PULMONARY GRAND ROUNDS

Natalie Held, MD and Jeremy Hua, MD

April 2, 2020

Case Discussants:

Dr. Jean Abbott

Dr. Abbey Lara

Dr. Marc Moss

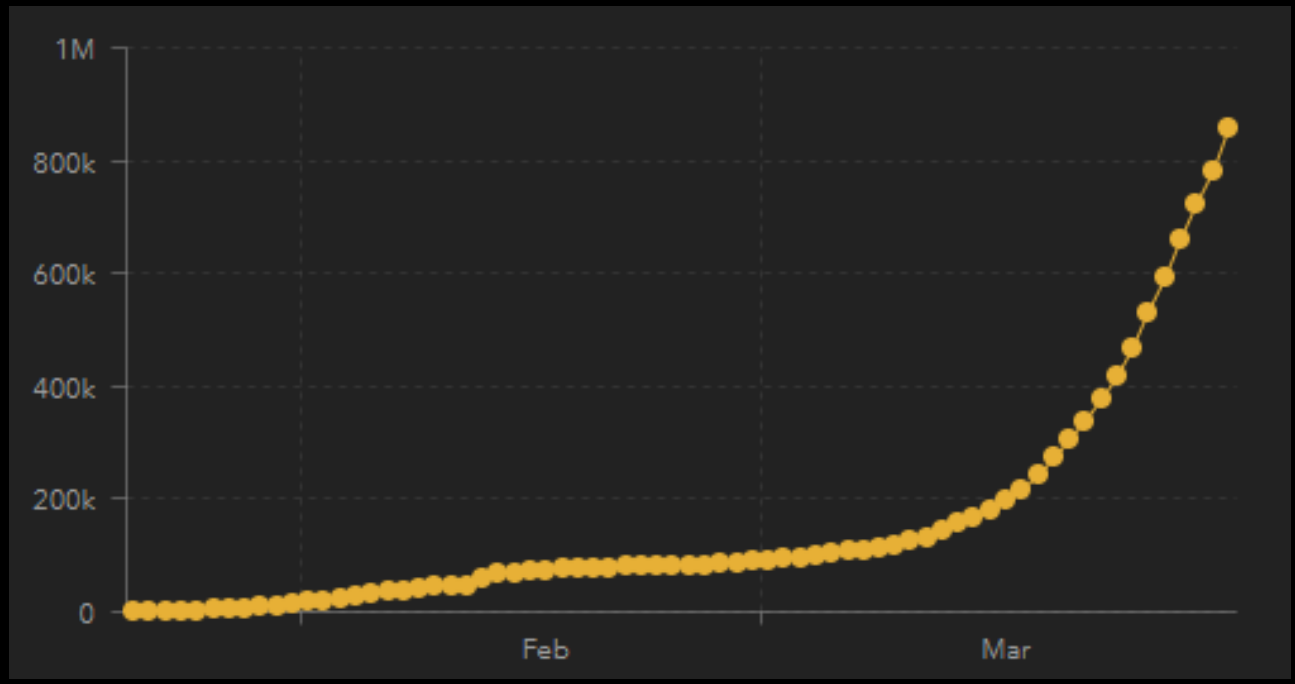
Total Confirmed

932,605

Confirmed Cases by Country/Region/Sovereignty

213,372	US
110,574	Italy
104,118	Spain
82,361	China
77,872	Germany
57,749	France
47,593	Iran
29,865	United Kingdom
17,768	Switzerland
15,679	Turkey

Total confirmed cases as of April 1, 2020



Johns Hopkins University, http://coronavirus.jhu.edu

HPI

73-year-old M h/o of TIA, HTN presents after syncope

- Sitting up from toilet, lightheaded, and syncopal episode with mild head trauma
- One week ago developed non-productive cough, fever, sweats, anorexia, worsening dyspnea on exertion
- No recent travel, wife with similar symptoms

- In ED, his temp is 102F and his O2 sat is 69% on 6L (88% on 12L nrb)
- Physical exam notable for diffuse coarse crackles
- Labs are relatively unremarkable (Na 133, SCr 1.1, WBC 7)
- He is started empirically on ceftriaxone and azithromycin

History

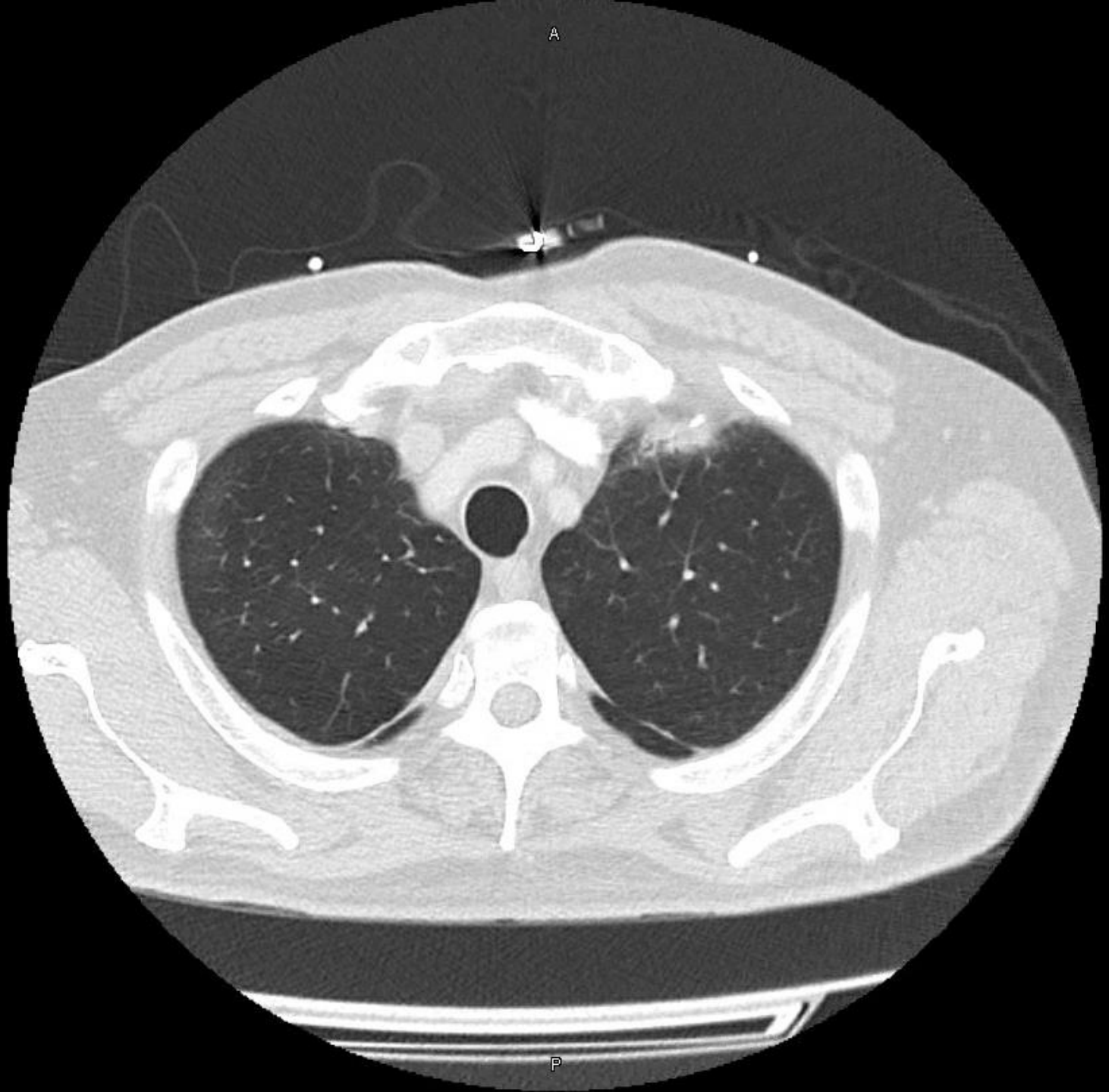
Past Medical History
- TIA
- HTN
- HLD

Social History
- Tobacco: remote 10 PY history
- No EtOH or illicits
- Volunteers at pet shelter, wife works at a bookstore

