Lymphomas	12	13	36	50	82	38
Digestive (noncolorectal)	<5	6	23	55	80	35
Other mature lymphoid leukemia	<5	<5	<5	8	17	8
Mesothelial and soft tissue	<5	<5	<5	11	10	<5
Melanoma	<5	6	11	23	20	69
Colorectal	<5	14	28	68	81	60
Ill-defined		<5		5	9	8
Female genital organs	5	14	16	32	32	8
Intrathoracic (not lung)			<5	9	6	<5
Lip, oral cavity, and pharynx	<5	5	14	13	11	8
Breast	11	23	64	53	76	64
Multiple sites				<5	<5	<5
Male genital organs (not prostate)	7	<5	<5	<5		<5
Bone and articular cartilage	<5		<5	<5	<5	



COVID-19 in lung cancer patients



Factors associated with severe COVID-19 in cancer patients

Table 2. Factors associated with severe COVID-19 and or mortality on multivariable regression analysis[#]

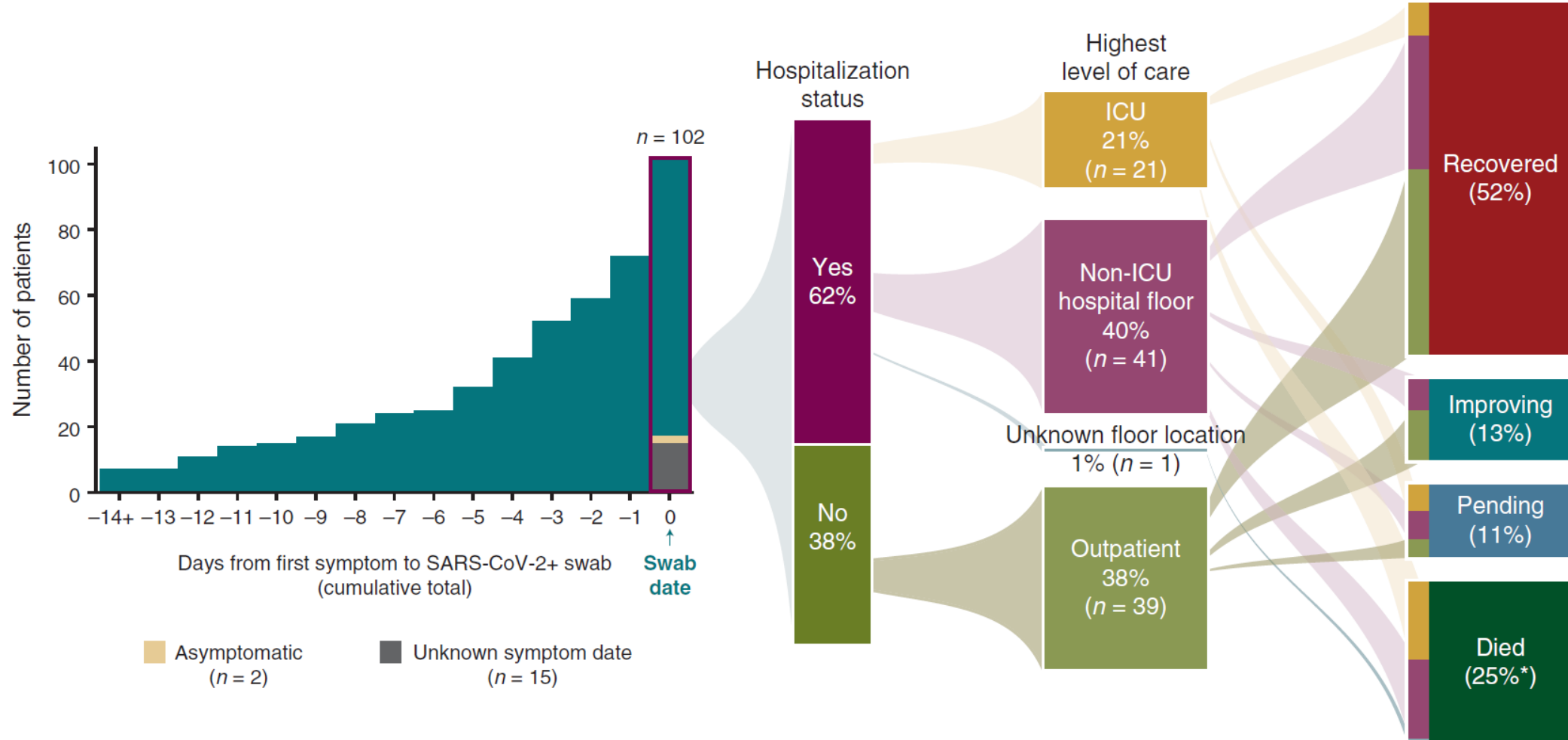
Study	Cancer type	Factors associated with severe COVID-19 and or mortality								
		Comorbidities				ECOG status	Cancer status	Laboratory variables	Treatment exposure	
		Age	Male gender	Smoking	Others				For COVID	For cancer
Yang et al. ^[13]	All cancers (N = 105)	NA	OR = 3.86 (1.57-9.50), P = 0.0033	NA	NA	NA	NA	NA	NA	Cytotoxic chemotherapy* (OR = 3.51, 95%CI: 1.16-10.59, P = 0.026)
Mehta et al. ^[10]	All cancers (N = 105)	Age < 65 (OR = 0.23, 95%CI: 0.07-0.6)	NA	NA	- Higher composite comorbidity score** (OR = 1.52, 95%CI: 1.02-2.33) - ICU admission (OR = 4.83, 95%CI: 1.46-17.15)	NA	NA	Elevated D-dimer, lactate, and LDH	NA	NA
Luo et al. ^[16]	Lung cancer (N = 101)	Advancing age (OR = 2.01, 95%CI: 1.34-3.19)	NA	OR 2.9, 95%CI: 1.07-9.44)	- COPD (OR = 3.87, 95%CI: 1.35-9.68) - HTN (OR = 2.68, 95%CI: 1.14-6.14)	NA	NA	NA	NA	NA
Lee et al. ^[8]	All cancers (N = 800)	OR = 9.42, 95%CI: 6.56-10.02, P < 0.0001	OR = 1.67 (1.19-2.34), P = 0.003	NA	- HTN (OR = 1.95, 1.36-2.80, P < 0.001) - CVD (OR = 2.32, 1.47-3.64)	NA	NA	NA	NA	NA
Kuderer et al. ^[7]	All cancers (N = 928)	Increased age (OR = 1.84, 95%CI: 1.53-2.21)	OR = 1.63, 95%CI: 1.07-2.48	OR = 1.60, 95%CI: 1.03-2.47	Number of comorbidities (two vs. none: OR = 4.50, 95%CI: 1.33-15.28)	ECOG 2 or more (OR = 3.89, 95%CI 2.11-7.18),	Active cancer (progressing vs. remission: OR = 5.20, 95%CI: 2.77-9.77)	NA	Azithromycin + hydroxychloroquine (vs. treatment with neither: OR = 2.93, 95%CI: 1.79-4.79)	NA
Garassino et al. ^[11,20]	Lung cancer (N = 400)	Age > 65 (OR = 1.70, 95%CI: 1.09-2.63, P = 0.018)	NA	NA	NA	ECOG ≥ 1 (OR = 2.14, 95%CI: 1.11-4.11, P < 0.001)	NA	NA	NA	Use of steroids (equivalent of prednisone > 10 mg/day) (OR = 1.49, 95%CI: 1.00-2.23, P = 0.052) Chemotherapy (+ or - immunotherapy) (OR = 1.71, 95%CI: 1.12-2.63, P = 0.025)

Age, Male gender
Smoking
Comorbidities

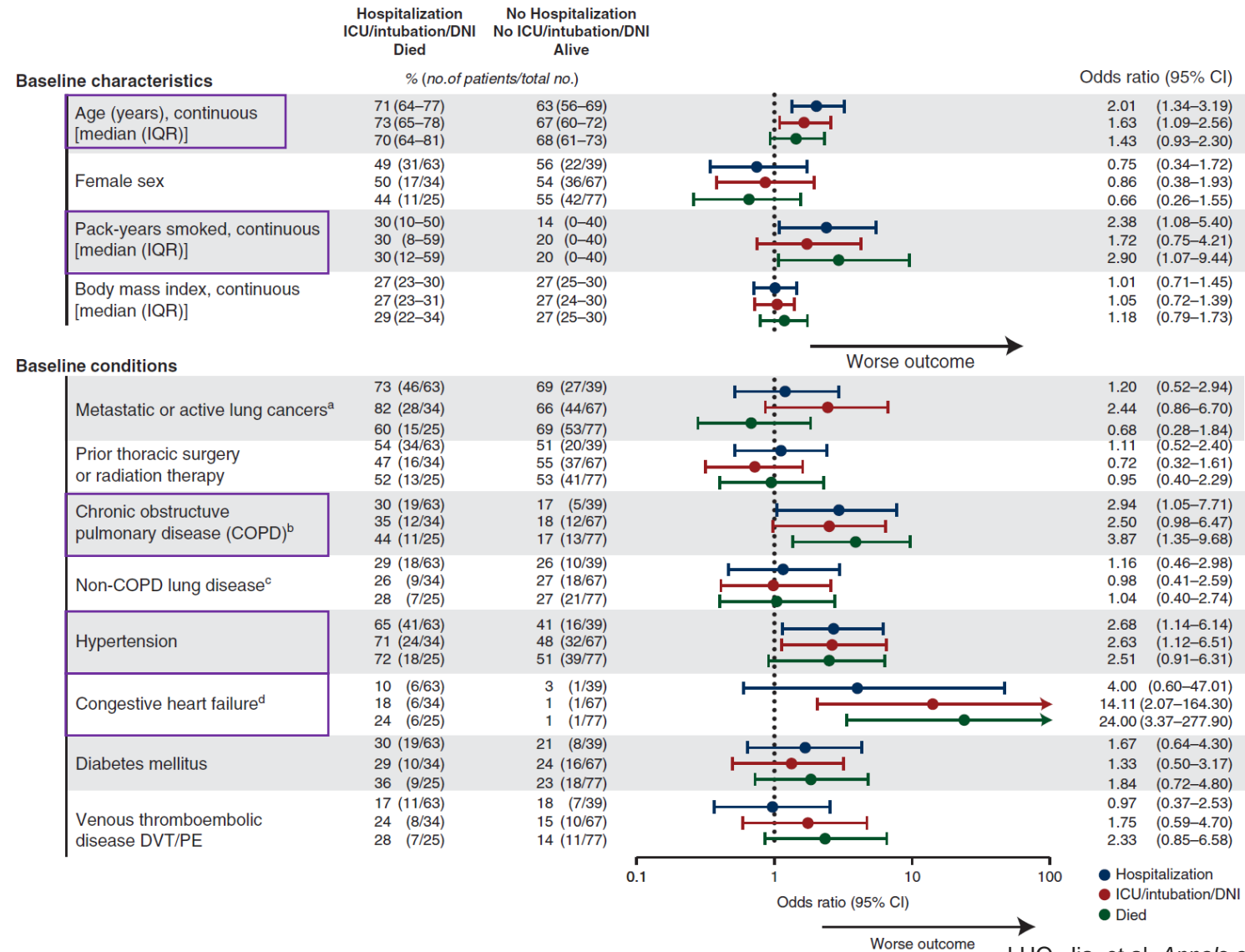
ECOG
Cancer status

Cytotoxic chemotherapy
Use of steroids

COVID-19 in patients with lung cancer



COVID-19 in patients with lung cancer



Contents

1. Lung cancer → Covid-19

- 1) Covid-19 in patients with lung cancer
- 2) Impact of cancer treatment on Covid-19
- 3) Vaccination

2. Covid-19 → Lung cancer

- 1) Impact of Covid-19 pandemic on lung cancer
- 2) Guideline on Covid-19 pandemic
- 3) Cancer treatment in Covid-19 patients

COVID-19 outcome according to cancer treatment

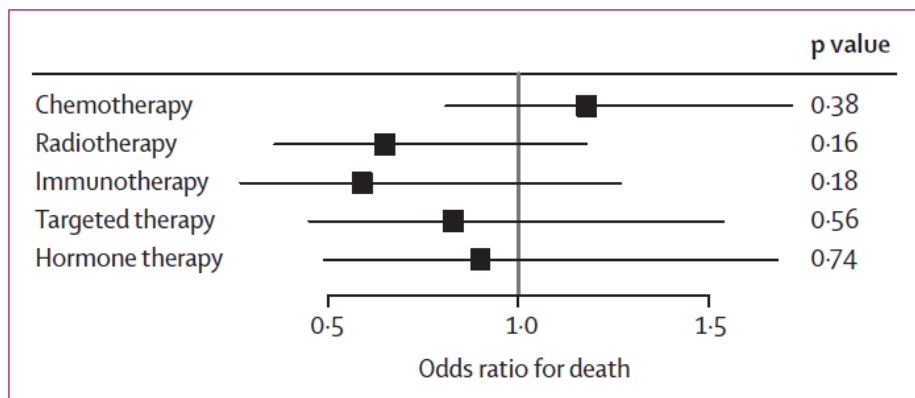
Table 5. Univariate and multivariable models of factors associated with outcomes

Variables	Univariate logistic regression analysis		Multivariable logistic regression analysis	
	Odds ratio (95% CI)	P ^a	Odds ratio (95% CI)	P ^a
Age (>65 y)	3.57 (1.80 to 7.06)	<.001	3.16 (1.45 to 6.88)	.004
Sex (male)	2.10 (1.07 to 4.13)	.03	2.29 (1.07 to 4.87)	.03
Comorbidities (all)	2.00 (1.04 to 3.85)	.04	—	—
Hypertension vs no	3.10 (1.38 to 6.99)	.006	1.37 (0.51 to 3.71)	.53
Diabetes vs no	4.16 (1.31 to 13.20)	.02	2.73 (0.76 to 9.81)	.13
Cardiovascular disease vs no	2.13 (0.74 to 6.14)	.16	—	—
Hematological vs lung	0.68 (0.14 to 3.28)	.63	—	—
Other solid cancer vs lung	0.80 (0.37 to 1.74)	.58	—	—
Treatment vs no	0.98 (0.51 to 1.90)	.95	—	—
Chemotherapy vs no	0.94 (0.40 to 2.20)	.89	—	—
Immunotherapy vs no	4.00 (0.77 to 20.90)	.10	—	—
Target therapy vs no	0.38 (0.08 to 1.94)	.25	—	—
Radiotherapy vs no	0.56 (0.18 to 1.71)	.31	—	—
Surgery vs no	1.00 (0.32 to 3.12)	1.00	—	—

^a P values were calculated using the Wald χ^2 2-sided test. CI = confidence interval.

