
COVID19: Imaging

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<https://www.economist.com/obituary/2020/02/13/li-wenliang-died-on-february-7th>

Coronavirus COVID-19 Global Cases by the Center for Systems Science and Eng...

Total Confirmed
399,929

Confirmed Cases by Country/Region/Sovereignty

- 399,929** US
- 146,690 Spain
- 135,586 Italy
- 110,070 France
- 107,663 Germany
- 82,809 China
- 64,586 Iran
- 55,957 United Kingdom
- 34,109 Turkey
- 23,403 Belgium
- 22,789 Switzerland
- 20,678 Netherlands
- 17,897 Canada
- 14,072 Brazil
- 12,824 Austria
- 12,442 Portugal
- 10,384 Korea

Last Updated at (M/D/YYYY)
4/8/2020, 7:15:00 AM



Cumulative Confirmed Cases Active Cases

184

Lancet Inf Dis Article: [Here](#). Mobile Version: [Here](#). Visualization: JHU CSSE. Automation Support: Esri Living Atlas team and JHU APL. Contact US, FAQ.

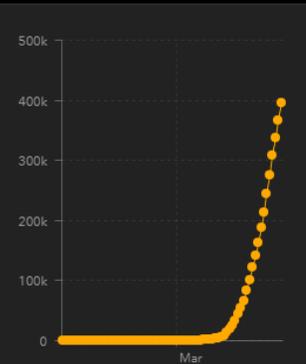
Data sources: WHO, CDC, ECDC, NHC, DXY, 1point3acres, Worldometers, etc.

Total Deaths
12,911

- 4,009 deaths New York City **New York** US
- 500 deaths Nassau **New York** US
- 402 deaths Wayne **Michigan** US
- 283 deaths Westchester **New York** US
- 263 deaths Bergen **New Jersey** US
- 263 deaths Suffolk **New York** US
- 249 deaths Cook **Illinois** US
- 232 deaths

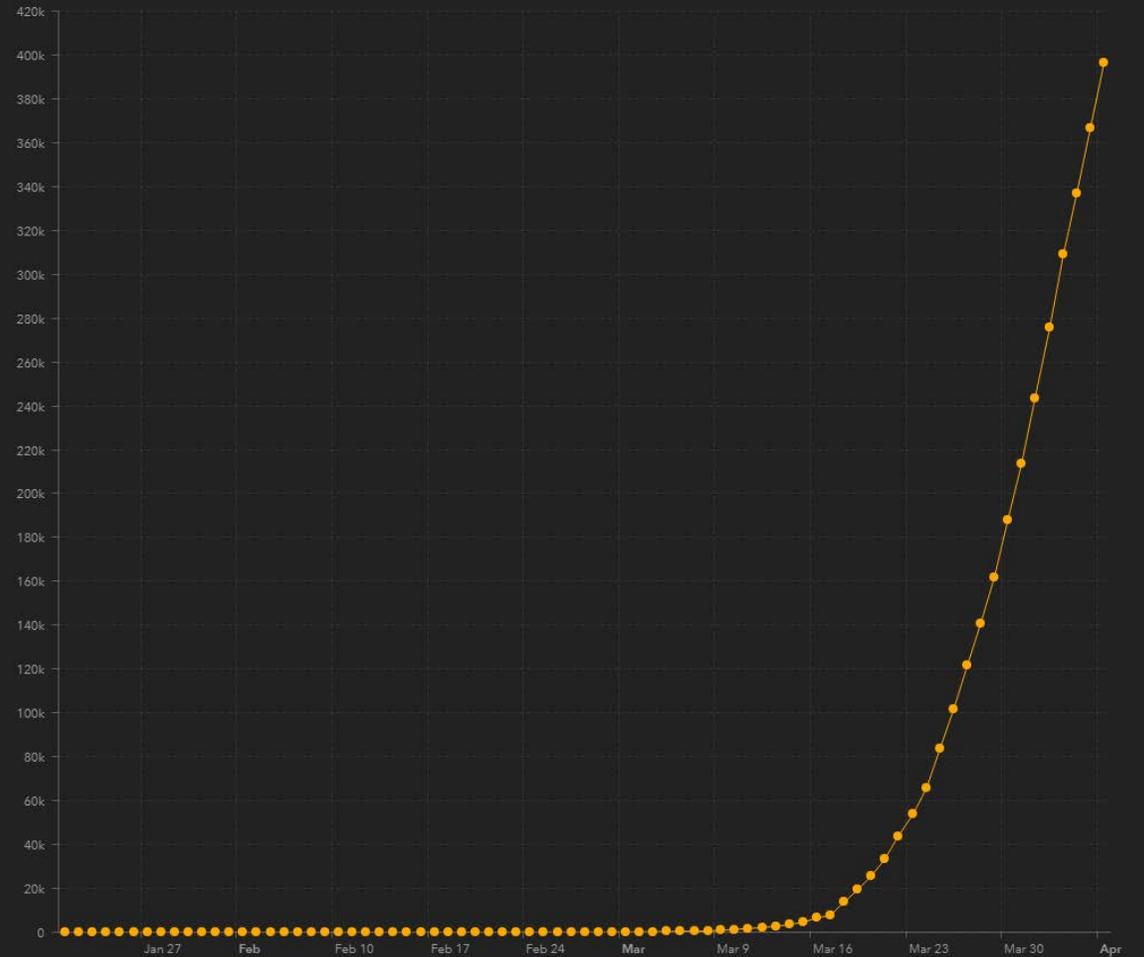
Total Recovered
22,539

22,539 recovered US



Confirmed

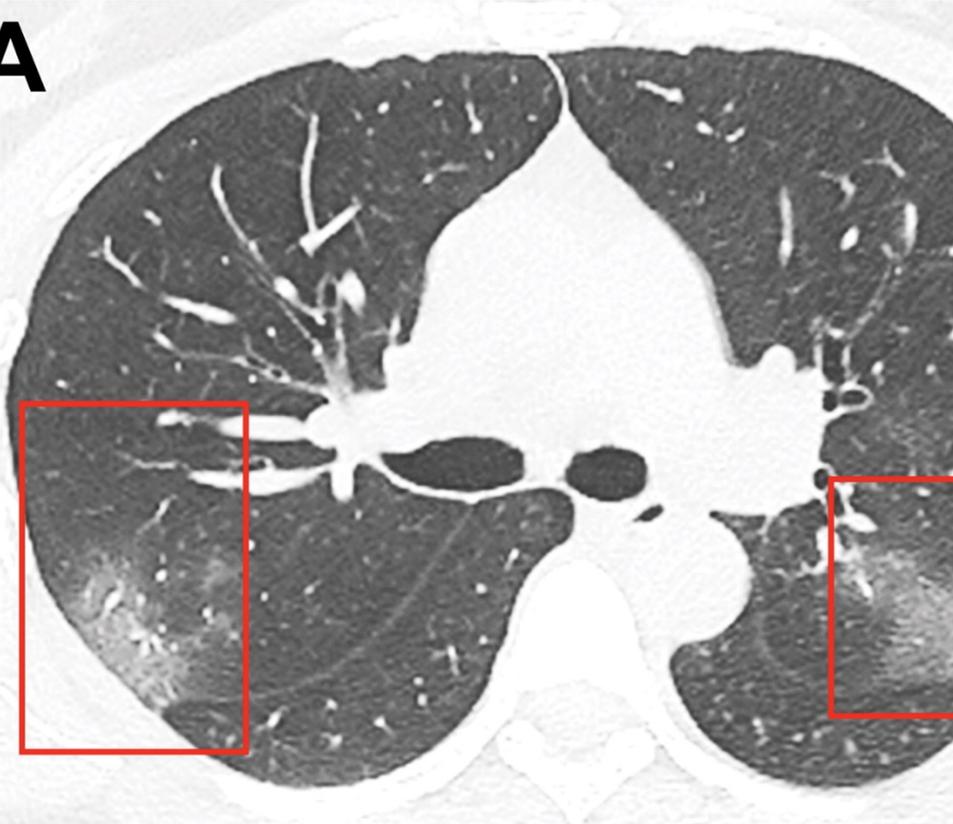
Coronavirus COVID-19 Global Cases by the Center for Systems Science and Eng...



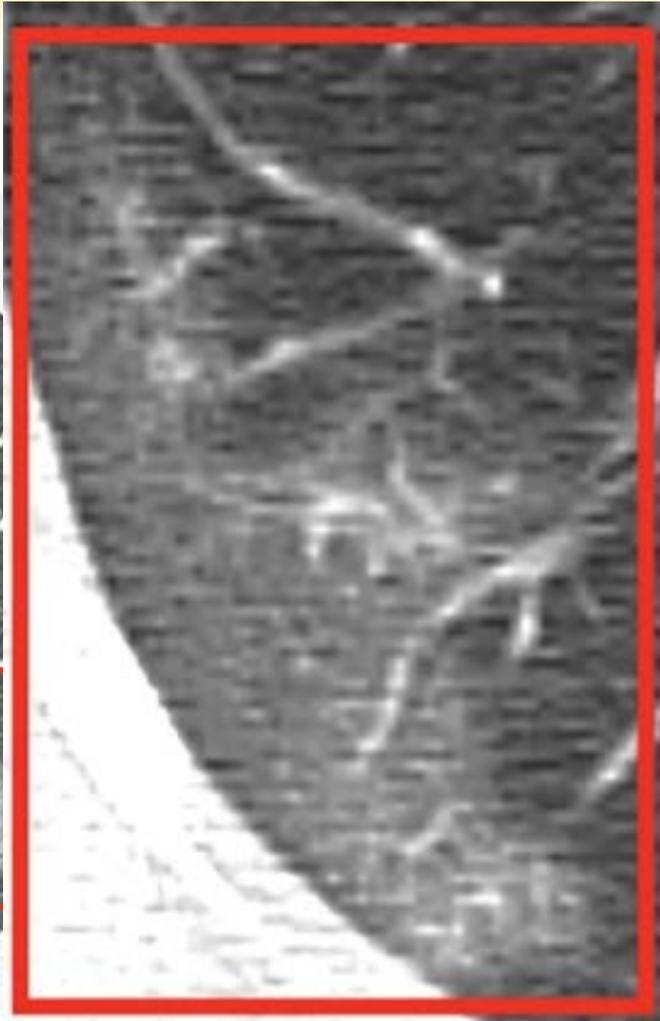
Confirmed Logarithmic Daily Increase

Baseline

A



3 days after



Bilateralism of the peripheral lung opacities are common CT findings of the 2019 novel coronavirus pneumonia.

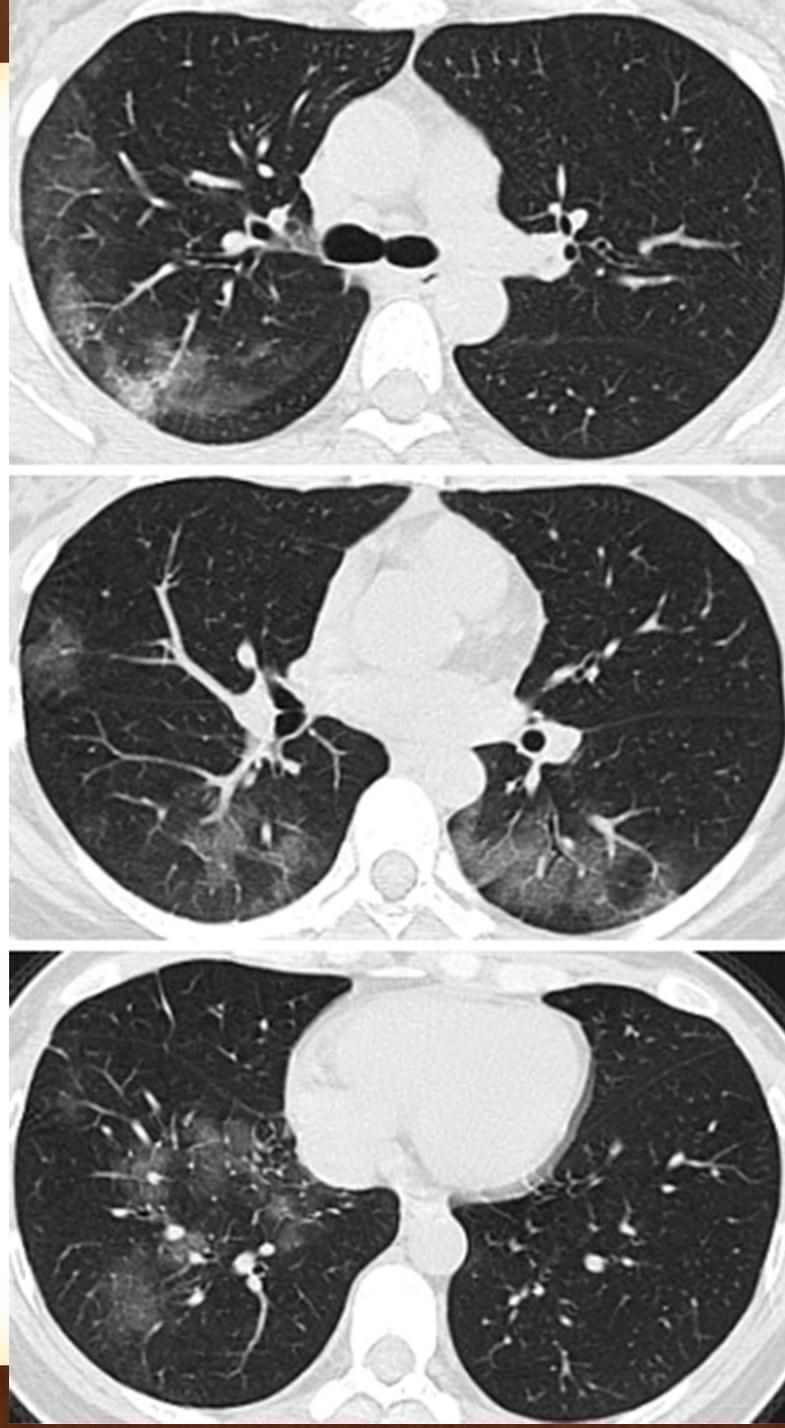
CT Imaging of the 2019 Novel Coronavirus (2019-nCoV) Pneumonia
[Junqiang Lei](#), [Junfeng Li](#), [Xun Li](#), [Xiaolong Qi](#)

<https://pubs.rsna.org/doi/10.1148/radiol.2020200236>

Published Online: Jan 31 2020

<https://pubs.rsna.org/doi/10.1148/radiol.2020200257>

2019 Novel Coronavirus (2019-nCoV) Pneumonia
Peng Liu, Xian-zheng Tan



Published Online: Feb 4 2020

81 patients presented to Taizhou Enze Medical Center (Group) Enze Hospital between January 19, 2020 and February 4, 2020 with eventual diagnosis of COVID-19 by RT-PCR testing and with initial chest CT.

