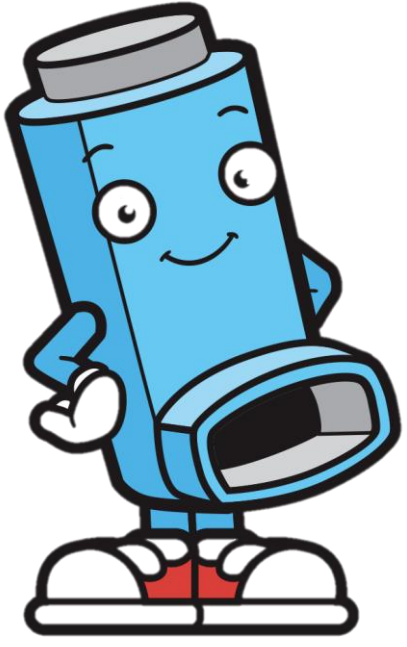
Pulmonology Month Exam Review

March 29, 2022



1. An 81-year-old woman is evaluated for dyspnea that has slowly worsened over the past 3 months. She has a history of severe COPD and has been on continuous oxygen therapy for 6 years. She has a minimal cough productive of scant sputum. Two weeks ago, she finished pulmonary rehabilitation, which provided some improvement in symptoms. Her medications are inhaled vilanterol trifenatate, umeclidinium bromide, and fluticasone furoate.

On physical examination, vital signs are normal. Breath sounds are diminished bilaterally.

Which of the following is the most appropriate treatment?

A Chest physiotherapy
B Handheld fan
C Levofloxacin
D Pulmonary rehabilitation

1. An 81-year-old woman is evaluated for dyspnea that has slowly worsened over the past 3 months. She has a history of **severe COPD** and has been on **continuous oxygen therapy for 6 years**. She has a minimal cough productive of scant sputum. Two weeks ago, she **finished pulmonary rehabilitation**, which provided some improvement in symptoms. Her medications are inhaled vilanterol trifenatate, umeclidinium bromide, and fluticasone furoate.

LABA LAMA CS

On physical examination, vital signs are normal. Breath sounds are diminished bilaterally.

Which of the following is the most appropriate treatment?

A Chest physiotherapy
B Handheld fan
C Levofloxacin
D Pulmonary rehabilitation

Short report

Battery operated fan and chronic breathlessness: does it help?

Matilda Barnes-Harris [1], Victoria Allgar [2], Sara Booth [3], David Currow [4], Simon Hart [1], Jane Phillips [5], Flavia Swan [1] and Miriam J Johnson [1]

Correspondence to Matilda Barnes-Harris, Hull York Medical School, Hull, HU6 7RX, UK; hymb13@hyms.ac.uk

Abstract

Objectives To examine whether use of a hand-held fan ('fan') improves breathlessness and increases physical activity.

Methods A secondary exploratory analysis using pooled data from the fan arms of two feasibility randomised controlled trials in people with chronic breathlessness: (1) fan and activity advice *vs* activity advice, (2) activity advice alone or with the addition or the 'calming hand', or the fan, or both. Descriptive statistics and regression analysis to explore patient characteristics associated with benefit (eg age, sex, diagnosis, general self-efficacy).

Results Forty-one participants were allocated the fan (73 years (IQR 65–76, range 46–88), 59% male, 20 (49%) chronic obstructive pulmonary disease (COPD), three (7%) heart failure, three (7%) cancer). Thirty-five (85%) reported that the fan helped breathing, and 22 (54%) reported increased physical activity.

Breathlessness benefit was more likely in older people, those with COPD and those with a carer. However, due to the small sample size none of these findings were statistically significant. Those with COPD were more likely to use the fan than people with other diagnoses (OR 5.94 (95% CI 0.63 to 56.21, p=0.120)).

Conclusions These exploratory data support that the fan helps chronic breathlessness in most people and adds new data to indicate that the fan is perceived to increase people's physical activity. There is also a signal of possible particular benefits in people with COPD which is worthy of further study.

2. A 23-year-old woman is evaluated for chronic cough. She reports several episodes of chronic bronchitis as a child and persistent cough productive of thick purulent sputum since childhood. She also has chronic nasal congestion and chronic diarrhea. Medications are albuterol and glucocorticoid inhalers and benzonatate as needed.

On physical examination, vital signs are normal; oxygen saturation is 96% with the patient breathing ambient air. BMI is 18. Lung examination reveals bilateral diffuse crackles. The remainder of the examination is normal.

Complete blood count and immunoglobulin levels are normal.

Chest CT scan shows bilateral upper-lobe-predominant bronchiectasis with luminal filling.

Spirometry shows an FEV1 of 68% of predicted.

Which of the following is the most likely diagnosis?

A Allergic bronchopulmonary aspergillosis

B α1-Antitrypsin deficiency

C Cystic fibrosis

D IgA deficiency

2. A 23-year-old woman is evaluated for chronic cough. She reports several episodes of chronic bronchitis as a child and persistent cough productive of **thick purulent sputum** since childhood. She also has **chronic nasal congestion and chronic diarrhea.** Medications are albuterol and glucocorticoid inhalers and benzonatate as needed.

On physical examination, vital signs are normal; oxygen saturation is 96% with the patient breathing ambient air. BMI is 18. Lung examination reveals bilateral diffuse crackles. The remainder of the examination is normal.

Complete blood count and immunoglobulin levels are normal.

Chest CT scan shows **bilateral upper-lobe-predominant bronchiectasis** with luminal filling.

Spirometry shows an FEV1 of 68% of predicted.

Which of the following is the most likely diagnosis?

A Allergic bronchopulmonary aspergillosis

B α1-Antitrypsin deficiency

C Cystic fibrosis

D IgA deficiency

Cystic fibrosis

- Autosomal recessive genetic disorder affecting the CFTR gene
- The most common genetic variant resulting in disease is ΔF508

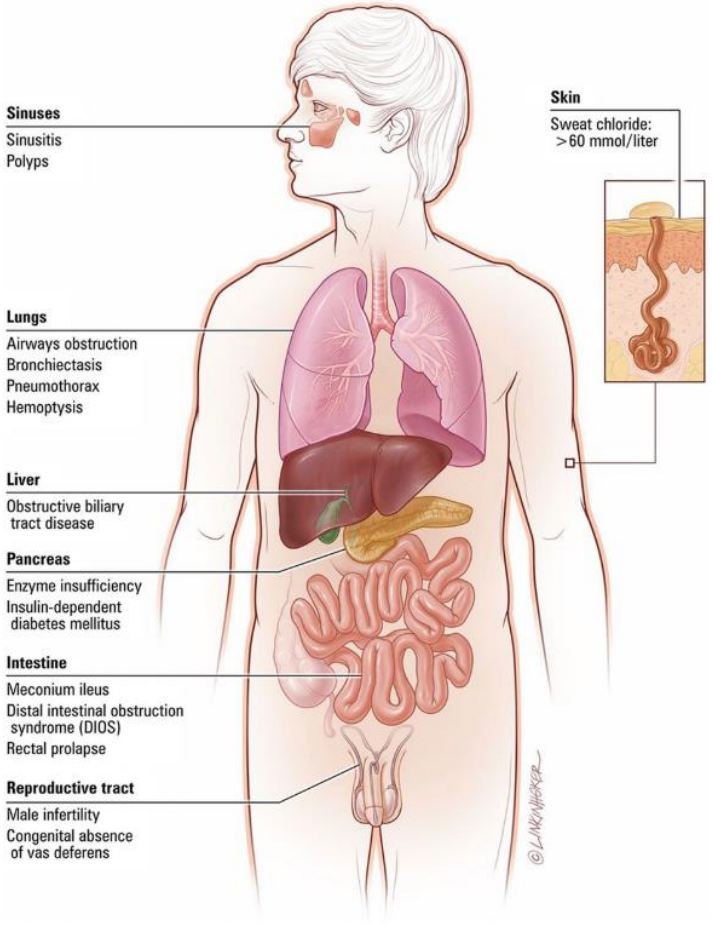


Figure 3. Common clinical manifestations of cystic fibrosis. Reprinted with permission from Link Studio LLC.

3. A 36-year-old woman is evaluated for a change in her asthma status. She has spirometry-confirmed asthma; she has never required hospitalization. She is a nonsmoker and has allergic rhinitis. Her only medication is an albuterol metered-dose inhaler as needed. She now requires albuterol use three times weekly but never more than once per day. She demonstrates good inhaler technique.

On physical examination, vital signs are normal. Oxygen saturation is 98% with the patient breathing ambient air. BMI is 24. She is not currently wheezing. The remainder of the examination is normal.