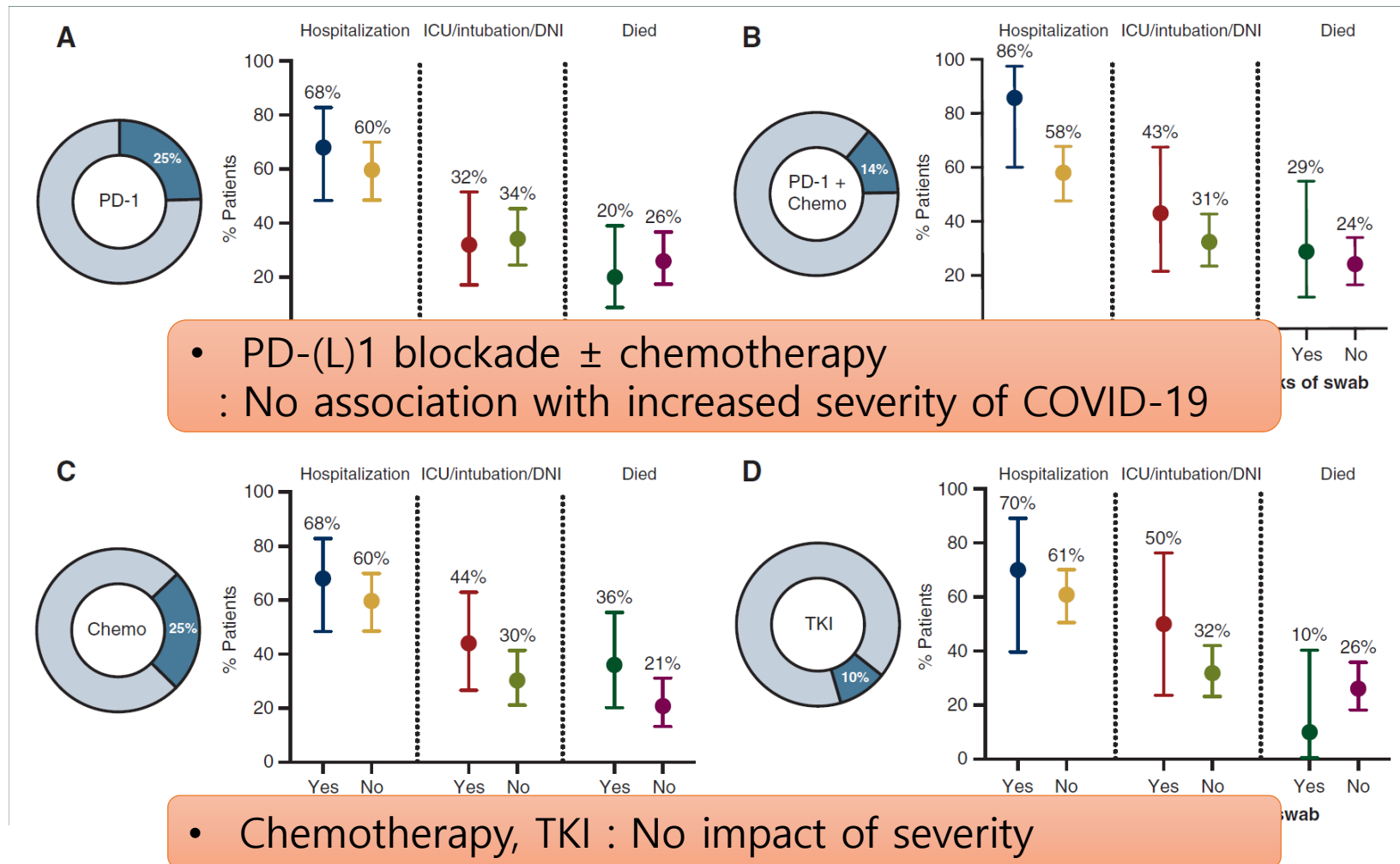
COVID-19 mortality ↔ anticancer treatment

	Odds ratio (95% CI)	p value	Adjusted p value
Sex	1.67 (1.19-2.34)	0.003	0.006
Age	9.42 (6.56-10.02)	<0.0001	<0.0001
Cancer treatment within 4 weeks of COVID-19 diagnosis			
Chemotherapy	0.78 (0.55-1.11)	0.173	1.000
Hormone therapy	1.16 (0.64-2.06)	0.659	1.000
Immunotherapy	0.60 (0.27-1.24)	0.179	1.000
Radiotherapy	0.66 (0.37-1.17)	0.178	1.000
Surgery	0.83 (0.32-2.15)	0.825	1.000
Targeted treatment	0.56 (0.30-1.01)	0.058	0.525



	Odds ratio (95% CI)	p value
Anticancer treatment within 4 weeks of COVID-19 diagnosis		
Chemotherapy vs no chemotherapy	1.18 (0.81-1.72)	0.380
Hormone therapy vs no hormone therapy	0.90 (0.49-1.68)	0.744
Immunotherapy vs no immunotherapy	0.59 (0.27-1.27)	0.177
Radiotherapy vs no radiotherapy	0.65 (0.36-1.18)	0.159
Targeted treatment vs no targeted treatment	0.83 (0.45-1.54)	0.559
Cytotoxic chemotherapy		
Non-palliative chemo vs palliative chemo	0.40 (0.17-0.96)	0.040
Palliative first-line chemotherapy vs other line	0.84 (0.36-1.98)	0.690
Palliative chemotherapy vs no chemotherapy	1.48 (0.93-2.36)	0.102
Palliative chemotherapy vs no treatment	1.05 (0.63-1.76)	0.854
Multivariate analysis was done correcting for age, sex, and patient comorbidities.		

Impact of cancer therapy on COVID-19 severity



COVID-19 outcomes in thoracic cancer patients

- 1012 patients from 20 countries
- 65% on treatment - 38% chemotherapy, 26% ICI, 16% TKI
- Only 33% of patients continued their oncology treatment after infection
- **Increased risk of death:** age ≥ 65 (OR 1.53 CI 1.11-2.1), active smoking (OR 2 CI 1.3-3), higher stage of cancer (OR 1.9 CI 1.3-2.7), ECOG PS ≥ 2 (OR 3.7 CI 2.7-5), steroids prior to COVID diagnosis (OR 1.8 CI 1.2-2.7)
- Chemotherapy and TKI therapy use were not and interestingly patients on immunotherapy appeared to be at **decreased risk for mortality** (OR 0.6 CI 0.5-0.97).

COVID-19 outcomes in patients ± cancer

Table 2. Logistic Regression Models of Adverse Outcomes Among Patients Diagnosed With COVID-19^a

Variable	30-d Mortality		30-d Mechanical ventilation		30-d ICU stay		30-d Hospitalization	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Patient group								
Without cancer	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
With no recent treatment	0.93 (0.84-1.02)	.12	0.61 (0.54-0.68)	<.001	0.98 (0.91-1.06)	.61	0.79 (0.75-0.83)	<.001
With recent treatment	1.74 (1.54-1.96)	<.001	1.00 (0.88-1.13)	.94	1.69 (1.54-1.87)	<.001	1.19 (1.11-1.27)	<.001
Age, y								
18-39	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
40-49	2.83 (2.37-3.39)	<.001	2.22 (2.02-2.45)	<.001	1.71 (1.60-1.82)	<.001	1.11 (1.07-1.14)	<.001
50-54	4.59 (3.83-5.49)	<.001	3.19 (2.89-3.53)	<.001	2.1 (1.95-2.25)	<.001	1.39 (1.34-1.44)	<.001
55-59	6.10 (5.15-7.23)	<.001	4.20 (3.82-4.61)	<.001	2.62 (2.45-2.81)	<.001	1.71 (1.66-1.77)	<.001
60-64	9.86 (8.40-11.57)	<.001	5.30 (4.84-5.81)	<.001	2.89 (2.70-3.08)	<.001	2.03 (1.97-2.10)	<.001
65-69	15.90 (13.58-18.61)	<.001	6.80 (6.19-7.46)	<.001	3.48 (3.25-3.73)	<.001	2.67 (2.58-2.76)	<.001
70-74	22.52 (19.23-26.37)	<.001	7.44 (6.75-8.20)	<.001	4.15 (3.86-4.47)	<.001	3.28 (3.16-3.41)	<.001
75-79	33.88 (28.92-39.69)	<.001	8.31 (7.50-9.21)	<.001	4.65 (4.30-5.02)	<.001	4.11 (3.94-4.28)	<.001
80-84	52.07 (44.43-61.02)	<.001	7.09 (6.34-7.94)	<.001	5.31 (4.89-5.76)	<.001	5.10 (4.87-5.34)	<.001
≥85	94.65 (81.10-110.48)	<.001	4.84 (4.31-5.44)	<.001	6.69 (6.19-7.22)	<.001	6.50 (6.22-6.78)	<.001
Sex								
Female	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Male	1.70 (1.62-1.78)	<.001	1.98 (1.90-2.06)	<.001	1.51 (1.46-1.56)	<.001	1.25 (1.23-1.28)	<.001
Race and ethnicity^b								
Hispanic	1.20 (1.10-1.31)	<.001	1.78 (1.67-1.9)	<.001	1.56 (1.48-1.64)	<.001	1.92 (1.87-1.97)	<.001
Non-Hispanic								
Black	0.98 (0.92-1.05)	.56	1.33 (1.27-1.4)	<.001	1.39 (1.33-1.45)	<.001	1.66 (1.62-1.70)	<.001
White	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Other	1.36 (1.27-1.47)	<.001	1.81 (1.70-1.92)	<.001	1.12 (1.06-1.18)	<.001	1.29 (1.26-1.33)	<.001
Severe obesity: BMI ≥40								
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Yes	1.61 (1.50-1.73)	<.001	1.82 (1.72-1.92)	<.001	1.41 (1.35-1.48)	<.001	1.64 (1.60-1.68)	<.001
Charlson-Deyo Comorbidity Index score^c								
0	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
1	1.91 (1.78-2.05)	<.001	2.30 (2.17-2.44)	<.001	2.39 (2.28-2.49)	<.001	1.97 (1.92-2.01)	<.001
≥2	3.49 (3.29-3.70)	<.001	4.83 (4.59-5.09)	<.001	3.86 (3.70-4.02)	<.001	3.22 (3.15-3.29)	<.001

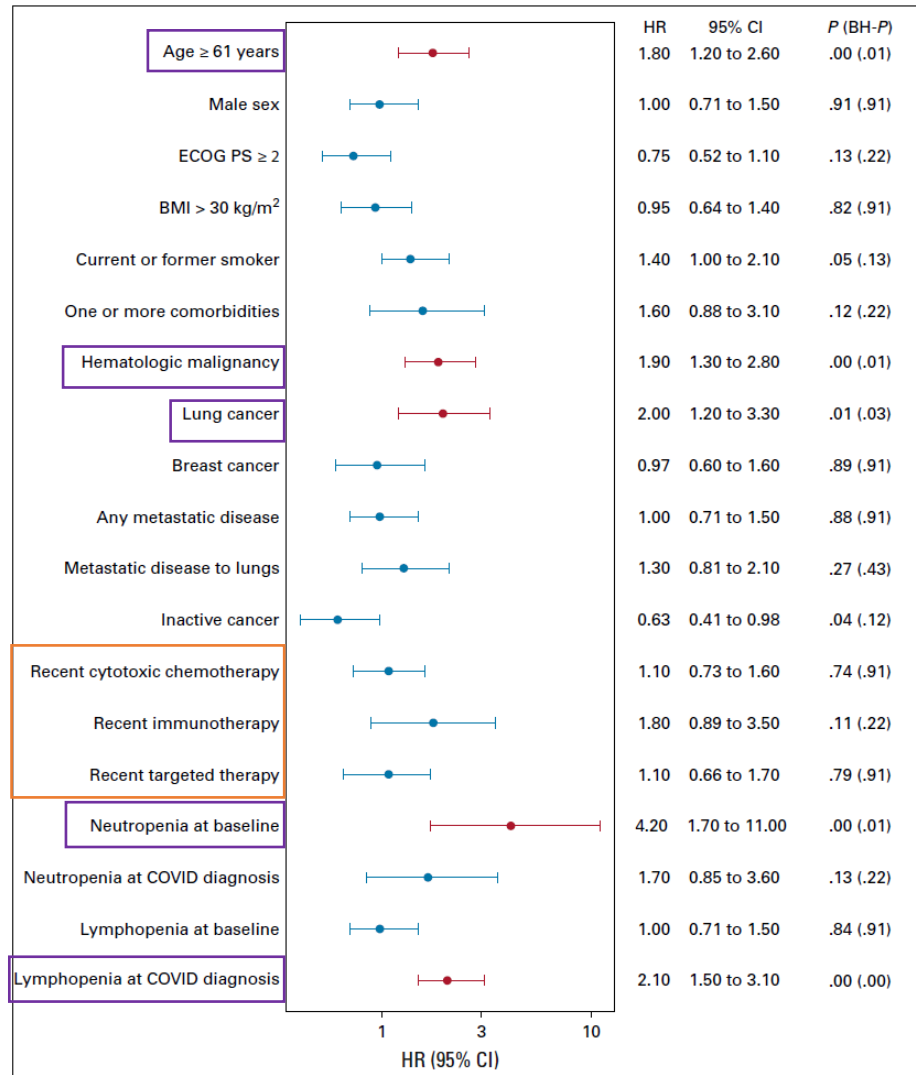
N=507307 patients
 Patient without cancer = 493020
 Patient with cancer
 with no recent treatment = 9991
 with recent treatment = 4296