30 patients: initial CT not performed within 3 days of RT-PCR

51 patients with both initial CT and RT PCR

15/51 patients with negative RT-PCR and positive CT at initial presentation (RT-PCR became positive between 1 and 7 days later)

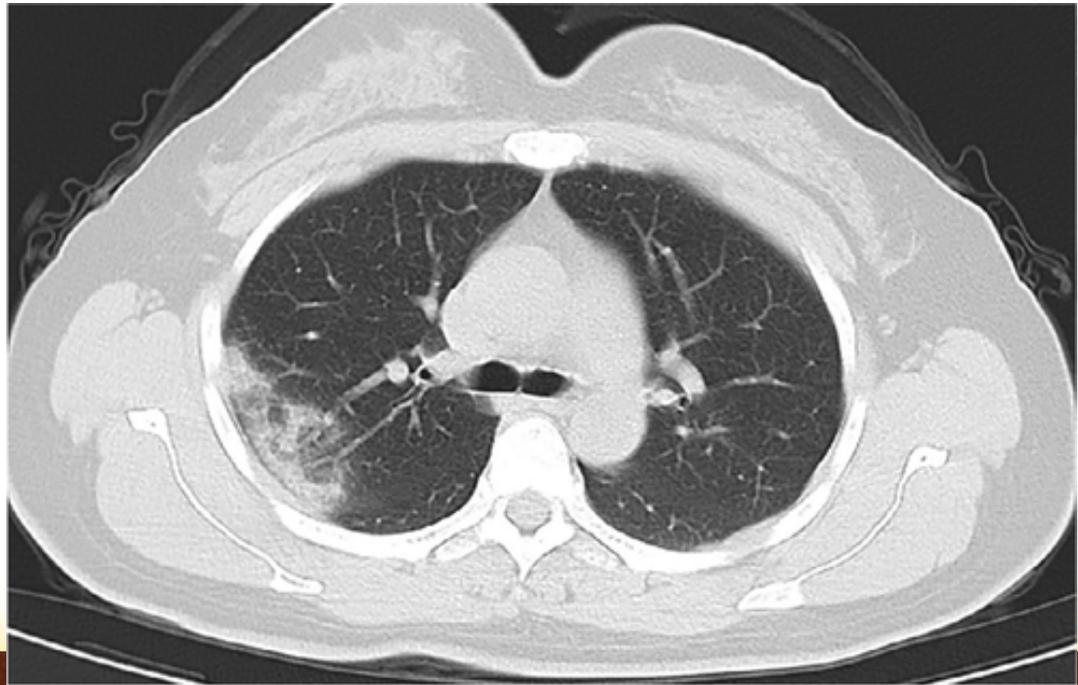
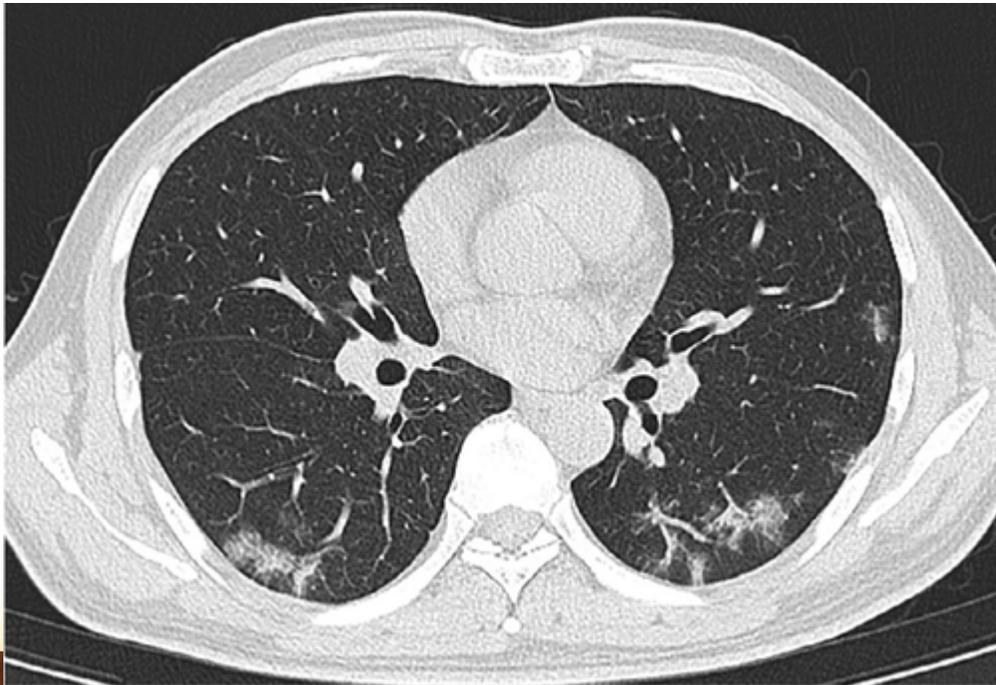
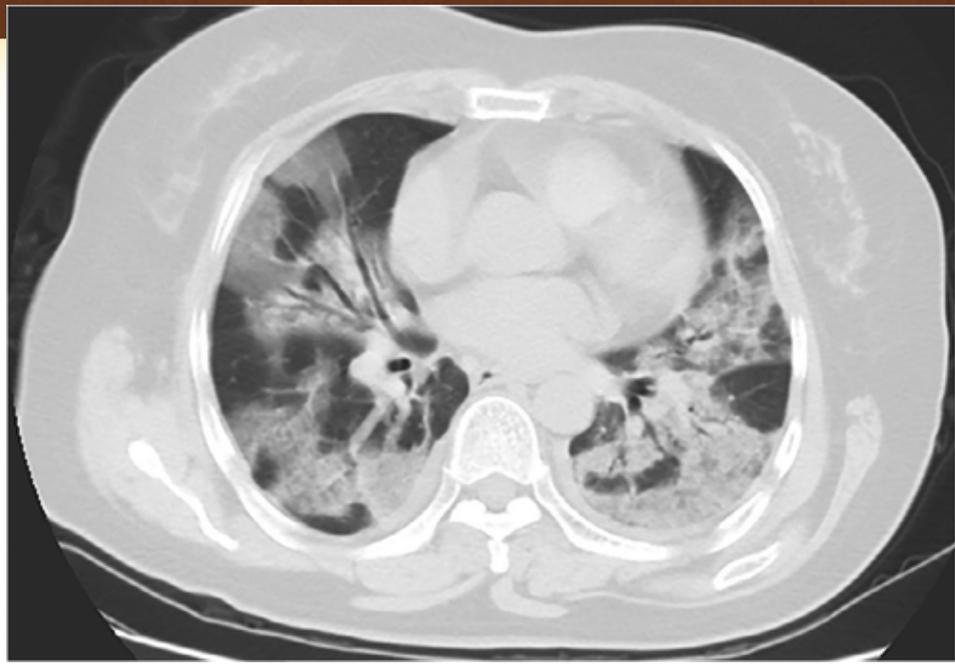
35/51 patients with positive RT-PCR and positive CT at initial presentation

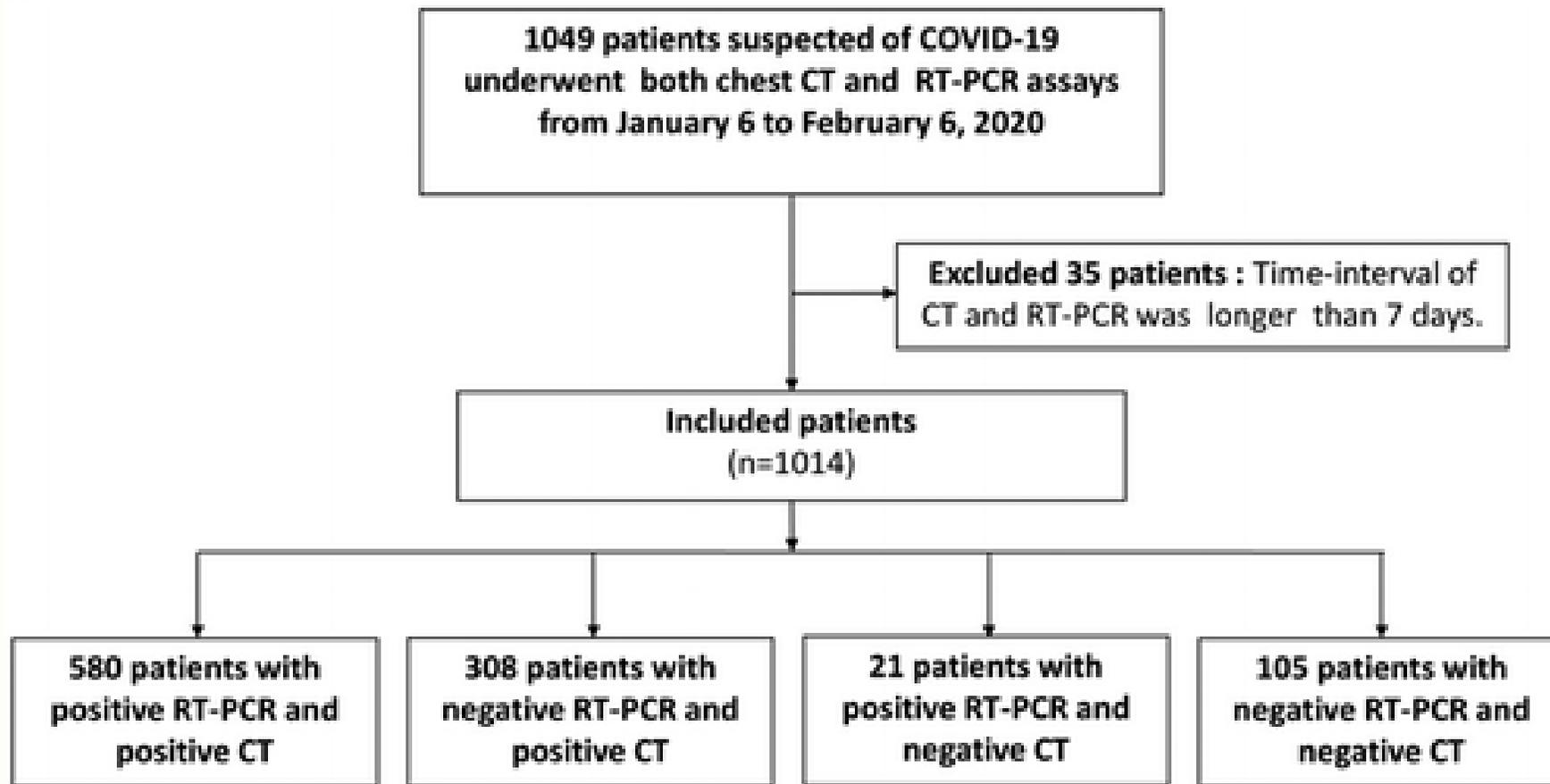
1/51 patients with positive RT-PCR and negative CT at initial presentation (CT became positive after 3 days for viral pneumonia).

Sensitivity of Chest CT for COVID-19:
Comparison to RT-PCR
Yicheng Fang, Huangqi Zhang, Jicheng Xie, Minjie Lin, Lingjun Ying, Peipei Pang, Wenbin Ji

<https://pubs.rsna.org/doi/10.1148/radiol.2020200432>

Published Online: Feb 19 2020



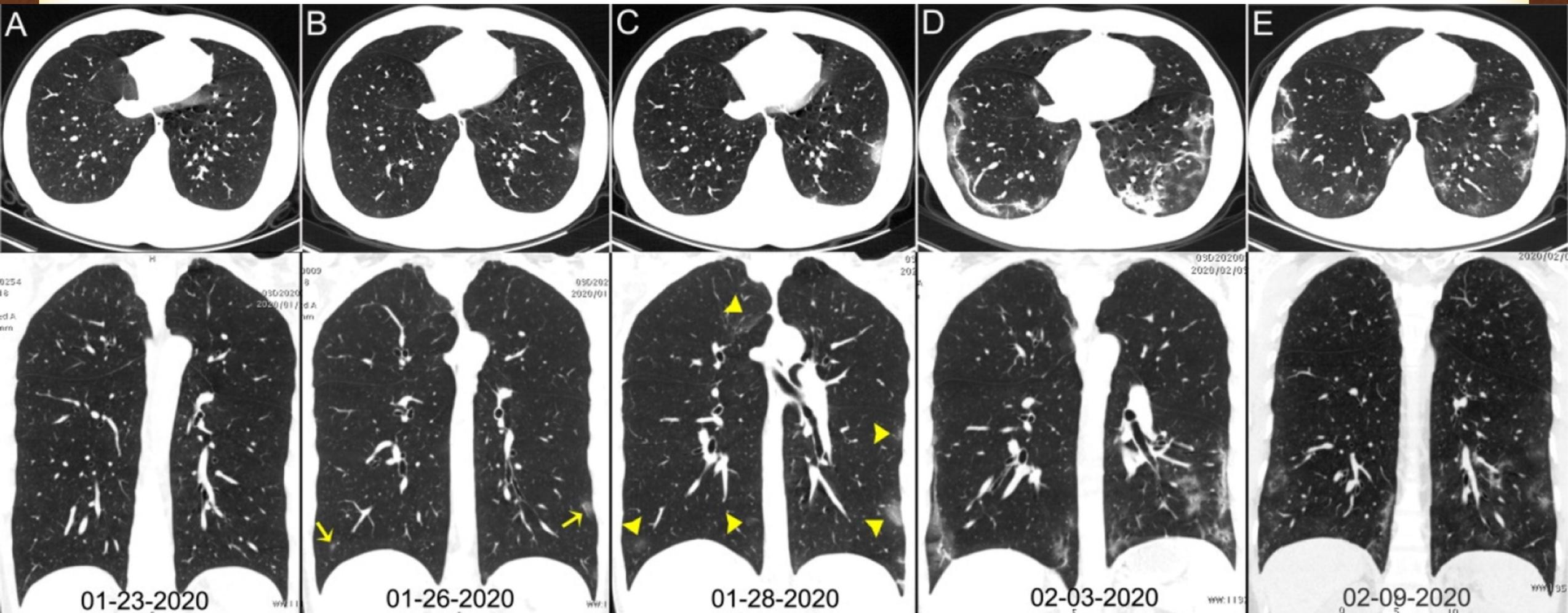


Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases
Tao Ai*, Zhenlu Yang*, Hongyan Hou, Chenao Zhan, Chong Chen, Wenzhi Lv, Qian Tao, Ziyong Sun, Liming Xia

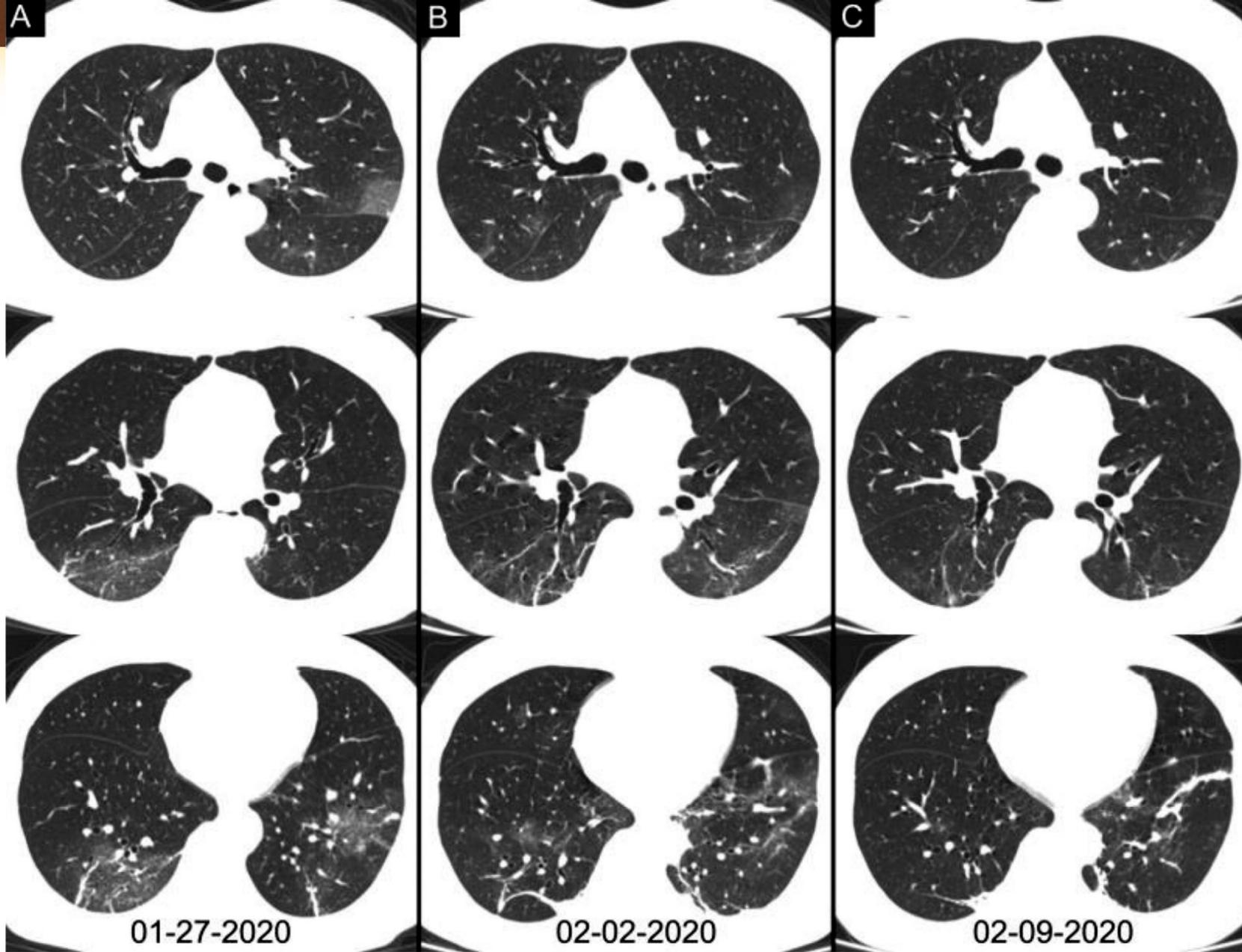
<https://pubs.rsna.org/doi/10.1148/radiol.2020200642>

With limitations of sample collection and transportation, and kit performance, the total positive rate of RT-PCR for throat swab samples was reported to be about 30% to 60% at initial presentation

In the current emergency, the low sensitivity of RT-PCR implies that *many COVID-19 patients may not be identified and may not receive appropriate treatment in time; such patients constitute a risk for infecting a larger population given the highly contagious nature of the virus.*



RT-PCR assay for the SARS-CoV-2 using a swab sample was performed on February 5, 2020, with a positive result



RT-PCR assay for the SARS-CoV-2 using a swab sample was positive on February 4, 2020

Conclusion

- Compared to RT-PCR, chest CT imaging may be a more reliable, practical, and rapid method to diagnose and assess COVID-19, especially in the epidemic area.
- With RT-PCR results as reference in 1014 patients, the sensitivity, specificity, accuracy of chest CT in indicating COVID-19 infection were 97% (580/601), 25% (105/413) and 68% (685/1014), respectively.
- The PPV and NPV were 65% (580/888) and 83% (105/126), respectively.
- *We also observed 42% (24/57) of patients showed improvement in follow-up chest CT scans, which was earlier than the RT-PCT results turning negative.*

<https://www.nytimes.com/2020/03/04/health/coronavirus-china-aylward.html?auth=login-google>

But if you thought you had coronavirus?