Medications
- Plavix
- Losartan
- Nifedipine
- Simvastatin

Clinical course

- COVID-19 testing is **positive**
- Head CT unremarkable
- Chest CT had been obtained in the ED: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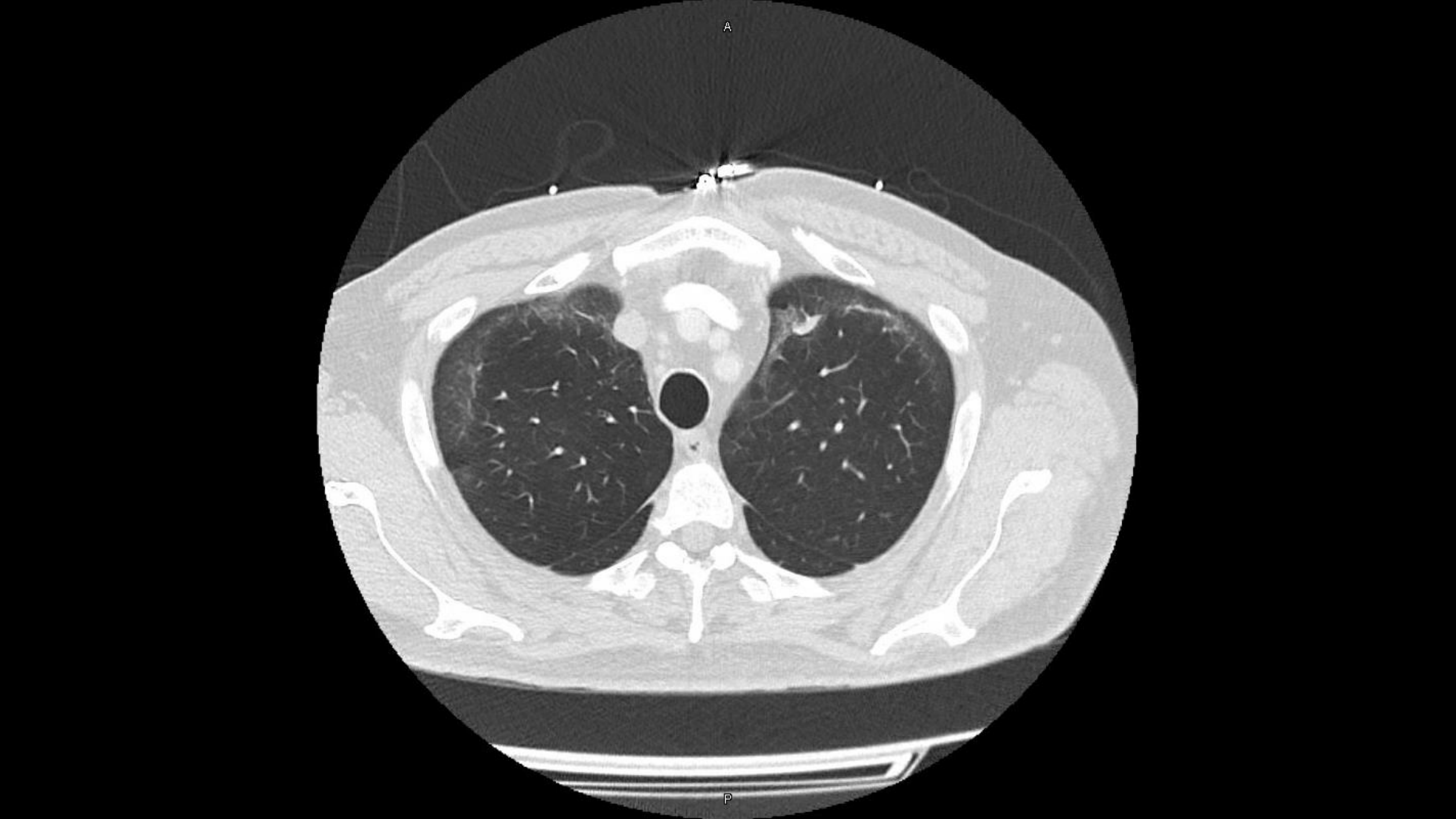
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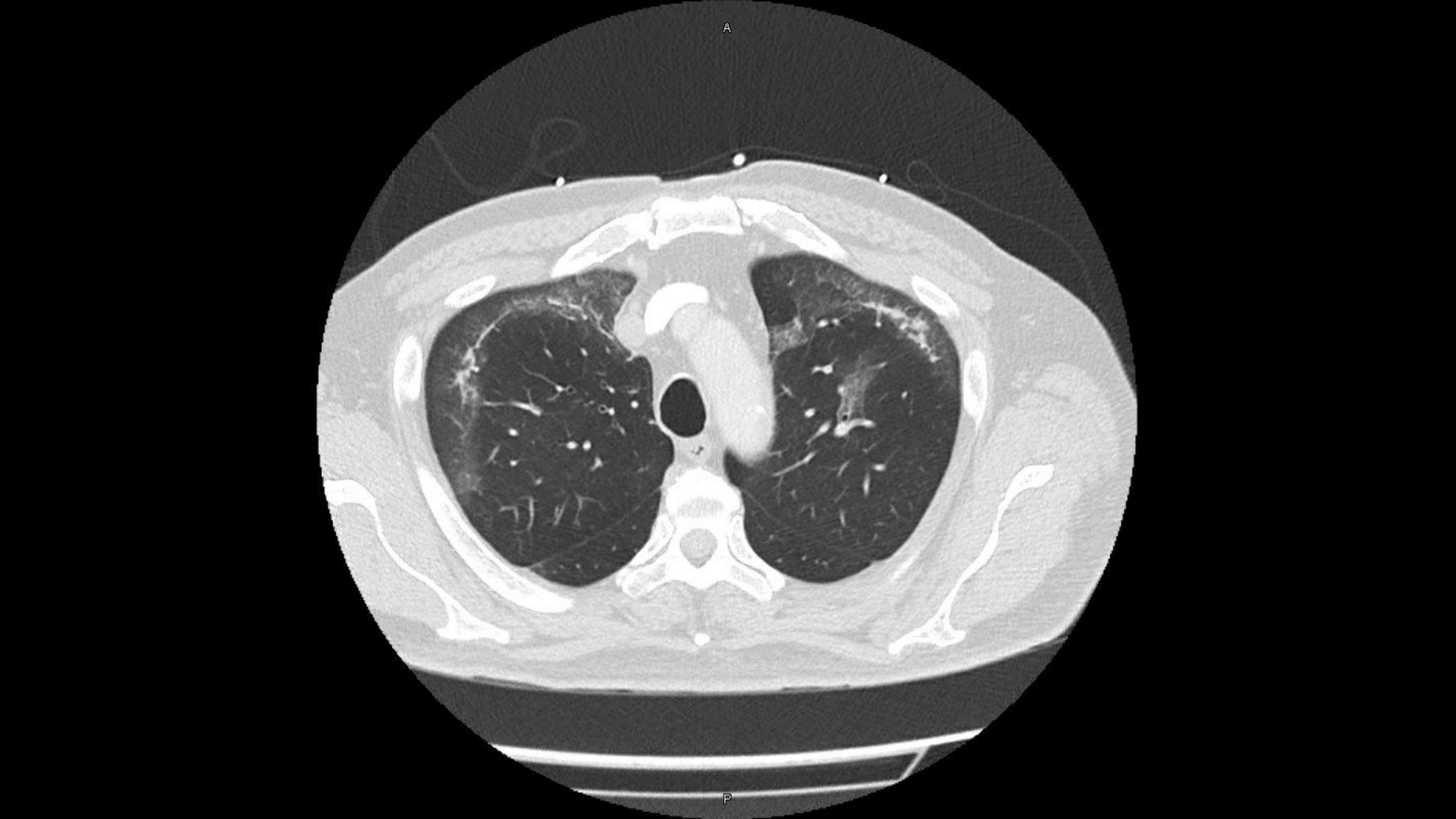
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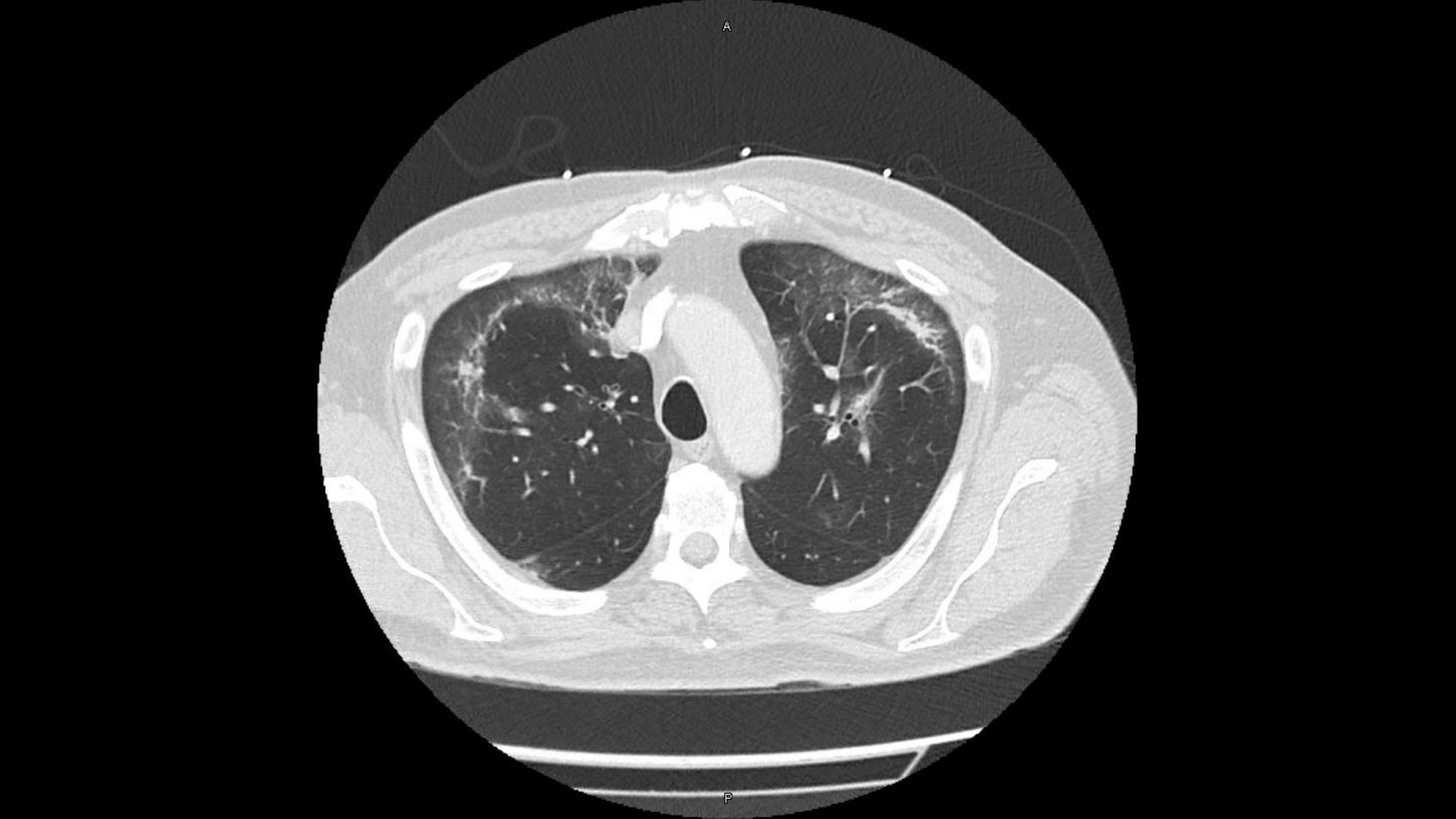
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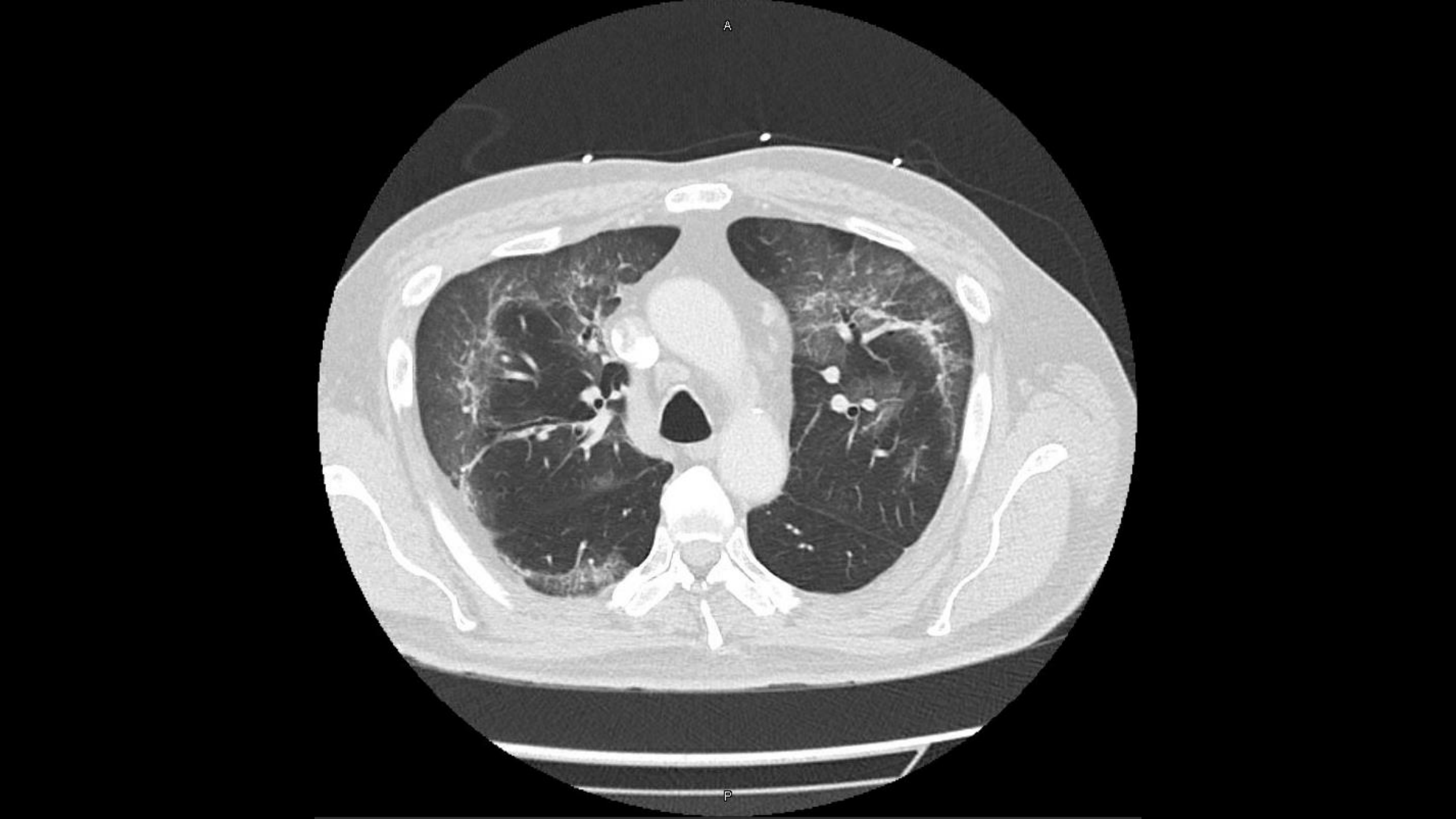
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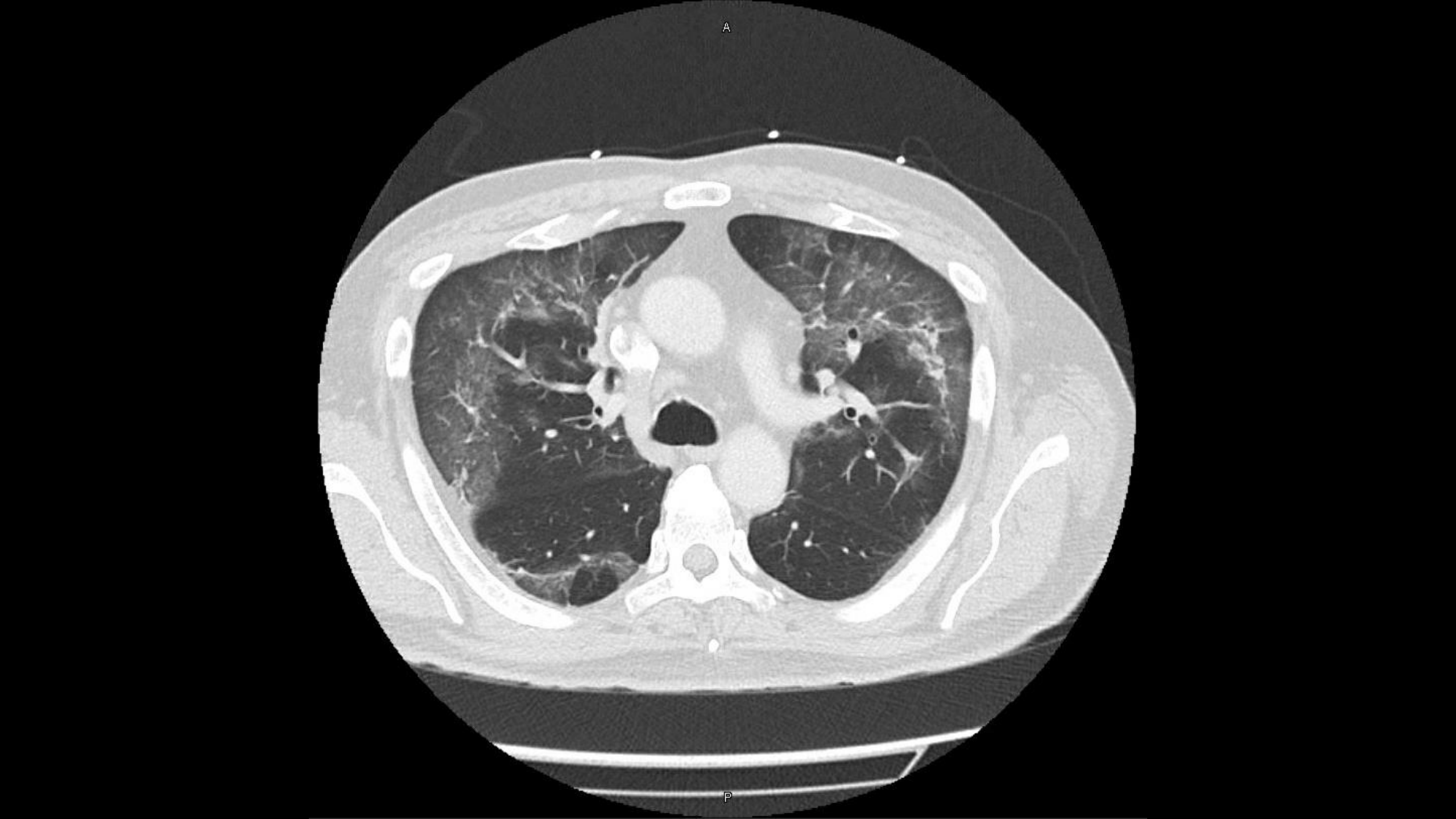
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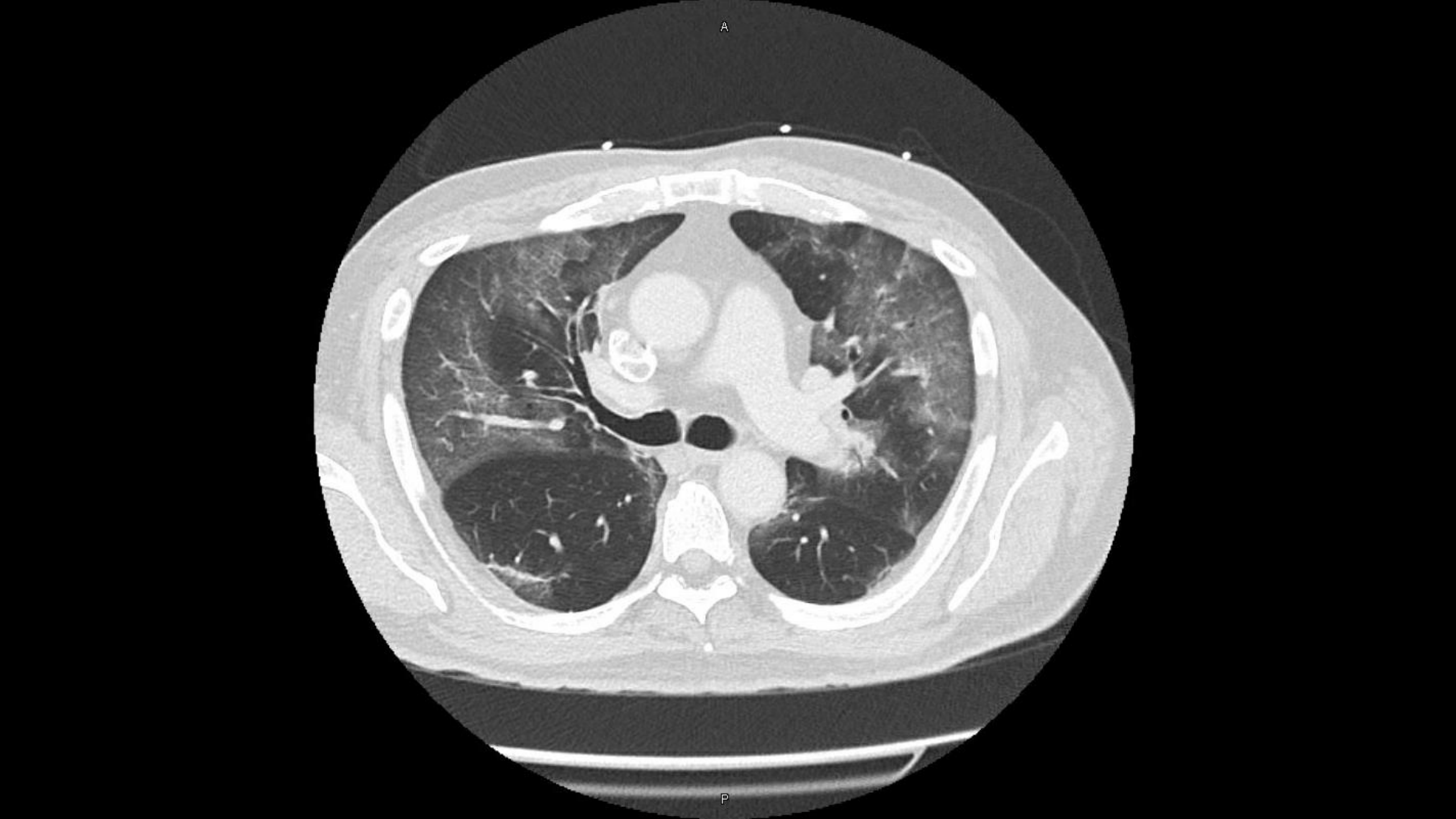
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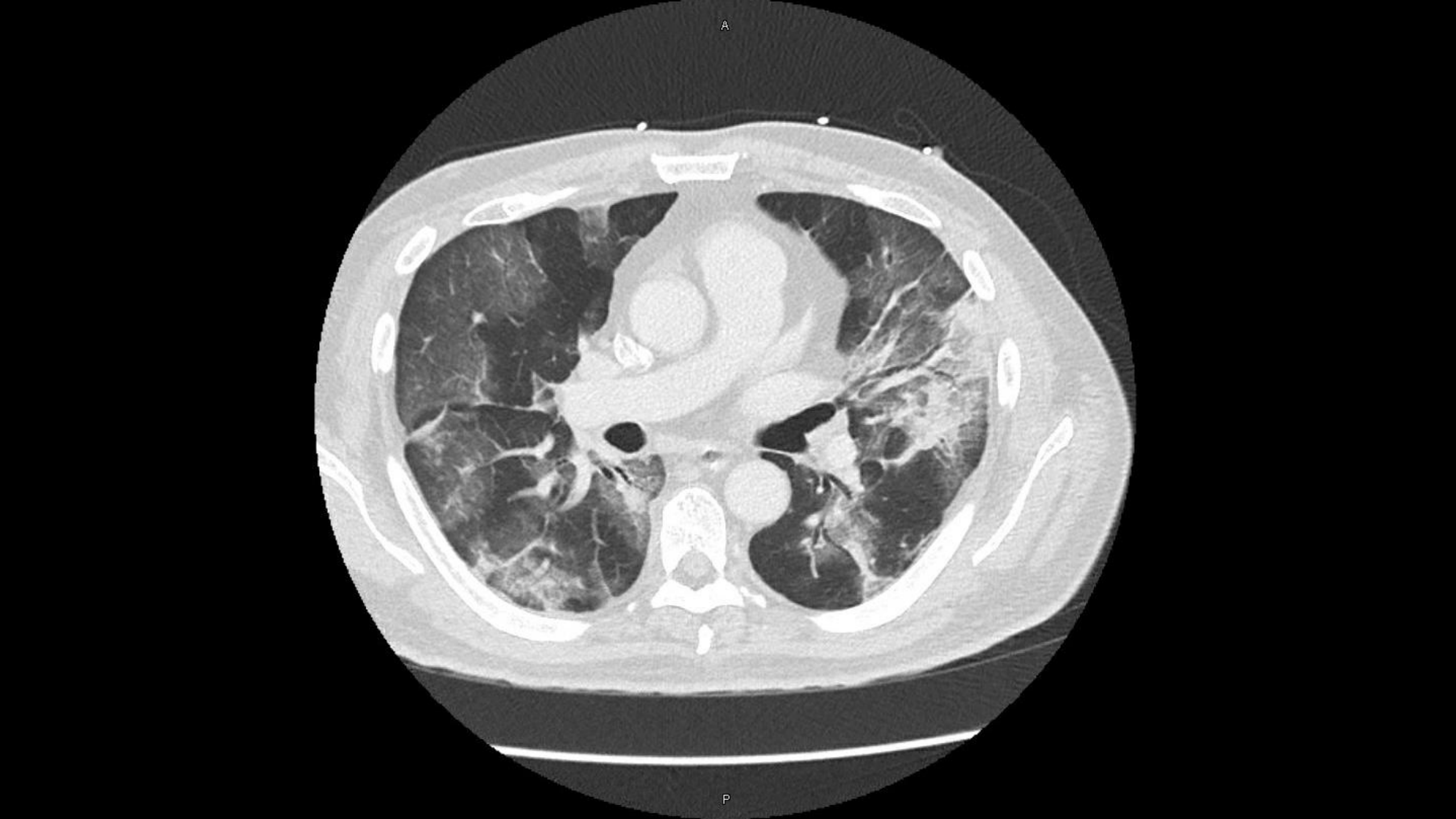
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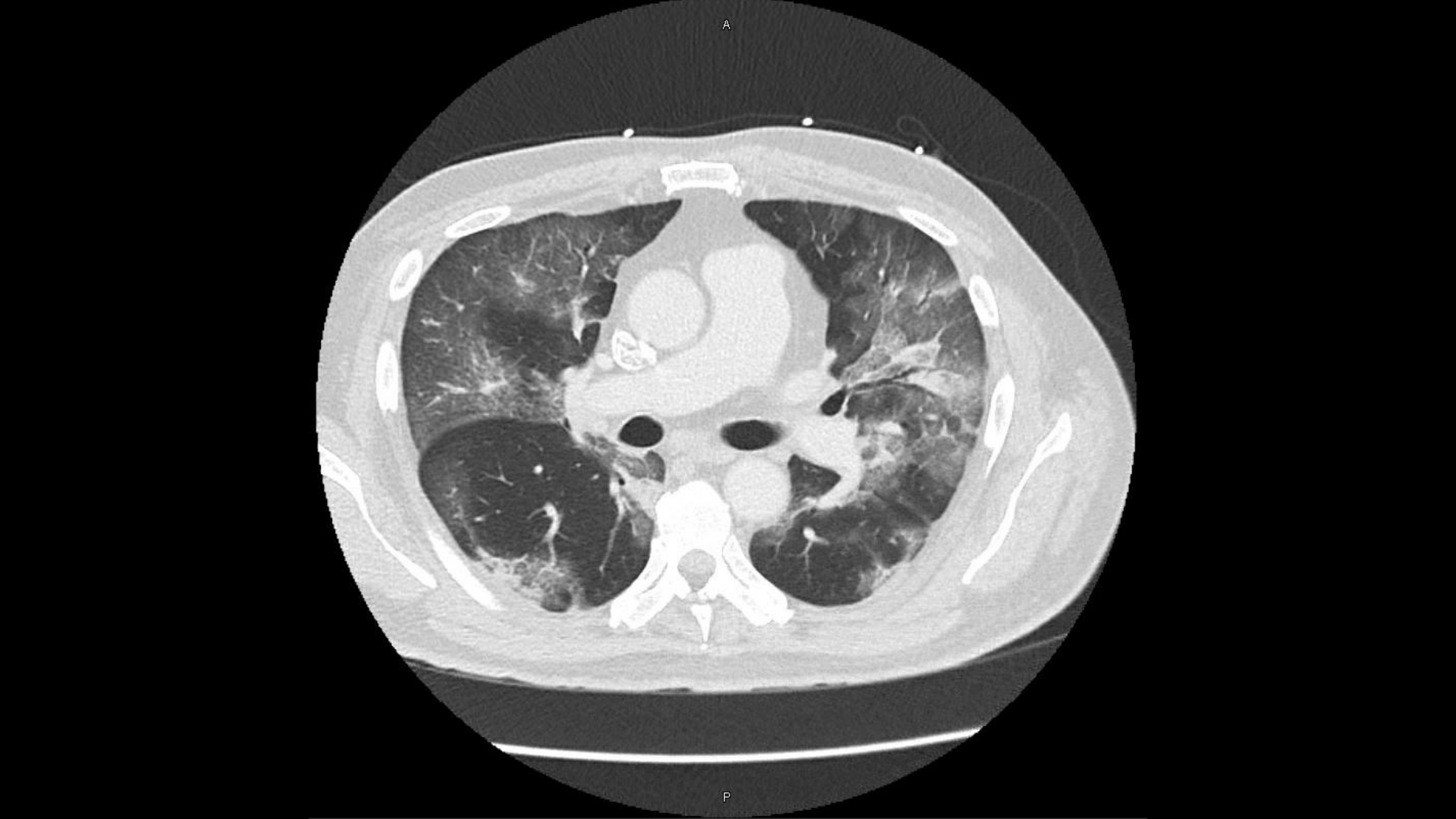
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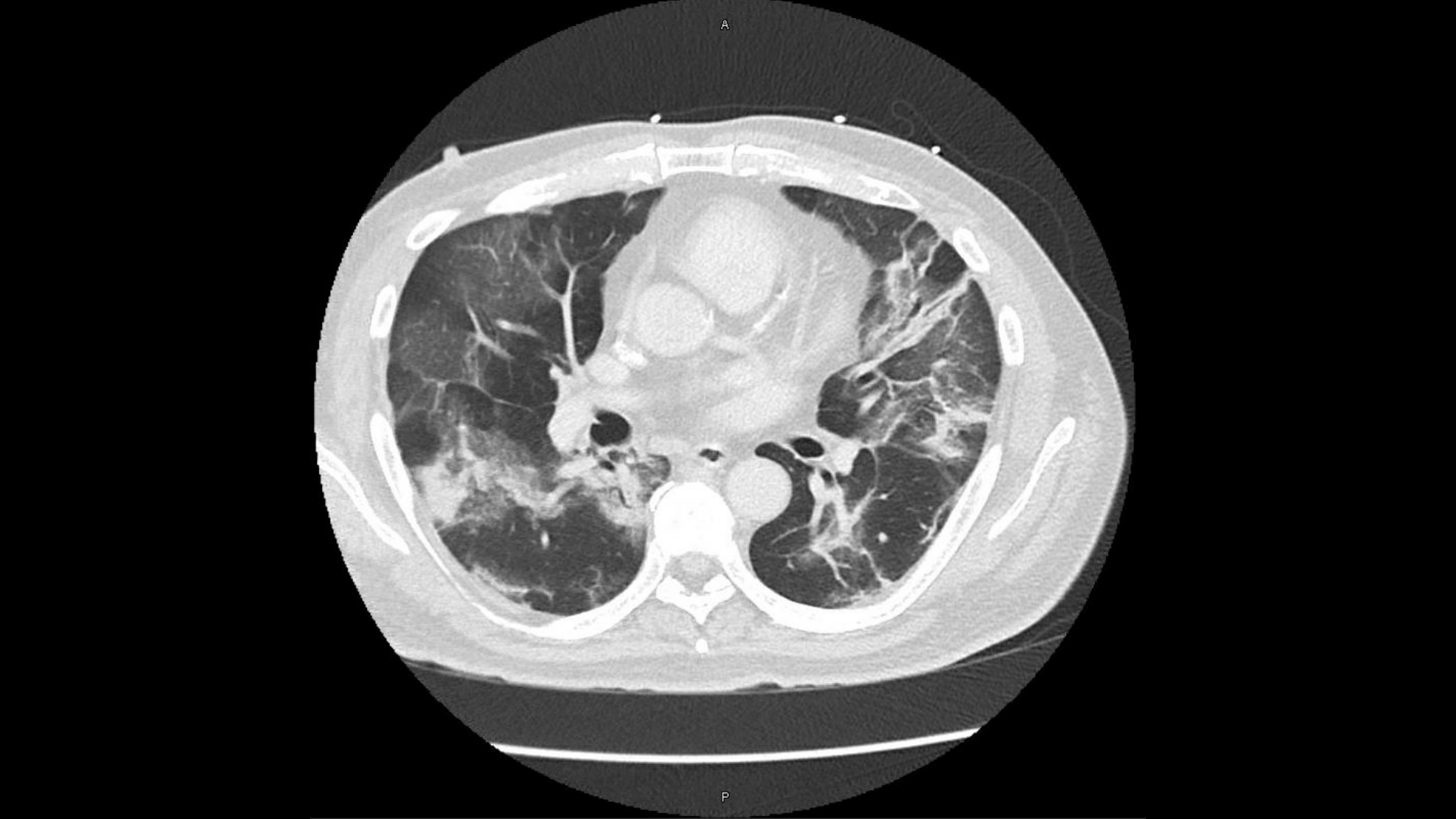
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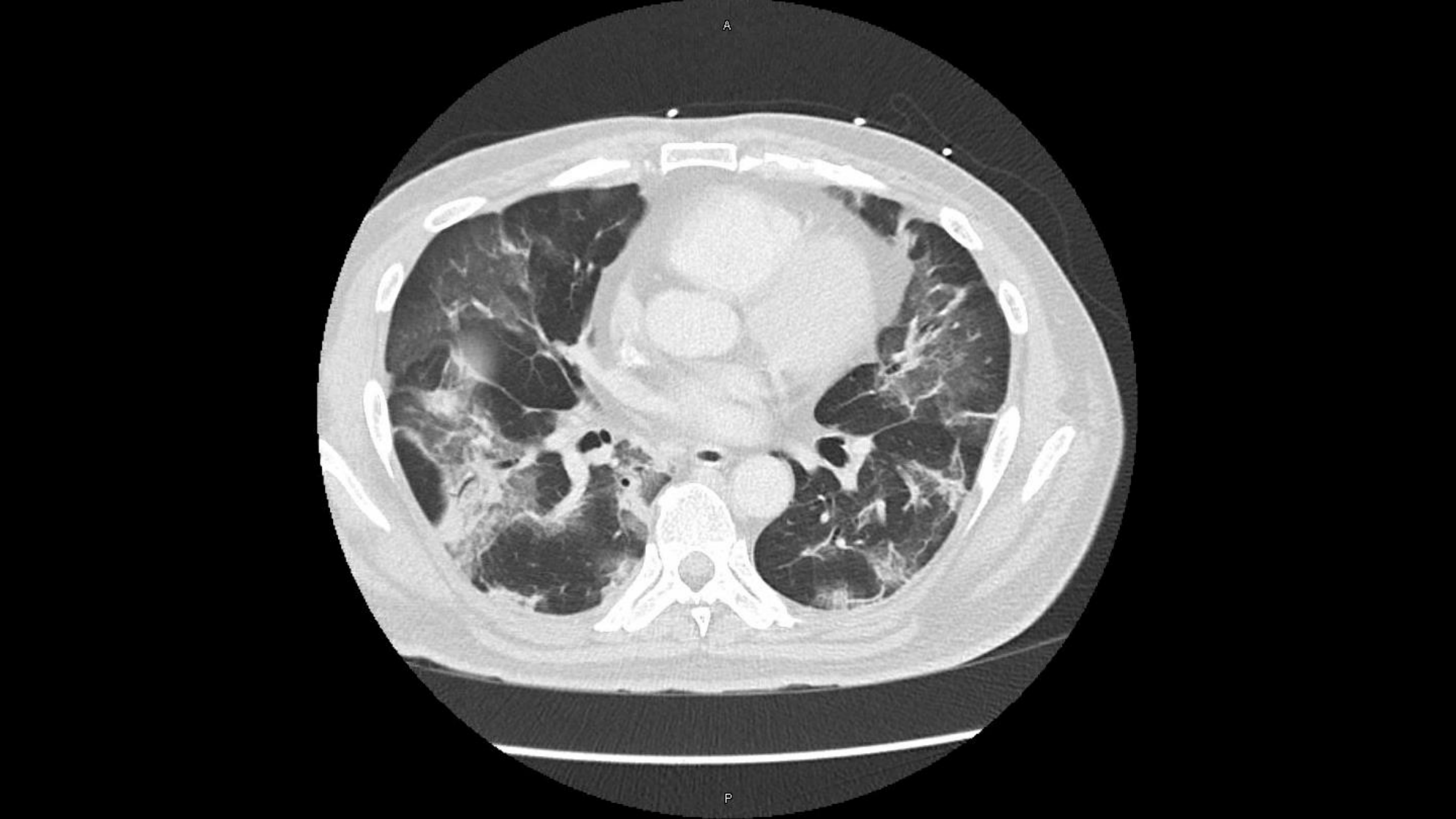
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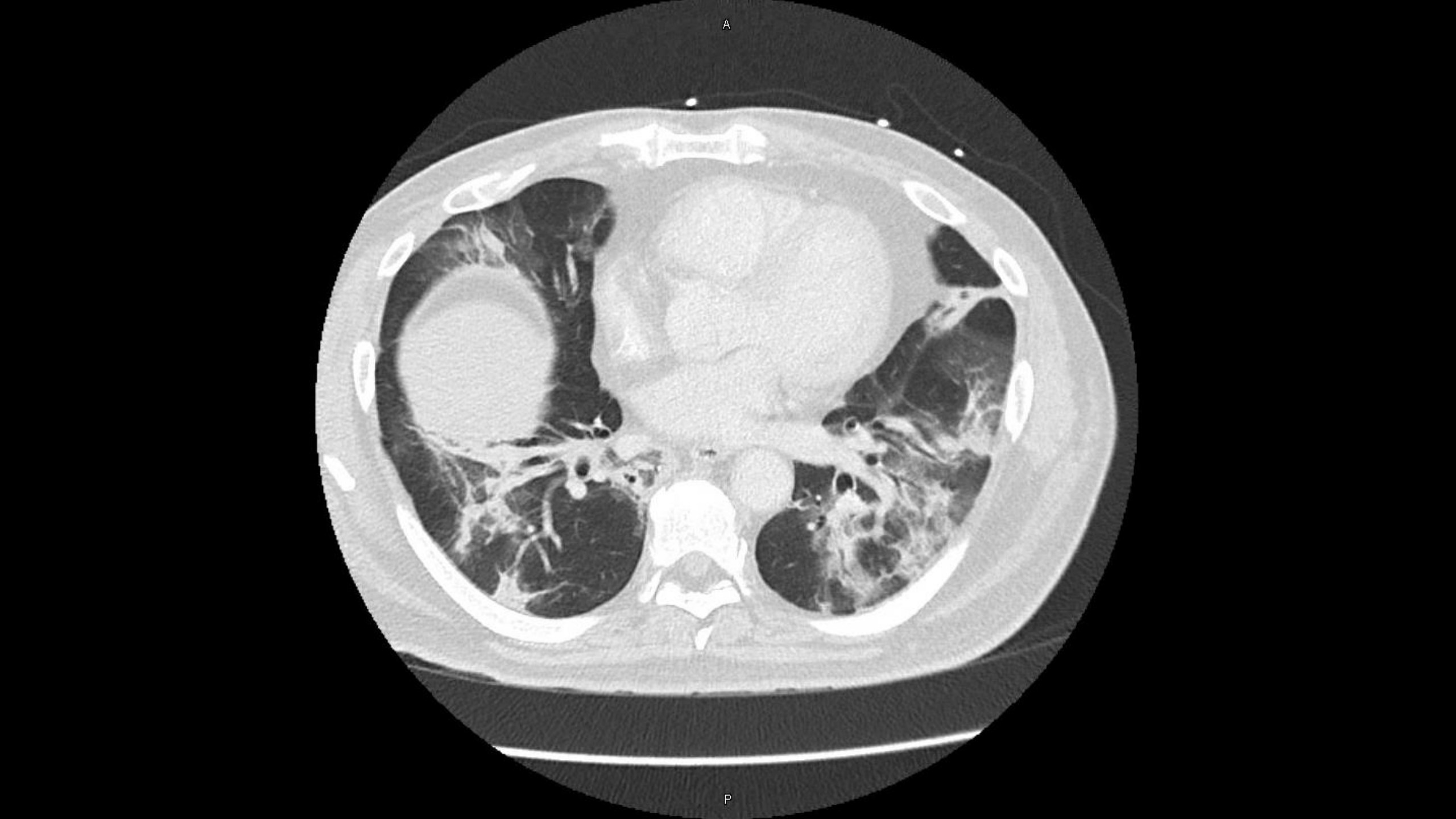
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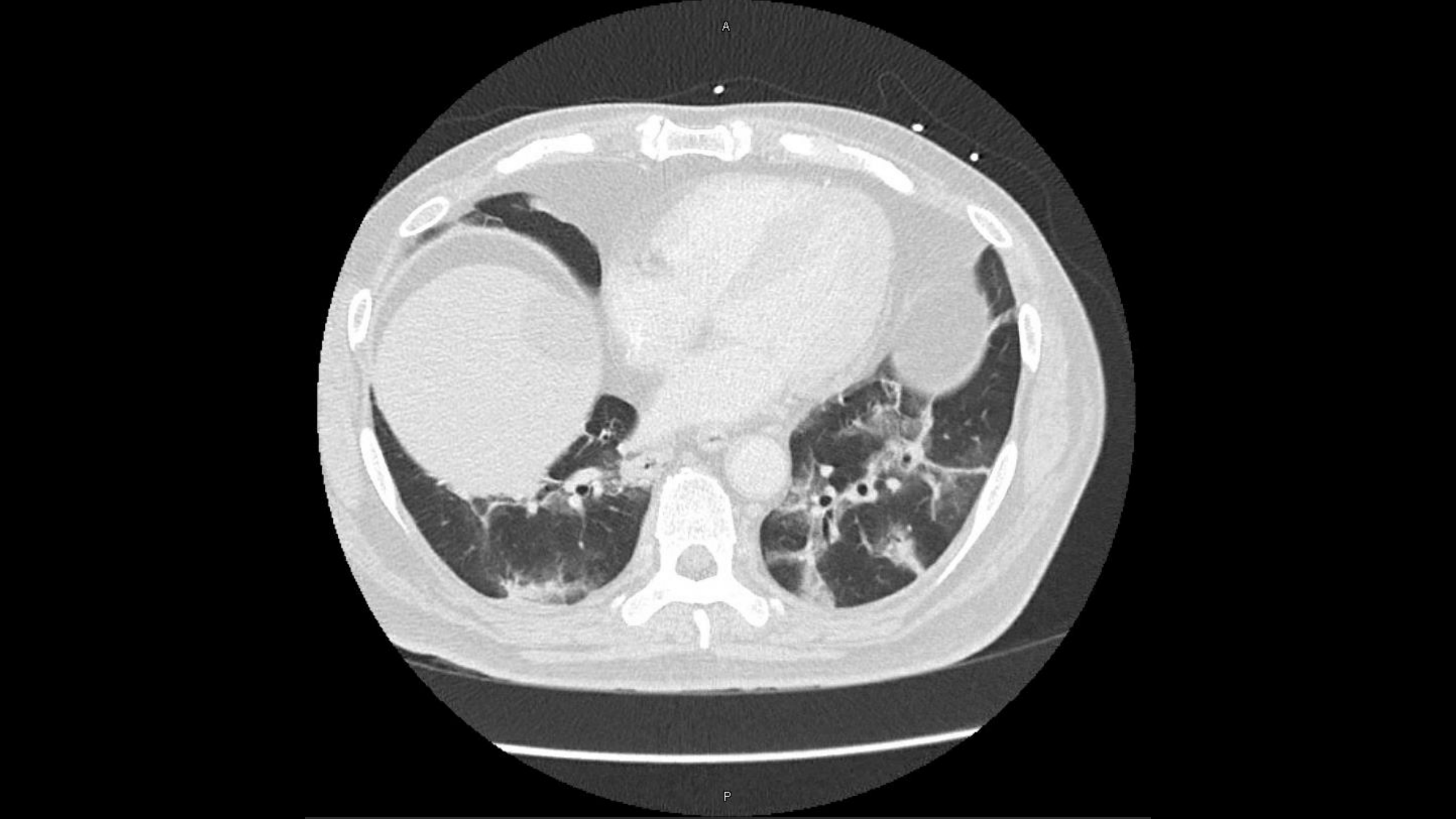
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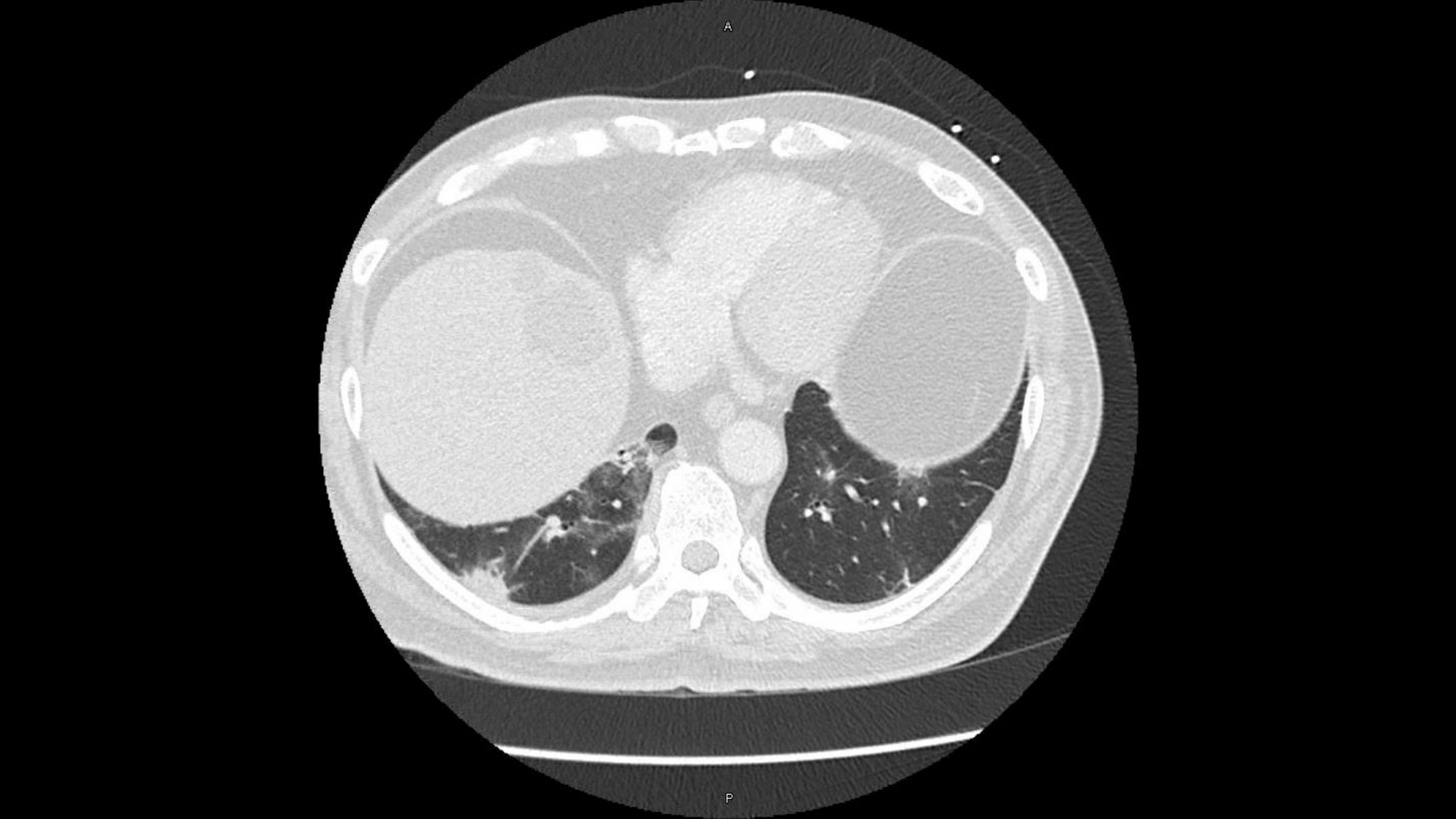
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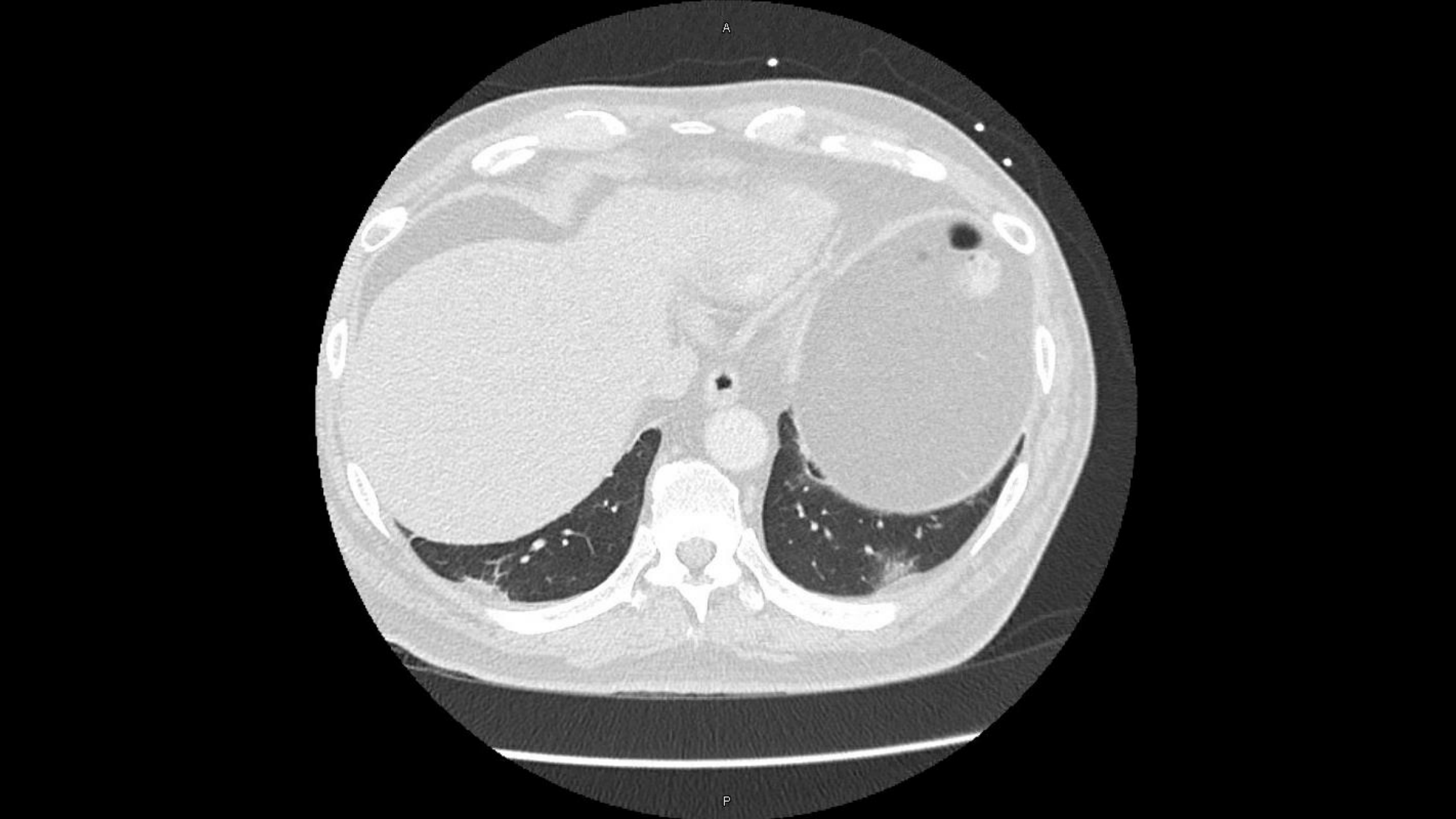
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The ICU is completely full of COVID patients on mechanical ventilation, and there are three other patients awaiting an ICU bed for possible intubation