COVID-19 outcomes in patients with cancer

Table 2. Logistic Regression Models of Adverse Outcomes Among Patients Diagnosed With COVID-19^a

Variable	30-d Mortality		30-d Mechanical ventilation		30-d ICU stay		30-d Hospitalization	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
Patient group								
Without cancer	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
With no recent treatment	0.93 (0.84-1.02)	.12	0.61 (0.54-0.68)	<.001	0.98 (0.91-1.06)	.61	0.79 (0.75-0.83)	<.001
With recent treatment	1.74 (1.54-1.96)	<.001	1.00 (0.88-1.13)	.94	1.69 (1.54-1.87)	<.001	1.19 (1.11-1.27)	<.001
Radiotherapy ^e								
No	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Yes	1.72 (1.28-2.31)	<.001	1.36 (0.96-1.93)	.08	1.47 (1.15-1.89)	.002	1.59 (1.32-1.92)	<.001
Systemic treatment ^e								
None	1 [Reference]		1 [Reference]		1 [Reference]		1 [Reference]	
Chemotherapy	1.84 (1.51-2.26)	<.001	1.74 (1.39-2.17)	<.001	2.21 (1.89-2.59)	<.001	1.40 (1.24-1.58)	<.001
Immunotherapy	0.88 (0.63-1.25)	.49	1.54 (1.07-2.22)	.02	1.15 (0.87-1.51)	.32	1.02 (0.85-1.22)	.83
Chemoimmunotherapy	2.31 (1.45-3.66)	<.001	3.64 (2.24-5.93)	<.001	3.29 (2.27-4.78)	<.001	2.22 (1.62-3.03)	<.001
Endocrine therapy or targeted therapy	1.08 (0.81-1.45)	.60	1.47 (1.09-1.97)	.01	0.80 (0.61-1.04)	.10	1.06 (0.91-1.23)	.47
Antilymphocyte/anti-CD20/SCT	1.51 (0.97-2.35)	.07	1.37 (0.87-2.15)	.18	1.25 (0.86-1.81)	.25	1.52 (1.18-1.95)	.001

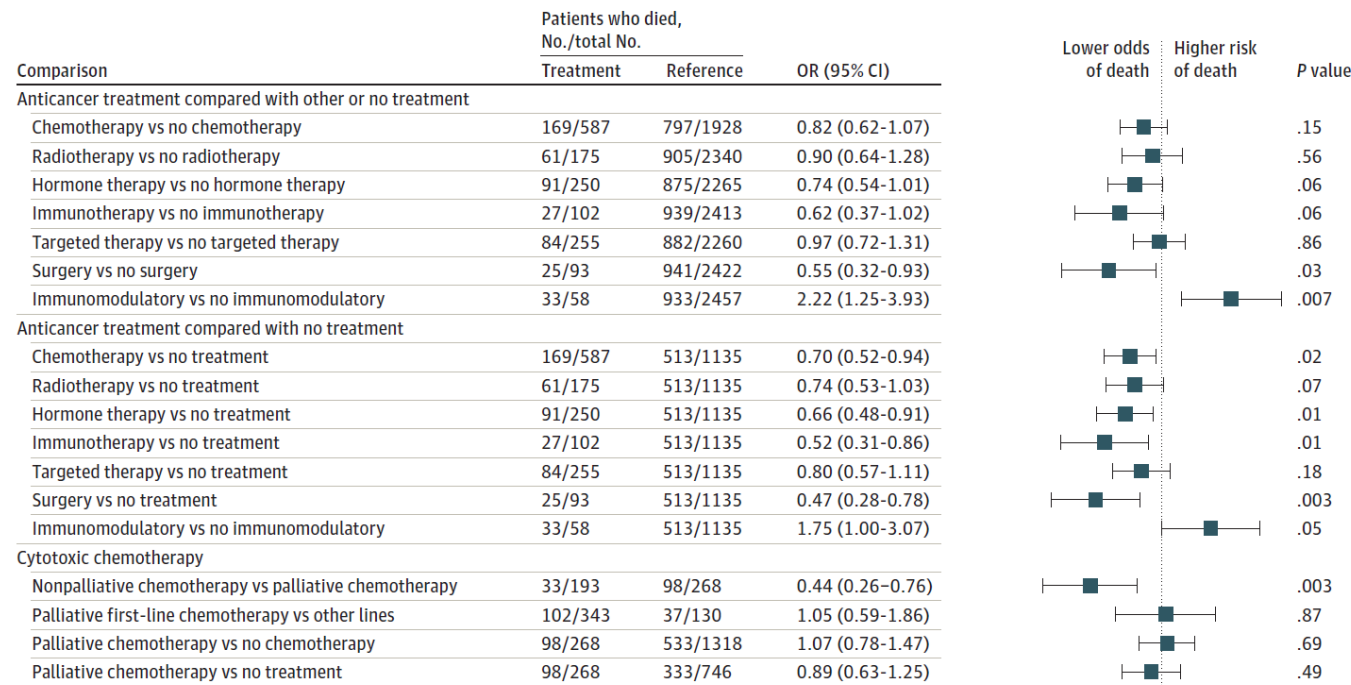
Chemotherapy and COVID-19 Outcomes in Patients with cancer



- 309 patients
- Cytotoxic chemotherapy administration was not significantly associated with a severe or critical COVID-19 event (HR, 1.10; 95% CI, 0.73 to 1.60).
- Hematologic malignancy was associated with increased COVID-19 severity (HR, 1.90; 95% CI, 1.30 to 2.80). Patients with lung cancer also demonstrated higher rates of severe or Critical COVID-19 events (HR, 2.0; 95% CI, 1.20 to 3.30).
- **Lymphopenia at COVID-19 diagnosis** was associated with **higher rates of severe or critical illness** (HR, 2.10; 95% CI, 1.50 to 3.10).
- **Patients with baseline neutropenia** 14-90 days before COVID-19 diagnosis had **worse outcomes** (HR, 4.20; 95% CI, 1.70 to 11.00).

COVID-19 mortality in cancer patients undergoing chemotherapy or immunotherapy

Figure 1. Association Between Anticancer Treatment Within 4 Weeks of COVID-19 Diagnosis and All-Cause Mortality

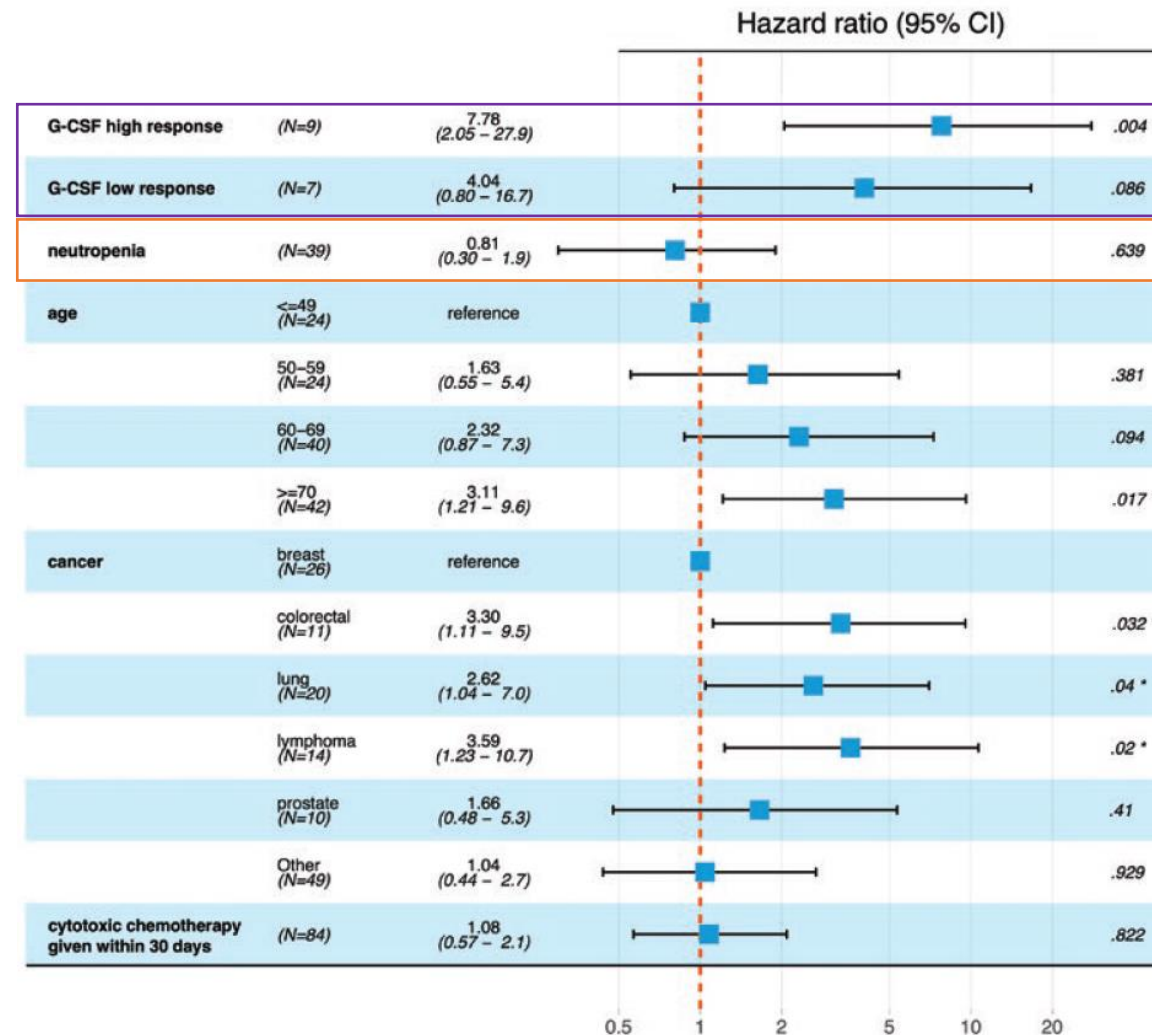


- 2515 Patients
- **No association** between higher mortality and receiving chemotherapy in the 4 weeks before COVID-19 diagnosis
- Association between **lower mortality** and receiving immunotherapy in the 4 weeks before COVID-19 diagnosis was observed (immunotherapy vs no cancer therapy: OR, 0.52; 95%CI, 0.31-0.86)

Association between higher mortality and chemotherapy in patients with hematological cancer → reclassification of immunomodulatory treatments into a separate category (58 patients)

Effect of Neutropenia and Filgrastim (G-CSF) on Cancer Patients With COVID-19 Infection

- 379 actively treated cancer patients with COVID-19



Contents

1. Lung cancer → Covid-19

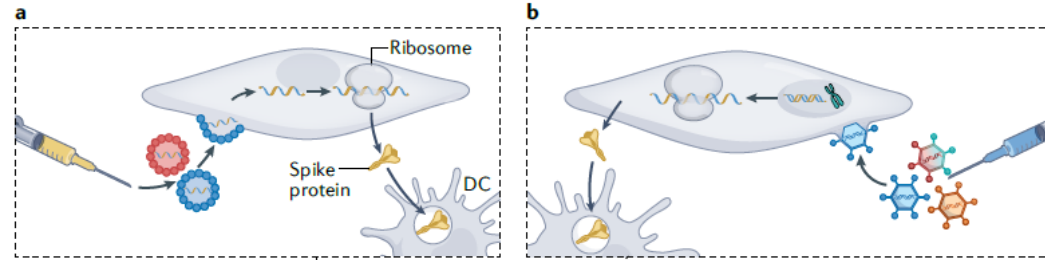
- 1) Covid-19 in patients with lung cancer
- 2) Impact of cancer treatment on Covid-19
- 3) Vaccination

