



Ente Ospedaliero Cantonale

# COVID19

## *Complicazioni in seno alla pneumologia*

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*Servizio di Pneumologia*

*Ospedale Regionale di Lugano*

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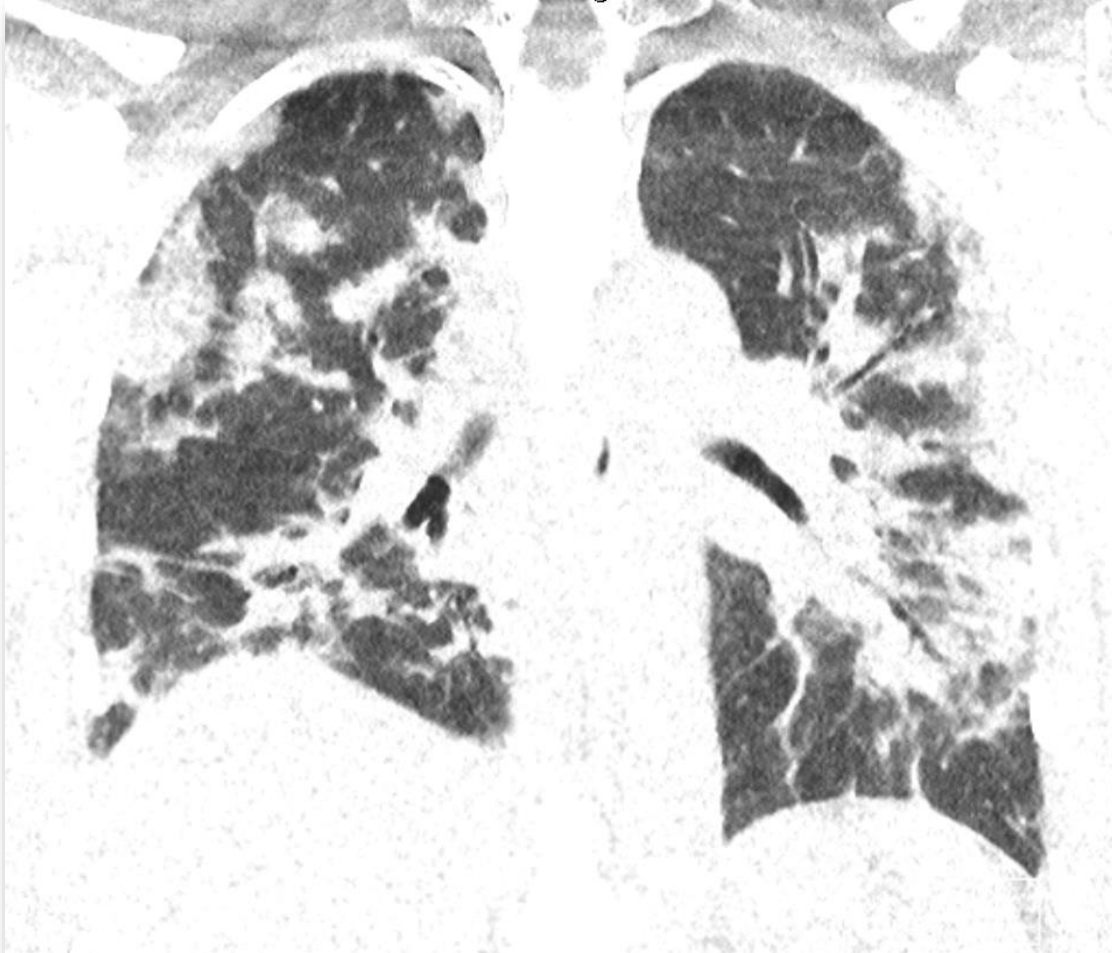
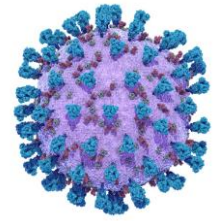
- Diagnosis and differential diagnosis
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- Complications

## 3. Lung sequelae

- SARS
- SARS-CoV-2

## FAQ

# Radio-histopathologic correlation

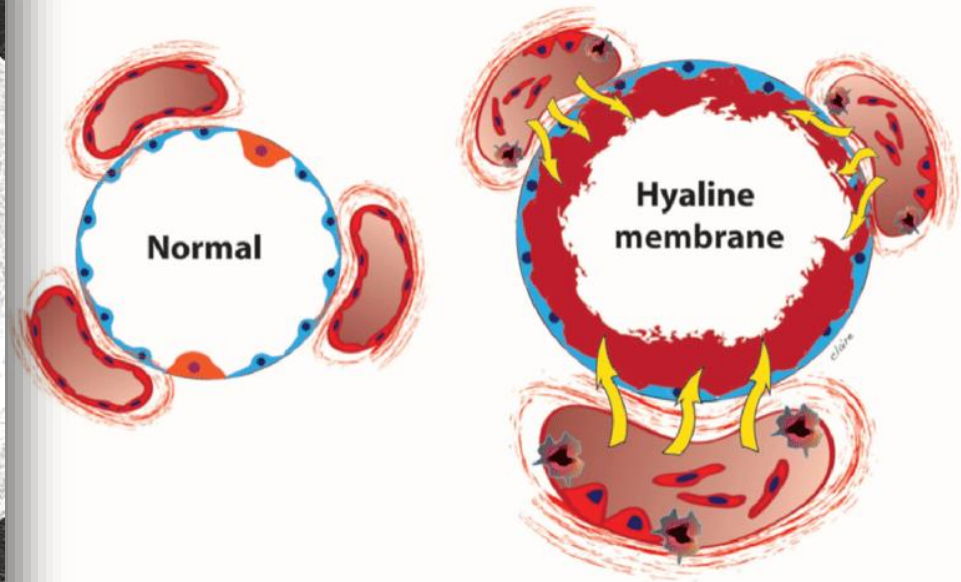
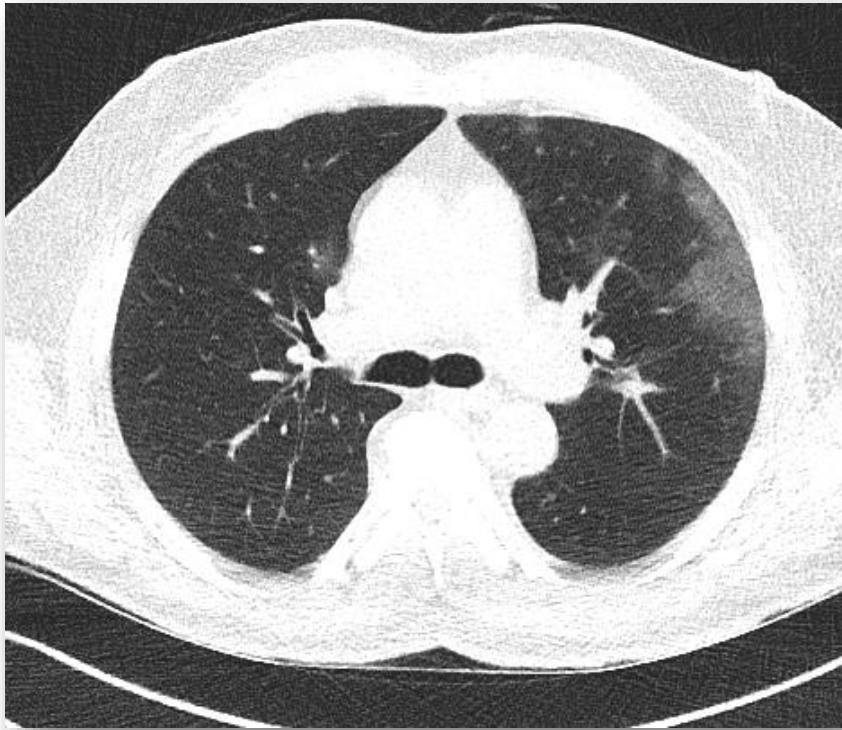


## Viral pneumonia

*diffuse alveolar damage*

- ❖ hyaline tissue formation
- ❖ edema
- ❖ alveolar hemorrhage
- ❖ interstitial lymphocyte infiltration
- ❖ type 2 cell hyperplasia
- ❖ fibrosis

# Radio-histopathologic correlation



**Ground glass opacity:** slight increase in density due to air space filling or interstitial thickening without loss of definition bronchial and vascular structures.