Considering the COVID epidemic, there has been discussion of how to allocate critical resources including ICU beds, ventilators, and staff expertise.

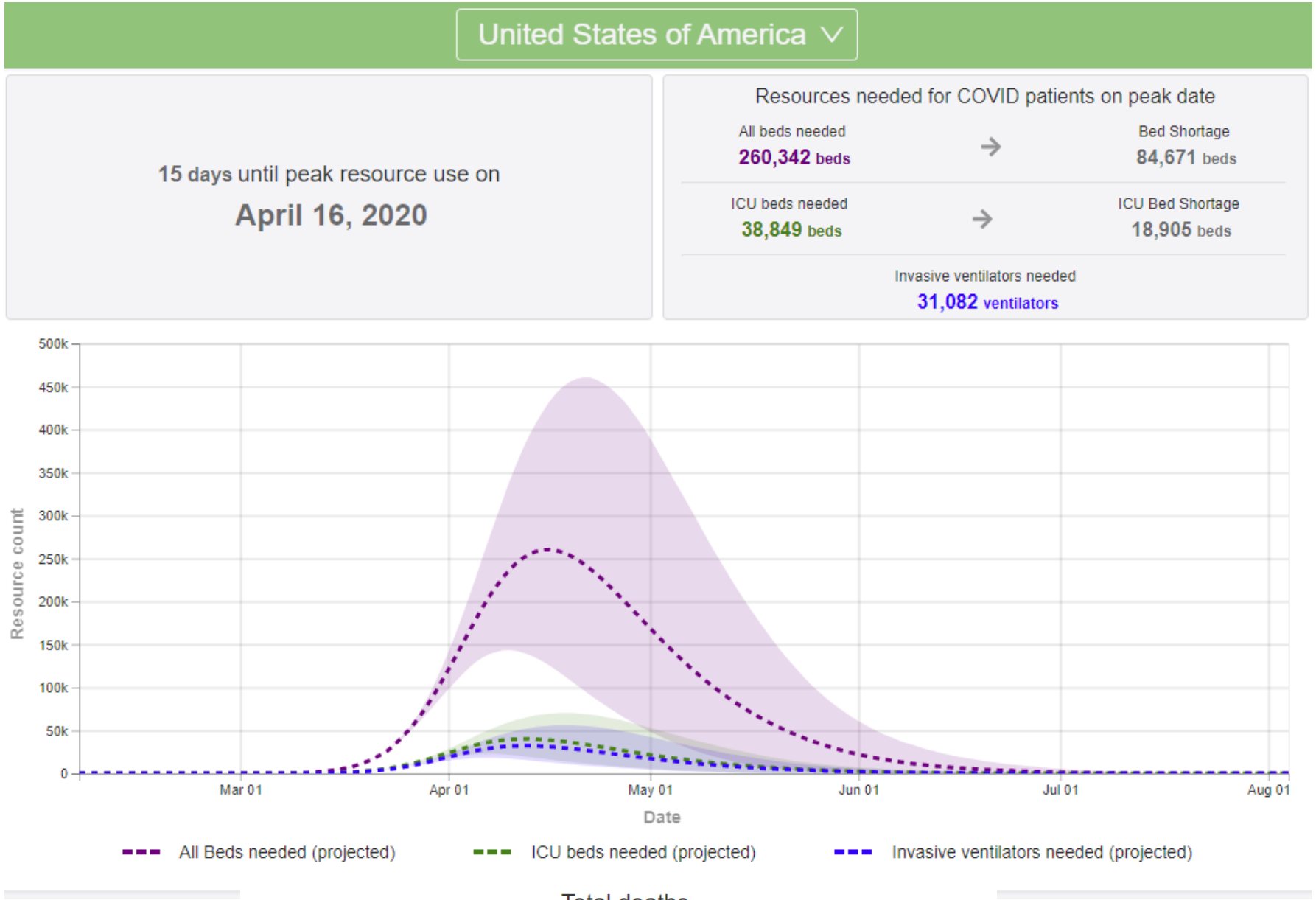
Would you offer ICU admission and intubation to this patient? How to decide?

Would you reallocate resources from a patient currently in the ICU?

What if the patient was a practicing physician?

Medical resource allocation in a time of scarcity

Ethical frameworks and challenges during a pandemic



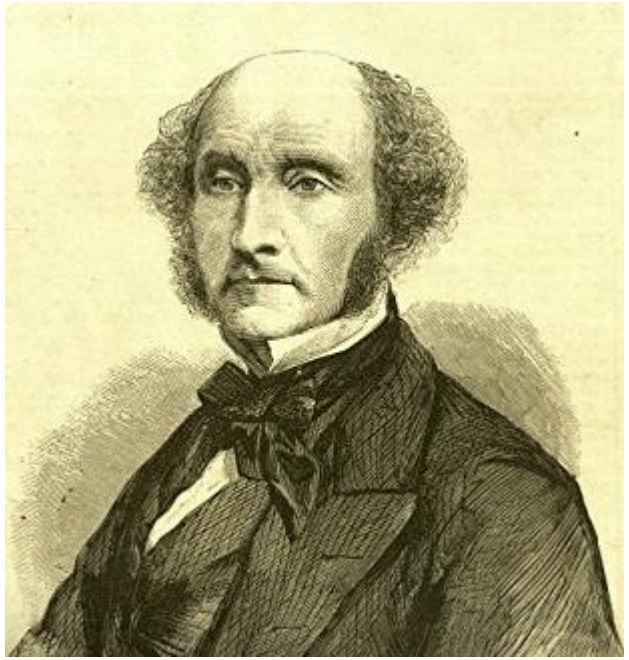
IHME. https://covid19.healthdata.org/projections

Allocation of scarce resources in a pandemic

1. What are the competing ethical interests and frameworks in place?
2. What are the current guidelines in Colorado?

Widely accepted tenants:

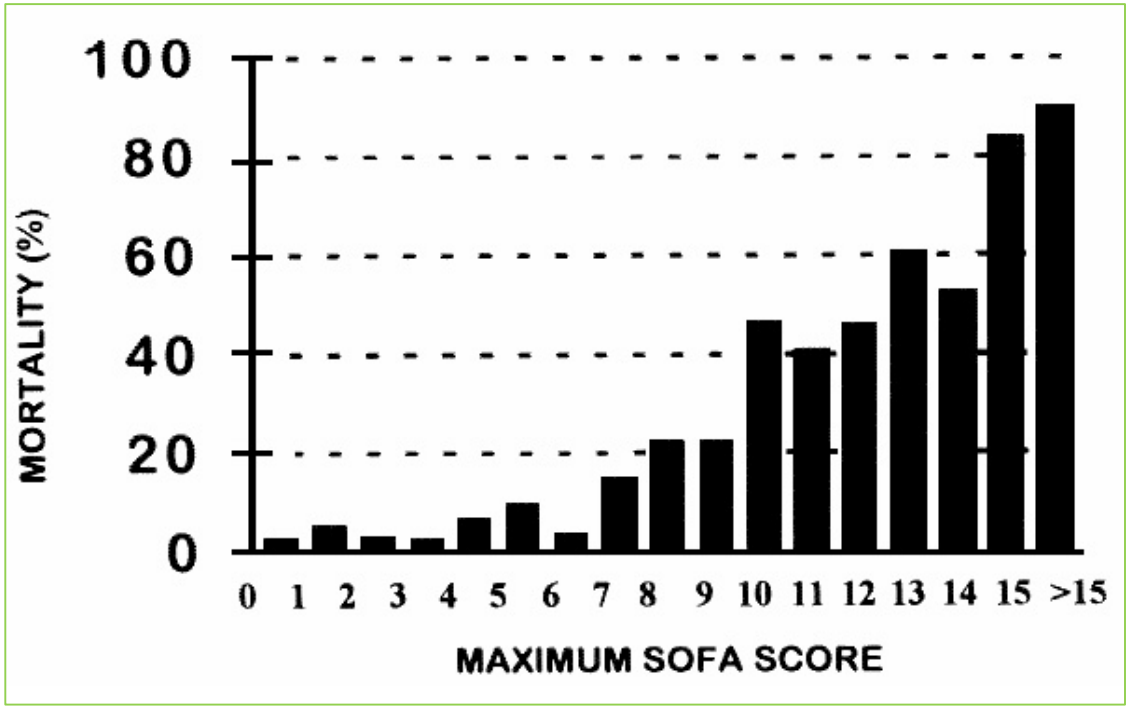
- Utilitarian approach of maximizing life and years of life
- Allocation should not be based on factors such as socioeconomic, insurance, racial/ethnic, nationality status
- Independent triage committees should be encouraged
- Repeated assessment of the process to ensure bias remains minimal

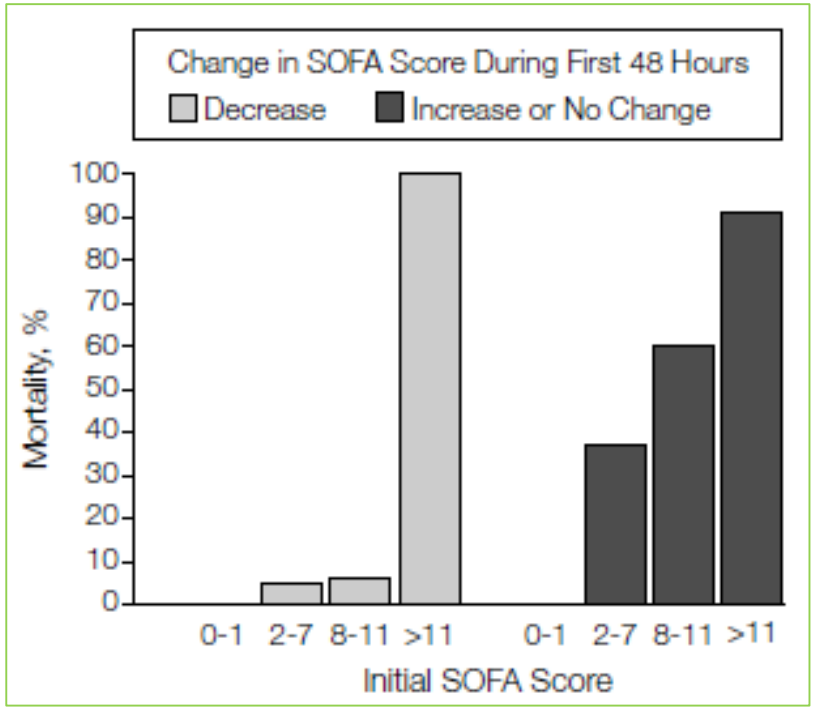


John Stuart Mills

Challenges that remain:

How to accurately triage based on short and long-term mortality?





