

呼吸治療師在宅急症照護實務應用及運作培訓課程

在宅急症居家呼吸困難及喘的評估及處理

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胸腔暨重症醫學專科醫師

肥胖症專科醫師

前衛生福利部雙和醫院睡眠中心主任

前臺北醫學大學人工智慧醫療碩士專班主任

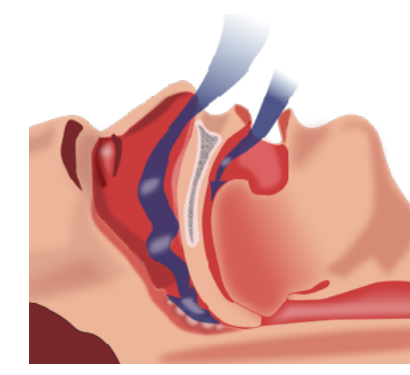
前林口長庚胸腔內科主治醫師



肺部浸潤
肺水腫

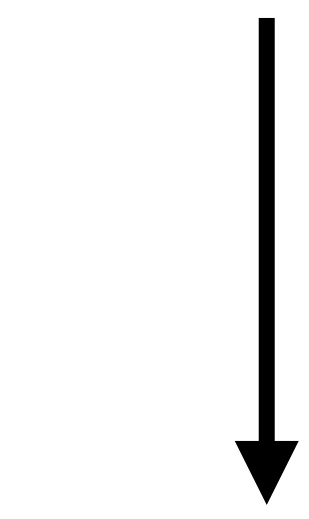


睡眠呼吸
中止症

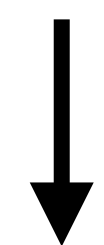


Chemoreceptors:
 O_2 , CO_2 , H^+

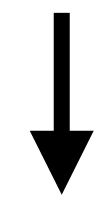
血中氧氣下降



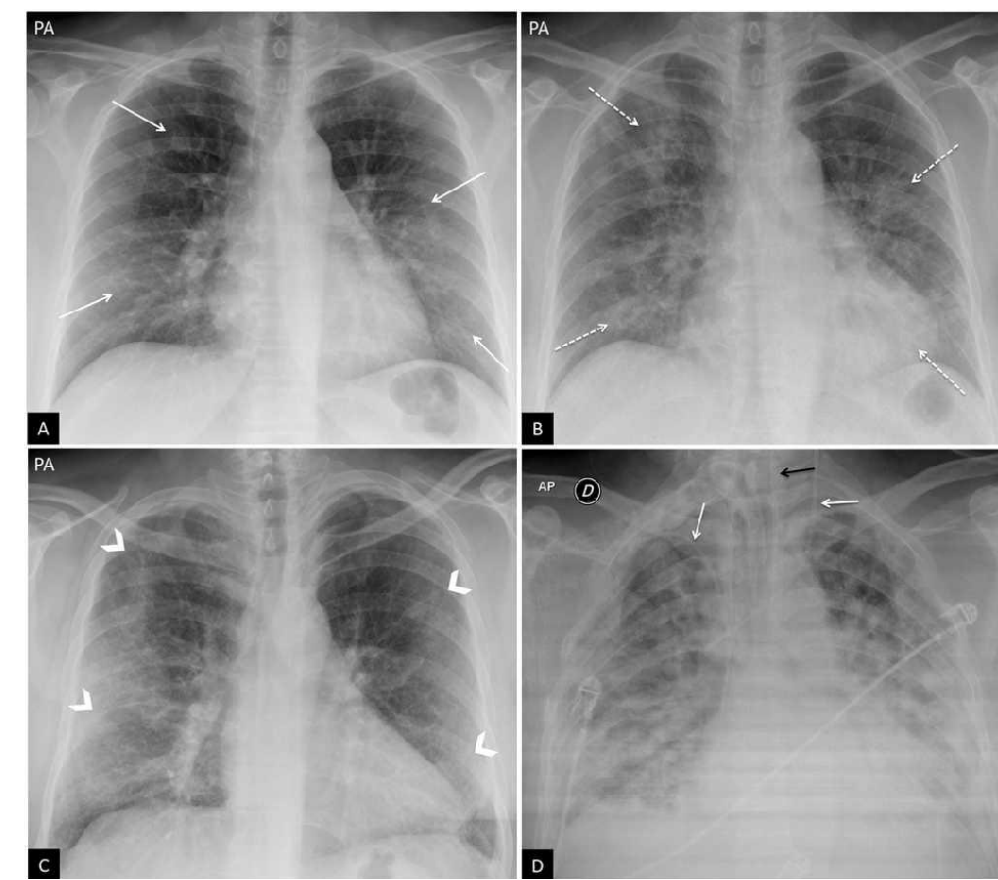
提高換氣量



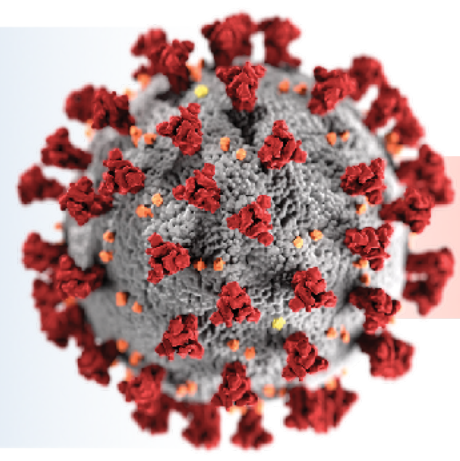
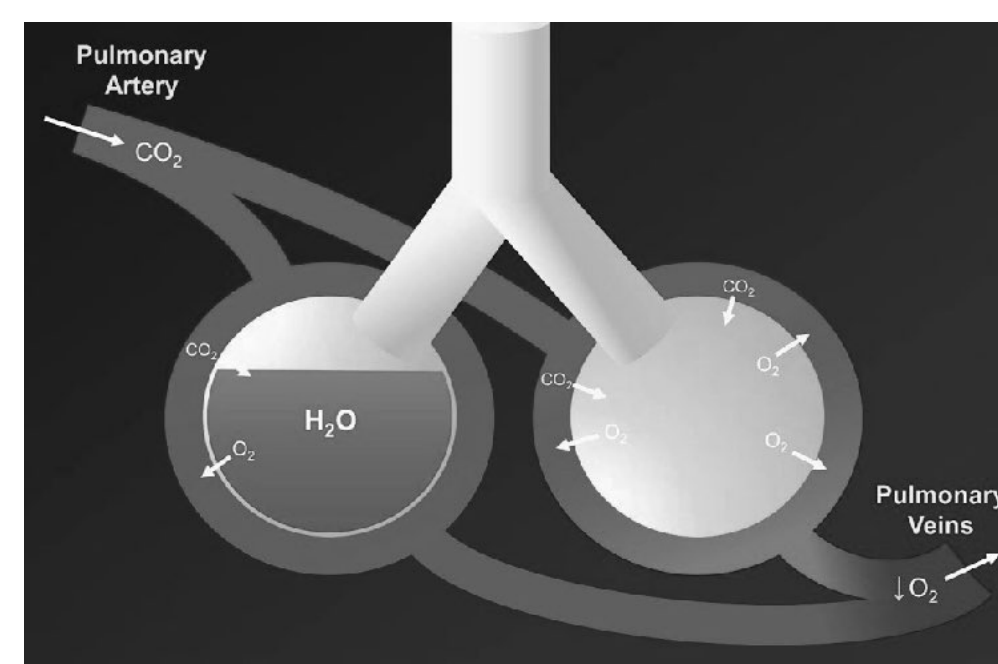
血液 CO_2 下降



換氣量下降，
不敷身體需求

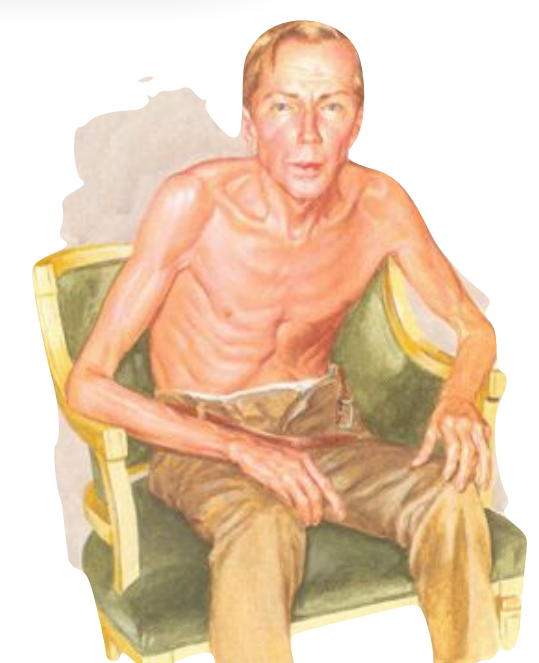


Delta: 危險



Mechanoreceptors:
Stretch,
Irritantant, etc.

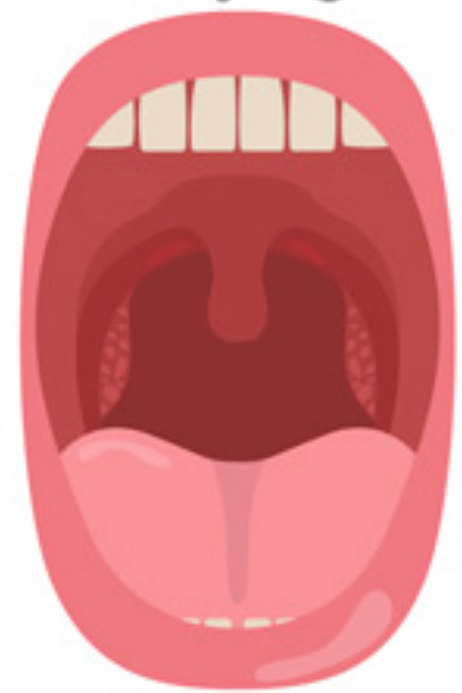
呼吸氣流
阻力增加



氣喘發作
肺阻塞
鼻塞
胸廓束縛

Omicron: 難受

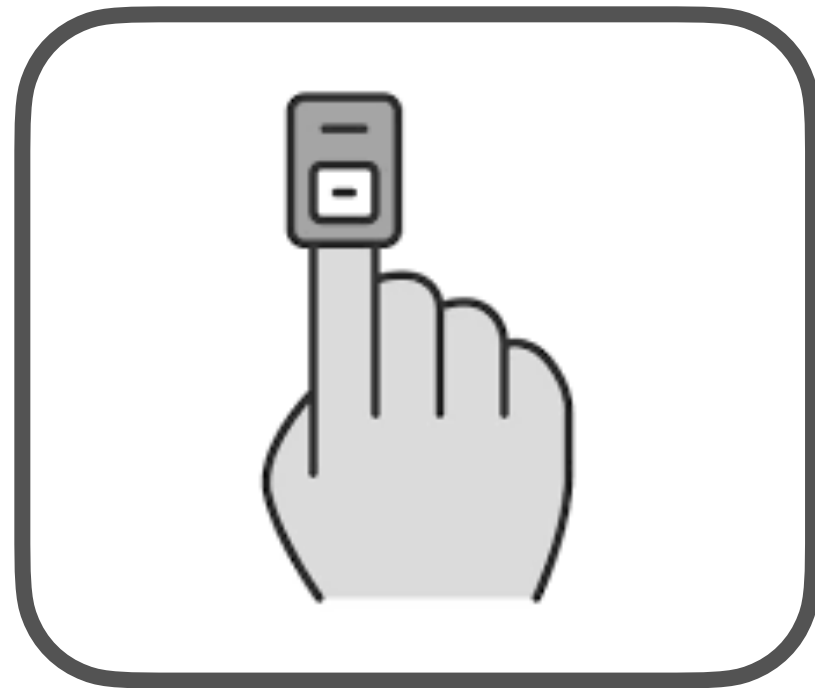
Pharyngitis



- 1 流鼻涕
- 2 頭痛
- 3 疲勞
- 4 打噴嚏
- 5 喉嚨痛



居家呼吸困難及喘的評估



缺氧



喘



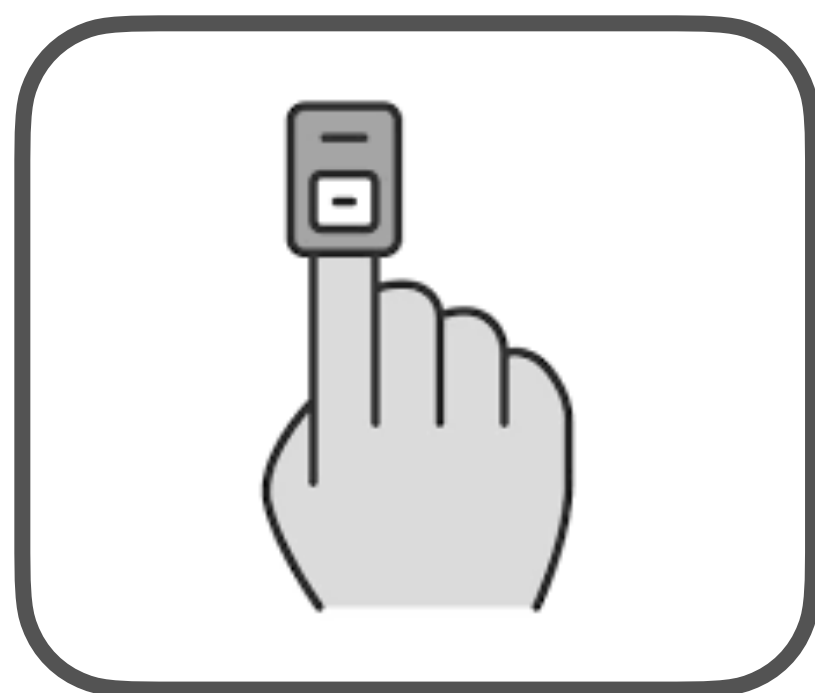
多痰



咳嗽

多痰與咳嗽真的是肺部的問題嗎？

居家呼吸困難及喘的評估



缺氧



喘

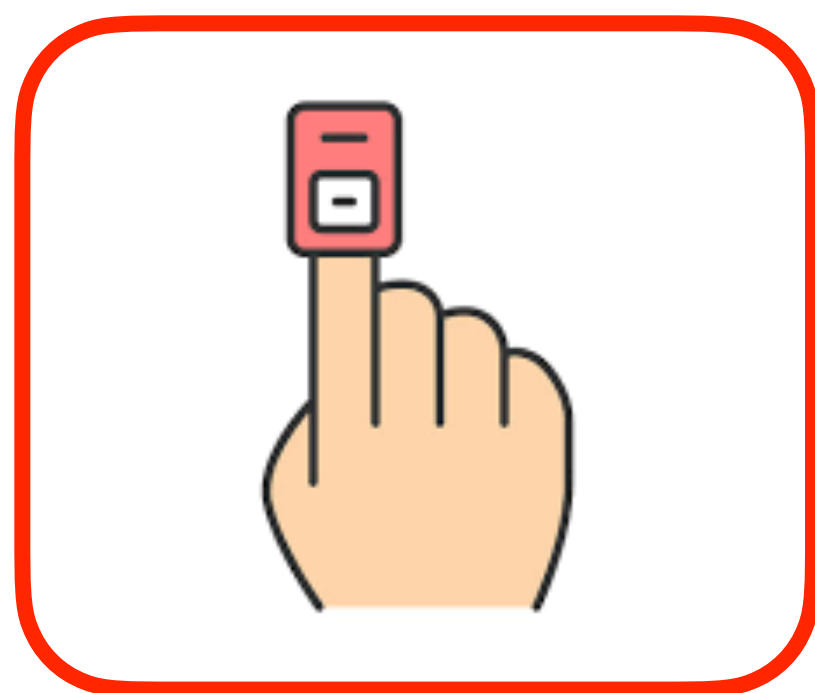


多痰



咳嗽

居家呼吸困難及喘的評估



缺氧



喘

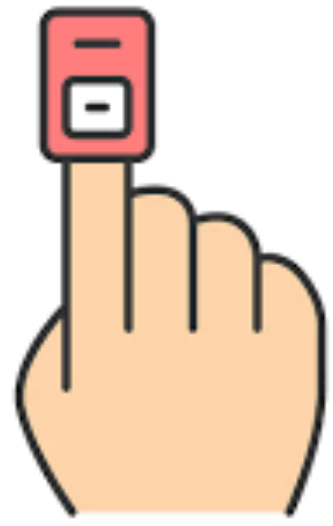


多痰

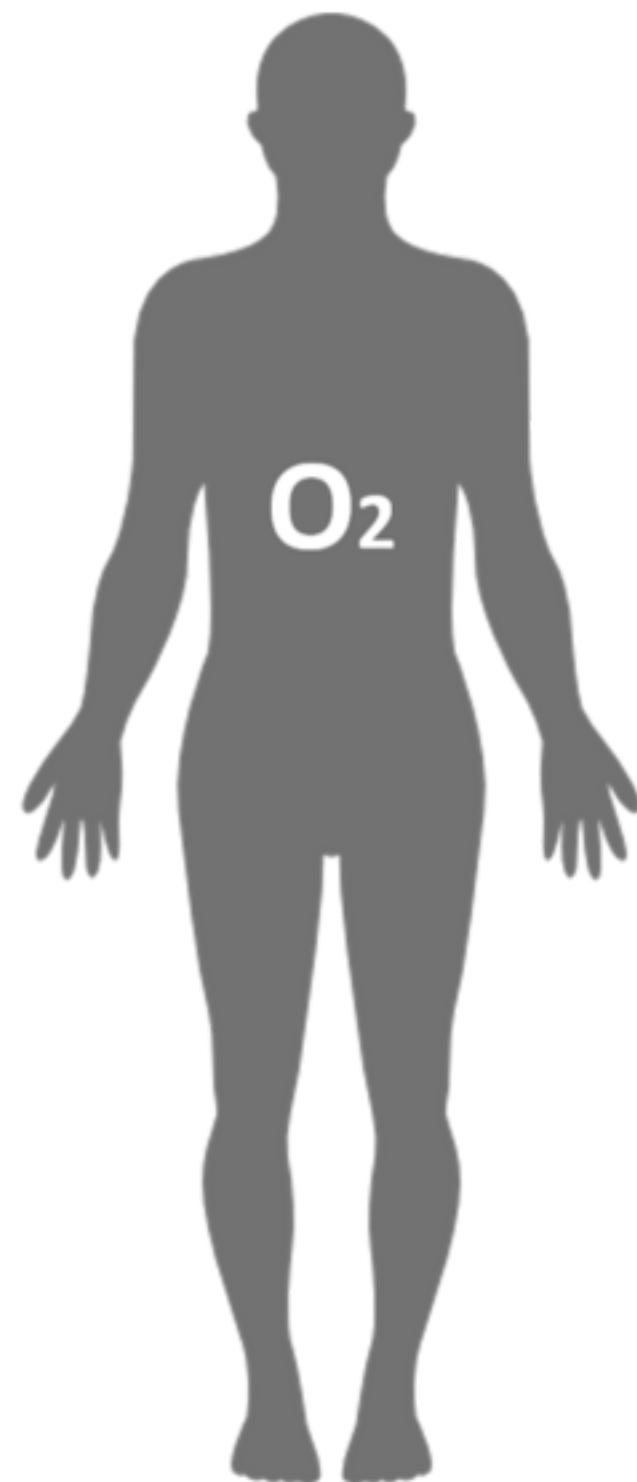


咳嗽

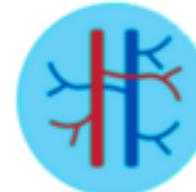
Clinical Signs and Symptoms of Acute Hypoxemia



缺氧



Brain
4.5%



Venous / Arterial blood
5.3% / 13.2%



Lung
5.6%



Adipose
7.5%



Skin
1.1-4.6%



Bone
1-6.5%



Cartilage
1-6%

- Tachycardia *Mild nausea, light-headedness, dizziness*
- Increased minute ventilation
- Restlessness and irritability
- Mild hypertension
- Peripheral vasoconstriction
- Muscular incoordination
- Confusion
- Cyanosis
- Bradycardia and arrhythmias
- Hypotension
- Loss of consciousness

心跳加速

過度換氣

躁動不安

50~60 mmHg

SpO2 < 90%

35~50 mmHg

SpO2: 70-85%

25~35 mmHg

SpO2: 50-70%

< 25 mmHg

發紺

心跳變慢

心律不整

昏迷

if **Anemia** or **Cardiac** insufficiency $\Rightarrow$ symptoms occur at higher PaO_2

HYPOXIA

**"Respiratory"
Hypoxic Hypoxia**

↓ P_aO_2

Response to
100% FiO_2

Yes

V/Q mismatch
Diffusion
impairment
↓ FiO_2
Hypoventilation

Oxygen,
Effective

No

Shunt (large)

Oxygen,
Not effective

**"Cardiac"
Stagnant Hypoxia**

normal P_aO_2

Related to ↓ CO
Results in ↓ S_vO_2 and P_vO_2
from increased tissue
extraction of O_2