Histopathology: **alveolar oedema and hyaline membranes** (*fibrin, cellular debris, red blood cells, rare neutrophils and macrophages*)

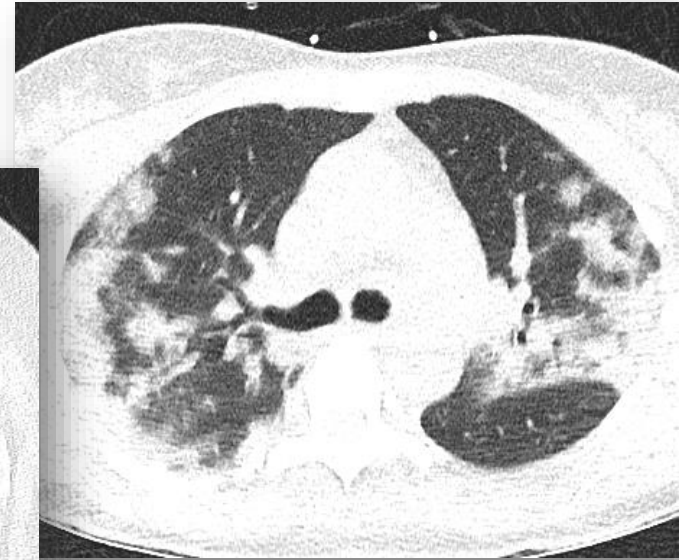
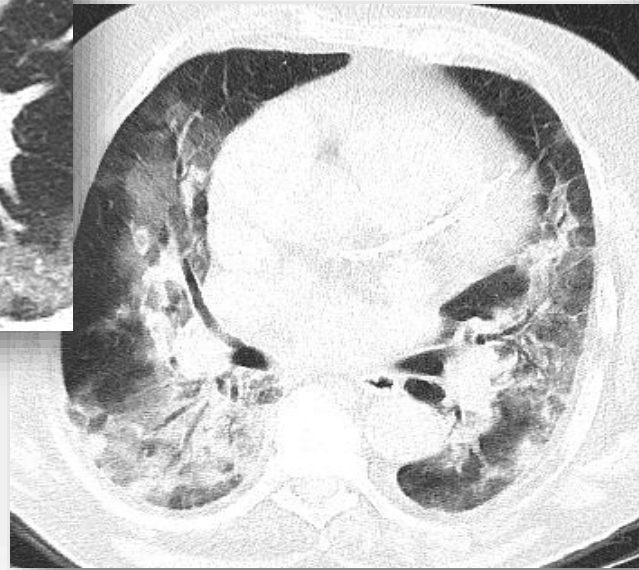
# Radio-histopathologic correlation



**Crazy paving:** thickening of interlobular and intralobular septa on ground glass.

Histopathology : **alveolar oedema** and **inflammatory interstitial damage**.

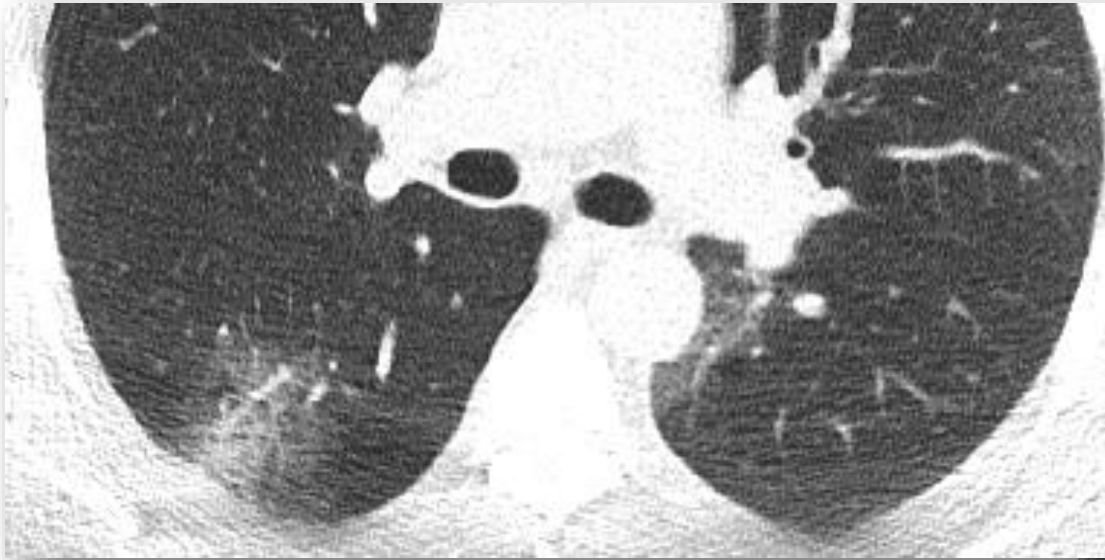
# Radio-histopathologic correlation



**Consolidation:** increased density when alveolar air is replaced by pathological fluids, cells or tissues with loss of definition of bronchial and vascular structures.

Histopathology: **fibromixoid exudate.**

# Radio-histopathologic correlation



**Vascular thickening:** segmental swelling around parenchymal lesions.

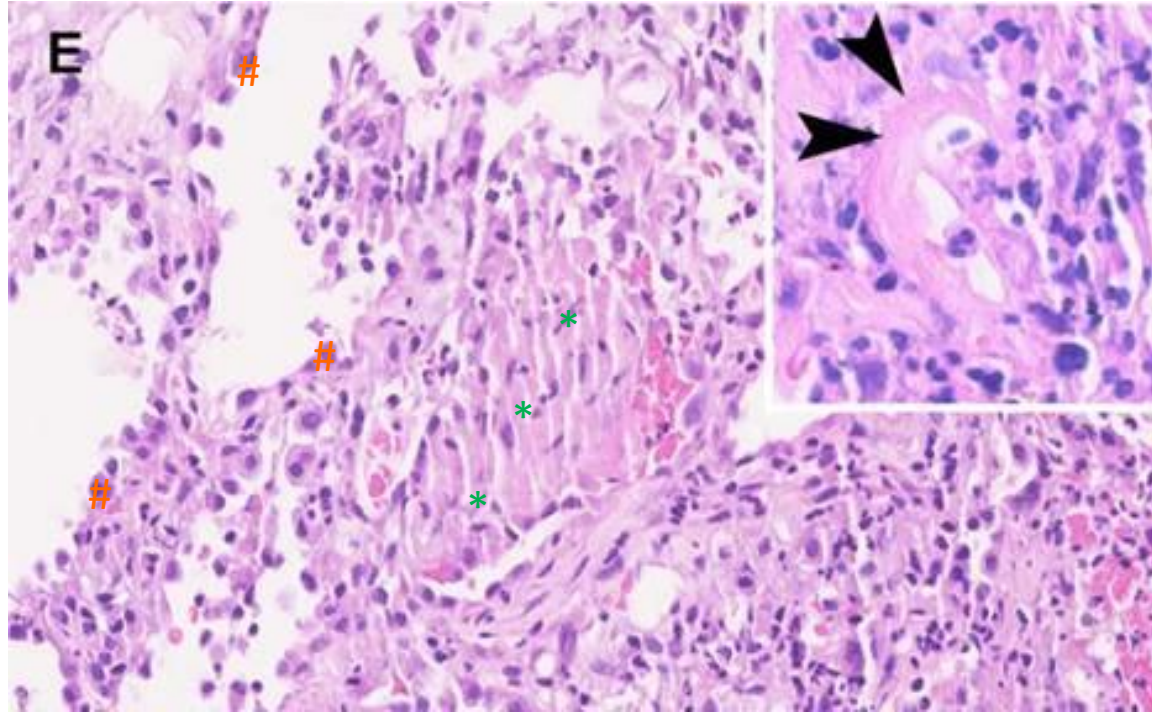
Histopathology: damage and swelling of the capillary walls caused by pro-inflammatory factors with possible micro-trombosis.

# Lung injury associated with SARS-CoV2

## 1. Organizing pneumonia

## 2. Diffuse Alveolar Damage

- *hyaline membrane formation*
- *pneumocyte injury*
- *vascular congestion*



- \* Intra-alveolar fibroblasts mixed with fibrin and inflammatory cellular infiltration
- # Diffuse type II pneumocyte hyperplasia
- ▶ Fibrinoid vascular necrosis

Tian S, et al.