Strict age cutoff?

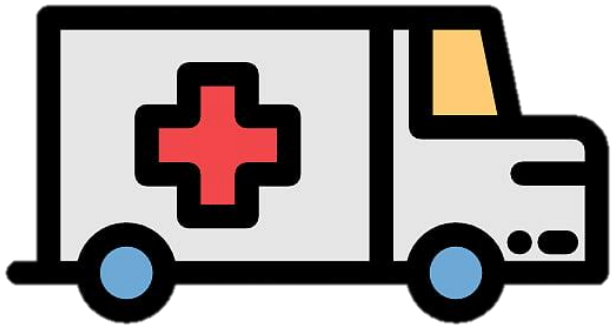
Singer et al., *JAMA*, 2016
Vincent et al., *Crit Care Med*, 1998
Ferreira et al., *JAMA*, 2001
Vergano, SIAARTI, 2020

Challenges that remain:

Are their populations that should receive priority?

Those with “instrumental value”, AKA:

- Frontline health workers
- Those who participate in research



SOUNDING BOARD

Fair Allocation of Scarce Medical Resources in the Time of Covid-19

Ezekiel J. Emanuel, M.D., Ph.D., Govind Persad, J.D., Ph.D., Ross Upshur, M.D., Beatriz Thome, M.D., M.P.H., Ph.D., Michael Parker, Ph.D., Aaron Glickman, B.A., Cathy Zhang, B.A., Connor Boyle, B.A., Maxwell Smith, Ph.D., and James P. Phillips, M.D.

Truog et al., *NEJM*, 2020
Emanuel et al., *NEJM*, 2020

Challenges that remain:

- First-come first-serve vs random allocation
- How to allocate to non-pandemic patients (non-COVID)?
- How do you manage involuntary withdrawal of care?

Lanken et al., *Am J Respir Crit Care Med*, 1987
Biddison et al., *CHEST*, 2019
Truog et al., *NEJM*, 2020

Crisis Standards of Care

- "To appropriately respond to a catastrophic disaster in which resources are overwhelmed, the needs of the greater community generally must rise above the needs of any single individual, and there may be circumstances in which resources should be diverted from patients with a lower likelihood of benefit to those with a greater likelihood of benefit."

Colorado Crisis Standards of Care Plan, 2018

STRATEGIES FOR SCARCE RESOURCE SITUATIONS

RECOMMENDATIONS	Strategy
Increase Hospital Stocks of Ventilators and Ventilator Circuits, ECMO or bypass circuits	*Prepare*
Access Alternative Sources for Ventilators / specialized equipment • Obtain specialized equipment from vendors, healthcare partners, regional, state, or Federal stockpiles via usual emergency management processes and provide just-in-time training and quick reference materials for obtained equipment.	*Substitute*
Decrease Demand for Ventilators • Increase threshold for intubation/ventilation. • Decrease elective procedures that require post-operative intubation. • Decrease elective procedures that utilize anesthesia machines. • Use non-invasive ventilatory support when possible.	*Conserve*
Re-use Ventilator Circuits • Appropriate cleaning must precede sterilization. • If using gas (ethylene oxide) sterilization, allow full 12 hour aeration cycle to avoid accumulation of toxic byproducts on surface. • Use irradiation or other techniques as appropriate.	*Re-use*
Use Alternative Respiratory Support Technologies • Use transport ventilators with appropriate alarms - especially for stable patients without complex ventilation requirements. • Use anesthesia machines for mechanical ventilation as appropriate/capable. • Use bi-level (BiPAP) equipment to provide mechanical ventilation. • Consider bag-valve ventilation as temporary measure while awaiting definitive solution/equipment (as appropriate to situation – extremely labor intensive and may consume large amounts of oxygen).	*Adapt*

On multiple patients per ventilator: *"Finally, there are ethical issues. If the ventilator can be lifesaving for a single individual, using it on more than one patient at a time risks life-threatening treatment failure for all of them."*

Colorado Crisis Standards of Care Plan, 2018

MECHANICAL VENTILATION / EXTERNAL OXYGENATION

STRATEGIES FOR SCARCE RESOURCE SITUATIONS (cont.)

RECOMMENDATIONS				***Strategy***	***Crisis***
STEP TWO: Compared to other patient(s) requiring and awaiting external ventilation/oxygenation, does this patient have significant differences in prognosis or resource utilization in one or more categories below that would justify re-allocation of the ventilator/unit? Factors listed in relative order of importance/weight. Injury/epidemiologic factors may have the highest predictive value in some cases and may also affect the predictive ability of the SOFA score.					
Criteria	Patient keeps resource →		Resource re-allocated		
1. Organ system function[a]	Low potential for death (SOFA score ≤ 7)	Intermediate potential for death (SOFA score 8-11)	High potential for death (SOFA score ≥12)		
2. Duration of benefit/prognosis	Good prognosis based upon epidemiology of specific disease/ injury.	Indeterminate/intermediate prognosis based upon epidemiology of specific disease/injury	Poor prognosis based upon epidemiology of specific disease / injury (e.g., pandemic influenza)		
	No severe underlying disease.[b]	Severe underlying disease with poor long-term prognosis and/or ongoing resource demand (e.g., home oxygen dependent, dialysis dependent) and unlikely to survive more than 1-2 years.	Severe underlying disease with poor short-term (e.g., <1 year) prognosis		
3. Duration of need	Short duration – flash pulmonary edema, chest trauma, other conditions anticipating < 3 days on ventilator	Moderate duration – e.g., pneumonia in healthy patient (estimate 3-7 days on ventilator)	Long duration – e.g., ARDS, particularly in setting of preexisting lung disease (estimate > 7 days on ventilator)		
4. Response to mechanical ventilation	Improving ventilatory parameters over time[c]	Stable ventilatory parameters over time	Worsening ventilatory parameters over time		

[a] The Sequential Organ Failure Assessment (SOFA) score is the currently preferred assessment tool but other predictive models may be used depending on the situation / epidemiology. Note: SOFA scores were not designed to forecast mortality, and thus single or a few point difference between patients may not represent a 'substantial difference' in mortality, but larger differences and trends can be extremely helpful in determining resource assignment.

[b] Examples of underlying diseases that predict poor short-term survival include (but are not limited to):

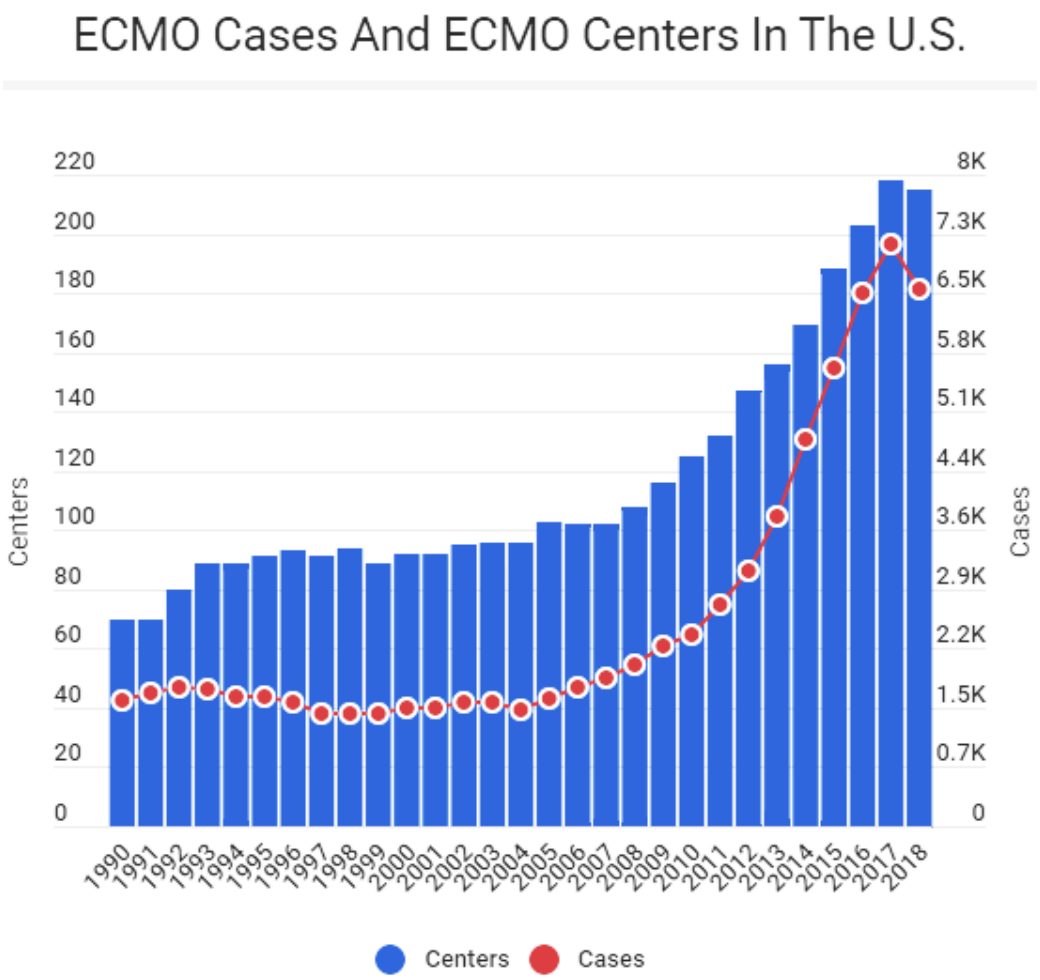
1. Congestive heart failure with ejection fraction < 25% (or persistent ischemia unresponsive to therapy or non-reversible ischemia with pulmonary edema)
2. Severe chronic lung disease including pulmonary fibrosis, cystic fibrosis, obstructive or restrictive diseases requiring continuous home oxygen use prior to onset of acute illness
3. Central nervous system, solid organ, or hematopoietic malignancy with poor prognosis for recovery
4. Cirrhosis with ascites, history of variceal bleeding, fixed coagulopathy or encephalopathy
5. Acute hepatic failure with hyperammonemia

[c] Changes in Oxygenation Index over time may provide comparative data, though of uncertain prognostic significance. OI = MAWP x FiO2 / PaO2 where: OI = oxygenation index, MAWP= Mean Airway Pressure, FiO2 = inspired oxygen concentration, PaO2 = arterial oxygen pressure (May be estimated from oxygen dissociation curve if blood gas unavailable.)

STEP THREE: Re-allocate ventilator/resource only if patient presenting with respiratory failure has significantly better chance of survival/benefit as compared to patient currently receiving ventilation. Follow additional regional and state/federal guidance and institutional processes for scarce resource situations.

Colorado Crisis Standards of Care Plan, 2018

ECMO in COVID



COVID in ICU (Wuhan, China)

	Survivors (n=20)	Non-survivors (n=32)	All patients (n=52)
Treatment			
High flow nasal cannula	17 (85%)	16 (50%)	33 (63·5%)
Mechanical ventilation	7 (35%)	30 (94%)	37 (71%)
Non-invasive	6 (30%)	23 (72%)	29 (56%)
Invasive	3 (15%)	19 (59%)	22 (42%)
Prone position ventilation	2 (10%)	4 (12·5%)	6 (11·5%)
Extracorporeal membrane oxygenation	1 (5%)	5 (16%)	6 (11·5%)
Renal replacement therapy	1 (5%)	8 (25%)	9 (17%)
Vasoconstrictive agents	2 (10%)	16 (50%)	18 (35%)
Antiviral agents	13 (65%)	10 (31%)	23 (44%)
APACHE II score on day 1	14 (12–17)	18 (16–20)	
SOFA score on day 1	4 (3–4)	6 (4–8)	

In 2013, median cost ECMO $590k / patient

Sibai et al., *BMC Emergency Medicine*, 2018
Yang et al., *Lancet Respir Med*, 2020
McClaren et al., *JAMA*, 2020

Clinical course

- Patient was intubated and developed rapid, severe ARDS
- Continued to worsened despite prone positioning and neuromuscular blockade
- ECMO was not offered
- Transitioned to comfort care

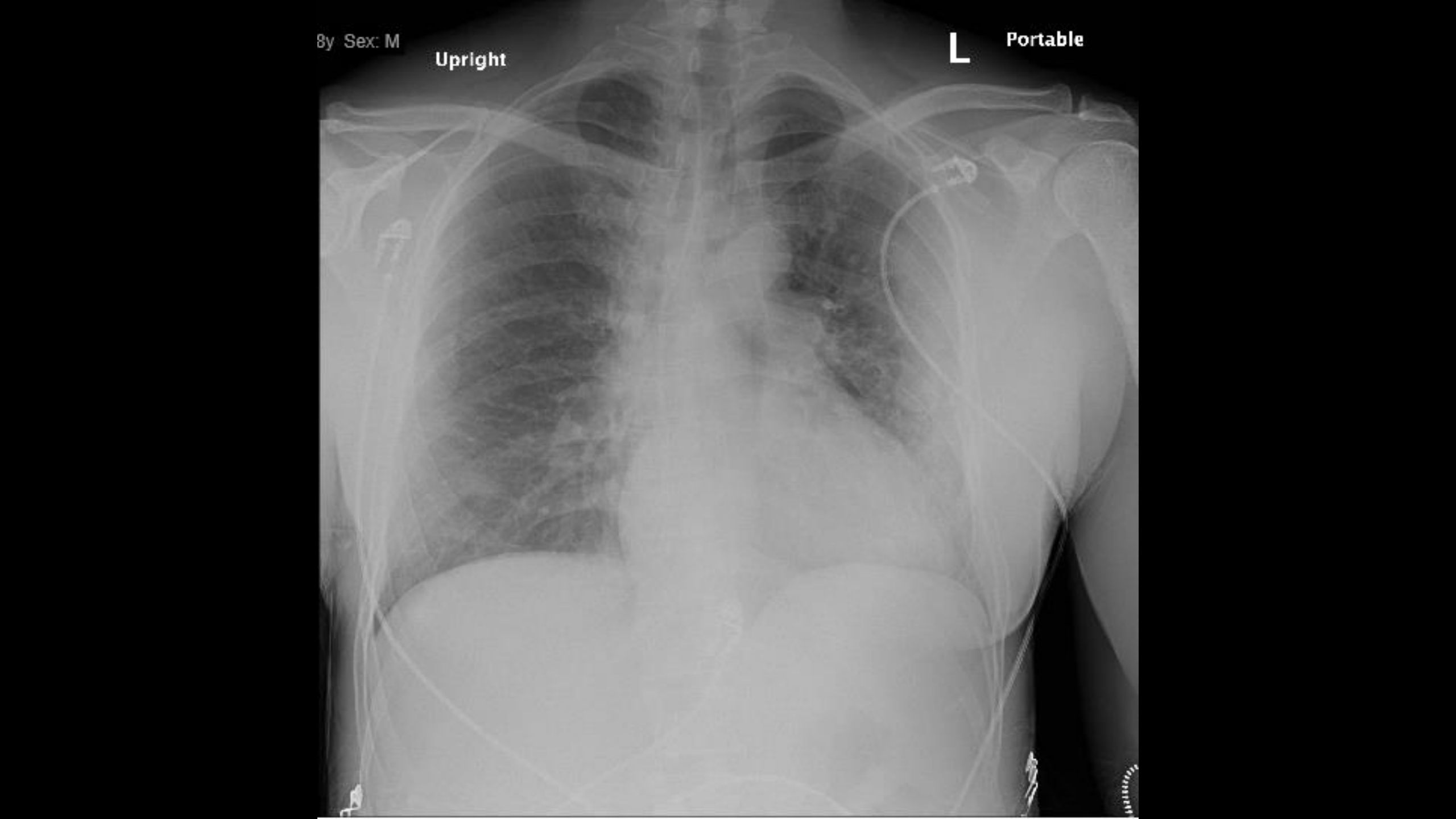
Case 2

HPI

85 year old with a hx of HTN and CAD presents with 5 days of feeling ill:

- Non-productive cough, headache, extreme fatigue, diarrhea, and chills
- Also notes shortness of breath that has been worsening
- No recent travel outside of Denver

- In ED, his temp is 99.9 and his O2 sat is 90% on RA
- Labs are relatively unremarkable (Na 133, Cr 1.3, WBC 5.5, AST 44)
- He is started empirically on ceftriaxone and azithromycin


8y Sex: M
Upright
L
Portable

History

Past Medical History

- Depression
- HTN
- CAD

Social History

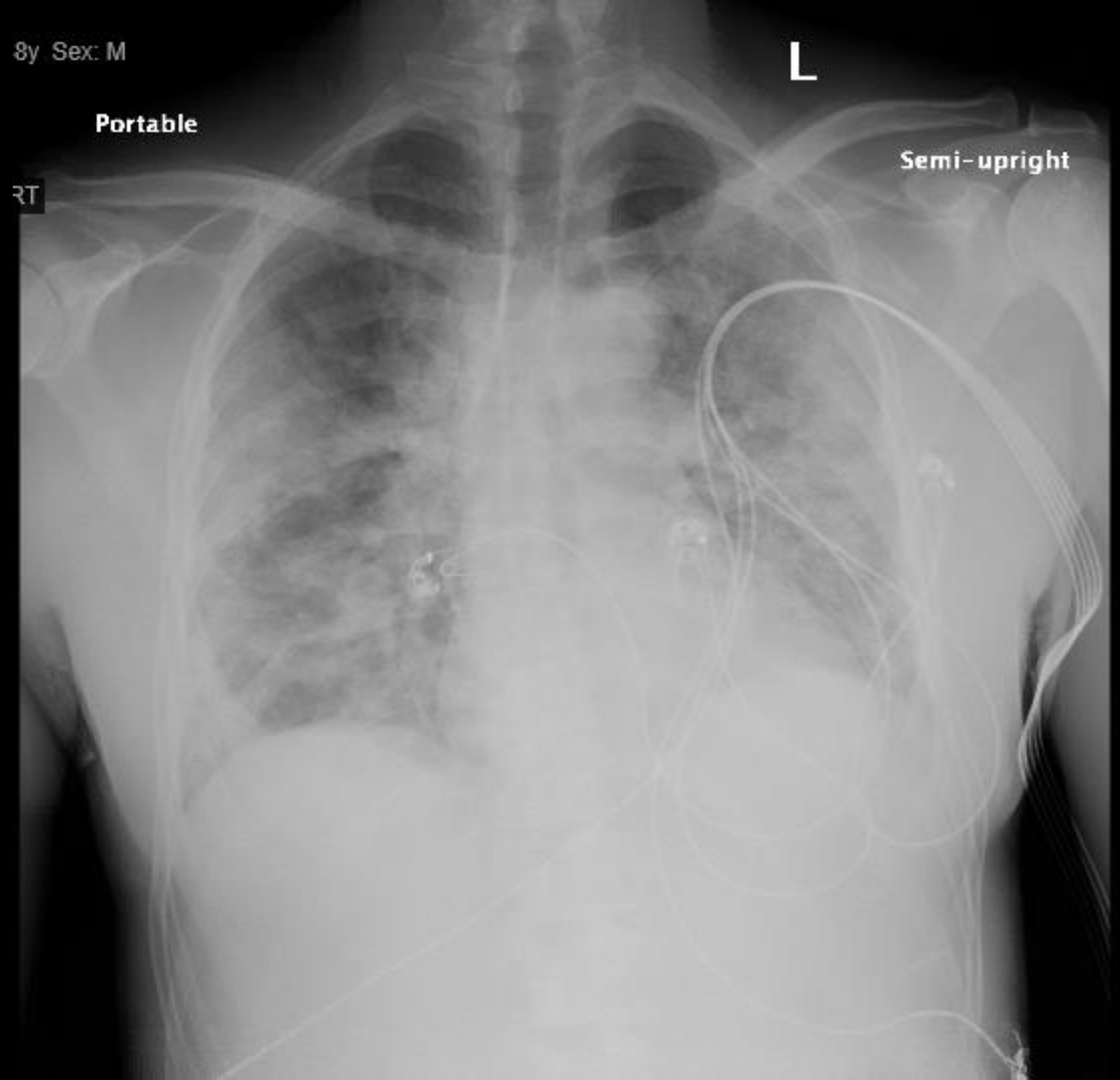
- Lives with his partner
- EtOH: none
- Former smoker
- Retired, previously worked as a middle school Spanish teacher

Medications

- Lisinopril-HCTZ 20-25mg qD
- ASA 81mg qD
- Plavix 75mg qD
- Atorvastatin 40mg qD
- Sertraline 100mg qD
- Lorazepam 1mg PO prn

Clinical course

- Admitted to the hospital floor
- COVID-19 **positive**
- By hospital day 3 is requiring 8-10L NC
- He is empirically started on Plaquinel, and is transferred to the ICU
- A CXR and CT chest are obtained:


