8. A 74-year-old woman is referred to you for persistent hypersomnia despite adequate adherence to nasal CPAP therapy. The patient is a retired lawyer, but she is frustrated about not being able to sustain wakefulness during social gatherings with her friends and family. Her medical history is pertinent for well-controlled hypertension and hypothyroidism. She was diagnosed with severe OSA 1 year ago and was prescribed auto-CPAP therapy set at a minimum pressure of 6 cm H_2O and a maximum pressure of 14 cm H_2O. She reports going to bed at 11:00 PM, has a short sleep latency of 10 to 15 min, and wakes up spontaneously without any alarm at 7:30 AM. She estimates getting close to 8 h of sleep each night. An objective CPAP download reveals she is using it 100% of the nights, with a mean use of 7 h 50 min per night. There is minimal mask leak, and the residual apnea-hypopnea index estimated by the auto-CPAP device is four events per hour. The median pressure delivered is 9 cm H_2O, and the maximum pressure is 12 cm H_2O. She reports some improvement in daytime sleepiness after initiating auto-CPAP therapy. Her Epworth Sleepiness Scale score before initiating auto-CPAP therapy was 18 out of 24 (scores >10 are suggestive of hypersomnolence). During the current visit, her Epworth Sleepiness Scale score has decreased to 13.

Which of the following interventions is most likely to improve this patient's residual daytime sleepiness?

A. Ask the patient to wake up at 8:30 AM instead of 7:30 AM (ie, sleep extension).
B. Increase the maximum level of the auto-CPAP device from 14 cm H_2O to 18 cm H_2O.
C. Increase the minimum level of the auto-CPAP device from 6 cm H_2O to 9 cm H_2O.
D. Prescribe modafinil.

9. A 73-year-old man with a history of diabetes mellitus (DM) is admitted to the ICU after being found unconscious at home. He takes insulin for his DM and also has a history of hypertension and coronary artery disease. He feels well and is compliant with medications, but after 2 days of not hearing from him, his family becomes concerned. After the police are called, he is found unconscious on the floor of his home. He is nonresponsive but breathing spontaneously. On arrival in the ED, his Glasgow Coma Scale score is 4 and he is intubated. Examination reveals a temperature of 37.2°C; pulse, 144/min; and BP, 82/44 mm Hg. His arterial Spo_2 by pulse oximetry is 96%. He has multiple violaceous lesions around his right orbit, nose, and cheek (Figure 1) as well as on the hard palate. His lung, heart, and abdominal exams are all unremarkable. His WBC count is 4,300/μL (4.30×10^9/L); hematocrit, 44% (0.44); and platelet count, 110×10^3/μL (110×10^9/L). His BUN is 73 mg/dL (26.06 mmol/L); creatine, 4.7 mg/dL (358.38 μmol/L); bicarbonate, 11 mEq/L (11 mmol/L); creatine kinase, 35,700 U/L (596.19 μkat/L); and lactate, 9.7 mg/dL (1.08 mmol/L). Arterial blood gas testing reveals a pH of 7.17; Pco_2, 29 mm Hg; and Po_2, 98 mm Hg on an Fio_2 of 0.45. He is suspected to have facial trauma, and imaging is performed. While no traumatic fracture is seen on head CT, the scan does show erosive changes in the maxillary, frontal, and sphenoid sinuses, along with the hard palate and cribriform plate. A skin biopsy of his facial lesions is performed, and the result is shown in Figure 2.

In addition to surgical consultation, what is the most appropriate antimicrobial to be administered?

Figure 1. Violaceous skin lesions on the face.

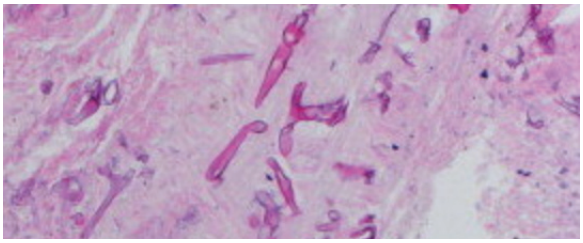

Figure 2. Skin biopsy of facial lesion. Hematoxylin and eosin-stained tissue (×100).