Pathological study of the COVID-19 through postmortem core biopsies.  
Mod Pathol. 2020



# Radio-histopathologic correlation

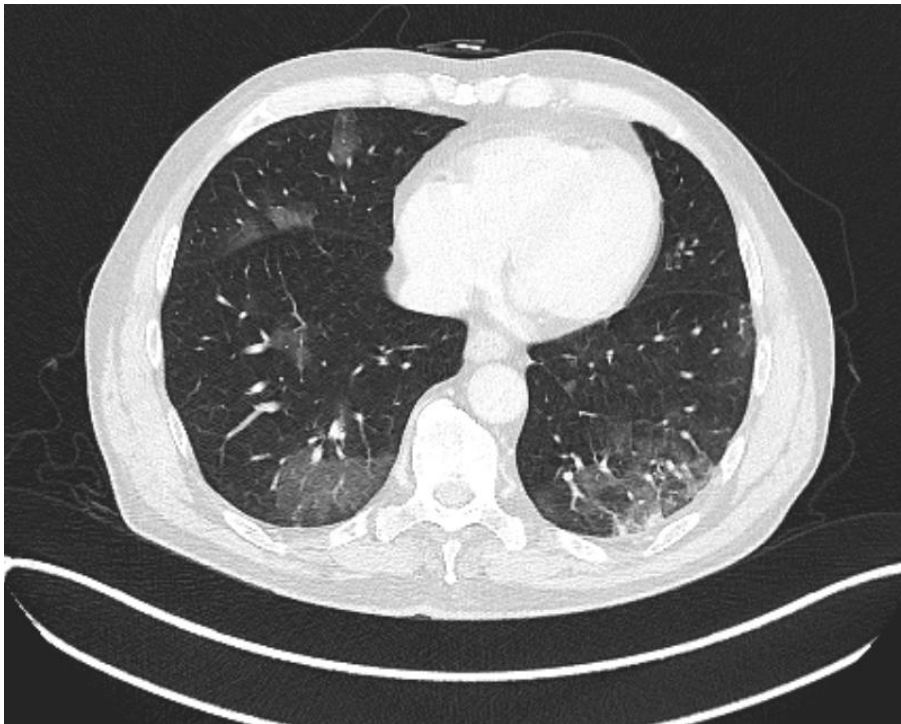
Stage	CT	Histopathology
<i>Initial stage</i>	ground-glass opacities	acute phase of diffuse alveolar damage
<i>Progression stage</i>	consolidation on the existing ground-glass opacities	evolution to <b>organizing phase</b> of diffuse alveolar damage
	pure consolidation or may present the melted sugar sign	
<i>Later stage</i>	consolidation to band-like opacities	gradual <b>resolution</b> of consolidation and turning into ground-glass opacities

S. Salehi, et al.

**Long-term Pulmonary Consequences of COVID-19**  
Journal of Thoracic Imaging 2020

# Radio-clinical presentation

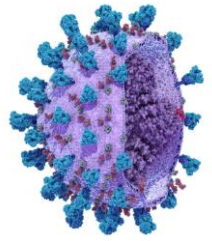
The radiologic presentation may not correlate with clinical symptomatology



72-yrs  
colon adenocarcinoma



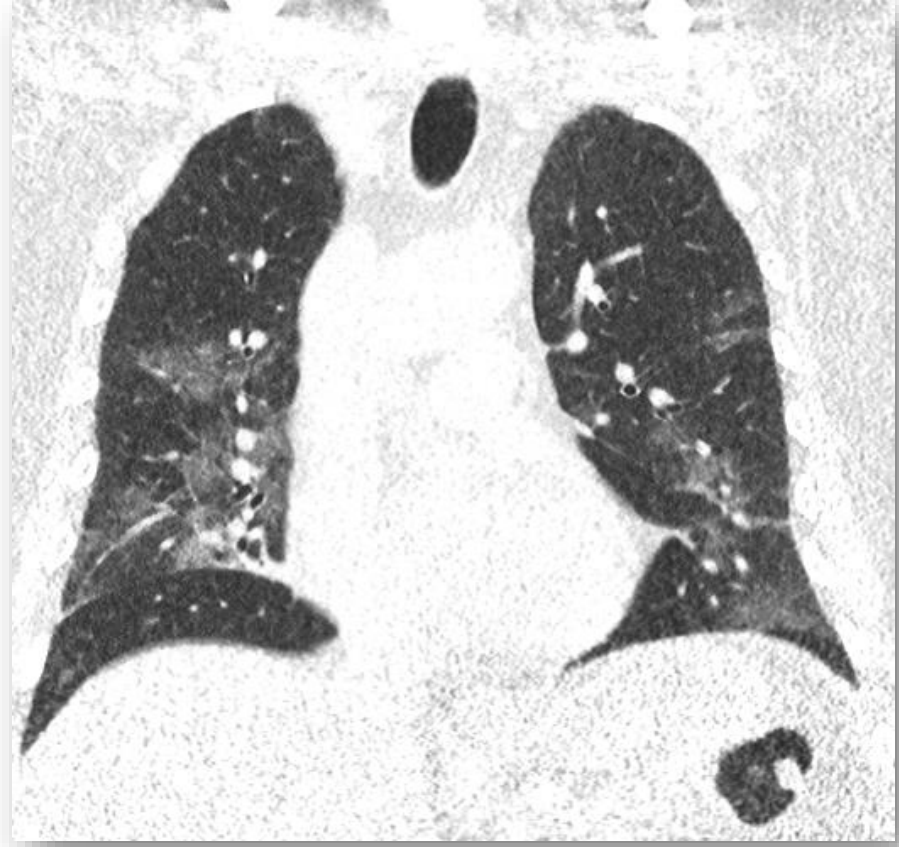
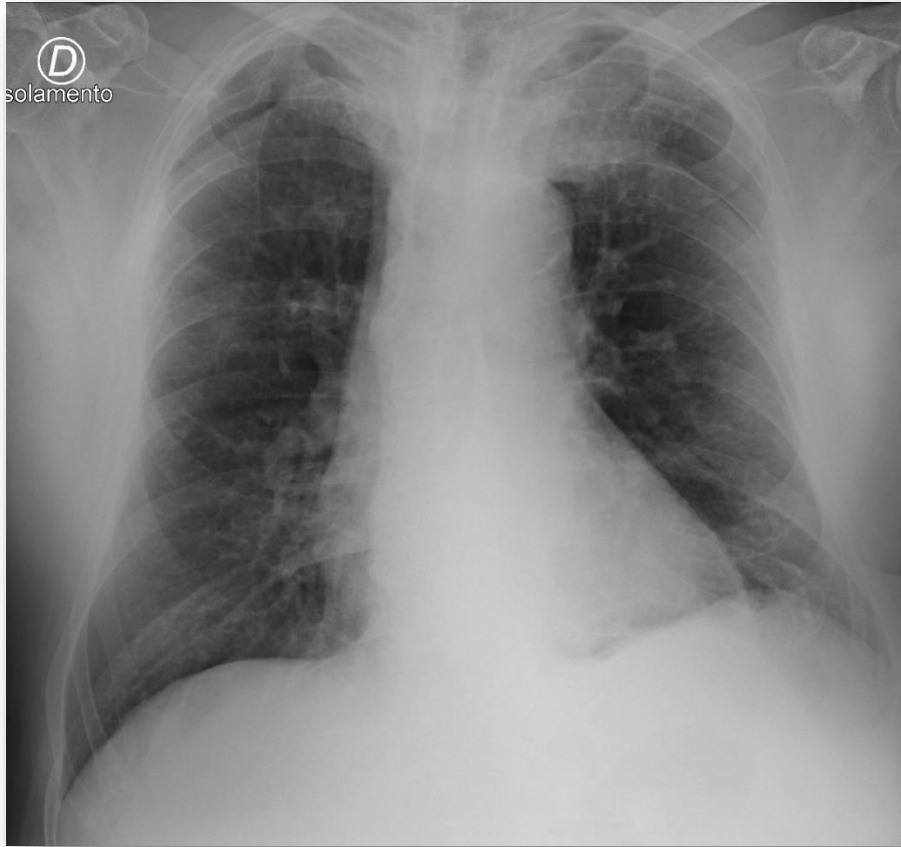
# Thorax CT