8y Sex: M
Portable
RT
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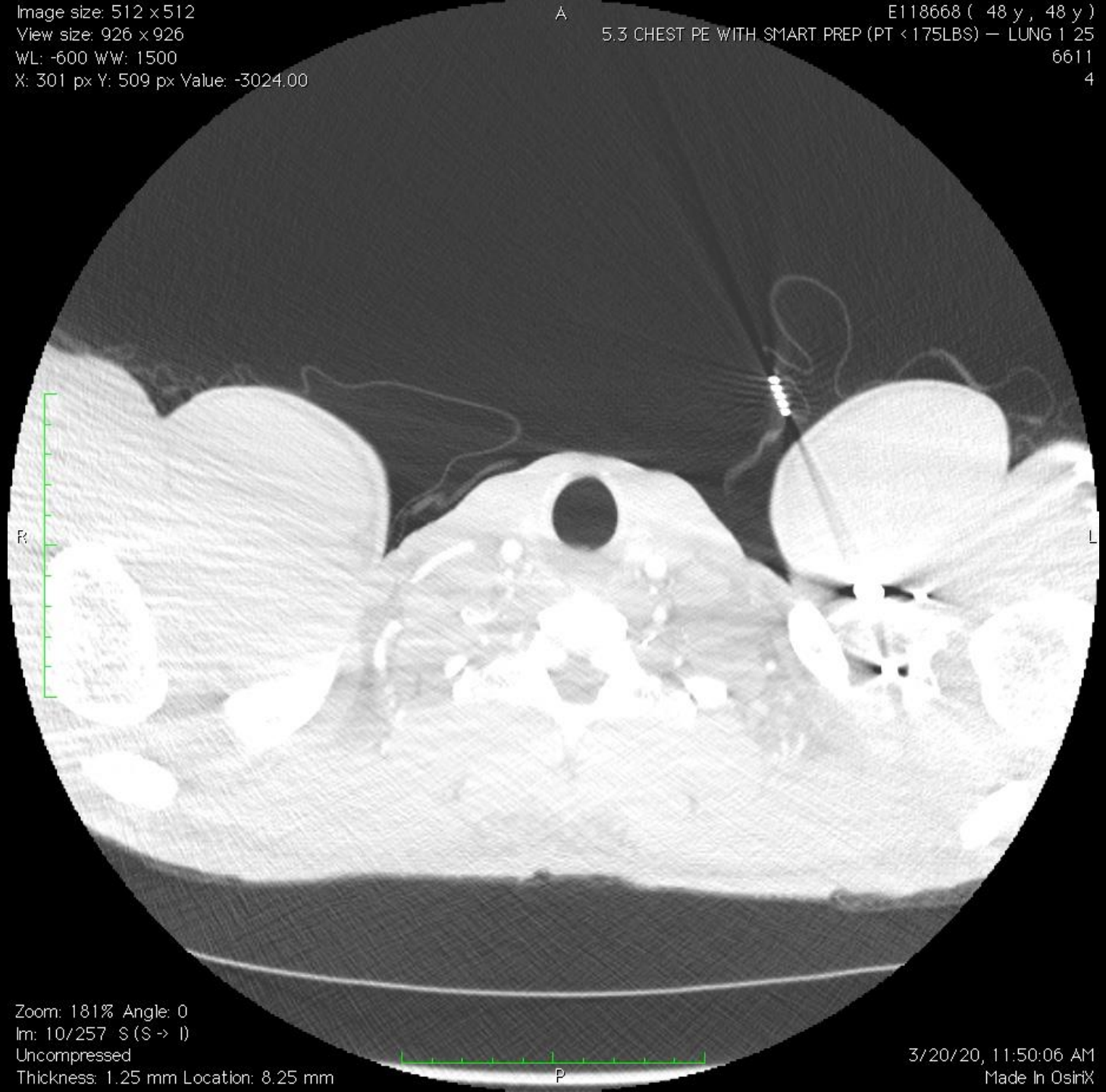
Semi-upright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E118668 (48 y , 48 y)
5.3 CHEST PE WITH SMART PREP (PT < 175LBS) — LUNG 1 25
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Zoom: 181% Angle: 0
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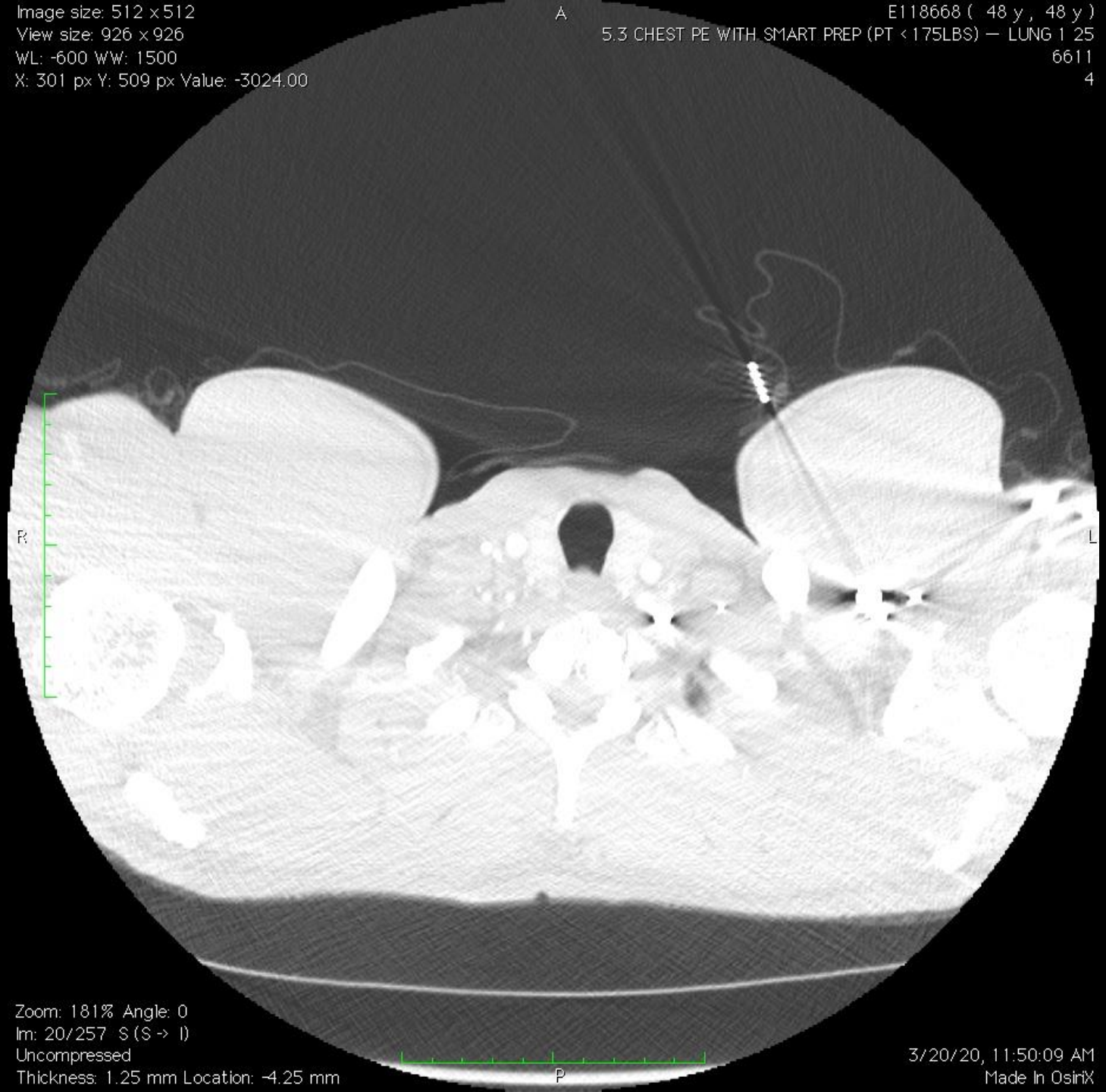
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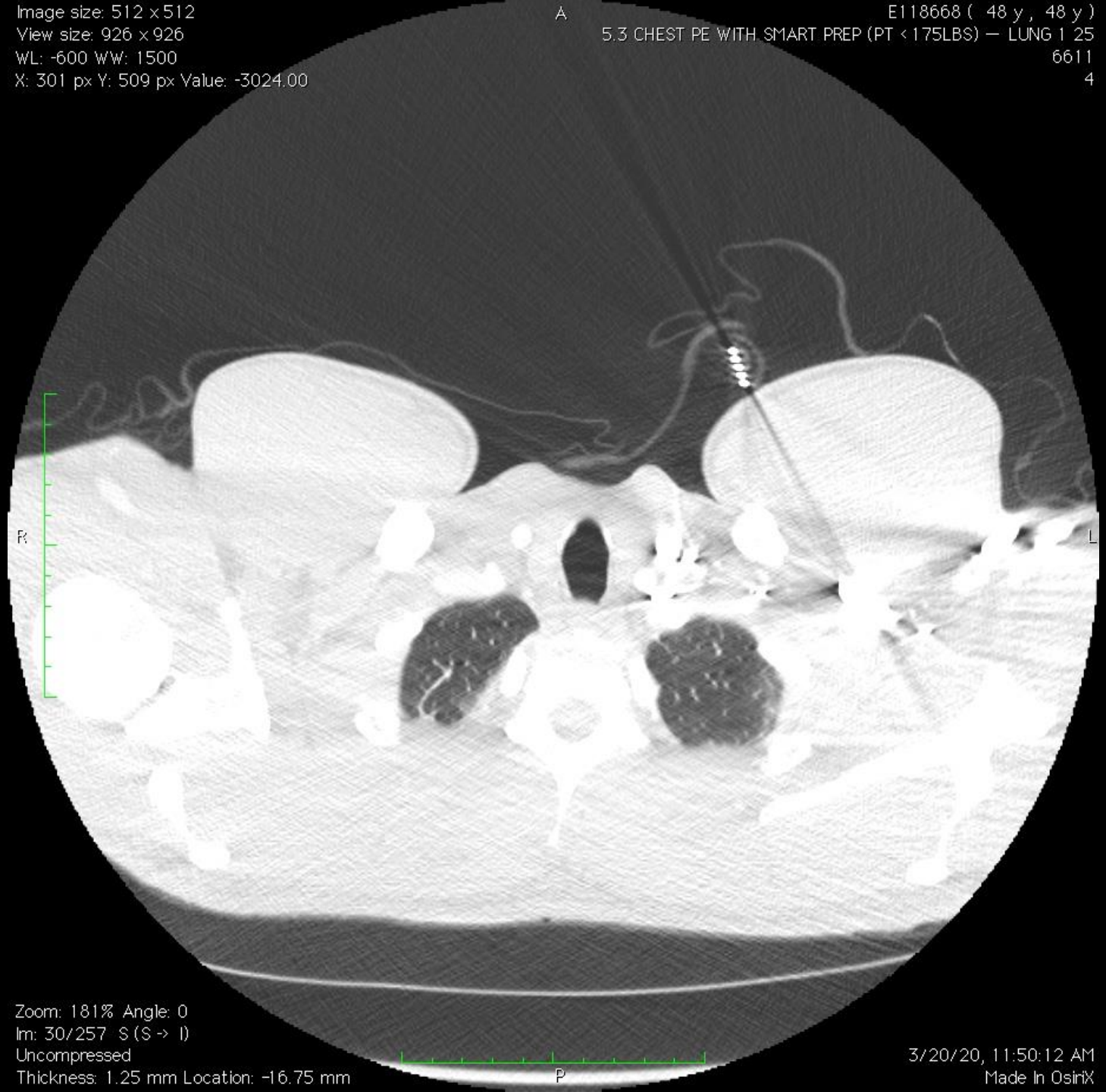
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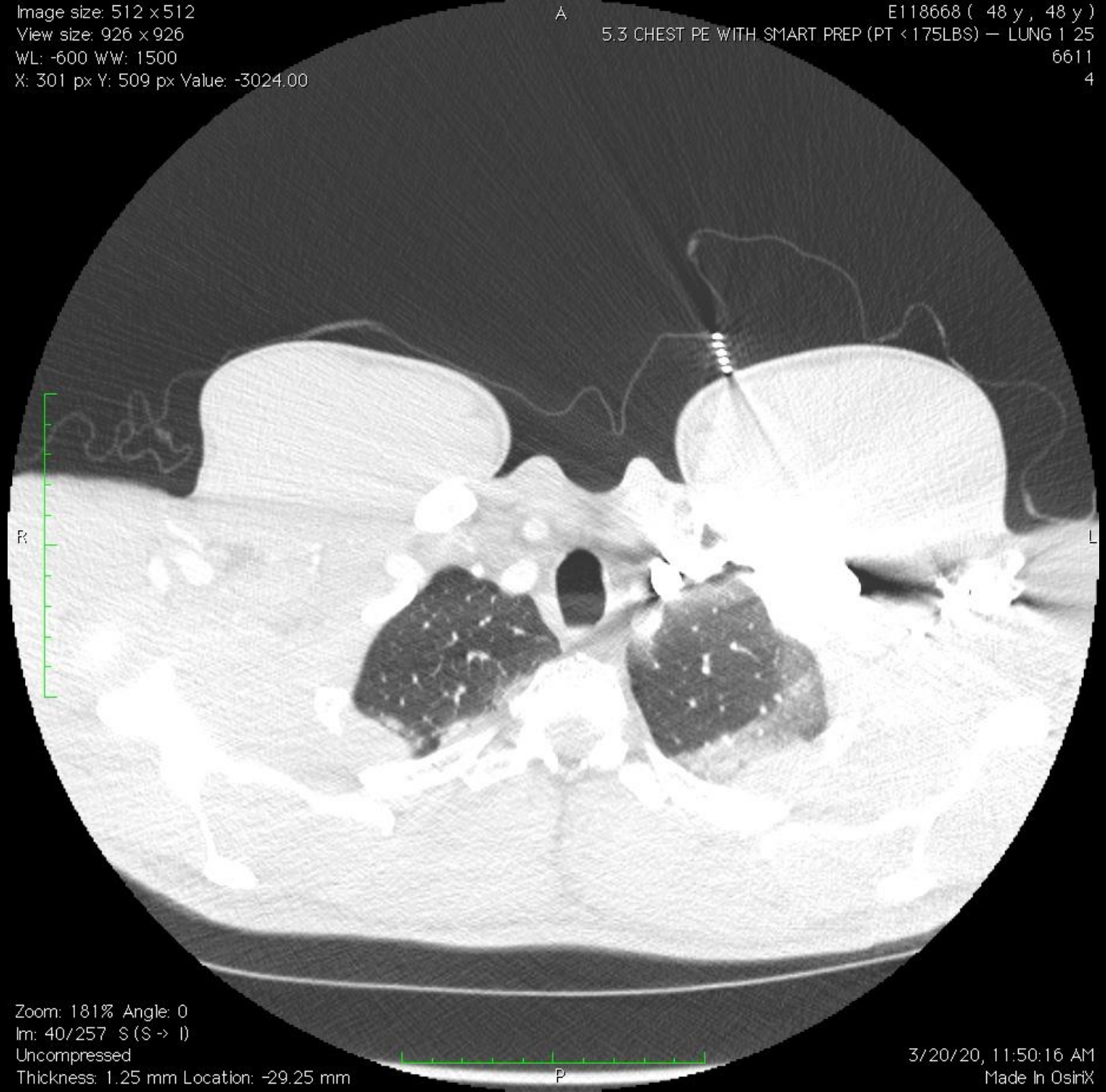
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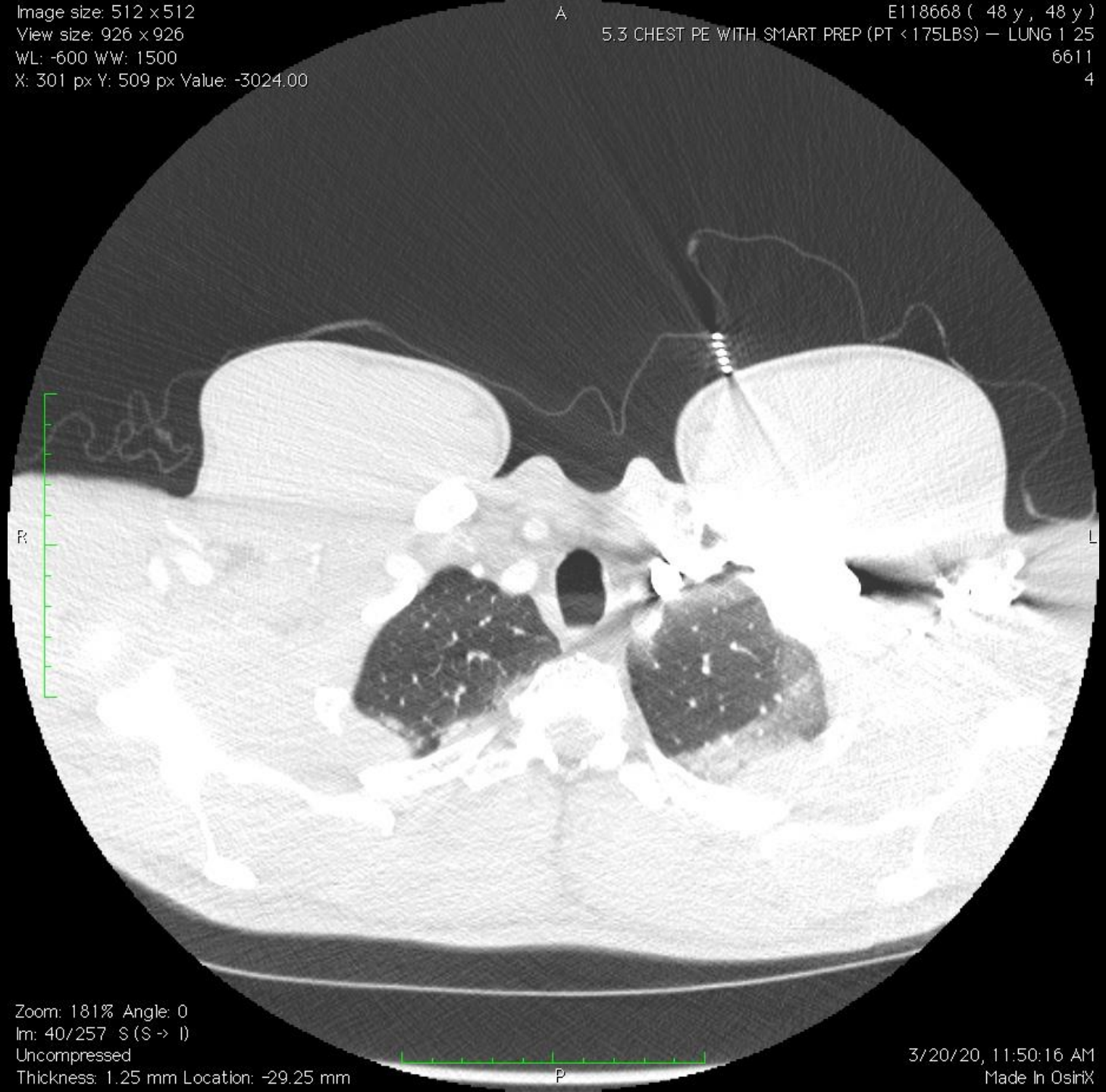
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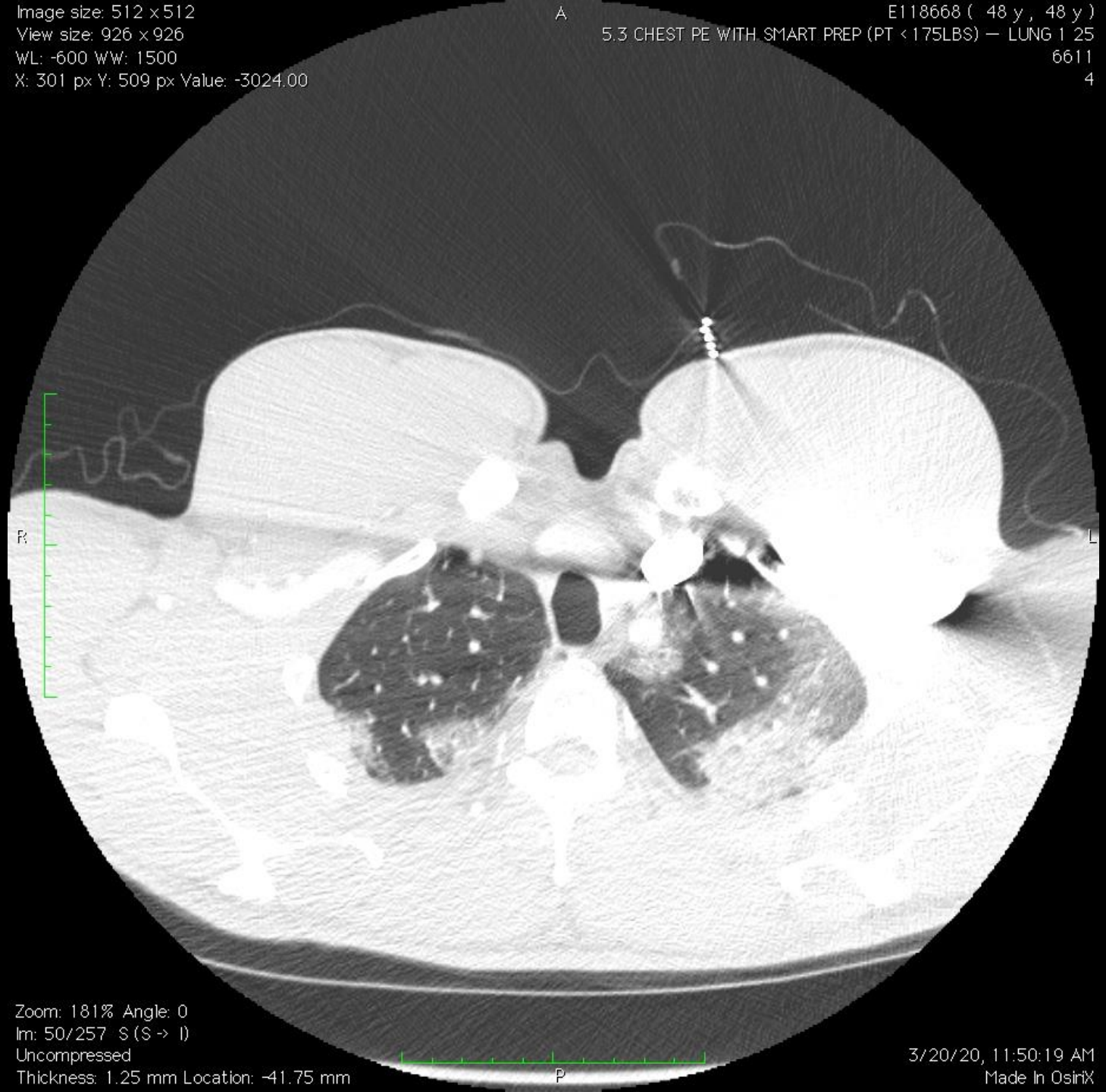