2. Covid-19 → Lung cancer

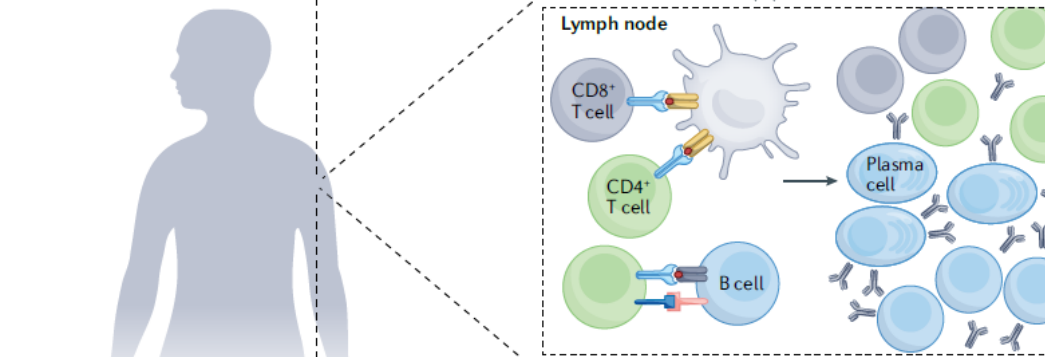
- 1) Impact of Covid-19 pandemic on lung cancer
- 2) Guideline on Covid-19 pandemic
- 3) Cancer treatment in Covid-19 patients

Immune responses by COVID-19 vaccines

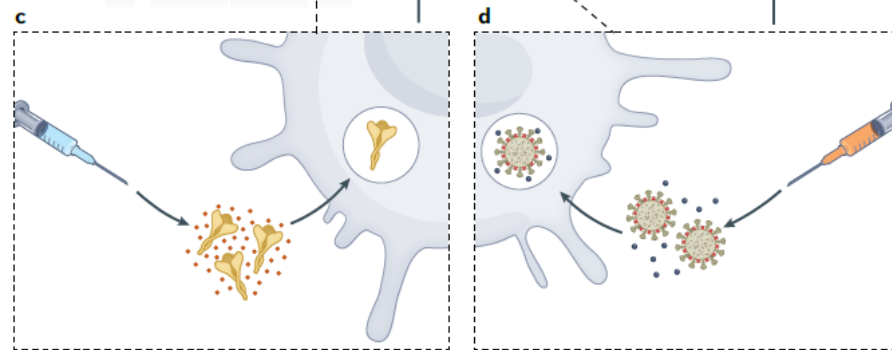
mRNA vaccines
(including BNT162b2
and mRNA-1273)



Adenoviral vector vaccines
(including ChAdOx1,
Ad26.COVS.2 and Sputnik V)



Protein-based vaccines
(including NVX-
CoV2373)



Attenuated virus vaccines
(including CoronaVac and
BBIBP-CorV)

Risk factors for reduced antibody response after vaccination

Patients with solid tumours

- Metastatic disease¹²⁴
- Advanced age^{65,99,103,127,224}
- Male sex^{99,103}

Patients with haematological malignancies

- Lymphoproliferative disorders (especially non-Hodgkin lymphoma) compared to myeloid malignancies¹⁴⁵
- Active disease^{119,122,125,225}
- Advanced age^{122,131,226–228}
- Male sex^{131,226,228}
- Immunoparesis (immunoglobulin deficiency or lymphopenia)^{122,134,225,226,229–231}

Plasma cell disorders

- Higher number of prior lines of therapy (more than four)^{122,225,228}

Allogeneic stem cell transplantation

- Advanced age^{232,233}
- Active graft-versus-host disease^{160,232,234,235}
- Lymphopenia^{160,236–238}

- **Reduced antibody response in solid tumor**
 - Advanced age
 - Male sex
 - Metastatic disease
- mRNA vaccines are more effective than adenovirus-vectored vaccines in cancer patients

Risks of reduced antibody responses after COVID-19 vaccination associated with cancer treatments

Relevant reduction in antibody response likely (>50% of patients, most prominent in patients currently undergoing therapy)

- B cell depletion with monoclonal antibodies^a, BTK inhibitors or BCL inhibitors^{69,100,109,125,129,131,134,145,226,227,229,231,239-244}
- BCMA-targeted therapies^{133,163,230,239}
- CD38-targeted therapies^{133,163,230,239,244,245}
- JAK inhibitors^{69,231}

Relevant reduction in antibody response possible (<50% of patients, probably dependent on dosing)

- Chemotherapy^{b,99,100,105,106,121,154,224,231,246}
- Steroids^{122,124,125,131,160,228}

- CDK4/6 inhibitors associated with lower binding antibody levels (not a risk factor in REF.²⁴⁷, a risk factor in REF.¹²⁰)
- Poly(ADP-ribose) polymerase inhibition associated with lower binding antibody levels¹²³

Relevant reduction in antibody response uncommon^c

- Endocrine therapy^{100,120,129,248}
- Tyrosine kinase inhibitors^{69,106,231}
- Immune checkpoint inhibitors (reduced immune response may occur in approximately 10% of patients)^{66,100,105,106,120,224,249}
- Immunomodulatory drugs^{163,231,239}
- Proteasome inhibitors^{163,231}

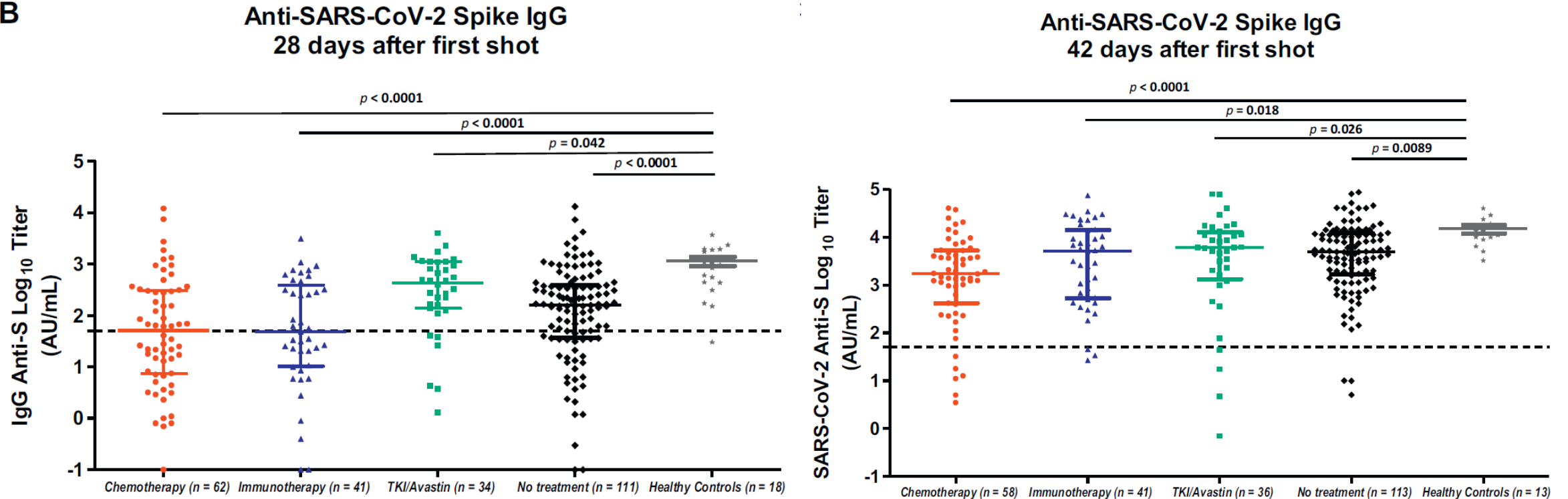
Recent chemotherapy (defined variably as receiving chemotherapy from within 28 days to within 6 months of vaccination) has been repeatedly identified as a risk factor for **lower seroconversion and neutralizing responses**

The timing of the vaccination with regard to the schedule of ongoing chemotherapy does **not seem to affect seroconversion**

Avoid administering vaccines and chemotherapy on the same day to minimize the risks of overlapping acute adverse effects, but do not reschedule cancer therapies

Serologic response to COVID-19 vaccine (BNT162b2)

B



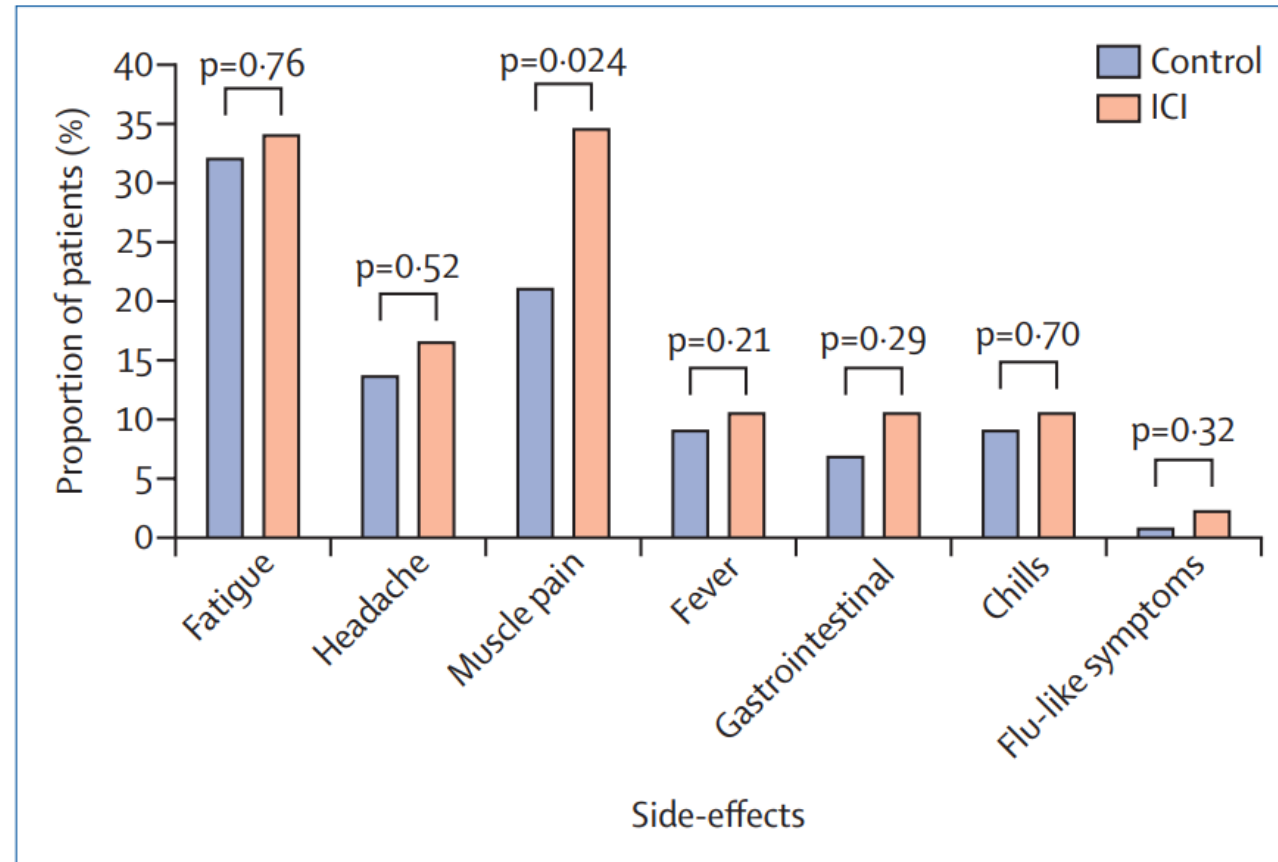
Efficacy of SARS-CoV-2 vaccine in patients with thoracic cancer

- Of the 269 serologic results available beyond day 14 after the second vaccine dose administration, **17 patients (6.3%) were still negative** (<50 arbitrary units/mL, whereas 34 (11%) were less than 300 arbitrary units/mL (12.5th percentile).
- In multivariate analysis, only **age** ($p < 0.01$) and **long-term corticosteroid treatment** ($p = 0.01$) were significantly associated with a **lack of immunization**.
- A total of 30 patients received a third vaccine dose, with **only three patients showing persistently negative serology** thereafter, whereas the others exhibited clear seroconversion.

COVID-19 vaccination (mRNA-1273) in patients receiving treatment for solid tumors

- No new safety signals were observed.
- Grade 3 or worse serious adverse events occurred in no participants in cohort A, three (2%) of 137 patients in cohort B, six (2%) of 244 patients in cohort C, and one (1%) of 163 patients in cohort D, with four events (two of fever, and one each of diarrhea and febrile neutropenia) potentially related to the vaccination.
- There were no vaccine-related deaths.

COVID-19 vaccine in patients with cancer treated with ICIs



mRNA vaccines and immune-related adverse events in cancer patients treated with ICIs

- After a minimum of 30 days of follow-up from the second dose of vaccine, **zero** of the 84 (95% CI, 0.0%-4.5%) patients had **exacerbation of previous irAEs or diagnosis of new irAEs**. One patient died during the 30-day follow up due to cancer progression.
- **No signal of increased risk of development or exacerbation of irAEs after mRNA COVID19 vaccination** (either the Pfizer-BioNTech or Moderna vaccine) among cancer patients who were on active treatment with ICIs.