Response to
100% FiO_2

No

Shock
LV failure
Hypovolemia
Hypothermia

Oxygen,
Not effective

**"Blood and tissue"
Hypoxia**

normal P_aO_2

Anemic Hypoxia

↓ in amount of
functioning Hgb

Histotoxic Hypoxia

Poisoning of cellular
machinery that uses O_2

Response to 100% FiO_2

Yes

CO
poisoning

Oxygen,
Effective

No

Anemia
Methemo-
globinemia

Oxygen,
Not effective

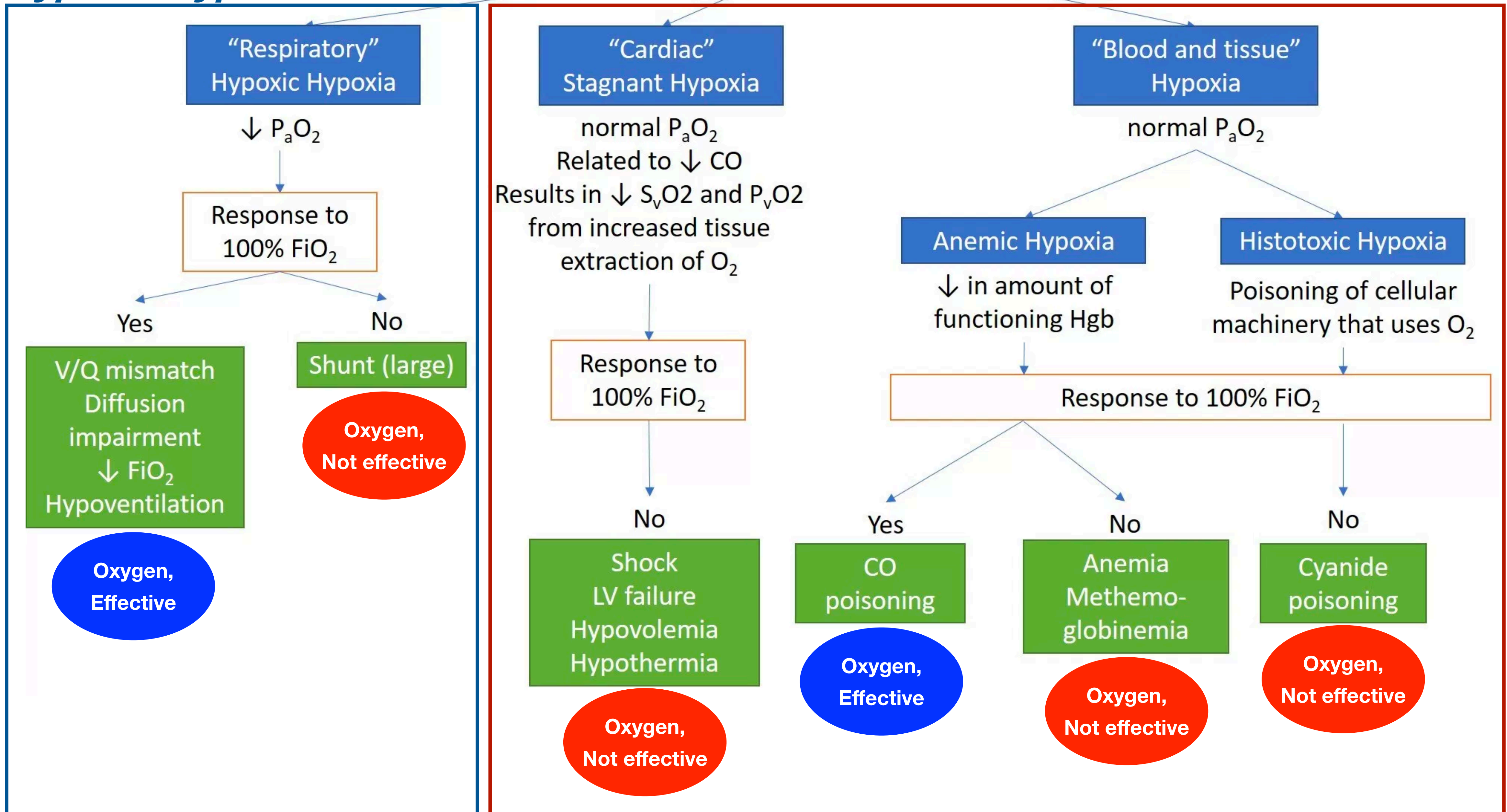
No

Cyanide
poisoning

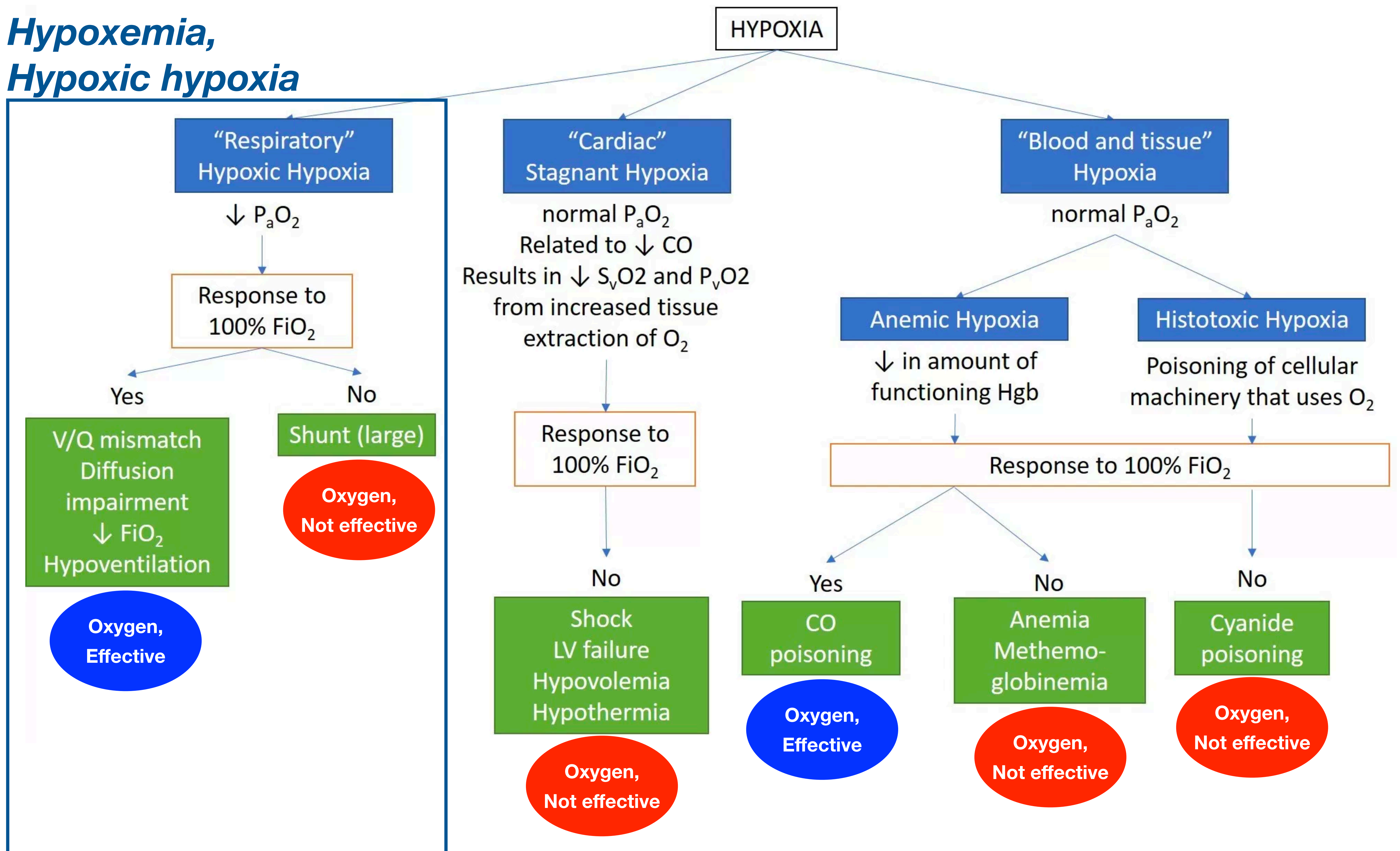
Oxygen,
Not effective

Hypoxemia, Hypoxic hypoxia

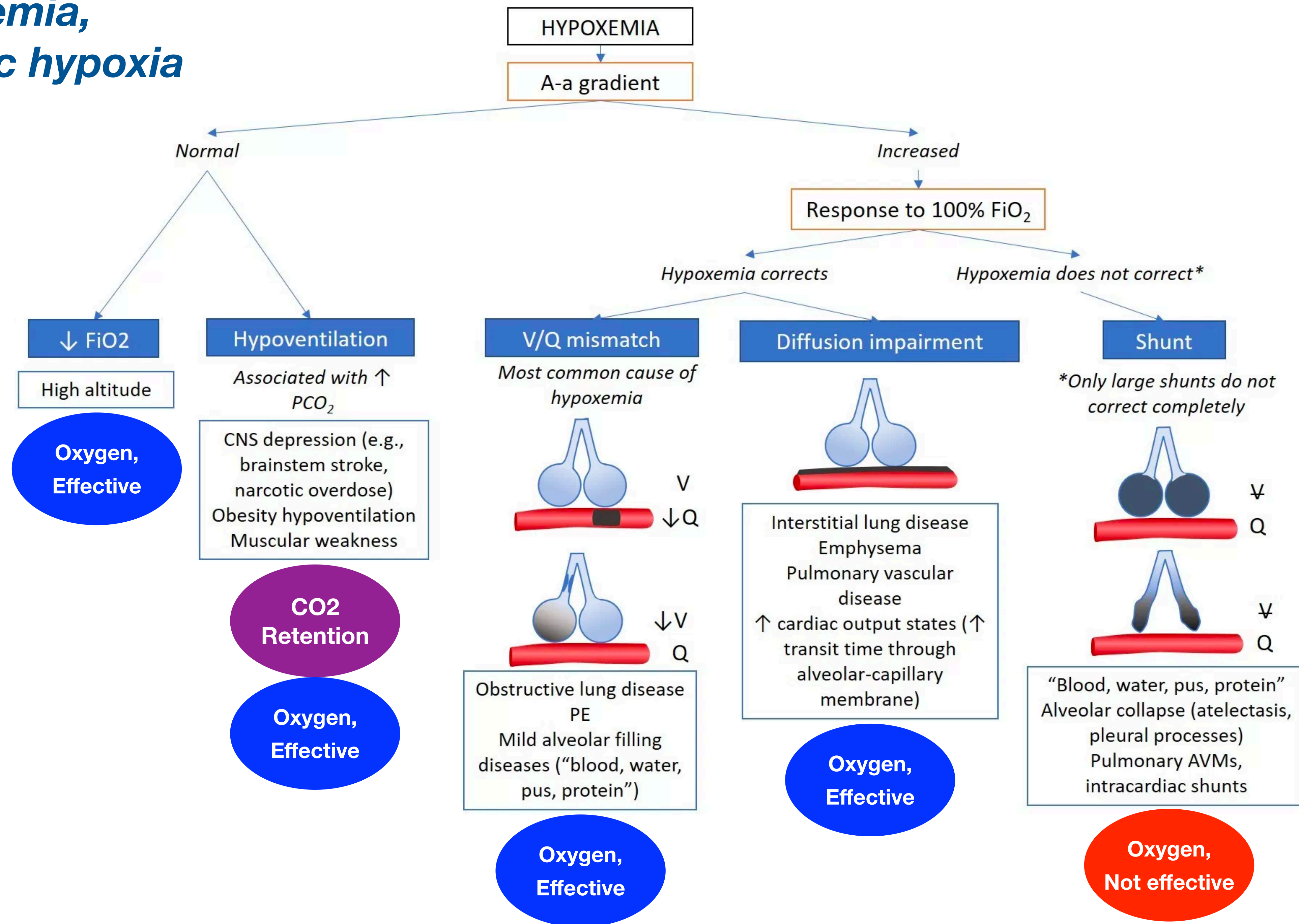
Hypoxia



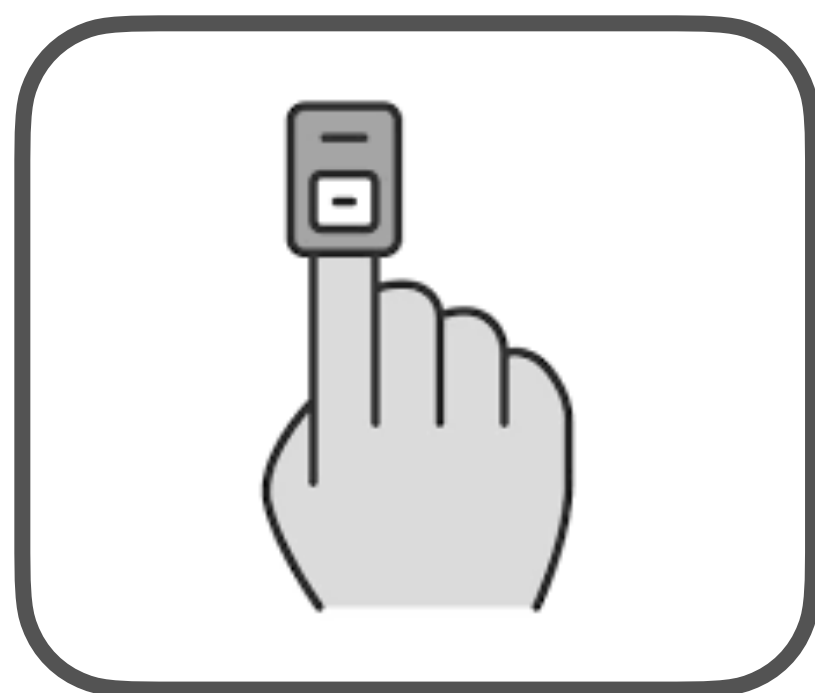
Hypoxemia, Hypoxic hypoxia



Hypoxemia, Hypoxic hypoxia



居家呼吸困難及喘的評估



缺氧



喘

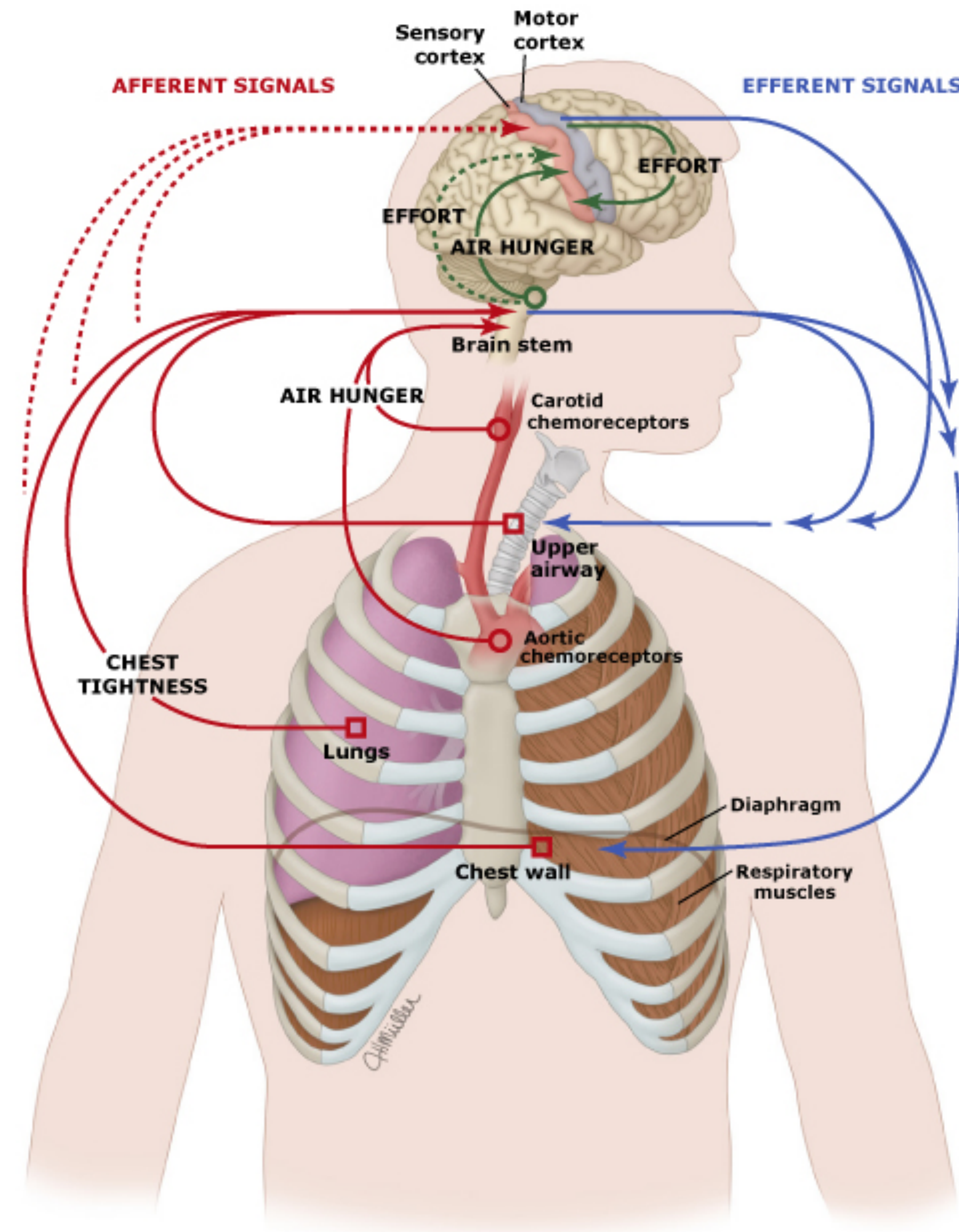


多痰

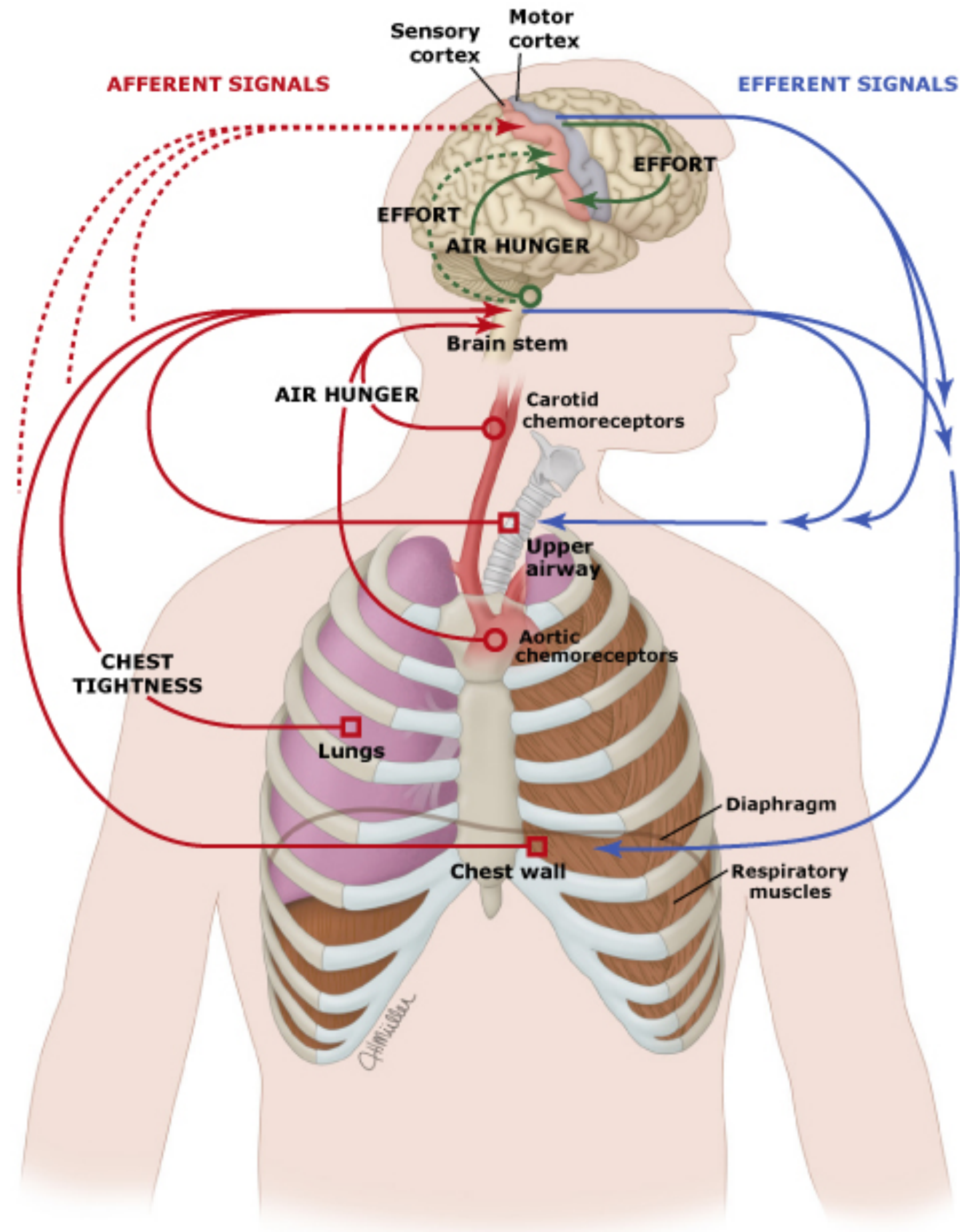


咳嗽

Efferent and Afferent signals that contribute to the sensation of dyspnea



Dyspnea



- **Respiratory centers: increased output**
 - Chemoreceptor: PO_2 , PCO_2
- **Stimulation of mechanoreceptors:**
 - Upper airway receptors: Trigeminal nerve (CN5)
 - Pulmonary receptors: Stretch, Irritant, C-fibers
 - Chest wall receptors: M. spindles
- **Mechanical loading of the respiratory system: dyspnea vs. effort**
- **Neuromechanical dissociation**
- **Impaired oxygen delivery or utilization**
 - Anemia
 - Cardiovascular deconditioning
- **Neural activation associated with breathing discomfort**
 - Sensory dimension: intensity, quality, time course
 - Affective dimension: immediate unpleasantness, evaluative and emotional response

肺部浸潤
肺水腫



Chemoreceptors:
 O_2 , CO_2 , H^+

血中氧氣下降



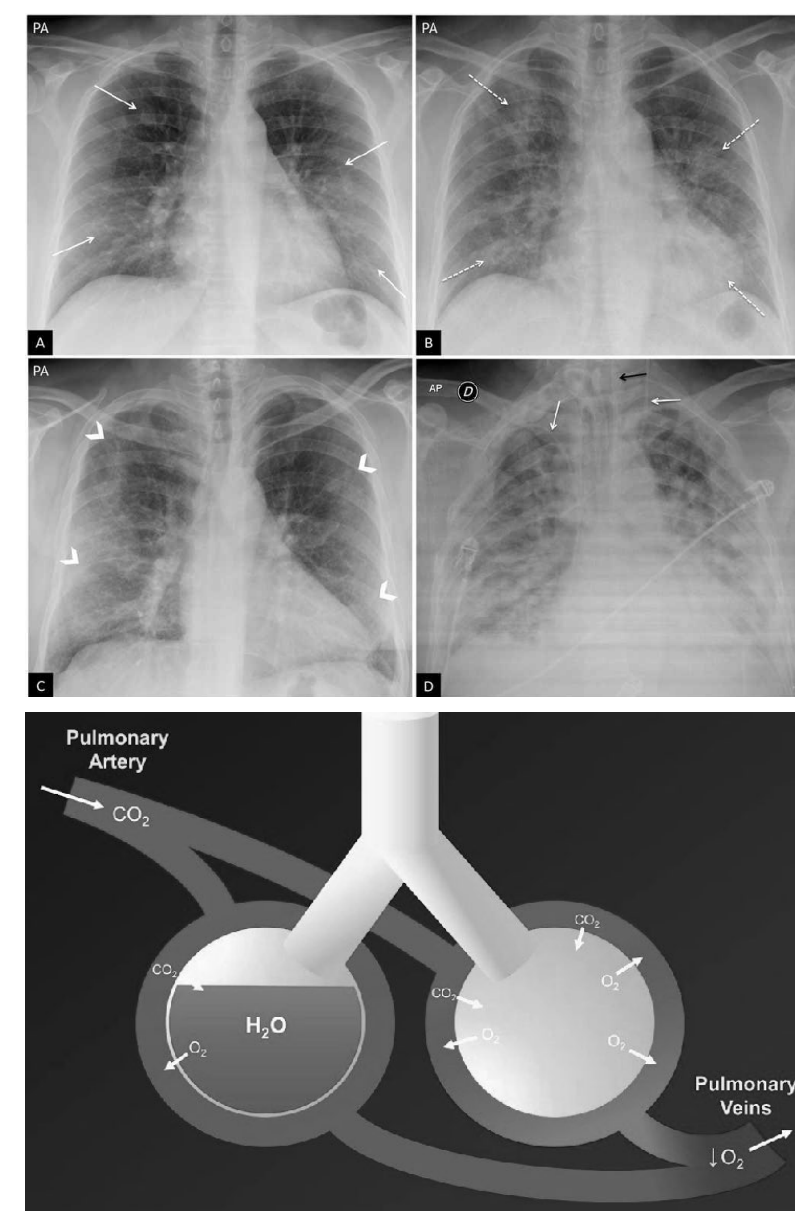
提高換氣量



血液 CO_2 下降



換氣量下降，
不敷身體需求

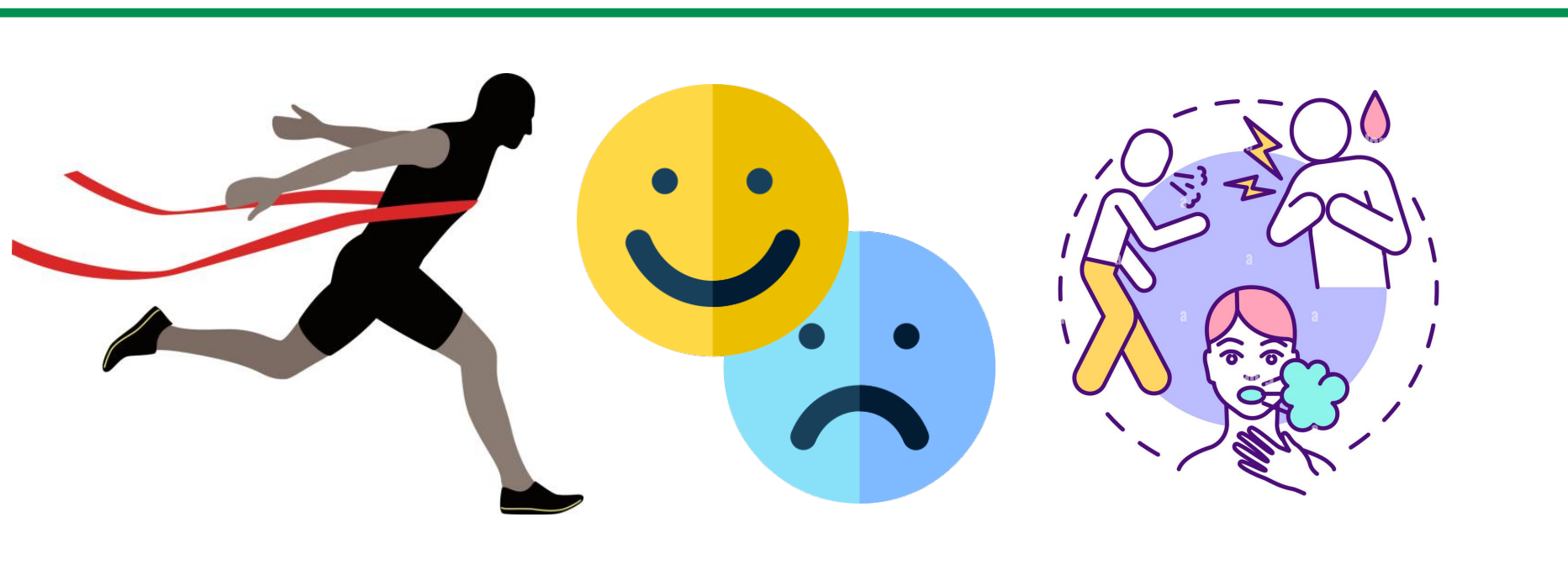
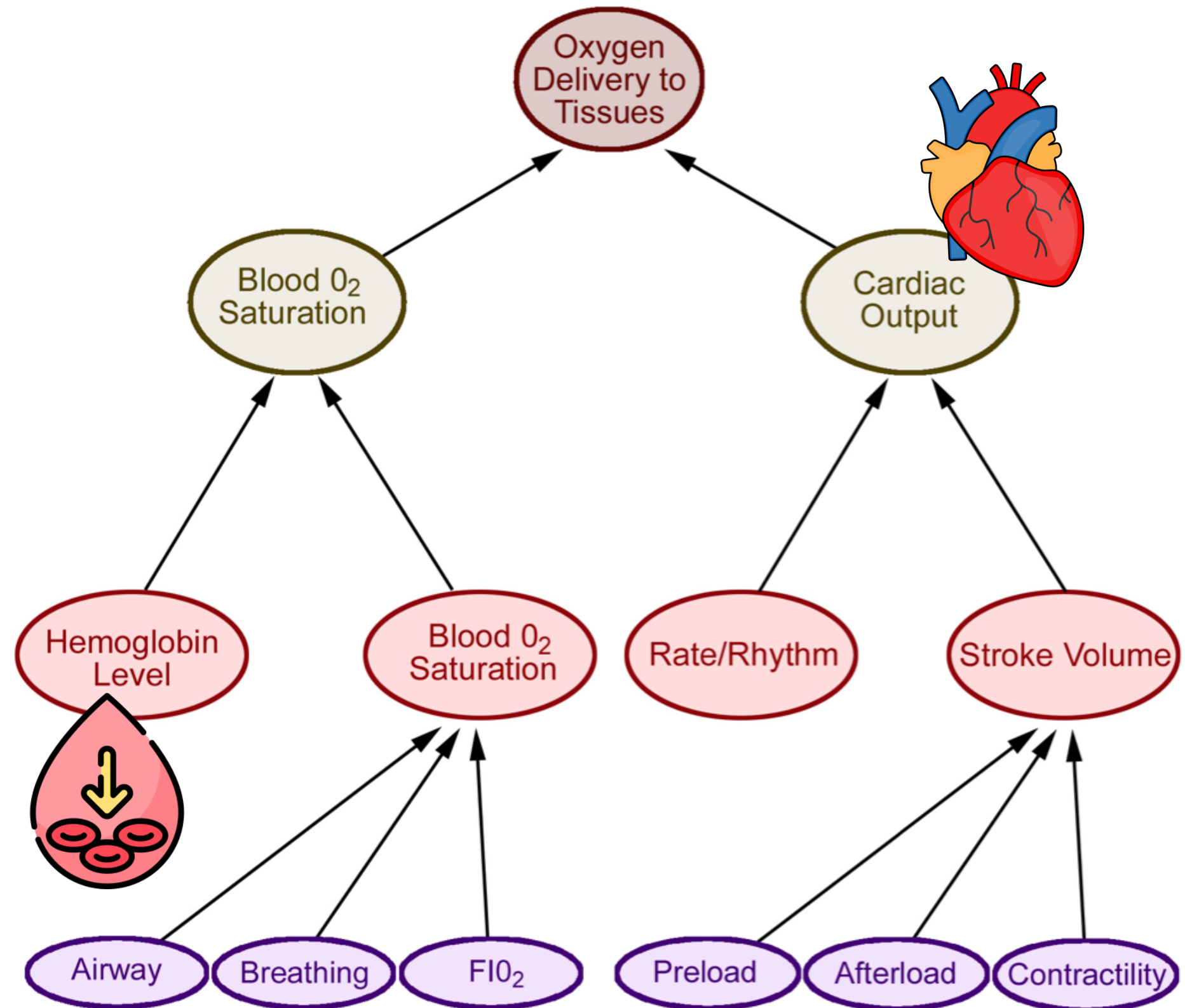


Delta: 危險

Dyspnea

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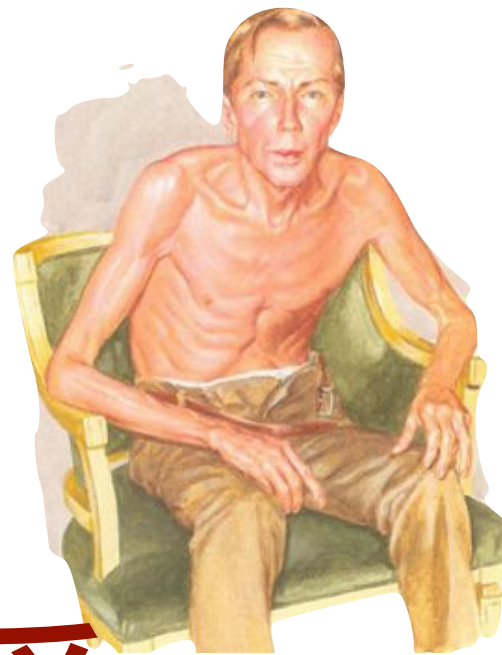
氣喘發作
肺阻塞
鼻塞
胸廓束縛