Spirometry today is normal.

Which of the following is the most appropriate management?

A Beclomethasone dipropionate with albuterol
B Methacholine challenge testing
C Montelukast at bedtime
D No additional management

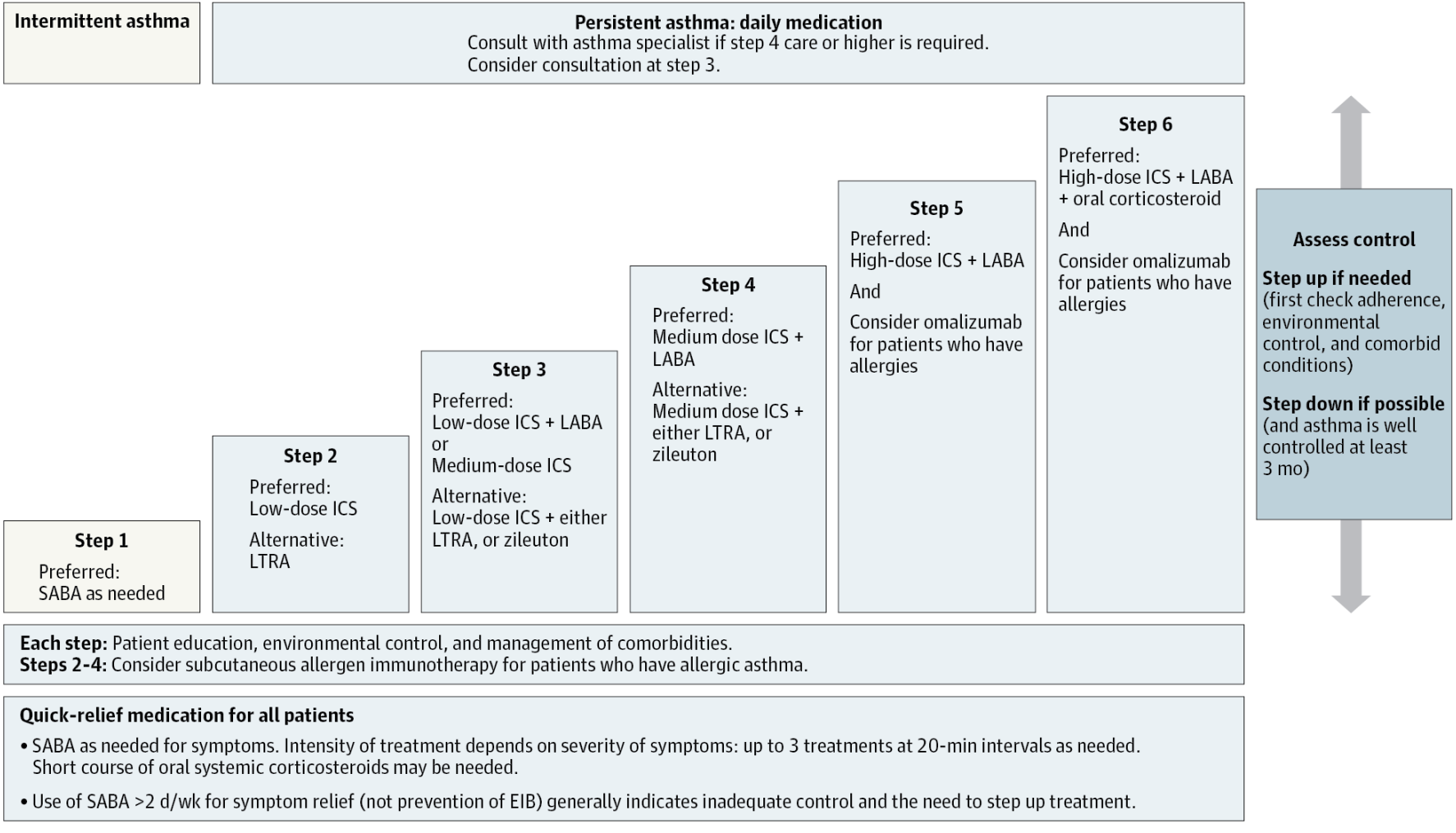
3. A 36-year-old woman is evaluated for a change in her asthma status. She has spirometry-confirmed asthma; she has never required hospitalization. She is a nonsmoker and has allergic rhinitis. Her only medication is an albuterol metered-dose inhaler as needed**. She now requires albuterol use three times weekly but never more than once per day.** She demonstrates good inhaler technique.

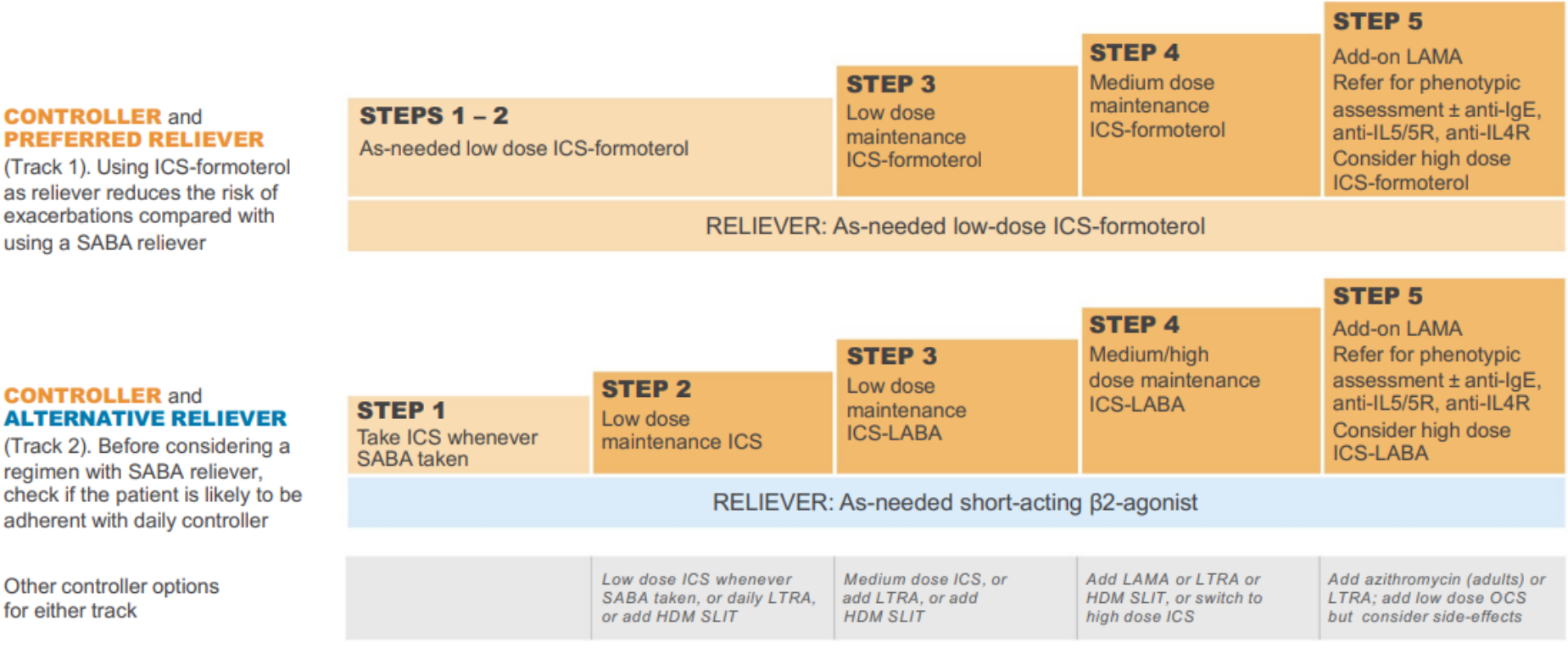
On physical examination, vital signs are normal. Oxygen saturation is 98% with the patient breathing ambient air. BMI is 24. She is not currently wheezing. The remainder of the examination is normal.

Spirometry today is normal.

Which of the following is the most appropriate management?