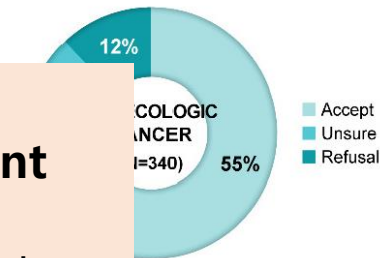
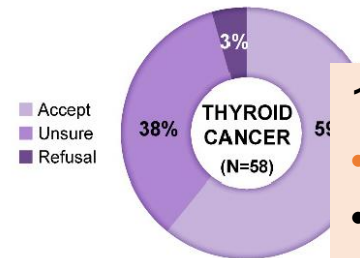
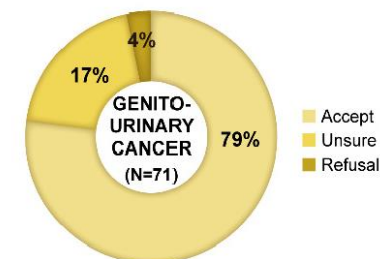
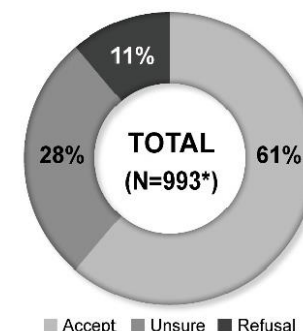
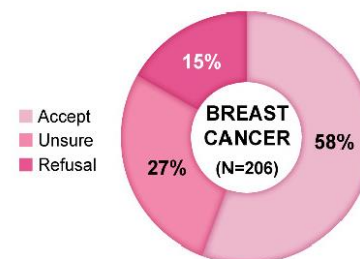
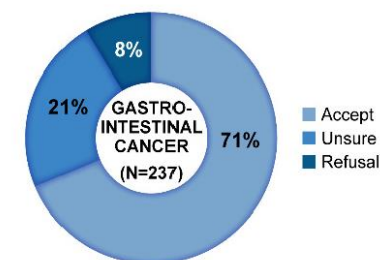
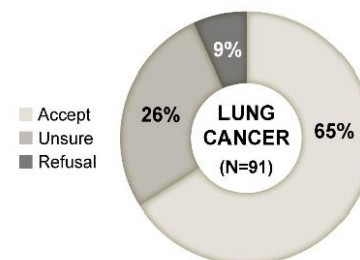
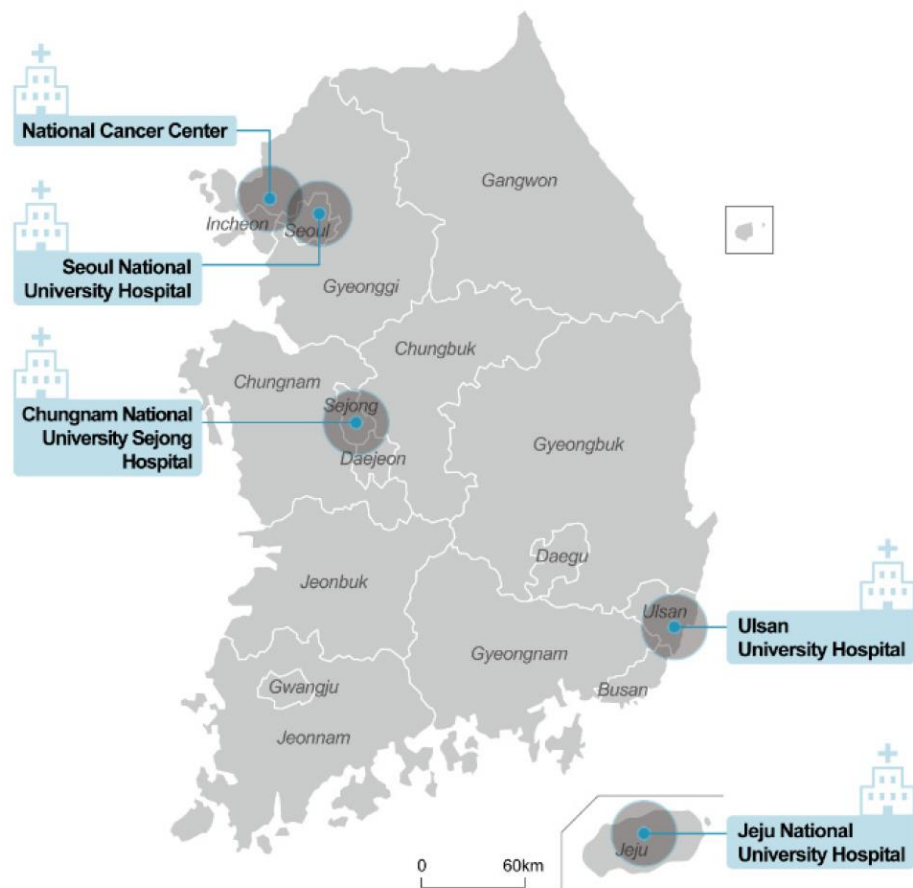
mRNA vaccines and immune-related adverse events in cancer patients treated with ICIs

- After investigating the 152,748 adverse events in the VAERS
- Only six adverse events, which were suspicious for irAEs following COVID-19 vaccine administration

Cases suspicious for irAEs following COVID-19 mRNA vaccine administration.

Age/ Sex ^a	Cancer	ICI ^b	Vaccine manufacturer	Symptoms onset after vaccination	Symptoms or diagnosis	Comments
79/F	Lung cancer	Pembrolizumab	Pfizer-BioNTech	7 days	Respiratory distress	History of pembrolizumab associated pneumonitis
37/M	Thymus cancer	Pembrolizumab	Pfizer-BioNTech	1 day	Acute hemolytic anemia	Labs consistent with haemolytic anaemia
48/M	Kidney cancer	Ipilimumab/nivolumab	Moderna	Same day	Shock requiring pressor support	Home medication includes hydrocortisone 10 mg/5 mg; history of adrenal insufficiency
70/M	Prostate cancer	Pembrolizumab	Pfizer-BioNTech	1 day	Myositis	Labs/Imaging work-up consistent with inflammatory myositis; last pembrolizumab was 2 months ago
77/F	Lung cancer	Pembrolizumab	Pfizer-BioNTech	4 days	Cardiogenic shock	Coronary angiography showed no significant narrowing or blockage; labs showed elevated troponins
68/M	Sarcoma	Pembrolizumab	Moderna	5 days	Pancreatitis/rash	No prior history of pancreatitis

Cancer patients' willingness to take COVID-19 vaccination

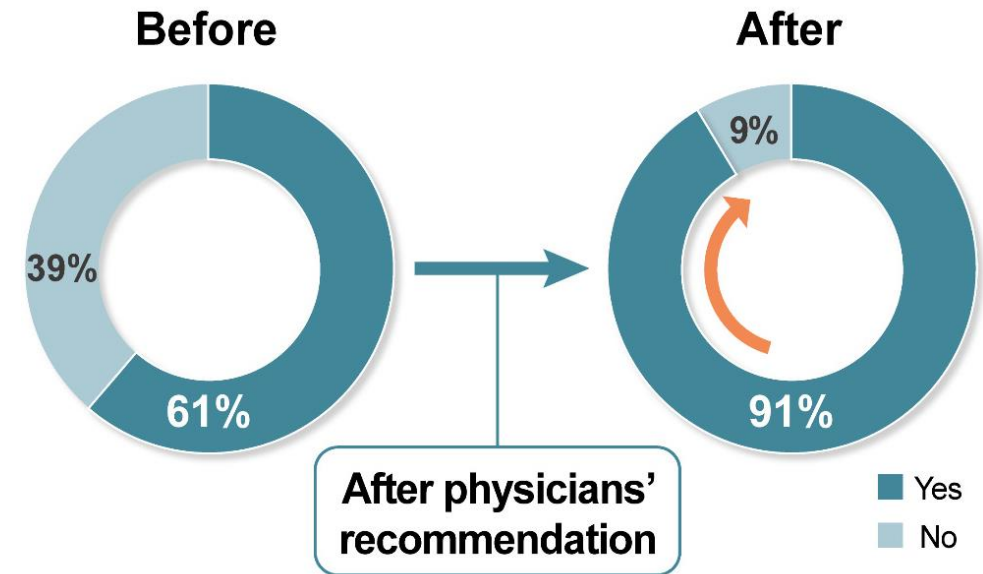


1073 respondents

- **84% : positive intent**
- 10% : undecided
- 6% : negative attitudes

Positive predictive factors associated with vaccination

- Male gender
- Older age
- Obesity
- Previous influenza vaccination history
- Absence of cancer recurrence (no current anticancer treatment)
- Time since cancer diagnosis over 5 years (longer time since cancer diagnosis)



Recommendations of the NCCN Advisory Committee on COVID-19 Vaccination

Patients Treatment/Cancer Type	Timing to Start Series ^{†,‡,¶}
Hematopoietic Cell Transplantation (HCT)/Cellular Therapy	
Allogeneic transplantation Autologous transplantation Cellular therapy (eg, CAR T cell)	At least 3 months post-HCT/cellular therapy ^{a,b}
Hematologic Malignancies	
Receiving intensive cytotoxic chemotherapy (eg, cytarabine/anthracycline-based induction regimens for acute myeloid leukemia)	Delay until absolute neutrophil count (ANC) recovery or for those not expected to recover, as soon as possible
Marrow failure from disease and/or therapy expected to have limited or no recovery	As soon as possible
Long-term maintenance therapy (eg, targeted agents for chronic lymphocytic leukemia, myeloma, or myeloproliferative neoplasms)	As soon as possible ^c
Solid Tumor Malignancies	
Receiving cytotoxic chemotherapy	As soon as possible ^{c,d}
Targeted therapy	As soon as possible
Checkpoint inhibitors and other immunotherapy	As soon as possible ^e
Radiation	As soon as possible
Major surgery	Separate date of surgery from vaccination by at least a few days ^f

- Due to short periods of neutropenia among solid tumor malignancies, **granulocytopenia is not used for timing of vaccination**
- In patients receiving chemotherapy, **optimal timing of vaccination** in relation to cycles of chemotherapy is **unknown**.



- **Mortality**
- **Impact of cancer treatment**
- **Vaccination**



Lung cancer



Contents

1. Lung cancer → Covid-19

- 1) Covid-19 in patients with lung cancer
- 2) Impact of cancer treatment on Covid-19
- 3) Vaccination

2. Covid-19 → Lung cancer

- 1) Impact of Covid-19 pandemic on lung cancer
- 2) Guideline on Covid-19 pandemic
- 3) Cancer treatment in Covid-19 patients

In COVID-19 pandemic...

**Interfere
with initial
diagnosis**

**Delayed
treatment**



COVID-19 PANDEMIC

**Worse
outcome**

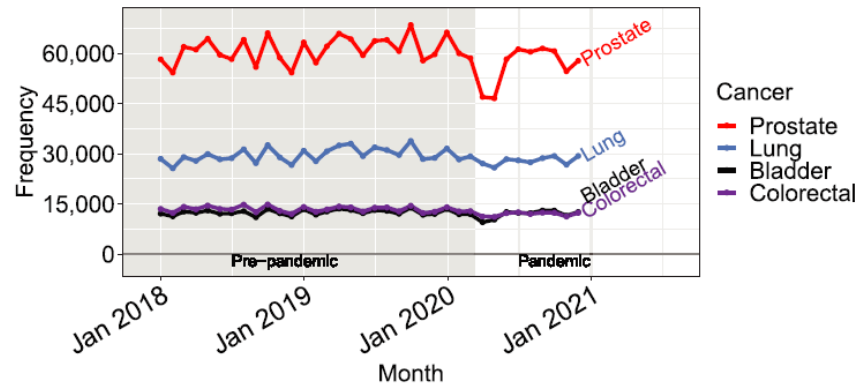
During-COVID vs. Before-COVID

	NSCLC (N=110)		SCLC (N=52)	
	During- COVID (2020) N=43 N (%)	Before-COVID (2019) N=67 N (%)	During- COVID (2020) N=19 N (%)	Before-COVID (2019) N=33 N (%)
Diagnosis				
Incidence (mean)	7 per month	11 per month	3 per month	4 per month
Principal symptom at diagnosis				
Asymptomatic	11 (26%)	25 (37%)	5 (26%)	17 (21%)
Respiratory symptoms	13 (30%)	16 (23%)	6 (32%)	8 (24%)
Pain	6 (14%)	7 (11%)	2 (11%)	3 (9%)
Neurological symptoms	2 (5%)	4 (6%)	1 (5%)	2 (6%)
PS at diagnosis				
0-1	36 (84%)	54 (81%)	13 (68%)	18 (55%)
≥2	7 (16%)	13 (19%)	6 (32%)	15 (45%)
Stage at diagnosis				
Early-stage	8 (19%)	21 (31%)	-	-
Locally advanced	10 (23%)	15 (22%)	9 (48%)*	12 (33%)*
Advanced	25 (58%)	31 (46%)	10 (52%)	22 (67%)
N# mts sites at diagnosis				
≤2	36 (84%)	59 (88%)	14 (74%)	21 (64%)
>2	7 (16%)	8 (12%)	5 (26%)	12 (36%)
Eligible for 1st line therapy (only stage IV)	21 (84%)	21 (68%)	10 (100%)	14 (64%)
Oncology Emergencies				
SVCS	2 (5%)	1 (2%)	1 (5%)	3 (9%)
SCC	1 (2%)	1 (2%)	0	1 (3%)
Hospitalization				
Yes	9 (21%)	12 (18%)	4 (21%)	11 (33%)
No	34 (79%)	55 (82%)	15 (79%)	22 (67%)
Death during hospitalization	4 (44%)	2 (17%)	0	2 (18%)
Early death				
Yes	21 (49%)	17 (25%)	6 (32%)	6 (18%)
No	22 (51%)	50 (75%)	13 (68%)	27 (82%)

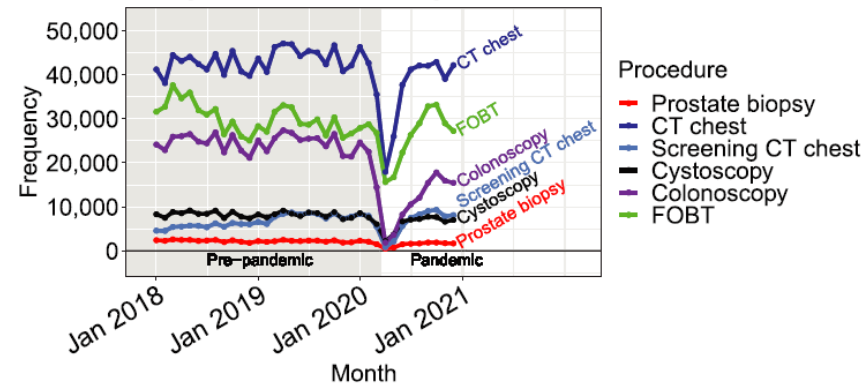
- Lung cancer diagnosis has been affected during the COVID-19 pandemic
- Fewer cases diagnosed and more symptomatic disease compared to 2019, which seems to be associated with worse outcomes.