You would be sent to a fever clinic. They would take your temperature, your symptoms, medical history, ask where you'd traveled, your contact with anyone infected. They'd whip you through a CT scan ...

Wait — “whip you through a CT scan”?

Each machine did maybe 200 a day. Five, 10 minutes a scan. Maybe even partial scans. A typical hospital in the West does one or two an hour. And not X-rays; they could come up normal, but a CT would show the “ground-glass opacities” they were looking for.

And then?

If you were still a suspect case, you'd get swabbed. But a lot would be told, “You're not Covid.” People would come in with colds, flu, runny noses. That's not Covid. If you look at the symptoms, 90 percent have fever, 70 percent have dry coughs, 30 percent have malaise, trouble breathing. Runny noses were only 4 percent.

The swab was for a PCR test, right? How fast could they do that? Until recently, we were sending all of ours to Atlanta.

They got it down to four hours.

CT technique

- Non-contrast chest CT
 - Specific “CT COVID chest w/o” order on EPIC
- Peak inspiration
- Lung apices to bases, include CP angles
- Axial, coronal and sagittal 3 mm, ST windows
- Axial MIP, and axial 1 mm in lung windows

CT technique

- PPE policies for techs
 - Universal mask, eye protection, gloves
 - N95/PAPR if patient intubated/aerosol generating procedure
- Room closure time/cleaning
 - If pt masked, may clean and scan next

CT interpretation: ONLY in appropriate clinical context

Normal	Probable COVID	Indeterminate	Alternate diagnosis
Normal	GGO (often patchy, rounded)	Consolidations	Lobar opacities
	Peripheral and posterior	Peribronchial opacities (GGO/consolidations)	Pleural effusions
	“Crazy paving”		Lymphadenopathy
	“Reverse halo”		Traction bronchiectasis
			“Tree-in-bud”
			Solid nodules
			Cavitation

March 11, 2020

ACR Recommendations for the use of Chest Radiography and Computed Tomography (CT) for Suspected COVID-19 Infection

Based on these concerns, the ACR recommends:

- CT should not be used to screen for or as a first-line test to diagnose COVID-19
- CT should be used sparingly and reserved for hospitalized, symptomatic patients with specific clinical indications for CT. Appropriate infection control procedures should be followed before scanning subsequent patients.
- Facilities may consider deploying portable radiography units in ambulatory care facilities for use when CXRs are considered medically necessary. The surfaces of these machines can be easily cleaned, avoiding the need to bring patients into radiography rooms.

STR / ASER COVID-19 Position Statement

March 11, 2020

At this time, the STR and ASER do not recommend routine CT screening for the diagnosis of patients under investigation for COVID-19. Chest CT can be restricted to patients who test positive for COVID-19 and who are suspected of having complicating features such as abscess or empyema.

<https://www.acr.org/Advocacy-and-Economics/ACR-Position-Statements/Recommendations-for-Chest-Radiography-and-CT-for-Suspected-COVID19-Infection>

<https://www.aser.org/covid-19-faqs/>

Radiological Society of North America Expert Consensus Statement on Reporting Chest CT Findings Related to COVID-19. Endorsed by the Society of Thoracic Radiology, the American College of Radiology, and RSNA.

Scott Simpson*,  Fernando U. Kay*,  Suhny Abbara,  Sanjeev Bhalla,  Jonathan H. Chung,  Michael Chung, Travis S. Henry,  Jeffrey P. Kanne,  Seth Kligerman... [Show all authors](#) 

Routine screening CT for the identification of COVID-19 pneumonia is currently not recommended by most radiology societies. However, the number of CTs performed in persons under investigation (PUI) for COVID-19 has increased.

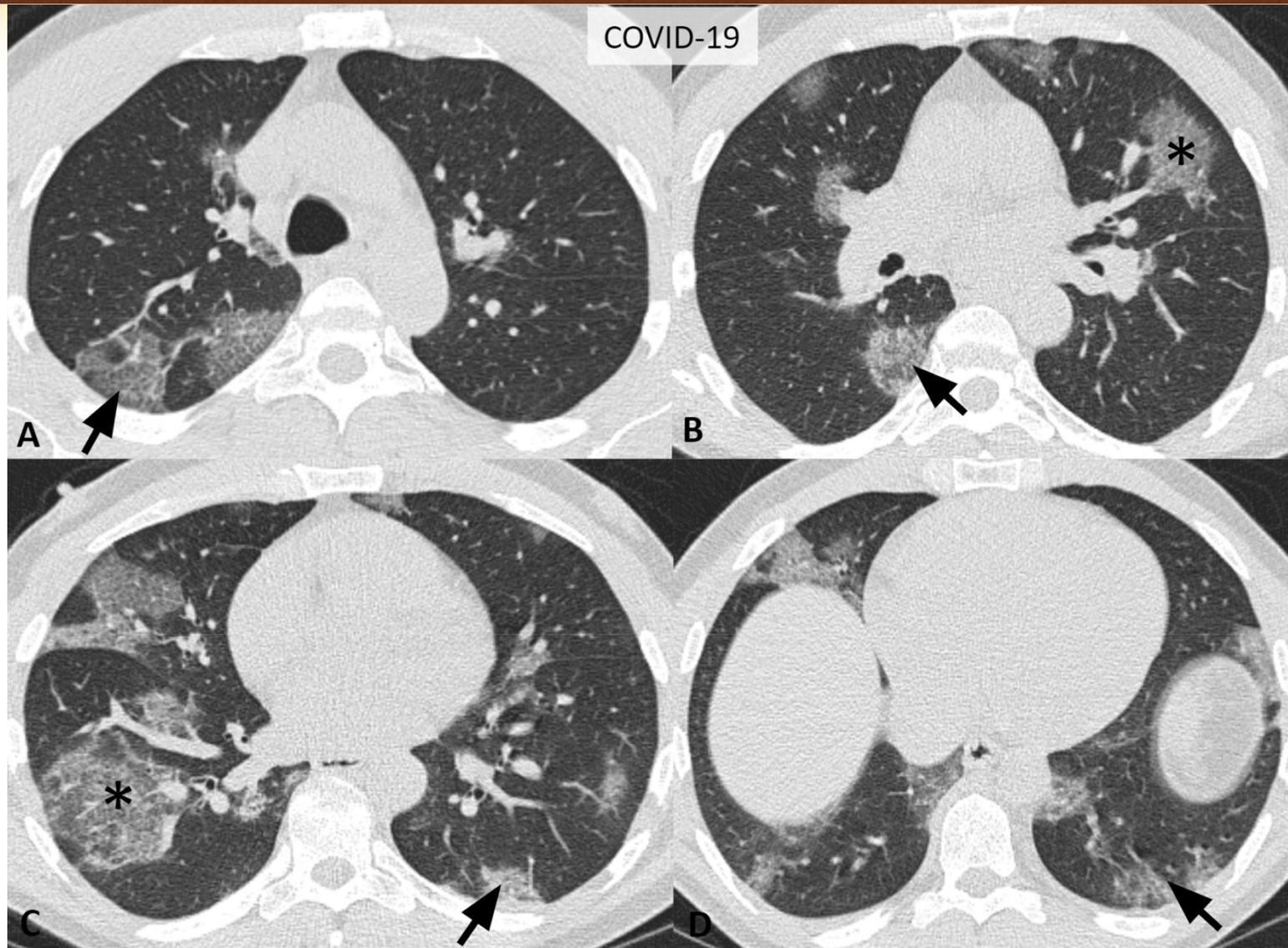
COVID-19: Structured Reporting for Chest CT

RSNA Expert Consensus Document on Reporting Chest CT findings related to COVID-19.

Endorsed by the STR & ACR 3/24/2020

Classification	Rationale	CT Finding	Suggested Reporting Language
Typical	Commonly reported imaging features of greater specificity for COVID-19 pneumonia	<ul style="list-style-type: none"> Peripheral, bilateral (multilobar), GGO w/ or w/o consolidation or visible intralobular lines ("crazy-paving") Multifocal GGO of rounded morphology w/ or w/o consolidation or visible intralobular lines ("crazy-paving") Reverse halo sign or other findings of organizing pneumonia (seen later in the disease) 	<p>Commonly reported imaging features of (COVID-19) pneumonia are present. Other processes such as influenza pneumonia and organizing pneumonia, as can be seen with drug toxicity and connective tissue disease, can cause a similar imaging pattern.</p> <p>[Cov19Typ]</p>
Indeterminate	Nonspecific imaging features of COVID-19 pneumonia	<p>Absence of typical features AND the presence of:</p> <ul style="list-style-type: none"> Multifocal, diffuse, perihilar or unilateral GGO w/ or w/o consolidation, lacking a specific distribution, & are non-rounded or non-peripheral Few very small GGO with a non-rounded & non-peripheral distribution 	<p>Imaging features can be seen with (COVID-19) pneumonia, though are nonspecific and can occur with a variety of infectious and noninfectious processes.</p> <p>[Cov19Ind]</p>
Atypical	Uncommonly or not reported features of COVID-19 pneumonia	<p>Absence of typical or indeterminate features AND presence of:</p> <ul style="list-style-type: none"> Isolated lobar or segmental consolidation w/o GGO Discrete small nodules (centrilobular, tree-in-bud) Lung cavitation Smooth interlobular septal thickening w/ pleural effusion 	<p>Imaging features are atypical or uncommonly reported for (COVID-19) pneumonia. Alternative diagnoses should be considered. [Cov19Aty]</p>
Negative	No features of pneumonia	<ul style="list-style-type: none"> No CT features to suggest pneumonia 	<p>No CT findings present to indicate pneumonia. (Note: CT may be negative in the early stages of COVID-19) [Cov19Neg]</p>

ORANGE optional; PURPLE for report coding



Radiology

**The Role of Chest Imaging in Patient Management
during the COVID-19 Pandemic:
A Multinational Consensus Statement from the
Fleischner Society**

<https://pubs.rsna.org/doi/pdf/10.1148/radiol.2020201365>

Imaging and PCR testing

- Variable sensitivities ranging from 37% to 71%
 - High analytical sensitivity and near-perfect specificity
 - Clinical sensitivity affected by a number of variables including: adequacy of specimen, specimen type, specimen handling, and stage of infection.
- False negative RT-PCR in patients with CT findings of COVID-19 who were eventually tested positive with serial sampling
- Limited testing capacity has contributed to rapid and unchecked transmission of infection within communities by undetected individuals with milder, limited, or no symptoms

CXR vs CT

CXR	CT
Insensitive for early changes (not relevant if pts told to stay home early)	More sensitive early (early presentation, isolation of all patients); PCR limited
Limited for alternate diagnosis	Alternate diagnosis, PE (with contrast)
Portable in pt room	Limited capacity (cleaning & disinfecting)
Disease progression in hospital	May be used for disposition
Low radiation dose	Moderate radiation dose

Summary of Recommendations for Imaging

Main Recommendations

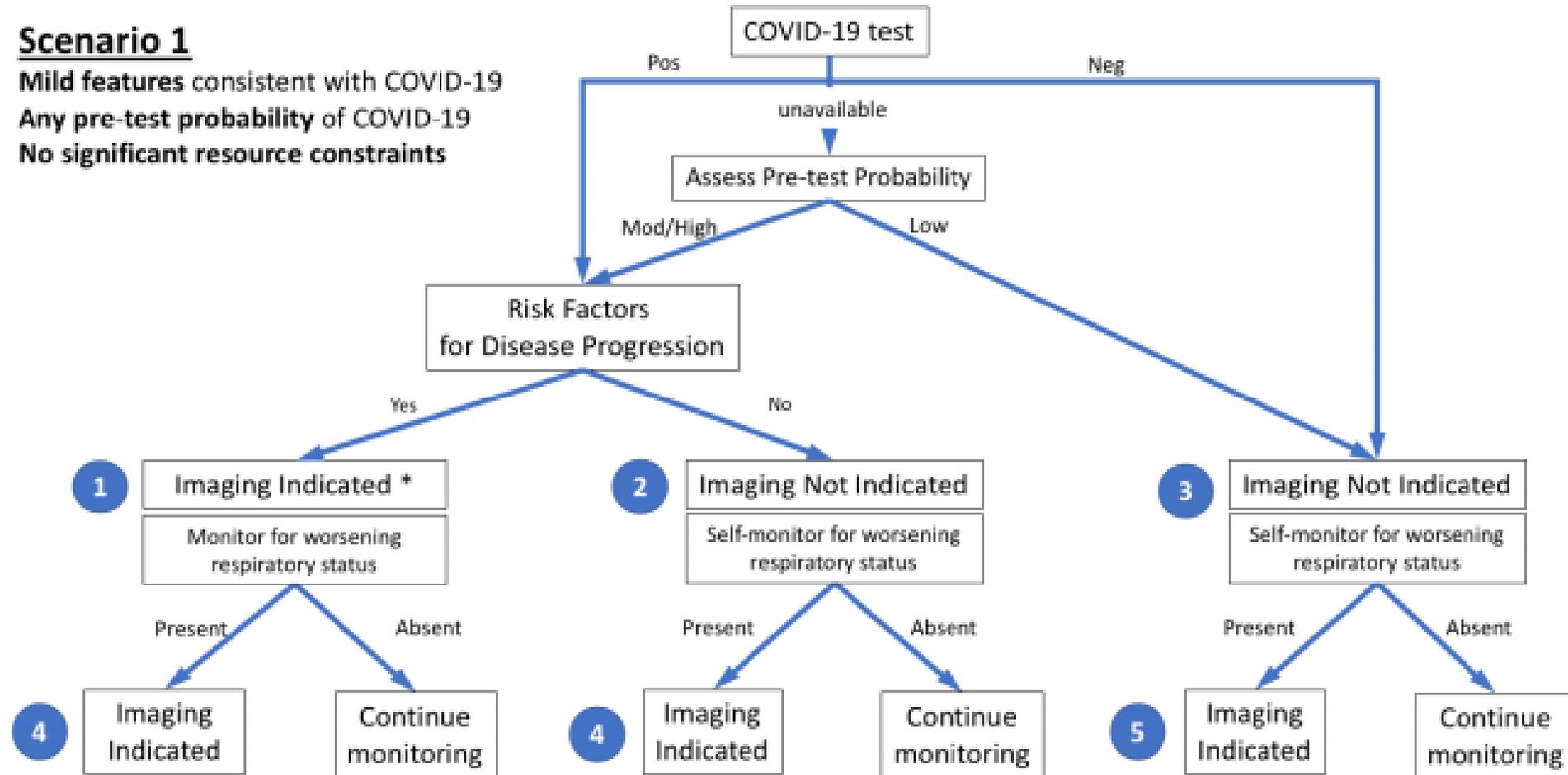
- Imaging is not routinely indicated as a screening test for COVID-19 in asymptomatic individuals
- Imaging is not indicated for patients with mild features of COVID-19 unless they are at risk for disease progression (Scenario 1)
- Imaging is indicated for patients with moderate to severe features of COVID-19 regardless of COVID-19 test results (Scenarios 2 and 3)
- Imaging is indicated for patients with COVID-19 and evidence of worsening respiratory status (Scenarios 1, 2, and 3)
- In a resource constrained environment where access to CT is limited, CXR may be preferred for patients with COVID-19 unless features of respiratory worsening warrant the use of CT (Scenarios 2 and 3)