A **Beclomethasone dipropionate with albuterol**
B Methacholine challenge testing
C Montelukast at bedtime
D No additional management


Intermittent asthma
Persistent asthma: daily medication
Consult with asthma specialist if step 4 care or higher is required.
Consider consultation at step 3.
Step 1
Preferred:
SABA as needed
Step 2
Preferred:
Low-dose ICS
Alternative:
LTRA
Step 3
Preferred:
Low-dose ICS + LABA
or
Medium-dose ICS
Alternative:
Low-dose ICS + either LTRA, or zileuton
Step 4
Preferred:
Medium dose ICS + LABA
Alternative:
Medium dose ICS + either LTRA, or zileuton
Step 5
Preferred:
High-dose ICS + LABA
And
Consider omalizumab for patients who have allergies
Step 6
Preferred:
High-dose ICS + LABA + oral corticosteroid
And
Consider omalizumab for patients who have allergies
Assess control
Step up if needed
(first check adherence, environmental control, and comorbid conditions)
Step down if possible
(and asthma is well controlled at least 3 mo)
Each step: Patient education, environmental control, and management of comorbidities.
Steps 2-4: Consider subcutaneous allergen immunotherapy for patients who have allergic asthma.
Quick-relief medication for all patients
• SABA as needed for symptoms. Intensity of treatment depends on severity of symptoms: up to 3 treatments at 20-min intervals as needed. Short course of oral systemic corticosteroids may be needed.
• Use of SABA >2 d/wk for symptom relief (not prevention of EIB) generally indicates inadequate control and the need to step up treatment.


CONTROLLER and PREFERRED RELIEVER
(Track 1). Using ICS-formoterol as reliever reduces the risk of exacerbations compared with using a SABA reliever
STEPS 1 – 2
As-needed low dose ICS-formoterol
STEP 3
Low dose maintenance ICS-formoterol
STEP 4
Medium dose maintenance ICS-formoterol
STEP 5
Add-on LAMA
Refer for phenotypic assessment ± anti-IgE, anti-IL5/5R, anti-IL4R
Consider high dose ICS-formoterol
RELIEVER: As-needed low-dose ICS-formoterol
CONTROLLER and ALTERNATIVE RELIEVER
(Track 2). Before considering a regimen with SABA reliever, check if the patient is likely to be adherent with daily controller
STEP 1
Take ICS whenever SABA taken
STEP 2
Low dose maintenance ICS
STEP 3
Low dose maintenance ICS-LABA
STEP 4
Medium/high dose maintenance ICS-LABA
STEP 5
Add-on LAMA
Refer for phenotypic assessment ± anti-IgE, anti-IL5/5R, anti-IL4R
Consider high dose ICS-LABA
RELIEVER: As-needed short-acting β2-agonist
Other controller options for either track
Low dose ICS whenever SABA taken, or daily LTRA, or add HDM SLIT
Medium dose ICS, or add LTRA, or add HDM SLIT
Add LAMA or LTRA or HDM SLIT, or switch to high dose ICS
Add azithromycin (adults) or LTRA; add low dose OCS but consider side-effects

4. A 38-year-old man is evaluated for shortness of breath and a dry cough for the past 3 months. He has a 20-pack-year smoking history and continues to smoke.

On physical examination, vital signs are normal. Oxygen saturation is 92% with the patient breathing ambient air. Auscultation of the lungs reveals coarse bibasilar inspiratory crackles. The cardiac examination and remainder of the physical examination are normal.

Chest radiograph demonstrates bilateral reticular infiltrates. High-resolution chest CT demonstrates patchy ground-glass infiltrates with lower-lobe predominance. Pulmonary function testing shows an FVC of 65% of predicted, an FEV1/FVC ratio of 0.81, and a DLCO of 56% of predicted.

Which of the following is the most appropriate treatment?

A Glucocorticoids
B Methotrexate
C Pirfenidone
D Smoking cessation

4. A 38-year-old man is evaluated for shortness of breath and a dry cough for the past 3 months. He has a **20-pack-year smoking history and continues to smoke.**

On physical examination, vital signs are normal. Oxygen saturation is 92% with the patient breathing ambient air. Auscultation of the lungs reveals coarse bibasilar inspiratory crackles. The cardiac examination and remainder of the physical examination are normal.

Chest radiograph demonstrates **bilateral reticular infiltrates**. High-resolution chest CT demonstrates **patchy ground-glass infiltrates with lower-lobe predominance**. Pulmonary function testing shows an FVC of 65% of predicted, an FEV1/FVC ratio of 0.81, and a DLCO of 56% of predicted.

Which of the following is the most appropriate treatment?

A Glucocorticoids
B Methotrexate
C Pirfenidone
D Smoking cessation

5. A 53-year-old woman presents for follow-up evaluation of an incidentally found 4-mm solid lung nodule in the right lower lobe on abdominal CT scan. The CT scan showed no other nodules, no lymphadenopathy, and unremarkable lung parenchyma. There are no old scans for comparison. She has no personal or family history of lung cancer.

She is asymptomatic, a lifelong nonsmoker, and has no significant exposure history.

Which of the following is the most appropriate management?

A Bronchoscopy with lung biopsy
B CT of chest in 12 months
C CT-guided lung biopsy
D Fluorodeoxyglucose PET
E No further follow-up

5. A 53-year-old woman presents for follow-up evaluation of an incidentally found 4-mm solid lung nodule in the right lower lobe on abdominal CT scan. The CT scan showed no other nodules, no lymphadenopathy, and unremarkable lung parenchyma. There are no old scans for comparison. She has no personal or family history of lung cancer.

She is asymptomatic, a lifelong nonsmoker, and has no significant exposure history.

Which of the following is the most appropriate management?

A Bronchoscopy with lung biopsy
B CT of chest in 12 months
C CT-guided lung biopsy
D Fluorodeoxyglucose PET
E No further follow-up

A: Solid Nodules*

Nodule Type	Size: <6 mm (<100 mm³)	Size: 6–8 mm (100–250 mm³)	Size: >8 mm (>250 mm³)	Comments
Single				
Low risk†	No routine follow-up	CT at 6–12 months, then consider CT at 18–24 months	Consider CT at 3 months, PET/CT, or tissue sampling	Nodules <6 mm do not require routine follow-up in low-risk patients (recommendation 1A).
High risk†	Optional CT at 12 months	CT at 6–12 months, then CT at 18–24 months	Consider CT at 3 months, PET/CT, or tissue sampling	Certain patients at high risk with suspicious nodule morphology, upper lobe location, or both may warrant 12-month follow-up (recommendation 1A).
Multiple				
Low risk†	No routine follow-up	CT at 3–6 months, then consider CT at 18–24 months	CT at 3–6 months, then consider CT at 18–24 months	Use most suspicious nodule as guide to management. Follow-up intervals may vary according to size and risk (recommendation 2A).
High risk†	Optional CT at 12 months	CT at 3–6 months, then at 18–24 months	CT at 3–6 months, then at 18–24 months	Use most suspicious nodule as guide to management. Follow-up intervals may vary according to size and risk (recommendation 2A).

B: Subsolid Nodules*

Nodule Type	Size: <6 mm (<100 mm³)	Size: ≥6 mm (>100 mm³)	Comments
Single			
Ground glass	No routine follow-up	CT at 6–12 months to confirm persistence, then CT every 2 years until 5 years	In certain suspicious nodules < 6 mm, consider follow-up at 2 and 4 years. If solid component(s) or growth develops, consider resection. (Recommendations 3A and 4A).
Part solid	No routine follow-up	CT at 3–6 months to confirm persistence. If unchanged and solid component remains <6 mm, annual CT should be performed for 5 years.	In practice, part-solid nodules cannot be defined as such until ≥6 mm, and nodules <6 mm do not usually require follow-up. Persistent part-solid nodules with solid components ≥6 mm should be considered highly suspicious (recommendations 4A-4C)
Multiple	CT at 3–6 months. If stable, consider CT at 2 and 4 years.	CT at 3–6 months. Subsequent management based on the most suspicious nodule(s).	Multiple <6 mm pure ground-glass nodules are usually benign, but consider follow-up in selected patients at high risk at 2 and 4 years (recommendation 5A).

6. A 28-year-old woman is evaluated for sleepiness and difficulty staying awake over the past 6 months. She works as a hospital respiratory therapist. Half of her shifts are from 7:00 PM to 7:00 AM. The sleepiness subsides by the time she drives home, and she then has difficulty falling asleep during the day. Her sleepiness has slowed her cognitive processing during working hours and has resulted in depressed mood.

On physical examination, blood pressure is 118/68 mm Hg and pulse rate is 76/min. BMI is 24.

Which of the following is the most appropriate management?

A Education and counseling
B Home sleep apnea testing
C Modafinil
D Zolpidem

6. A 28-year-old woman is evaluated for sleepiness and difficulty staying awake over the past 6 months. She works as a hospital respiratory therapist. Half of her shifts are from 7:00 PM to 7:00 AM. The sleepiness subsides by the time she drives home, and she then has difficulty falling asleep during the day. Her sleepiness has slowed her cognitive processing during working hours and has resulted in depressed mood.

On physical examination, blood pressure is 118/68 mm Hg and pulse rate is 76/min. BMI is 24.