Impact of COVID-19 pandemic on diagnosis of new cancers

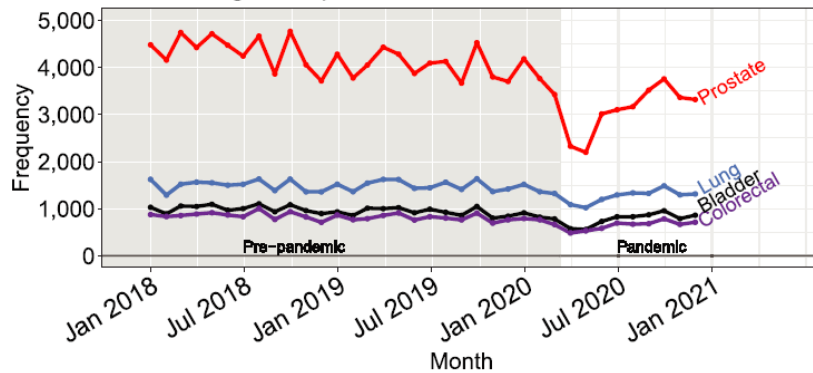
A Cancer outpatient encounters per month



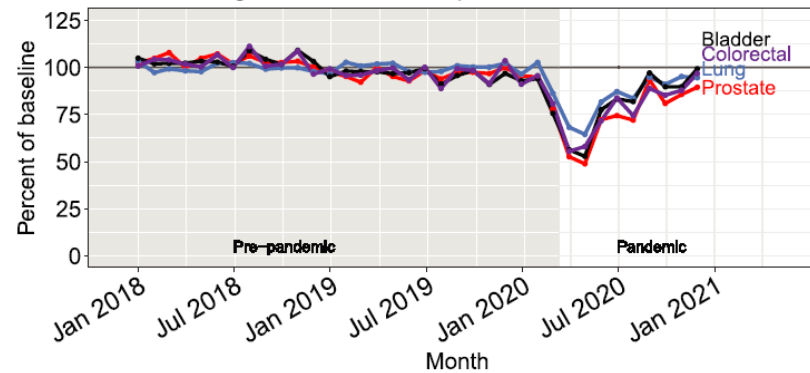
B Cancer diagnostic and screening procedures per month



A New cancer diagnoses per month



B New cancer diagnoses normalized per month



- Substantial reductions in procedures used to diagnose cancer
- Subsequent reductions in new diagnoses of cancer across the United States

COVID-19 impact on DELAYing diagnostic-therapeutic pathways of lung cancer patients in Italy (COVID-DELAY study)

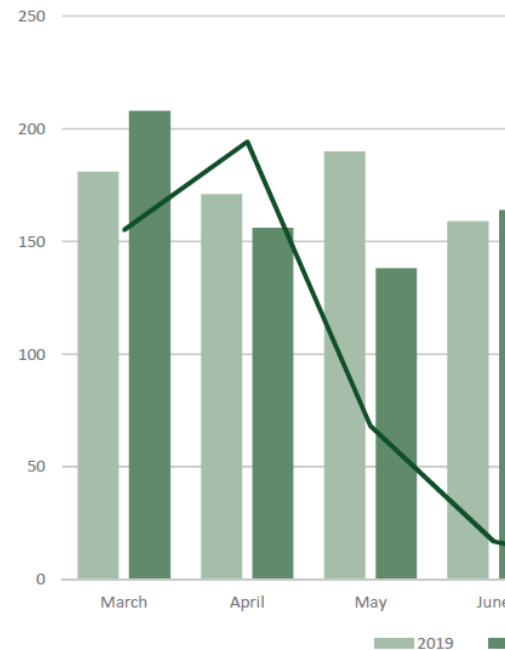
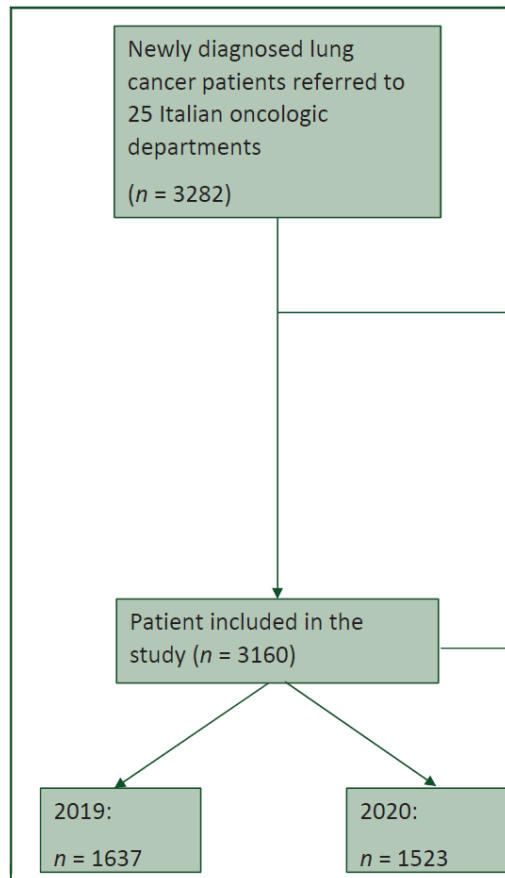
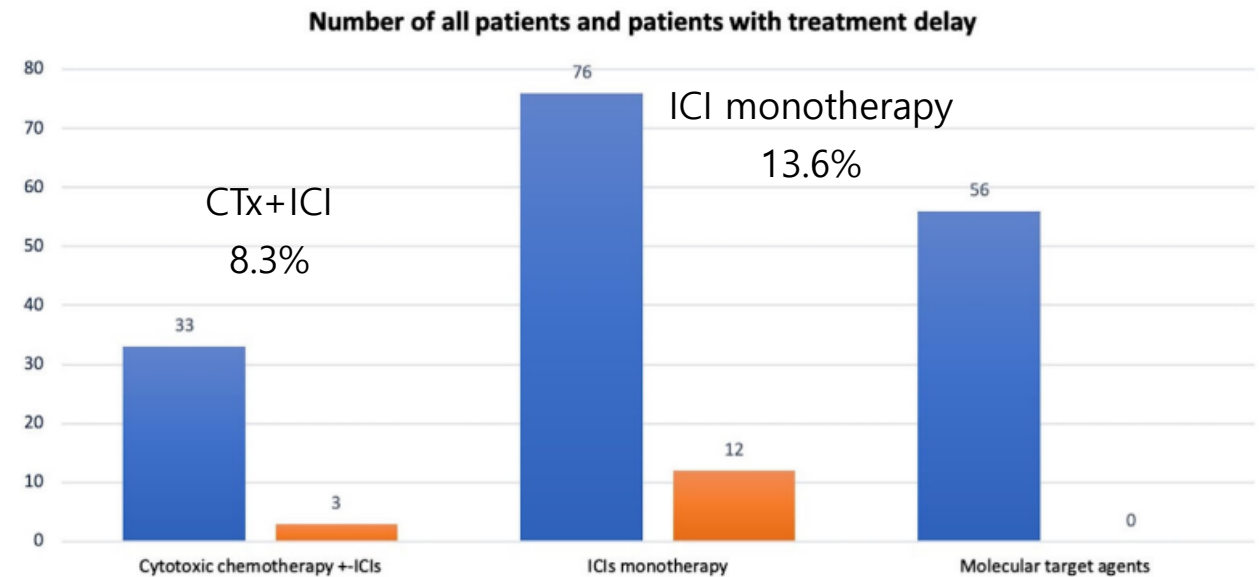
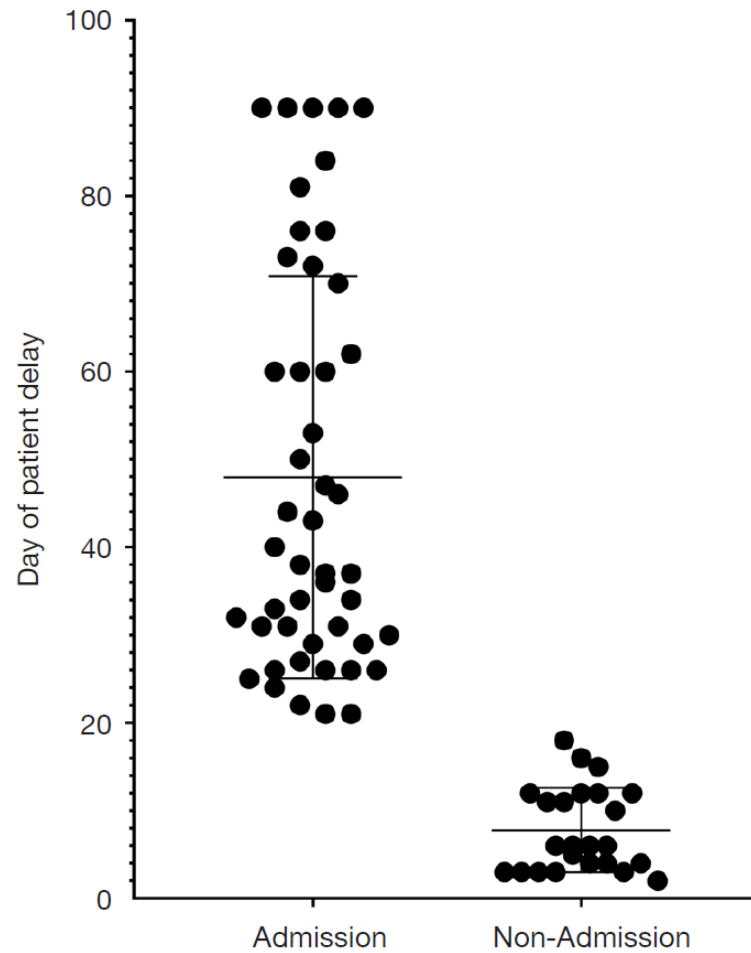


Table 1. Patient baseline characteristics by year of diagnosis

Characteristic	2019	2020	P value ^a
Patients, <i>n</i>	1637	1523	
Monthly access rate, <i>n</i>	163.7	152.3	0.09
Median age, years (IQR)	69 (13)	69 (14)	0.96
Male, <i>n</i> (%)	1028 (63)	974 (64)	0.53
Smoking status, <i>n</i> (%)			<0.01 ^b
Current smoker	550 (34)	589 (39)	
Former smoker	834 (52)	697 (46)	
Never smoker	212 (14)	220 (15)	
Asymptomatic disease onset, <i>n</i> (%)	243 (19)	300 (21)	<0.01 ^b
Tumor histology			0.04 ^b
NSCLC adenocarcinoma, <i>n</i> (%)	1007 (61)	984 (65)	
NSCLC squamocellular carcinoma, <i>n</i> (%)	303 (19)	267 (18)	
NSCLC others, <i>n</i> (%)	142 (9)	90 (6)	
SCLC, <i>n</i> (%)	180 (11)	175 (11)	
Stage at diagnosis, <i>n</i> (%)			<0.01 ^b
Stage I	106 (6)	71 (5)	
Stage II	126 (8)	69 (4)	
Stage III	304 (19)	281 (19)	
Stage IV	1083 (67)	1076 (72)	

