RESPIRATORY EMERGENCIES

[Document subtitle]

EPOMEDICINE

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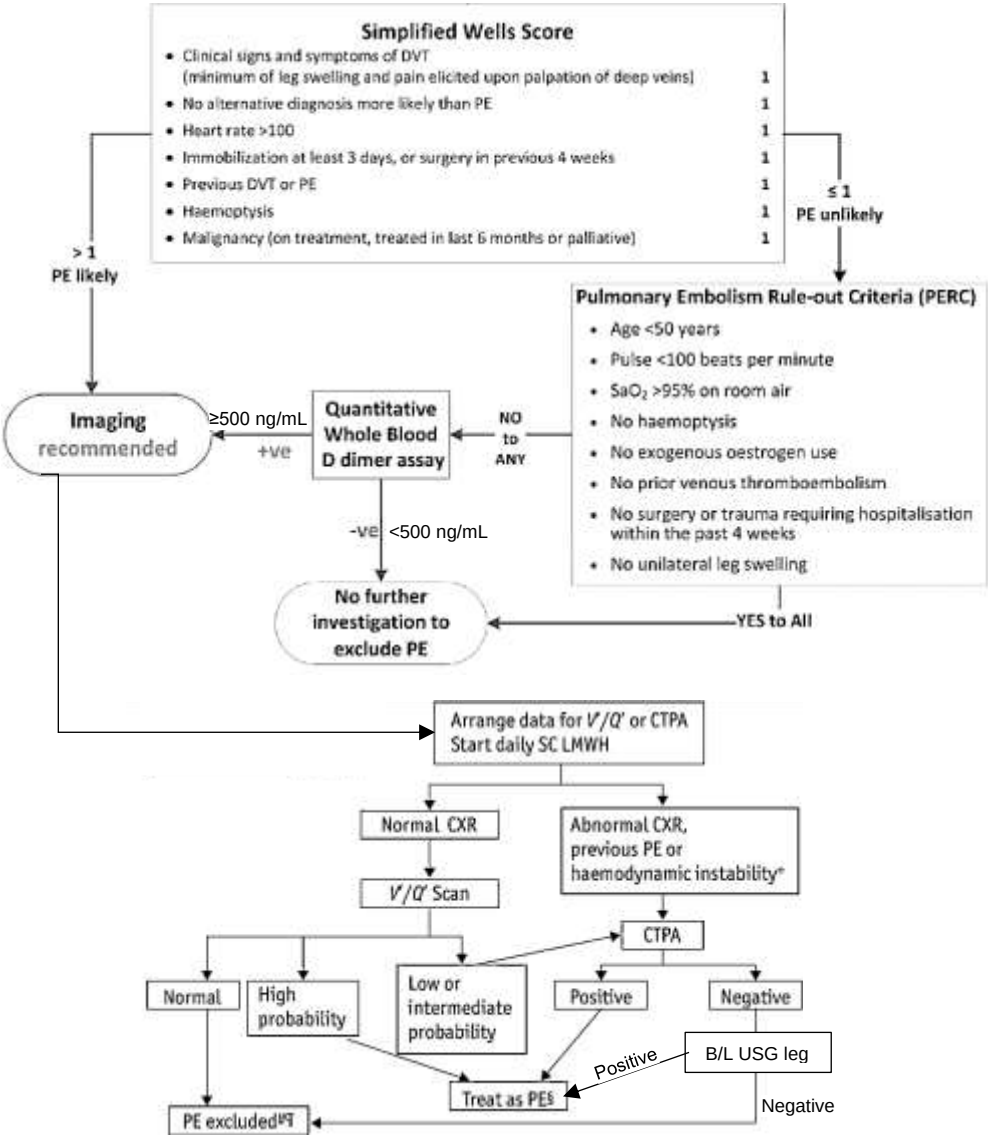
EPOMEDICINE

PULMONARY EMBOLISM

Diagnostic algorithm:



Well's criteria is a risk stratification and clinical decision rule to estimate the probability of PE in patients with history and examination suggesting acute PE as a diagnostic possibility.

Investigations

CXR	Normal CXR Plate atelectasis Hampton hump (pleural-based opacity) Small pleural effusion Elevated hemidiaphragm Fleischner's sign (prominent amputated pulmonary artery) Westermark's sign (peripheral oligaemia) The more abnormal the CXR, the less likely is PE Normal CXR in a breathless hypoxic person in the absence of bronchospasm means that PE is likely
ECG	Sinus tachycardia Nonspecific T-wave changes P-pulmonale RV strain Right bundle branch block S1, Q3, T3 (deep S-wave in lead I, Q-wave in lead II and T-wave inversion in lead III) ECG is very useful at revealing alternative diagnoses (*e.g.* myocardial infarction)
ABGs	Hypoxaemia, hypocapnia and increased $P_{A-a}O_2$ Can be normal in PE, especially in young people with good pulmonary reserve
D-dimer	D-dimer should always be considered with the clinical probability Negative D-dimer is useful in excluding PE in the setting of low clinical probability and obviate the need for further imaging. D-dimer is not recommended to be used when the clinical probability of PE is high, as it is unlikely to influence the decision for further imaging and would most likely be positive.
CUS	Leg ultrasound study can be helpful as an adjunctive test to nondiagnostic imaging (*V'/Q'* or CTPA) in diagnosis of PE.
V'/Q'	A high *V'/Q'* probably indicates that PE is very likely, especially when combined with a high clinical probability. Normal or near-normal *V'/Q'* scan virtually excludes PE. Nondiagnostic scans occur in most of the patients undergoing *V'/Q'* scanning, especially when there is cardiopulmonary disease or abnormal CXR; these patients should be investigated further
CTPA	CTPA is easier to read than *V'/Q'* scans, even in the presence of cardiopulmonary disease or abnormal CXR; CTPA has now replaced *V'/Q'* scanning as the screening diagnostic test for PE in many institutions The diagnosis of PE using CTPA can be improved if CUS is used as an adjunctive test and clinical probability is taken into account. It is safe to withhold anticoagulant therapy after a negative CTPA and a negative CUS if the clinical probability is low. It is also probably safe to withhold anticoagulant therapy after a negative CTPA and a negative CUS with intermediate clinical probability, although this approach should be considered with caution. The chance of missing PE with a negative CTPA and a negative CUS in patients with high clinical probability is relatively high and further evaluation is warranted in these patients.
Troponin-T and -I	Can be raised in severe PE Can not be used to rule out PE, but can be used in risk stratification of PE to identify low-risk patients with PE who can be treated as outpatients
BNP	Elevated levels of BNP are associated with RV dysfunction in PE It can be used in risk stratification of PE severity

CXR: chest radiography; RV: right ventricular; ABG: arterial blood gas; $P_{A-a}O_2$: alveolar–arterial oxygen tension difference; CUS: compression ultrasound; *V'/Q'*: ventilation/perfusion; CTPA: computerised tomographic pulmonary angiography; BNP: B-type natriuretic peptide.

Anticoagulation at ER before disposition:

1. Enoxaparin (Clexane) 1 mg/kg s.c. BD (CrCl >30) or OD (CrCl <30) stat (cont. min. 5 days)
2. Tab. Warfarin 5 mg PO stat and continue 2.5-5 mg PO OD (Target INR: 2-3)

References:

1. Gibson NS, Sohne M, Kruip MJ, Tick LW, Gerdes VE, Bossuyt PM, et al. Further validation and simplification of the Wells clinical decision rule in pulmonary embolism. J Thromb Haemost. 2008; 99(1): 229-34.
2. Hamad M, Bhatia P, Ellidir E, Abdelaziz M, Connolly V. Diagnostic approach to pulmonary embolism and lessons from a busy acute assessment unit in the UK. Breathe. 2011;7(4):315-323.
3. Pulmonary Embolism Management – Adult – Ambulatory – Emergency Department Clinical Practice Guideline (CPG) Cover Sheet [Internet]. UWHealth; 2018 [cited 1 January 2018]. Available from: https://www.uwhealth.org/files/uwhealth/docs/anticoagulation/Pulmonary_Embolism_Management_in_the_Emergency_Department_Guideline.pdf

Further Reading:

https://www.escardio.org/static_file/Escardio/Guidelines/publications/APEAcute%20PE_Web%20Addenda.pdf

EPOMEDICINE

AECOPD

Empiric Antibiotics for 5-7 days (1):

Antibiotics should only be started or continued in patients with signs and symptoms of a bacterial infection that include the following:

1) Increased dyspnea, increased purulence of sputum, and increased volume of sputum OR

2) Ventilator support (invasive or non-invasive) for AECOPD

Patients with a PCT <0.1 ng/mL are unlikely to benefit from antibiotic administration

- **Mild exacerbation (no respiratory failure+, FEV_1 >50% predicted, < 3 exacerbations/year)**
  - 1st line: Doxycycline 100 mg PO BID OR Cefuroxime 500 mg PO BID
  - 2nd line: Azithromycin 500 mg PO daily*
- **Moderate exacerbation (non-life-threatening respiratory failure+, FEV_1 36-50%, ≥ 3 exacerbations/year, ≥65 years of age)**
  - 1st line: Amoxicillin-clavulanate 875-125 mg PO BID OR Doxycycline 100 mg PO BID
  - 2nd line: Azithromycin 500 mg PO daily*
- **Severe exacerbation (life-threatening respiratory failure+, FEV_1 ≤35%, ≥ 3 exacerbations/year, ≥ 65 years of age) OR Requires ventilator support:**
  - No risk factors for *Pseudomonas aeruginosa*:
    - Ceftriaxone 1 gram IV every 24 hours (>80 kg: Ceftriaxone 2 grams IV every 24 hours)
    - Severe beta-lactam allergy: Levofloxacin 750 mg po or IV every 24 hours**
  - Risk factors for *Pseudomonas aeruginosa* (see Table 1):
    - 1st line: Cefepime 1 gram IV every 6 hours
    - 2nd line: Piperacillin-tazobactam 4.5 grams IV every 8 hours
    - Severe beta-lactam allergy: Aztreonam 2 grams IV every 8 hours + levofloxacin 750 mg po or IV every 24 hours**

+ Respiratory status adapted from the 2017 GOLD guidelines. See Table 1. For patients with re-admission within 30 days or recurrent AECOPD, consider expert consultation with a pulmonologist.