Which of the following is the most appropriate management?

A **Education and counseling**
B Home sleep apnea testing
C Modafinil
D Zolpidem

Shift Work

- Conservative strategies for shift work sleep disorder to promote wakefulness include caffeinated beverages, bright-light exposure during the work shift, and short naps during breaks.
- Promote sleep include avoidance of direct sunlight in the early morning and avoidance of exertion, eating, and alcohol consumption before the morning sleep period.

7. A 50-year-old man is referred for poorly controlled asthma. Triggers include exercise and exposure to dust, pollen, and fumes. He has allergic rhinitis. He has been treated with several courses of glucocorticoids, but symptoms recurred after he stopped treatment despite regular use of his fluticasone-salmeterol and tiotropium inhalers. His only other medication is albuterol. He has good inhaler technique.

On physical examination, vital signs are normal. BMI is 23. Pulmonary examination reveals few expiratory wheezes. The remainder of the examination is unremarkable.

Laboratory studies reveal a normal total IgE level and complete blood count.

Chest radiograph is normal. Spirometry demonstrates moderate airflow obstruction that improves with bronchodilators.

Which of the following is the most appropriate diagnostic test to perform next?

A Absolute blood eosinophil count

B α1-Antitrypsin level

C Aspergillus-specific IgE level

D Measurement of common allergen-specific IgE levels

7. A 50-year-old man is referred for **poorly controlled asthma**. Triggers include exercise and **exposure to dust, pollen, and fumes**. He has **allergic rhiniti**s. He has been treated with several courses of glucocorticoids, but symptoms recurred after he stopped treatment despite regular use of his fluticasone-salmeterol and tiotropium inhalers. His only other medication is albuterol. He has good inhaler technique.

On physical examination, vital signs are normal. BMI is 23. Pulmonary examination reveals few expiratory wheezes. The remainder of the examination is unremarkable.

Laboratory studies reveal **a normal total IgE** level and complete blood count.

Chest radiograph is normal. Spirometry demonstrates moderate airflow obstruction that improves with bronchodilators.

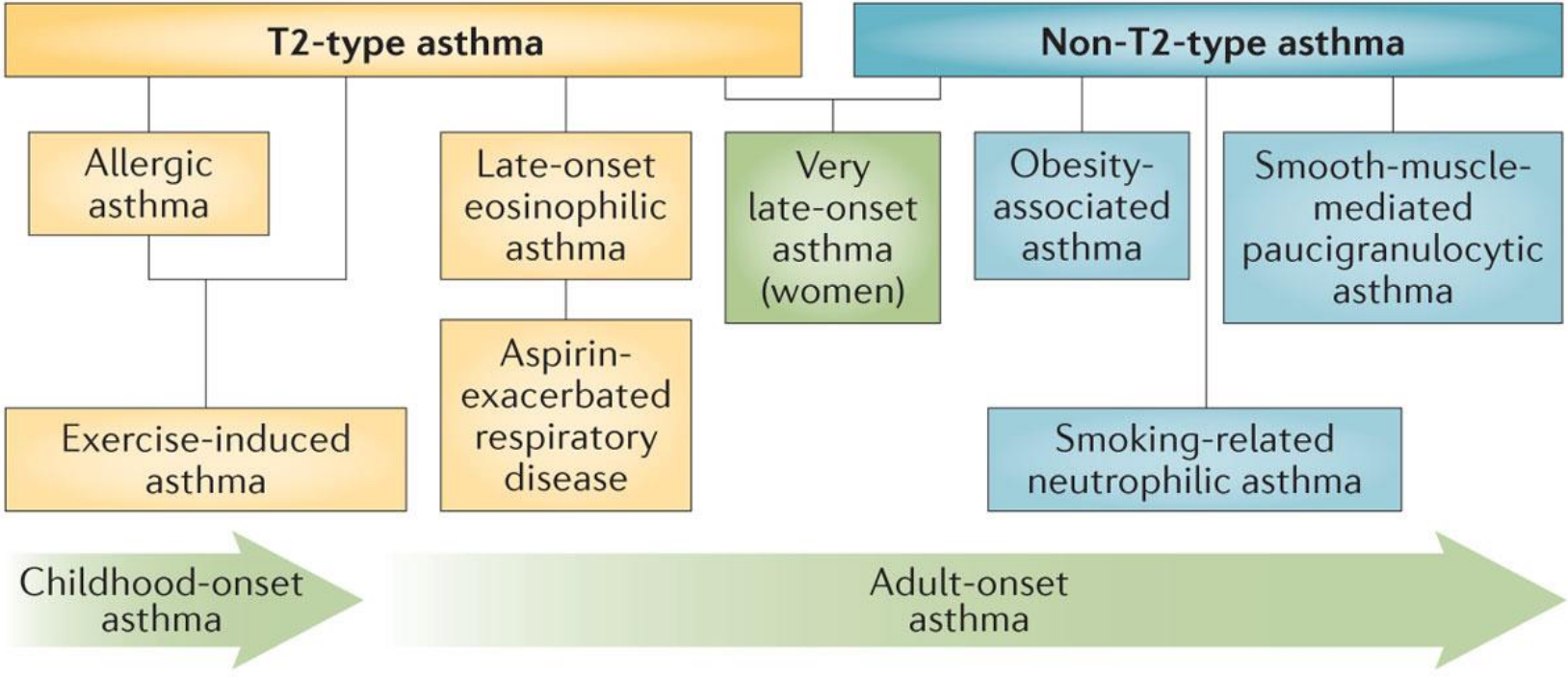
Which of the following is the most appropriate diagnostic test to perform next?

A **Absolute blood eosinophil count**

B α1-Antitrypsin level

C Aspergillus-specific IgE level

D Measurement of common allergen-specific IgE levels

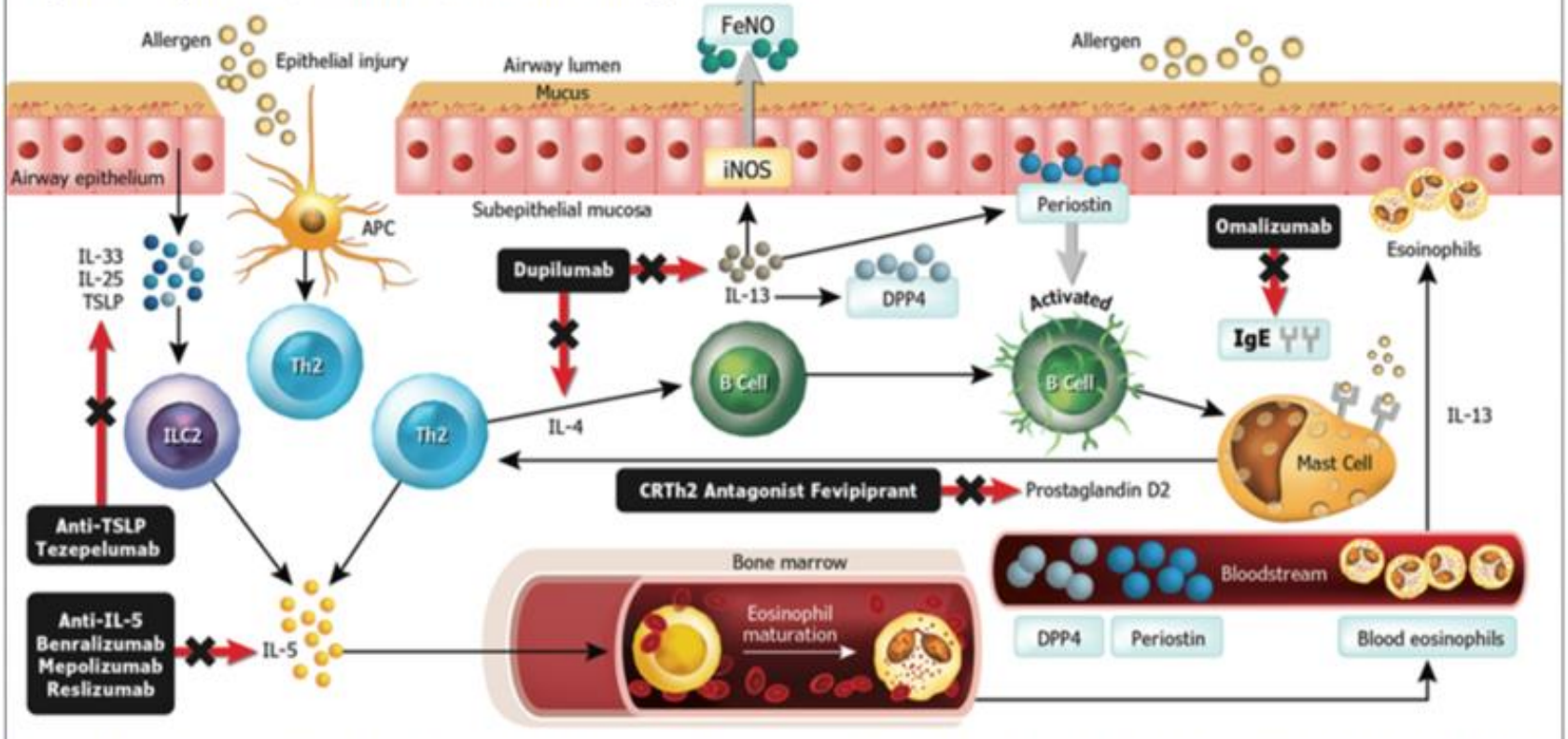


Nature Reviews | Disease Primers

Type 2 Asthma

- Clinical characteristics suggesting a type 2 asthma phenotype include atopy, seasonal exacerbations, hay fever, and allergen sensitization.
- For patients with symptoms suggestive of type 2 asthma phenotype, measurement of IgE levels and total eosinophil count can be used to confirm this asthma phenotype and direct therapy.