Mechanoreceptors:
**Stretch,
Irritantant, etc.**

Dyspnea

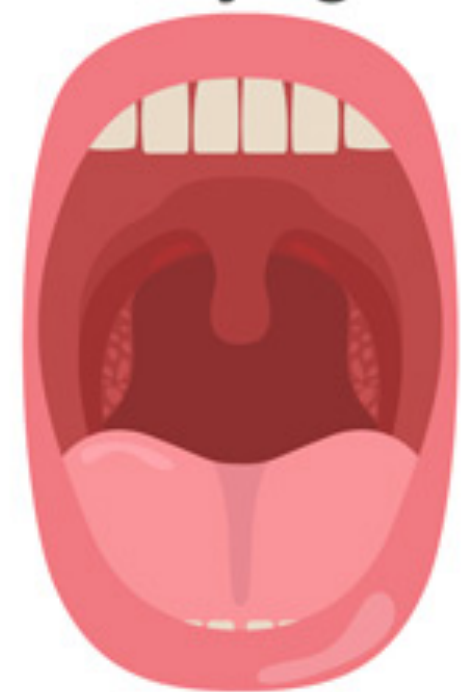
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呼吸氣流
阻力增加

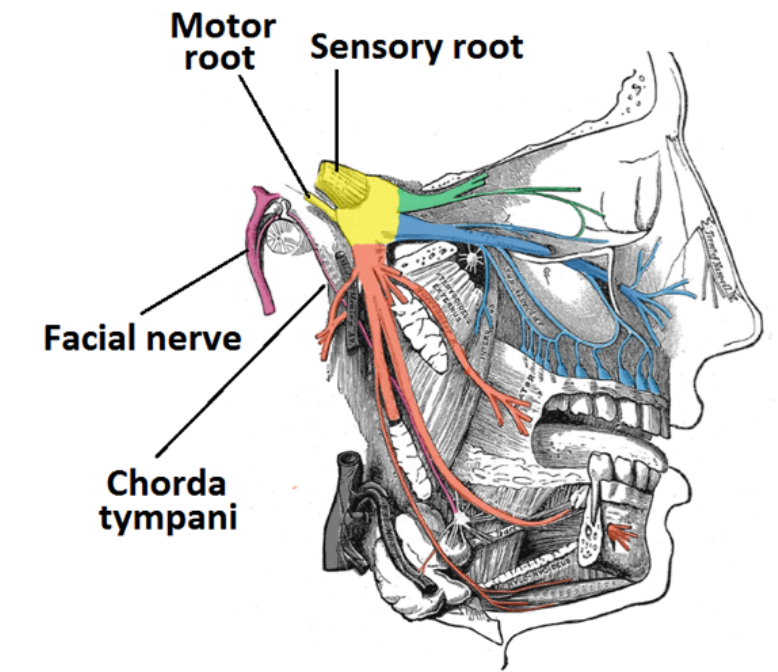
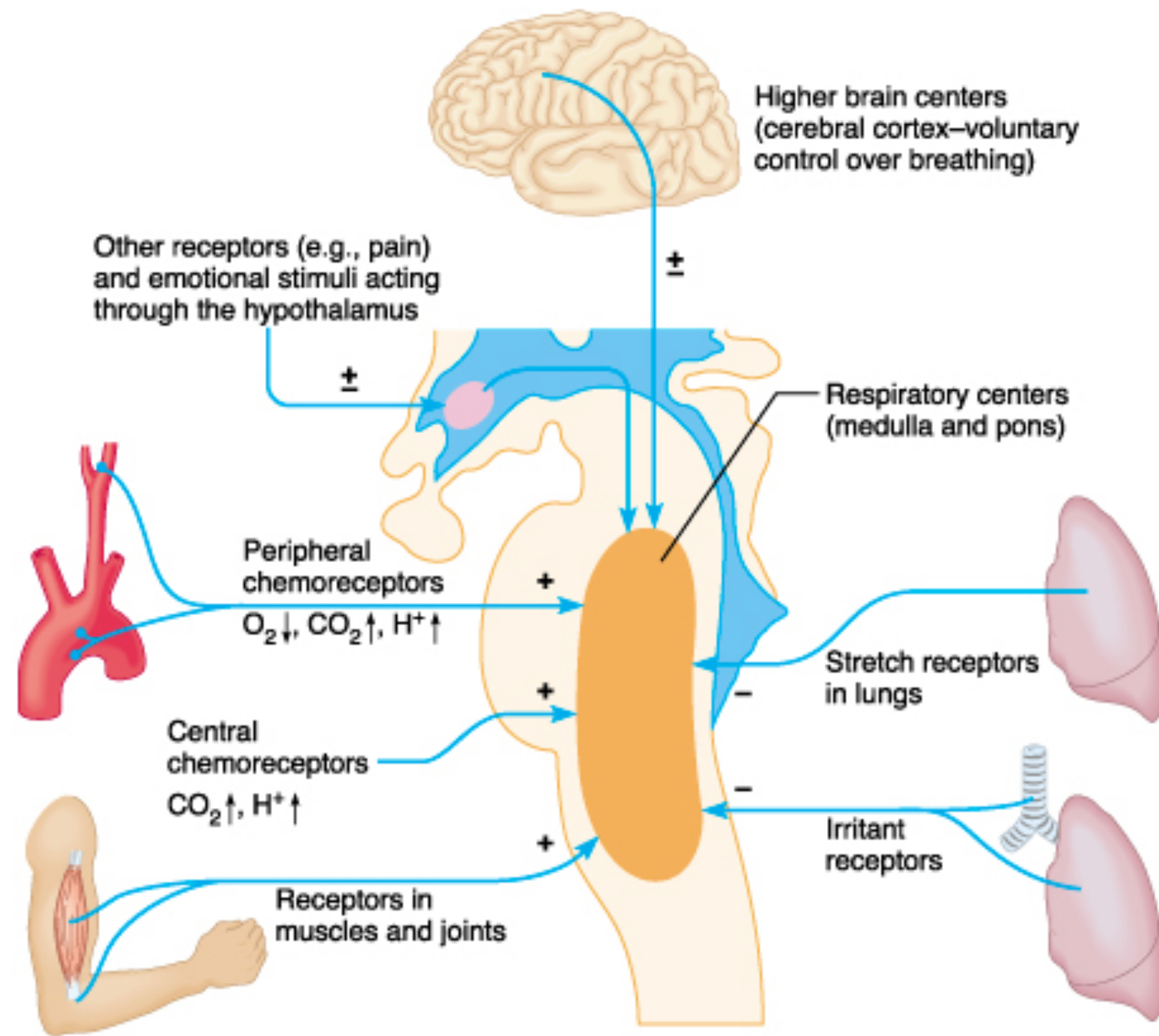


Omicron: 難受

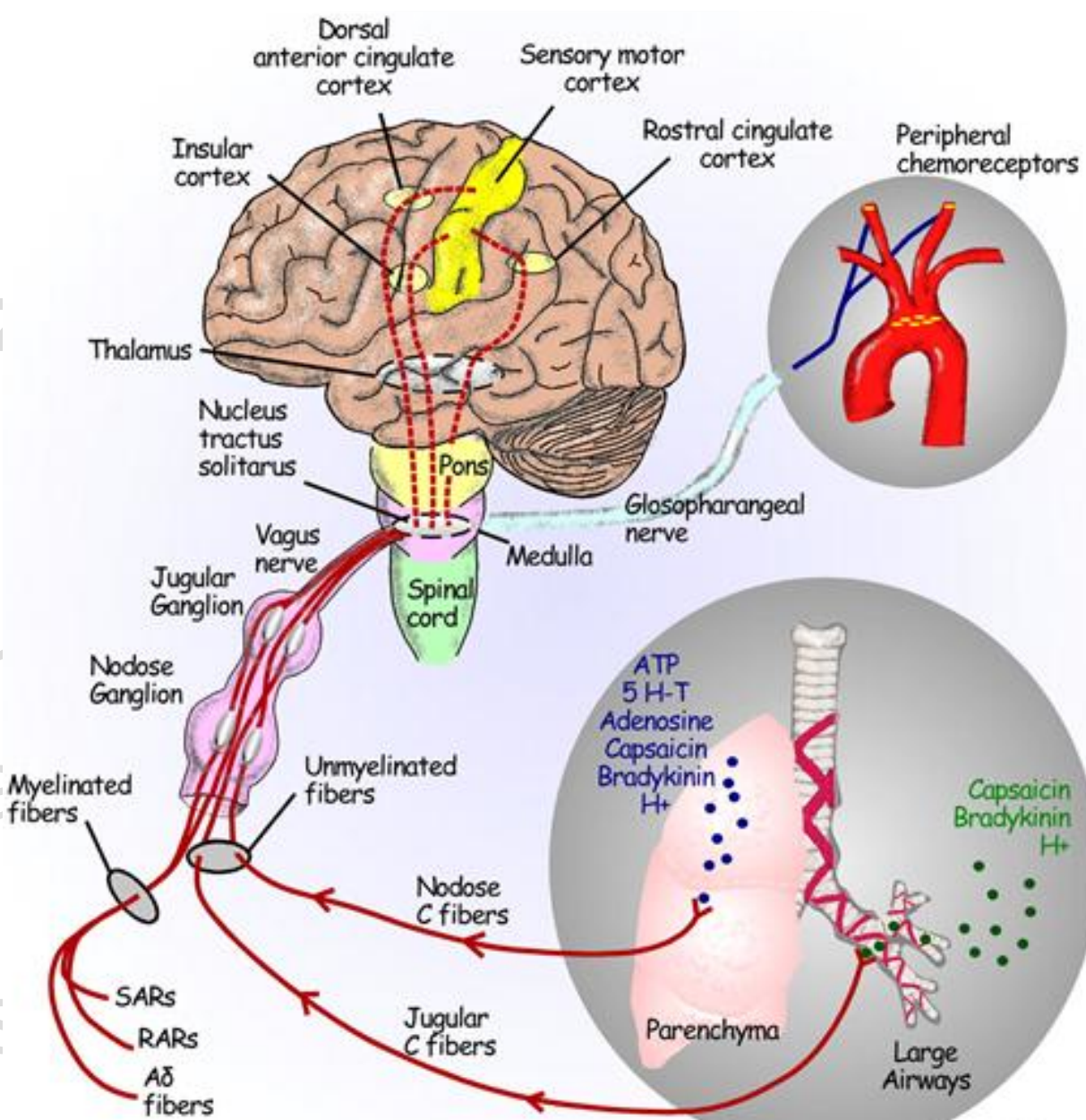
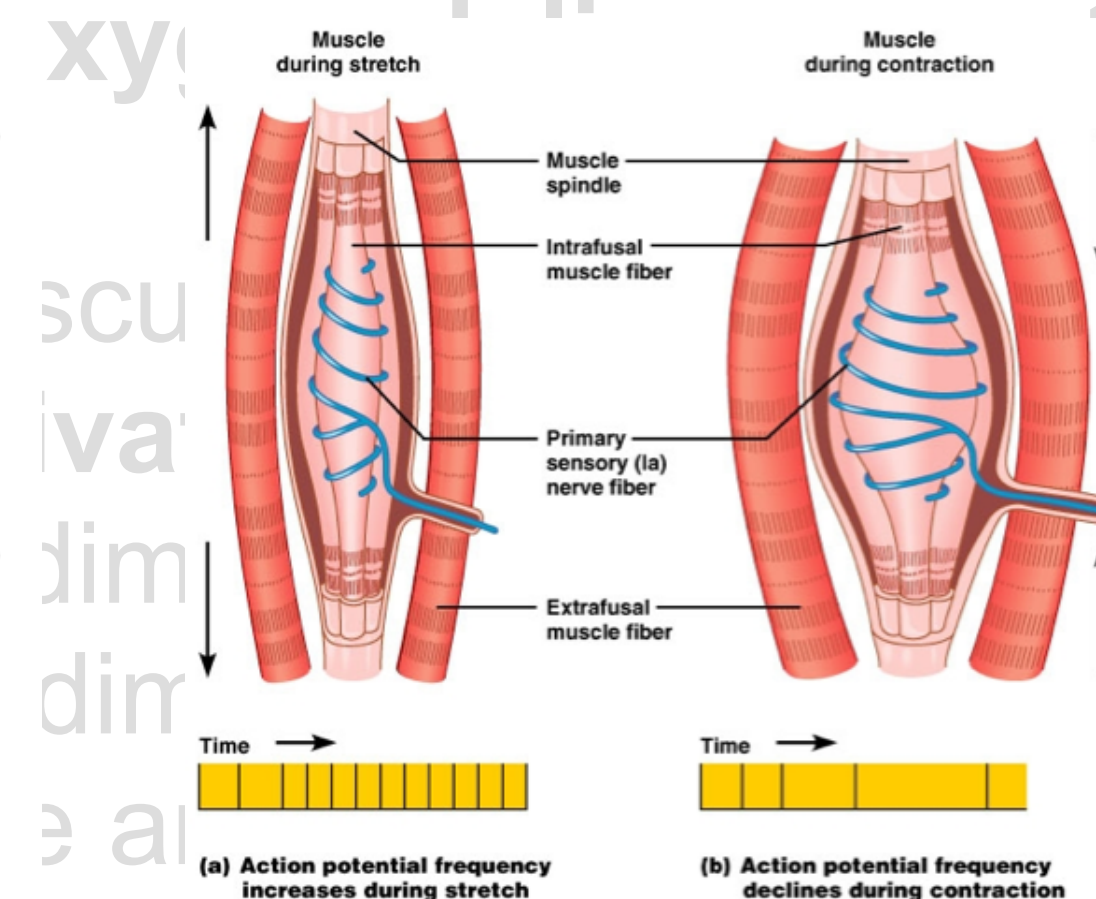
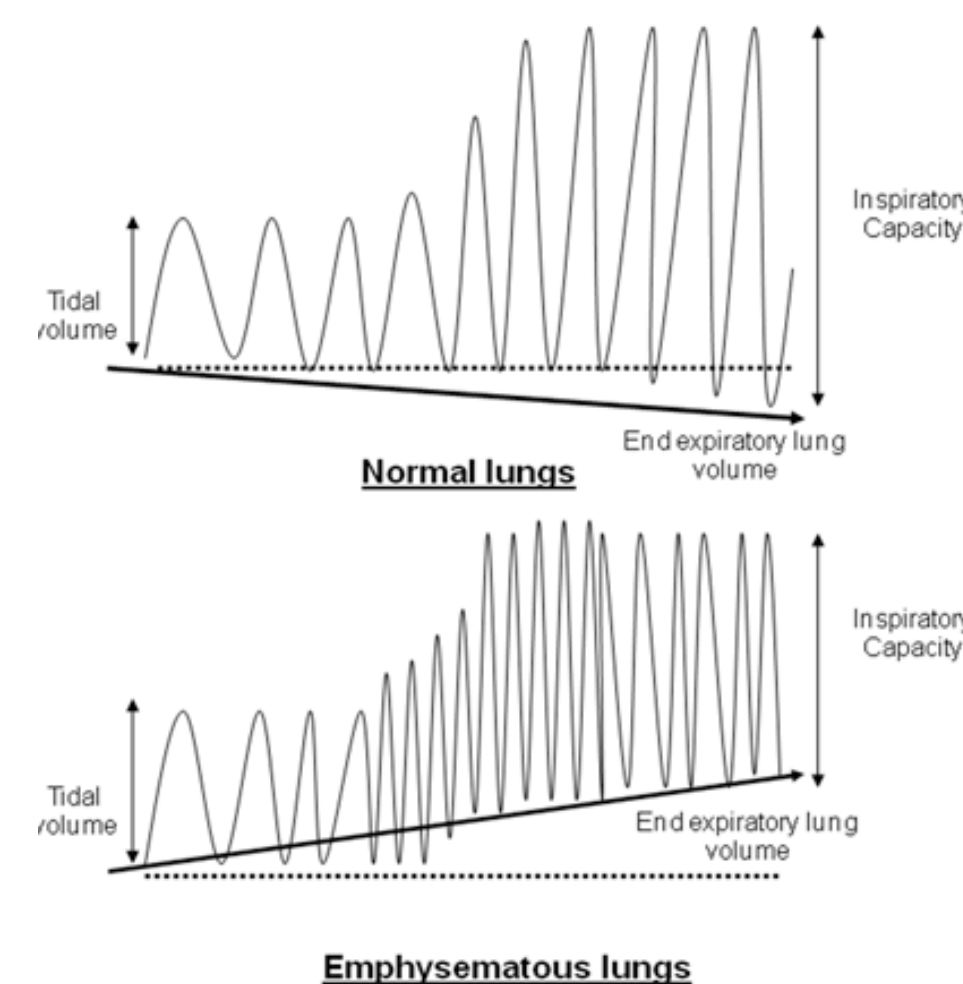
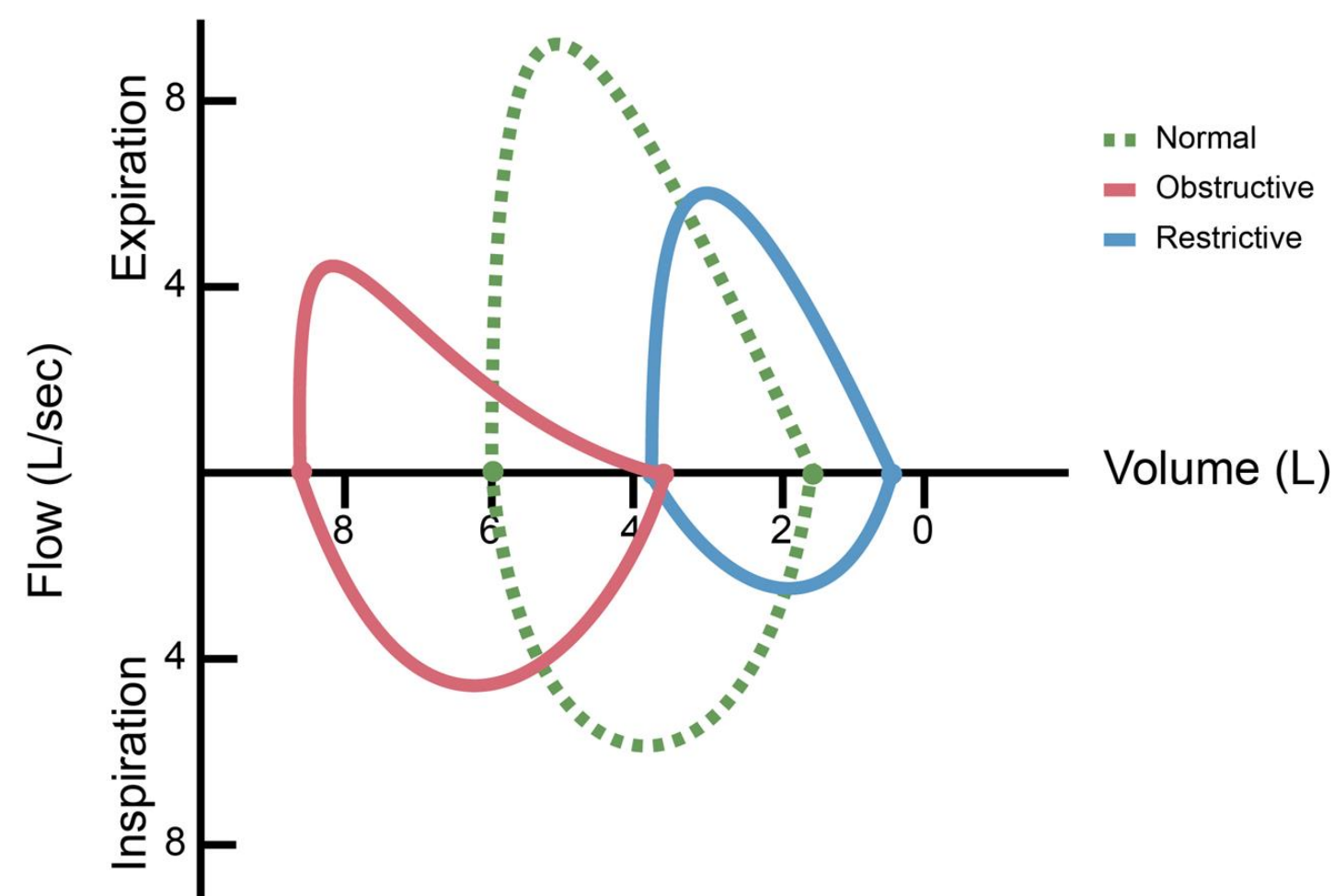
Pharyngitis



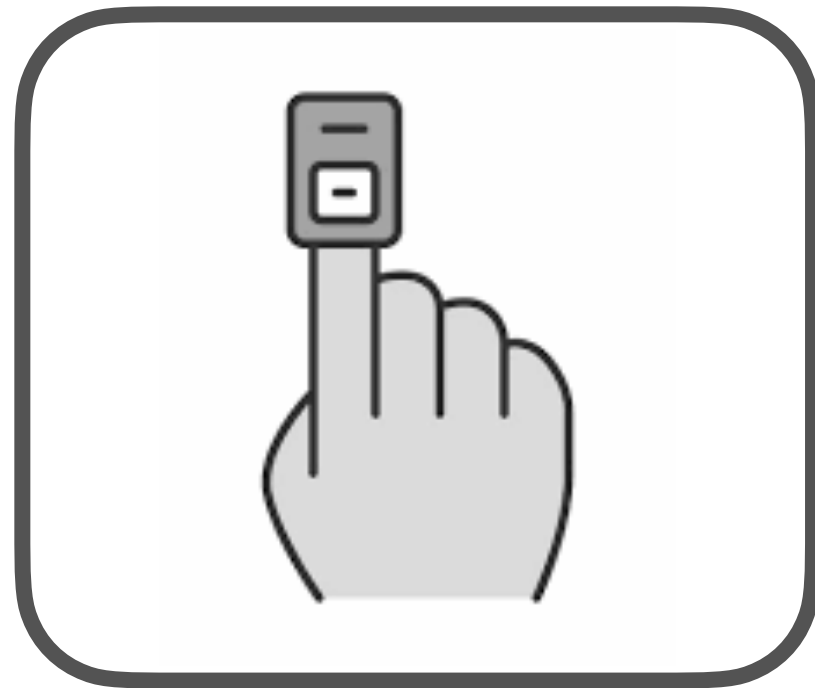
Dyspnea



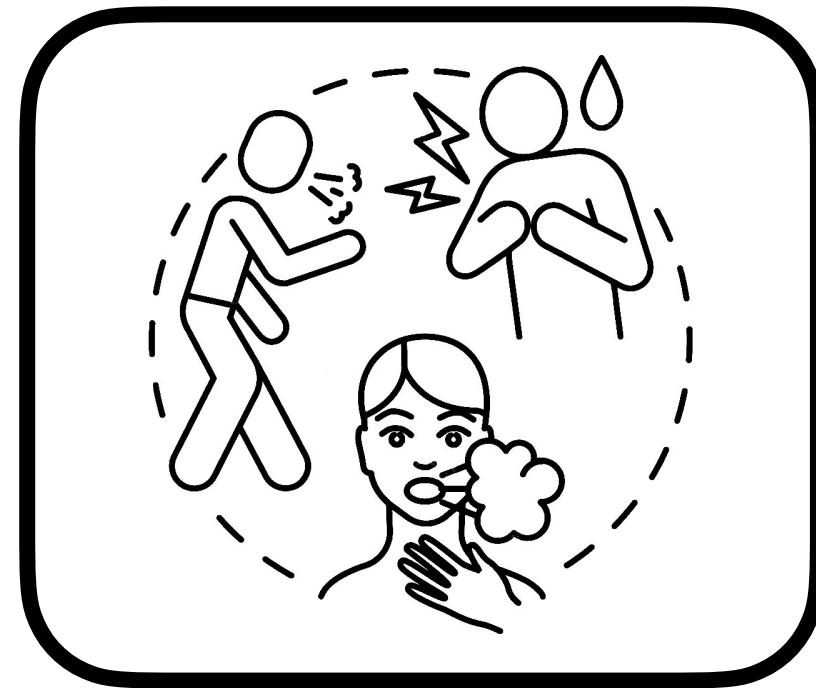
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- Mechanical loading of the respiratory system: dyspnea vs. effort**
- Neuromechanical dissociation**