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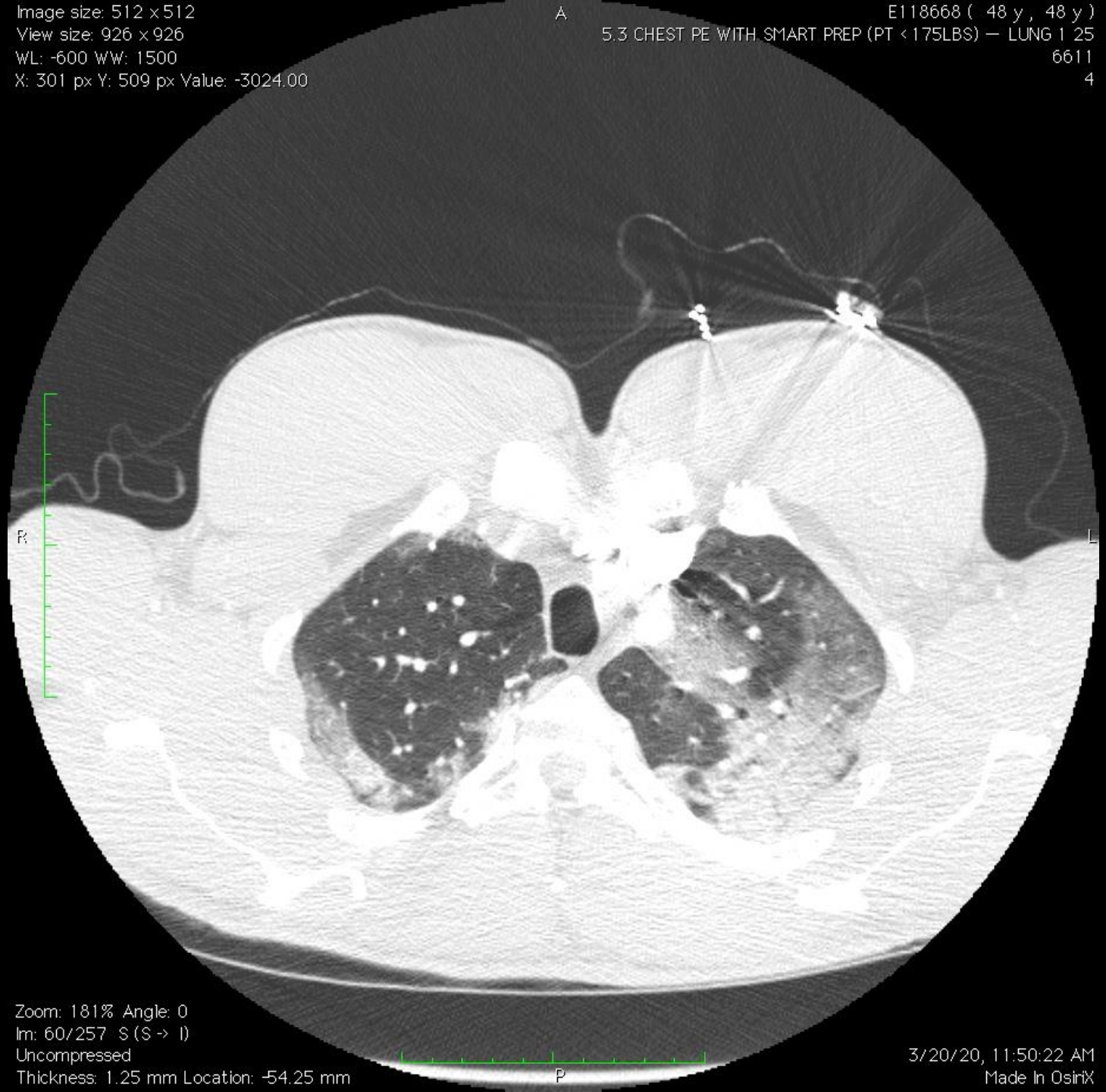
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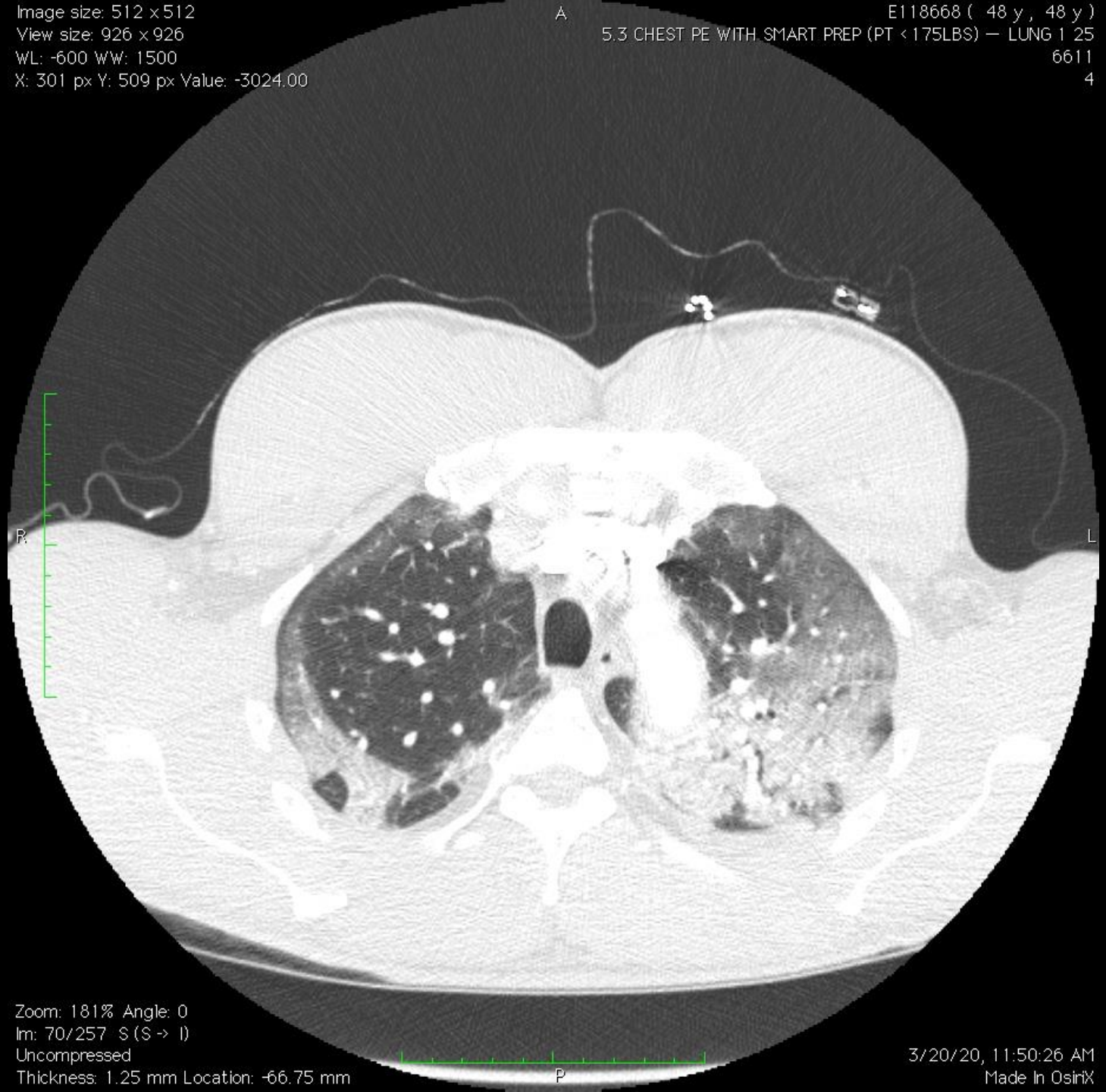
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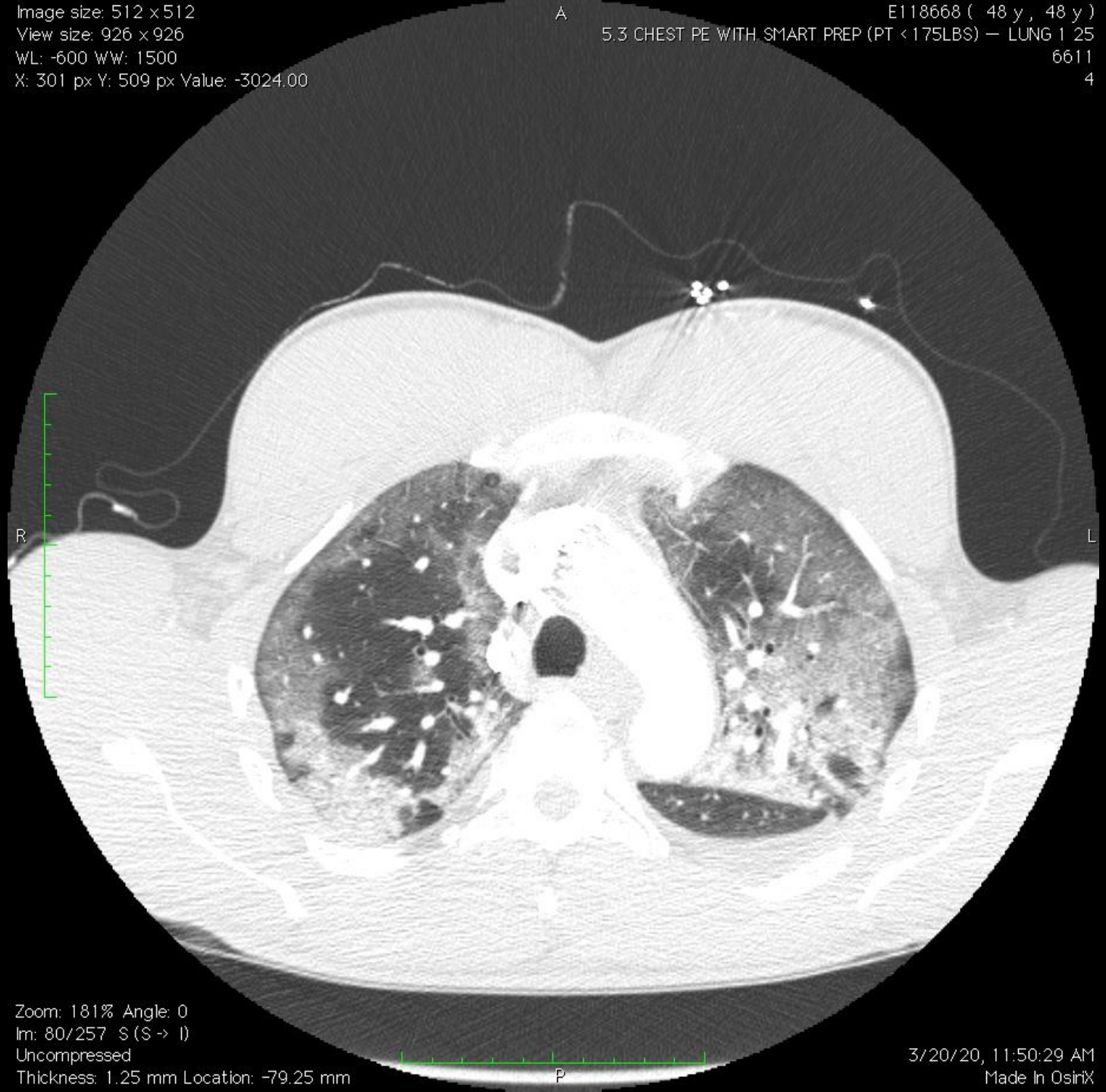
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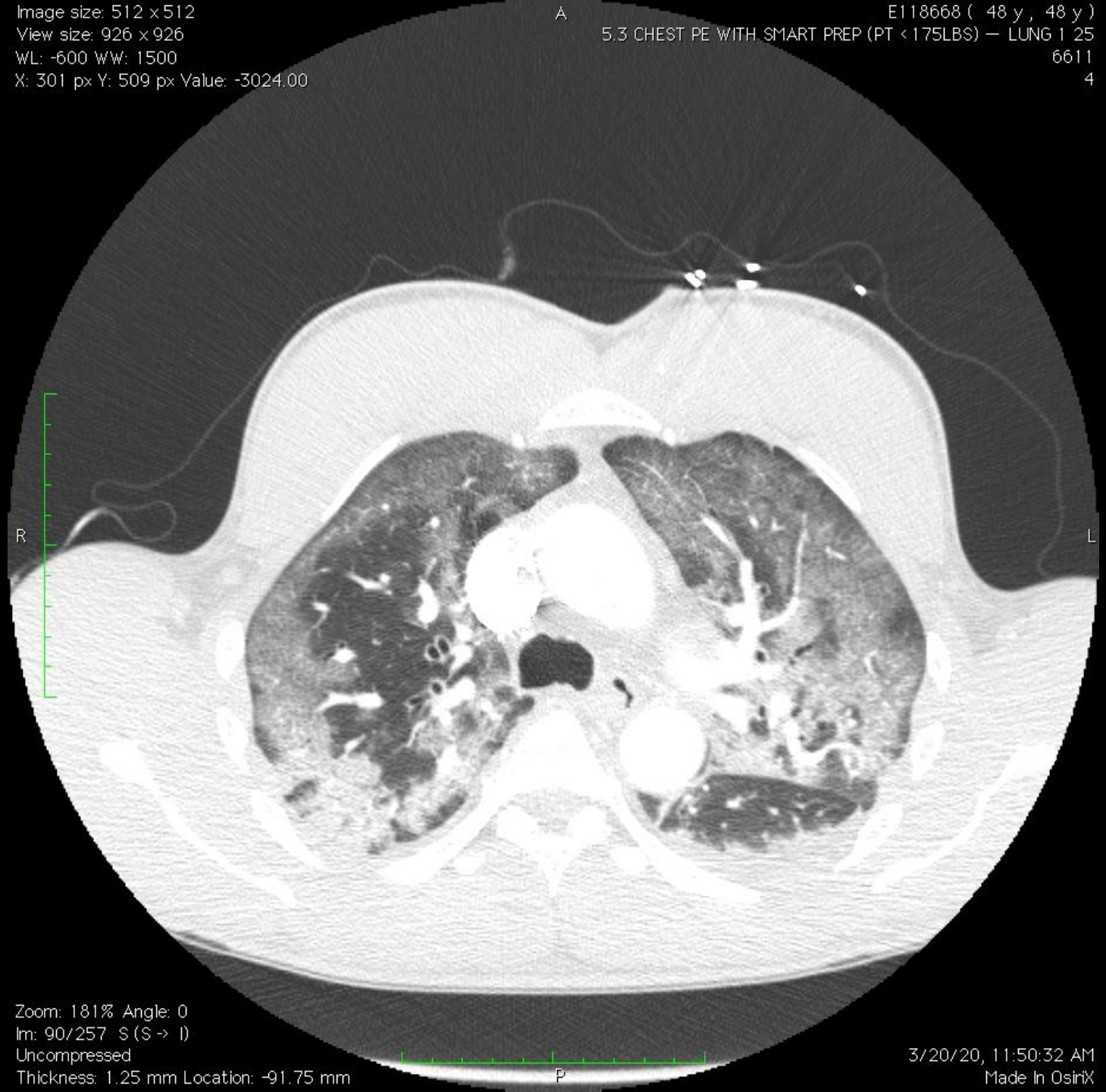
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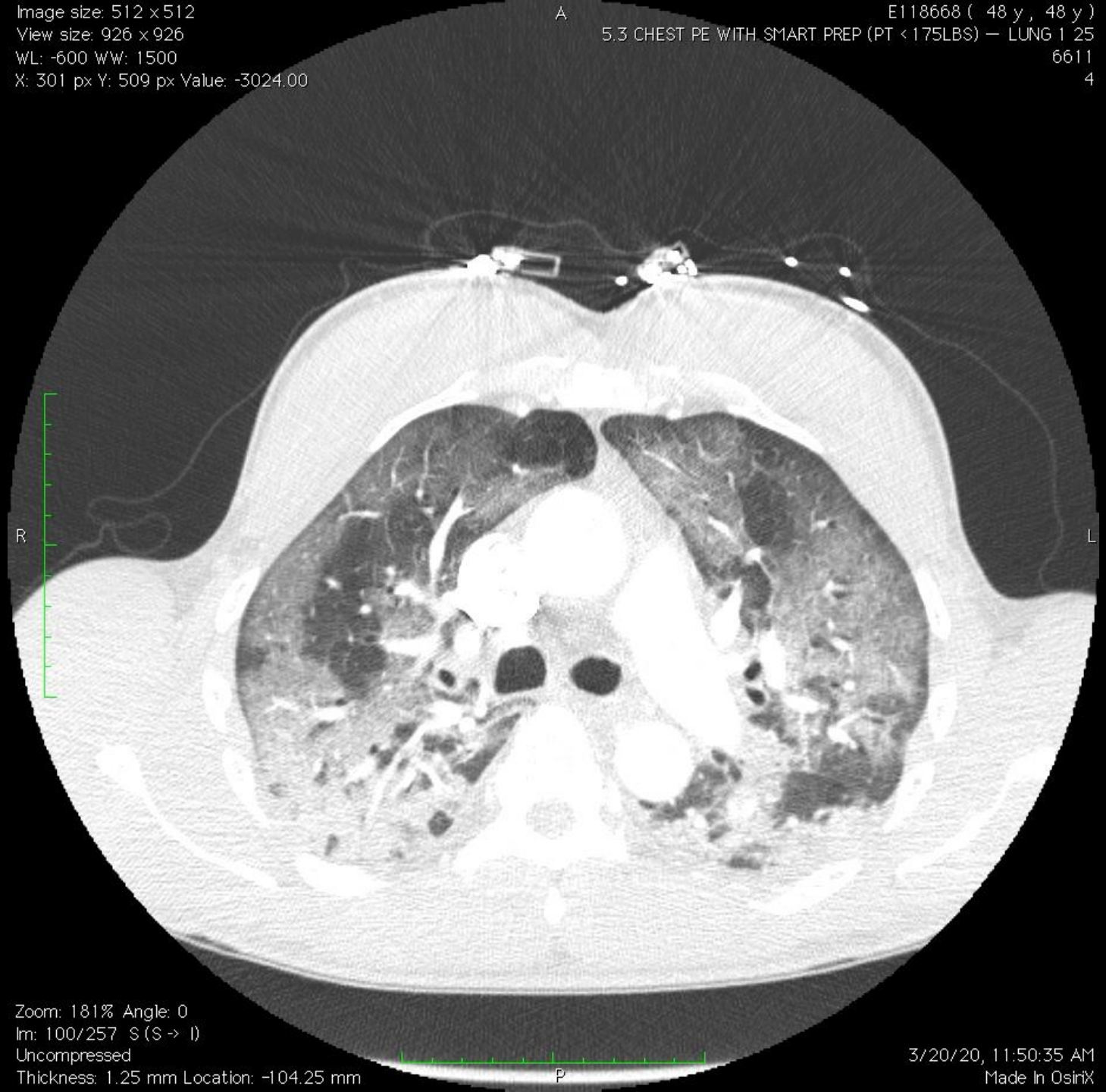
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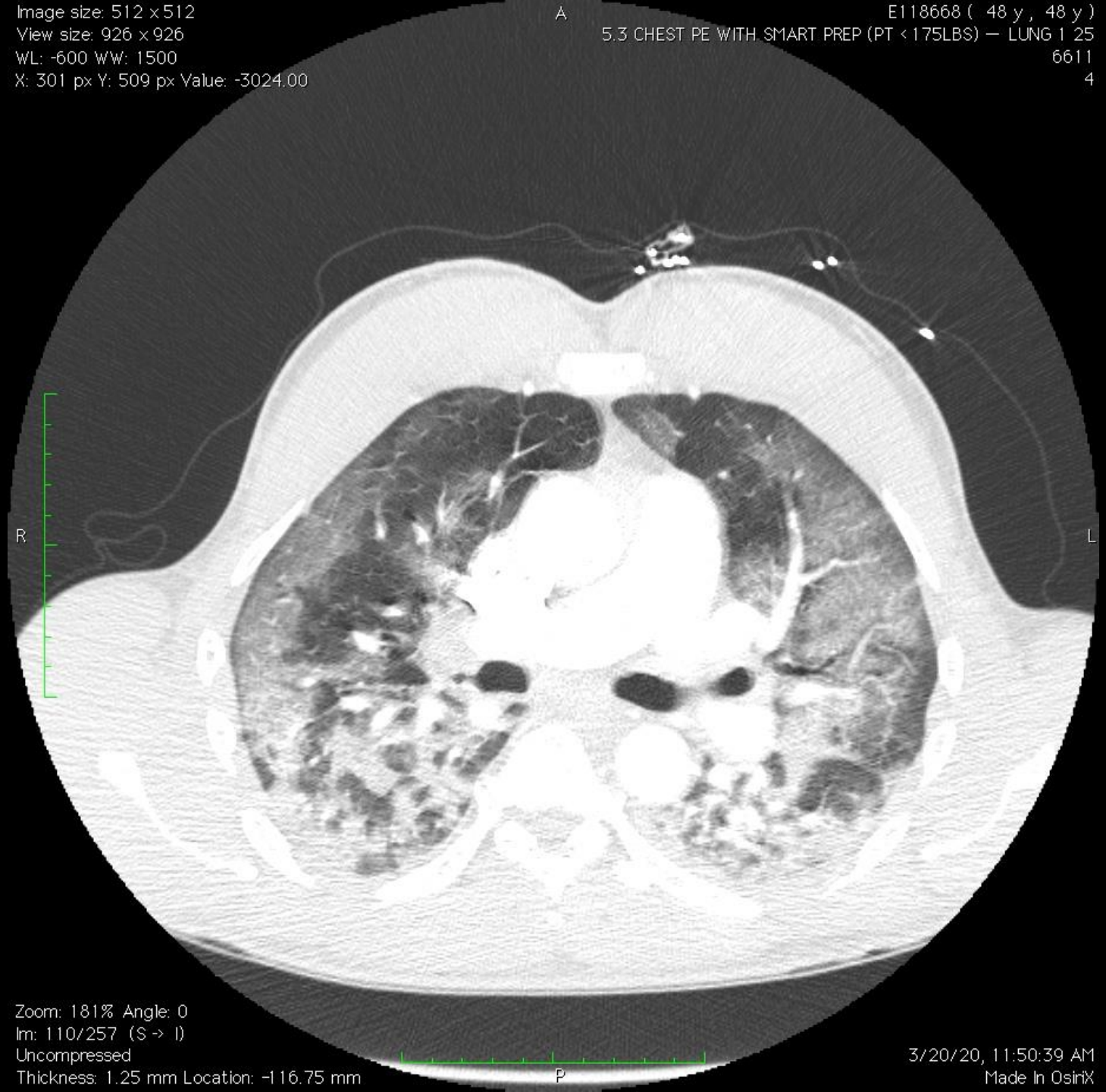
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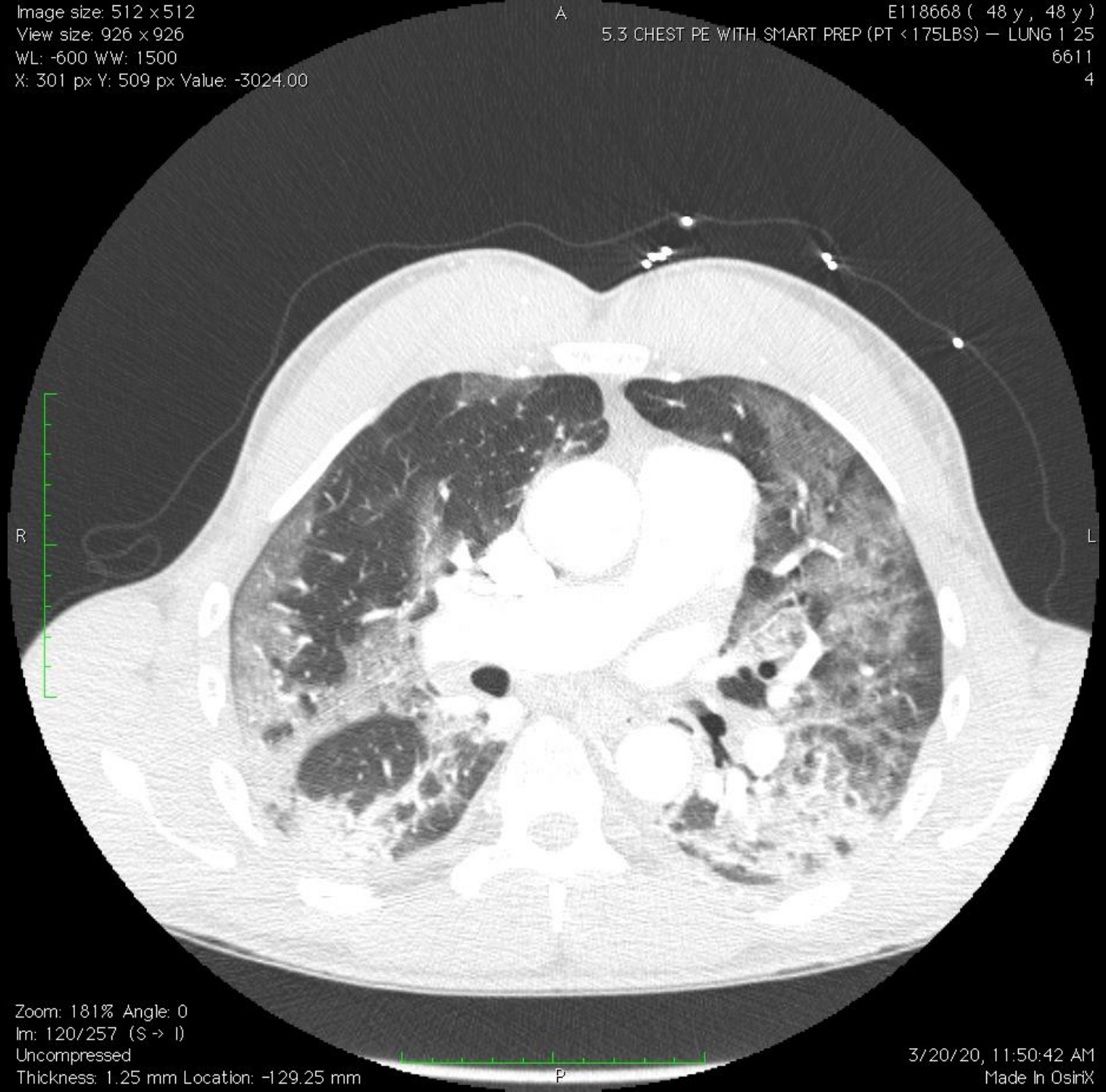
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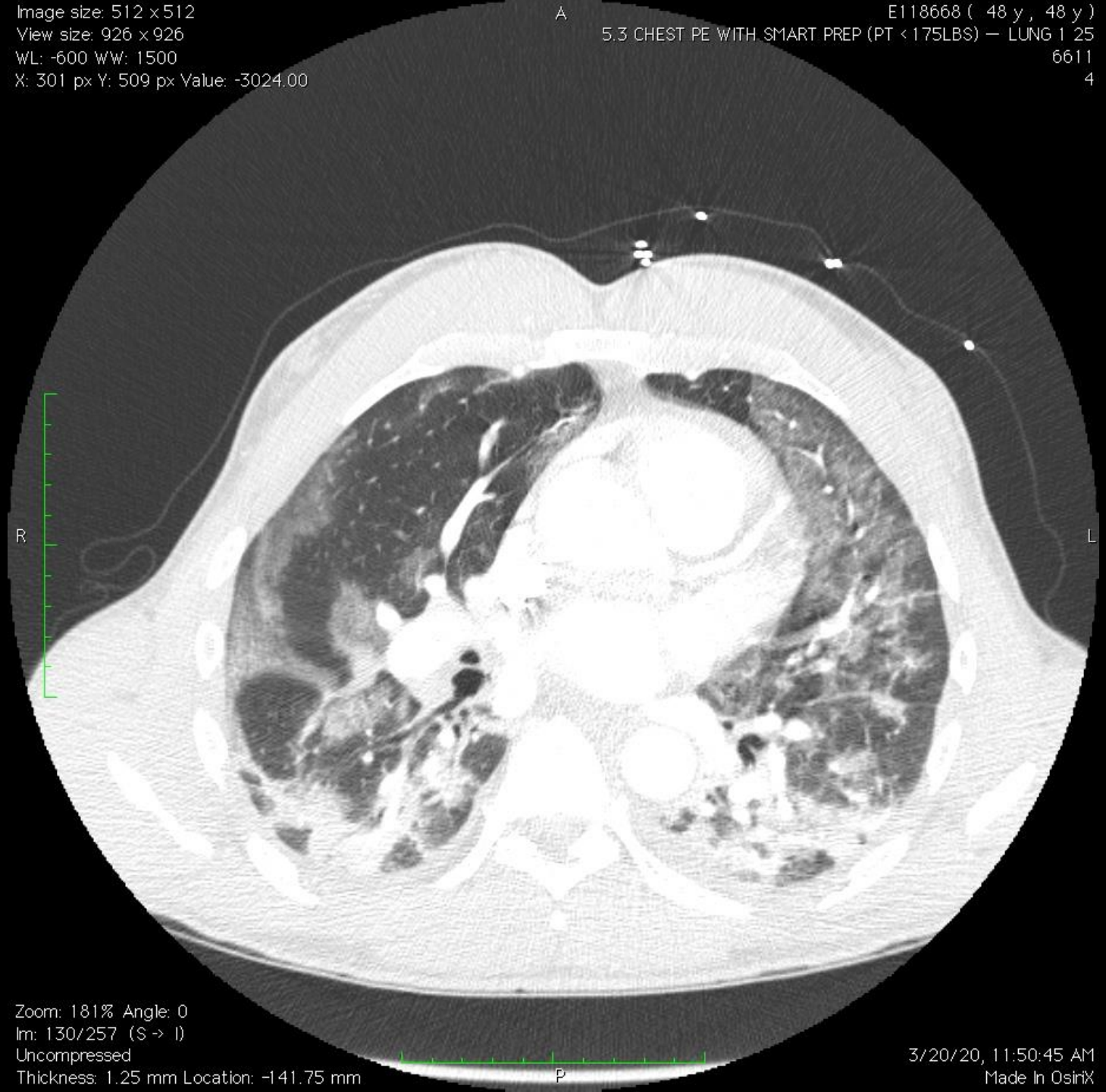
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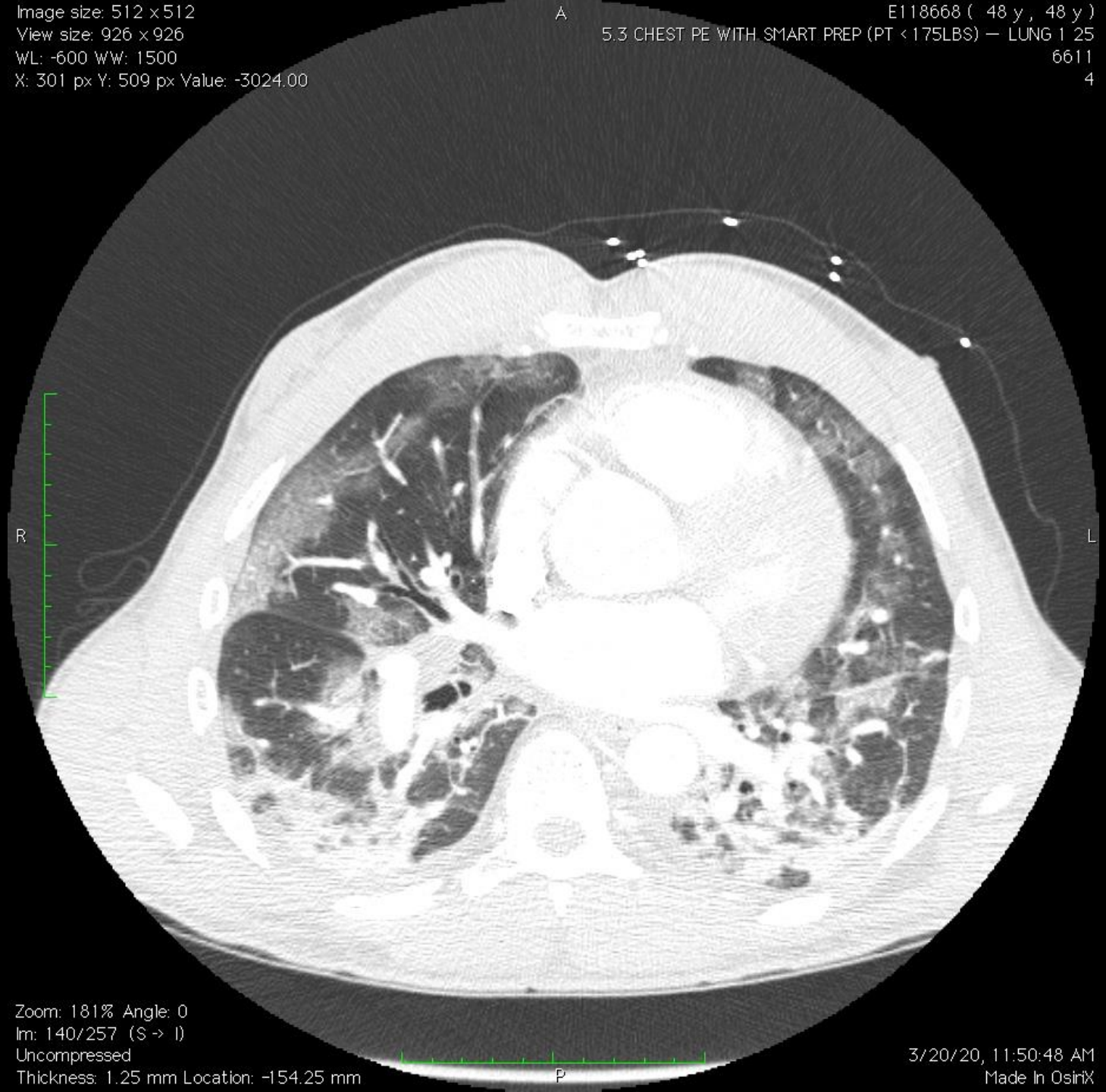