Additional Recommendations

- Daily chest radiographs are NOT indicated in stable intubated patients with COVID-19
- CT is indicated in patients with functional impairment and/or hypoxemia after recovery from COVID-19
- COVID-19 testing is indicated in patients incidentally found to have findings suggestive of COVID-19 on a CT scan

Scenario 1

Mild features consistent with COVID-19
Any pre-test probability of COVID-19
No significant resource constraints



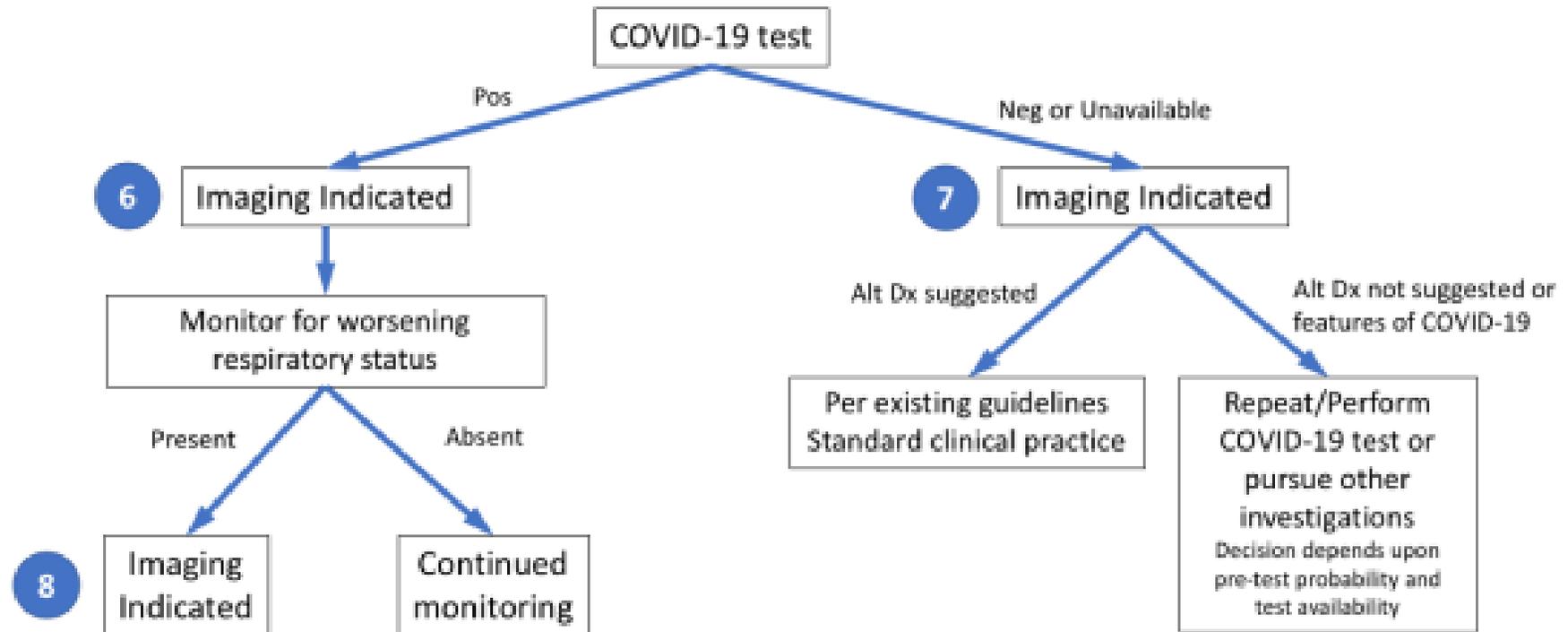
* Clinical judgement should dictate the use of imaging through consideration of patient risk factors and local resources.

Scenario 2

Moderate to severe features consistent with COVID-19

Any pre-test probability of COVID-19

No significant resource constraints

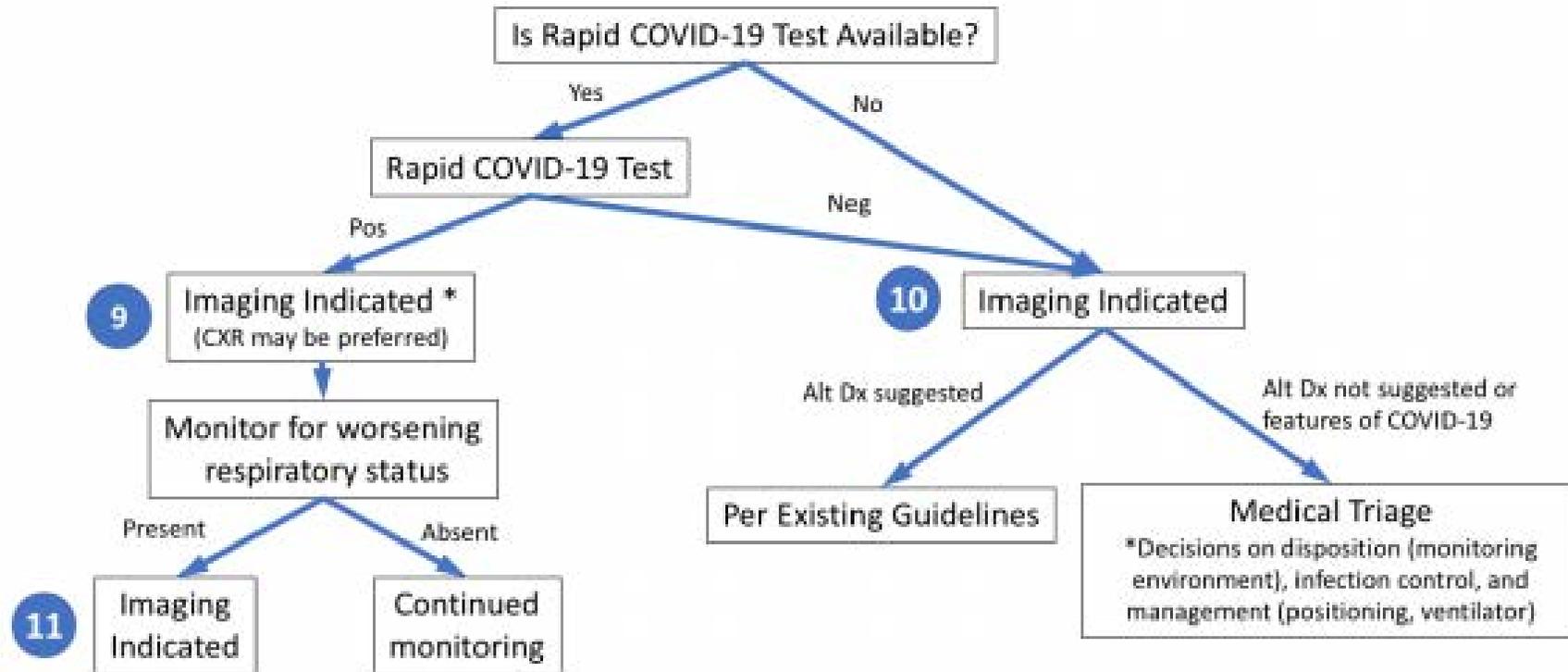


Scenario 3

Moderate to severe features consistent with COVID-19

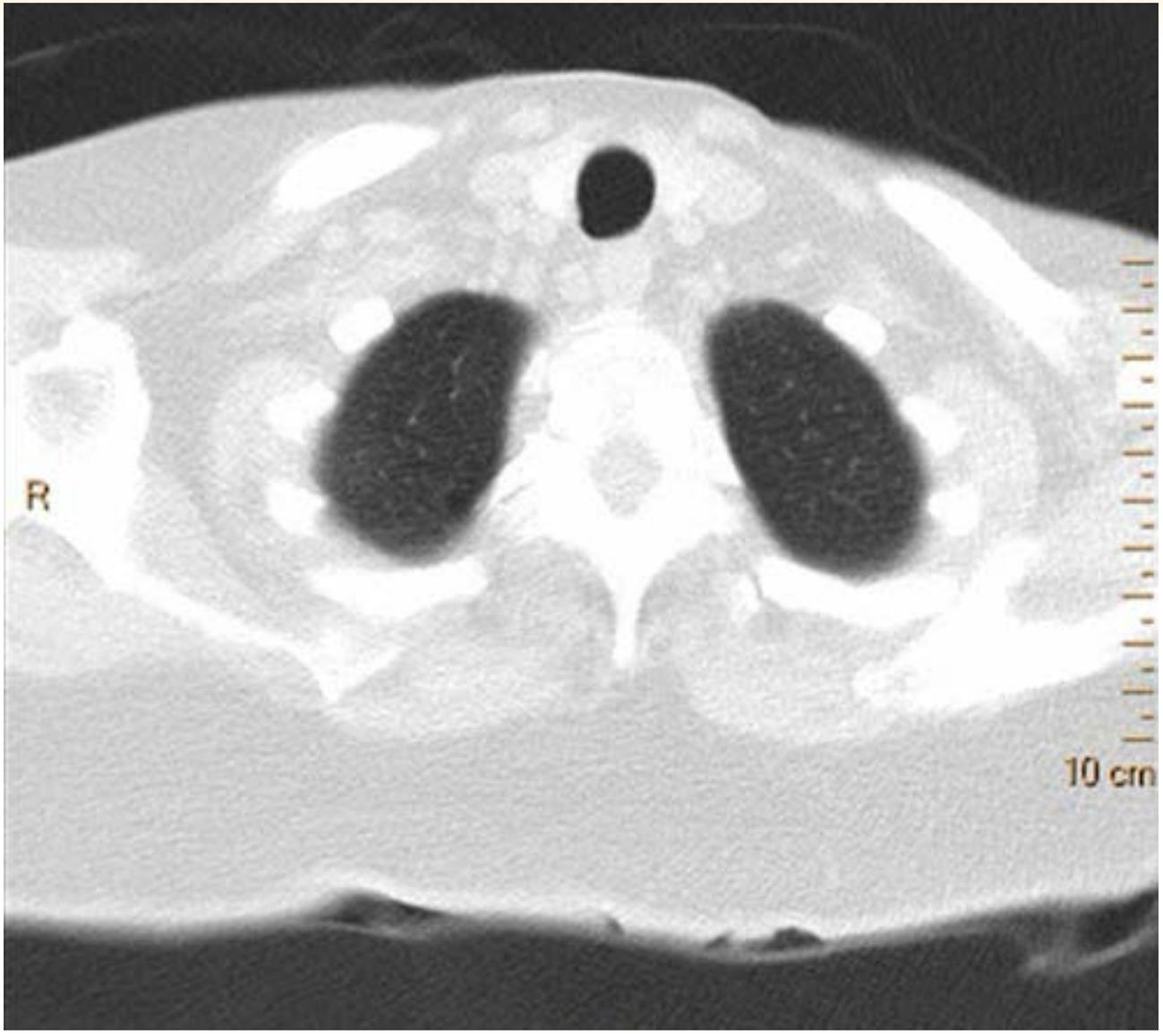
High pre-test probability of COVID-19

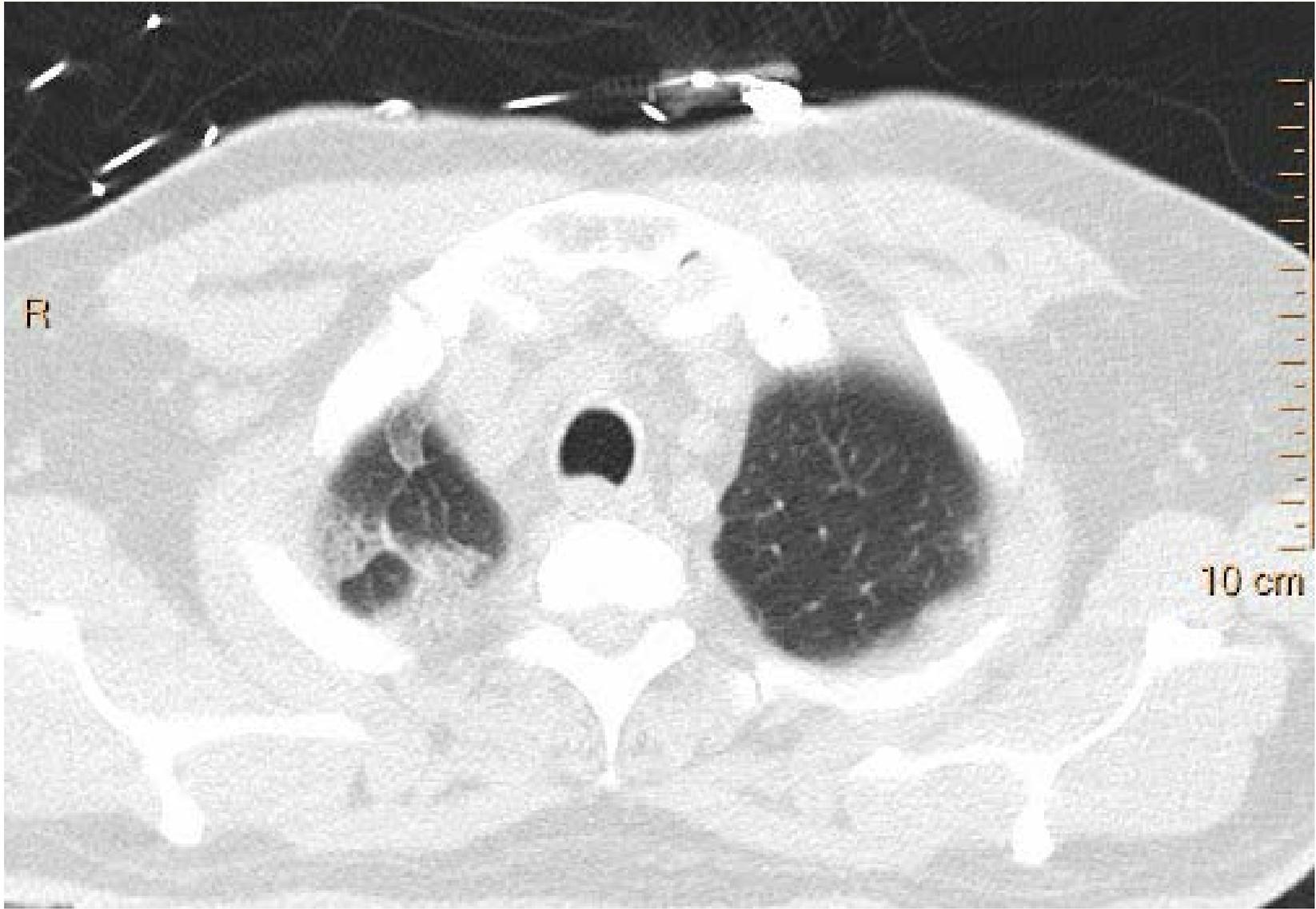
Resource constrained (Need for urgent patient triage due to lack of resources – beds, ventilators, medical personnel, PPE, COVID tests)



* Lower priority if severely resource constrained, relative to 10 or 11.