居家呼吸困難及喘的評估



缺氧



喘



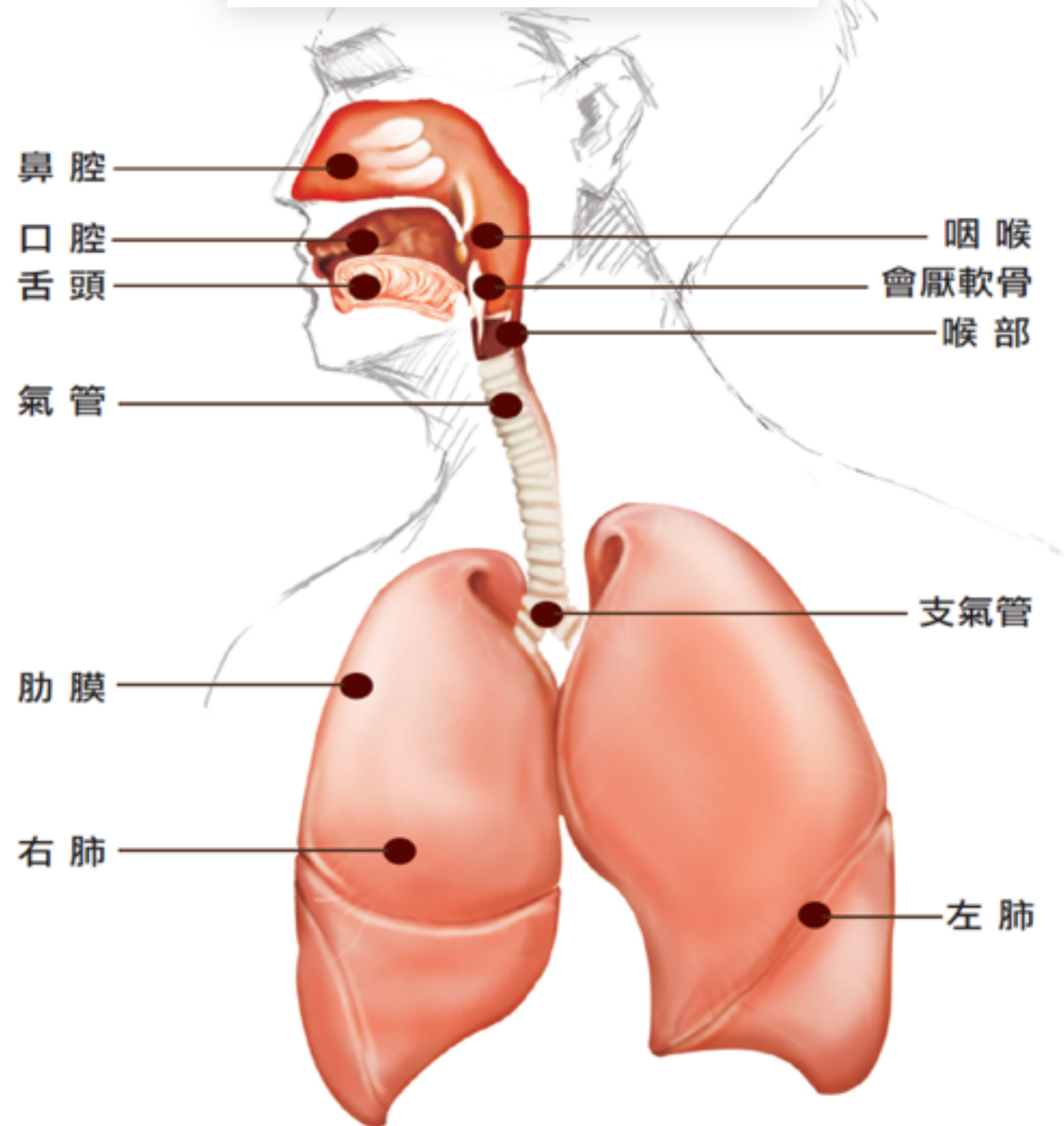
咳嗽



多痰

咳嗽與多痰真的是肺部的問題嗎？

身體的咳嗽接受器

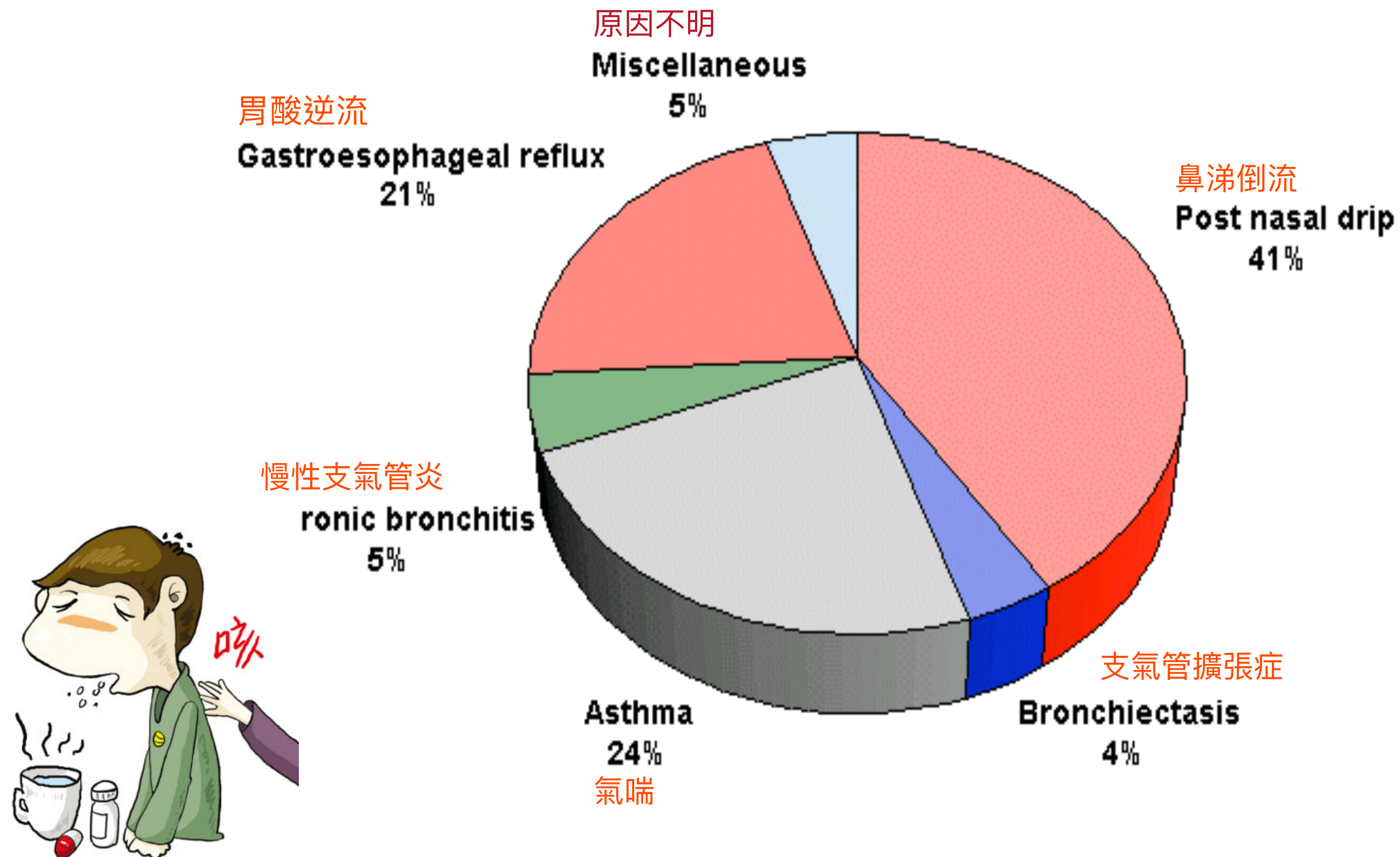


慢性咳嗽:
>8 weeks

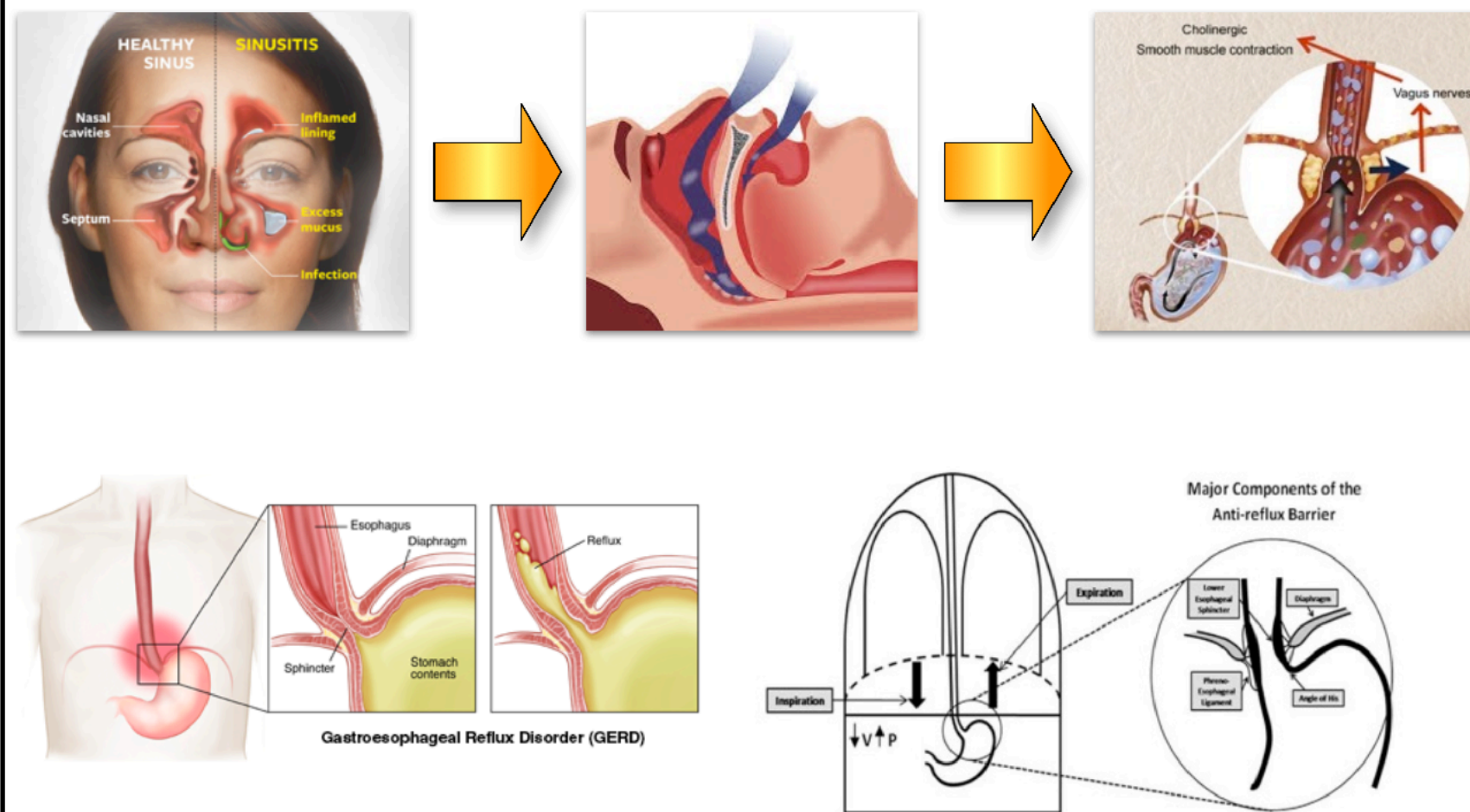
亞急性咳嗽:
3~8 weeks

急性咳嗽:
< 3 weeks

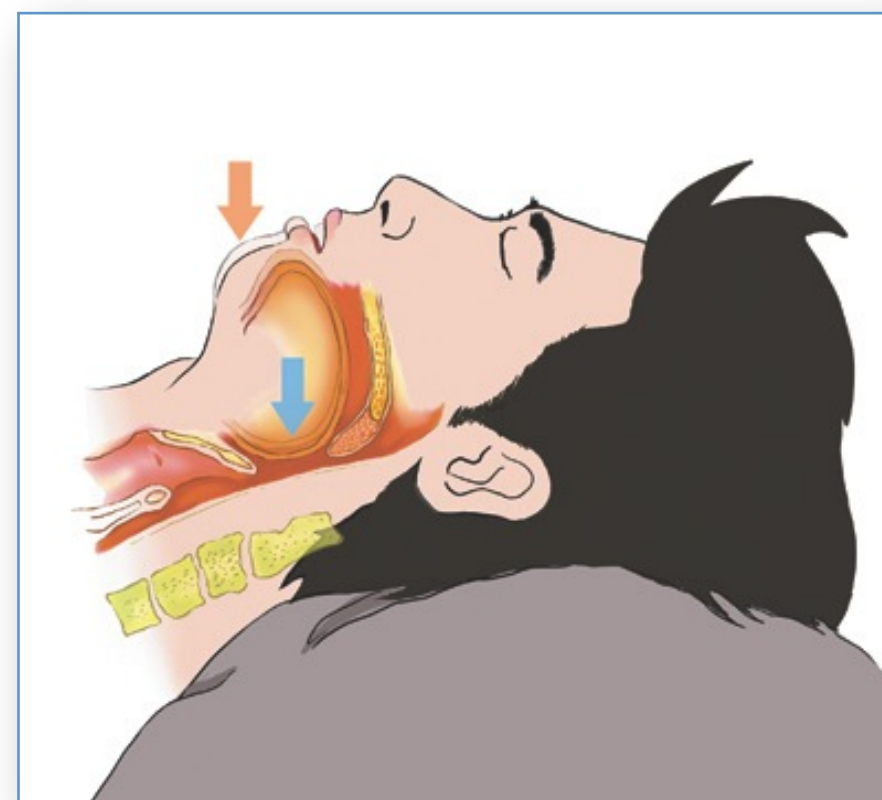
成年人常見慢性咳嗽的原因



OSA and Associated Manifestations

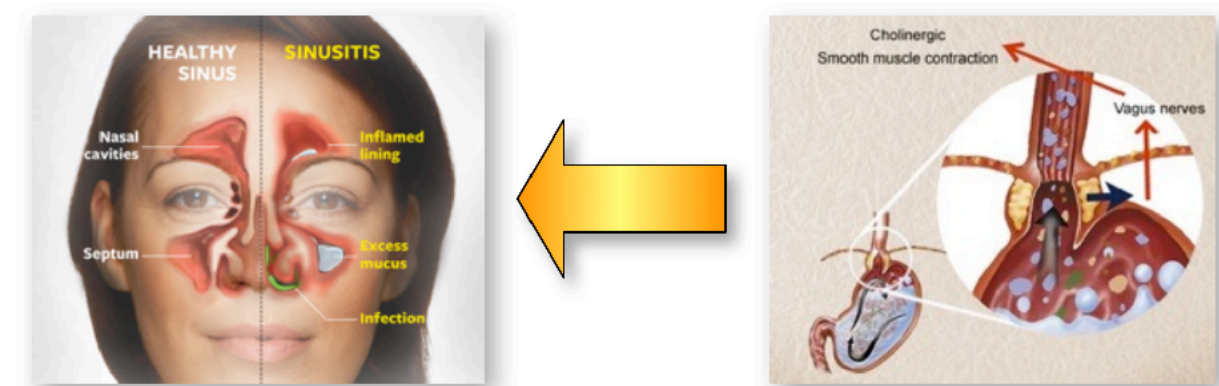


GERD: Gastroesophageal reflux disease

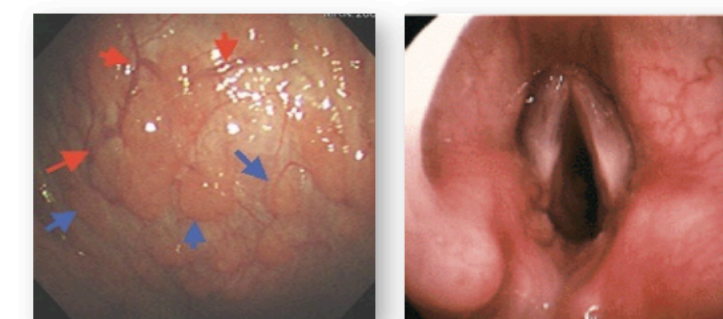


Vibration Trauma

GERD vs Chronic Sinusitis

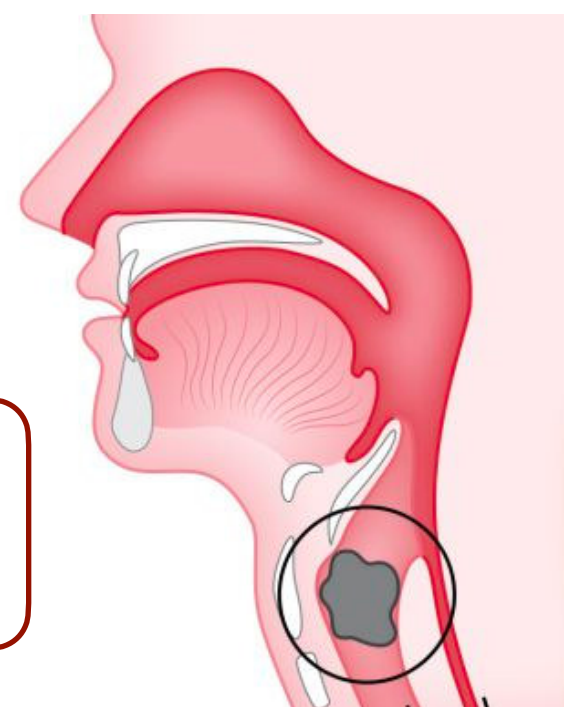


- Treatment of GERD could improve Chronic Rhinitis and Post Nasal Drips
- However, no reflux contents found in Nasal Cavity
- Gastroesophageal **"REFLEX"** (instead of REFLUX): nasal congestion, irritation and increased secretion



- H⁺ induced sensory neuropeptides
- Neurogenic inflammation
- reduced Cough receptor threshold

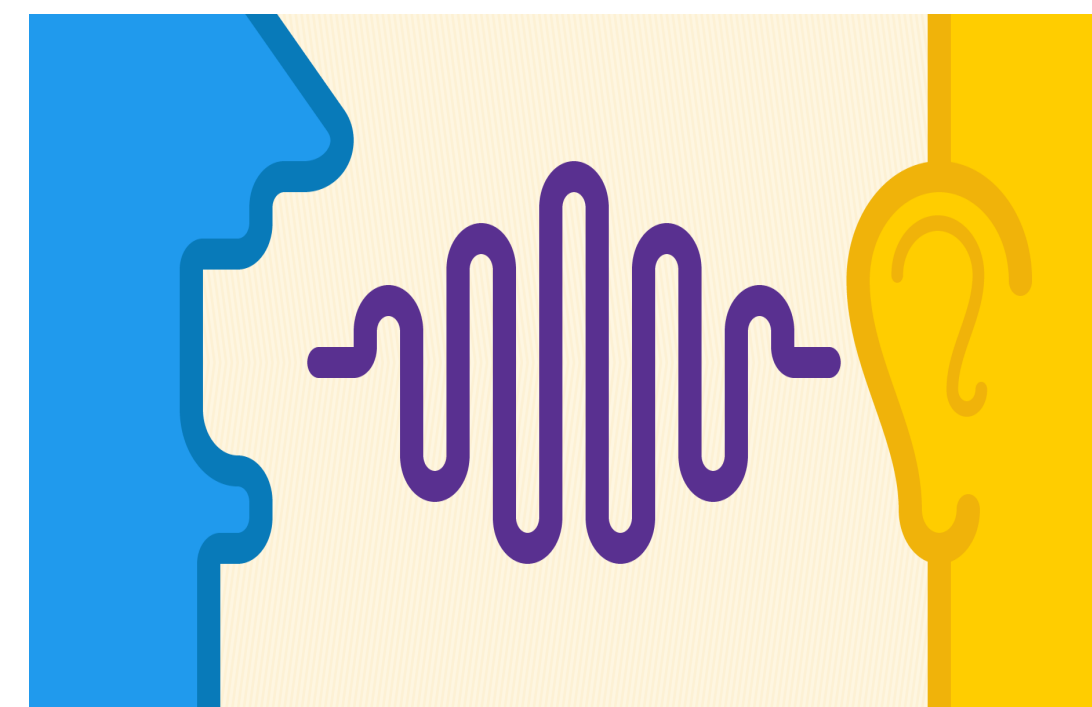
容易噎到



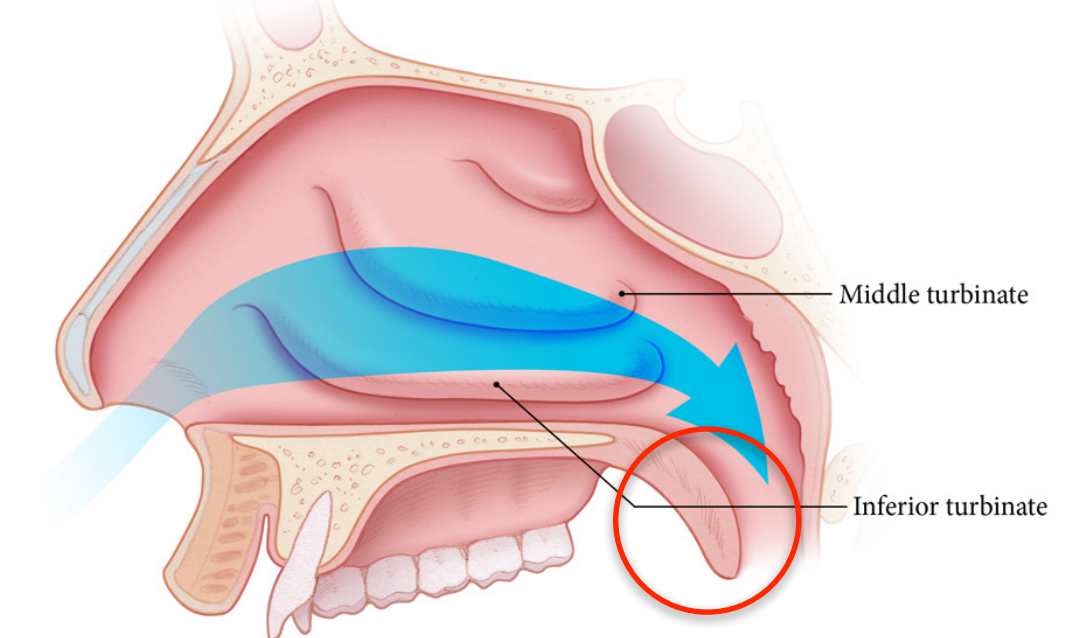
吞嚥反射受影響
吞嚥後吸氣延遲時間縮短



黏膜振動產生的
慢性咽喉炎

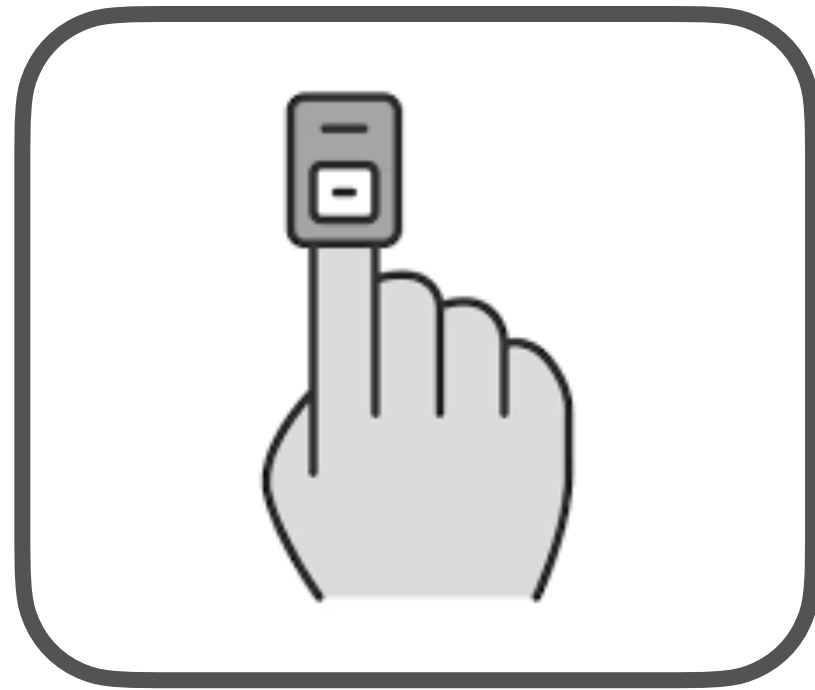


神經受損影響發聲
與說話的清晰度



呼吸道氣流感受減弱，
感覺氣悶

居家呼吸困難及喘的處理



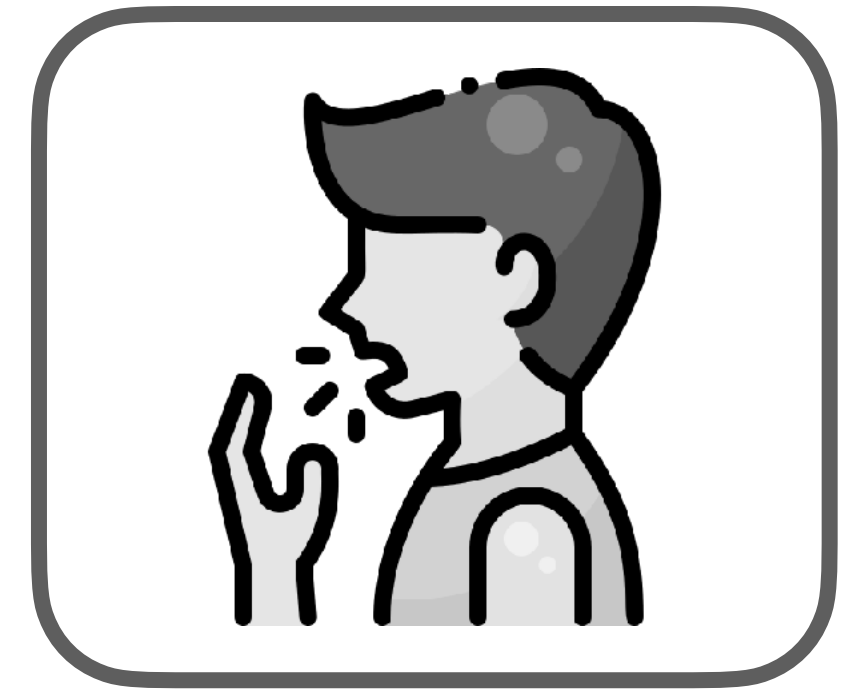
缺氧



喘



多痰



咳嗽

?

?

?

?

?

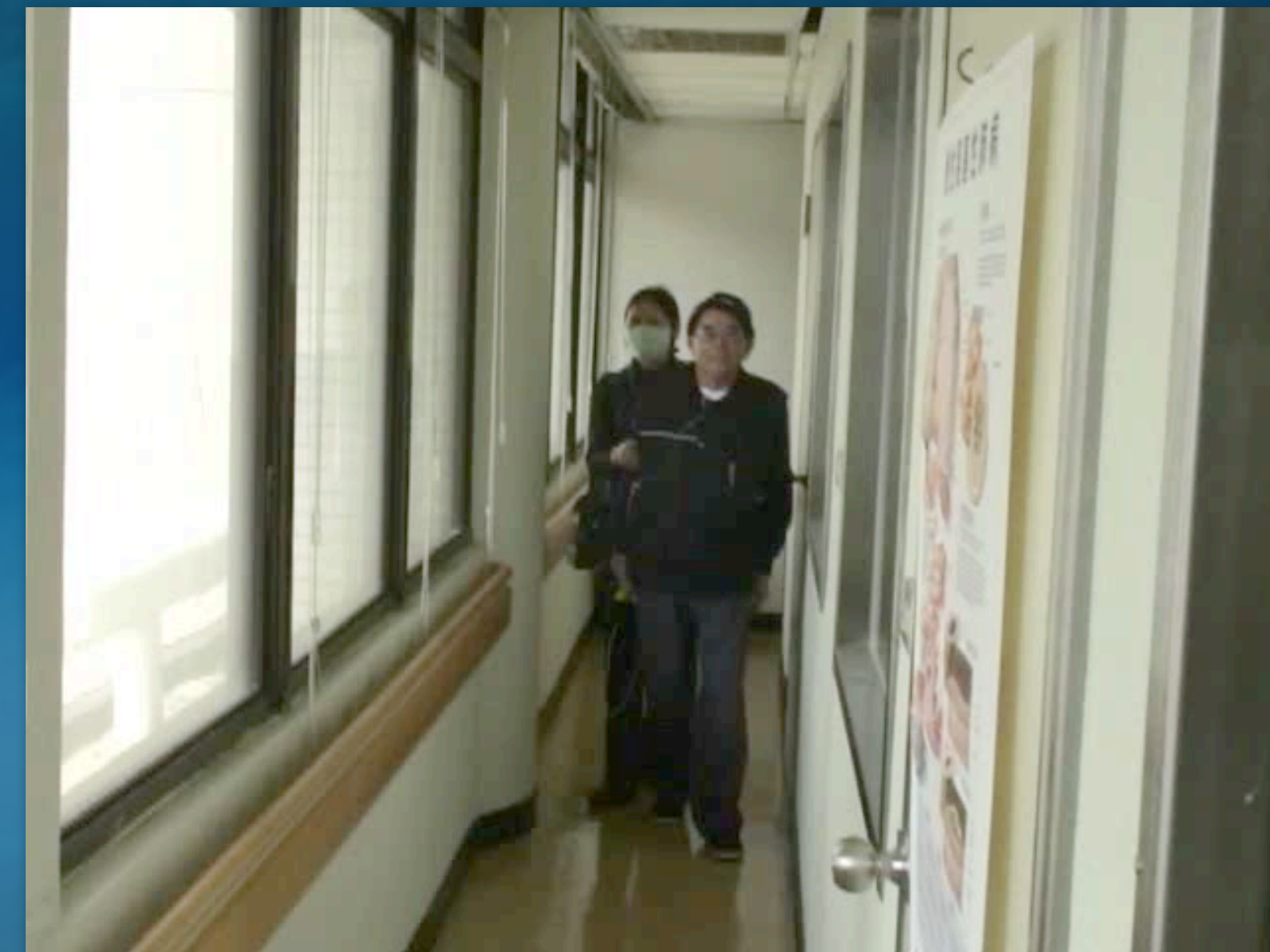
?

The reason(s) of dyspnea on exertion?