A. Posaconazole
B. Fluconazole
C. Itraconazole
D. Lipid preparation amphotericin B

10. A 71-year-old man is admitted to a general medical inpatient unit with a 2-day history of fever and productive cough. Physical examination is notable for bibasilar inspiratory crackles with egophony, and chest radiographs show bibasilar airspace disease. Gram stain of sputum shows leukocytes but no organisms, and nucleic acid testing of sputum is negative for influenza, SARS-CoV-2, and other respiratory viruses.

The patient is without known prior pulmonary disease, and his medical history is notable only for hypertension and a "minor stroke" 2 years prior to this admission. He states that since his stroke he has had intermittent "trouble with things going down the wrong tube" when he swallows, followed by a coughing paroxysm. His last hospitalization was for his stroke 2 years ago, and medical records do not document previous isolation of methicillin-resistant *Staphylococcus aureus* or *Pseudomonas aeruginosa* at any time. He does not believe that he has ever received IV antibiotics.

Which of the following antibiotic regimens is most appropriate for him to receive?

A. Vancomycin + piperacillin/tazobactam
B. Ceftriaxone + azithromycin
C. Ceftriaxone + doxycycline + metronidazole
D. Clindamycin

11. A 65-year-old woman was diagnosed with nodular bronchiectatic *Mycobacterium avium* complex (MAC) lung disease and was started on azithromycin, rifampicin, and ethambutol. At 6 months, she shows up to your clinic with relative stability, and the follow-up culture yields a pansusceptible MAC. The daughter confirms that she has been compliant with the therapy. What would be the next step in the treatment of this patient?

A. Add oral linezolid.
B. Add amikacin liposome inhalation suspension.
C. Continue with current therapy and assess culture conversion at 12 months.
D. Change clarithromycin and rifabutin to azithromycin and rifampicin.

12. A 63-year-old woman with advanced COPD is referred to you because of worsening shortness of breath. She gets short of breath and must stop after walking approximately 367 ft (110 m). She has a prior 60 pack-year smoking history but has been a nonsmoker for 4 years. She has been hospitalized on two occasions for acute exacerbation of COPD but has no other significant comorbid conditions. Her vaccinations are up-to-date. She is adherent to her medications, which include an inhaled long-acting muscarinic antagonist and a combination inhaled corticosteroid/long-acting β_2-agonist, as well as albuterol as needed. Physical examination is consistent with advanced COPD. A chest radiograph demonstrates striking vascular deficiency and hyperlucency, with no masses, adenopathy, or effusions. Pulmonary function testing reveals FEV_1 of 0.73 L (29% predicted), FEV_1/FVC of 0.36, residual volume of 3.97 L (180% predicted), and D_{LCO} of 8.9 mL/min/mm Hg (40% predicted).

You are considering evaluation to assess whether the patient might benefit from endobronchial valve insertion. Before proceeding with further investigations, the patient asks for more information. Which of the following statements regarding outcomes from endobronchial valve insertion in this patient with advanced COPD are true?

A. Upper lobe emphysema and low exercise capacity are necessary for benefit.
B. Pneumothorax is the most common adverse effect.
C. The 6-min walk distance but not FEV_1 improves following insertion.
D. St. George's Respiratory Questionnaire score improves in the short term but returns to baseline at 12 mo.

13. A 65-year-old man with a 20-pack-year smoking history and severe COPD (FEV_1 of 35% predicted) is discharged home after a hospitalization for an acute exacerbation of COPD complicated by myocardial infarction. He is started on daily aspirin and a cardioselective β-blocker and continued on his maintenance inhalers, including a combination inhaled corticosteroid/long-acting β_2-agonist and a long-acting muscarinic antagonist.

Which of the following statements is true regarding the use of cardioselective β-blockers in this patient?

A. All-cause mortality will increase as a result of treatment.
B. He will be at greater risk for an acute exacerbation of COPD.
C. The long-acting β_2-agonist should be discontinued while receiving β-blocker treatment.
D. Respiratory symptoms and lung function should not significantly change.

14. A 56-year-old man presented with increased cough with sputum production and scant hemoptysis refractory to a course of antibiotics. Chest imaging revealed a 4-cm left hilar mass. Endobronchial ultrasound–guided bronchoscopy with systematic staging of the hila and mediastinum revealed a squamous cell carcinoma in a normal-sized station 4L lymph node. The tumor did not enter the central airway. Fluorodeoxyglucose PET and brain MRI did not show other evidence of disease (T2aN2M0, stage IIIA). He was an active man.