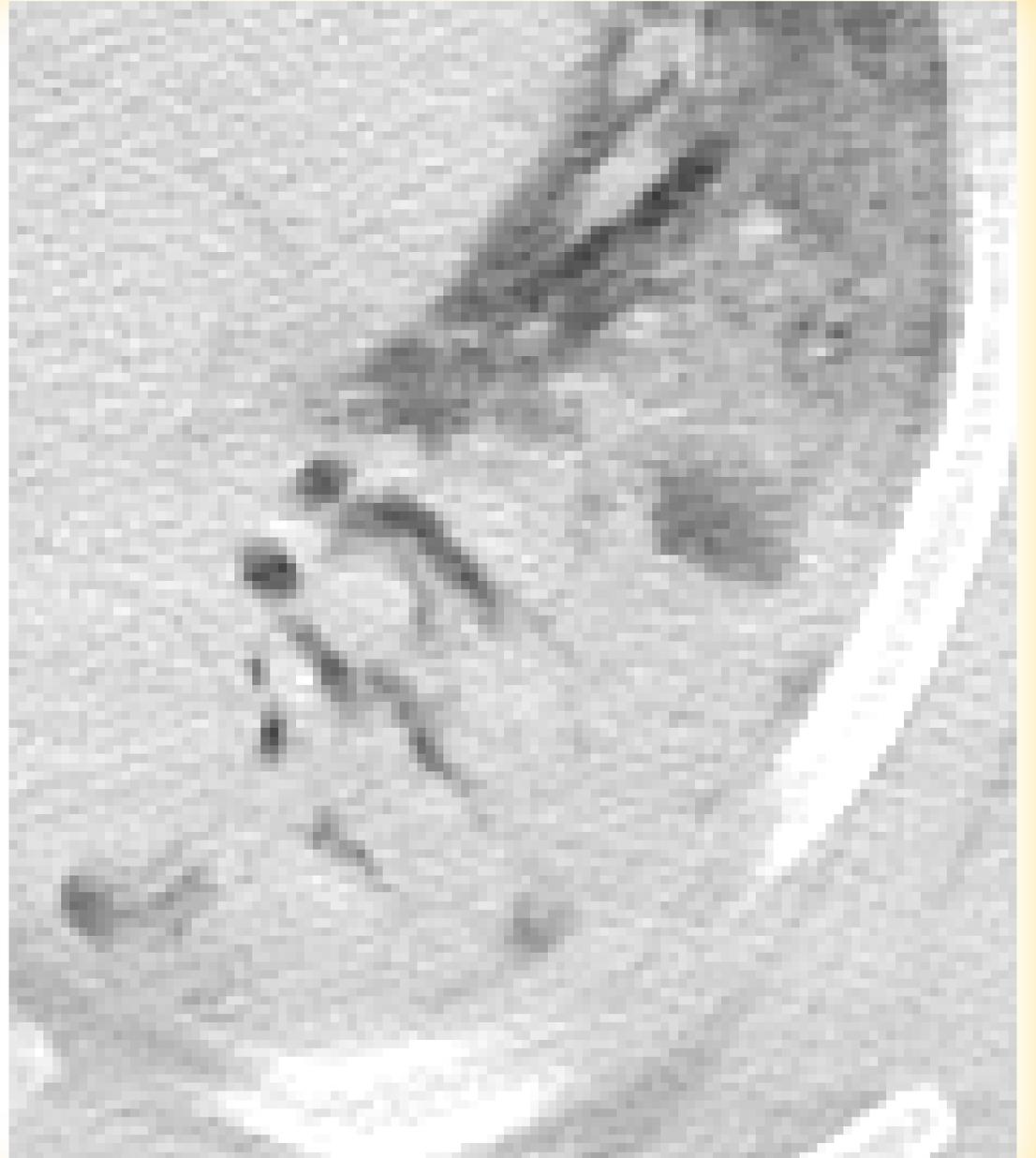
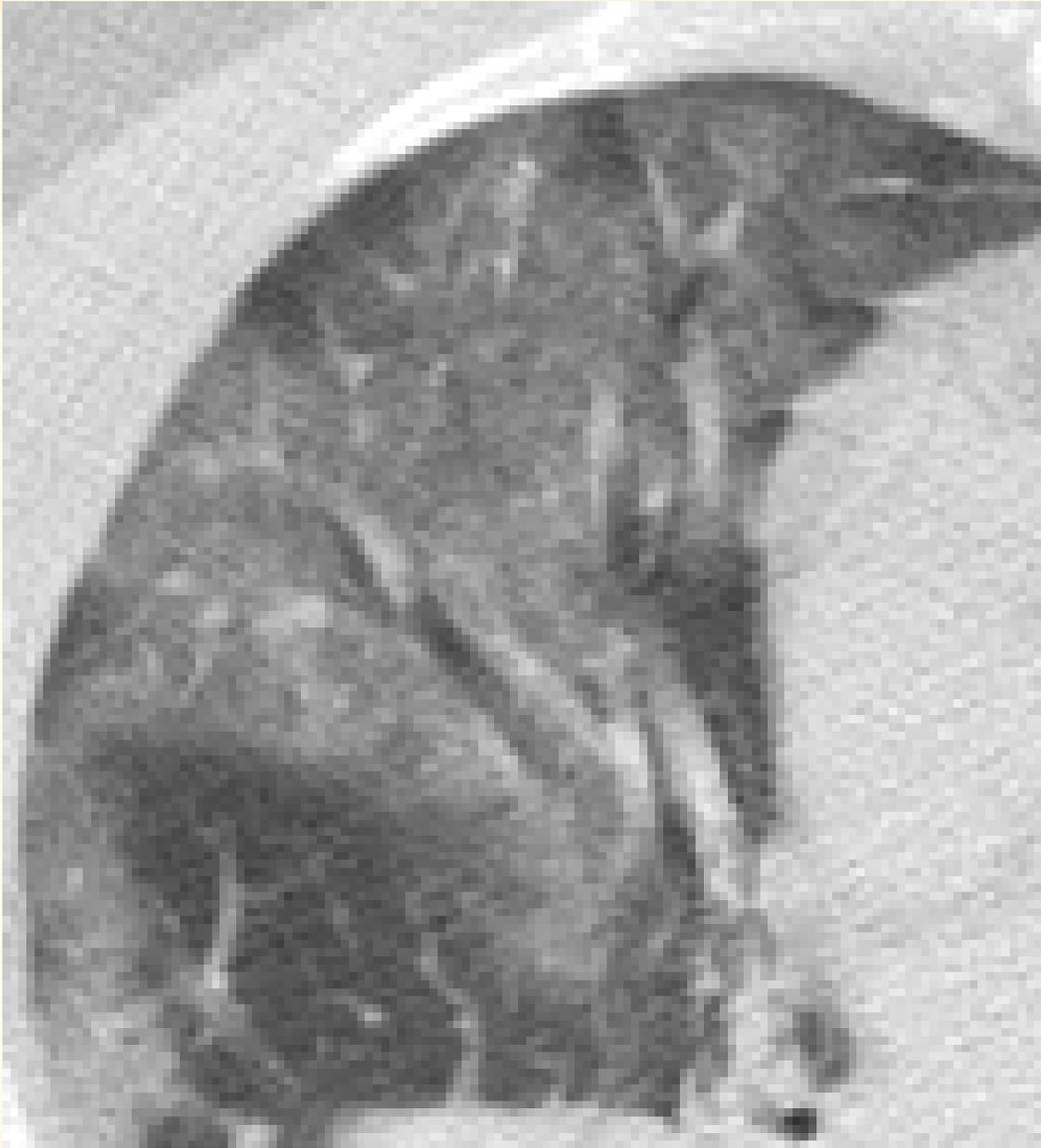