1. Air-trapping (dynamic hyperinflation)
2. Poor breathing pattern
3. Respiratory muscle impairment
4. Limb muscle impairment

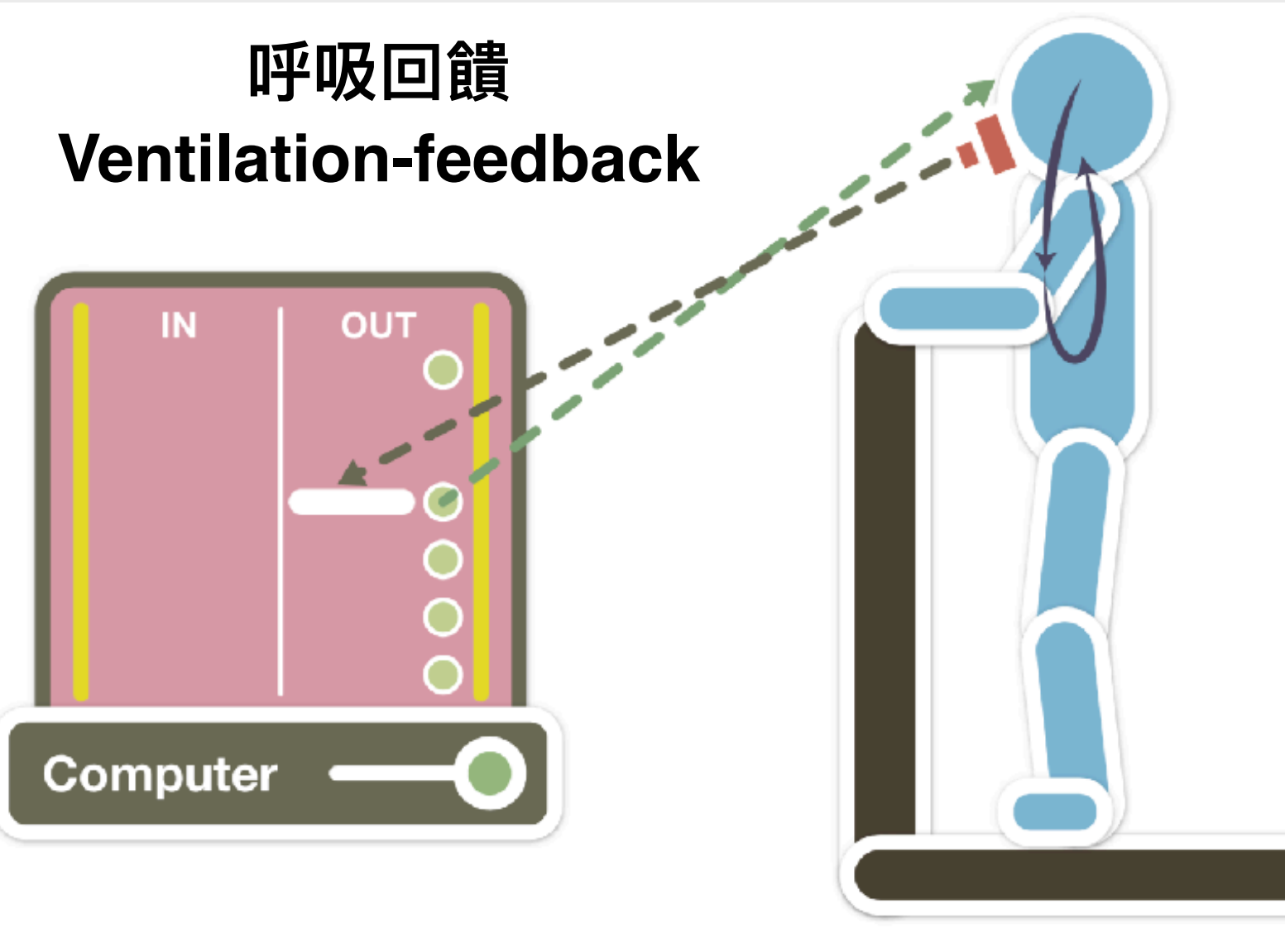
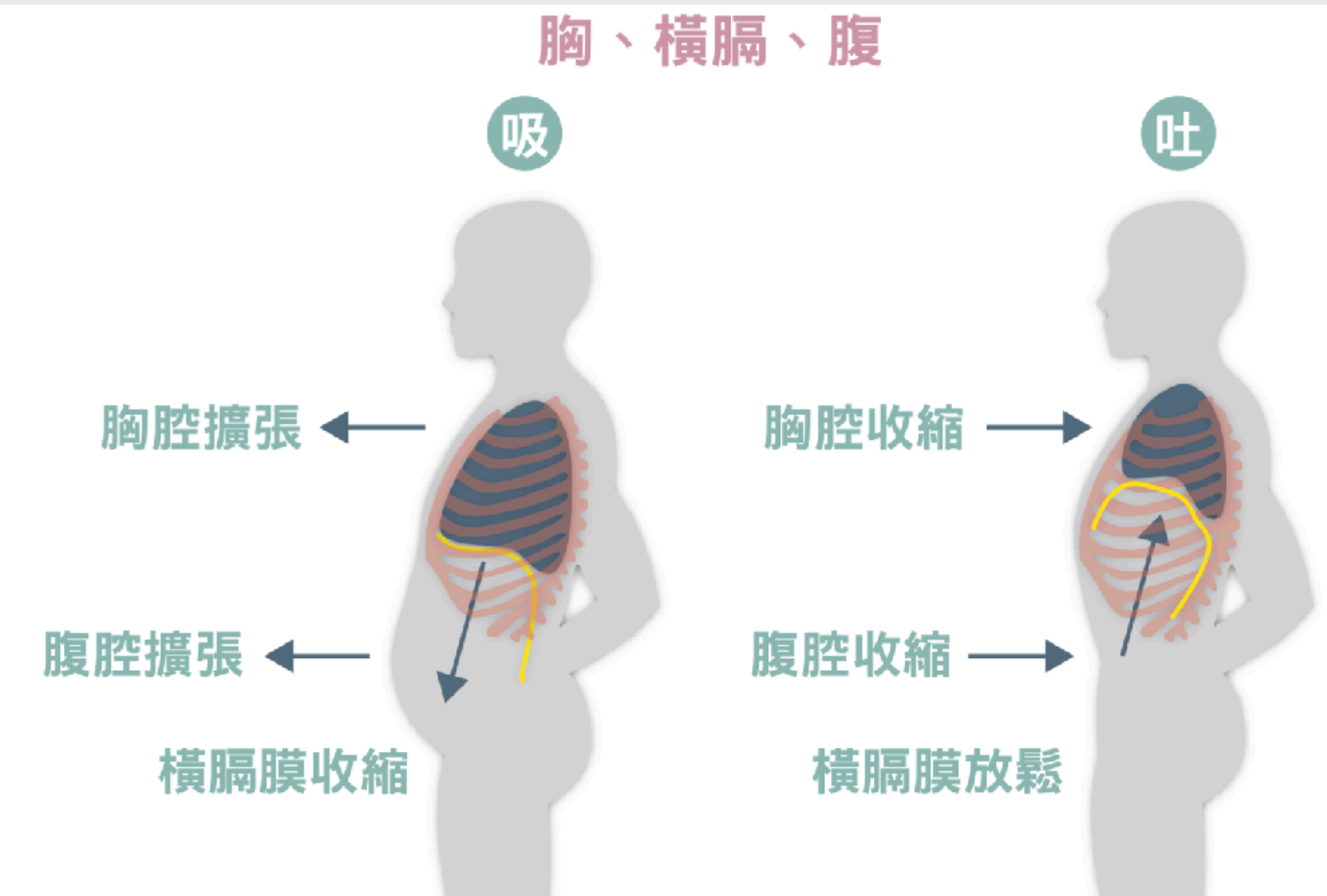
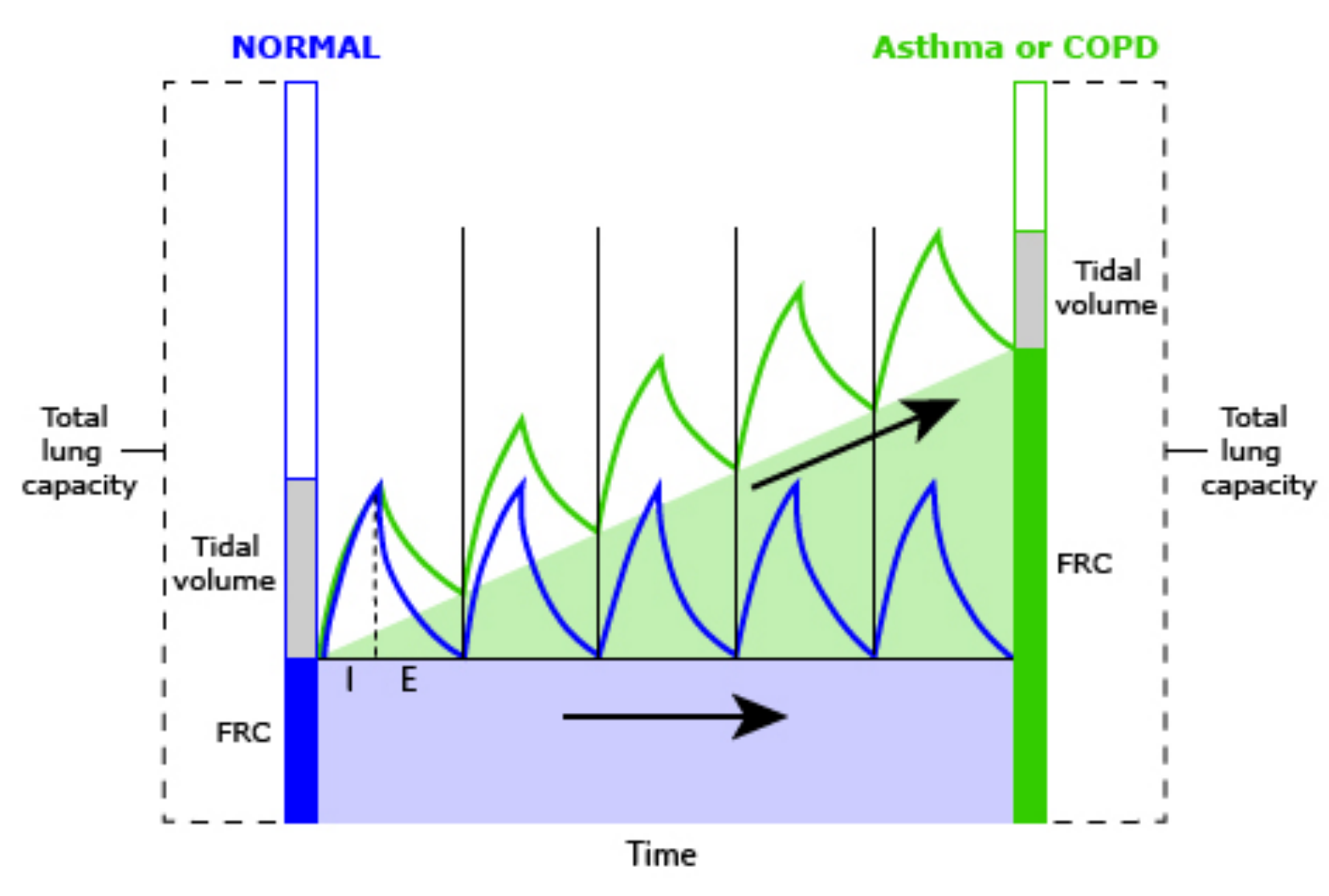


Case 1

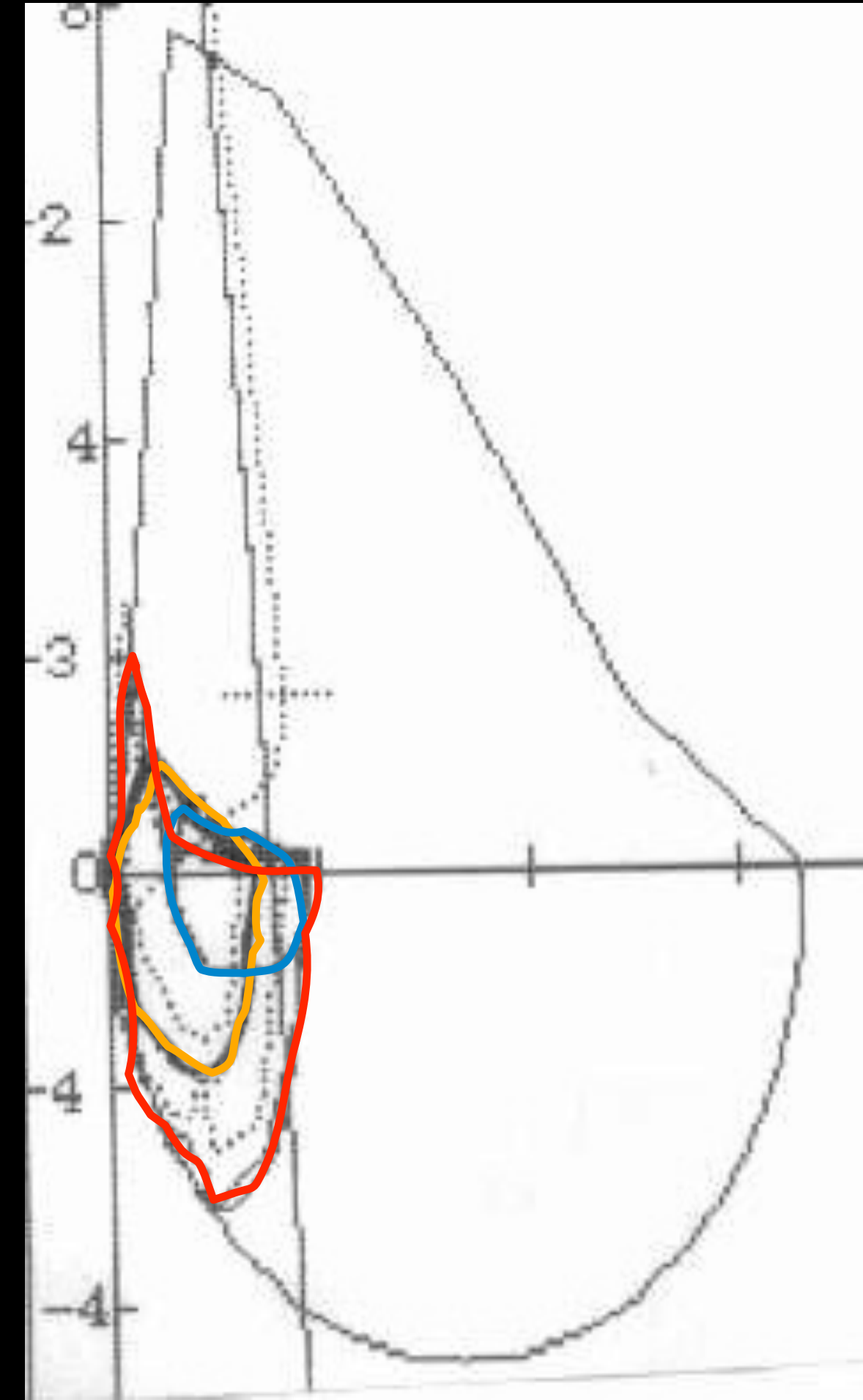


Case 2

Dynamic Hyperinflation (Air-trapping)



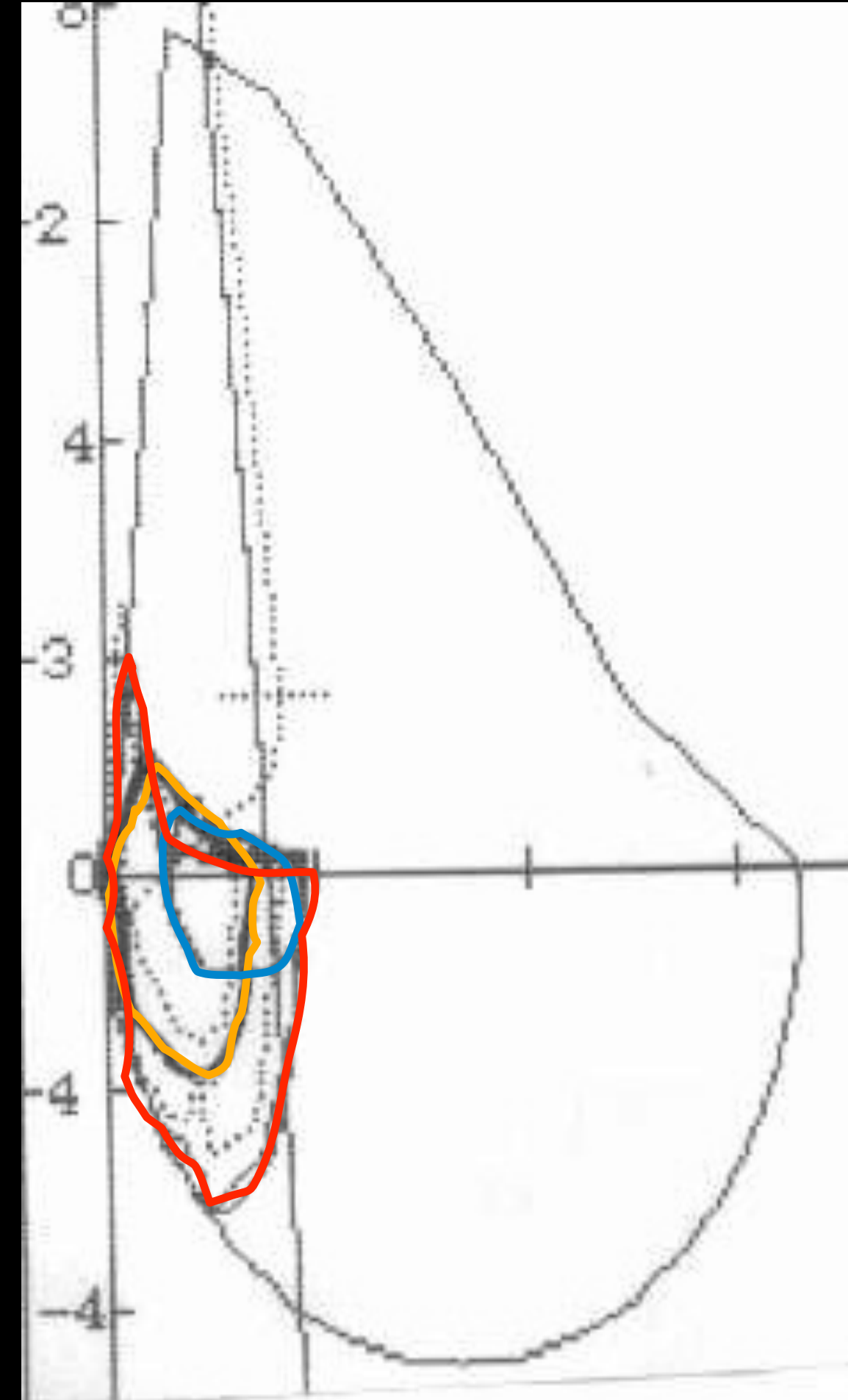
Only Dynamic hyperinflation?



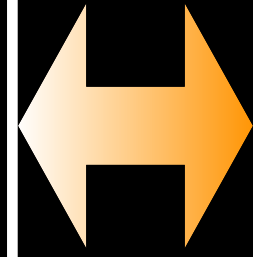
Only Dynamic hyperinflation?



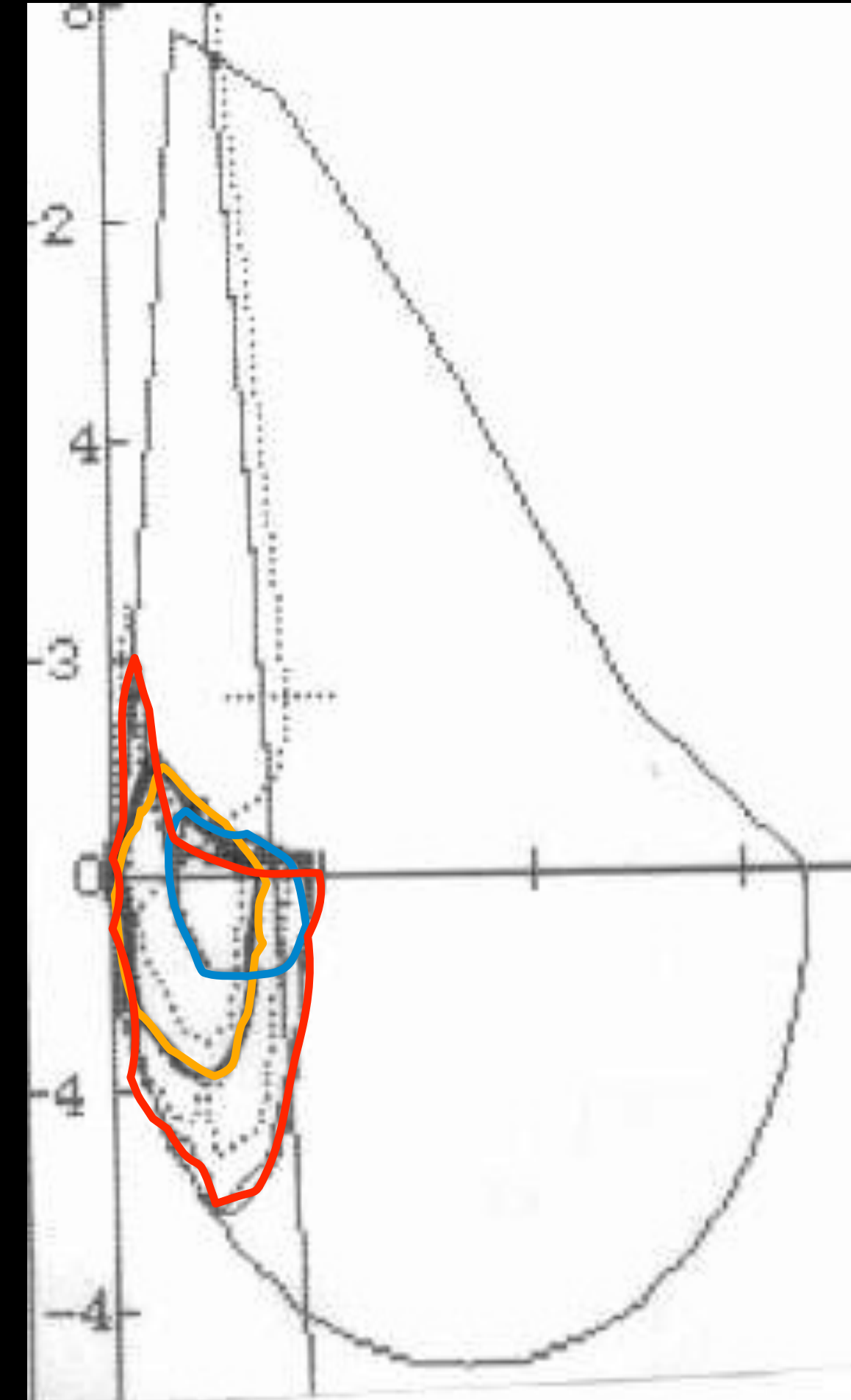
Lower lung atelectasis



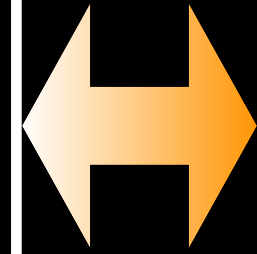
Dynamic Hyperinflation



Lower lung atelectasis
Accessory muscle overuse



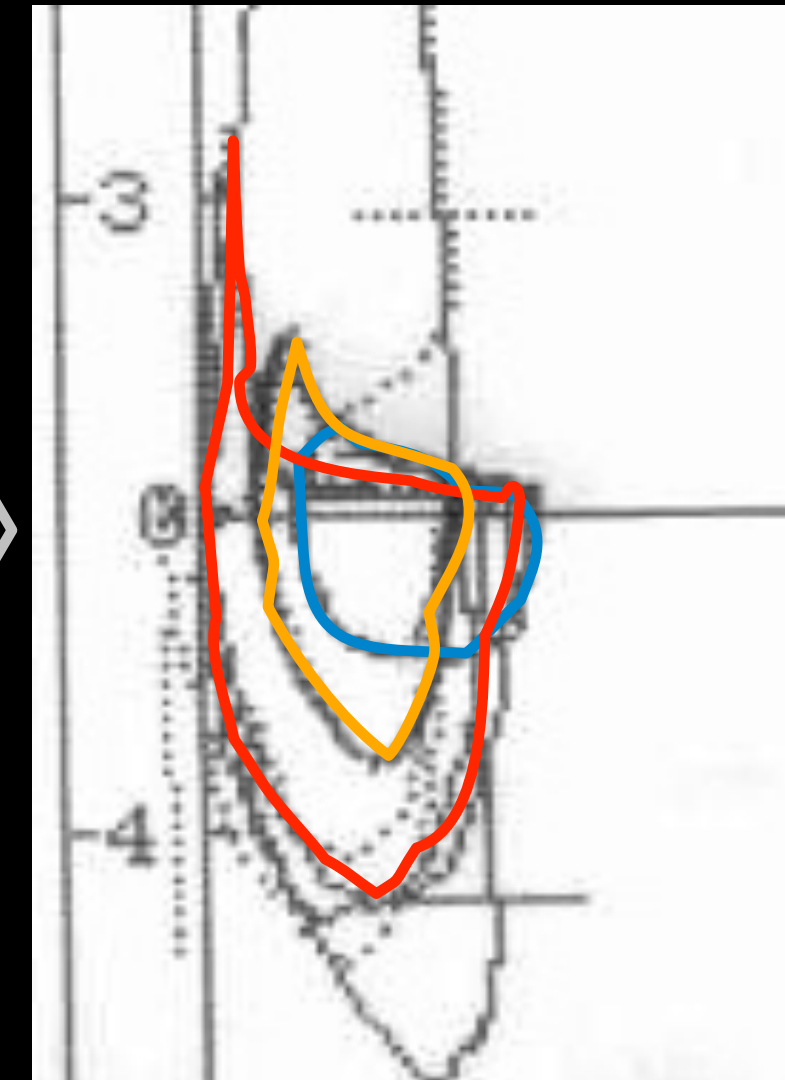
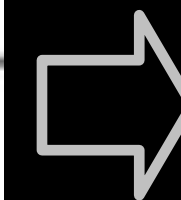
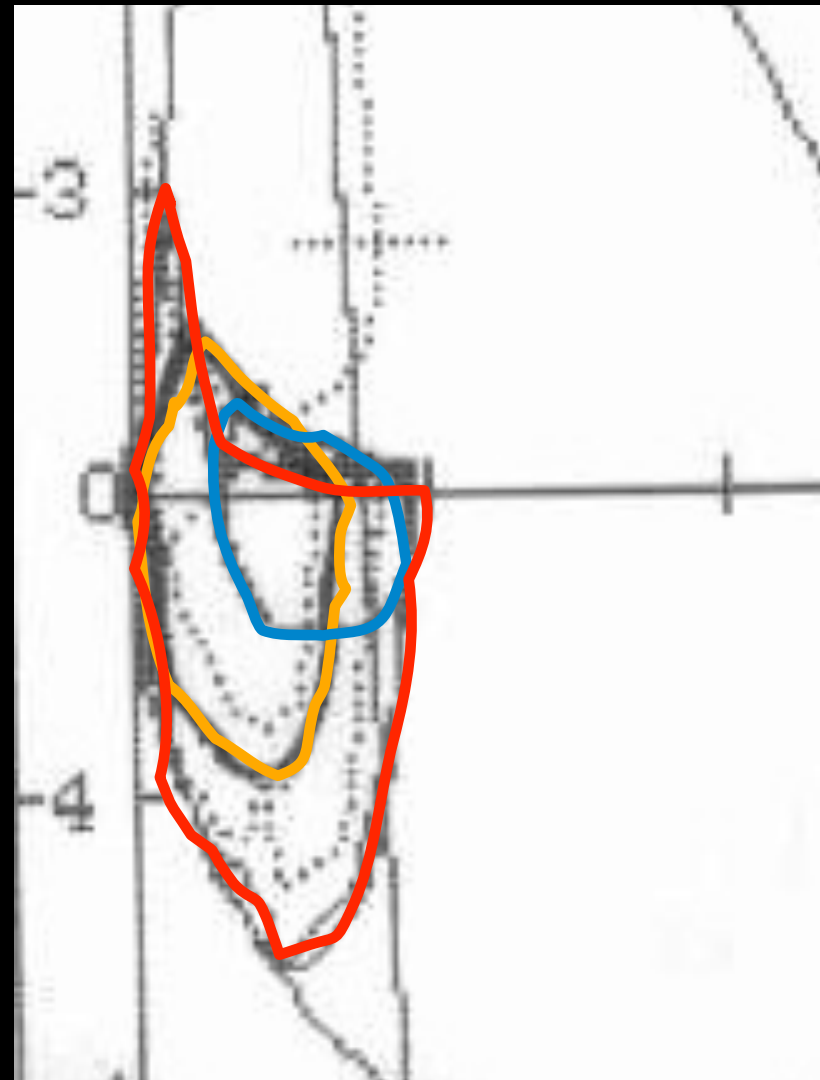
Dynamic Hyperinflation