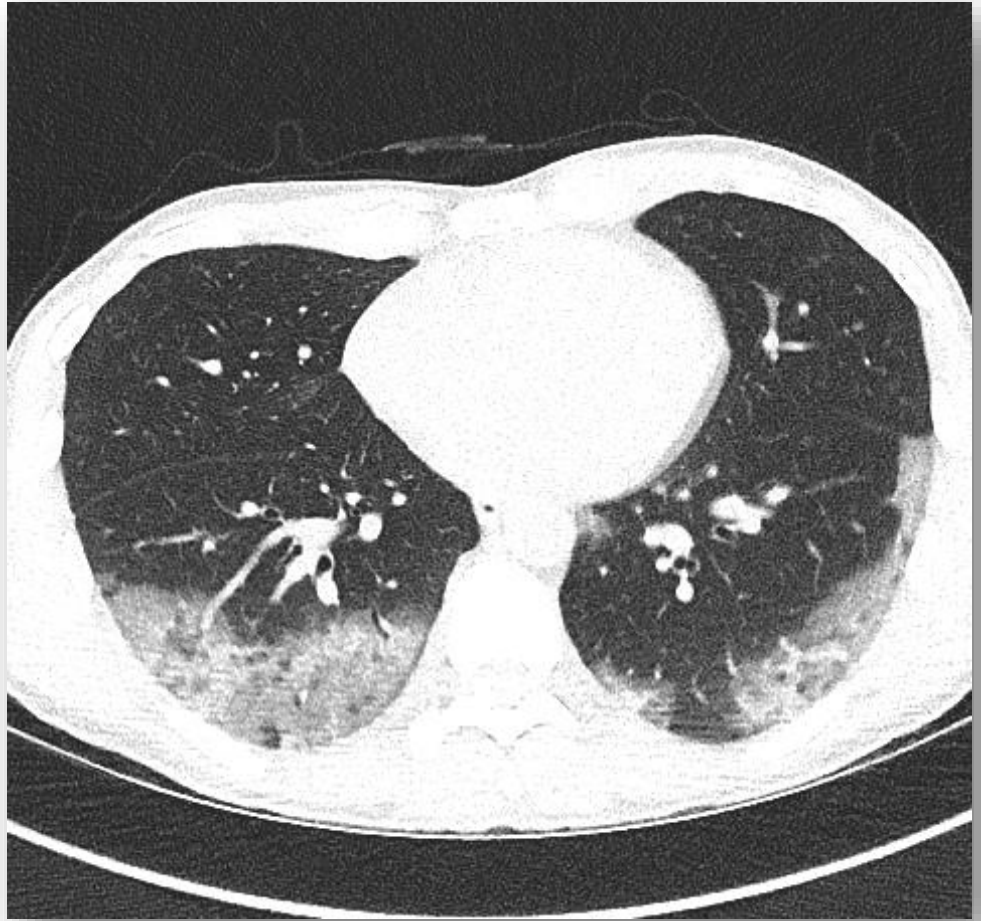
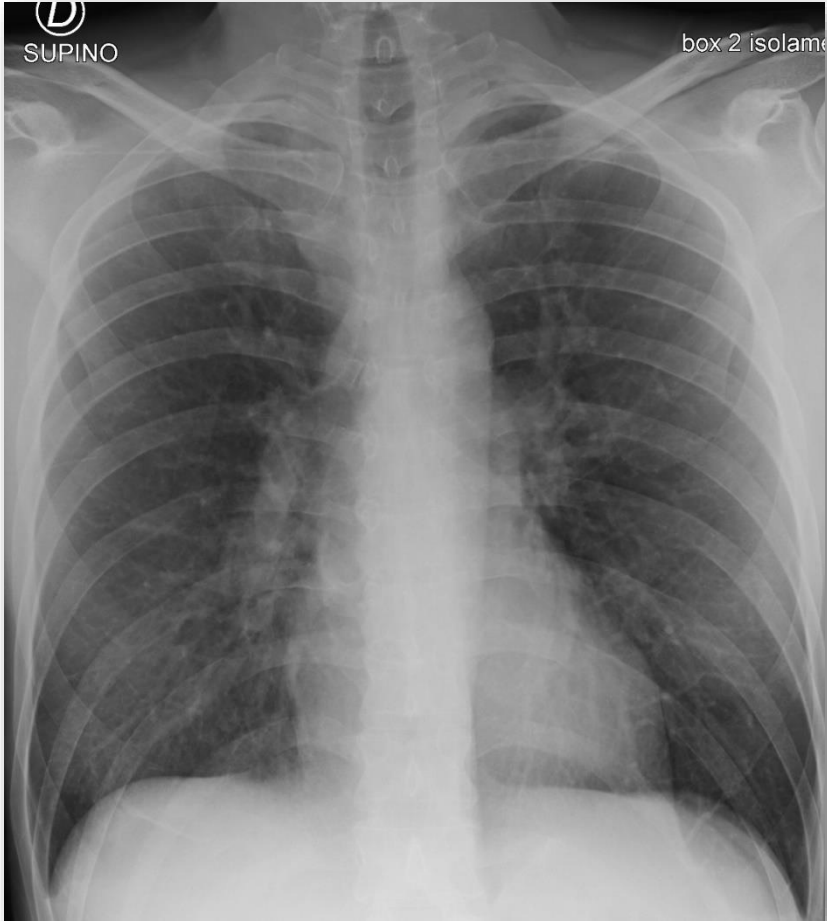


- A. Diagnostic value
- B. Staging
- C. Complications



# A) Diagnostic value





# CO-RADS (*Covid-19 Imaging Reporting and Data System*)

## CO-RADS\*

### Level of suspicion COVID-19 infection

		CT findings
<b>CO-RADS 1</b>	No	normal or non-infectious abnormalities
<b>CO-RADS 2</b>	Low	abnormalities consistent with infections other than COVID-19
<b>CO-RADS 3</b>	Indeterminate	unclear whether COVID-19 is present
<b>CO-RADS 4</b>	High	abnormalities suspicious for COVID-19
<b>CO-RADS 5</b>	Very high	typical COVID-19
<b>CO-RADS 6</b>	PCR +	

SEN (95-98%)

SPEC (35-65%)

# Differential diagnosis of SARS-CoV2 infections

Date	Mar. 23	Mar. 24	Mar. 25	Mar. 26	Mar. 27	Mar. 28	Mar. 29	Mar. 30	Mar. 31	Apr. 1	Apr. 2	Apr. 3	Apr. 4	Apr. 5	Apr. 6	Apr. 7	Apr. 8	Apr. 9	Apr. 10	
									RX		Chest uld CT								Best supportive care	
Hospital day									1	2	3	4	5	6	7	8	9	10	11	
Day of illness	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	†	
Laboratory testing									a	b	c									
PaO2/FiO2 (mmHg)									339			332								
CRP (mg/L)									68		38				14	15				
Leukocytes (x10E9/L)									8.6		9.2				13.7					
Lymphocytes (x10E9/L)									0.52		1.75				4.36					
Thrombocytes (x10E9/L)									204		195				285					
									Acute dyspnea											
									Pharingodynia - Dry cough											
									Productive cough											
Temperature (°C)									37	37.1	37.5	37.5	37.5	36.4	37.4	37	37	37		
Respiratory rate (/min)									40	26	22	24	28	22	26	24	28	30		
EWS-nCoV									10											
									Levofloxacin					Trimethoprim-Sulfamethoxazole						
Laboratory testing	<p>a SARS-CoV-2 PCR nasofaringeal swab: negative. Influenza A/B +RSV: negative. Pneumococcal and Legionella urinary AG: negative.</p> <p>b SARS-CoV-2 PCR stool + induced sputum + SARS-CoV-2 serum IgG and IgM: negative.</p> <p>c Pneumocystis jirovecii PCR sputum: positive.</p>																			