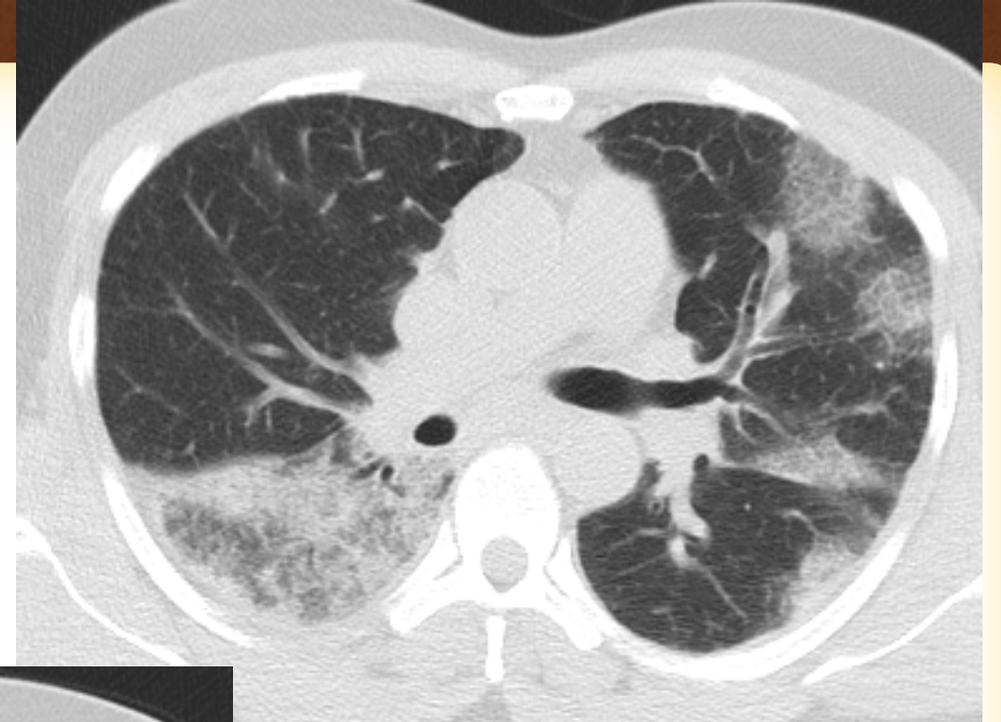


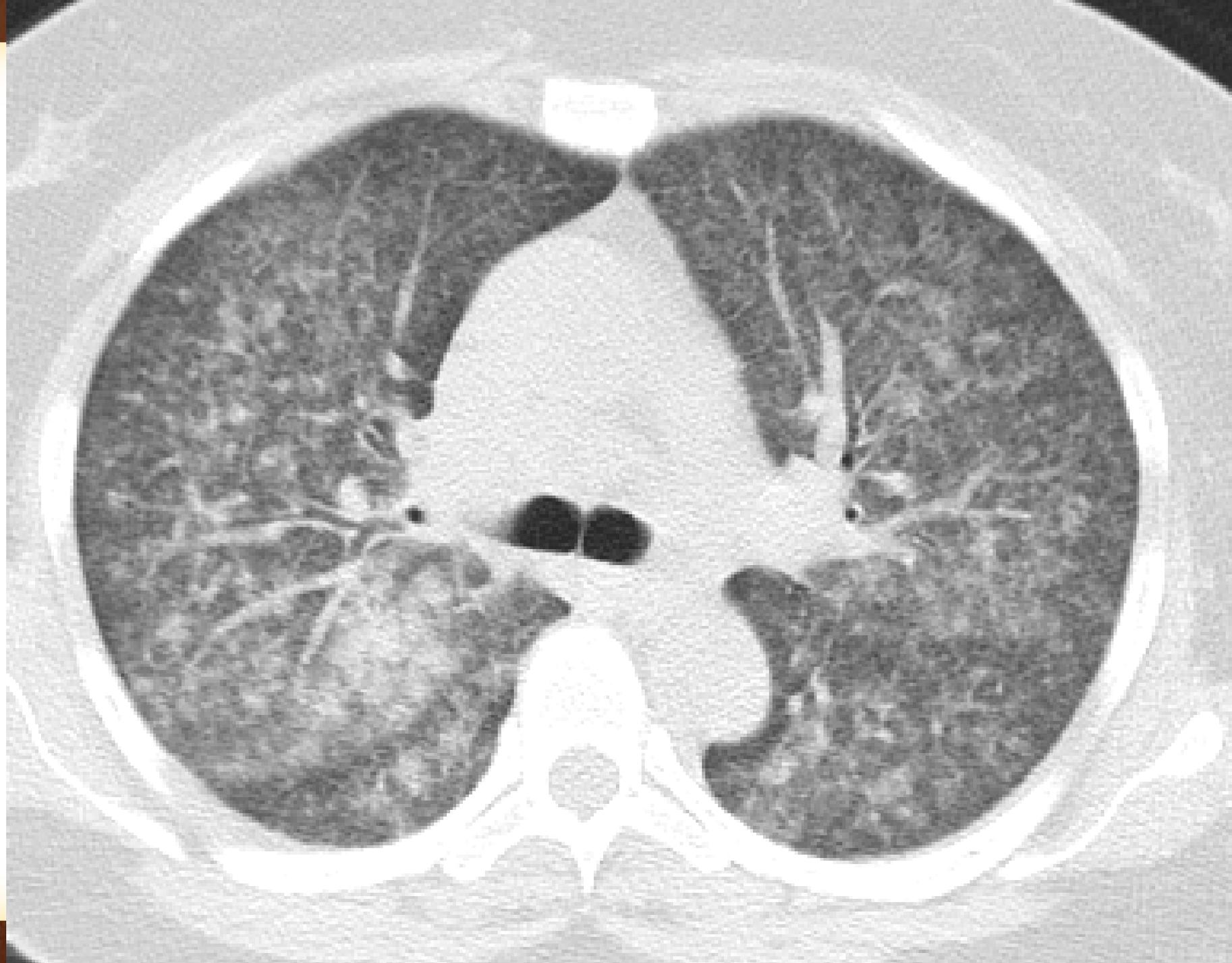


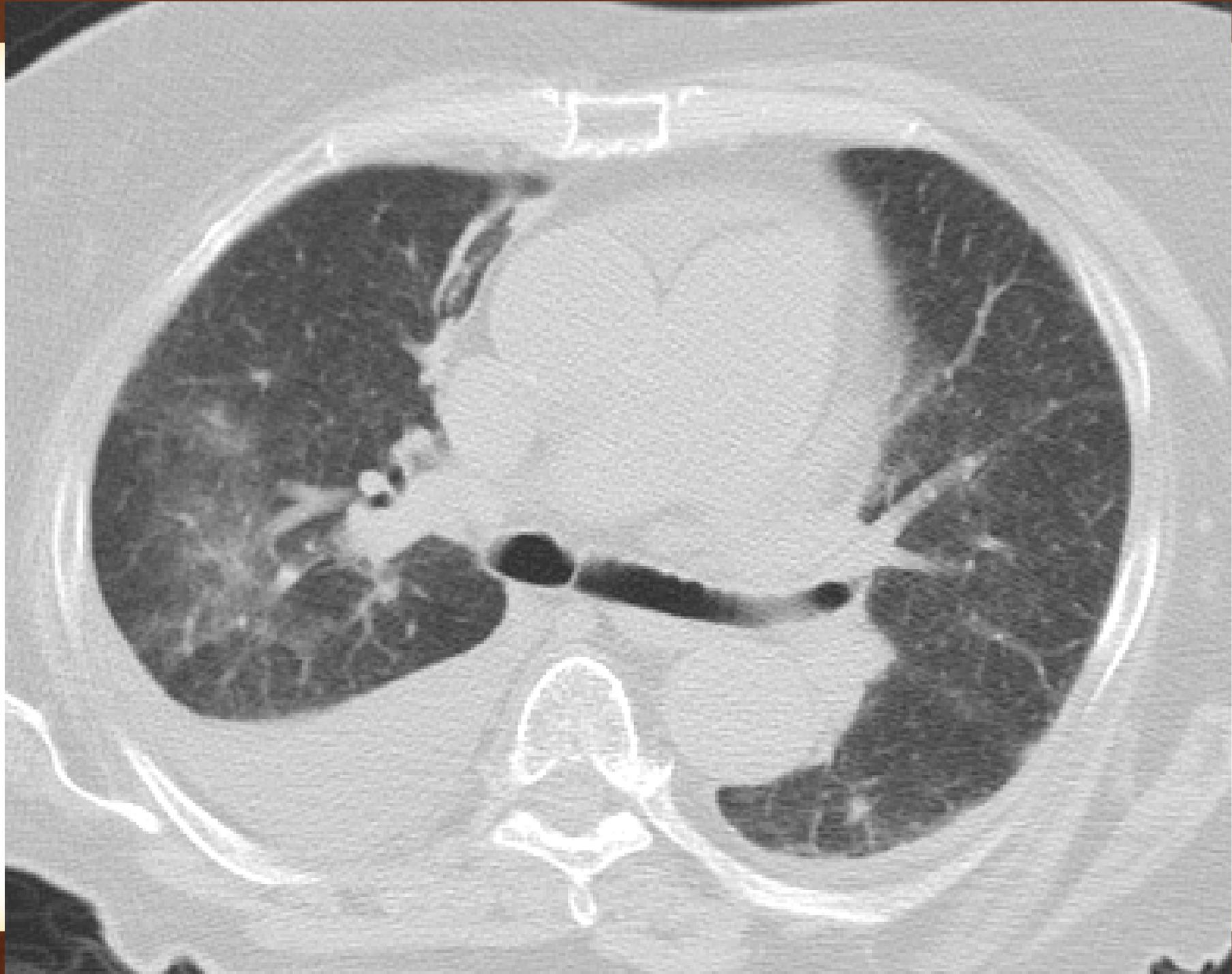


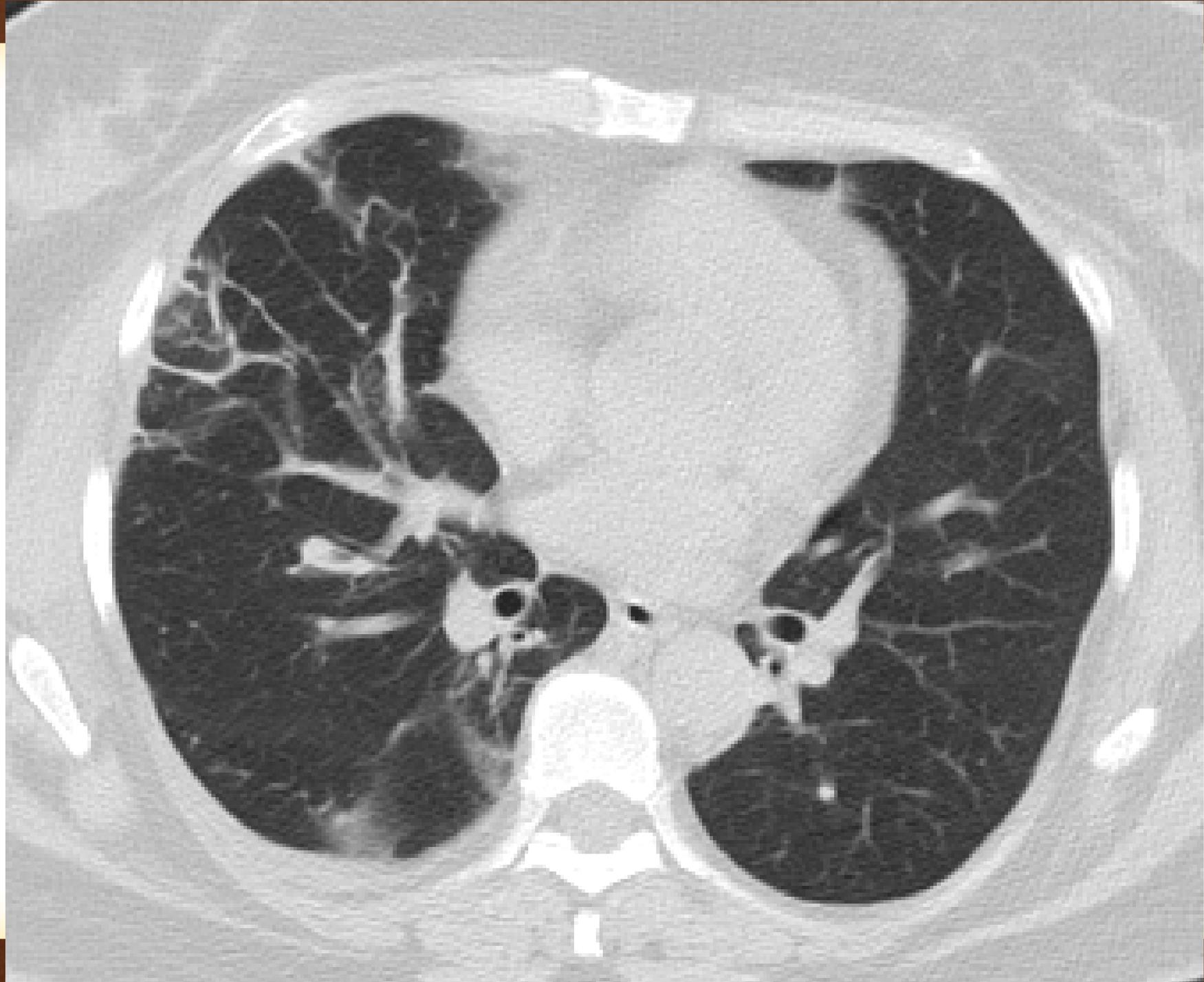


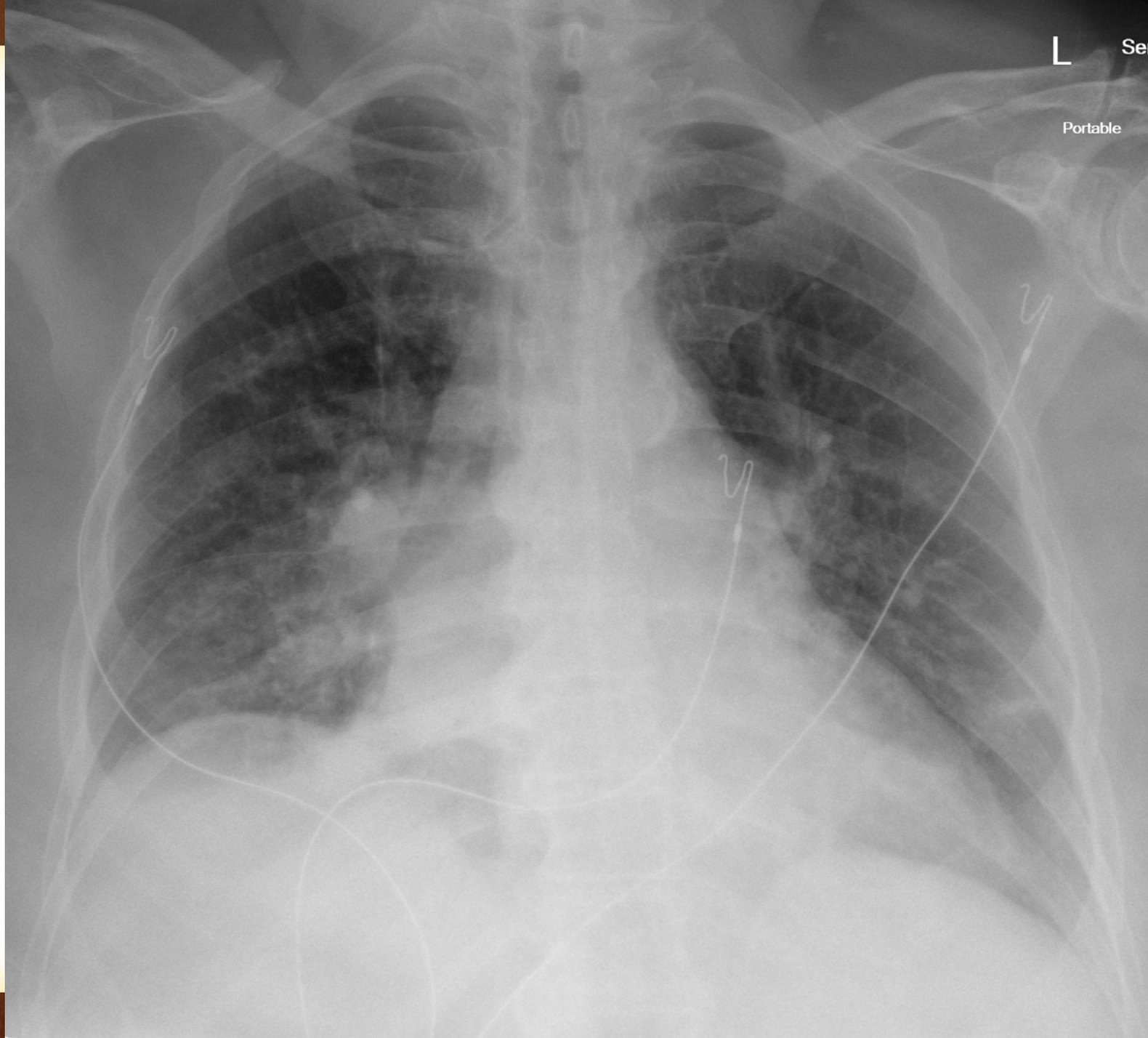
D Dimer	26,985 ^	0 - 229 ng/mL
Procalcitonin	0.08	ng/mL
Ferritin	575.0 ^	30.0 - 400.0 ng/mL
C-Reactive Protein - HS	75.35 ^	<=5.00 mg/L
COVID-19	Detected !	Not Detected