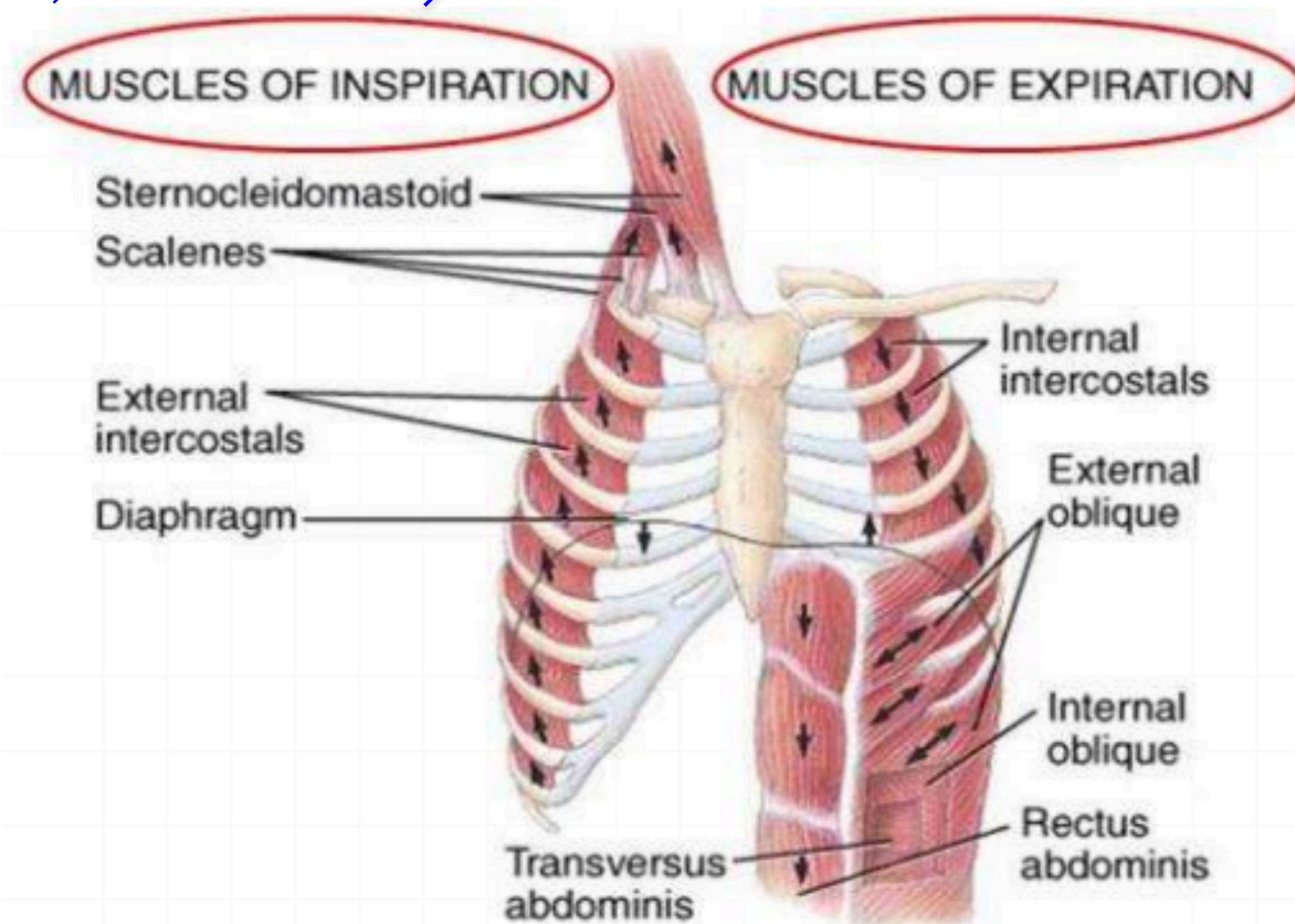
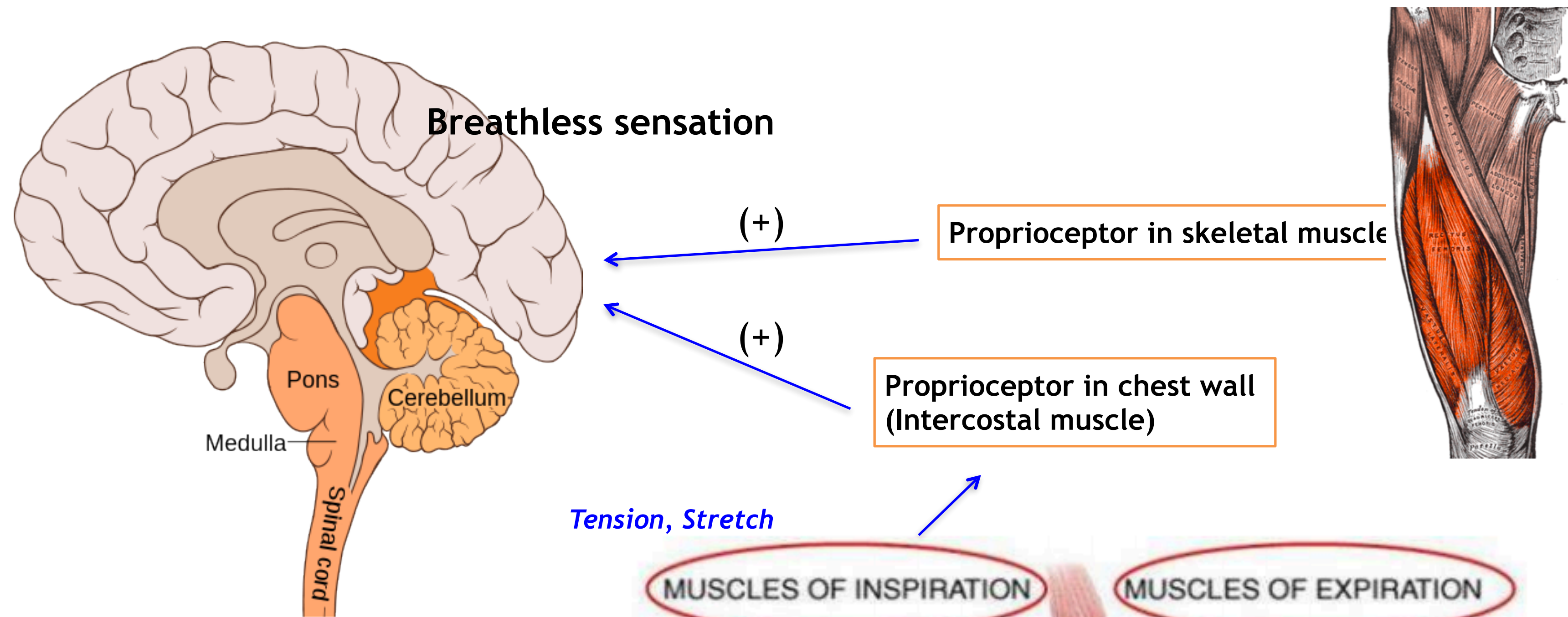


Lower lung atelectasis
Accessory muscle overuse

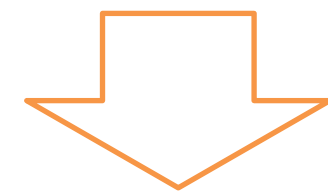


Coach diaphragmatic
breathing
Expansion therapy
Relaxation therapy

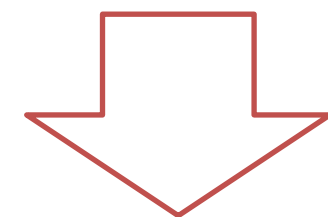




**Tonic contraction of
Accessory Muscle**

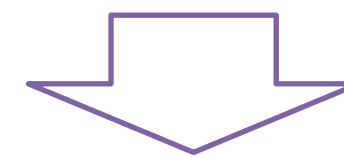
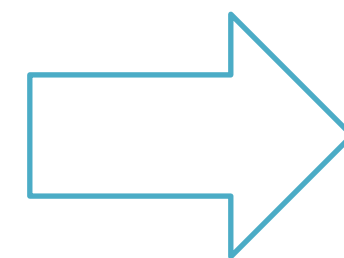


Impeded descent of diaphragm



Fail to recruit IRV & ERV

Paradoxical Abdominal Movement



Relax Accessory Muscle

Relaxation First!



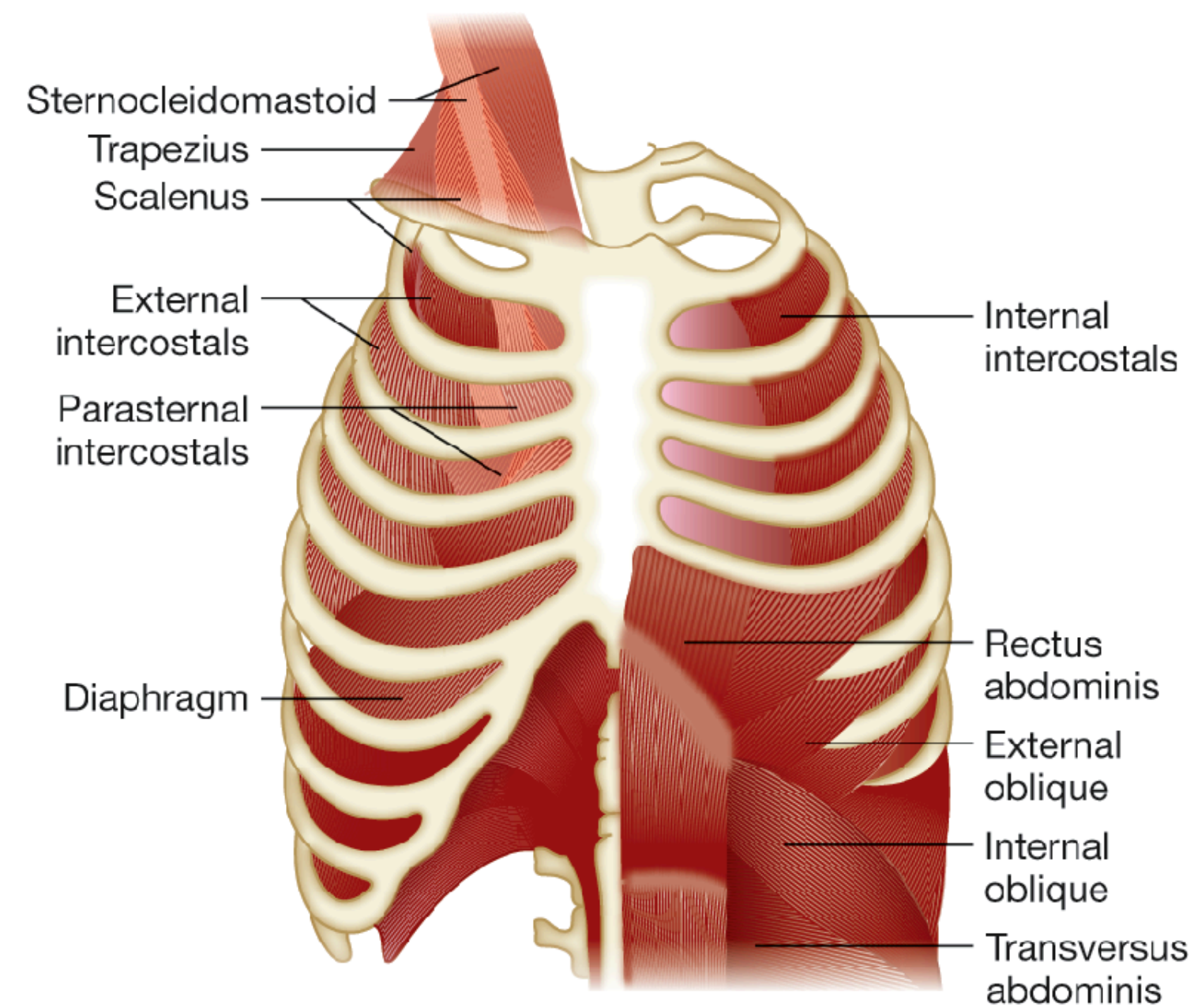
Heat packing

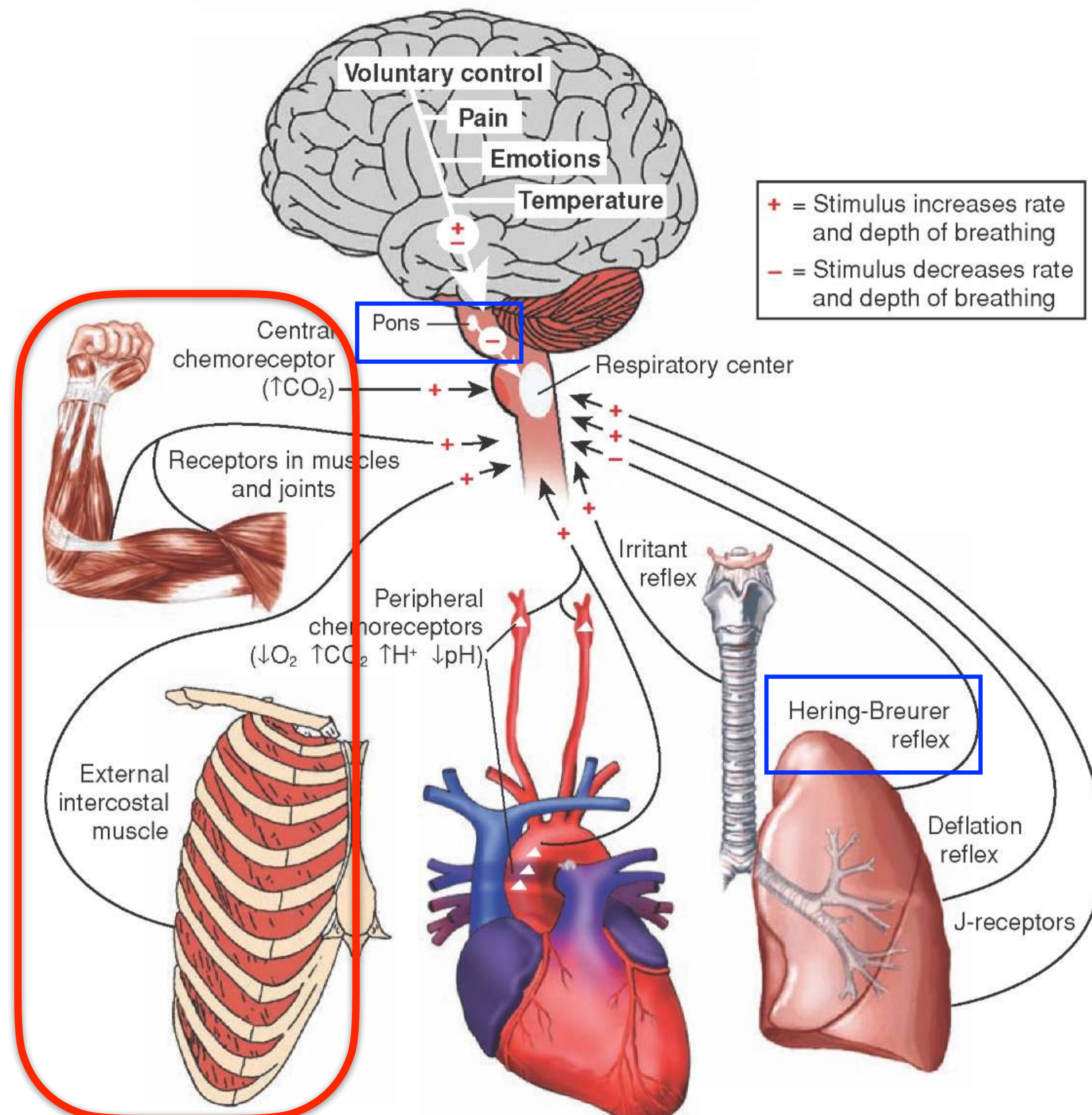


Massage

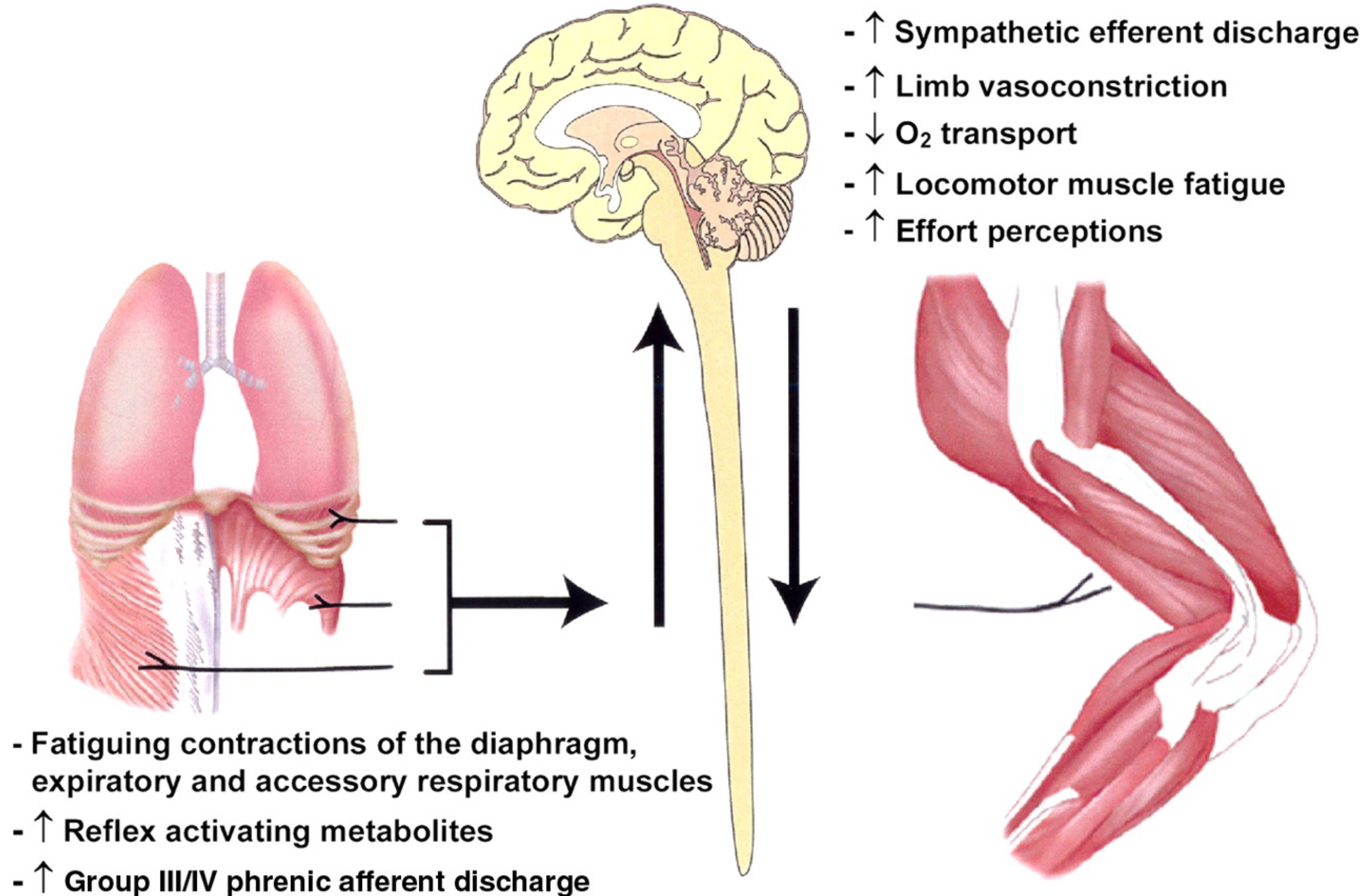
Fatiguing contractions of the diaphragm, expiratory and accessory respiratory muscles