Figure 7. Cytokines, Biomarkers, and New Biologic Therapies



Targets of biologic therapies: Omalizumab is an antibody against IgE. Mepolizumab and reslizumab are antibodies against IL-5. Benralizumab binds to the IL-5 receptor. Dupilumab is an antibody to the IL-4-α receptor subunit and inhibits both IL-4 and IL-13 signaling. Tezepelumab is an anti-TSLP monoclonal antibody. Fevipiprant is a CRTh2 antagonist.

APC, antigen-presenting cell; CRTh2, chemoattractant receptor-homologue molecule expressed on Th2 cells; DPP4, dipeptidyl peptidase-4; FeNO, fractional exhaled nitric oxide; IgE, immunoglobulin E; IL, interleukin; ILC2, type-2 innate lymphoid cells; iNOS, inducible nitric oxide synthase; Th2, T-helper type 2; TSLP, thymic stromal lymphopoietin.

Source: Adapted from Parulekar AD, Diamant Z, Hanania NA. *Curr Opin Pulm Med.* 2017;23:3-11.[57]

8. A 66-year-old man is evaluated for a 7-month history of gradually progressive shortness of breath and dry cough. Medical history is otherwise unremarkable, and he takes no medications.

On physical examination, vital signs are normal. Oxygen saturation is 93% with the patient breathing ambient air. Auscultation reveals fine end-inspiratory bibasilar crackles. Clubbing is present. There are no rashes or edema. Cardiac examination is unremarkable.

Chest radiograph reveals small lung volumes and bibasilar reticular infiltrates without lymphadenopathy. Spirometry reveals an FEV1/FVC ratio of 0.87, an FVC of 62% of predicted, and a DLCO of 48% of predicted.

Which of the following is the most appropriate diagnostic test to perform next?

A Bronchoscopic lung biopsy
B Cardiopulmonary exercise test
C Chest CT angiography
D High-resolution chest CT
E Transthoracic echocardiography

8. A 66-year-old man is evaluated for a **7-month history of gradually progressive shortness of breath and dry cough**. Medical history is otherwise unremarkable, and he takes no medications.

On physical examination, vital signs are normal. Oxygen saturation is 93% with the patient breathing ambient air. Auscultation reveals fine end-inspiratory bibasilar crackles. **Clubbing is present**. There are no rashes or edema. Cardiac examination is unremarkable.

Chest radiograph reveals **small lung volumes and bibasilar reticular infiltrate**s without lymphadenopathy. Spirometry reveals an FEV1/FVC ratio of 0.87, an FVC of 62% of predicted, and **a DLCO of 48% of predicte**d.

Which of the following is the most appropriate diagnostic test to perform next?

A Bronchoscopic lung biopsy
B Cardiopulmonary exercise test
C Chest CT angiography
D High-resolution chest CT
E Transthoracic echocardiography

9. A 24-year-old woman is evaluated in the emergency department for acute onset of dyspnea and pleuritic chest pain. She is 10 weeks pregnant. She is otherwise well, and her only medication is folic acid.

On physical examination, temperature is 37.7 °C (99.9 °F), blood pressure is 140/78 mm Hg, pulse rate is 90/min, respiration rate is 24/min, and oxygen saturation is 95% with the patient breathing ambient air. Cardiopulmonary examination is normal. There is no evidence of deep venous thrombosis.

A chest radiograph is normal. A ventilation/perfusion lung scan is interpreted as high probability for pulmonary embolism.

Which of the following is the most appropriate treatment?

A Dabigatran
B Fondaparinux
C Low-molecular-weight heparin
D Rivaroxaban
E Unfractionated heparin followed by warfarin

9. A 24-year-old woman is evaluated in the emergency department for **acute onset of dyspnea and pleuritic chest pain. She is 10 weeks pregnant.** She is otherwise well, and her only medication is folic acid.

On physical examination, temperature is 37.7 °C (99.9 °F), blood pressure is 140/78 mm Hg, pulse rate is 90/min, respiration rate is 24/min, and oxygen saturation is 95% with the patient breathing ambient air. Cardiopulmonary examination is normal. There is no evidence of deep venous thrombosis.

A chest radiograph is normal**. A ventilation/perfusion lung scan is interpreted as high probability for pulmonary embolism.**

Which of the following is the most appropriate treatment?

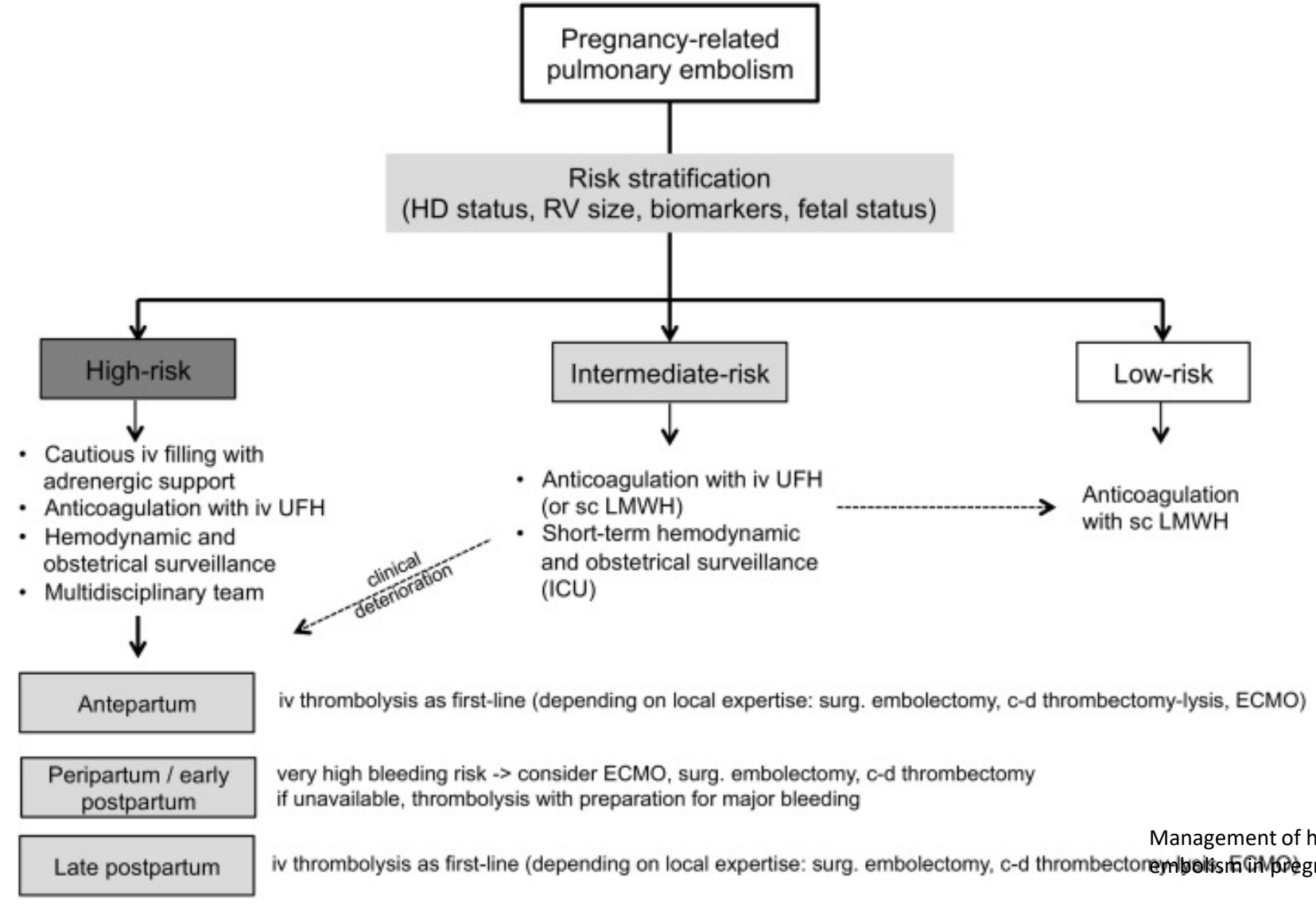
A Dabigatran

B Fondaparinux

C Low-molecular-weight heparin

D Rivaroxaban

E Unfractionated heparin followed by warfarin



Management of high-risk pulmonary embolism in pregnancy

10. A 69-year-old man is evaluated for shortness of breath and a dry cough progressing over the past 7 months. His medical history is otherwise unremarkable, and he does not take any medications.