* Consider ECG prior to initiating, especially if other QTc-prolonging medications are present. Alternate therapy may need to be considered in patients at high risk of cardiovascular events.

Table 1 - Risk factors for Pseudomonas:

Bronchiectasis	Antibiotics in past 90 days
Prior Pseudomonas respiratory culture	History of intubation
Systemic steroids	Frequent exacerbations
Residence in a longterm care facility	Immunocompromised

Classification of Acute Exacerbation of COPD: (2)

Parameters	No respiratory failure	Acute respiratory failure – non-life threatening	Acute respiratory failure – life threatening
RR (/min)	20-30	>30	>30
Accessory muscles of respiration	Unused	Used	Used
Mental status	Normal	Normal	Altered
Hypoxemia	Improved with oxygen via nasal cannula	Improved with oxygen via nasal cannula	Requires more than nasal cannula (FiO2 >40%)
Hypercarbia	Absent	50-60 mmHg	>60 mmHg or pH ≤7.25

Defer sputum cultures unless risk factors for pseudomonas are present or treatment failure of AECOPD.
Patients diagnosed with pneumonia should be treated with the antibiotics appropriate for the diagnosis.

Management (2):

1. Resuscitation
2. Oxygen therapy as per Acute respiratory failure in protocol (Target SpO2 88-92%)
3. Salbutamol 2.5-5 mg +/- Ipratropium 0.5 mg via nebulizer or 2-4 puffs from MDI every hour for 2-3 doses, then every 2-4 hours based on response (Withold long acting bronchodilators).
4. Consider use of long-acting bronchodilators when the patient becomes stable.
5. Tab. Prednisone 40 mg PO or Inj. Methylprednisolone 40 mg IV OD X 5 days.
6. Consider non-invasive or invasive mechanical ventilation (as indicated).
7. Others (3):
    a. Monitor fluid balance
    b. Consider subcutaneous heparin or LMWH for VTE prophylaxis.

c. Identify and treat associated conditions (heart failure, arrhythmias, PE, etc.)

Tables (2):

Table 5.1. Potential indications for hospitalization assessment*

- Severe symptoms such as sudden worsening of resting dyspnea, high respiratory rate, decreased oxygen saturation, confusion, drowsiness.
- Acute respiratory failure.
- Onset of new physical signs (e.g., cyanosis, peripheral edema).
- Failure of an exacerbation to respond to initial medical management.
- Presence of serious comorbidities (e.g., heart failure, newly occurring arrhythmias, etc.).
- Insufficient home support.

Table 5.4. Indications for respiratory or medical intensive care unit admission*

- Severe dyspnea that responds inadequately to initial emergency therapy.
- Changes in mental status (confusion, lethargy, coma).
- Persistent or worsening hypoxemia (PaO_2 < 5.3 kPa or 40 mmHg) and/or severe/worsening respiratory acidosis (pH < 7.25) despite supplemental oxygen and noninvasive ventilation.
- Need for invasive mechanical ventilation.
- Hemodynamic instability—need for vasopressors.

Table 5.5. Indications for noninvasive mechanical ventilation (NIV)

At least one of the following:

- Respiratory acidosis ($PaCO_2$ ≥ 6.0 kPa or 45 mmHg and arterial pH ≤ 7.35).
- Severe dyspnea with clinical signs suggestive of respiratory muscle fatigue, increased work of breathing, or both, such as use of respiratory accessory muscles, paradoxical motion of the abdomen, or retraction of the intercostal spaces.
- Persistent hypoxemia despite supplemental oxygen therapy.

Table 5.6. Indications for invasive mechanical ventilation

- Unable to tolerate NIV or NIV failure.
- Status post - respiratory or cardiac arrest.
- Diminished consciousness, psychomotor agitation inadequately controlled by sedation.
- Massive aspiration or persistent vomiting.
- Persistent inability to remove respiratory secretions.
- Severe hemodynamic instability without response to fluids and vasoactive drugs.
- Severe ventricular or supraventricular arrhythmias.
- Life-threatening hypoxemia in patients unable to tolerate NIV.

Diagnostic testing and Monitoring (3):

1. Continuous/Close monitoring: vital signs, ECG, respiratory status
2. Monitor blood glucose

3. ABG: Obtain ABG in all patients with severe COPD exacerbation
4. Portable chest radiograph: Look for signs of pneumonia, acute heart failure, pneumothorax
5. CBC, electrolytes (Na+, K+), BUN, and creatinine; also obtain cardiac troponin, BNP, or NT-proBNP, if diagnosis is uncertain
6. ECG: Look for arrhythmia, ischemia, cor pulmonale

Key elements of discharge (4):

1. Improved dyspnea: to the point that patient can eat, sleep, walk and correctly use inhaler medications.
2. Clinically stable: for 12-24 hours, with short-acting bronchodilators required no more frequently than q4h.
3. Antibiotics and steroids: complete the course, if initiated in the hospital.
4. Inhaler regimen: a minimum of a long-acting bronchodilator +/- inhaled steroids and a rescue inhaler.
5. Education: on importance of adherence to inhaler regimen, correct inhaler technique and smoking cessation.
6. Domicilliary oxygen: If –
    a. Room air SpO2 <88% (or pO2 <56), or
    b. Room air SpO2 88% (or pO2 56-59) + 1 of the 3: Lower extremity edema suggestive of CHF, pulmonary HTN/cor pulmonale, or erythrocytosis (hematocrit >56%)
7. Readmission risk: Use assessment tool to estimate readmission risk.
    a. High risk of readmission: Follow up in 1 week
    b. Moderate or low risk of readmission: Follow up in 1 month
8. PFT: Schedule full PFTs (including bronchodilators) 4-6 weeks after AECOPD, if not previously performed.

References:

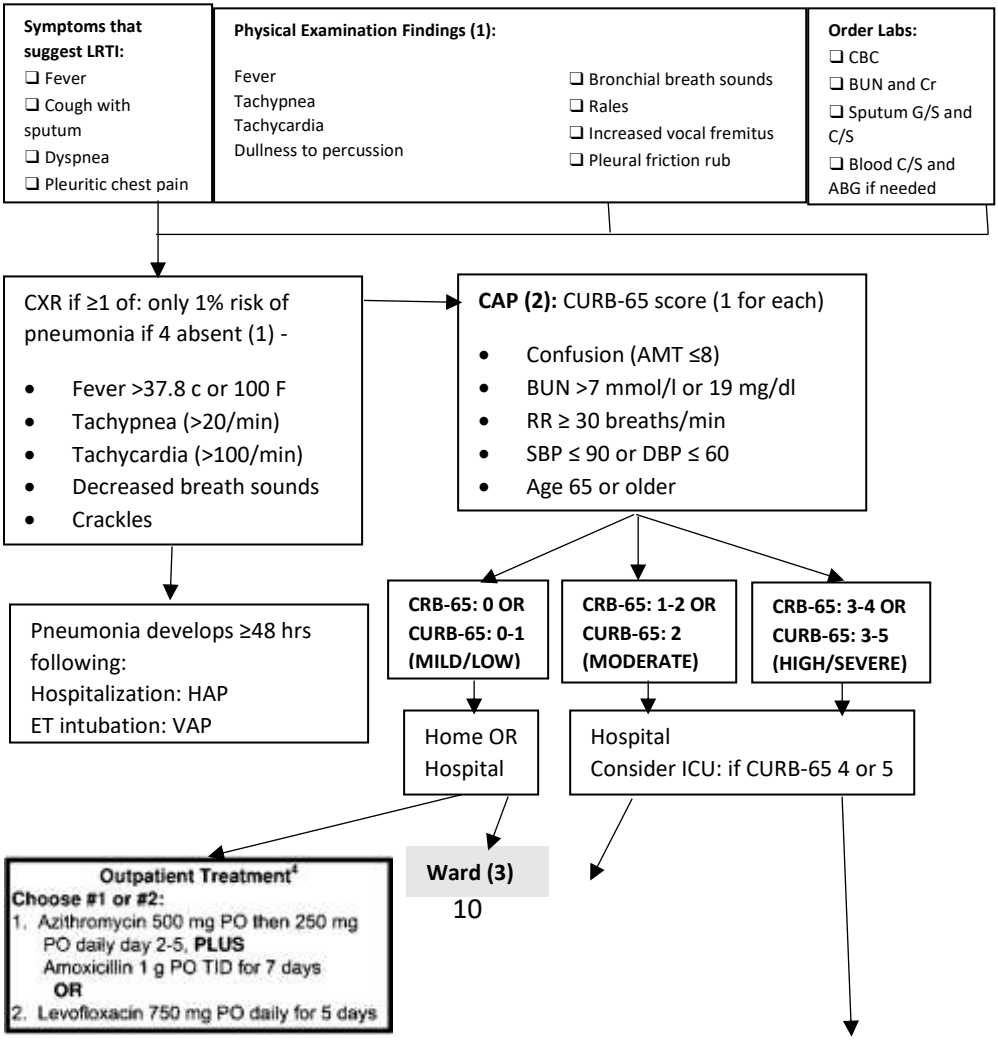
1. Antibiotic Guidance for Treatment of Acute Exacerbations of COPD (AECOPD) in Adults [Internet]. Nebraska Medicine. 2017 [cited 4 January 2018]. Available from: https://www.nebraskamed.com/sites/default/files/documents/for-providers/asp/COPD_pathway2016_Final.pdf
2. Global Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2017. Available from: http://goldcopd.org/.
3. Rapid overview severe COPD exacerbation [Internet]. Uptodate. [cited 2018Jan4]. Available from:

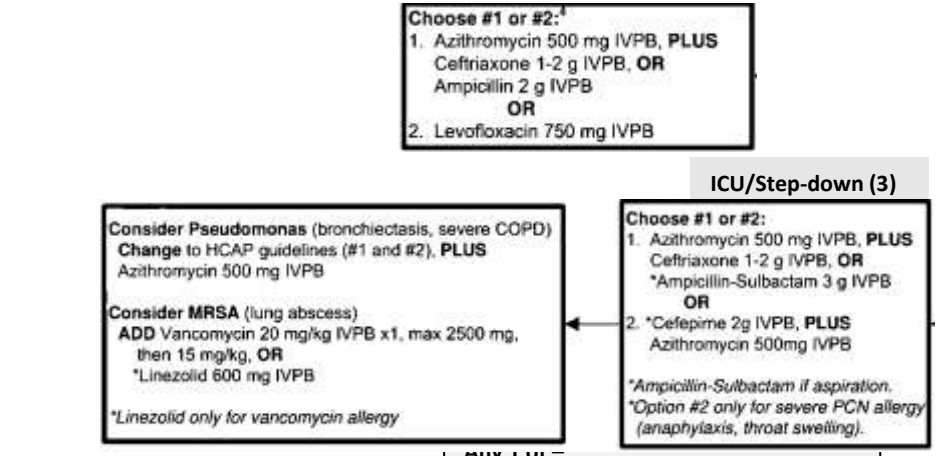
https://www.uptodate.com/contents/image?imageKey=EM%2F65420&topicKey=PULM%2F1461&search=copd&source=outline_link&selectedTitle=4~150

4. Sagana R, Wesorick D. Care of the Hospitalized Patient with Acute Exacerbation of COPD [Internet]. Michingan Medicine. 2016 [cited 1 January 2018]. Available from: http://www.med.umich.edu/1info/FHP/practiceguides/InptCOPD/COPD.final.pdf

Further reading: http://goldcopd.org/wp-content/uploads/2016/12/wms-GOLD-2017-Pocket-Guide.pdf

Community Acquired Pneumonia (CAP)





Indications for ward admission: Any 1 -

- Inability to maintain oral intake
- Concern about adherence to therapy
- H/O substance abuse
- Mental illness
- Cognitive or functional impairment
- Concern about living/social situation
- SpO2 <92% in room air (represent a significant change from baseline)

Any 1 of –

- Invasive mechanical ventilation
- Septic shock requiring vasopressor

≥3 of -

- Altered mental status
- Hypotension requiring fluid support
- Temp <36c (96.8 F)
- RR >/= 30/min
- PaO2/FiO2 ratio ≤ 250
- BUN >7 mmol/l or 19 mg/dl
- Leukocyte <4000/cu.mm
- Platelet <100,000/ml
- Multilobar infiltrates

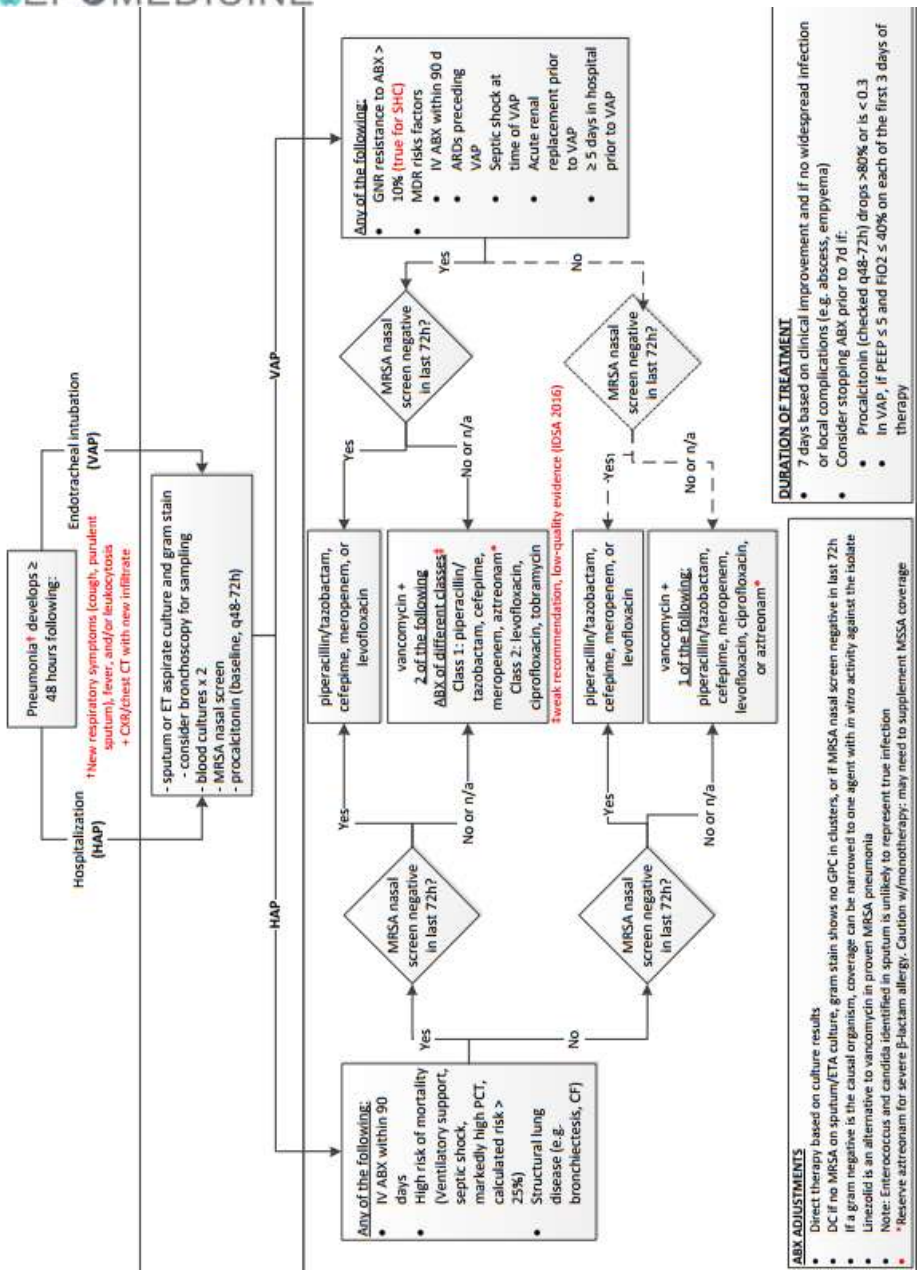
References:

1. Kelsberg G, Safranek S, Ely JW. Clinical inquiries. How accurate is the clinical diagnosis of pneumonia? J Fam Pract. 2003 Jan;52(1):63-4. Review. PubMed PMID: 12540315.
2. Lim WS, Baudouin SV, George RC, et al. BTS guidelines for the management of community acquired pneumonia in adults: update 2009 Thorax 2009;64:iii1-iii55.

3. Emergency KT: Suspected pneumonia [Internet]. Tamingthesru.com. 2014 [cited 4 January 2018]. Available from: http://www.tamingthesru.com/s/Pneumonia-Flow-6-24-14-3dg7.pdf

Further reading: http://www.japi.org/january_special_2012/08_pneumonia_review_of.pdf

VAP/HAP


Pneumonia† develops ≥ 48 hours following:
Hospitalization (HAP)
Endotracheal intubation (VAP)
†New respiratory symptoms (cough, purulent sputum), fever, and/or leukocytosis + CXR/chest CT with new infiltrate
- sputum or ET aspirate culture and gram stain
- consider bronchoscopy for sampling
- blood cultures x 2
- MRSA nasal screen
- procalcitonin (baseline, q48-72h)
HAP
VAP
Any of the following:
• IV ABX within 90 days
• High risk of mortality (Ventilatory support, septic shock, markedly high PCT, calculated risk > 25%)
• Structural lung disease (e.g. bronchiectesis, CF)
Yes
No
MRSA nasal screen negative in last 72h?
Yes
No or n/a
piperacillin/tazobactam, cefepime, meropenem, or levofloxacin
vancomycin + 2 of the following ABX of different classes‡
Class 1: piperacillin/tazobactam, cefepime, meropenem, aztreonam*
Class 2: levofloxacin, ciprofloxacin, tobramycin
‡weak recommendation, low-quality evidence (IDSA 2016)
MRSA nasal screen negative in last 72h?
Yes
No or n/a
piperacillin/tazobactam, cefepime, meropenem, or levofloxacin
vancomycin + 1 of the following: piperacillin/tazobactam, cefepime, meropenem, levofloxacin, ciprofloxacin, or aztreonam*
MRSA nasal screen negative in last 72h?
Yes
No
Any of the following:
• GNR resistance to ABX > 10% (true for SHC)
• MDR risks factors
• IV ABX within 90 d
• ARDs preceding VAP
• Septic shock at time of VAP
• Acute renal replacement prior to VAP
• ≥ 5 days in hospital prior to VAP
DURATION OF TREATMENT
• 7 days based on clinical improvement and if no widespread infection or local complications (e.g. abscess, empyema)
• Consider stopping ABX prior to 7d if:
• Procalcitonin (checked q48-72h) drops >80% or is < 0.3
• In VAP, if PEEP ≤ 5 and FiO2 ≤ 40% on each of the first 3 days of therapy
ABX ADJUSTMENTS
• Direct therapy based on culture results
• DC if no MRSA on sputum/ETA culture, gram stain shows no GPC in clusters, or if MRSA nasal screen negative in last 72h
• If a gram negative is the causal organism, coverage can be narrowed to one agent with in vitro activity against the isolate
• Linezolid is an alternative to vancomycin in proven MRSA pneumonia
• Note: Enterococcus and candida identified in sputum is unlikely to represent true infection
• *Reserve aztreonam for severe β-lactam allergy. Caution w/monotherapy: may need to supplement MSSA coverage

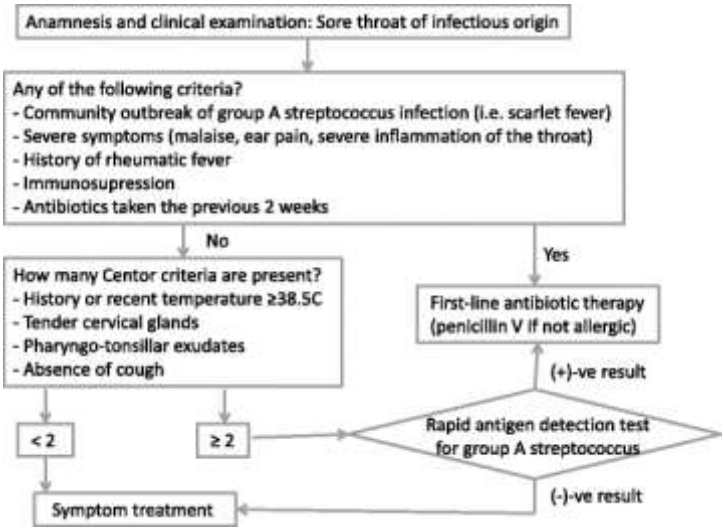
Reference:

Hitchcock M. SHC Clinical Pathway: Hospital-Acquired and Ventilator-Associated Pneumonia [Internet]. Stanford Medicine. 2017 [cited 5 January 2018]. Available from: http://med.stanford.edu/bugsanddrugs/guidebook/_jcr_content/main/panel_builder_1454513702/panel_0/download_798094518/file.res/SHC%20pathway%20HAP-VAP.pdf

Further reading:

Kalil AC, Metersky ML, Klompas M, Muscedere J, Sweeney DA, Palmer LB, Napolitano LM, O'Grady NP, Bartlett JG, Carratalà J, El Solh AA, Ewig S, Fey PD, File TM Jr, Restrepo MI, Roberts JA, Waterer GW, Cruse P, Knight SL, Brozek JL. Management of Adults With Hospital-acquired and Ventilator-associated Pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. Clin Infect Dis. 2016 Sep 1;63(5):e61-e111. doi: 10.1093/cid/ciw353. Epub 2016 Jul 14. PubMed PMID: 27418577; PubMed Central PMCID: PMC4981759.

Acute Uncomplicated Pharyngitis



Antibiotics for GABHS acute pharyngitis:

Antibiotic	Dose	Duration
1st choice: Penicillin V (Penoxymethyl penicillin)	1.2M IU / oral / 12h	8-10 days
Alternatives: Penicillin G	1.2M IU im	1 dose
Amoxicillin	500mg / 12h	8-10 days
Cefadroxil	500mg / 12h	8-10 day

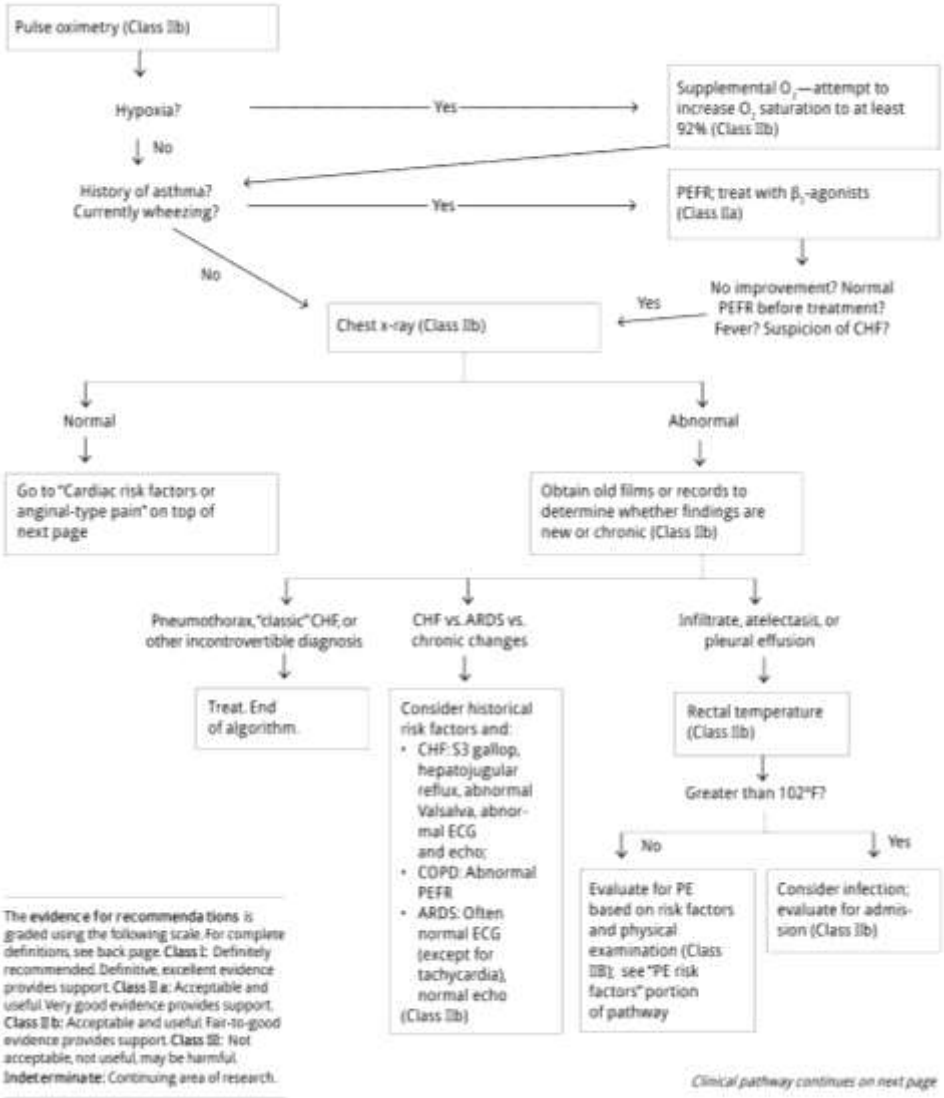
Symptomatic treatment:

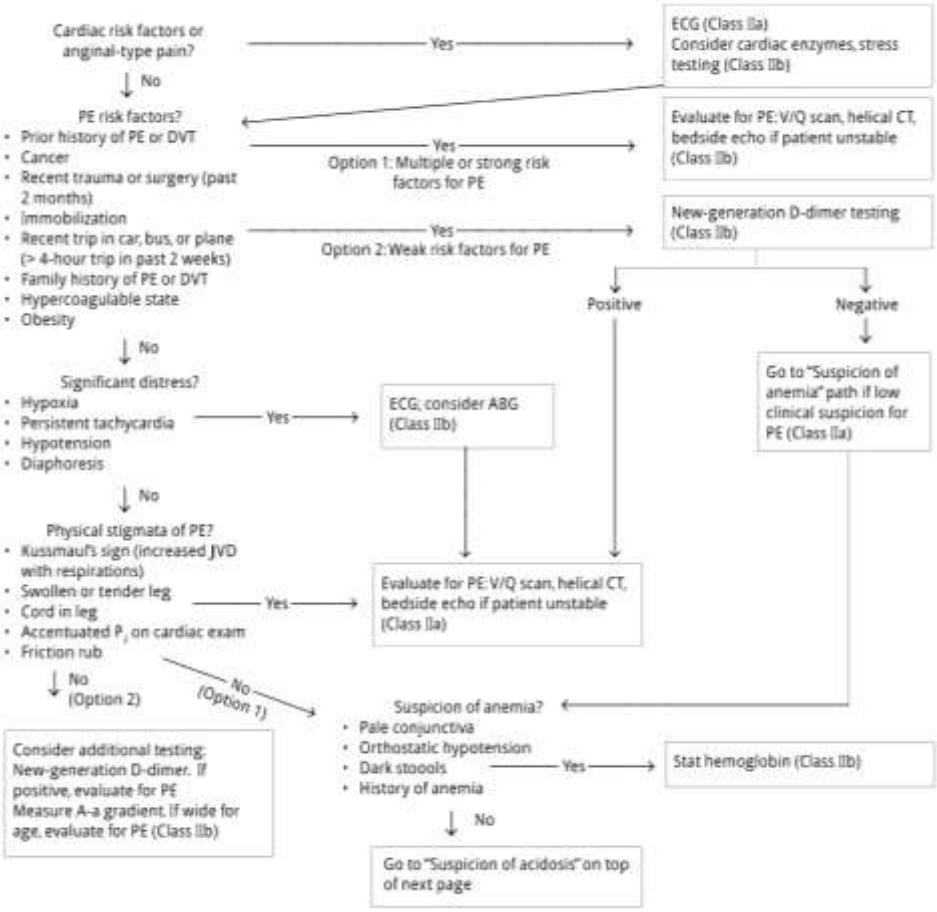
1. Rest; Ensure adequate intake of fluids, avoid irritants and gargle with warm water and salt.
2. Analgesics and anti-inflammatories
    - Ibuprofen and diclofenac > PCM in relieving sorethroat
    - Alternative: Lozenges containing flurbiprofen 8.75 mg (Strepsils, Strepfen)

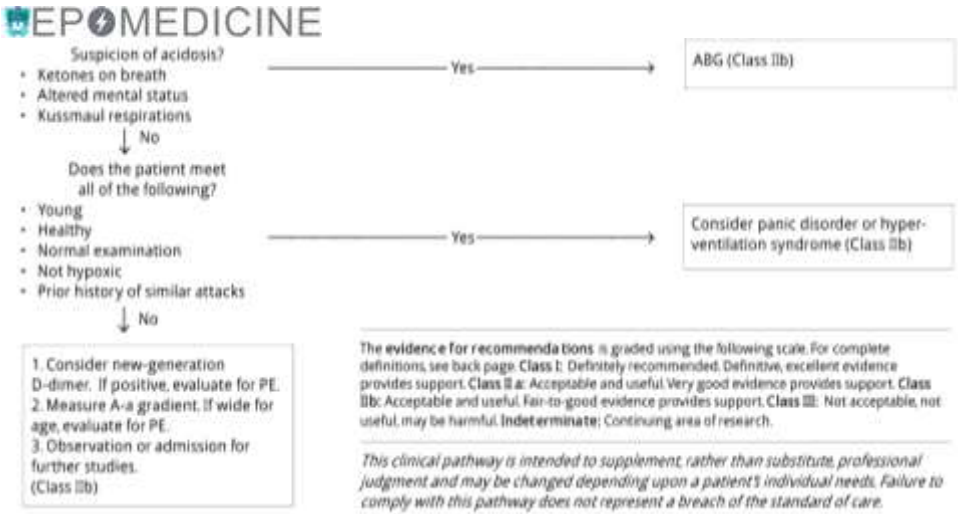
Reference:

Cots JM, Alós JI, Bárcena M, Boleda X, Cañada JL, Gómez N, Mendoza A, Vilaseca I, Llor C. [Recommendations for management of acute pharyngitis in adults]. Enferm Infecc Microbiol Clin. 2016 Nov;34(9):585-594. doi: 10.1016/j.eimc.2015.02.010. Epub 2015 Apr 11. Spanish. PubMed PMID: 25869058.