Pulmonary function testing was normal. He was treated with neoadjuvant chemoradiotherapy followed by a left upper lobectomy. There was an adequate resection margin. His postoperative course was uncomplicated.

Which of the following is true of the recommended follow-up for this man?

A. He should have a bronchoscopy performed in 3 months.
B. He should have a chest CT scan performed in 6 months.
C. He should have a PET-CT scan performed in 6 months.
D. His carcinoembryonic antigen level should be monitored in 6 months.

15. A COVID-19 critically ill patient on mechanical ventilation went into pulseless electrical activity. During resuscitation, a right-sided pneumothorax was identified and initially managed with decompression with a 16-gauge IV catheter followed by an emergent right chest tube placement. However, there were difficulties during the emergency to identify the location of the appropriate IV catheter, locate the proper sized chest tube, and bring to the bedside a full chest tube placement tray. In order to address these issues, the medical ICU team developed materials to instruct health care providers about the appropriate location of this equipment and its proper deployment. Which of the following best describes this type of quality improvement?

A. Five S (5S)
B. Plan-Do-Study-Act
C. 5 Whys
D. SWOT analysis

16. A 55-year-old man is referred to your clinic by his primary care provider with complaints of disrupted sleep, breathing pauses while sleeping, and daytime fatigue. Additional symptoms include dyspnea on exertion. These symptoms have been present for the last year. He denies daytime sleepiness. His medical history is notable for hypertension, well-controlled type 2

diabetes, dyslipidemia, and ischemic cardiomyopathy. His surgical history includes a three-vessel coronary artery bypass graft 2 years ago. A recent transthoracic echocardiogram revealed a left ventricular systolic ejection fraction of 27%. His current medication regimen includes metformin, atorvastatin, furosemide, metoprolol, valsartan, and spironolactone. On physical examination, his BMI is 33 kg/m^2, BP is 115/65 mm Hg, heart rate is 60/min, and respiratory rate fluctuates between 10/min and 20/min. His Spo_2 also fluctuates between 90% and 98% during the clinic visit while he is awake and breathing ambient air. An oropharyngeal exam reveals a mildly overcrowded oropharynx. His lungs are clear to auscultation. His heart rhythm is regular without any murmurs. There is no evidence of lower extremity pitting edema.

You order an in-laboratory polysomnogram to assess for sleep-disordered breathing. A 5-min excerpt that is representative of the entire recording is shown in Figure 1. In addition to referring the patient to be evaluated for an implantable cardioverter-defibrillator, what other intervention should be instituted to address this patient's sleep-disordered breathing?

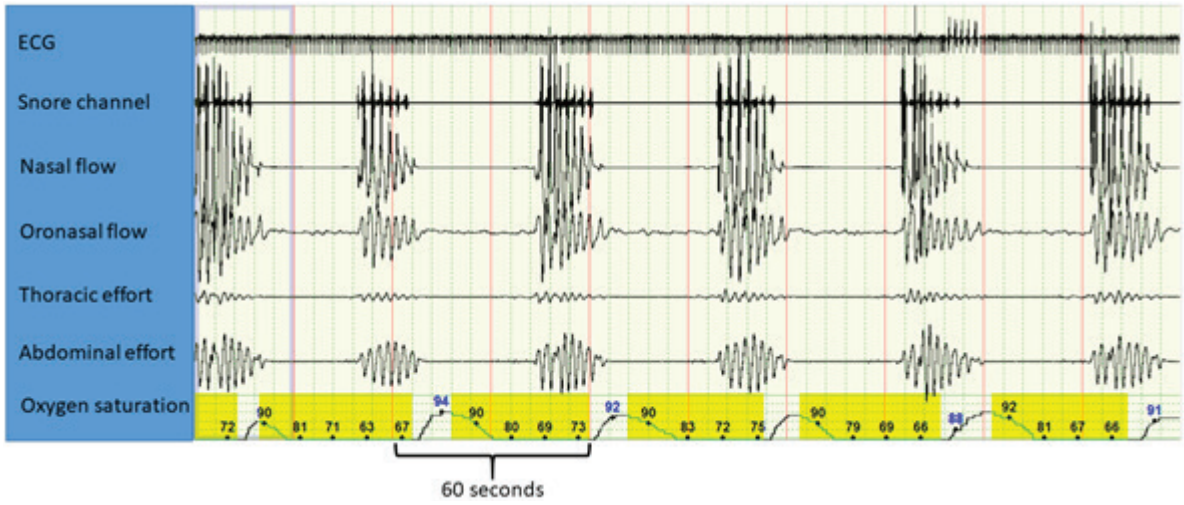

Figure 1.