On physical examination, respiration rate is 25/min. Oxygen saturation is 94% with the patient breathing ambient air. Auscultation of the lungs reveals Velcro-like crackles at both lung bases. Cardiac examination is normal.

Laboratory test results, including serologic tests for connective tissue disease, are negative.

Pulmonary function testing reveals a restrictive pattern and a DLCO of 42% of predicted.

Chest radiograph reveals reticular infiltrates in the lower lung zones. High-resolution chest CT scan findings are consistent with a usual interstitial pneumonia pattern.

Which of the following is the most appropriate treatment?

A N-acetylcysteine
B Pirfenidone
C Prednisone, N-acetylcysteine, and azathioprine
D Warfarin

10. A 69-year-old man is evaluated for **shortness of breath and a dry cough progressing over the past 7 months**. His medical history is otherwise unremarkable, and he does not take any medications.

On physical examination, respiration rate is 25/min. Oxygen saturation is 94% with the patient breathing ambient air. Auscultation of the lungs reveals Velcro-like crackles at both lung bases. Cardiac examination is normal.

Laboratory test results, including serologic tests for connective tissue disease, are negative.

Pulmonary function testing reveals a **restrictive pattern and a DLCO of 42% of predicted**.

Chest radiograph reveals **reticular infiltrates in the lower lung zones**. High-resolution chest CT scan findings are consistent with a **usual interstitial pneumonia** pattern.

Which of the following is the most appropriate treatment?

A N-acetylcysteine

B Pirfenidone

C Prednisone, N-acetylcysteine, and azathioprine

D Warfarin

12. A 52-year-old man is evaluated following a diagnosis of severe obstructive sleep apnea 8 weeks ago. He was prescribed auto-adjusting positive airway pressure therapy. He uses a nasal mask with heated humidification. He still feels drowsy during the day.

Which of the following is the most appropriate management?

A Assess adherence
B Bilevel positive airway pressure ventilation
C Eszopiclone
D Modafinil

12. A 52-year-old man is evaluated following a diagnosis of severe obstructive sleep apnea 8 weeks ago. He was prescribed auto-adjusting positive airway pressure therapy. He uses a nasal mask with heated humidification. He still feels drowsy during the day.

Which of the following is the most appropriate management?

A Assess adherence
B Bilevel positive airway pressure ventilation
C Eszopiclone
D Modafinil

- The treatment response for patients with sleep apnea depends on adherence to positive airway pressure therapy and should be assessed in all patients.
- Download of adherence data from the positive airway pressure device yields important information about use that can be discussed with the patient with sleep apnea to explore barriers and formulate a plan to promote adherence.

13. A 23-year-old man is evaluated for cough, rhinorrhea, and wheezing of 3 weeks' duration. He has no fevers, chills, or chest pain and no history of asthma or allergies. He is a pastry chef and notes that his symptoms improve on nonworking weekends.

On physical examination, vital signs are normal. Oxygen saturation is 94% with the patient breathing ambient air. Expiratory wheezing is noted.

Laboratory studies show a normal Aspergillus-specific IgE level.

Spirometry reveals moderate airflow obstruction that improves after inhaled albuterol.

Chest radiograph is normal.

Which of the following is the most likely diagnosis?

A Acute bronchitis
B Acute hypersensitivity pneumonitis
C Allergic bronchopulmonary aspergillosis
D Occupational asthma

13. A 23-year-old man is evaluated for **cough, rhinorrhea, and wheezing of 3 weeks' duration**. He has no fevers, chills, or chest pain and no history of asthma or allergies. He is **a pastry chef and notes that his symptoms improve on nonworking weekends.**

On physical examination, vital signs are normal. Oxygen saturation is 94% with the patient breathing ambient air. Expiratory wheezing is noted.

Laboratory studies show **a normal Aspergillus-specific IgE level.**

Spirometry reveals moderate airflow obstruction that improves after inhaled albuterol.

Chest radiograph is normal.

Which of the following is the most likely diagnosis?

A Acute bronchitis

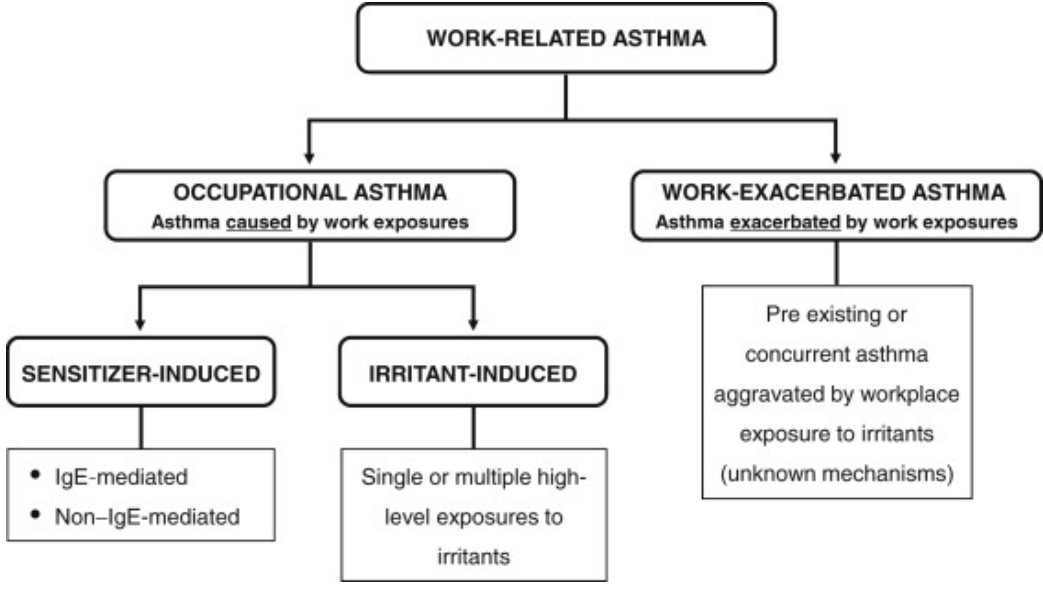
B Acute hypersensitivity pneumonitis

C Allergic bronchopulmonary aspergillosis

D Occupational asthma

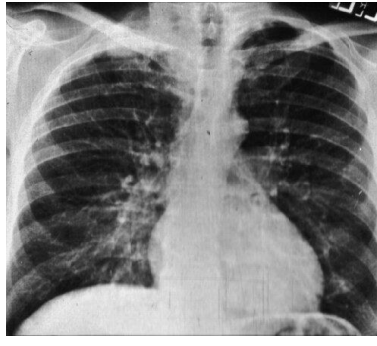
Occupational Asthma

- Occupational asthma includes asthma caused by exposure to sensitizing or irritant substances in the workplace, including high-molecular-weight substances, such as proteins, that induce an IgE-mediated immunologic response.
- Occupational asthma is characterized by an improvement in symptoms when the patient is away from work.



14. A 55-year-old man is evaluated for a 2-month history of shoulder pain and progressive weakness in his right hand. The pain radiates to his scapula. He has no shortness of breath or cough. He has a 30-pack-year smoking history and quit smoking 15 years ago. His only medication is ibuprofen for pain.

On physical examination, vital signs are normal. Ptosis and miosis of the right eye are observed. He has mild atrophy of the right hand muscles and decreased grip strength in his right hand. Lungs are clear to auscultation.



Complete blood count and metabolic profile are normal.

Chest radiograph is shown.

Which of the following is the most appropriate next step in management?