Unexplained Dyspnea




Cardiac risk factors or anginal-type pain?
Yes
ECG (Class IIa)
Consider cardiac enzymes, stress testing (Class IIb)
No
PE risk factors?
Prior history of PE or DVT
Cancer
Recent trauma or surgery (past 2 months)
Immobilization
Recent trip in car, bus, or plane (> 4-hour trip in past 2 weeks)
Family history of PE or DVT
Hypercoagulable state
Obesity
Yes
Option 1: Multiple or strong risk factors for PE
Evaluate for PE: V/Q scan, helical CT, bedside echo if patient unstable (Class IIb)
Yes
Option 2: Weak risk factors for PE
New-generation D-dimer testing (Class IIb)
Positive
Negative
Go to "Suspicion of anemia" path if low clinical suspicion for PE (Class IIa)
No
Significant distress?
Hypoxia
Persistent tachycardia
Hypotension
Diaphoresis
Yes
ECG; consider ABG (Class IIb)
No
Physical stigmata of PE?
Kussmaul's sign (increased JVD with respirations)
Swollen or tender leg
Cord in leg
Accentuated P_2 on cardiac exam
Friction rub
Yes
Evaluate for PE: V/Q scan, helical CT, bedside echo if patient unstable (Class IIa)
No (Option 2)
No (Option 1)
Suspicion of anemia?
Pale conjunctiva
Orthostatic hypotension
Dark stools
History of anemia
Yes
Stat hemoglobin (Class IIb)
No
Consider additional testing: New-generation D-dimer. If positive, evaluate for PE Measure A-a gradient. If wide for age, evaluate for PE (Class IIb)
Go to "Suspicion of acidosis" on top of next page



Modified Borg Dyspnea Scale

Patient instructions

The Borg scale is used to help us understand the intensity or severity of your breathlessness. We will ask you to use this scale to rate the intensity of your breathlessness before, during, and after your exercise.

Please review the scale to see the various levels from which you can choose.

The top of the scale, "0 or nothing at all," means *no breathlessness at all.*

The bottom of the scale, "10 or maximal," means the *most severe breathlessness that you have ever experienced or could imagine experiencing.*

When we ask you to rate the intensity of your breathlessness, please place the tip of your finger on the number that best describes the intensity that you are experiencing at that moment. You may also place a finger between 2 numbers if that better describes the intensity of your breathlessness.

Please let us know if you have any questions before we begin.

0	Nothing at all
0.5	Very, very slight (just noticeable)
1	Very slight
2	Slight
3	Moderate
4	Somewhat severe
5	Severe
6	
7	Very severe
8	
9	Very, very severe (almost maximal)
10	Maximal

Reference:

1. Kline J. Dyspnea: Fear, Loathing and Physiology [Internet]. Ebmedicine.net. 1999 [cited 4 January 2018]. Available from: http://www.ebmedicine.net/topics.php?paction=dLoadTopic&topic_id=44
2. Hareendran A, Leidy NK, Monz BU, Winnette R, Becker K, Mahler DA. Proposing a standardized method for evaluating patient report of the intensity of dyspnea during exercise testing in COPD. Int J Chron Obstruct Pulmon Dis. 2012;7:345-55. doi: 10.2147/COPD.S29571. Epub 2012 May 28. PubMed PMID: 22745534; PubMed Central PMCID: PMC3379870.

Acute Cough (<3 weeks)

Algorithm (1):

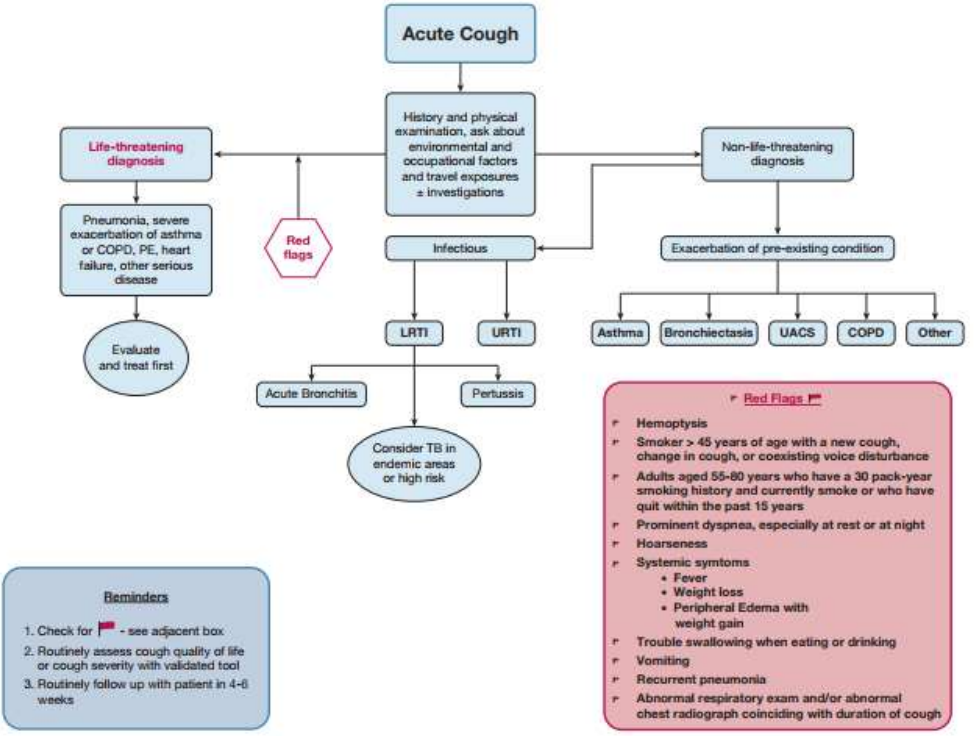


Figure 3 – *Acute cough algorithm for the management of patients ≥ 15 years of age with cough lasting < 3 weeks. Always screen for the presence of red flags as a clue to a potentially life-threatening condition. Always consider the presence of TB in endemic areas or high-risk populations even if chest radiographs are normal. Remember to routinely assess cough severity or quality of life before and after treatment and routinely follow patients 4-6 weeks after initial visit. LRTI = lower respiratory tract infection; PE = pulmonary embolism; UACS = upper airway cough syndrome; URI = upper respiratory tract infection.*

Control of cough (2):

1. "Home remedy" such as honey and lemon.
2. Simple voluntary suppression of cough may be sufficient to reduce cough frequency.
3. Opiate anti-tussives have a significant adverse side effect profile and are not recommended.
4. Recommended anti-tussives: Dextromethorphan (60 mg BD), 1st generation anti-histaminics (Levodropropizine 60 mg TDS).

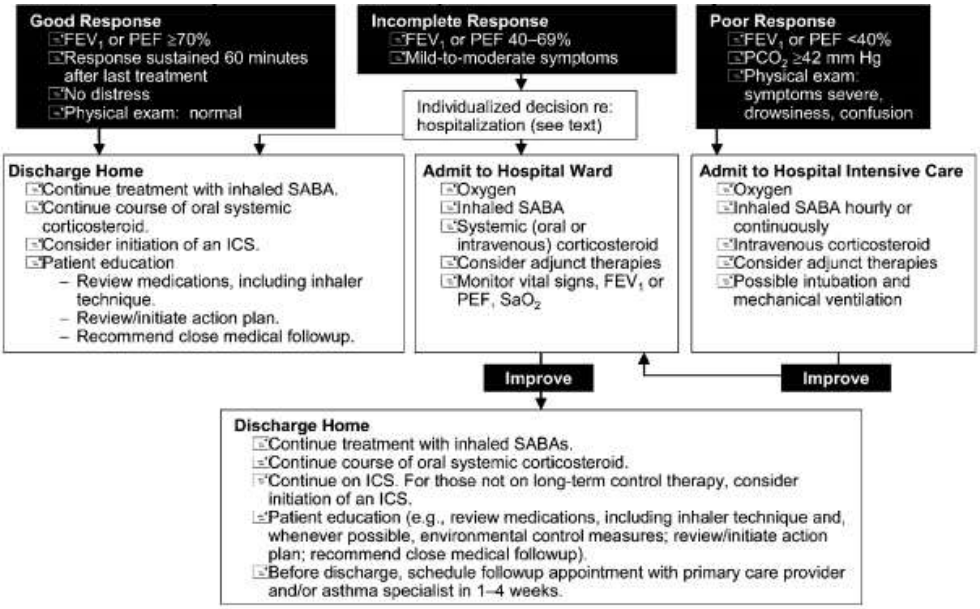
Reference:

1. Irwin RS, French CL, Chang AB, Altman KW; CHEST Expert Cough Panel*. Classification of Cough As a Symptom in Adults and Management Algorithms: CHEST Guideline and Expert Panel Report. Chest. 2017 Nov 10. pii:S0012-3692(17)32918-5. doi: 10.1016/j.chest.2017.10.016. [Epub ahead of print] PubMed PMID: 29080708.
2. Morice AH, McGarvey L, Pavord I; British Thoracic Society Cough Guideline Group. Recommendations for the management of cough in adults. Thorax. 2006 Sep;61 Suppl 1:i1-24. PubMed PMID: 16936230; PubMed Central PMCID: PMC2080754.