A. CPAP during sleep
B. No treatment
C. Adaptive servoventilation during sleep
D. Bilevel positive airway pressure spontaneous timed mode (with a backup respiratory rate) during sleep

17. The ICU bedside nurse is concerned about a patient's BP and asks you to assess the patient. You note that the systolic BP from the right radial arterial line is 80 mm Hg and the systolic BP measured by an automatic cuff on the left upper extremity is 95 mm Hg. A rapid flush test of the arterial line is performed and is shown in Figure 1. Which of these scenarios could explain this discrepancy?

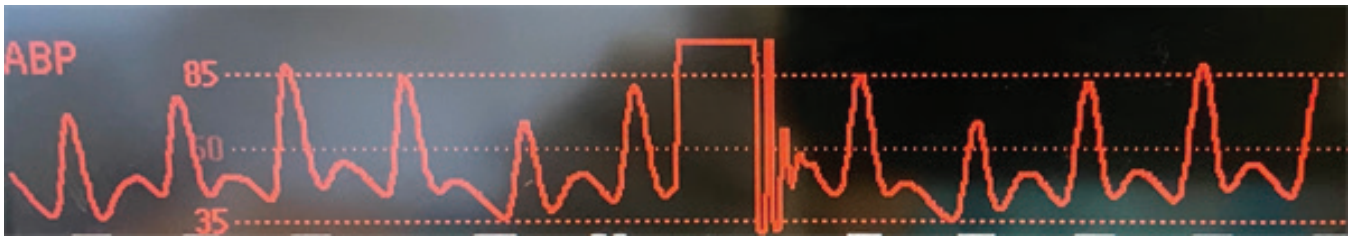

Figure 1. Arterial waveform with fast flush test.

A. The right arm is 20 cm below the level of the heart, and the arterial line transducer is at the level of the heart.
B. The arterial line transducer is positioned 20 cm above the level of the heart.
C. The arterial line system is overdamped.
D. The right arm is 20 cm above the level of the heart, and the arterial line transducer is at the level of the heart.

18. You are interpreting cardiopulmonary exercise test results from a 72-year-old man who underwent testing in your laboratory. The requisition notes "shortness of breath" as the indication for testing and mentions a history of well-controlled hypertension and hypercholesterolemia.

The patient relates a 2-year history of progressive shortness of breath to the point that he now needs to stop walking after 2 blocks. He has a dry cough, but no sputum production or hemoptysis, and denies chest pain, palpitations, orthopnea, or ankle edema. He has a 10-pack-year smoking history but quit when he was 30 years old. The patient's medication includes lisinopril and atorvastatin. His BMI is 29.4 kg/m^2, and vital signs are normal. An ECG reveals normal sinus rhythm. Pulmonary function test results are shown (Figure 1).

For further objective evaluation, the patient undergoes cardiopulmonary exercise testing on an upright bicycle ergometer while breathing room air using an incremental ramp protocol of 15 W/min. Repeated arterial blood sampling was performed during the test. The cardiopulmonary exercise test results are shown (Figure 2, Figure 3, and Figure 4).

The 12-lead continuous ECG monitoring revealed no arrhythmias, significant ST segment, or T-wave changes. The patient reported discontinuing exercise because of a combination of shortness of breath and leg fatigue, and he had no chest pain, palpitations, or presyncope. The results from these investigations are most consistent with the patient discontinuing exercise from which of the following?

	Pre- Bronchodilator				Post- Bronchodilator		
	Observed	Predicted	LLN-ULN	%Predicted	Observed	%Predicted	%Change
FVC [L]	2.34	3.90	(3.0 – 5.1)	60%	2.38	61%	2%
FEV_1 [L]	1.70	2.62	(2.0 – 3.6)	65%	1.69	65%	0%
FEV_1/FVC	0.73	0.67	(62.7 – 80.7)	---	0.71	---	---
TLC [L]	3.78	5.73	(5.3 – 8.0)	66%	---	---	---
RV [L]	1.60	2.39	(1.7 – 3.2)	67%	---	---	---
DLco [mL/min/mmHg]	12.1	28.4	(17.1 – 34.8)	43%	---	---	---

Figure 1. Pulmonary function test results. FRC = functional residual capacity; LLN = lower limit of normal; RV = residual volume; TLC = total lung capacity; ULN = upper limit of normal.