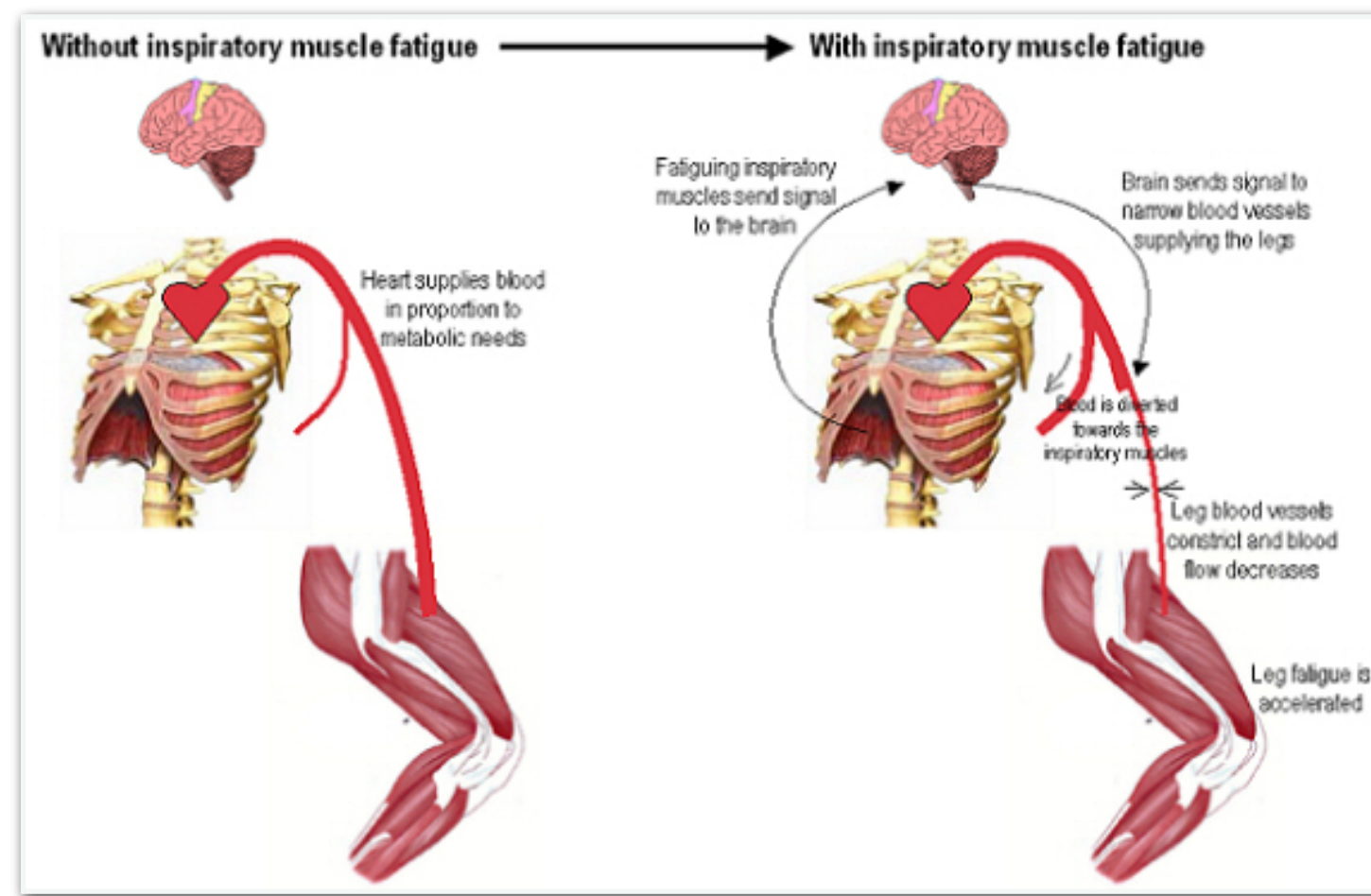
呼吸肌肉疲乏時會發生什麼現象？



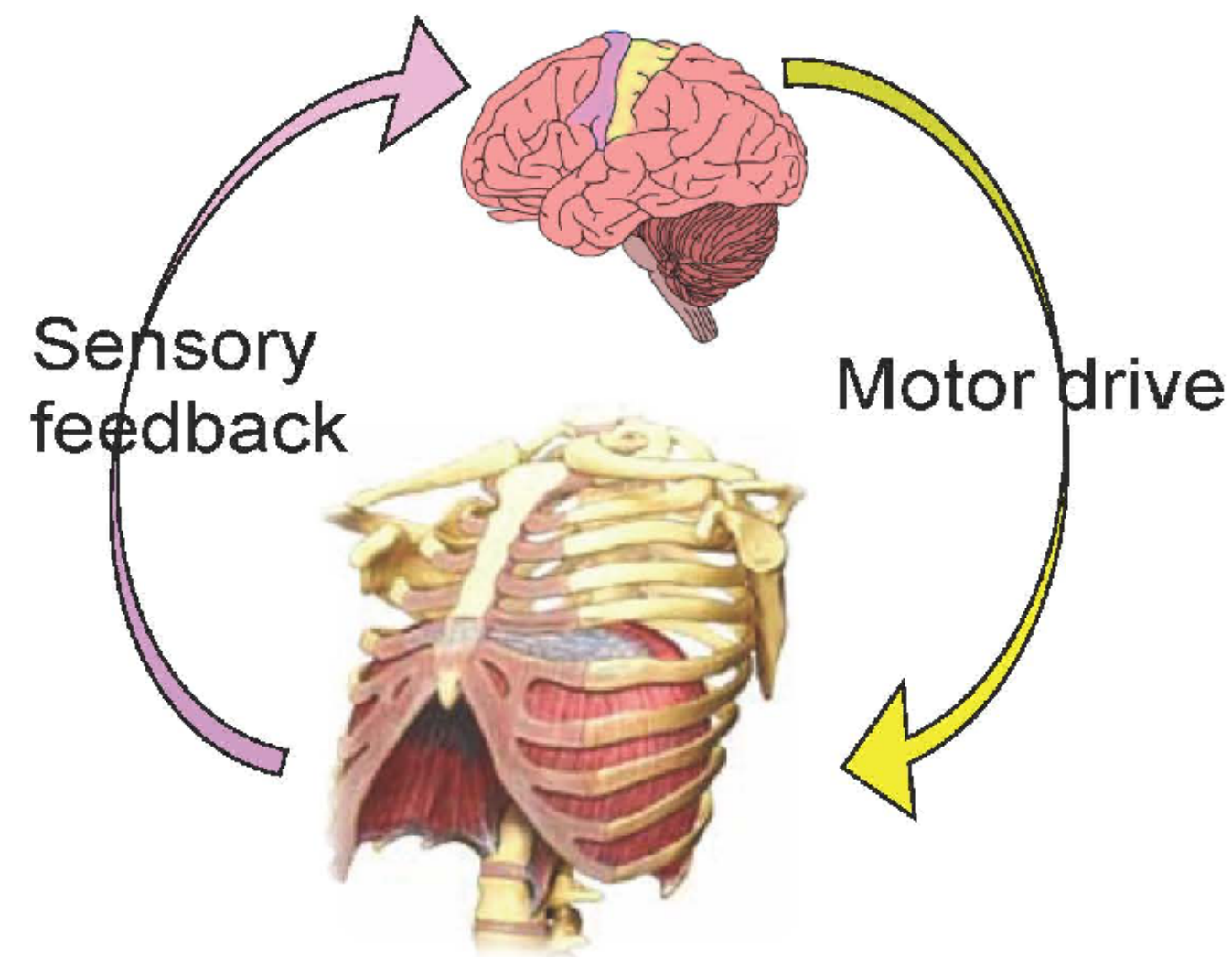


RESPIRATORY MUSCLE METABOREFLEX

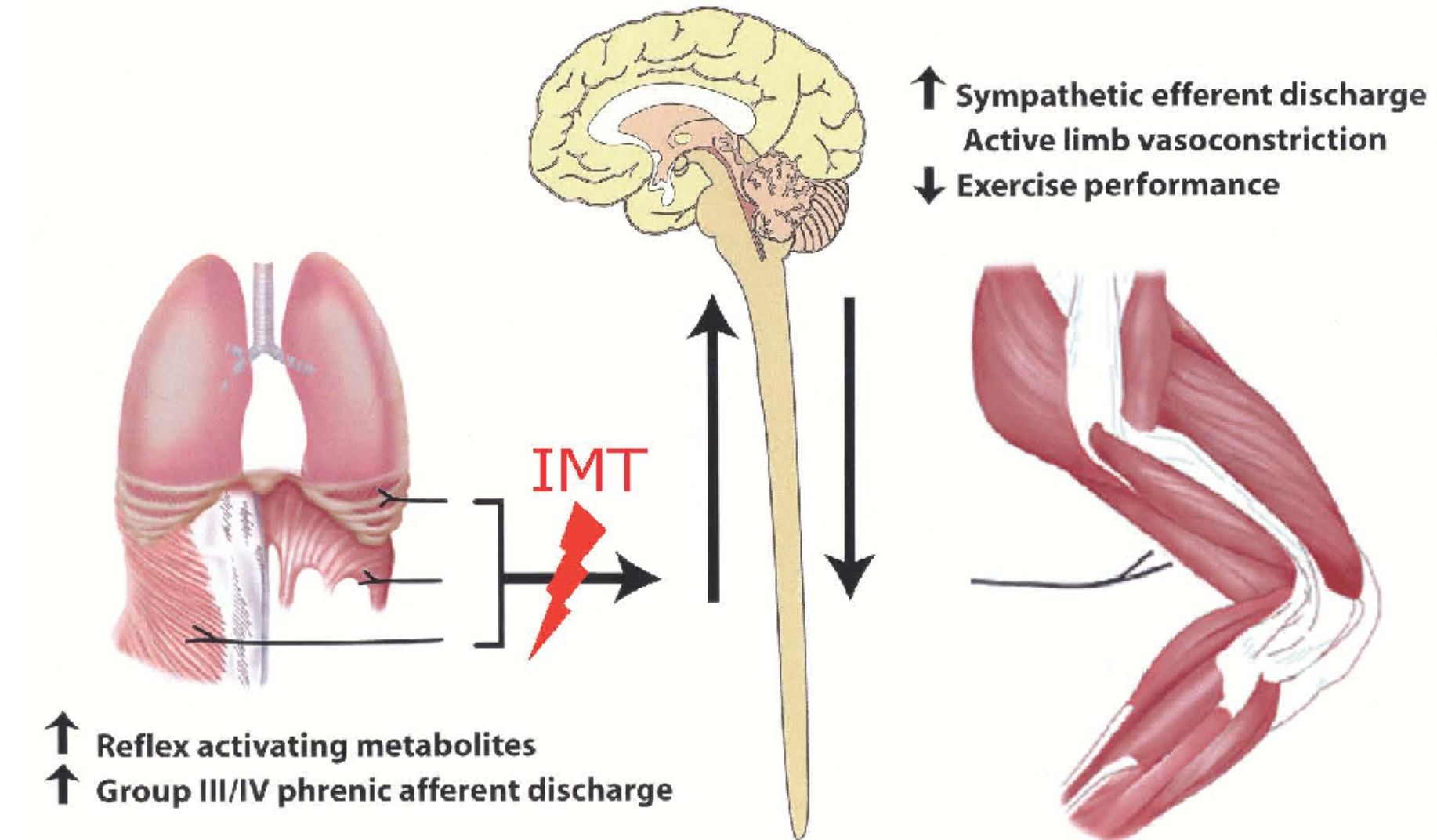




The effect of inspiratory muscle training



Stronger inspiratory muscles reduce inspiratory motor drive attenuating effort perception

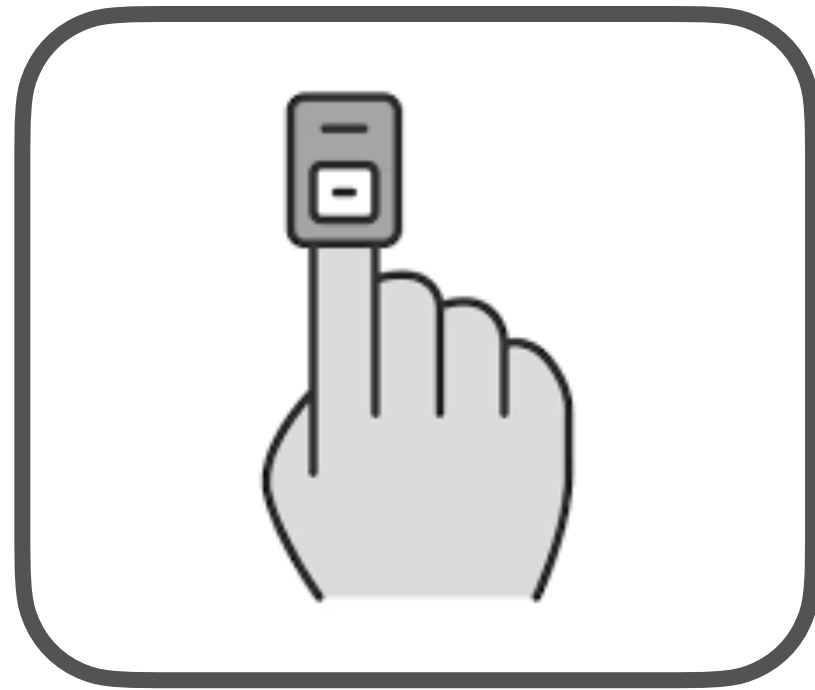


IMT raises threshold for inspiratory muscle metaboreflex activation

Volianitis et al, *MSSE*, 2001
 Romer et al, *Int. J. Sports Med*, 2002
 Romer et al, *J. Sports Sci*, 2002
 Griffiths & McConnell, *Eur J Appl Physiol.*, 2007
 Kilding et al, *Eur J Appl Physiol.*, 2010

McConnell & Lomax, *J. Physiol.*, 2006

居家呼吸困難及喘的處理



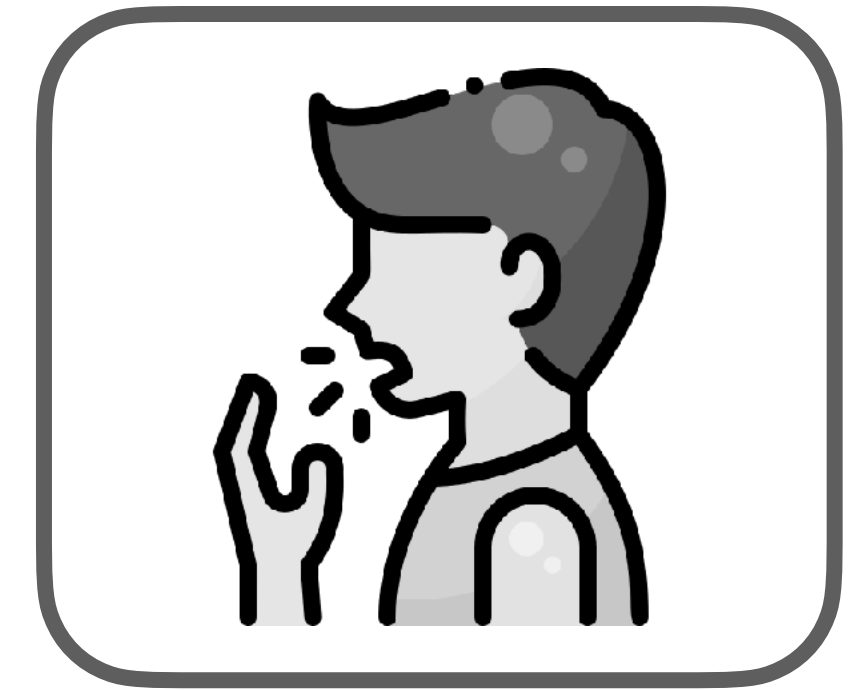
缺氧



喘



多痰



咳嗽

呼吸模式

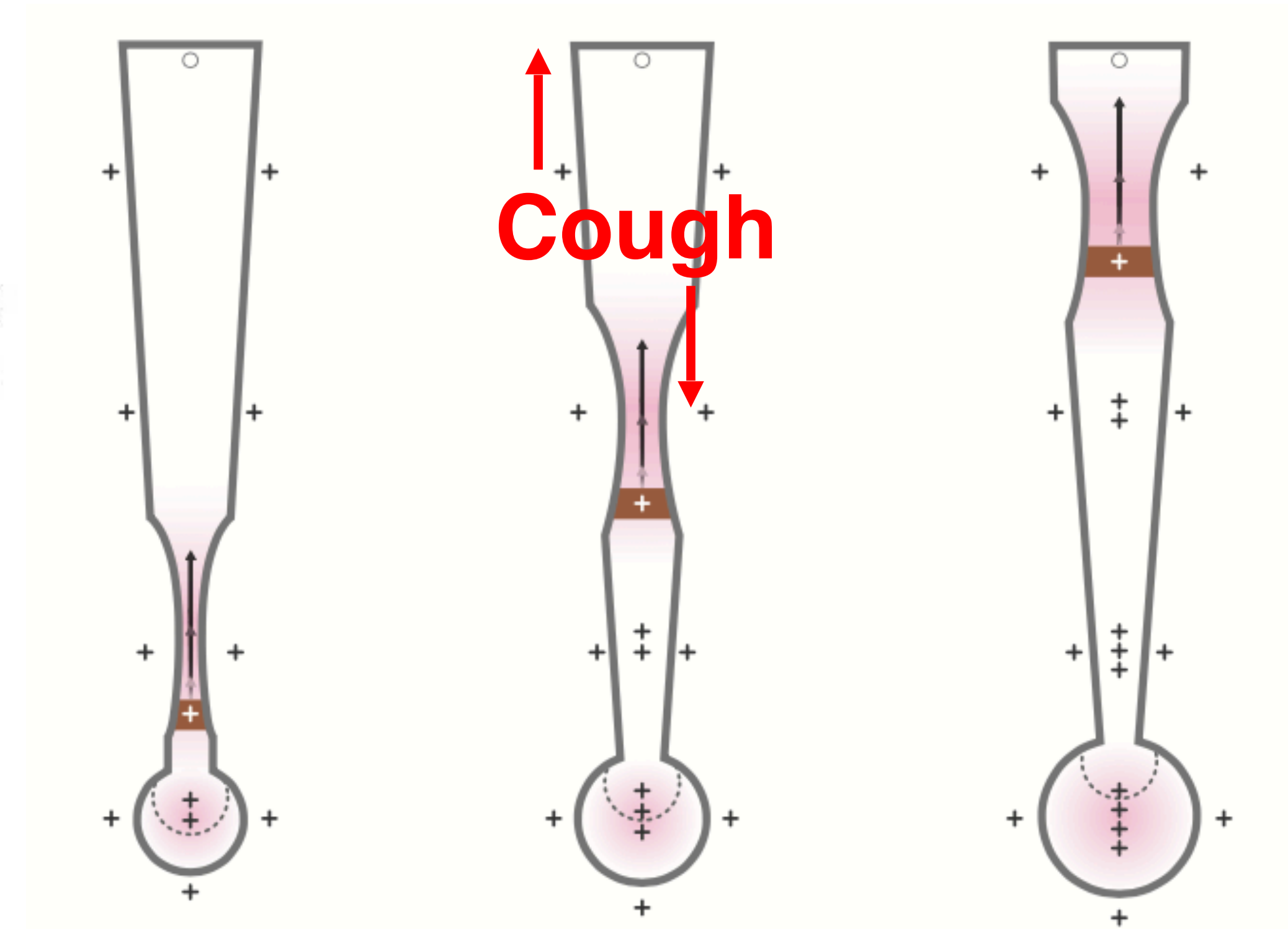


Airway Clearance Techniques

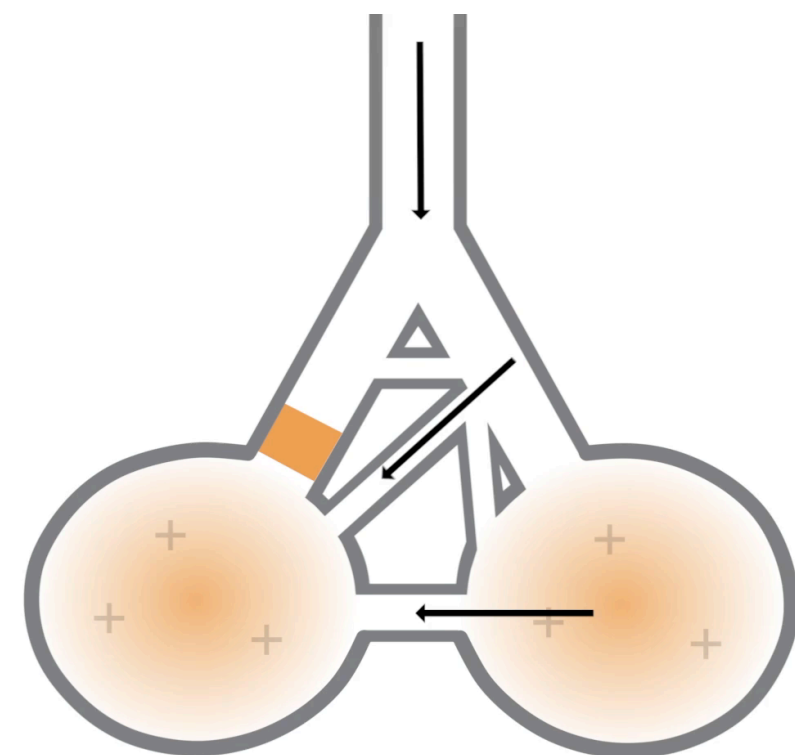
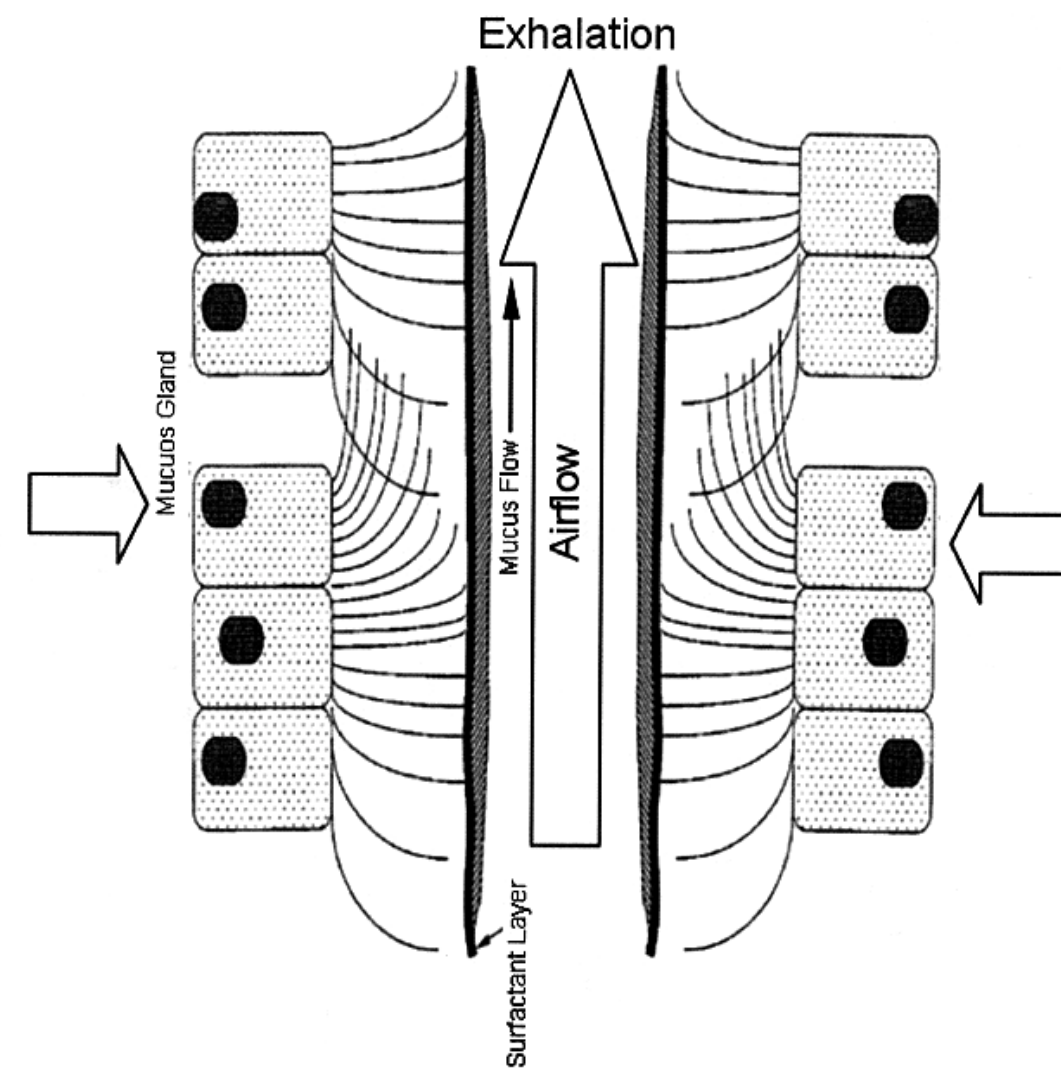
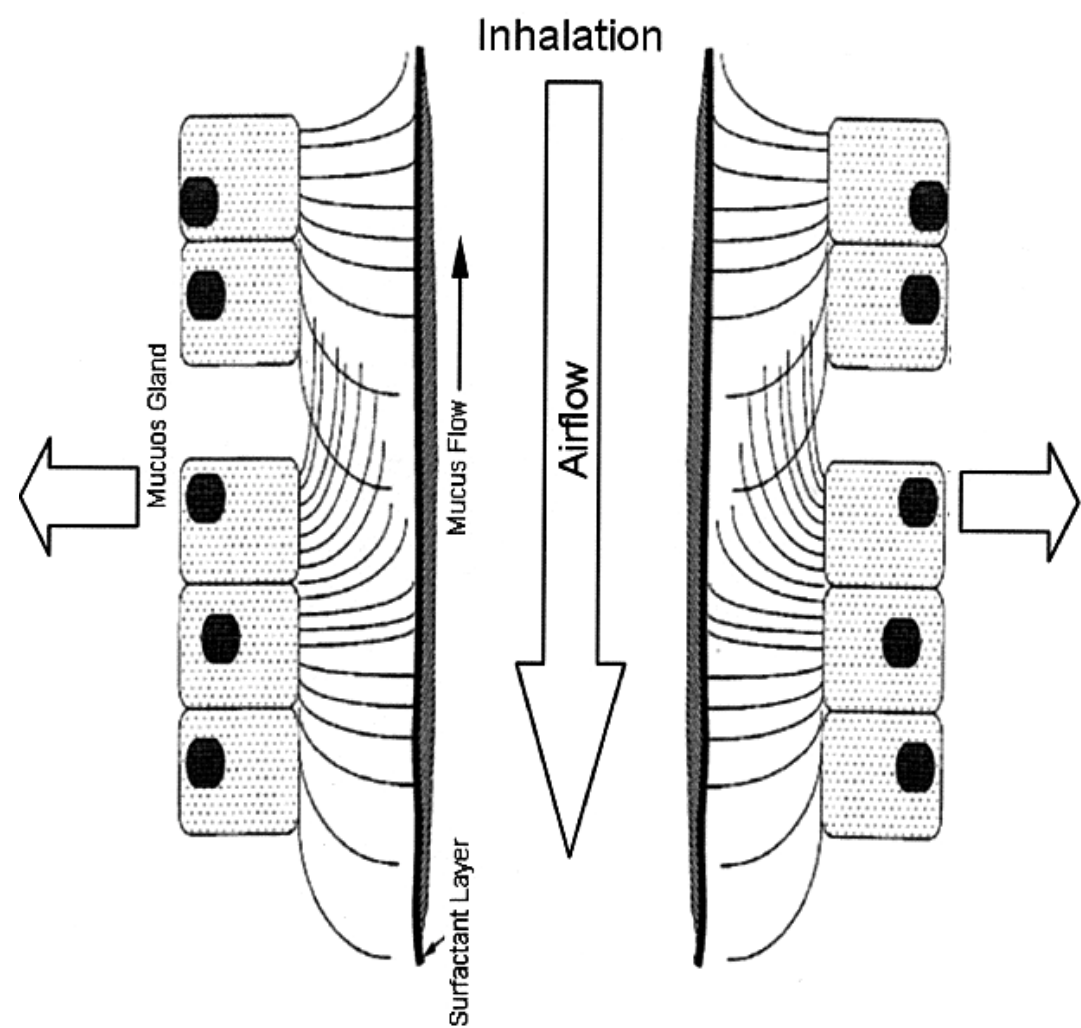
**Pressure
Volume → Airflow**



Clearance ≠ Cough



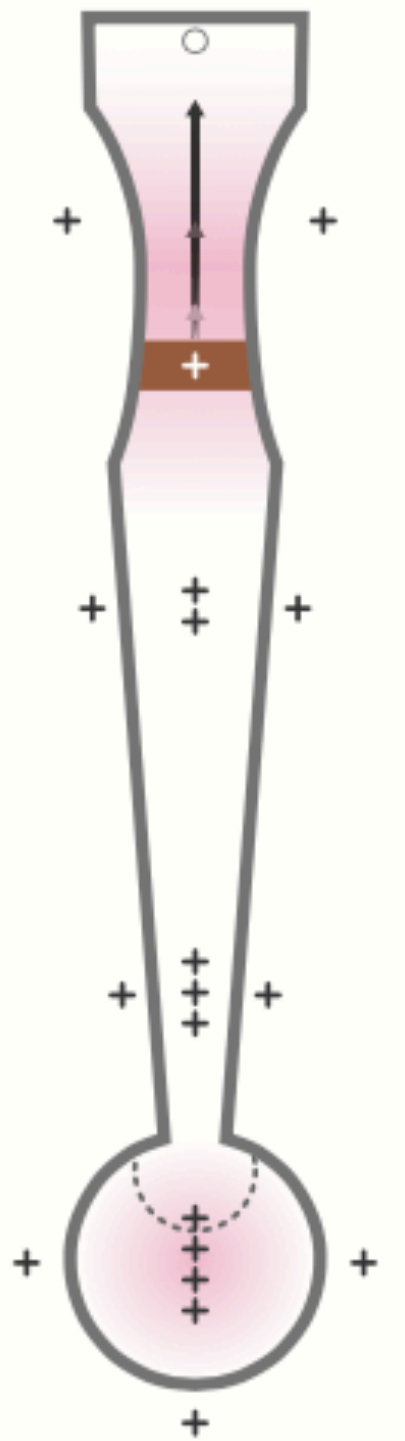
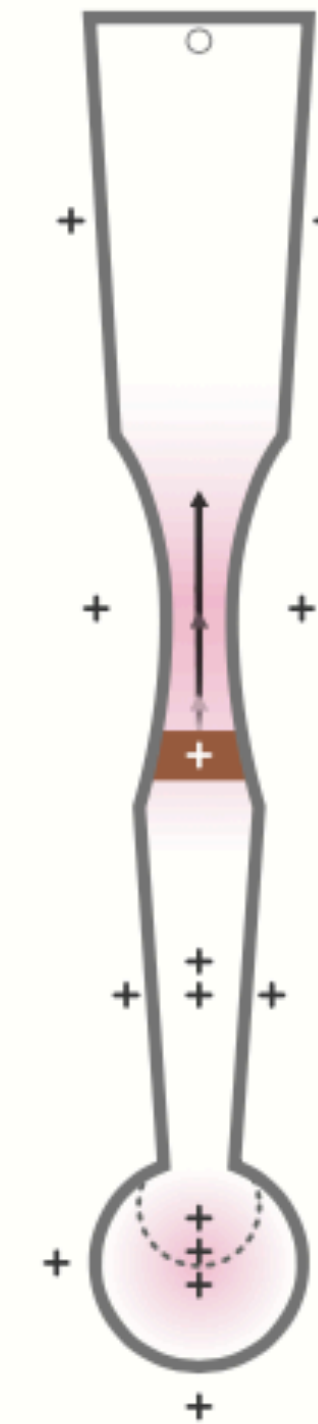
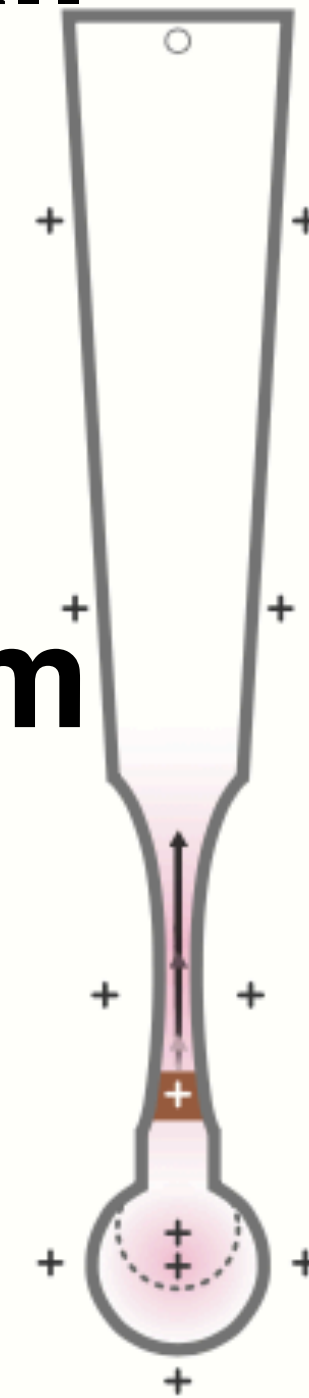
Forced Expiratory Technique