Severity of Asthma Exacerbation				
	Mild	**Moderate**	**Severe**	**Respiratory Arrest Imminent**
SIGNS / SYMPTOMS				
Activity Level:	Walks briskly	Walks slowly	Walks with assistance	Unable to walk
Feeding (infant):	Normal	Difficulty feeding	Unable to feed	Unable to suck
Talks in:	Sentences	Phrases	Words	Too dyspneic to speak; perspiring
Sounds (infant):	Normal cry, cooing	Short, clipped cry	Faint cry, grunting	
Alertness:	May be agitated	Usually agitated	Usually agitated	Drowsy or confused
Respiratory rate:	Increased	Increased	Often > 30/min	
	Normal rates of breathing in awake children: Age — Normal rate < 2 months — < 60/min 2-12 months — < 50/min 1-5 years — < 40/min 6-8 years — < 30/min			
Retractions & accessory muscle use:	Usually not	Usually	Usually	Paradoxical thoraco-abdominal movement (see-saw breathing)
Wheeze:	Moderate, often only end expiratory	Loud expiratory	Usually loud, may be biphasic (inspiratory and expiratory)	Absence of wheeze
Pulse/min. > 8 yrs:	< 100	100-120	>120	Bradycardia
Pulse/min. < 8 yrs:	Guideline limits of normal pulse rate in children: Infants (2-12 months): < 160/min Preschool (1-2 years): < 120/min School age (2-8 years): < 110/min			
Pulsus paradoxus:	Absent < 10 mm Hg	May be present 10-25 mm Hg	Often present > 25 mm Hg (adult) 20-40 mm Hg (child)	Absence suggests respiratory muscle fatigue
TESTS				
SaO2% (on room air)	*> 95%*	*91-95%*	*< 90%*	
PEF after initial bronchodilator treatment	*Over 80%*	*Approx. 60-80%*	*< 60% predicted*	
PaO2 (on room air)	*Normal* *Test not usually necessary*	*> 60 mm Hg*	*< 60 mm Hg* *Possible cyanosis*	*Cyanosis*
PaCO2	*< 45 mm Hg*	*< 45 mm Hg*	*> 45 mm Hg*	*>50 mm Hg*
	Note: Hypercapnea (hypoventilation) develops more readily in young children than in adolescents and adults.			
INTERVENTION				
Response to inhaled Short-Acting Bronchodilator (SABA)	*Prompt relief*	*Complete relief after multiple treatments*	*Partial relief after multiple treatments. Requires continuous inhaled SABA*	*Minimal or no relief from inhaled SABA. Requires systemic bronchodilator (subcutaneous epinephrine, terbutaline)*
Location of care	*Home Management*	*Office or emergency department*	*Emergency department; possible hospitalization*	*Hospitalization following stabilization in emergency department*
**Note: The presence of several parameters, but not necessarily all, indicates the general classification of the exacerbation.*				

Salbutamol			
Kg	**Unit Dose (0.5%)**	**MDI**	**Continuous**
5-10	2.5 mg (0.5 mL)	4 puffs	7.5 mg/hr
> 10-20	3.75 mg (0.75mL)	6 puffs	11.25 mg/hr
> 20	5 mg (1.0 mL)	8 puffs	15 mg/hr
Ipratropium			
5-10	500 mcg over 1 hr in nebulizer or 250 mcg q20 min x 3		
> 10	1000 mcg over 1 hr in nebulizer or 500 mcg q20 min x 3		
Prednisone/Methylprednisolone			
	1-2 mg/kg p.o./IV, **MAX 60 mg** or equivalent		
Dexamethasone			
	0.6 mg/kg, to maximum dose of 16 mg, for 2 dose		
Magnesium Sulfate			
50 mg/kg, **MAX 2 g** Give with Normal saline bolus, 20ml/kg (max 1 liter) over 20 min, observe in ED 60 min prior to transfer to inpatient floor			
Terbutaline			
Subcutaneous: 0.01 mg(mL)/kg MAX 0.25 mg (0.25 mL) q20 min X 3 doses			
Epinephrine (1:1000)			
Subcutaneous: 0.01 mg(mL)/kg MAX 0.3-0.5 mg (0.3-0.5 mL) q20 min X 3 doses			

1. **Oxygen:** Target SpO2 – 93 to 95% adults and 94-98% children 6-11 years
2. **Bronchodilators:** Salbutamol + Ipratropium Neb. Or MDI q20 min X 1-3 doses
3. **Corticosteroid:** Oral (if tolerated) or IV and continue for 5 days
4. **Refractory cases (after 1 hour) and Respiratory failure imminent:**
   Add: Magnesium sulfate X 1 dose
   Consider s.c. terbutaline OR epinephrine
   Consider RSI (slowing of RR, severe hypoxemia, depressed mental status, inability to maintain respiratory effort)
   Consider ICU admission
5. **Fever, purulent sputum or CXR suggestive of pneumonia:**
   Add antibiotics
6. Avoid sedatives



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4. http://ginasthma.org/wp-content/uploads/2016/04/GINA-2016-main-report_tracked.pdf

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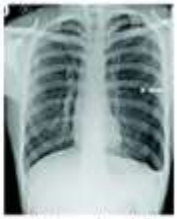
Spontaneous Pneumothorax (1)



measure the interpleural distance at the level of the hilum

Spontaneous Pneumothorax
If Bilateral/Haemodynamically unstable proceed to chest drain.

Age >50 and significant smoking history. Evidence of underlying lung disease on exam or CXR?

NO → **PRIMARY Pneumothorax**

YES → **SECONDARY Pneumothorax**

PRIMARY Pneumothorax

Size >2cm and/or breathless

NO → Consider discharge review in OPD in 2-4 weeks

YES* → Aspirate 16-18G cannula Aspirate <2.5l

Success (<2cm and breathing improved)

NO → Chest drain. Size 8-14Fr. Admit.

YES → Consider discharge review in OPD in 2-4 weeks

SECONDARY Pneumothorax

>2cm or breathless

YES → Chest drain. Size 8-14Fr. Admit.

NO → Size 1–2cm

YES → Aspirate. 16-18G cannula Aspirate <2.5l

Success. Size now <1cm.

YES → Admit. High flow oxygen (unless suspected oxygen sensitive). Observe for 24 hours.

NO → Admit. High flow oxygen (unless suspected oxygen sensitive). Observe for 24 hours.

NO → Chest drain. Size 8-14Fr. Admit.

* In some patients with a large pneumothorax but minimal symptoms conservative management may be appropriate.

Occasionally a "skin fold" may be confused with a pneumothorax. To make this distinction, look for whether the "line" in question extends beyond the chest wall - this is suggestive of a skin fold.

Deep sulcus sign – Dark lateral sulcus where the chest wall meets the diaphragm (subtle sign of pneumothorax in supine position).

Tension Pneumothorax

Symptoms and Signs (2):

1. Universal findings: Chest pain and Respiratory distress
2. Common findings (50-75% cases): Tachycardia, Ipsilateral decreased air entry
3. Inconsistent findings (<25% cases): Low SpO2, Tracheal deviation, Hypotyension
4. Rare findings (10% cases): Cyanosis, Hyper-resonance, Decreased level of consciousness, Ipsilateral chest hyper-expansion and hypo-mobility, Acute epigastric pain, Cardiac apical displacement, Sternal resonance

Indications for immediate chest decompression (2):

Chest radiograph not immediately available and:

- Sp02<92% on 02
- Systolic BP<90 mm Hg
- Respiratory rate<10
- Decreased level of consciousness on 02
- Cardiac arrest
  - bilateral finger or tube thoracostomy
  - not needle thoracocentesis

CXR in tension pneumothorax (2):

<u>Ipsilateral hyper-expansion:</u>
Hemidiaphragmatic depression, Increased rib separation, Increased thoracic volume

<u>Mediastinal pressure:</u>
Ipsilateral flattening of heart border, Contralateral mediastinal deviation

Emergent needle thoracocentesis (2)

1. 14-16 G cannula
2. Just above 3rd rib (2nd ICS) in **MCL**
3. Remove the needle from cannula

fail

Reattempt needle thoracocentesis (4)

1. 14-16 G cannula
2. Just above 5th or 6th rib (4th or 5th ICS) in **MAL**
3. Remove the needle from cannula

A gush of air (2): Fix cannula & Prepare for tube thoracostomy

Catheter aspiration of pneumothorax (3):

1. **Landmark:** Identify the 3rd rib in the mid-clavicular line.
2. **Local anesthesia:** Infiltrate 5 to 10 mL of 1% lignocaine subcutaneously and deeper until reaching the pleural space; this must be confirmed by aspiration of air into the syringe.
3. **Catheter insertion:** Insert venous catheter 16-18 G with 3 way above the 3rd rib in the mid-clavicular line, unless the pneumothorax is elsewhere.
4. **Aspirate:** until no more air is returned.
5. **Repeat CXR:** Leave the catheter in situ and immediately repeat the chest X-ray. Repeat the chest X-ray again in 2 to 4 hours.
6. **Reaccumulation of pneumothorax and removal of catheter:**
    a. If the pneumothorax has not reaccumulated, remove the catheter and discharge with advice to return if symptoms recur, or every 2 weeks until pneumothorax has resolved.
    b. If the pneumothorax has reaccumulated, connect the catheter to a continuous drainage underwater seal or Heimlich valve.

Indications for tube thoracostomy in Thoracic trauma (5):

1. Simple pneumothorax associated with any chest trauma
2. Tension pneumothorax
3. Pneumothorax increasing in size
4. Pneumothorax in any unstable patient
5. Bilateral pneumothorax
6. Hemothorax or Hemopneumothorax
7. Pneumothorax in an intubated, ventilated patient (including those about to undergo general anesthesia)
8. Open pneumothorax ("sucking" chest wound) in association with application of sterile occlusive dressing over the chest wall defect

Indications for thoracotomy in Thoracic trauma (5):

1. Operating room thoracotomy:
    a. Initial evacuation of 1500 ml of blood or more from thoracostomy tube
    b. Persistent hemorrhage (≥200 ml/hr for 4 hours)
    c. Failure of tube thoracostomy with enlarging hemothorax

   d. Hemodynamic instability despite adequate resuscitation
2. Emergency department thoracotomy:
   a. Penetrating injury with trauma arrest en route to or in the emergency department.