Patients delays in COVID-19 era



- 161 cases of lung cancer

Contents

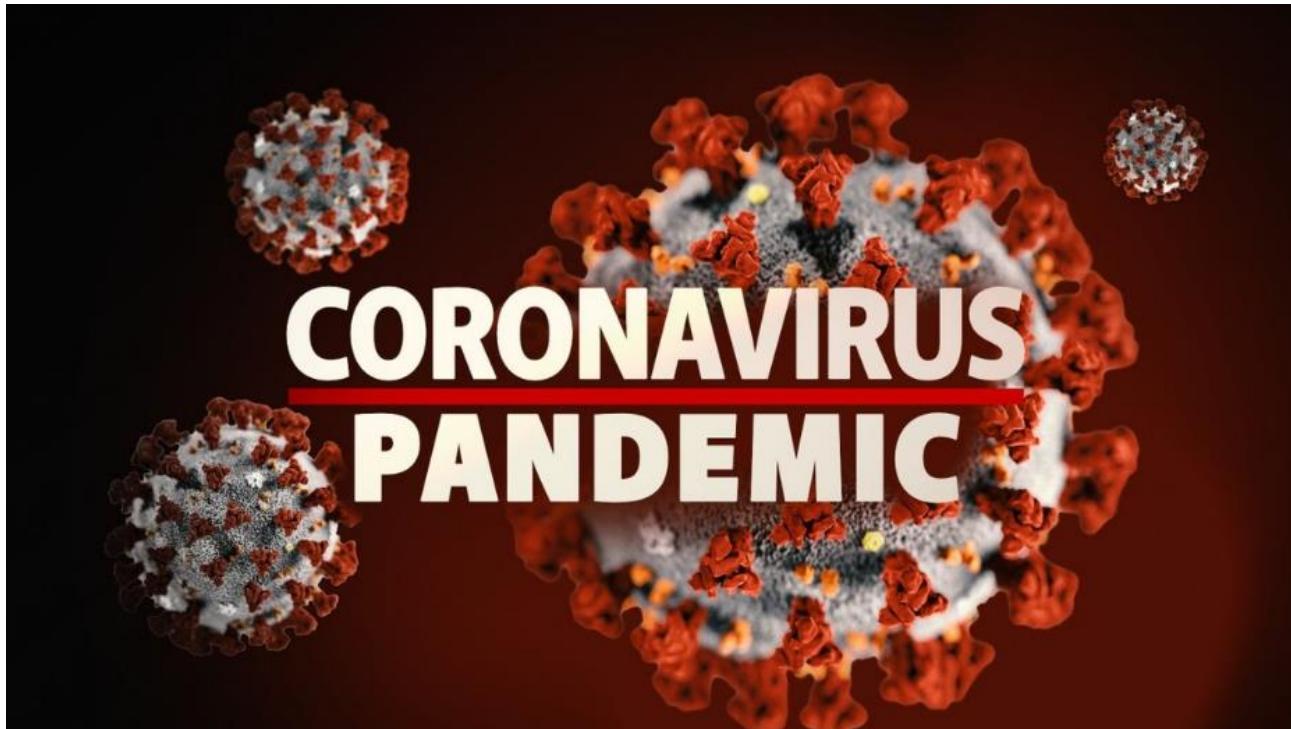
1. Lung cancer → Covid-19

- 1) Covid-19 in patients with lung cancer
- 2) Impact of cancer treatment on Covid-19
- 3) Vaccination

2. Covid-19 → Lung cancer

- 1) Impact of Covid-19 pandemic on lung cancer
- 2) Guideline on Covid-19 pandemic
- 3) Cancer treatment in Covid-19 patients

The Goal of lung cancer patients during the COVID-19 pandemic



To minimize the risk of patient exposure as well as the risks of complication should they contact COVID-19

To diagnose and manage lung cancer, which has a high risk of mortality

코로나19 상황에서 폐암환자 진료에 대한 권고사항

- 코로나 19의 증상에 대해 환자에게 알려야 하며 암환자는 정상인에 비해 면역기능이 저하되어 있는 경우가 많아 적절한 손씻기 등 **개인 위생을 강조**하는 한편, **대중에 대한 노출을 최소화**하도록 합니다. (대한폐암학회)
- 코로나 19의 대유행 단계에서 감염의 위험이 높은 환자는 **외래진료를 통한 검사 및 투약을 권장**하며 가능하다면 **병원 방문을 최소화**합니다. **진행성 또는 전이성 폐암환자에 대한 항암치료나 방사선 치료는 현 시점에서는 연기할 필요는 없습니다.** (대한폐암학회)
- 과거 암치료 시행 후 완치되거나 경과관찰 중인 환자는 현 시점에서 **예정된 검사나 병원 방문을 연기할 필요는 없다.** 단, COVID-19의 확산으로 지역사회 내 의료 자원이 부족한 경우 검사 및 외래 방문을 연기할 수 있다. (대한암학회)

ESMO guideline - Outpatients

	High Priority	Medium Priority	Low Priority
Outpatients	<ul style="list-style-type: none">• New diagnosis of stage \geq II invasive LC with disease-related symptoms• Visits for treatment administration	<ul style="list-style-type: none">• New diagnosis of stage I LC• Follow-up for patients at high risk of relapse• Symptoms from treatment: convert to telemedicine visits where possible	<ul style="list-style-type: none">• Follow-up for patients at low/intermediate risk of relapse• Psychological support: convert to telemedicine

Surgery - ESMO guideline

	High Priority	Medium Priority	Low Priority
Surgery	<ul style="list-style-type: none">• Surgery for T2N0, resectable• T3/T4, resectable N1/N2• Drainage ± pleurodesis of pleural and/or pericardial effusion	<ul style="list-style-type: none">• Surgery for T1AN0• Solid nodules or solid components in partially solid nodules >500 mm³, pleural solid nodules > 1 cm, a volume doubling time <400 days, new solid component in a previously nonsolid nodule	<ul style="list-style-type: none">• Surgery for pure GGO nodule (T1a)• Diagnostic workup or resection of nodules >500 mm³ with a known volume doubling time >600 days

Surgery

- In the early phase of the pandemic, many hospitals were forced to **delay surgical procedures** due to shortages of personal protective equipment (PPE) and ICU beds and overwhelming numbers of COVID-19 patients. Some centers suggested **postponing nonurgent surgical treatments** for NSCLC or to **consider nonsurgical treatment** approaches using stereotactic body radiation therapy (SBRT)
- **Perioperative COVID-19** has been associated with **mortality rates as high as 10%–24%** in the overall surgery population.
- For **patients undergoing surgery for lung cancer**, the UK Lung Cancer Coalition's Clinical Advisory Group stated that **increased mortality as high as 40%–50%** has been seen in patients who contracted COVID-19 following surgery for lung cancer.
- To reduce the risk of operation during the incubation period for COVID-19, patients should receive COVID-19 testing prior to surgery

Surgery

- The **ESMO** recommends keeping all NSCLC surgeries as a priority and that **surgical delays should not last more than 6–8 weeks**.
- The **ASCO** recommends clinicians and patients make **individual determinations of risk and benefit** in proceeding with surgery.
- The **American College of Surgeons** has published **guidelines** on triaging elective cases for surgical care during the COVID-19 pandemic.

ACS COVID-19 Guideline

- **Phase I. Semi-Urgent Setting (Preparation Phase):** Few COVID 19 patients, hospital resources not exhausted, institution still has ICU vent capacity, and COVID trajectory not in rapid escalation phase
 - Surgery restricted to patients likely to have **survivorship compromised if surgery not performed within next 3 month**
- **Phase II. Urgent Setting:** Many COVID 19 patients, ICU and ventilator capacity limited, OR supplies limited or COVID trajectory within hospital in rapidly escalating phase
 - Surgery restricted to patients likely to have **survivorship compromised if surgery not performed within next few days**
- **Phase III.:** Hospital resources are all routed to COVID 19 patients, no ventilator or ICU capacity, OR supplies exhausted.
 - Surgery restricted to patients likely to have **survivorship compromised if surgery not performed within next few hours**

Phase I. Semi-Urgent Setting

- **Cases that need to be done as soon as feasible**
(recognizing status of hospital likely to progress over next few weeks)
 - Solid or predominantly solid (>50%) lung cancer or presumed lung cancer >2cm, clinical node negative
 - Node positive lung cancer
 - Post induction therapy cancer
 - Chest wall tumors of high malignant potential not manageable by alternative therapy
 - Staging to start treatment (mediastinoscopy, diagnostic VATS for pleural dissemination)
 - Patients enrolled in therapeutic clinical trials

Phase I. Semi-Urgent Setting

- **Cases that should be deferred**

- Predominantly ground glass (< 2 cm)
- Indolent histology (e.g. carcinoid, slowly enlarging nodule)
- Thymoma (non-bulky, asymptomatic)
- Pulmonary Oligometastases - unless clinically necessary for pressing therapeutic or diagnostic indications (i.e. surgery will impact treatment)
- Patients unlikely to separate from mechanical ventilation or likely to have prolonged ICU needs (i.e. particularly high-risk patients)
- Tracheal resection (unless aggressive histology)
- Bronchoscopy
- Tracheostomy

Phase I. Semi-Urgent Setting

- **Alternative treatment approaches to be considered**

- (assuming resources permit)**

- If eligible for adjuvant therapy, then give neoadjuvant therapy (e.g. chemotherapy for 5cm lung cancer)
 - Stereotactic Ablative Radiotherapy (SABR)
 - Ablation (e.g. cryotherapy, radiofrequency ablation)
 - Nonsurgical staging (EBUS, Imaging, Interventional Radiology biopsy)
 - Extending chemotherapy (additional cycles) for patients completing a planned neoadjuvant course

Phase II. Urgent Setting

- **Cases that need to be done as soon as feasible**
(recognizing status of hospital likely to progress over next few days)
 - Tumor associated infection – compromising, but not septic (e.g. debulking for post obstructive pneumonia)
 - Management of surgical complications (hemothorax, empyema, infected mesh) – in a hemodynamically stable patient
- **Cases that should be deferred**
 - All thoracic procedures typically scheduled as routine/elective

Radiation therapy - ESMO guideline

	High Priority	Medium Priority	Low Priority
Radiation	<ul style="list-style-type: none">• Unresectable stage II-III not feasible for CT• Life-threatening conditions (SVC obstruction, hemoptysis, spinal cord compression)	<ul style="list-style-type: none">• SABR-SBRT for stage I• Adjuvant PORT for R1• PCI in limited stage SCLC	<ul style="list-style-type: none">• Palliative RT for symptomatic patients• Adjuvant PORT for N2 R0• PCI in extensive stage SCLC may be replaced by MRI active surveillance

Radiation therapy - ESTRO-ASTRO consensus

Would you recommend postponing the initiation of treatment by 4-6 weeks?	
Stage I NSCLC	Yes: 43%
	No: 57%
Stage III NSCLC	Yes: 4%
	No: 96% (strong consensus)
PORT NSCLC	Yes: 82% (strong consensus)
	No: 18%
LS SCLC	Yes: 11%
	No: 89% (strong consensus)
PCI SCLC	Yes: 70% (consensus)
	No: 30%
Palliative NSCLC	Yes: 4%
	No: 96% (strong consensus)

Radiation therapy - ESTRO-ASTRO consensus

	Would you recommend hypofractionating beyond your usual fractionation?
Stage I NSCLC	Yes: 50%
	No: 50%
Stage III NSCLC	Yes: 46%
	No: 54%
PORT NSCLC	Yes: 29%
	No: 71% (consensus)
LS SCLC	Yes: 33%
	No: 67% (consensus)
PCI SCLC	Yes: 7%
	No: 93% (strong consensus)
Palliative NSCLC	Yes: 89% (strong consensus)
	No: 11%

45-54 Gy in 3 Fx, 48 Gy in 4 Fx
 → 30-34 in 1 Fx: 90% support
 if choosing hypofractionation

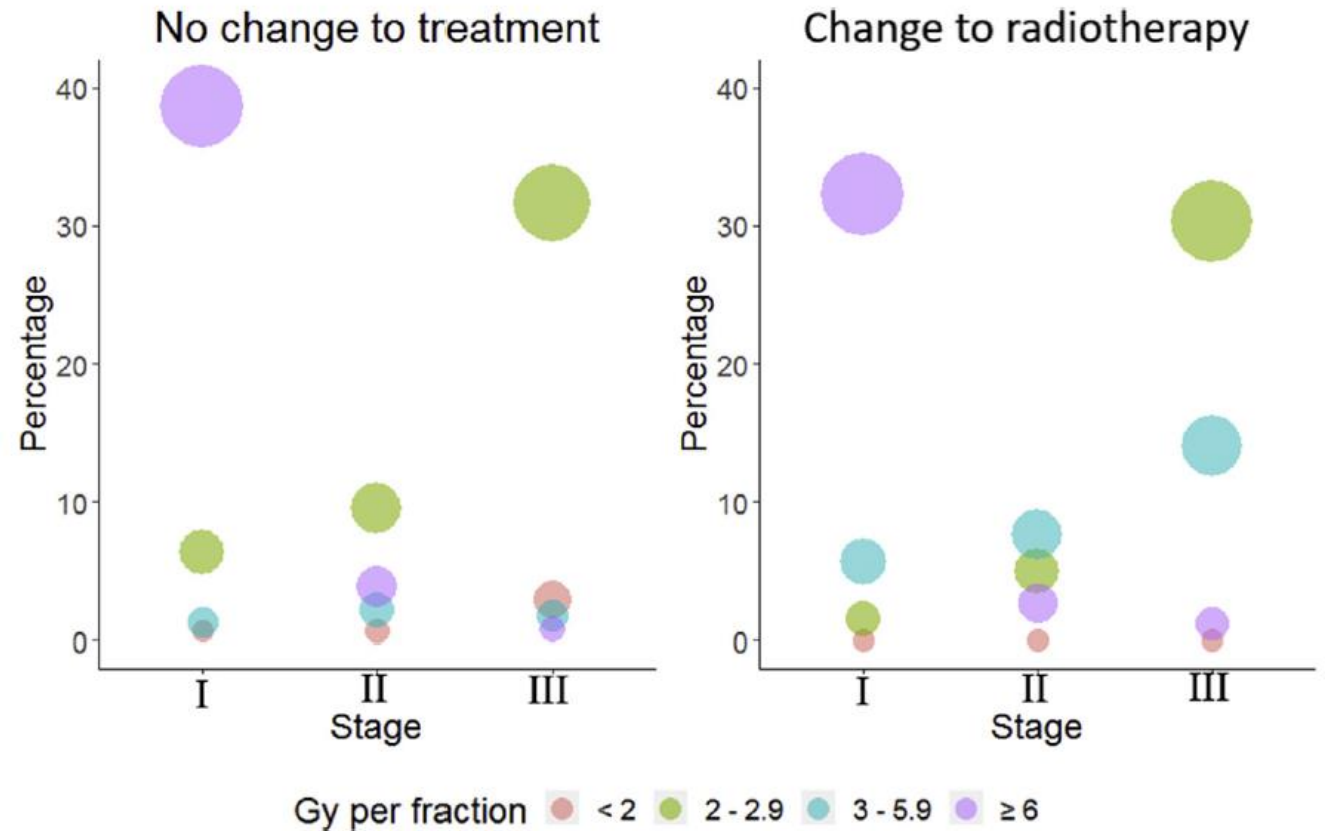
30 Gy in 10 Fx over 2 weeks
 → 20 Gy in 4 Fx (30%)
 17 Gy in 2 Fx (37%)
 8-10 Gy in 1 Fx (33%)