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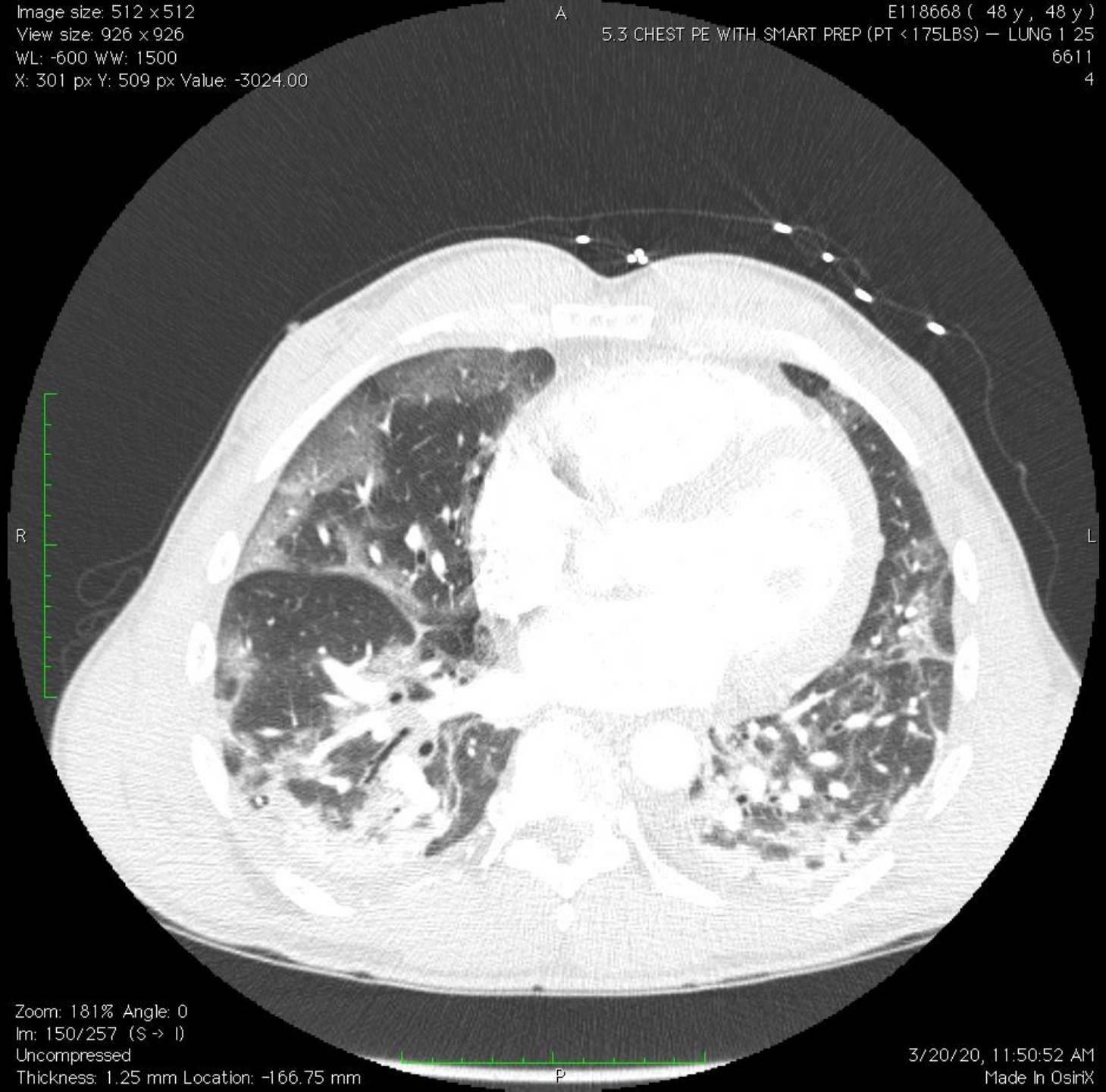
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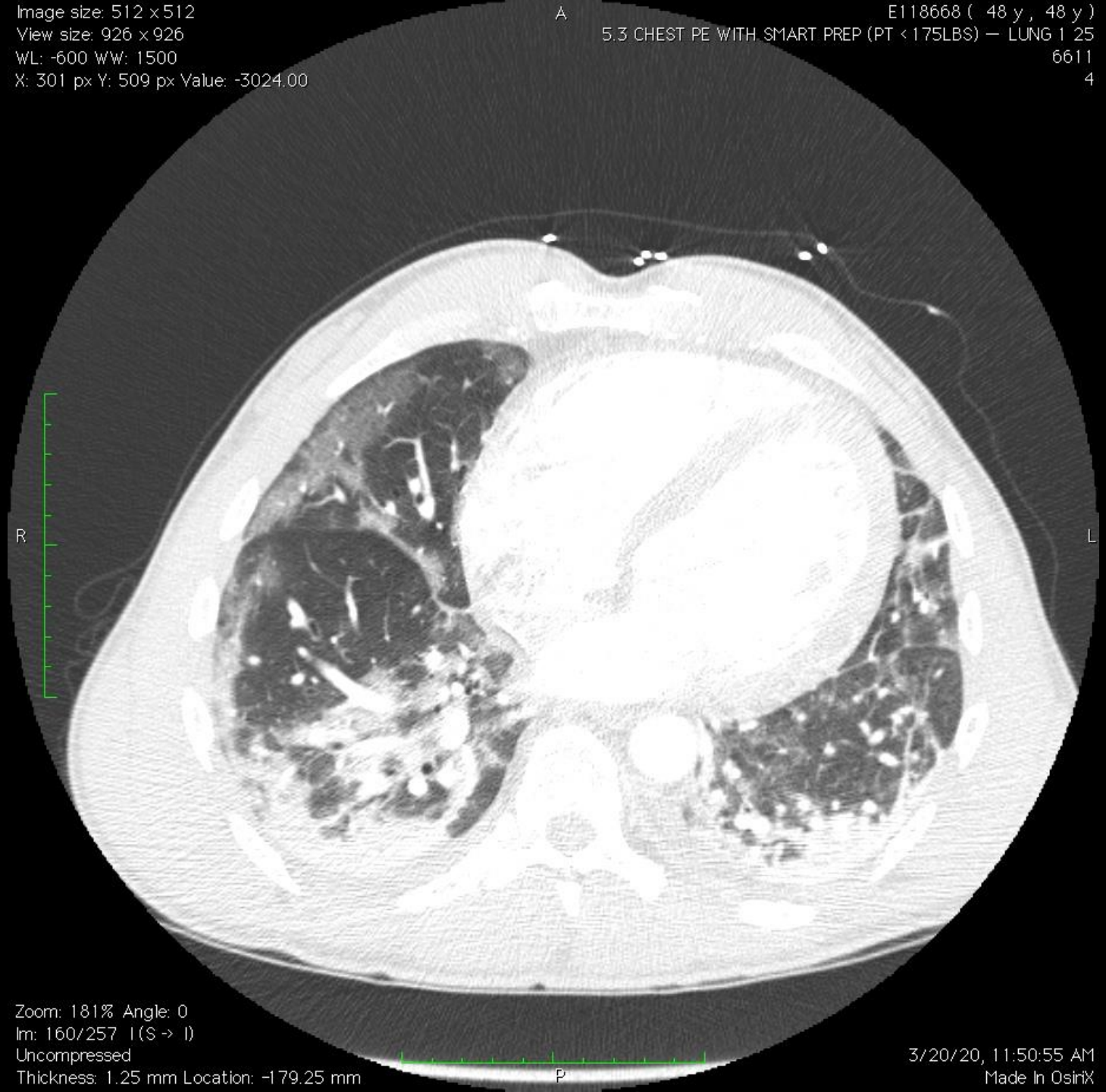
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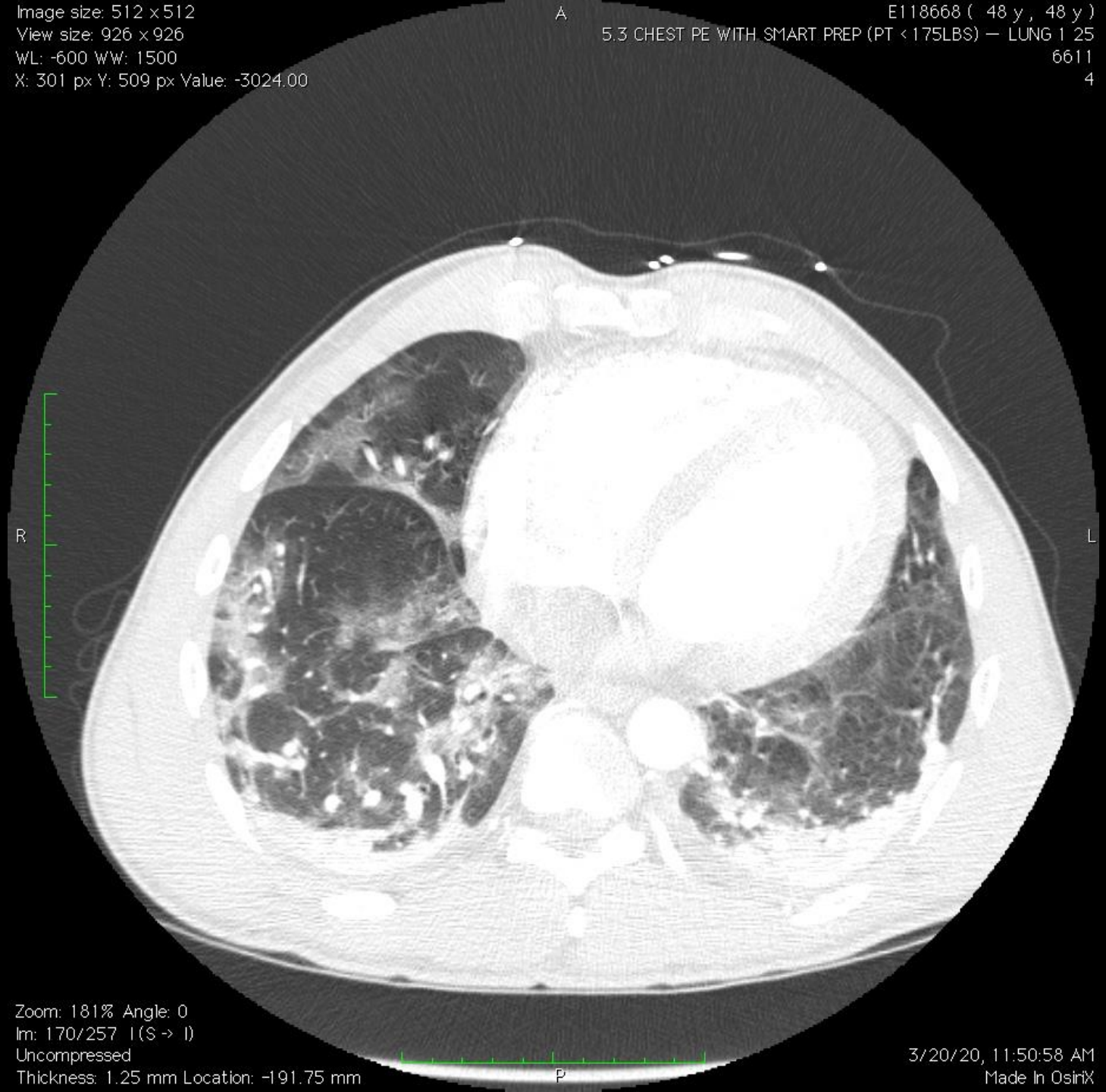
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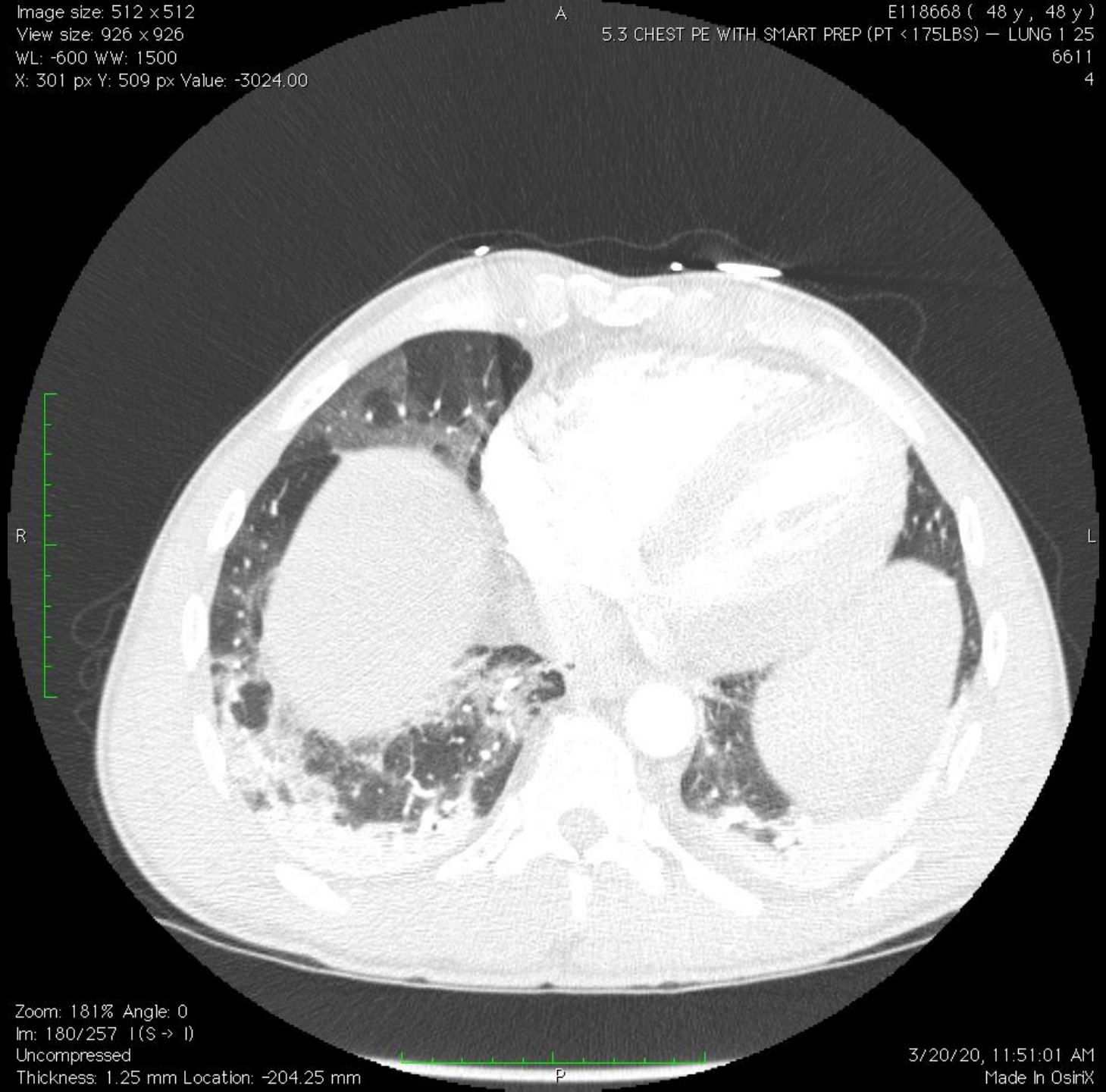
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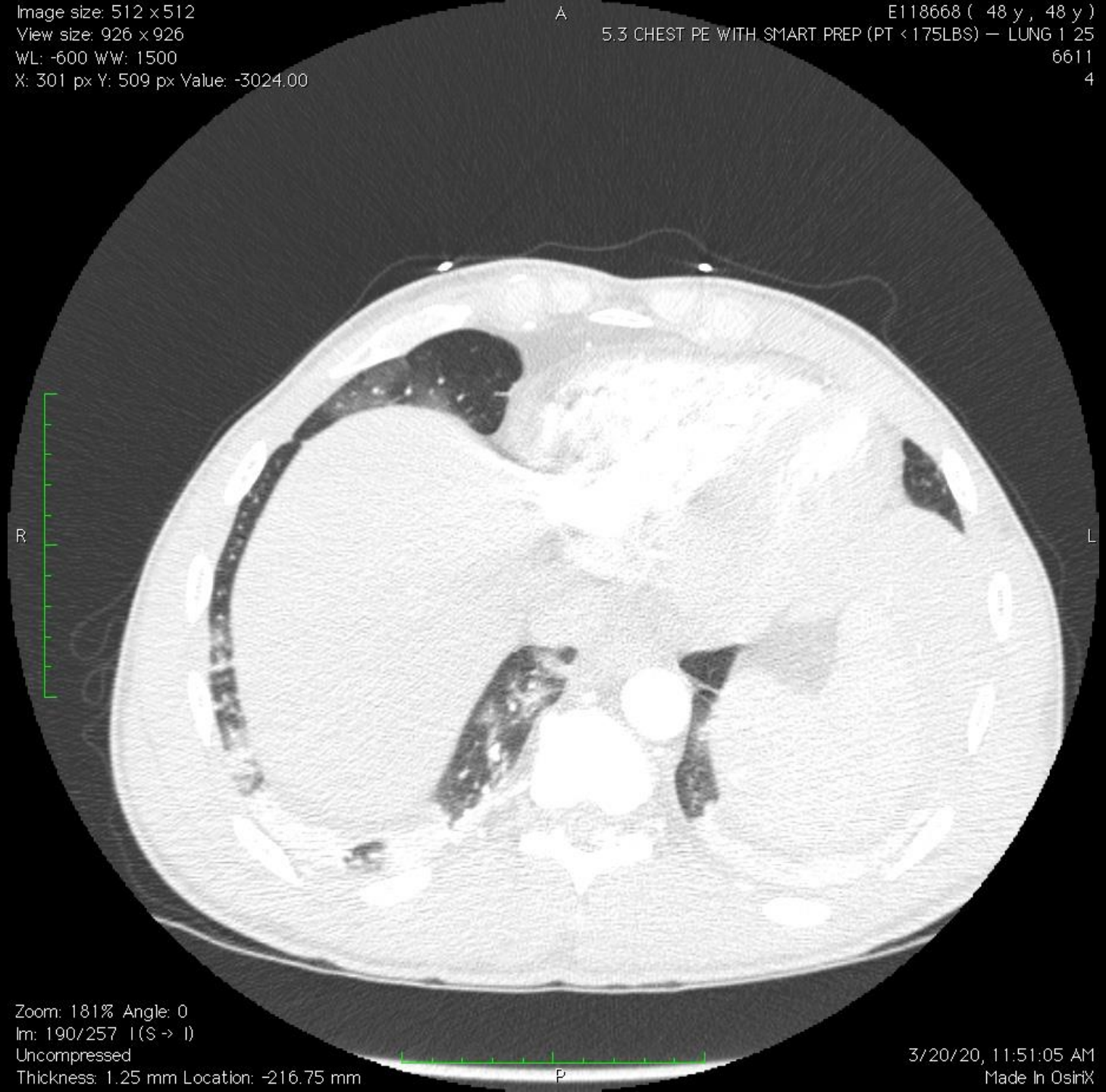
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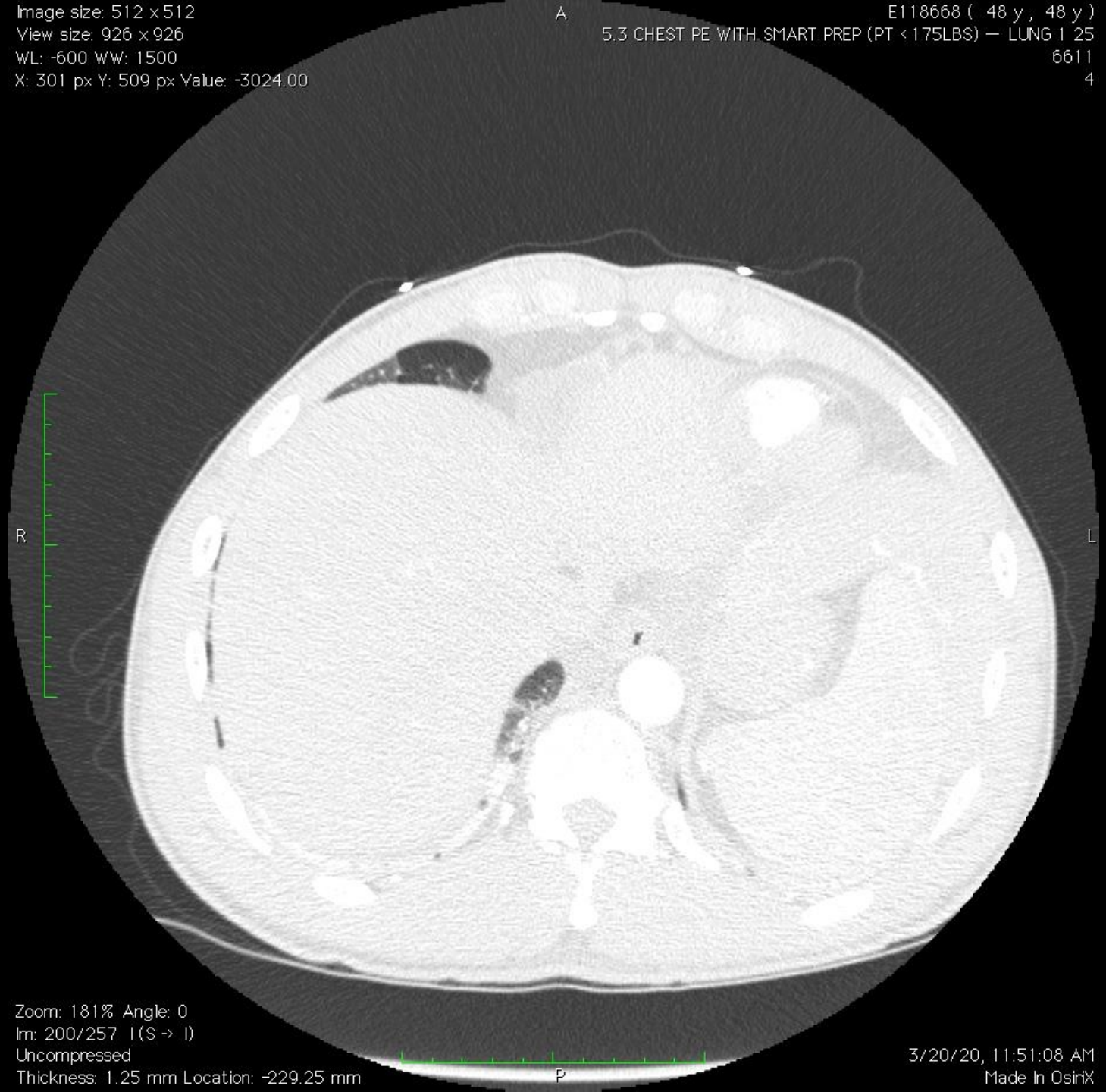
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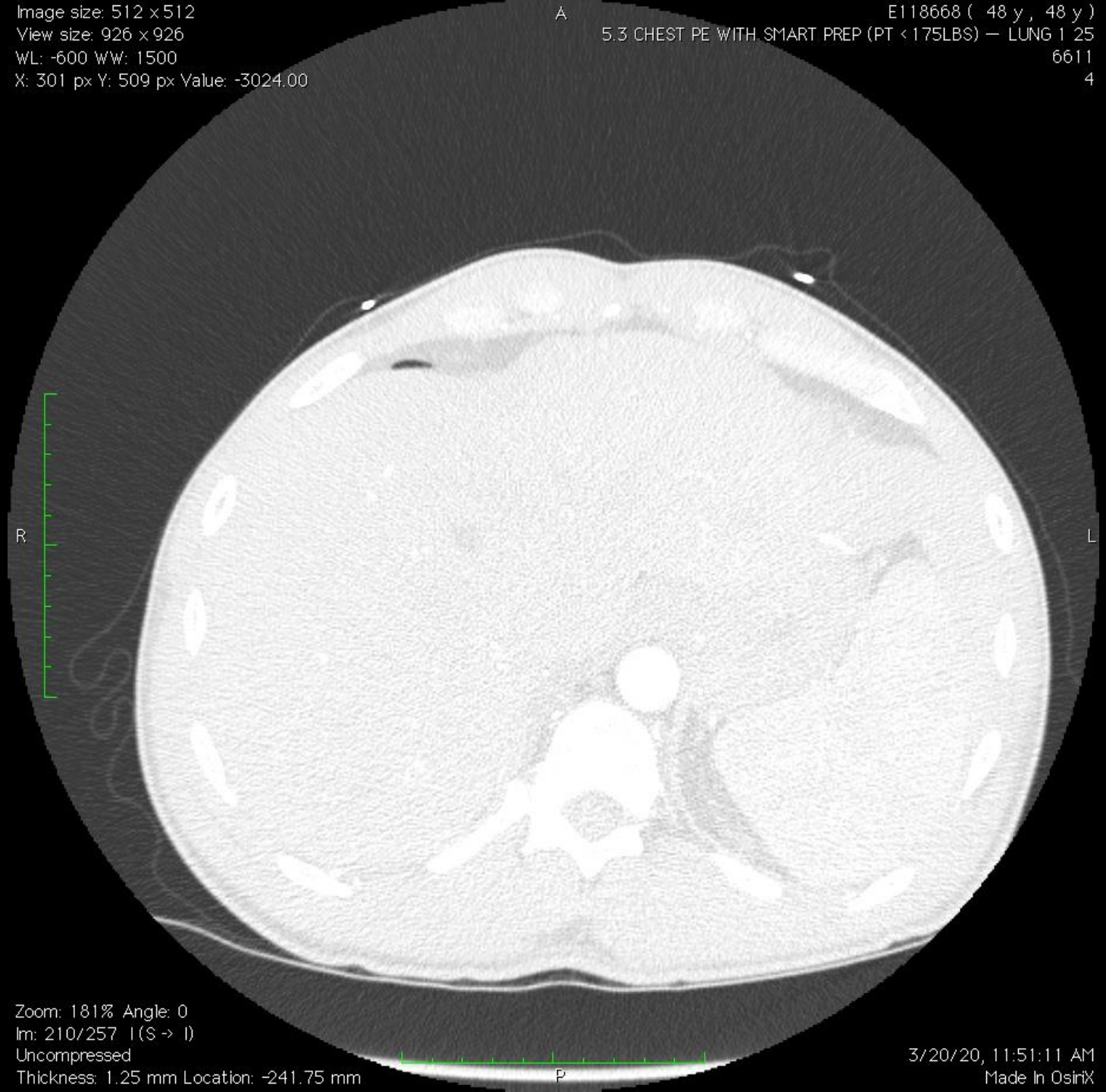
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Upon arrival to the ICU, the patient decompensates and is intubated.