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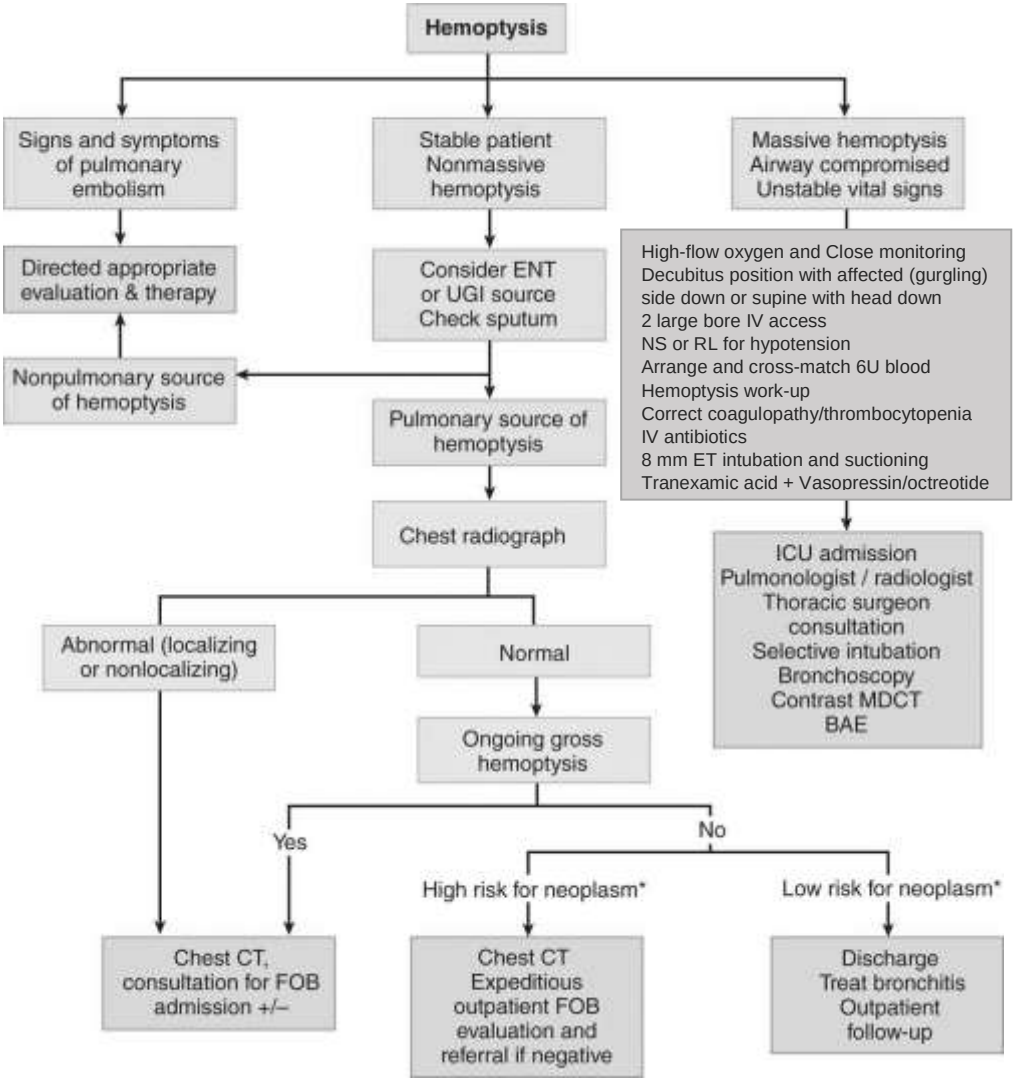
2. Brohi K. Tension Pneumothorax [Internet]. Trauma.org. 2006 [cited 5 January 2018]. Available from: http://www.trauma.org/index.php/main/article/199/

Hemoptysis


Hemoptysis
Signs and symptoms of pulmonary embolism
Stable patient Nonmassive hemoptysis
Massive hemoptysis Airway compromised Unstable vital signs
Directed appropriate evaluation & therapy
Consider ENT or UGI source Check sputum
High-flow oxygen and Close monitoring
Decubitus position with affected (gurgling) side down or supine with head down
2 large bore IV access
NS or RL for hypotension
Arrange and cross-match 6U blood
Hemoptysis work-up
Correct coagulopathy/thrombocytopenia
IV antibiotics
8 mm ET intubation and suctioning
Tranexamic acid + Vasopressin/octreotide
Nonpulmonary source of hemoptysis
Pulmonary source of hemoptysis
Chest radiograph
ICU admission
Pulmonologist / radiologist
Thoracic surgeon consultation
Selective intubation
Bronchoscopy
Contrast MDCT
BAE
Abnormal (localizing or nonlocalizing)
Normal
Ongoing gross hemoptysis
Yes
No
High risk for neoplasm*
Low risk for neoplasm*
Chest CT, consultation for FOB admission +/–
Chest CT Expeditious outpatient FOB evaluation and referral if negative
Discharge
Treat bronchitis
Outpatient follow-up

FOB = Fiber-optic bronchoscopy; BAE = Bronchial Artery Embolization

Massive hemoptysis:

- Volumetric: 600 ml within 24 hours; >8 ml/kg/day (pediatric)
- Magnitude of effect: Respiratory or hemodynamic compromise
- Asphyxiating hemoptysis: >150 ml/hr (volume of anatomical deadspace)

High risk for neoplasm*:

1. Age >40 years old
2. >40 pack-year smoking
3. Recurrent bleed
4. No history consistent with lower respiratory tract infection

Quantifying hemorrhage:

1. 1 teaspoonful (tspf) = 5 ml
2. 1 table spoon full (tbspf) = 15 ml
3. 1 cup = 250 ml

Tranexamic acid: 15-25 mg/kg IV q6h; for less severe – 1 gm PO TDS X 5 days

Vasopressin: 0.3 U/kg over 20 min followed by 0.3 U/kg/hr; 20 U in 100 ml D5% IV over 15 minutes followed by 0.2 U/min)

Octreotide: 50 mcg IV over 15 minutes followed by 2.5 ml/hr (400 mcg in 20 ml D5%)

Hemoptysis work-up

Labs

- Complete blood count
- Electrolytes
- Bleeding dyscrasia work-up
- Liver function tests
- Urine analysis
- Blood gas

Radiography*

- Chest X-ray
- CT scan with contrast

Interventional*

- Flexible bronchoscopy with BAL

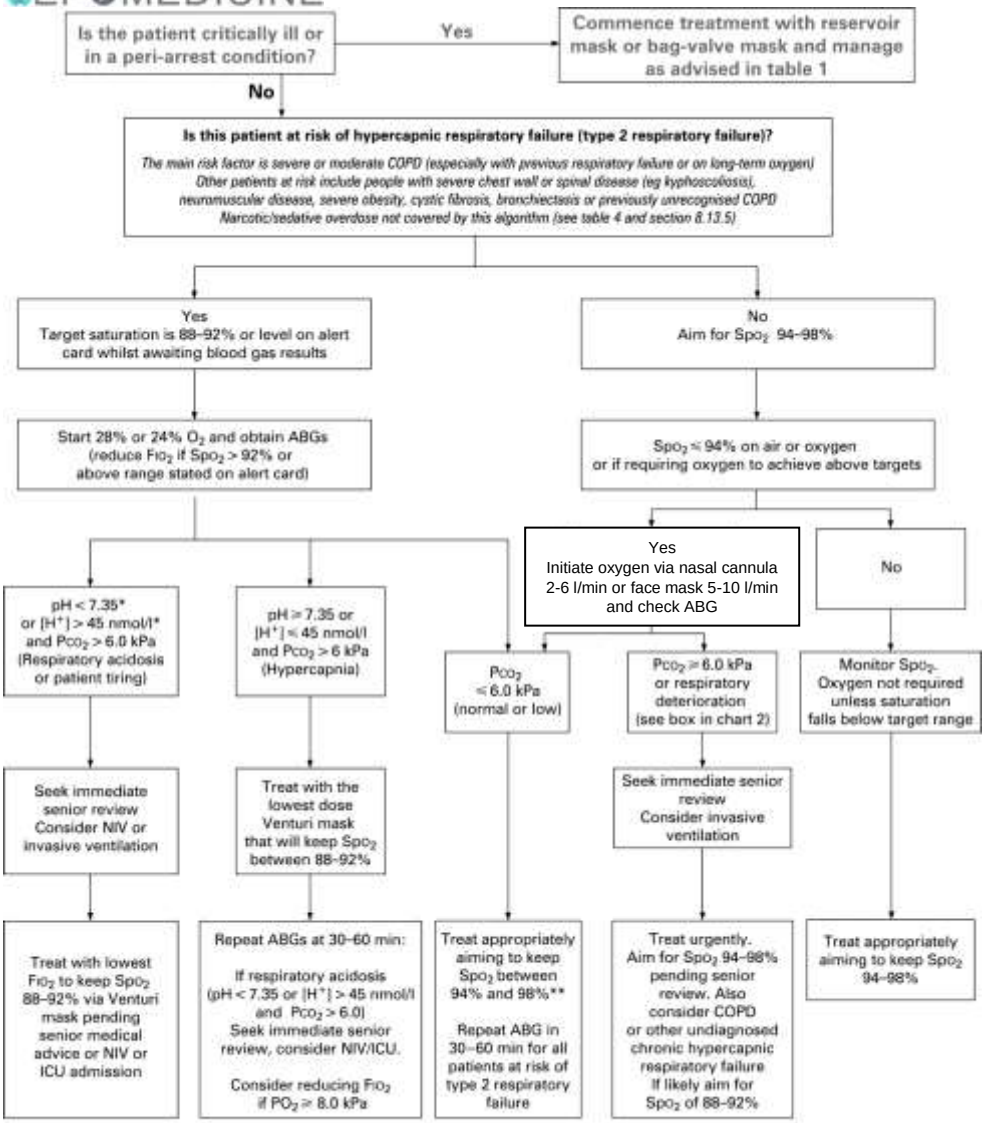
Reference and Further reading: Tintinalli's Emergency Medicine: A Comprehensive Study Guide, 7th ed., see Chapter 66, "Hemoptysis," by William Franklin Young, Jr.

Oxygenation in Acute Respiratory Failure

Chart 1: pCO2 6kPa = 45 mmHg

Oxygen with reservoir mask at 15l/min.

Once stable, reduce oxygen dose and aim for SpO2 94-98%.