Variable	Rest	End-Exercise	Predicted	% Predicted
Workload (watts)	---	95	144	66%
$\dot{V}O_2$ (L/min)	0.27	1.19	1.72	69%
$\dot{V}O_2$/kg (mL/min/kg)	---	14.0	26.1	54
Anaerobic Threshold (L/min)	---	0.62	>0.77	36%
$\dot{V}_E$ (L/min)	14.1	51.5	64.4	80%
PaO_2 (mmHg)	72	49	---	---
$PaCO_2$ (mmHg)	40	42	---	---
SpO_2	94	79	---	---
HR	84	132	163	81%
O_2 Pulse (mL/beat)	3.3	9.9	10.6	94%
B/P (mmHg)	132/87	175/85	---	---
Modified Borg – Dyspnea	0	5	(range 0-10)	---
Modified Borg – Leg Fatigue	0	5	(range 0-10)	---

Figure 2. Cardiopulmonary exercise testing tabular results. B/P = blood pressure; HR = heart rate; O_2 pulse = oxygen pulse; V_E = minute ventilation; $\dot{V}O_2$ = oxygen uptake.

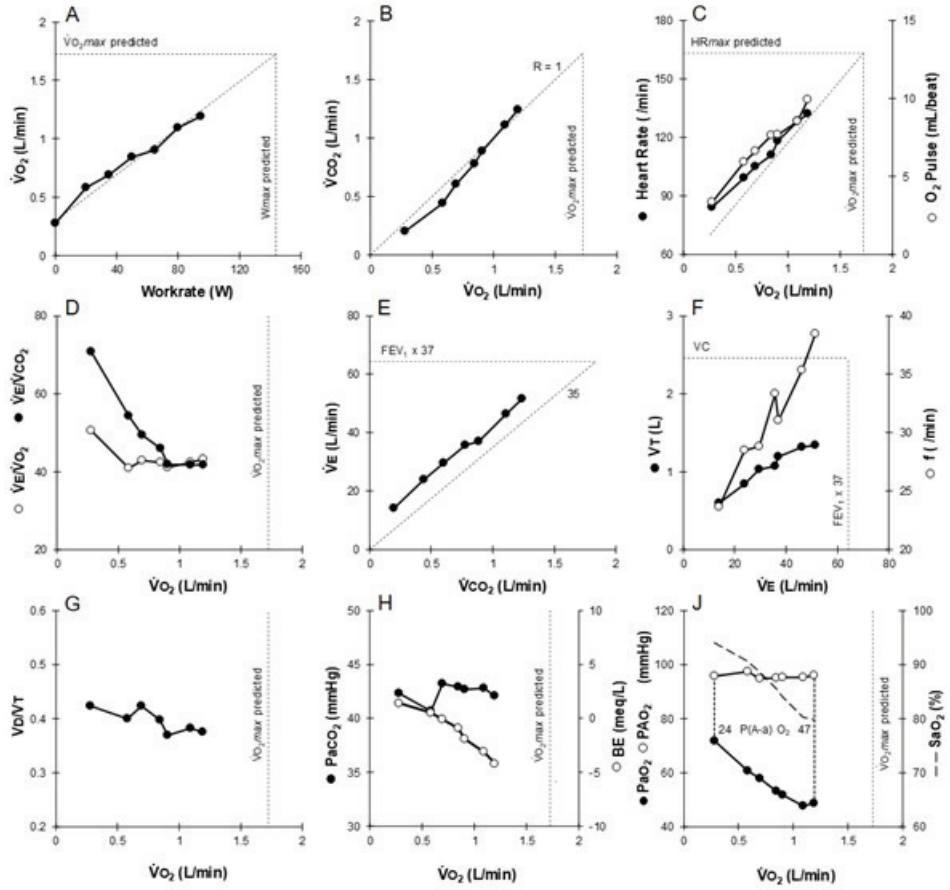

Figure 3. Cardiopulmonary exercise testing graphical results.