In light of the COVID pandemic, there has been discussion about initiating a unilateral DNR policy to intubated patients with COVID.

I*n the chance of a cardiac arrest, would you offer CPR to this patient?*

What if the patient was 45 years old? What if the patient was your coworker?

CPR in patients with airborne pathogens

Potential barriers and ethical issues in times of pandemic

CPR in patients with airborne pathogens

- What are the values of medical ethics that underlie CPR?
- What is the risk to healthcare workers?

2 models of CPR decision-making

- Rule of rescue
  - Based on the ethical principal of *beneficence*
  - When a patient faces a threat to their welfare that may lead to preventable death, it is a benefit to them when physicians intervene
- Informed consent/substituted interests
  - Based on the ethical principal of *autonomy*
  - Transforms what would be an assault on an individual into the treatment of a patient
  - Gives patients the right to choose between available treatment options or to refuse treatment, but not to demand treatment that is not indicated

Bester and Kodish. The Journal of Clinical Ethics, 2019

Unilateral DNR

- In extreme situations in which CPR may not be effective or may put health care workers at risk, clinicians may unilaterally decide to write a DNR order *without* patient or surrogate consent

Curtis et al. JAMA 2020

Does unilateral DNR break the rule of rescue?

- Clinicians should rescue patients with the means at their disposal, unless there are compelling reasons to refrain
- No demand for CPR can be asserted by patients if it is not authorized by conditions consistent with the rule of rescue:
  - Cardiac arrest is not reversible
  - Rescue is not possible due to physiological or physical impediments
  - Patient has a clear objection to CPR

What about in times of resource scarcity?

- In a crisis, we may have to shift the standard of care to emphasize the needs of the community

Bester and Kodish. The Journal of Clinical Ethics, 2019

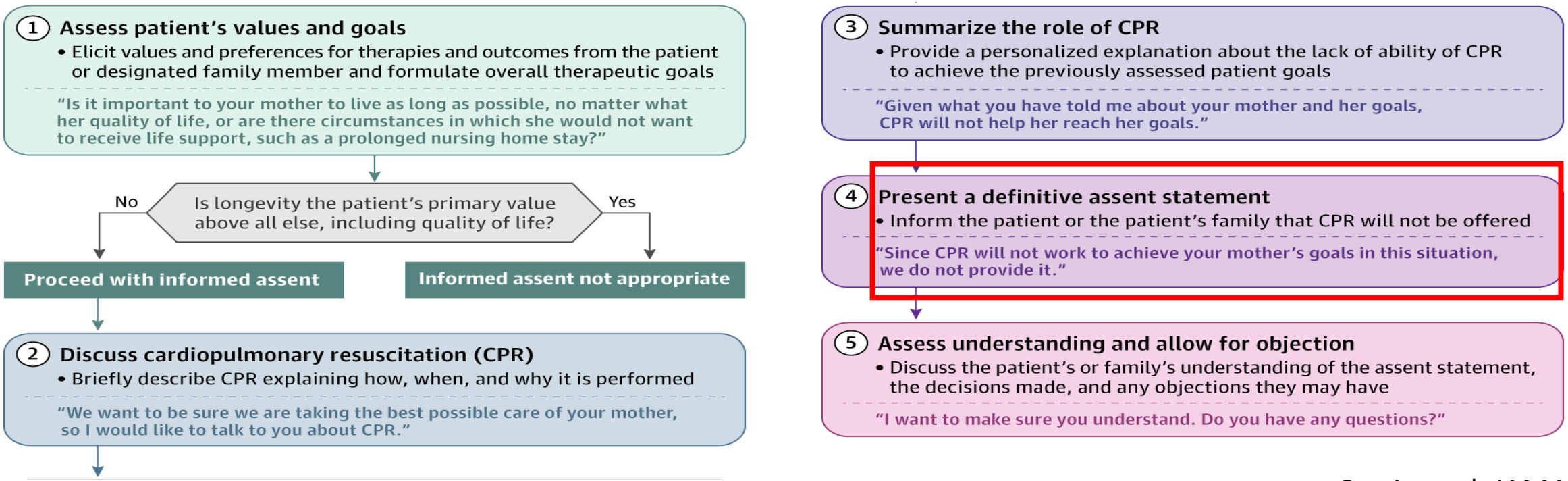
Crisis Standards of Care

- “To appropriately respond to a catastrophic disaster in which resources are overwhelmed, the needs of the greater community generally must rise above the needs of any single individual, and there may be circumstances in which resources should be diverted from patients with a lower likelihood of benefit to those with a greater likelihood of benefit.”

Colorado Crisis Standards of Care Plan 2018

Informed assent is an alternative approach to unilateral DNR decisions

- The clinician does not ask the patient or family member to take responsibility for the DNR decision, but rather asks the patient or family member to allow the clinician to assume responsibility



Curtis et al. JAMA 2020

UCHealth suggested language for unilateral DNR

“Based on our review of your loved one’s clinical status, we are worried that the COVID-19 infection along with their previous medical conditions, is leading to an end-of-life process”

“We are sorry to share that we believe your loved one is dying”

“Under these circumstances we are unable to provide advanced cardiovascular support”

“What we can do is focus our efforts and care on your loved one’s comfort and support your family during that time”

“We are also worried about the risk to health care workers of exposure to COVID-19 that may occur while conducting a procedure that is not expected to improve your loved one’s outcome”

What about when CPR provides risk to the health care worker?

- Health care workers need to be protected
  - Training in infection control
  - Personal protective equipment (PPE)

Gostin et al. Hastings Center Report, 2020

Aerosol-generating procedures expose providers to a greater risk of disease transmission

- Systematic review of HCWs caring for patients with acute respiratory infections (1990 – 2010)
  - 10 non-randomized studies identified that evaluated the risk of transmission in providers treating patients undergoing aerosolizing procedures
    - All studies evaluated transmission of SARS-CoV
    - All considered low quality evidence

Tran et al. Plos One 2012

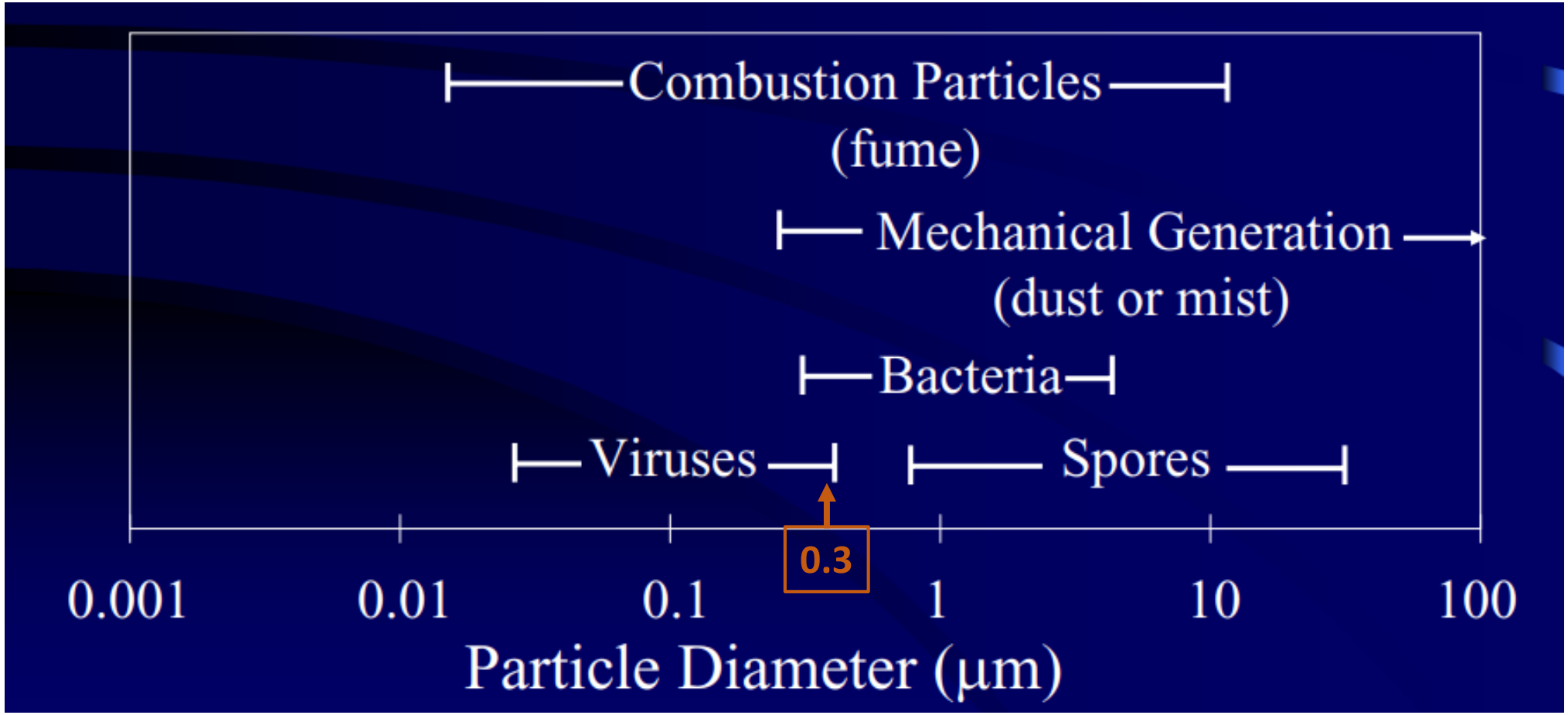
Table 2. Risk of SARS Transmission to HCWs Exposed and Not Exposed to Aerosol-Generating Procedures, and Aerosol Generating Procedures as Risk Factors for SARS Transmission

Aerosol Generating Procedures	Odds ratio (95% CI)	
	Point estimate	Pooled estimate; I^2
Tracheal intubation (4 cohort studies)	3.0 (1.4, 6.7) [25]	6.6 (2.3, 18.9); 39.6%
	22.8 (3.9, 131.1) [26]	
	13.8 (1.2, 161.7) [27]	
	5.5 (0.6, 49.5) [29]	
Tracheal intubation (4 case-control studies)	0.7 (0.1, 3.9) [23]	6.6 (4.1, 10.6); 61.4%
	9.2 (4.2, 20.2) [21]	
	8.0 (3.9, 16.6) [20]	
	9.3 (2.9, 30.2) [24]	
Suction before intubation (2 cohort studies)	13.8 (1.2, 161.7) [27]	3.5 (0.5, 24.6); 59.2%
	1.7 (0.7, 4.2) [25]	
Suction after intubation (2 cohort studies)	0.6 (0.1, 3.0) [27]	1.3 (0.5, 3.4); 28.8%
	1.8 (0.8, 4.0) [25]	
Nebulizer treatment (3 cohort studies)	6.6 (0.9, 50.5) [27]	0.9 (0.1, 13.6); 73.1%
	0.1 (0.0*, 1.0) [28]	
	1.2 (0.1, 20.7) [25]	
Manipulation of oxygen mask (2 cohort studies)	17.0 (1.8, 165.0) [27]	4.6 (0.6, 32.5); 64.8%
	2.2 (0.9, 4.9) [25]	
Bronchoscopy (2 cohort studies)	3.3 (0.2, 59.6) [27]	1.9 (0.2, 14.2); 0%
	1.1 (0.1, 18.5) [25]	
Non-invasive ventilation (2 cohort studies)	2.6 (0.2, 34.5) [26]	3.1 (1.4, 6.8); 0%
	3.2 (1.4, 7.2) [25]	
Insertion of nasogastric tube (2 cohort studies)	1.7 (0.2, 11.5) [27]	1.2 (0.4, 4.0); 0%
	1.0 (0.2, 4.5) [25]	
Chest compressions (1 case-control study)	4.5 (1.5, 13.8) [24]	
Chest compressions (2 cohort studies)	3.0 (0.4, 24.5) [25]	1.4 (0.2, 11.2); 27.3%
	0.4 (0.0**, 7.8) [27]	
Defibrillation (2 cohort studies)	0.5 (0.0**, 12.2) [27]	2.5 (0.1, 43.9); 55.3%

Intubation:
OR 6.6

CPR:
OR 1.4

N95 masks protect against 95% of droplets <0.3µm

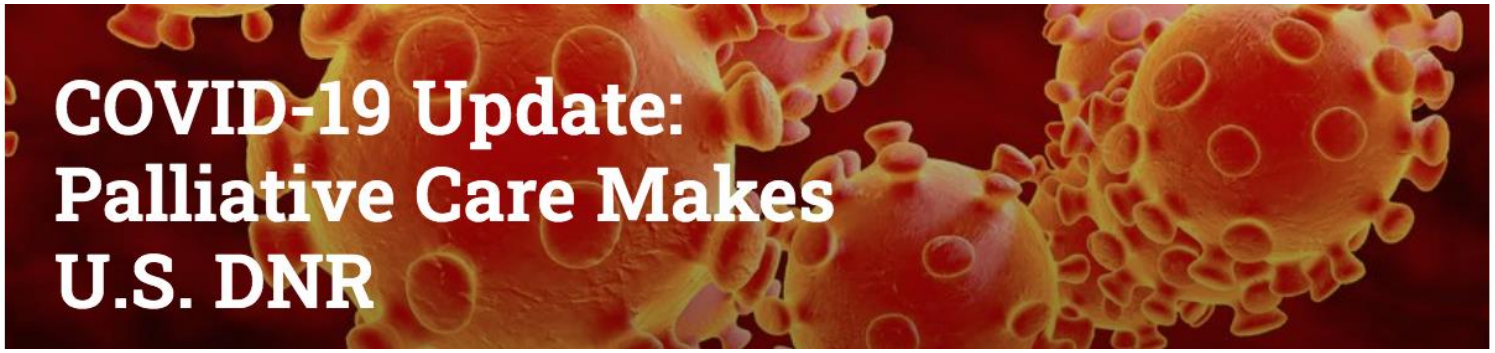


https://www.cdc.gov/niosh/topics/aerosols/pdfs/Aerosol_101.pdf

Clinical course

- Patient remains intubated…
- He has required prone ventilation and paralysis, however vent requirements have improved and is now is on 50% FiO2 and PEEP of 10
- Course has been complicated by profound anasarca and delirium, which has prohibited weaning from the ventilator

GomerBlog



ATLANTA, GA – Accepting that COVID-19 is progressing despite all of our best efforts, Palliative has been consulted and has officially made the United States DNR…

There had been a delay in calling together hundreds of millions of Americans for fear that a prolonged family meeting would lead to every single one of them being infected with COVID-19. “But everyone’s DNR now, myself included,” Dolphy pointed out, “so it’s a moot point.”

Other countries battling COVID-19 remain Full Code.

https://gomerblog.com/2020/03/covid-19-update-palliative-care-makes-u-s-dnr/