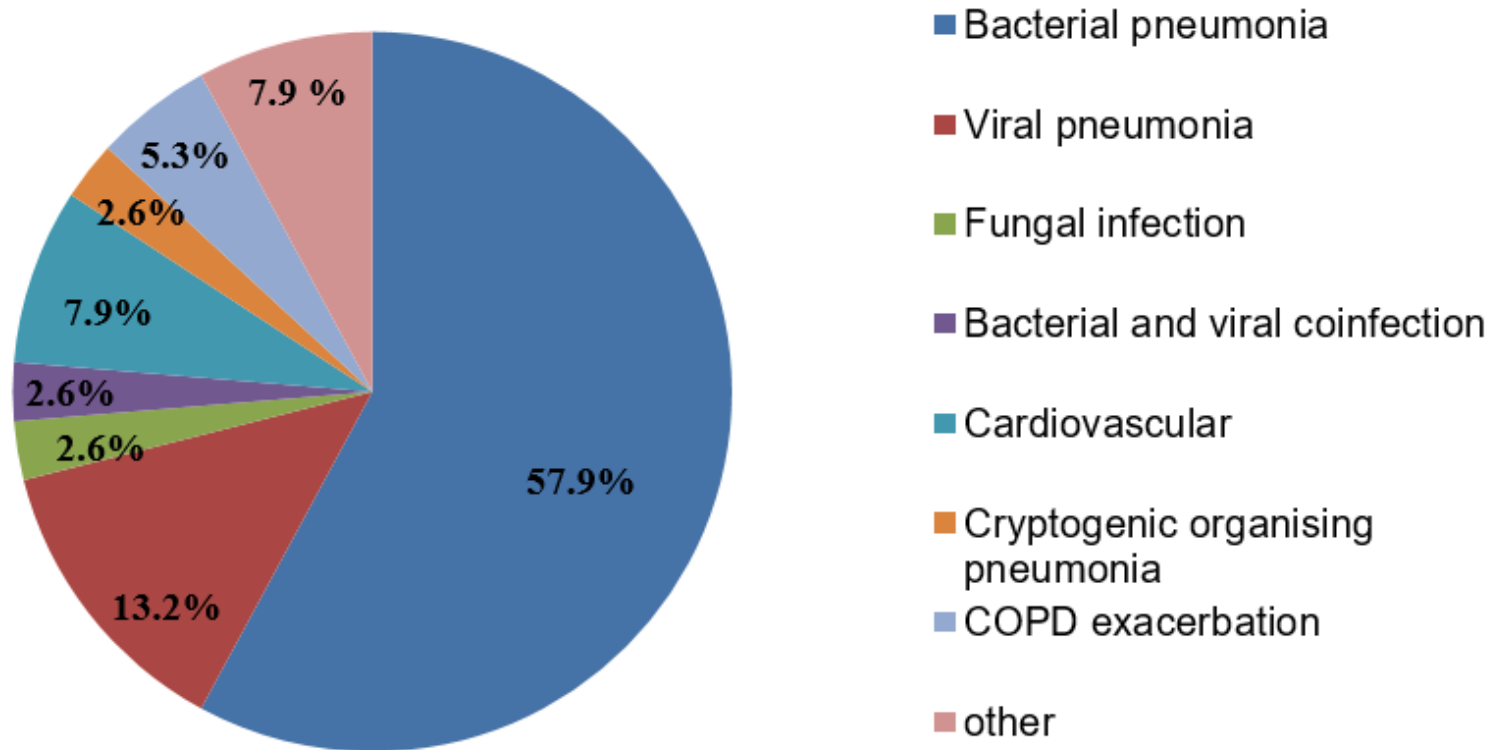
77-yrs  
stage IV lung NSCLC



E. Rigamonti, D. Salera, AC Gheorghiu, C. Fratila, P. Gianella  
**The many faces of interstitial pneumonia: a case of presumed SARS-CoV-2 infection.**  
 Swiss Med Wkly 2020

# Differential diagnosis of SARS-CoV2 infections

- ❖ **pathological chest CT-scan result** (March-April 2020 - EOC) [210]
- ❖ **suspicion of SARS-CoV-2 infection**
- ❖ **negative RT-PCR for SARS-CoV-2** (30% = 1; 70% =  $\geq 2$ ) [38; 18%]



E. Rigamonti, T. Fusi-Schmidhauser, G Argentieri, P. Gianella

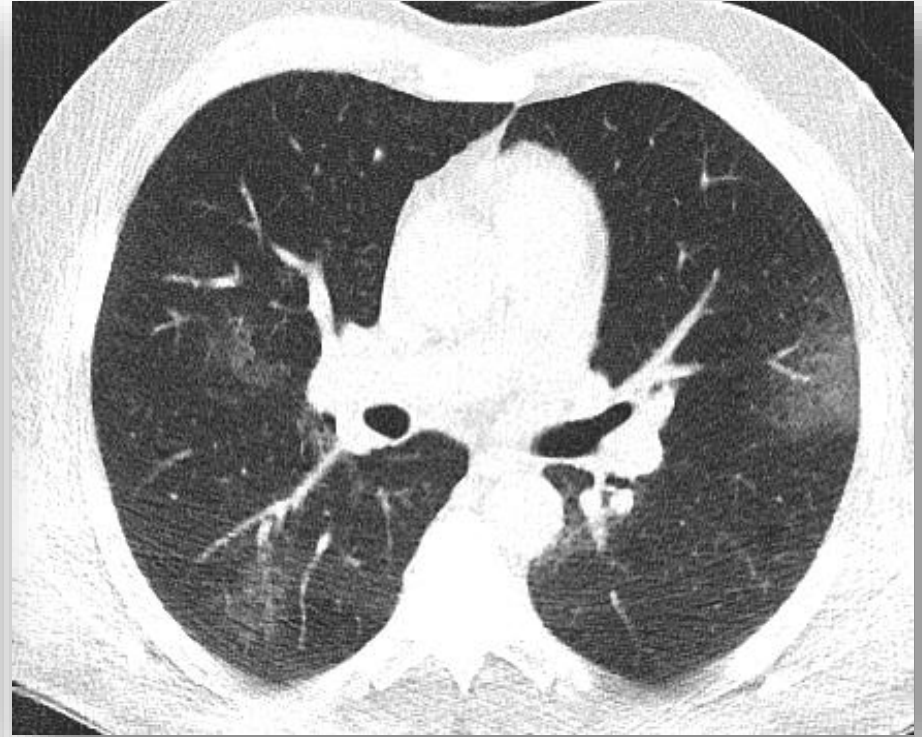
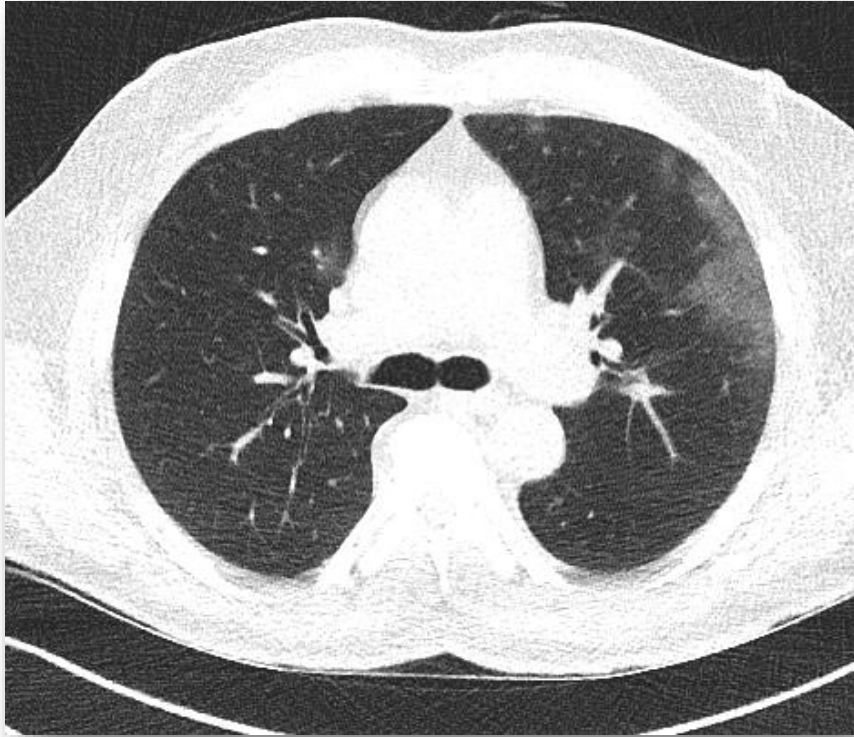
**Differential diagnoses in COVID-19 pandemic: a retrospective descriptive study**