Any increase in F_{IO_2} must be followed by repeat ABGs in 1 h (or sooner if conscious level deteriorates)
*If pH is < 7.35 ($[H^+]$ > 45 nmol/l) with normal or low P_{aCO_2}, investigate and treat for metabolic acidosis and keep S_{pO_2} 94–98%
**Patients previously requiring NIV or IPPV should have a target range of 88–92%, even if the initial P_{aCO_2} is normal.

Chart 2:

EPOMEDICINE

Choose the most suitable delivery system and flow rate

Titrate oxygen up or down to maintain the target oxygen saturation.

The table below shows available options for stepping dosage up or down. The chart does not imply any equivalence of dose between Venturi masks and nasal cannulae.
Allow at least 5 minutes at each dose before adjusting further upwards or downwards (except with major and sudden fall in saturation).
Once your patient has adequate and stable saturation on minimal oxygen dose, consider discontinuation of oxygen therapy.

Seek medical advice if patient appears to need increasing oxygen therapy or if there is a rising mEWS or Track and Trigger score

All patients must have ABG or earlobe blood gases (ELBG) within 1 h of requiring increased oxygen dose

Blue	Venturi 24% 2–4 l/min*	Nasal cannulae 1 l/min
White	Venturi 28% 4–6 l/min	Nasal cannulae 2 l/min
Yellow	Venturi 35% 8–10 l/min	Nasal cannulae 4 l/min
Red	Venturi 40% 10–12 l/min	or simple face mask at 5–6 l/min
Green	Venturi 60% 12–15 l/min	or simple face mask 7–10 l/min

Reservoir mask at 15 l/min oxygen flow

If reservoir mask required, seek senior medical input immediately

Signs of respiratory deterioration

- ⇑ Respiratory rate (especially if >30)
- ⇓ Spo_2
- ⇑ oxygen dose needed to keep Spo_2 in target range
- ⇑ EWS/trigger score
- CO_2 retention
- Drowsiness
- Headache
- Flushed face
- Tremor

Seek medical advice

* For Venturi masks, the higher flow rate is required if the respiratory rate is >30

Patients in a peri-arrest situation and critically ill patients should be given maximal oxygen therapy via reservoir mask or bag-valve mask whilst immediate medical help is arriving (except for patients with COPD with known oxygen sensitivity recorded in patient's case notes and drug chart or in the EPR: keep saturation at 88–92% for this subgroup of patients)

NIMV Indications

- Moderate to severe dyspnea
- Tachypnea (24 in hypercapnia- 30 in hypoxemic)
- Increase breath work
- $PaCO_2$ > 45mmHg in hypercapnia, and > 50mmHg in hypoxemic
- pH < 7.35
- PaFiO2 < 200

NIMV Contraindication

- Severe hypoxemia (PAFi < 75)
- Severe acidemia
- Multiorgan failure
- Upper airway obstruction
- Anatomical abnormalities (facial trauma)
- Respiratory arrest, Apnea
- Cardiac arrest, hemodynamic instability
- Inability to protect airway, with high risk of aspiration (GCS < 8)
- Increased risk of aspiration vomiting or severe gastrointestinal bleeding

Failure criteria
(Reevaluate 1 hours)

- Shock with refractory hemodynamic instability
- GCS < 8
- pH < 7.25
- PaFiO2 < 146 in 1hour
- Vme > 12 lts/m
- Refractory hyperlactatemia

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Hidalgo V, Giugliano-Jaramillo C, Pérez R, Cerpa F, Budini H, Cáceres D, Gutiérrez T, Molina J, Keymer J, Romero-Dapueto C. Noninvasive Mechanical Ventilation in Acute Respiratory Failure Patients: A Respiratory Therapist Perspective. Open Respir Med J. 2015 Jun 26;9:120-6. doi: 10.2174/1874306401509010120. eCollection 2015.

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Further reading: Nee PA, Al-Jubouri MA, Gray AJ, et al Critical care in the emergency department: acute respiratory failure Emergency Medicine Journal 2011;28:94-97.

ABG

ABG and VBG correlation (1):

Parameter	No. studies	No. patients	Weighted mean difference (bias)	95% limits of agreement*	Clinical interpretation
pH	13	2009	−0.033	Approximately ±0.1	Clinically interchangeable
pCO_2	8	965	6.2 mm Hg (0.83 kPa)	−17.4 to 23.9 mm Hg (−2.32 to +3.19 kPa)	Poor, unpredictable agreement
Bicarbonate	8	1211	−1.3 mmol/L	Approximately ±5 mmol/L	Probably close enough agreement for classification as high, normal or low
Base excess	2	429	Divergent results	Up to −4.4 to 3.9 BE units	Agreement unclear
Lactate	3	338	0.25 mmol/L	−2 to +2.3 mmol/L	May be close enough agreement for classification as high or normal

Parameter	No. studies	No. patients	Sensitivity for hypercarbia	NPV for hypercarbia	Clinical interpretation
pCO_2 ≤45 mm Hg (6 kPa) as a screening test for hypercarbia	4	529	100% (95% CI 97% to 100%)	100% (95% CI 97% to 100%)	Reliable screening test; congruence with clinical assessment required

*Interpreted from available data; not reported by all studies.
BE, base excess; NPV, negative pressure ventilation.

Indications (2)	**Contraindications**
All critically ill patients.	Negative modified Allen's test
Unexpected or inappropriate hypoxaemia (SpO2 <94%) or any patient requiring oxygen to achieve this target range.	Arteriovenous fistula
Deteriorating oxygen saturation or increasing breathlessness in a patient with previously stable chronic hypoxaemia.	Peripheral arterial disease
Any previously stable patient who deteriorates and requires a significantly increased fraction of inspired oxygen to maintain constant oxygen saturation.	Distorted anatomy/ trauma/burns to the limb - at or proximal to the attempted arterial puncture site.
Any patient with risk factors for hypercapnic respiratory failure who develops acute breathlessness, deteriorating oxygen saturation or drowsiness or other symptoms of CO2 retention.	Medium or high dose anticoagulation therapy, or history of clotting disorder.
Breathless patients with risk of metabolic conditions such as diabetic ketoacidosis or metabolic acidosis due to renal failure.	Severe coagulopathy

Any other evidence that would indicate that blood gas results would be useful in the patient's management.	Abnormal or infectious skin processes at/or near puncture site.

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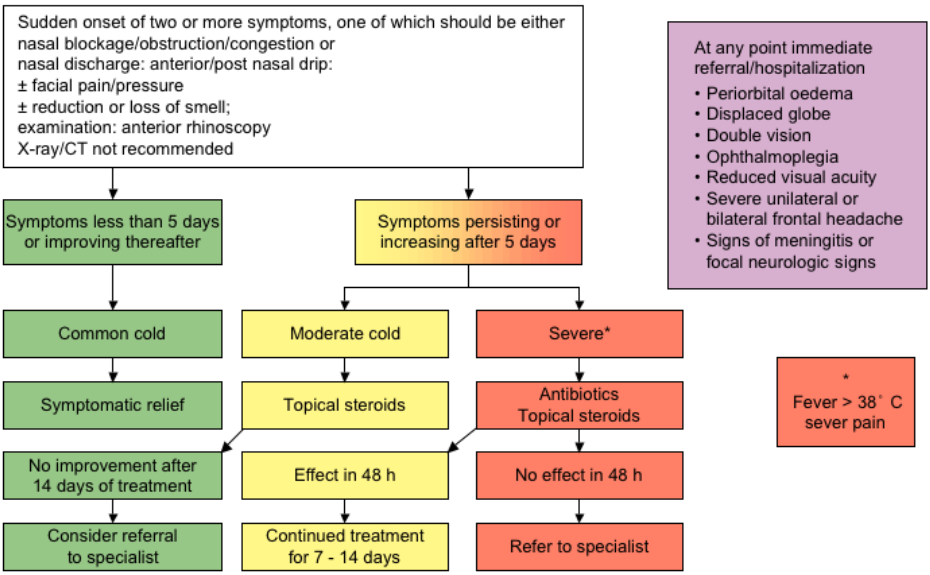
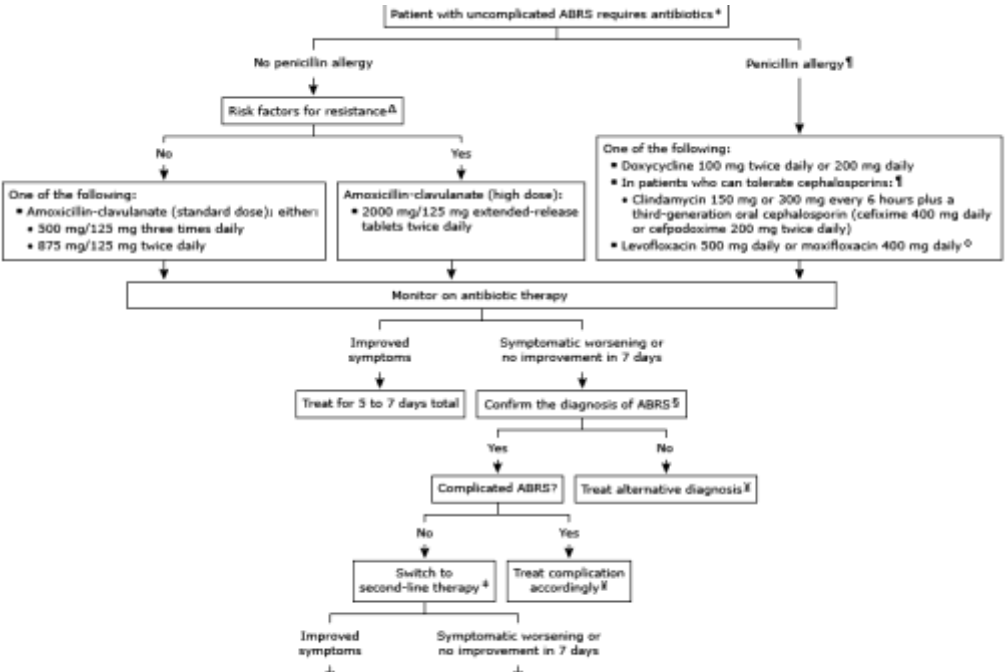
EPOMEDICINE

Uncomplicated Acute Rhinosinusitis





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