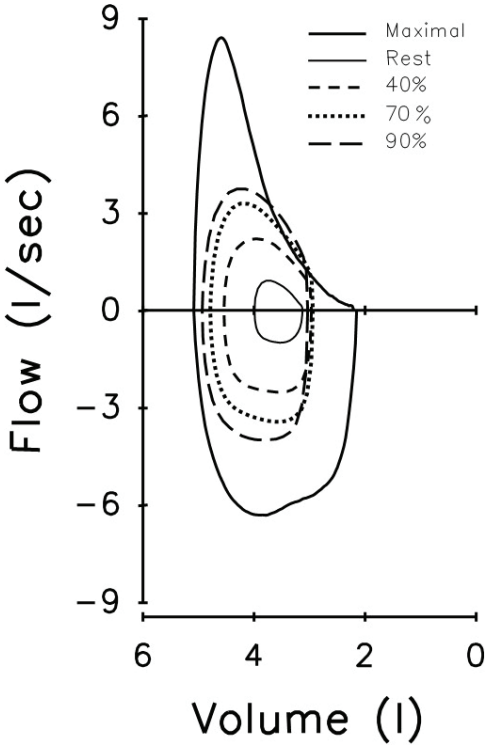

Figure 4. Flow-volume curves at rest, during exercise, and at the end of exercise.

A. The test cannot be appropriately interpreted because of technical reasons.
B. Deconditioning
C. Heart failure
D. Interstitial lung disease

19. A 67-year-old current 40-pack-year smoker was found to have mild polycythemia on lab work performed during evaluation of chronic sinusitis. As part of her evaluation, chest imaging was performed, revealing a solid 1.5-cm spiculated nodule in the apex of the right upper lobe (Figure 1). The nodule was fluorodeoxyglucose avid on PET imaging, with a standard uptake value of 7.8 and no evidence of regional or distant spread. A transthoracic needle biopsy showed a lung adenocarcinoma. A second smaller nodule was seen in the periphery of the right lower lobe, too small to sample (Figure 2). Her cardiopulmonary assessment revealed a moderate risk for pulmonary complications from a lobectomy. A wedge resection of the right apex was performed. Intraoperatively, the smaller peripheral right lower lobe nodule was also identified, and a wedge resection of this nodule was performed. It also revealed an adenocarcinoma. Hilar and mediastinal lymph nodes sampled during her surgery did not show any evidence of regional spread.

What is the stage of her cancer?

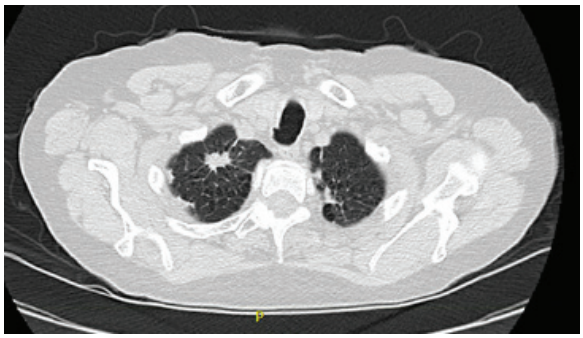

Figure 1. Solid spiculated nodule in the right apex.

Figure 2. Small peripheral nodule in the right lower lobe.

A. Cannot determine
B. T3N0M0, stage IIB
C. T4N0M0, stage IIIA
D. T1bN0M0, stage IA2 and T1aN0M0, stage IA1

20. A 58-year-old patient with hypertension, type 2 diabetes, and acute myelogenous leukemia (M1) is hospitalized and undergoes induction treatment with cytarabine and daunorubicin that finishes on day 8. On day 11, she develops a neutropenic fever without an obvious source of infection and is started on an empiric course of piperacillin-tazobactam. On day 15, a follow-up bone marrow biopsy demonstrates 15% blasts. She develops a new fever on day 17, with progressive dyspnea and cough, which has become mildly productive but without hemoptysis. She reports severe fatigue and malaise, with generalized myalgias that have worsened since yesterday. Review of systems is significant for mild headache, mild diarrhea, nasal congestion, and irritation from her tunneled IV chemotherapy port.

On physical examination, she is febrile and appears ill, with pulse oximetry of 97% on 2 L O_2 nasal cannula. Auscultation of the lungs reveals scattered wheezes. The tunneled central venous access port reveals no crackles, erythema, or pain to palpation. Bacterial cultures have remained negative. A β-d-glucan assay comes back positive, while a serum galactomannan antigen test is negative (<0.3). A representative chest CT scan is shown in Figure 1.