*In press*



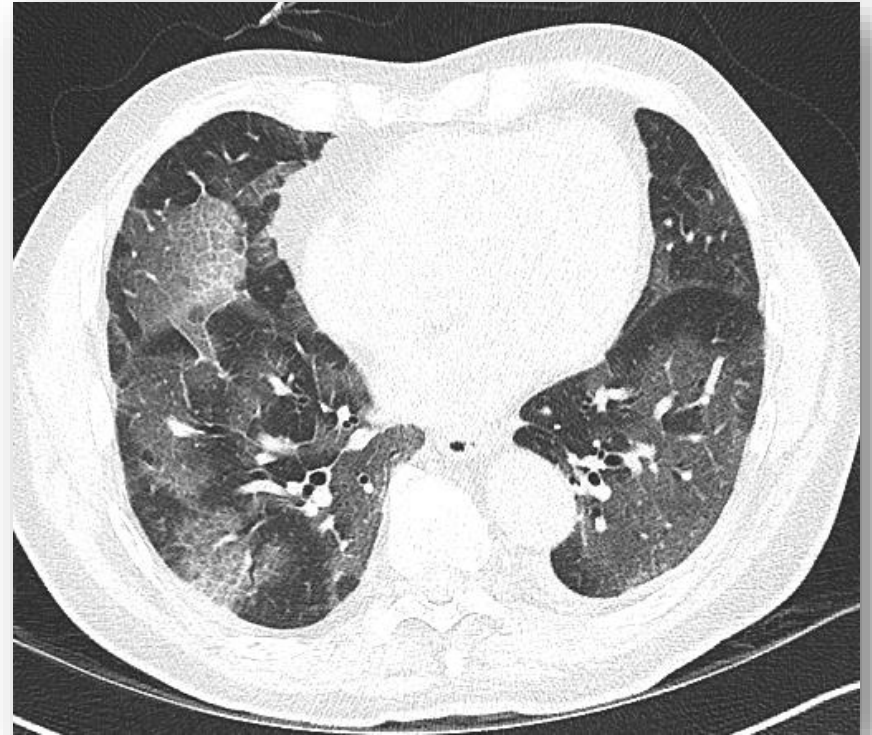
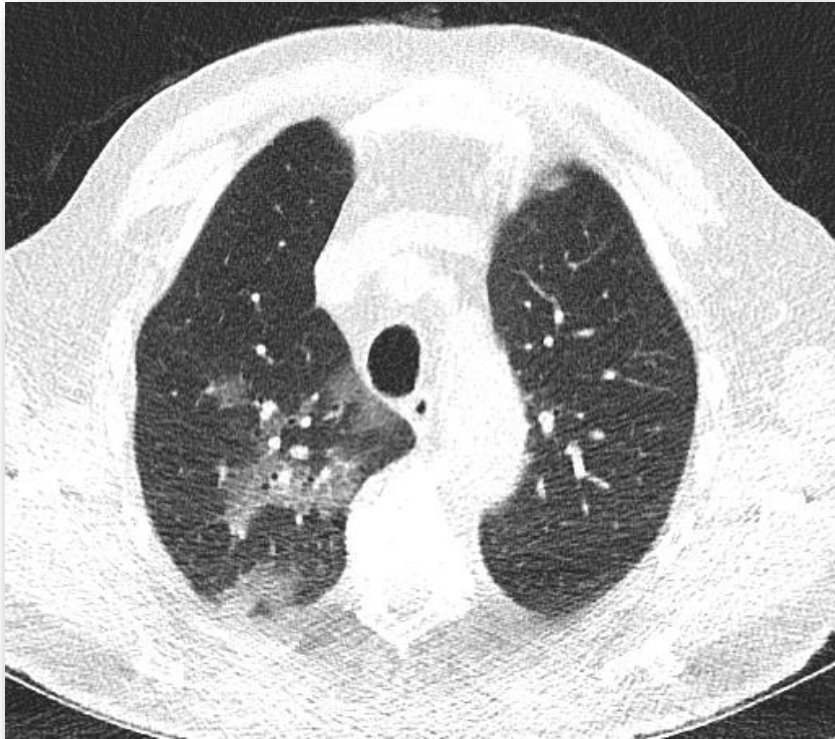
# Staging bilateral interstitial pneumonia

Early stage : day 0-4



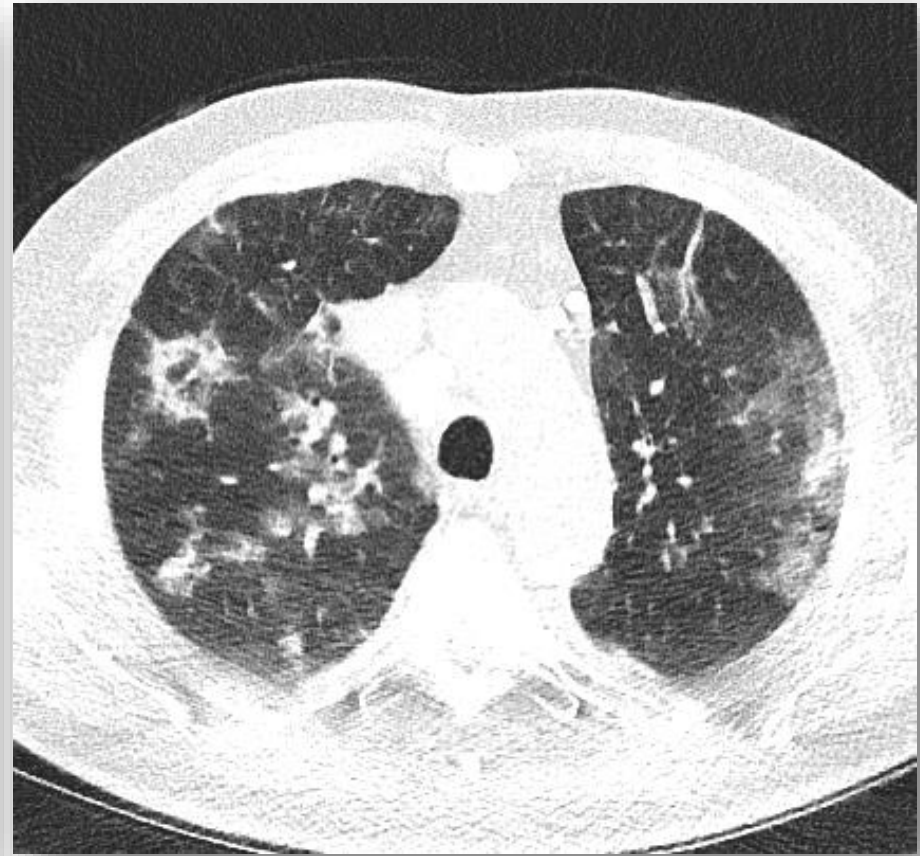
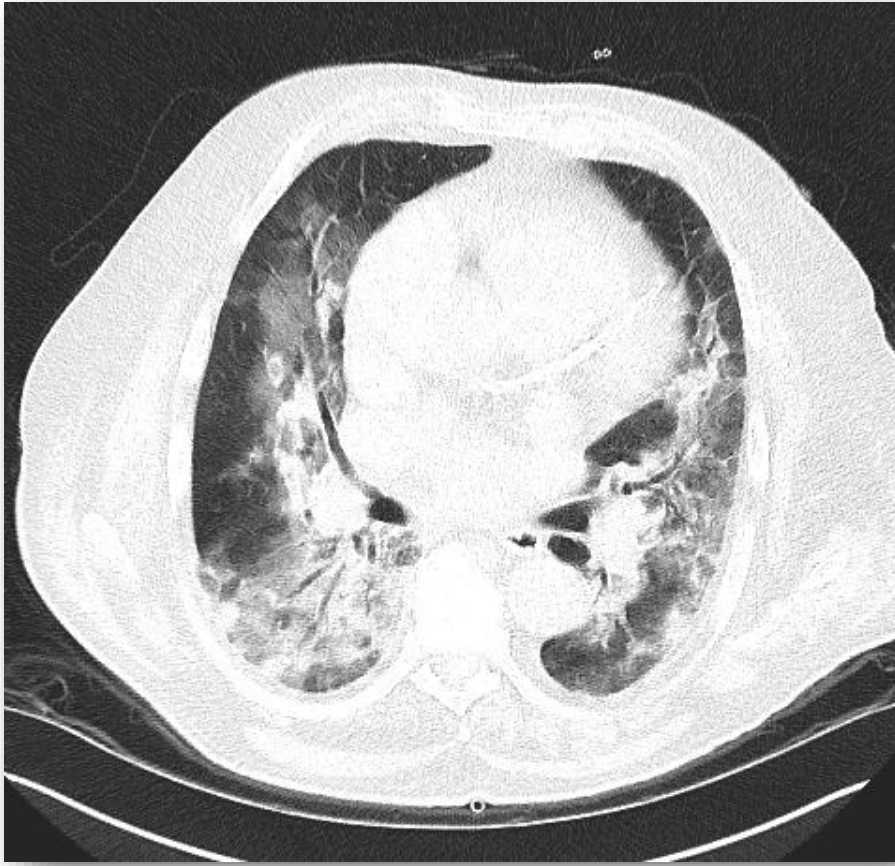
# Staging bilateral interstitial pneumonia