A Bronchoscopy with biopsy

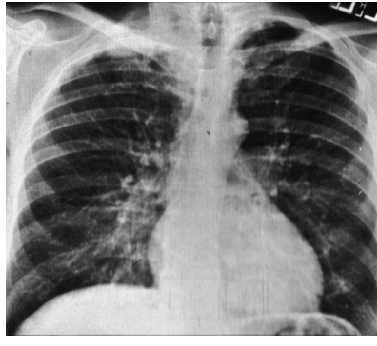
B CT of chest

C CT-guided biopsy

D Referral for surgical resection

14. A 55-year-old man is evaluated for a 2-month history of **shoulder pain and progressive weakness in his right hand**. The pain radiates to his scapula. He has no shortness of breath or cough. He has a 30-pack-year smoking history and quit smoking 15 years ago. His only medication is ibuprofen for pain.

On physical examination, vital signs are normal. **Ptosis and miosis of the right eye are observed. He has mild atrophy of the right hand muscles and decreased grip strength in his right hand**. Lungs are clear to auscultation.



Complete blood count and metabolic profile are normal.

Chest radiograph is shown.

Which of the following is the most appropriate next step in management?

A Bronchoscopy with biopsy

B CT of chest

C CT-guided biopsy

D Referral for surgical resection

15. A 29-year-old man is evaluated in the emergency department after transport by emergency medical services. He was found sitting on his garage floor, lethargic, with an empty container of automotive coolant nearby.

On physical examination, temperature is 37.4 °C (99.3 °F), blood pressure is 108/58 mm Hg, pulse rate is 118/min, respiration rate is 26/min, and oxygen saturation is 99% with the patient breathing ambient air. He arouses briefly to loud voice but is not interactive.

Which of the following is the most appropriate treatment?

A Ethanol

B Fomepizole

C Fomepizole and hemodialysis

D Lorazepam

Laboratory studies:

Creatinine	1.3 mg/dL (114.9 µmol/L)
Glucose	Normal
Sodium	138 mEq/L (138 mmol/L)
Potassium	4.8 mEq/L (4.8 mmol/L)
Chloride	104 mEq/L (104 mmol/L)
Bicarbonate	12 mEq/L (12 mmol/L)
Lactate	Normal
Calculated osmolal gap	Elevated

Arterial blood gas studies:

pH	7.25
PCO2	28 mm Hg (3.7 kPa)
PO2	98 mm Hg (13.0 kPa)

15. A 29-year-old man is evaluated in the emergency department after transport by emergency medical services. He was found sitting on his garage floor, lethargic, with an empty container of automotive coolant nearby.

On physical examination, temperature is 37.4 °C (99.3 °F), blood pressure is 108/58 mm Hg, pulse rate is 118/min, respiration rate is 26/min, and oxygen saturation is 99% with the patient breathing ambient air. He arouses briefly to loud voice but is not interactive.

Which of the following is the most appropriate treatment?

Laboratory studies:

Creatinine	1.3 mg/dL (114.9 µmol/L)
Glucose	Normal
Sodium	138 mEq/L (138 mmol/L)
Potassium	4.8 mEq/L (4.8 mmol/L)
Chloride	104 mEq/L (104 mmol/L)
Bicarbonate	12 mEq/L (12 mmol/L)
Lactate	Normal
Calculated osmolal gap	Elevated

AG 22

Arterial blood gas studies:

pH	7.25
PCO2	28 mm Hg (3.7 kPa)
PO2	98 mm Hg (13.0 kPa)

A Ethanol

B Fomepizole

C Fomepizole and hemodialysis

D Lorazepam

16. A 25-year-old man is seen in follow-up examination for asthma diagnosed 2 months ago. He reports that his symptoms are now well controlled without use of his rescue inhaler, and results of the Asthma Control Test confirm well-controlled asthma. During the visit, he describes feeling down on many days, with difficulty falling asleep and early morning awakening. Depression screening with the Patient Health Questionnaire-2 is positive. Medications are beclomethasone, montelukast, and albuterol.

On physical examination, vital signs and pulmonary examination are normal.

Which of the following is the most appropriate treatment?

A Begin escitalopram
B Begin salmeterol
C Stop beclomethasone; begin budesonide-formoterol
D Stop montelukast

16. A 25-year-old man is seen in follow-up examination for **asthma diagnosed 2 months ago.** He reports that his symptoms are now well controlled without use of his rescue inhaler, and results of the Asthma Control Test confirm well-controlled asthma. During the visit, he describes **feeling down on many days, with difficulty falling asleep and early morning awakening**. Depression screening with the Patient Health Questionnaire-2 is positive. Medications are beclomethasone, montelukast, and albuterol.

On physical examination, vital signs and pulmonary examination are normal.

Which of the following is the most appropriate treatment?

A Begin escitalopram
B Begin salmeterol
C Stop beclomethasone; begin budesonide-formoterol
D Stop montelukast

17. A 64-year-old woman has been hospitalized for 4 days for a first COPD exacerbation and is now being discharged. Before hospitalization she had mild symptoms such as breathlessness when hurrying on level ground or walking up a slight hill. She stopped smoking 7 years ago. Immunizations are up to date. Medications are a fluticasone furoate-umeclidinium-vilanterol inhaler and an additional day of prednisone.

Today, vital signs are normal. Breath sounds are distant without wheezing. Cardiovascular examination is normal.

A review of the admission chest radiograph shows homogeneous emphysema without other findings. Today, results of laboratory evaluation are normal. Spirometry shows a FEV1/FVC ratio of 0.6 and an FEV1 42% of predicted. A 6-minute walk test shows a minimum oxygen saturation of 89% with the patient breathing ambient air.

Which of the following is the most appropriate additional treatment?

A α1-Antitrypsin augmentation therapy
B Lung volume reduction surgery
C Pulmonary rehabilitation
D Supplemental home oxygen

17. A 64-year-old woman has been hospitalized for **4 days for a first COPD exacerbation** and is now being discharged. Before hospitalization she **had mild symptoms such as breathlessness** when hurrying on level ground or walking up a slight hill. She stopped smoking 7 years ago. Immunizations are up to date. Medications are a fluticasone furoate-umeclidinium-vilanterol inhaler and an additional day of prednisone.

Today, vital signs are normal. Breath sounds are distant without wheezing. Cardiovascular examination is normal.

A review of the admission chest radiograph shows homogeneous emphysema without other findings. Today, results of laboratory evaluation are normal. Spirometry shows a **FEV1/FVC ratio of 0.6 and an FEV1 42% of predicted**. A 6-minute walk test shows a minimum oxygen saturation of 89% with the patient breathing ambient air.

Which of the following is the most appropriate additional treatment?

A α1-Antitrypsin augmentation therapy
B Lung volume reduction surgery
C Pulmonary rehabilitation
D Supplemental home oxygen

Pulmonary Rehab

Benefit	Evidence Grade*
Improves exercise capacity	A
Reduces perceived intensity of breathlessness	A
Can improve health-related quality of life	A
Reduces the number of hospitalizations and number of days hospitalized	A
Reduces anxiety and depression associated with COPD	A
Strength and endurance training of upper limbs improves arm function	B
Benefits extend well beyond the immediate period of training	B
Improves survival	B
Respiratory muscle training is beneficial, especially when combined with general exercise training	C
Psychosocial intervention is helpful	C

COPD = chronic obstructive pulmonary disease

*The evidence is graded per the GOLD (Global Initiative for Chronic Obstructive Lung Disease) evidence-rating system.

(Adapted from Reference 12.)

18. A 61-year-old woman is evaluated in the emergency department for a COPD exacerbation characterized by increased dyspnea and increased purulent sputum production. Home medications are mometasone furoate-formoterol, tiotropium bromide, and albuterol inhalers.

On physical examination, temperature is 37.2 °C (99.0 °F), blood pressure is 135/82 mm Hg, pulse rate is 112/min, respiration rate is 21/min, and oxygen saturation is 94% breathing oxygen, 5 L/min by nasal cannula. Pulmonary examination reveals diffuse expiratory wheezing but no use of accessory muscles. The remainder of the physical examination is noncontributory.

Arterial blood gas studies:

pH 7.36
PCO2 43 mm Hg (5.7 kPa)
PO2 65 mm Hg (8.6 kPa)

Chest radiograph shows hyperinflation and flattened diaphragm but no infiltrate.

Nebulized albuterol and oral azithromycin are initiated.

Which of the following is the most appropriate additional management?

A High-flow nasal cannula
B Noninvasive bilevel positive airway pressure ventilation
C Prednisone
D Sputum culture

18. A 61-year-old woman is evaluated in the emergency department for a COPD exacerbation characterized by increased dyspnea and increased purulent sputum production. Home medications are mometasone furoate-formoterol, tiotropium bromide, and albuterol inhalers.