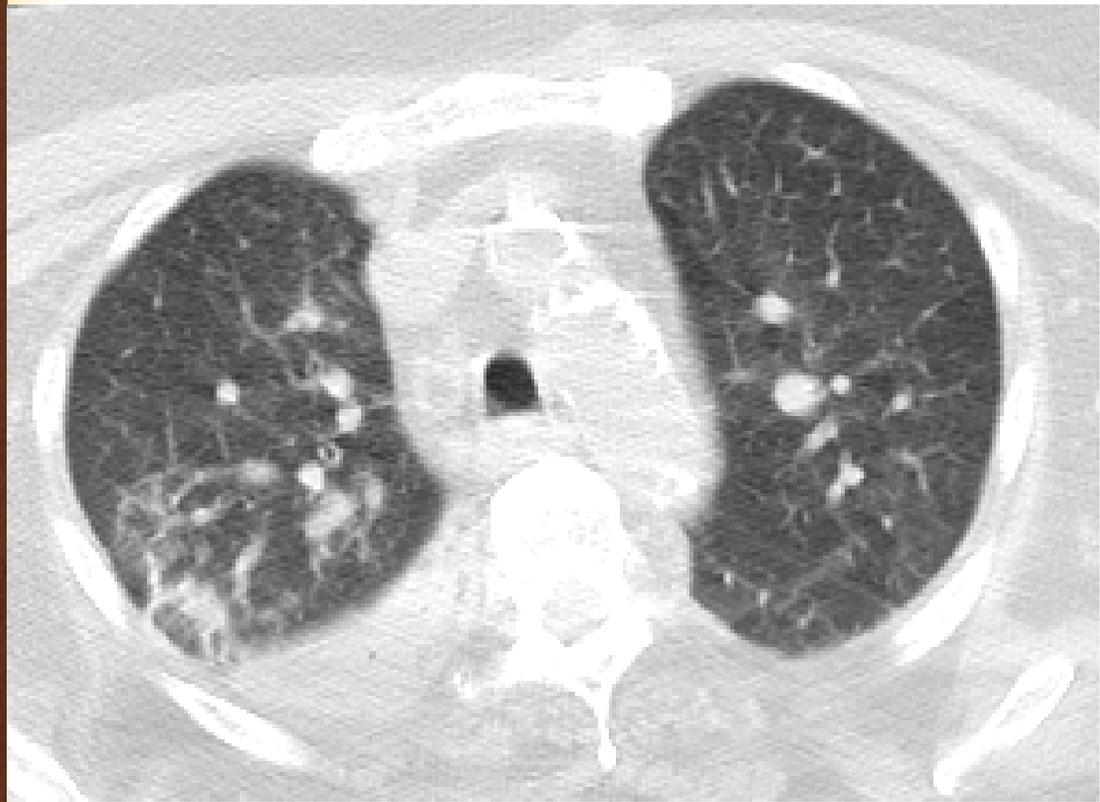


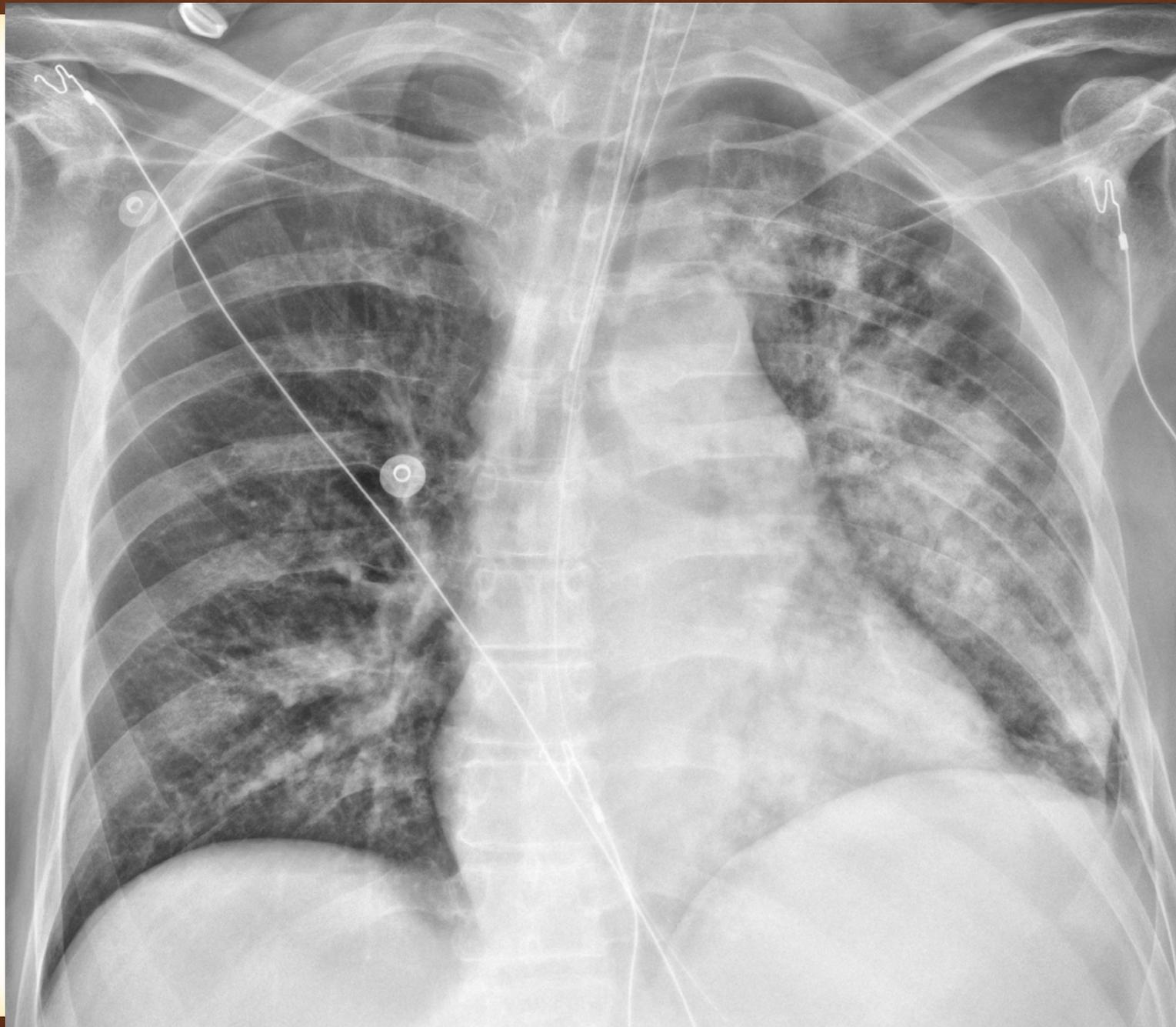


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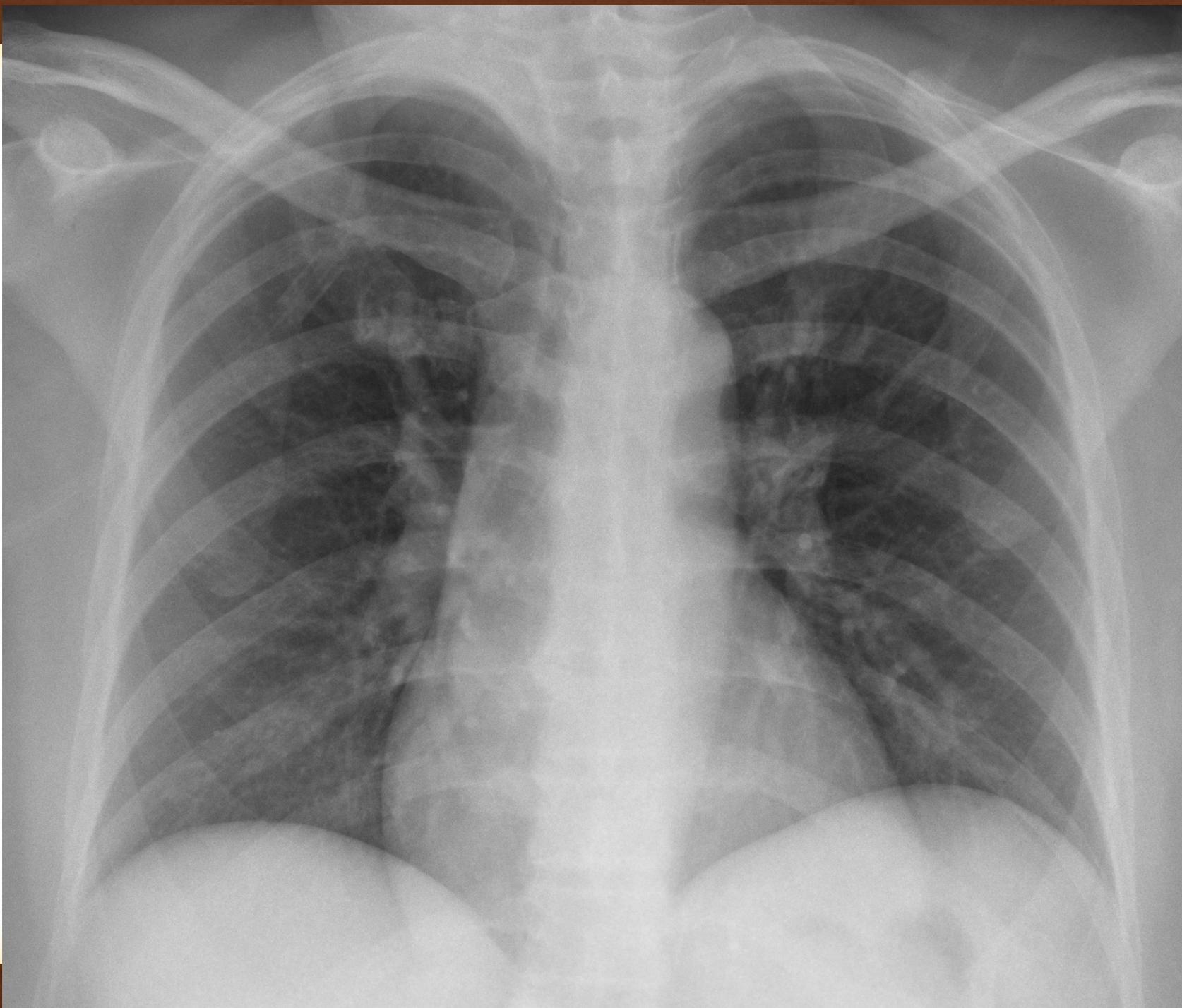
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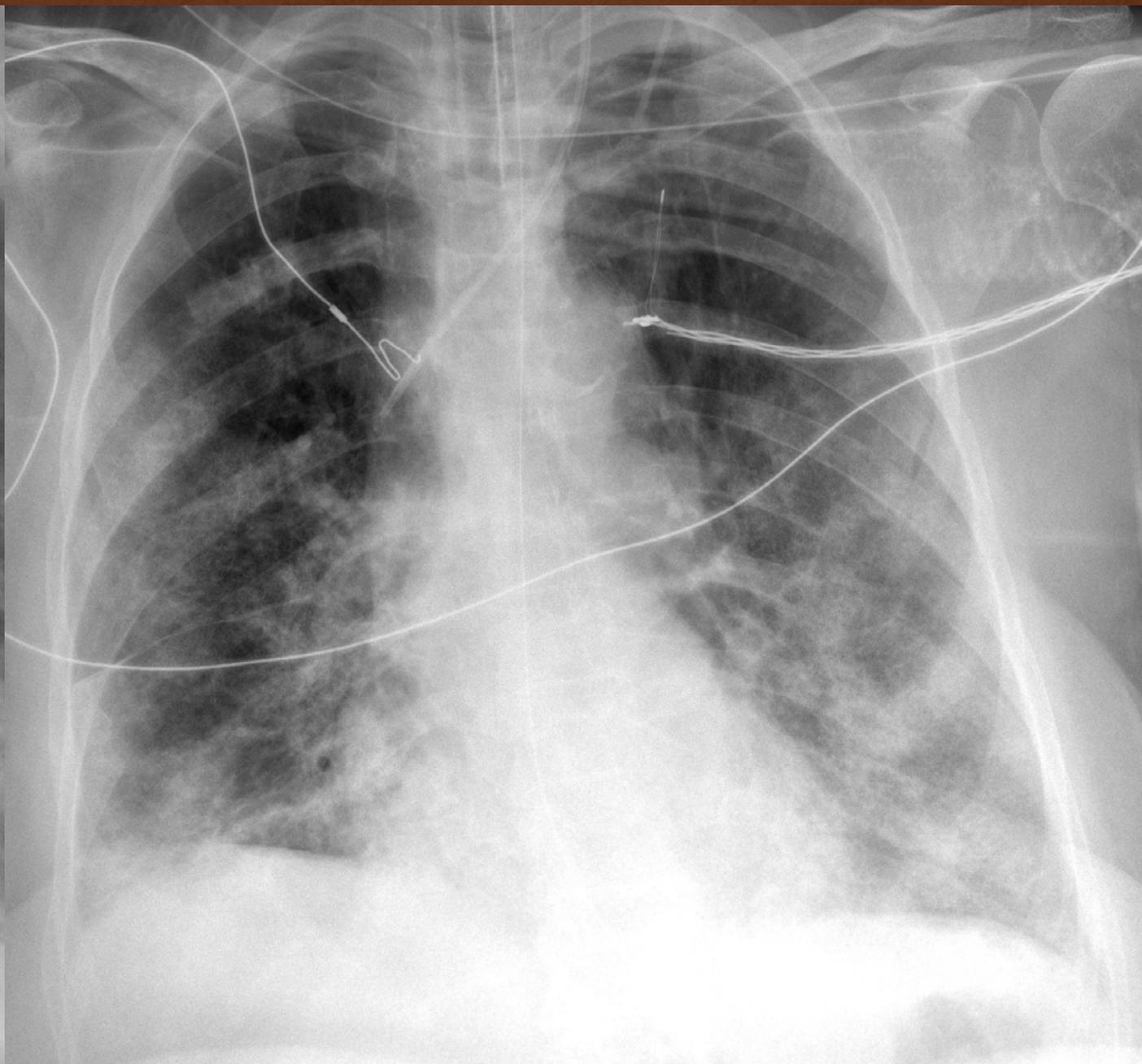
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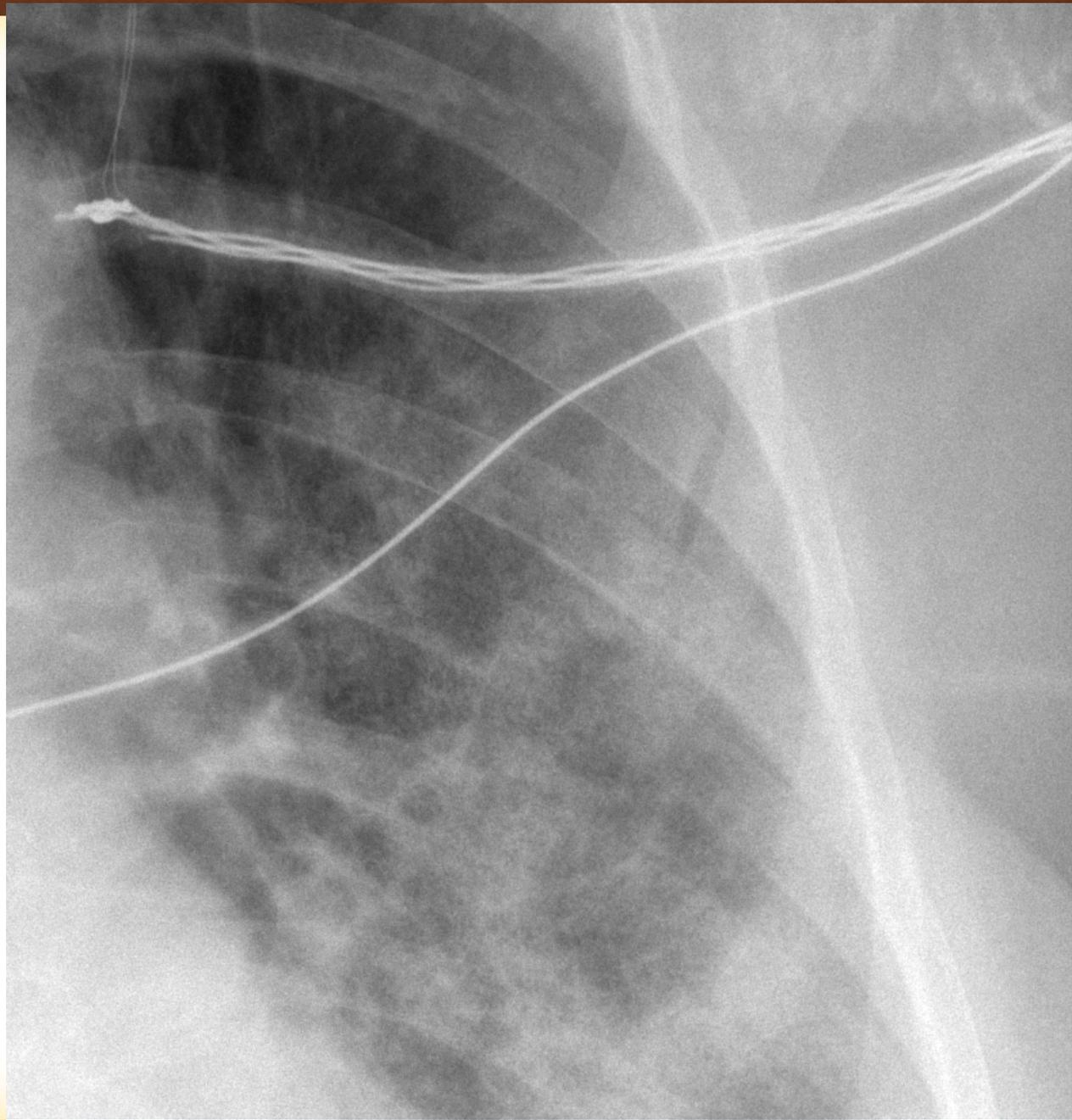
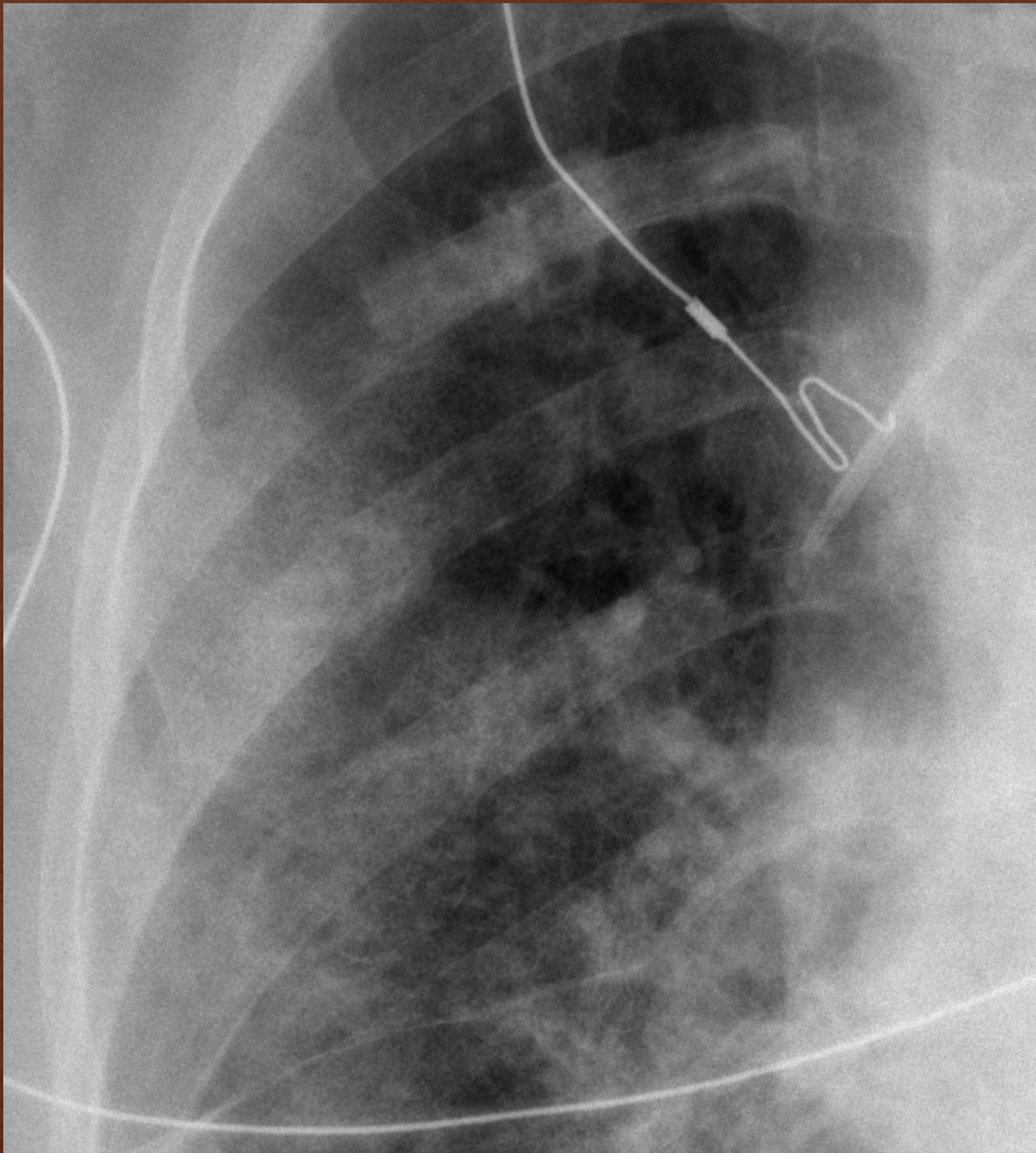