Progression: day 5-8



# Staging bilateral interstitial pneumonia

Culminating stage: day 9-13



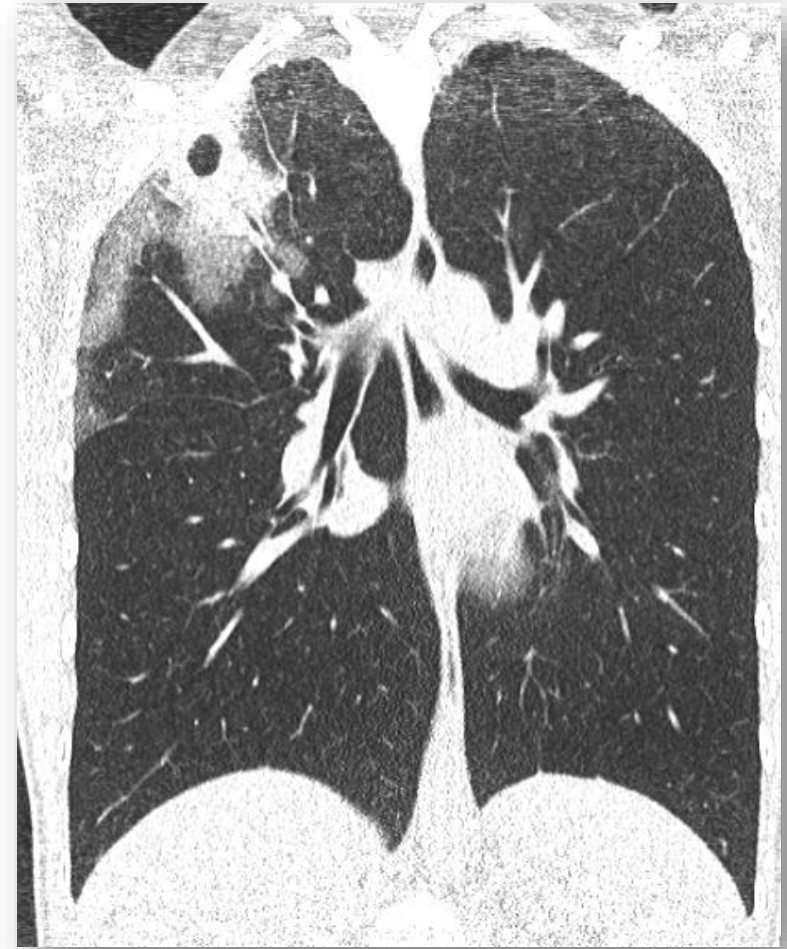
## C) Complications

21 yrs



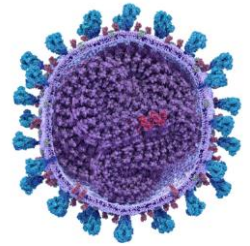
- Productive cough
- $T^{\circ} 38.5^{\circ}\text{C}$
- Increase in PCR and Lc
- RT-PCR for SARS-CoV-2 in progress





Pulmonary abscess

# Functional and radiological outcomes in SARS-CoV-2



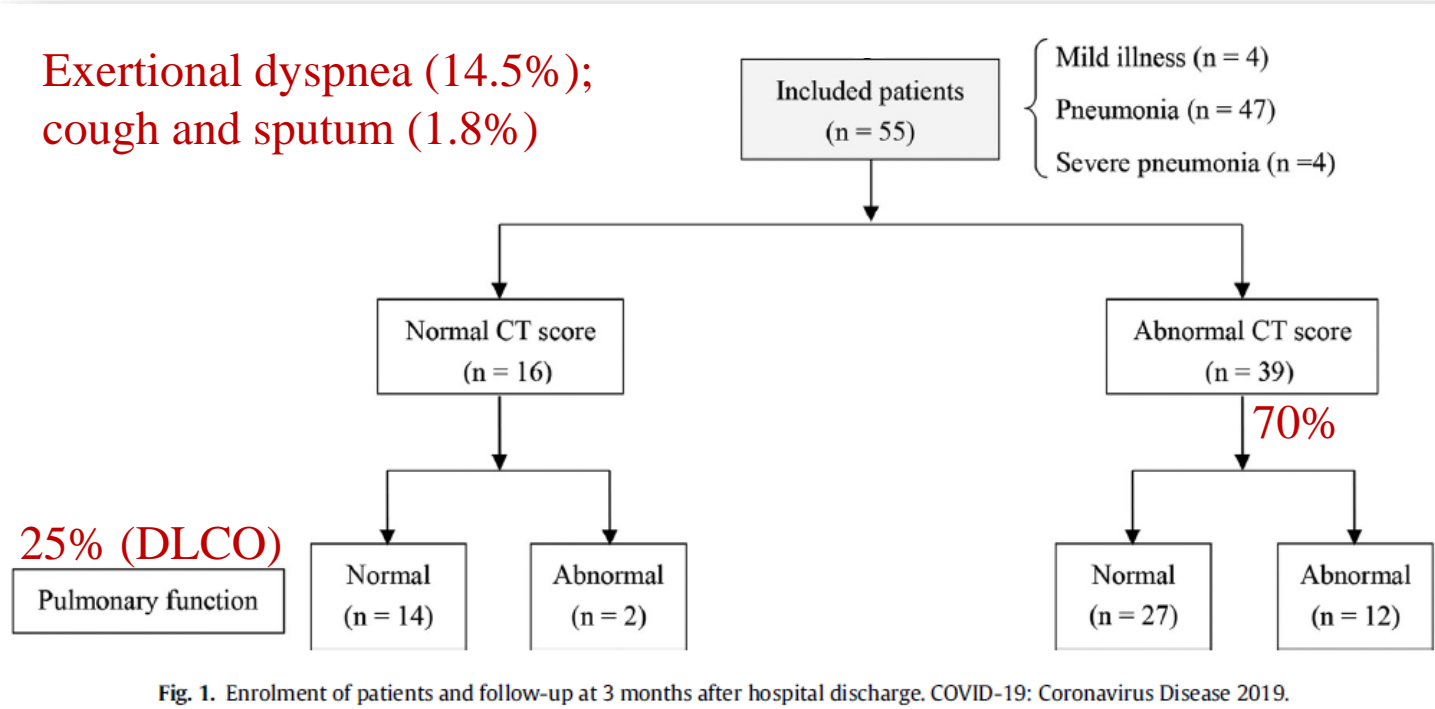
- 3 months follow up of 39 SARS-CoV-2+ patients and abnormal Thorax CT
- ✓ 49% dyspnoea (2/3 mMRC 1; 1/3 mMRC 2-4)
- ✓ 56% DLCO abnormalities
- ✓ 82% residual TC abnormalities

P. Gianella, E. Rigamonti, L. Grazioli, G. Argentieri, T. Fusi-Schmidhauser, M. Pons

**Three- months functional and radiological outcomes in SARS-CoV-2**

*In press*

# Functional and radiological outcomes in SARS-CoV-2



*Higher level of D-dimer on admission could predict impaired DLCO after 3 months*

Y. Zhao, et al.

**Follow-up study of the pulmonary function and related physiological characteristics of COVID-19 survivors three months after recovery.**  
Eclinical Medicine 2020

# Lessons from severe acute respiratory syndrome (SARS)

- ❑ 15-year follow-up on SARS infections survivors (2003)
- ❑ 27 patients: chest CT from 2003 to 2018
- ❑ The extent of pulmonary injury gradually decreased, but the findings were not completely resolved.