Change to treatment in COVID-19 era

Median number of fractions of radiotherapy: 15 Fx vs. 20 Fx, $p < 0.001$

Changes made to patients' treatment according to lung cancer

Change to treatment
Any change
Change to radiotherapy dose/fractionation
Radiotherapy given instead of surgery
Chemotherapy dose reduced
Chemotherapy omitted
Immunotherapy dose reduced or omitted
Watch and wait
Best supportive care
Other



Chemotherapy - ESMO guideline

	High Priority	Medium Priority	Low Priority
Early stage LC	<ul style="list-style-type: none"> • Adjuvant CT in T3/4 or N2, young and fit patients • Neoadjuvant CT for stage II • Concomitant CT-RT for SCLC stage I/II 	<ul style="list-style-type: none"> • Adjuvant CT in T2b-T3N0 or N1 	<ul style="list-style-type: none"> • Adjuvant CT for stage T1A-T2bN0 with negative prognostic features • Adjuvant CT for elderly or pts with comorbidities
Locally advanced LC	<ul style="list-style-type: none"> • Neoadjuvant CT for NSCLC stage III • Concomitant CT-RT for SCLC or Unresectable NSCLC stage III • Starting consolidation durvalumab (within 42 days) 		

Chemotherapy - ESMO guideline

	High Priority	Medium Priority	Low Priority
Metastatic LC	<ul style="list-style-type: none">• 1st line treatment• Start 2nd line treatment in symptomatic and progressive disease pts• Anti-PD-(L)1 scheduled cycles may be modified/delayed using 4- or 6-weekly dosing	<ul style="list-style-type: none">• Consider oral CT instead of intravenous• Start 2nd and later lines treatment in asymptomatic pts• For pts ongoing with IO from more than 12/18 months, consider enlarging intervals	<ul style="list-style-type: none">• Consider discontinuation of IO after 2 years of treatment

Immunotherapy

- Early in the pandemic, there was concern that immune checkpoint inhibitors (ICIs) may worsen the complications of COVID-19. The concern was that ICIs may increase the cytokine storm causing ARDS of COVID-19, as well as the possibility of overlapping pneumonitis from ICIs and COVID-19.
- **ICIs alone, without chemotherapy, had outcomes equivalent or better to those receiving other cancer treatments.**

Immunotherapy

- **Alternative dosing of immunotherapy regimens**, which are administered less frequently, can and should be considered. This can limit both patient and provider exposures, while retaining efficacy, thereby optimizing the risk–benefit ratio.
 - Pembrolizumab 400 mg given every 6 weeks
 - Nivolumab 480 mg every 4 weeks
 - Atezolizumab 1680mg every 4 weeks
 - Durvalumab 1500 mg every 4 weeks
- Pneumonitis present on CT scans for patients with lung cancer has traditionally had a differential of immunotherapy pneumonitis, radiation pneumonitis, or progressive lung cancer depending on the clinical context. CT findings suggestive of COVID-19 should lead to an appropriate infectious workup for COVID-19.

Targeted therapy

- **Patients receiving targeted therapies do not have increased risk of death** in multivariate analysis
- TKIs are known to cause interstitial-like pneumonitis at varying rates and can be difficult to distinguish from COVID-19 induced pneumonia.
- The clinical picture of new or progressive cough, dyspnea, and/or fever can also be similar. Patients should receive COVID-19 based testing if there is either radiographic or clinical concern

Contents

1. Lung cancer → Covid-19

- 1) Covid-19 in patients with lung cancer
- 2) Impact of cancer treatment on Covid-19
- 3) Vaccination

2. Covid-19 → Lung cancer

- 1) Impact of Covid-19 pandemic on lung cancer
- 2) Guideline on Covid-19 pandemic
- 3) Cancer treatment in Covid-19 patients

코로나19 확진 폐암환자 진료에 대한 권고사항

- 폐암 환자가 코로나 19로 확진이 되었을 경우 **진행 중인 암치료는 중단**하고 코로나 19 치료 여부를 관련 의료진과 상의하여야 합니다. 이후 **코로나 19가 완치되면 암치료를 시작**하도록 합니다. (대한폐암학회)
- 암환자가 COVID-19로 확진이 되었을 경우 **진행 중인 암치료 (예정된 비응급수술, 항암치료, 방사선치료)는 중단**하고 **COVID-19 치료를 선행**하는 것에 대해 의료진과 상의하여야 한다. COVID-19 치료가 선행되어야 하는 경우, 암환자는 고위험군에 속하기 때문에 병원에 입원하여 치료를 하도록 한다. 이후 **COVID-19가 완치되면 암치료를 시작**하도록 한다. (대한암학회)

Surgery in COVID-19 patients

- Patients planned for surgery should undergo RT-PCR testing prior to treatment.
- If the COVID-19 test is positive, **surgical treatment should be delayed for 2 to 3 weeks or until the patient is asymptomatic**. All patients should be tested after their isolation period.
- Physicians and all operating room personnel should be screened daily for fever or COVID-19 symptoms. Healthcare providers with symptoms should be tested for COVID-19 and be quarantined for 2 weeks if the results are positive.
- In urgent surgical cases, procedures can be performed in specialized negative-pressure operating rooms. Surgeons and operating personnel should use full PPE.
- Postoperatively, patients should be treated in negative-pressure isolation rooms. Furthermore, the number of visitors should be drastically reduced or visitors should be prohibited altogether for patients after surgical treatment during their hospital stay

Recommendations on delay or interruption of radiotherapy in COVID-19 patients

	Time patient is diagnosed as COVID-19 positive	Postpone or interrupt RT?
Stage I NSCLC	Start of Tx	Yes: 96% (Strong consensus)
	After start of Tx	Yes: 54%
Stage III NSCLC	Start of Tx	Yes: 100% (Strong consensus)
	After start of Tx	Yes: 57%
PORT NSCLC	Start of Tx	Yes: 96% (Strong consensus)
	After start of Tx	Yes: 68% (Consensus)
LS SCLC	Start of Tx	Yes: 89% (Strong consensus)
	After start of Tx	Yes: 87% (Consensus)
Palliative NSCLC	Start of Tx	Yes: 74% (Consensus)
	After start of Tx	Yes: 78% (Consensus)

- Radiotherapy **postponement or discontinuation** for COVID-19-positive patients should always be considered to avoid the exposure of negative patients and health care personnel to a risk of infection

Anti-cancer therapy for COVID-19 patients

Should cancer therapy be delayed in patients who are infected with COVID-19?



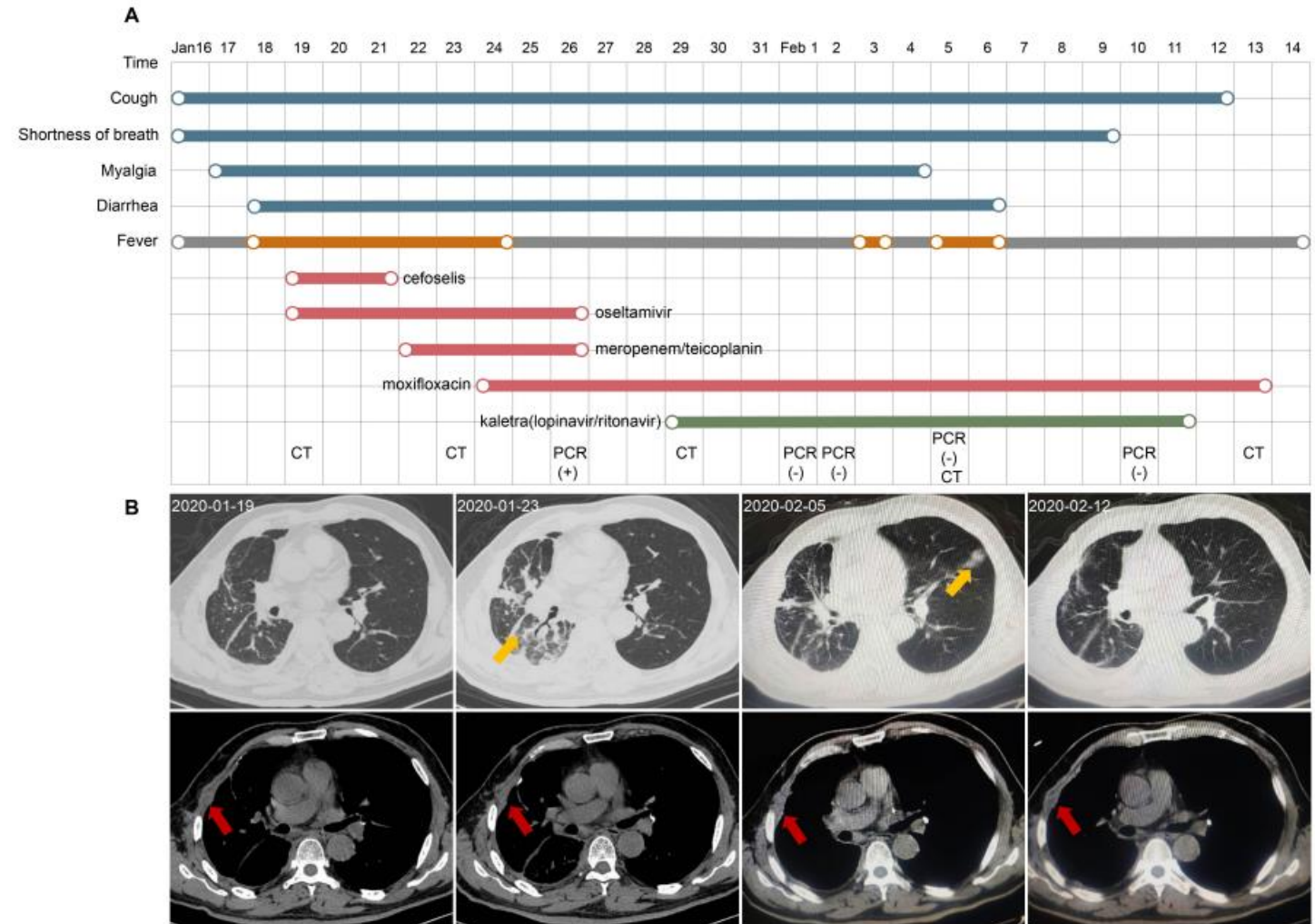
- No evidence of interaction for surgery, targeted therapy, and immunotherapy, but have **mixed results with respect to chemotherapy**
- The **risk of COVID-19 infection** for patients with cancer, **delays in cancer care** can also negatively affect patients' cancer course.
- Decisions about interrupting anti-cancer treatment in patients with active COVID-19 should be based on a **clinical benefit:risk assessment**

Anti-cancer therapy for COVID-19 patients

- It is unclear how long a delay after the infection has resolved may be necessary before initiating/restarting anti-cancer therapy
- If the decision was made to interrupt treatment, it should not be resumed **until symptoms of COVID-19 have resolved** and there is **some certainty the virus is no longer present** (e.g., a negative SARS-Cov-2 test)
- The cancer is rapidly progressing and the **risk:benefit assessment** favors proceeding with cancer treatment.
- Initiating/resuming anti-cancer therapy once **transmission-based precautions are no longer necessary** would be reasonable. (The CDC recommends immunocompromised individuals with COVID-19 quarantine for **20 days**)

Targeted therapy in COVID-19 patient

- A case report: **lung cancer patient infected with SARS-CoV-2 continued targeted therapy** with stable cancer control and recovered from pneumonia after kaletra (lopinavir/ritonavir) treatment





- **Mortality**
- **Impact of cancer treatment**
- **Vaccination**

- **Impact of Covid-19 pandemic**
- **Diagnosis, Treatment**

Lung cancer



COVID-19: From Pandemic to Endemic ?



**Thank you
for your attention**