On physical examination, temperature is **37.2 °C (99.0 °F)**, blood pressure is 135/82 mm Hg, pulse rate is 112/min, respiration rate is 21/min, and oxygen saturation **is 94% breathing oxygen, 5 L/min by nasal cannula.** Pulmonary examination reveals diffuse expiratory wheezing but no use of accessory muscles. The remainder of the physical examination is noncontributory.

Arterial blood gas studies:

pH 7.36
PCO2 43 mm Hg (5.7 kPa)
PO2 65 mm Hg (8.6 kPa)

Chest radiograph shows hyperinflation and flattened diaphragm but no infiltrate.

Nebulized albuterol and oral azithromycin are initiated.

Which of the following is the most appropriate additional management?

A High-flow nasal cannula
B Noninvasive bilevel positive airway pressure ventilation
C Prednisone
D Sputum culture

MANAGEMENT OF SEVERE BUT NOT LIFE-THREATENING EXACERBATIONS*

- Assess severity of symptoms, blood gases, chest radiograph.
- Administer supplemental oxygen therapy, obtain serial arterial blood gas, venous blood gas and pulse oximetry measurements.
- Bronchodilators:
  - » Increase doses and/or frequency of short-acting bronchodilators.
  - » Combine short-acting beta 2-agonists and anticholinergics.
  - » Consider use of long-active bronchodilators when patient becomes stable.
  - » Use spacers or air-driven nebulizers when appropriate.
- Consider oral corticosteroids.
- Consider antibiotics (oral) when signs of bacterial infection are present.
- Consider noninvasive mechanical ventilation (NIV).
- At all times:
  - » Monitor fluid balance.
  - » Consider subcutaneous heparin or low molecular weight heparin for thromboembolism prophylaxis.
  - » Identify and treat associated conditions (e.g., heart failure, arrhythmias, pulmonary embolism etc.).

*Local resources need to be considered.

19. A 55-year-old man is evaluated in the hospital for fever, dry cough, and shortness of breath of 3 days' duration. He has advanced squamous cell lung cancer, for which he recently started treatment with pembroluzimab. The patient received thoracic radiation to the right hilum 2 months ago.

On physical examination, temperature is 37.8 °C (100.0 °F), blood pressure is 110/70 mm Hg, pulse rate is 102/min, and respiration rate is 22/min. Oxygen saturation is 92% with the patient breathing ambient air. BMI is 17. Crackles are present in the right infrascapular region. Cardiovascular examination is normal.

CT scan of the chest is shown.

Bronchoscopy is unremarkable; bronchoalveolar lavage fluid cultures are negative.

Which of the following is the most likely diagnosis?

A Hospital-acquired pneumonia
B Hypersensitivity pneumonitis
C Pulmonary edema
D Radiation pneumonitis

19. A 55-year-old man is evaluated in the hospital for fever, dry cough, and shortness of breath of 3 days' duration. He has advanced squamous cell lung cancer, for which he recently started treatment with pembroluzimab. The patient received thoracic radiation to the right hilum 2 months ago.

On physical examination, temperature is 37.8 °C (100.0 °F), blood pressure is 110/70 mm Hg, pulse rate is 102/min, and respiration rate is 22/min. Oxygen saturation is 92% with the patient breathing ambient air. BMI is 17**. Crackles are present in the right infrascapular region**. Cardiovascular examination is normal.

CT scan of the chest is shown.

Bronchoscopy is unremarkable;

bronchoalveolar lavage fluid cultures are negative.

Which of the following is the most likely diagnosis?

A Hospital-acquired pneumonia

B Hypersensitivity pneumonitis

C Pulmonary edema

D Radiation pneumonitis

20. A 57-year-old woman is evaluated for progressive dyspnea of 1 year's duration. She has otherwise been well and takes no medications.

On physical examination, blood pressure is 121/82 mm Hg. Oxygen saturation is 94% with the patient breathing ambient air. There is a grade 2/6 systolic murmur at the left lower sternal border that increases with inspiration and persistent splitting of S2. Central venous pressure is elevated. There is a prominent venous a wave.

ECG shows right atrial enlargement. Chest radiograph shows prominence of the pulmonary artery. Echocardiogram reveals a right ventricular systolic pressure of 64 mm Hg and an estimated right atrial pressure of 15 mm Hg. Left ventricular function is normal. Pulmonary function tests show decreased DLCO but are otherwise normal. Ventilation/perfusion scan is low probability for pulmonary embolism.

Which of the following is the most appropriate management?

A Coronary angiography
B Right heart catheterization
C Start nifedipine
D Start sildenafil

20. A 57-year-old woman is evaluated for progressive dyspnea of 1 year's duration. She has otherwise been well and takes no medications.

On physical examination, blood pressure is 121/82 mm Hg. Oxygen saturation is 94% with the patient breathing ambient air. There is a grade 2/6 systolic murmur at the left lower sternal border that increases with inspiration and persistent splitting of S2. Central venous pressure is elevated. There is a prominent venous a wave.

ECG shows right atrial enlargement. Chest radiograph shows prominence of the pulmonary artery. Echocardiogram reveals a **right ventricular systolic pressure of 64** mm Hg and an estimated right atrial pressure of 15 mm Hg. Left ventricular function is normal. Pulmonary function tests show decreased DLCO but are otherwise normal. Ventilation/perfusion scan is low probability for pulmonary embolism.

Which of the following is the most appropriate management?

A Coronary angiography

B Right heart catheterization

C Start nifedipine

D Start sildenafil

Pulmonary Hypertension Algorithm

by Matthew Watto, MD

PH suspected
by signs/Sx and echo

Initial Workup
EKG, PFTs + DLCO, CXR, overnight oximetry +/- ABG +/- HRCT

Dx left heart or lung disease?

Yes → **Treat underlying dz**
Wt loss, CPAP, diuretics, anti-HTN, cardiac rehab, inhalers for COPD

No

V/Q scan dx of CTEPH?

Yes → *Surgical thrombectomy* (curative) or *Riociguat* (vasodilator)

No

RHC w/mPAP ≥25, PCWP <15, PVR >3 Wood Units?

Yes → Refer for PAH-specific dx & tx

No → Consider alternate dx

Key: Sx=symptom, PH=pulmonary hypertension, PAH= pulmonary arterial hypertension, PFT= pulmonary function testing, DLCO =diffusion capacity carbon monoxide, CXR= chest X-ray, ABG= arterial blood gas, HRCT =hi resolution CT chest, V/Q= ventilation perfusion scan, CTEPH= chronic thromboembolic pulmonary hypertension, RHC= right heart cath, mPAP= mean pulmonary artery pressure, PCWP= pulmonary capillary wedge pressure, PVR= pulmonary venous resistance, CTD= connective tissue disease; Dz= disease, IVC= inferior vena cava, TR= tricuspid regurgitation, PA= pulmonary artery, LV= left ventricle, RV= right ventricle, Dx= diagnosis, Tx= treatment, HTN= hypertension, ANA= antinuclear antibody

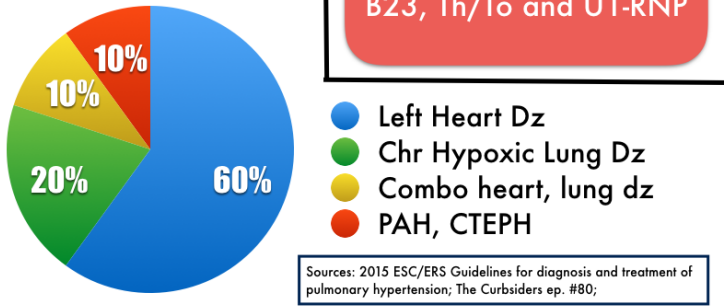
Echo findings of PH

- Peak TR >2.8 m/s (esp. >3.4 m/s)
- Flattening IV septum
- RV:LV diameter >1
- PA diameter >25mm
- IVC diameter >21, or
- blunted inspiratory collapse

Causes PAH
HIV
Schistosomiasis
CTD
Congenital heart dz
Portopulmonary HTN
Drugs/toxins: meth, amphetamines
Heritable
Idiopathic

PAH Dx/Serologies
ANA, anti-centromere , dsDNA, anti-Ro, U3-RNP, B23, Th/To and U1-RNP

Causes of PH



Sources: 2015 ESC/ERS Guidelines for diagnosis and treatment of pulmonary hypertension; The Curbsiders ep. #80;

Curbsiders #80: Pulmonary Hypertension, freeways, and cows in heart failure