Zhang P, et al.

**Long-term bone and lung consequences associated with hospital-acquired SARS: a 15-year follow-up from a prospective cohort study.**  
Bone Res. 2020



# Lessons from severe acute respiratory syndrome (SARS)

- ❑ The evolution of the pulmonary disease were most prominent within the **first year** after recovery and remained stable afterward until 2018.
- ❑ Even in patients with early complete resolution of chest CT abnormalities, pulmonary function took **several years** to return to normal.
- ❑ 15 years after the initial infection, the **FEV1/FVC ratio** were **significantly reduced in patients with residual chest CT abnormalities** compared with those with complete radiologic recovery.



Zhang P, et al.

**Long-term bone and lung consequences associated with hospital-acquired SARS: a 15-year follow-up from a prospective cohort study.**  
Bone Res. 2020

# Determinant factors of residual functional or imaging pulmonary abnormalities

- ✓ Age
- ✓ Comorbidities
- ✓ History of cigarette smoking
- ✓ Length of hospital admission
- ✓ Severity of the acute disease (ICU admission)
- ✓ Type of medications administered (such as antiviral or corticosteroid therapy)



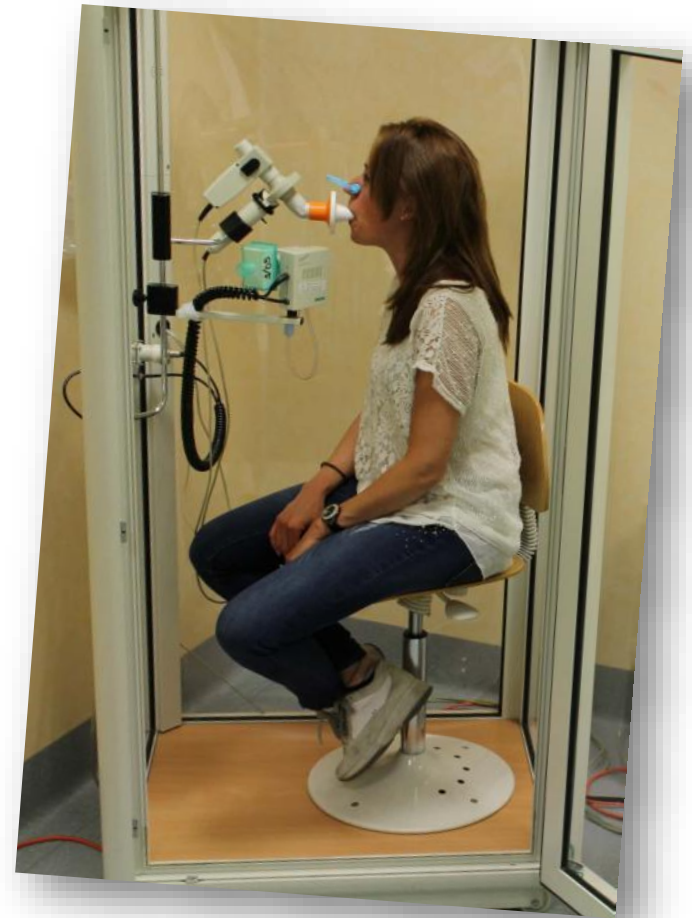
Xie L, et al.

**Follow-up study on pulmonary function and lung radiographic changes in rehabilitating SARS patients after discharge.**

Chest 2005

# Which patients should be referred to a pulmonologist for post COVID19 check-up?

- Patients who have residual dyspnea one to two months after diagnosis.
- Elite athletes.
- Excessively anxious patients.



# What is the role of smoking in COVID19 infections?

❑ Quitting smoking reduces the chance of developing a severe COVID19 by 50%.

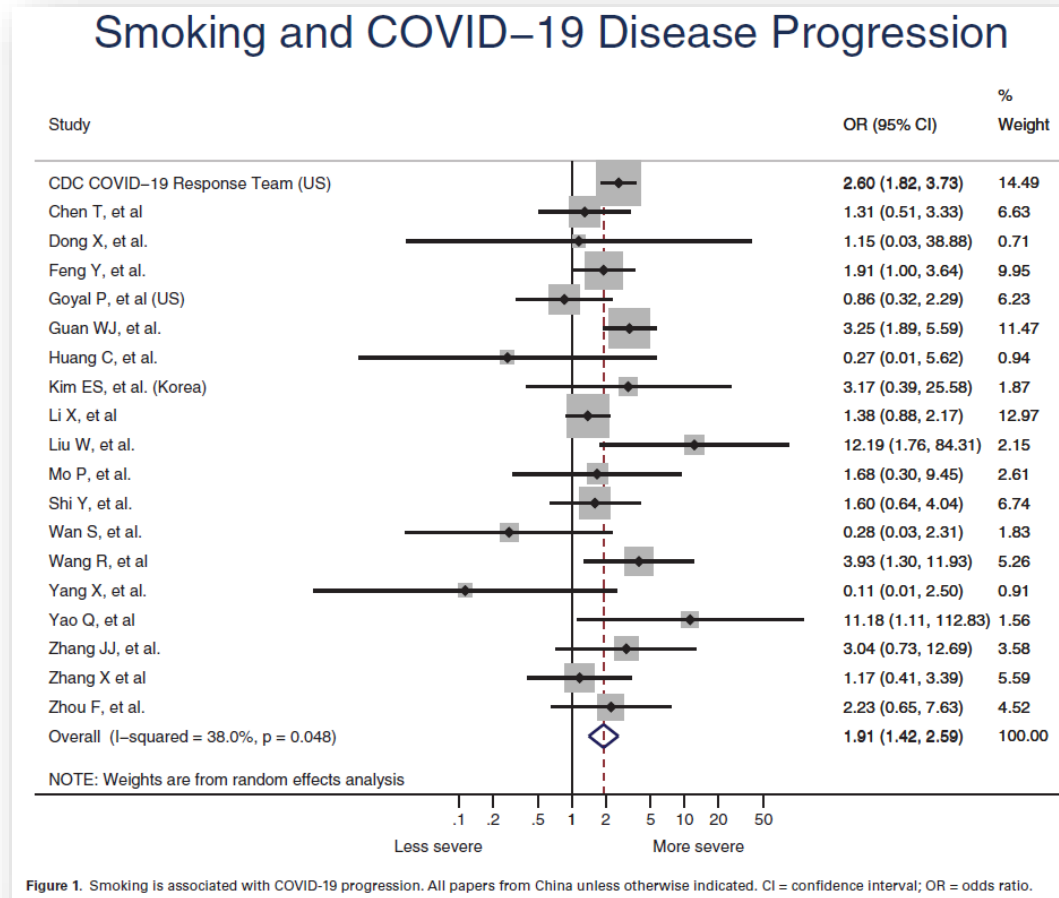


Figure 1. Smoking is associated with COVID-19 progression. All papers from China unless otherwise indicated. CI = confidence interval; OR = odds ratio.

Patanavanich R, Glantz SA.

**Smoking is associated with COVID-19 progression: a meta-analysis.**

Nicotine Tob Res. 2020

# What is the role of smoking in COVID19 infections?

- ❑ Nicotine is not protective against COVID19.
- ❑ Quitting smoking is always the best choice for health.



*Richard N van Zyl-Smit et al.*

**Tobacco smoking and COVID-19 infection**  
*The Lancet 2020*

# Take home messages

## 1. Correlations

- Radio-histopathological 
- Radio-clinical 

## 2. Thorax CT

- SEN  SPEC 
- Complications 

## 3. Lung sequelae

- The long-term effect of COVID-19 on lung parenchyma and pulmonary function remains an outstanding question.



EDWARD JENNER (1749-1823)

*« Il pratique la vaccine pour la premiere fois »*

# Thank you for your attention

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