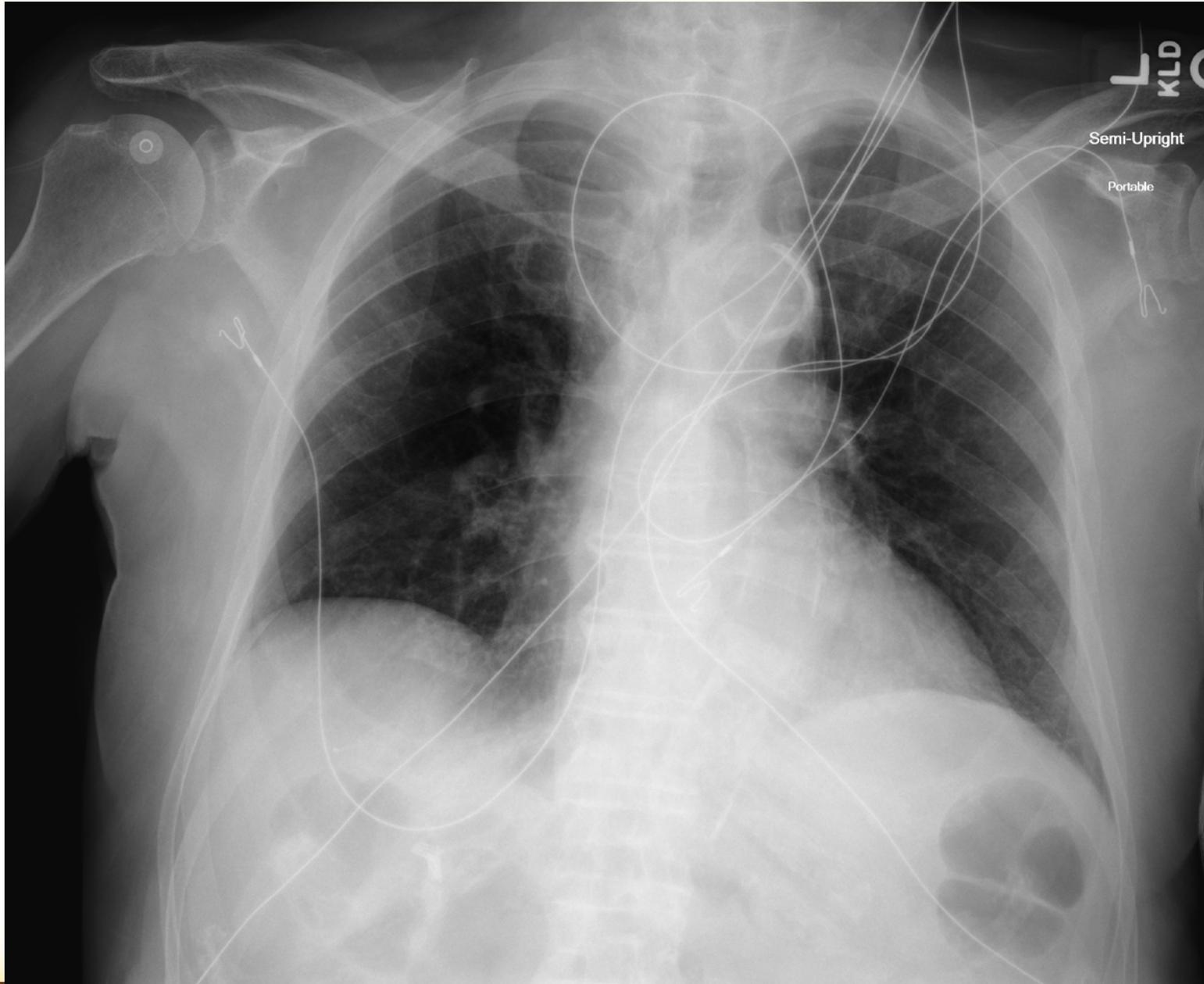






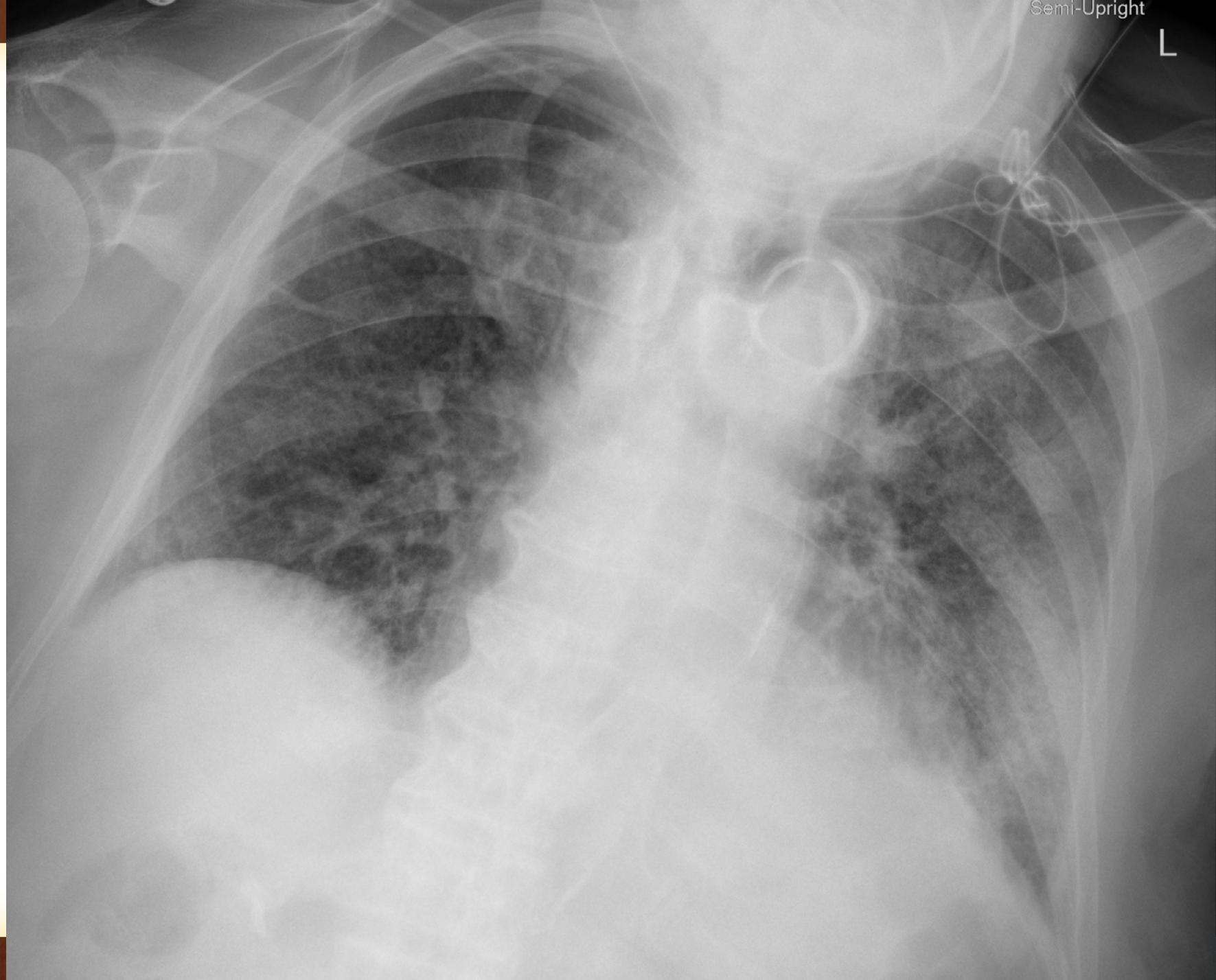


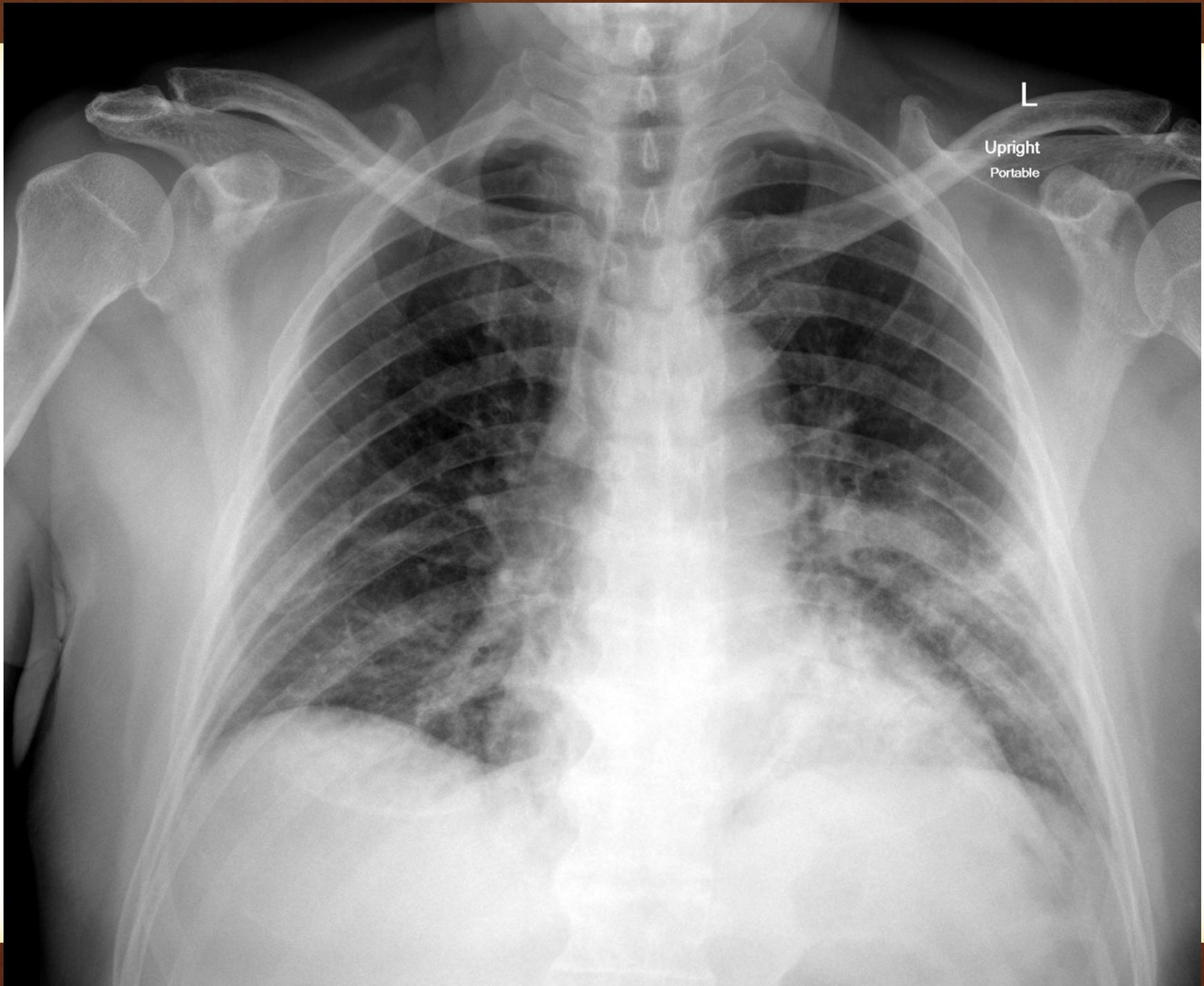




Semi-Upright

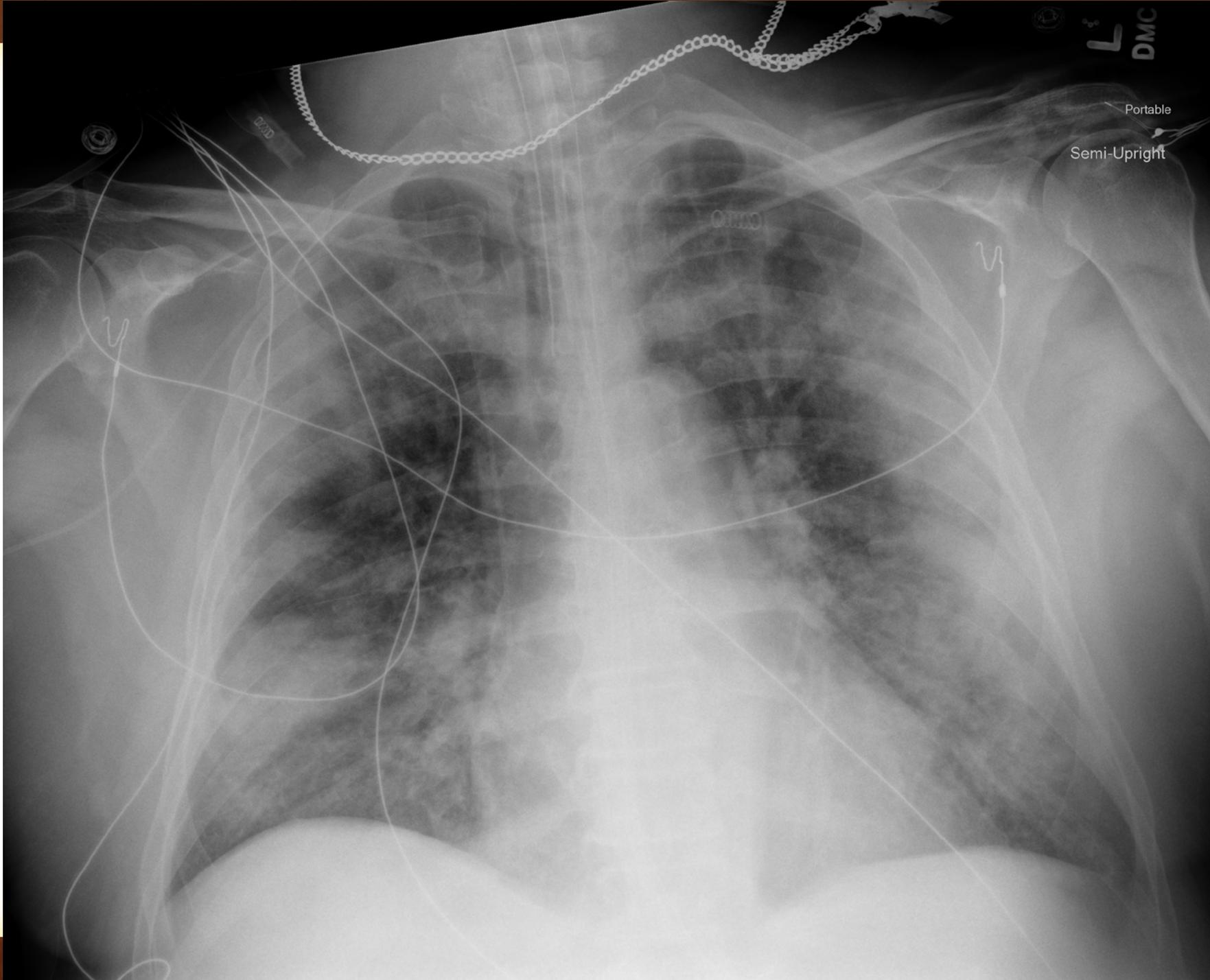
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Upright
Portable



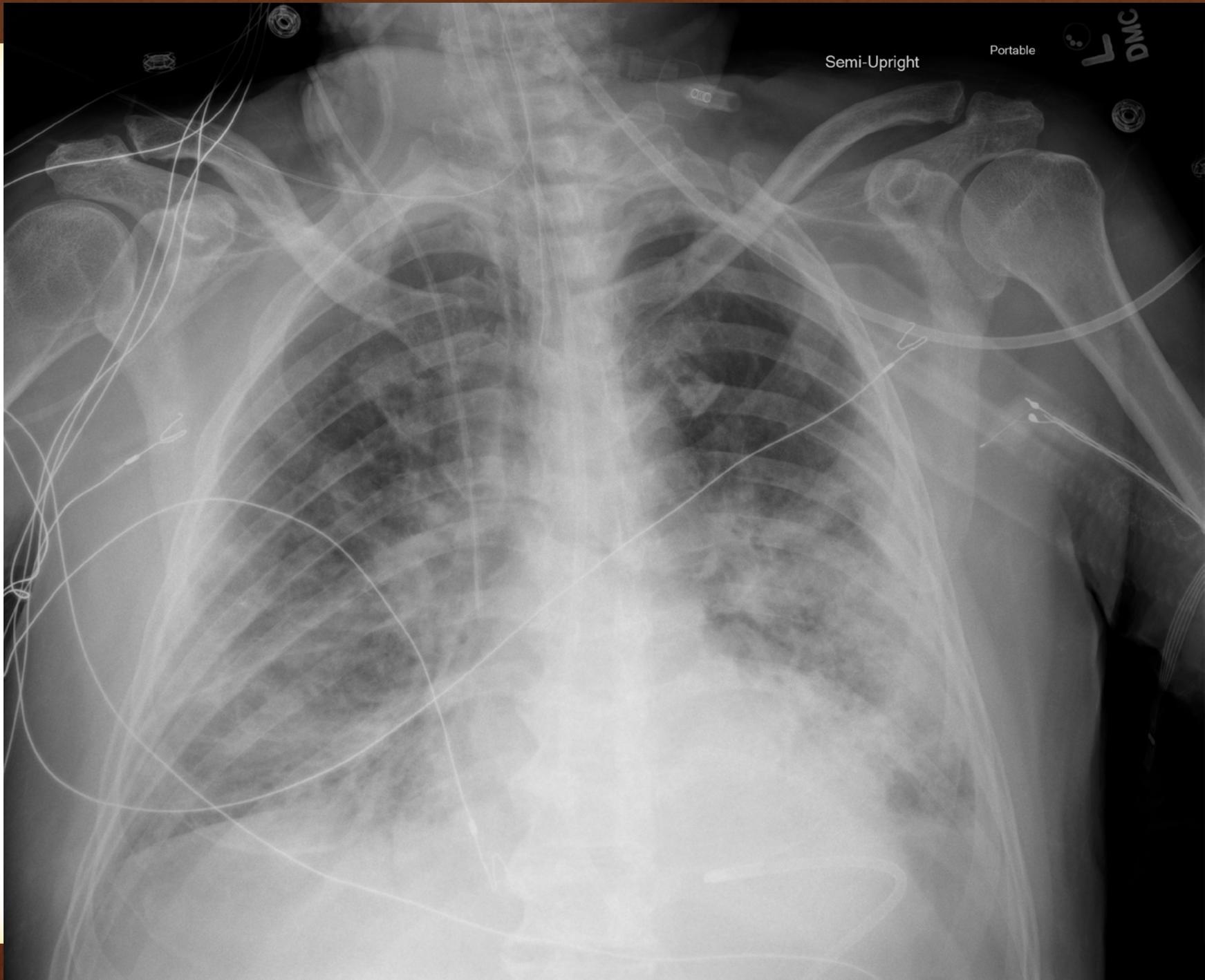
Portable

Upright

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Conclusion

- CXR will have a central role
- Role of CT is evolving in the US
 - Peripheral ground glass opacities are fairly characteristic of COVID19
 - Mass utilization depends on PCR (availability and reliability) and isolation policies
- With appropriate infection control policies, CT should not be a bottleneck
- The virus decides what happens next
- Thanks for all you do!