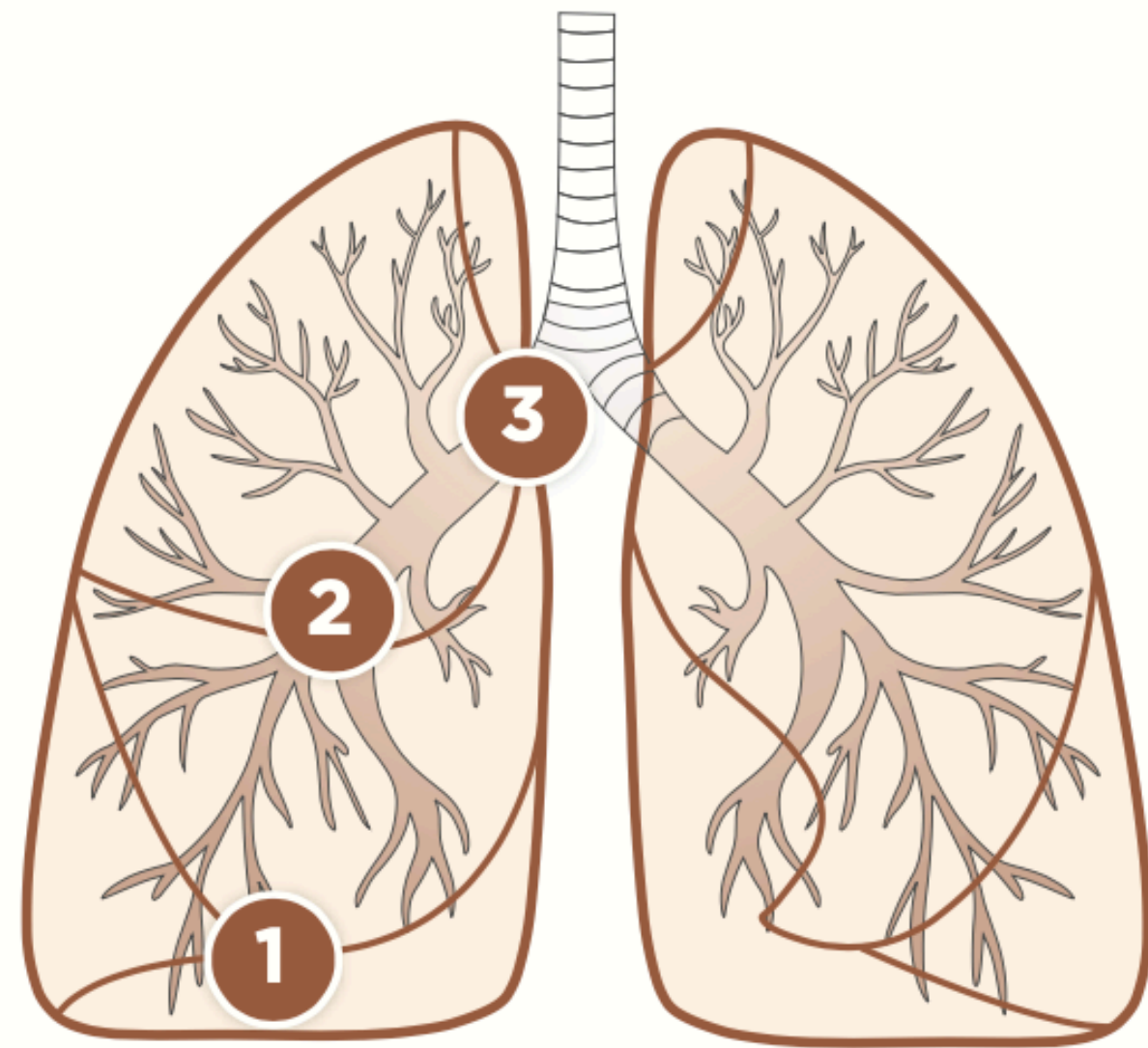
Small

Medium

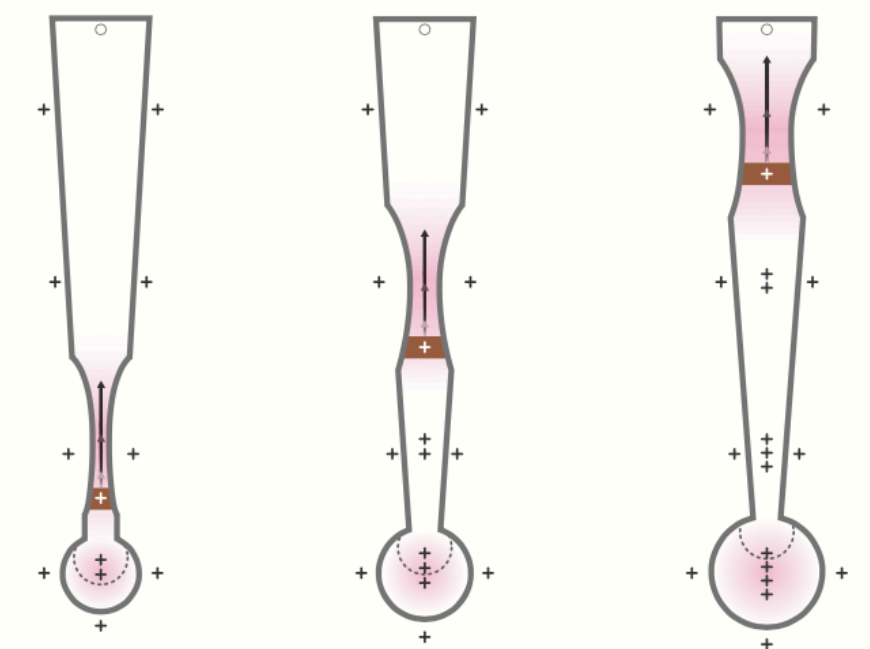
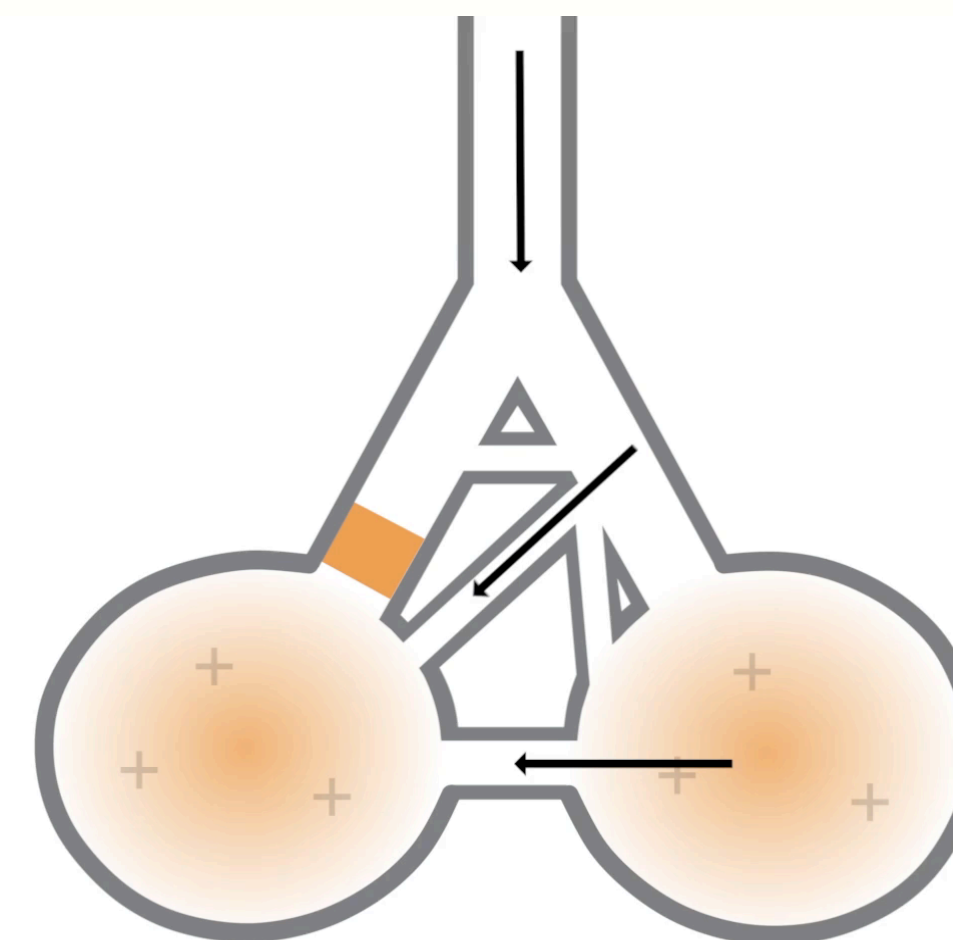
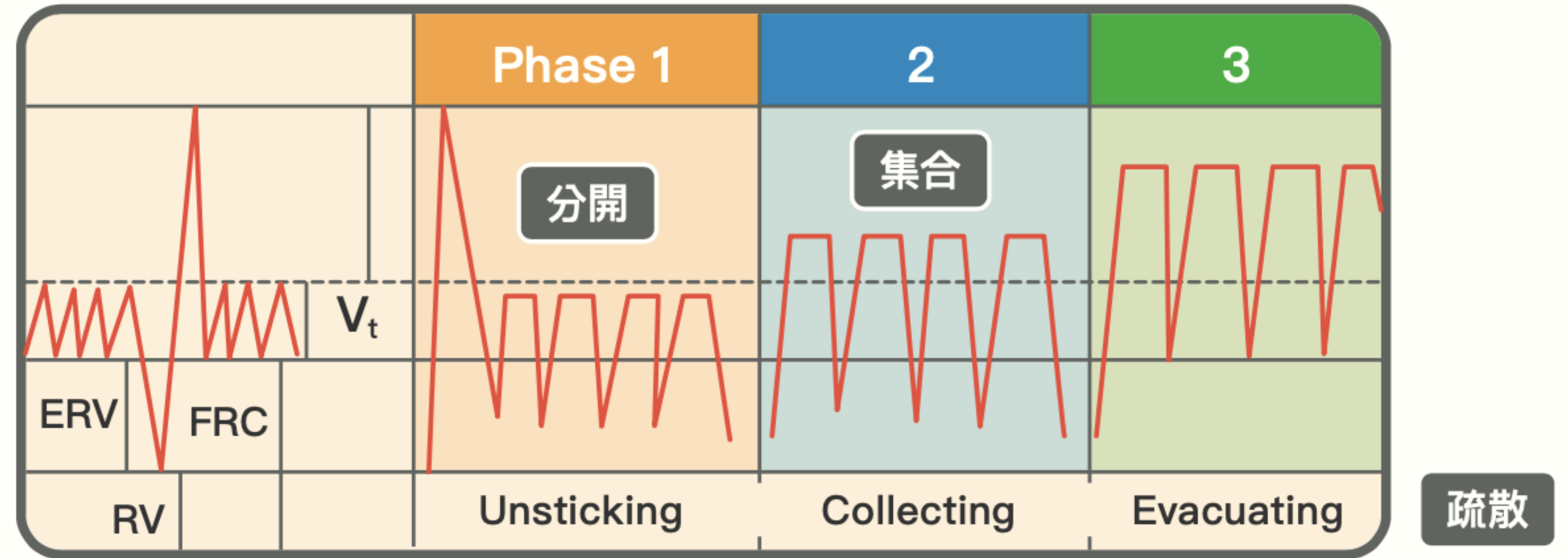
Large



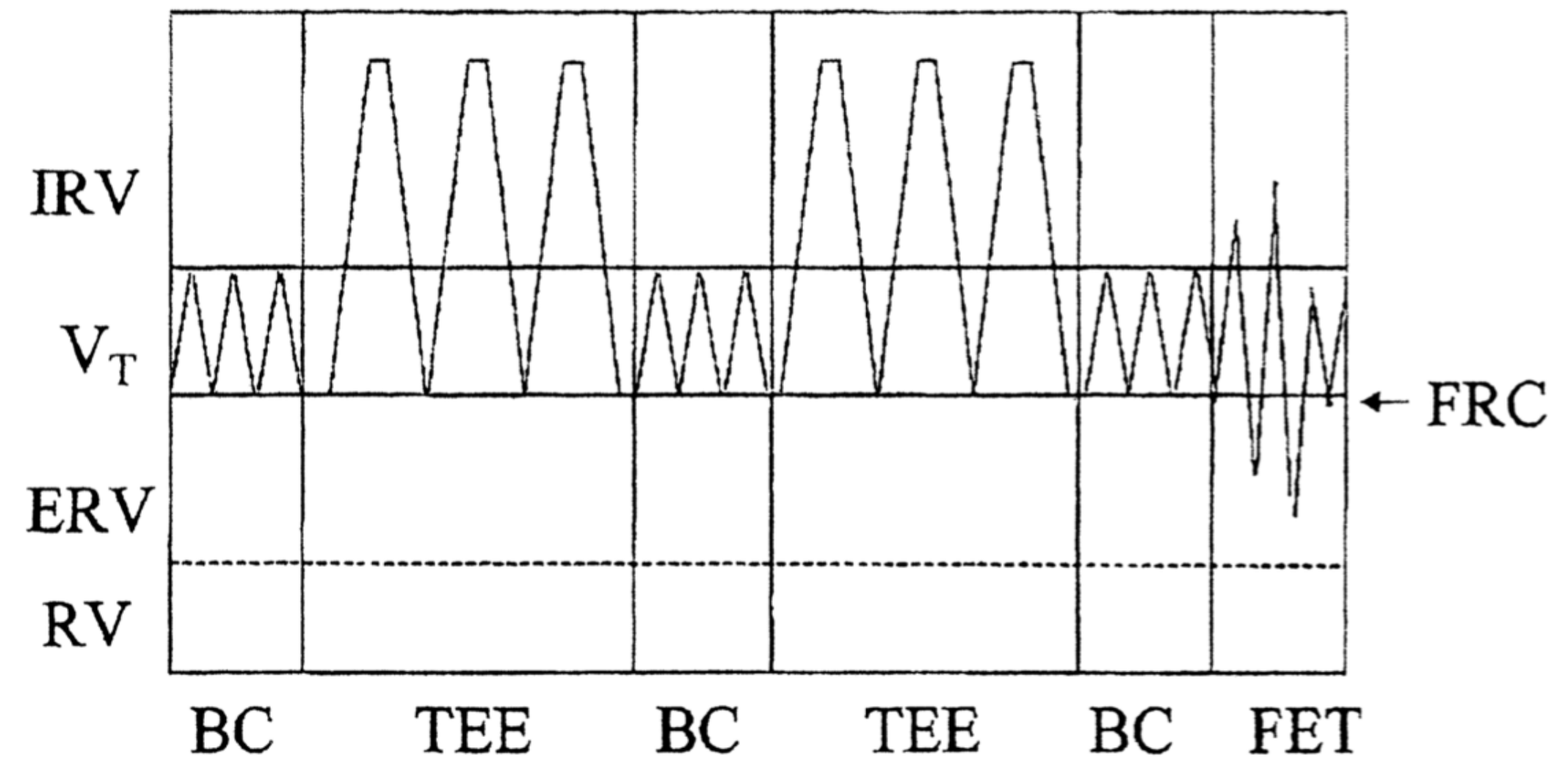
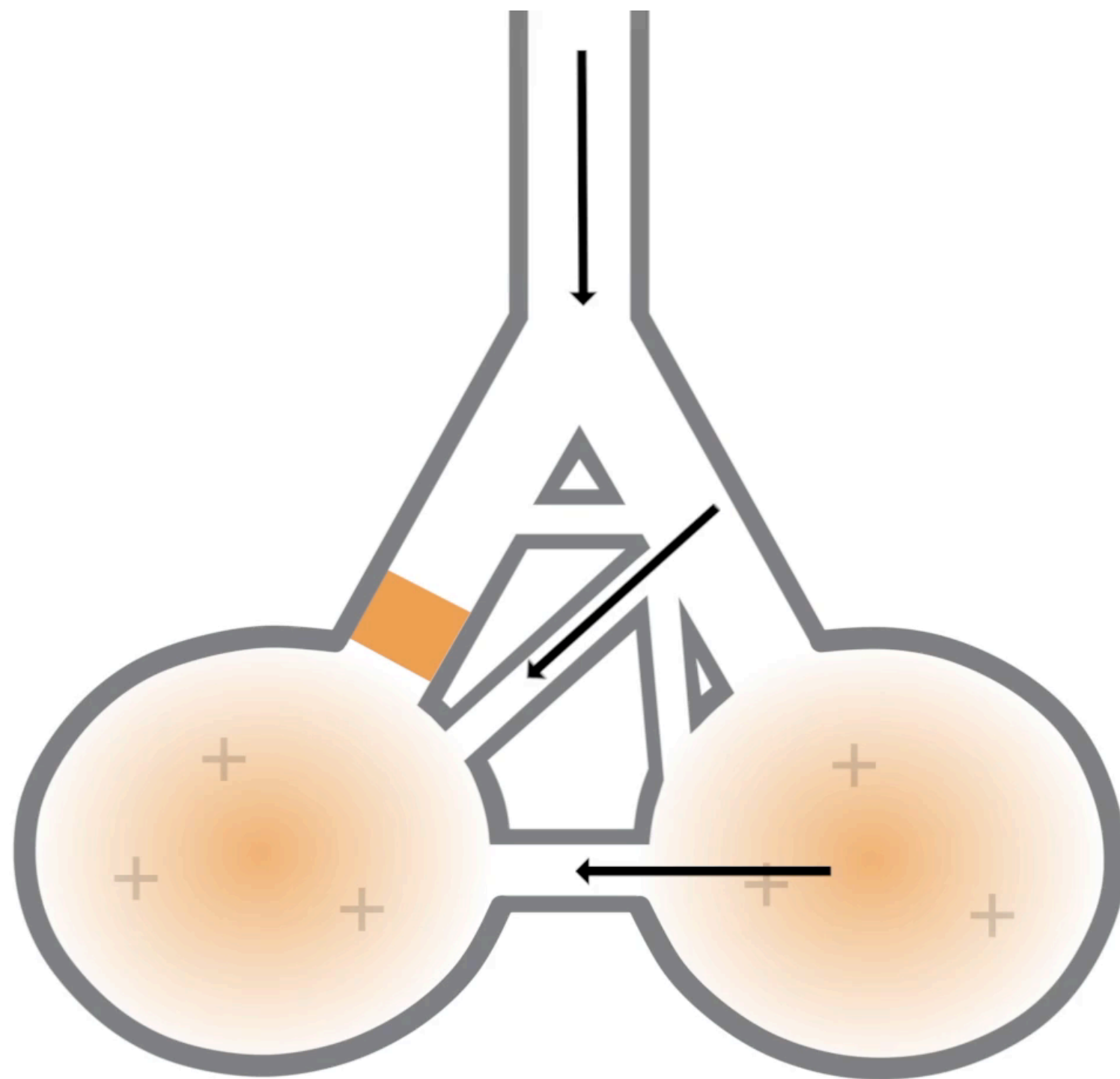
Autogenic Drainage



Hold 2-3 seconds before exhalation

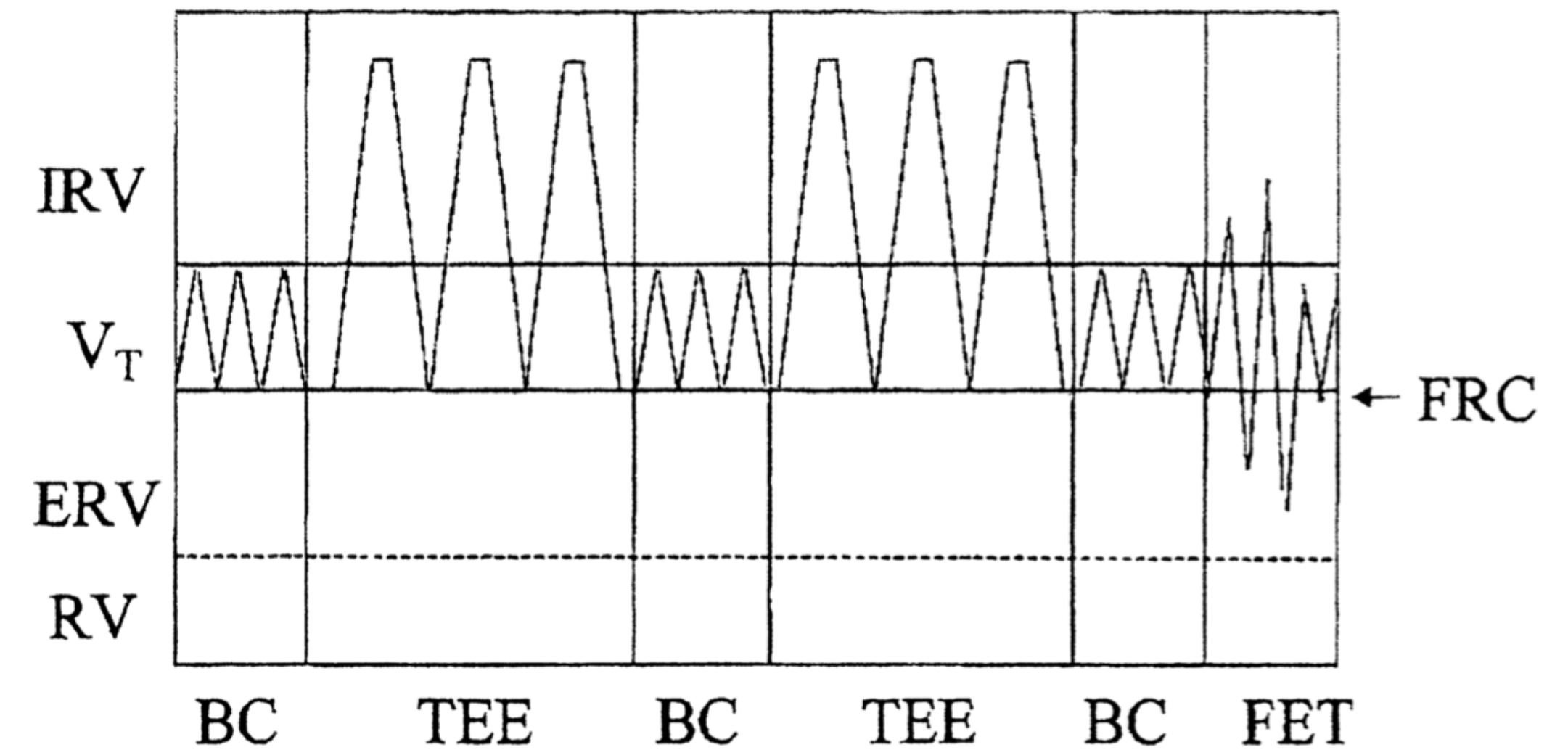
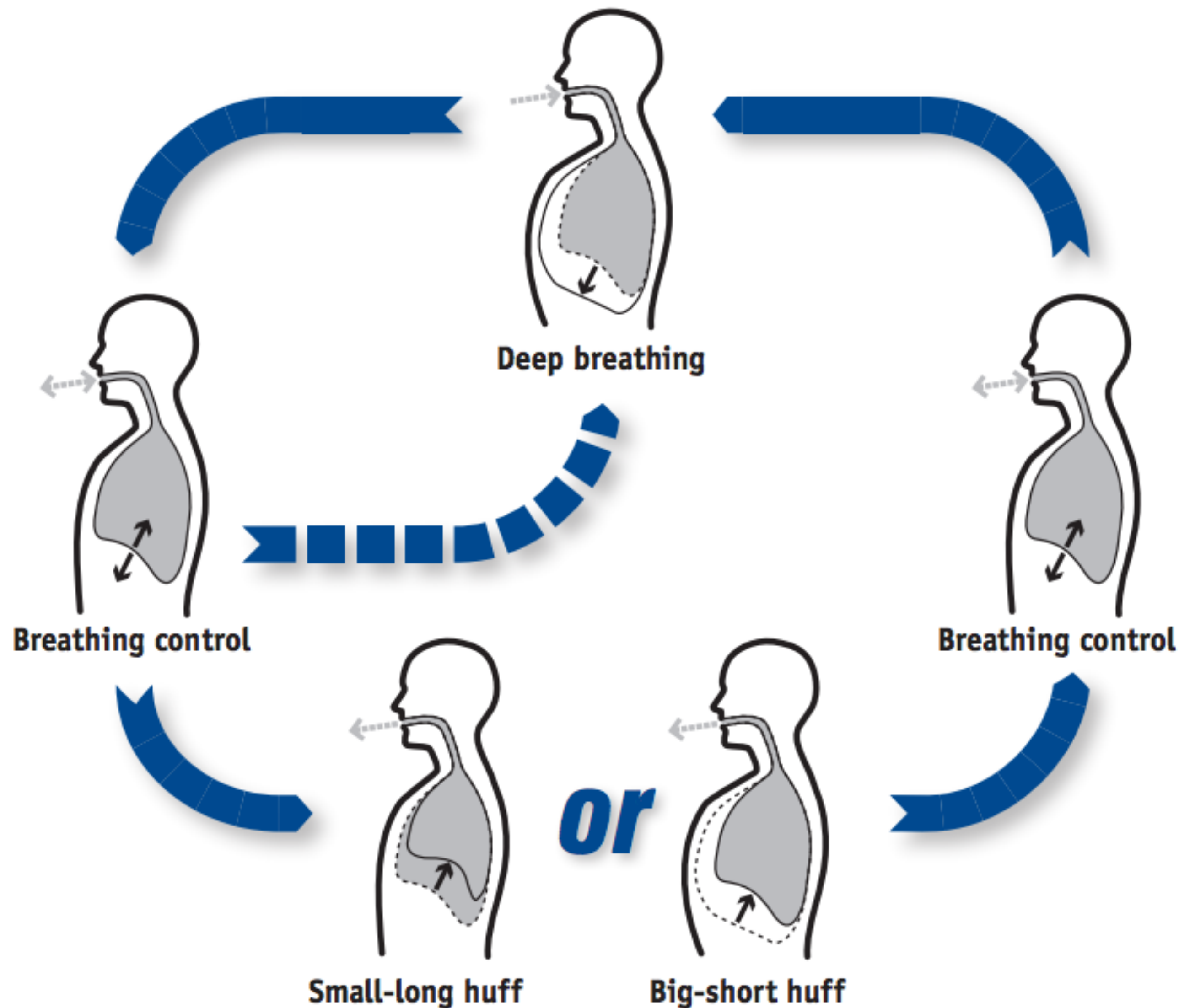


Active Cycle of Breathing Techniques



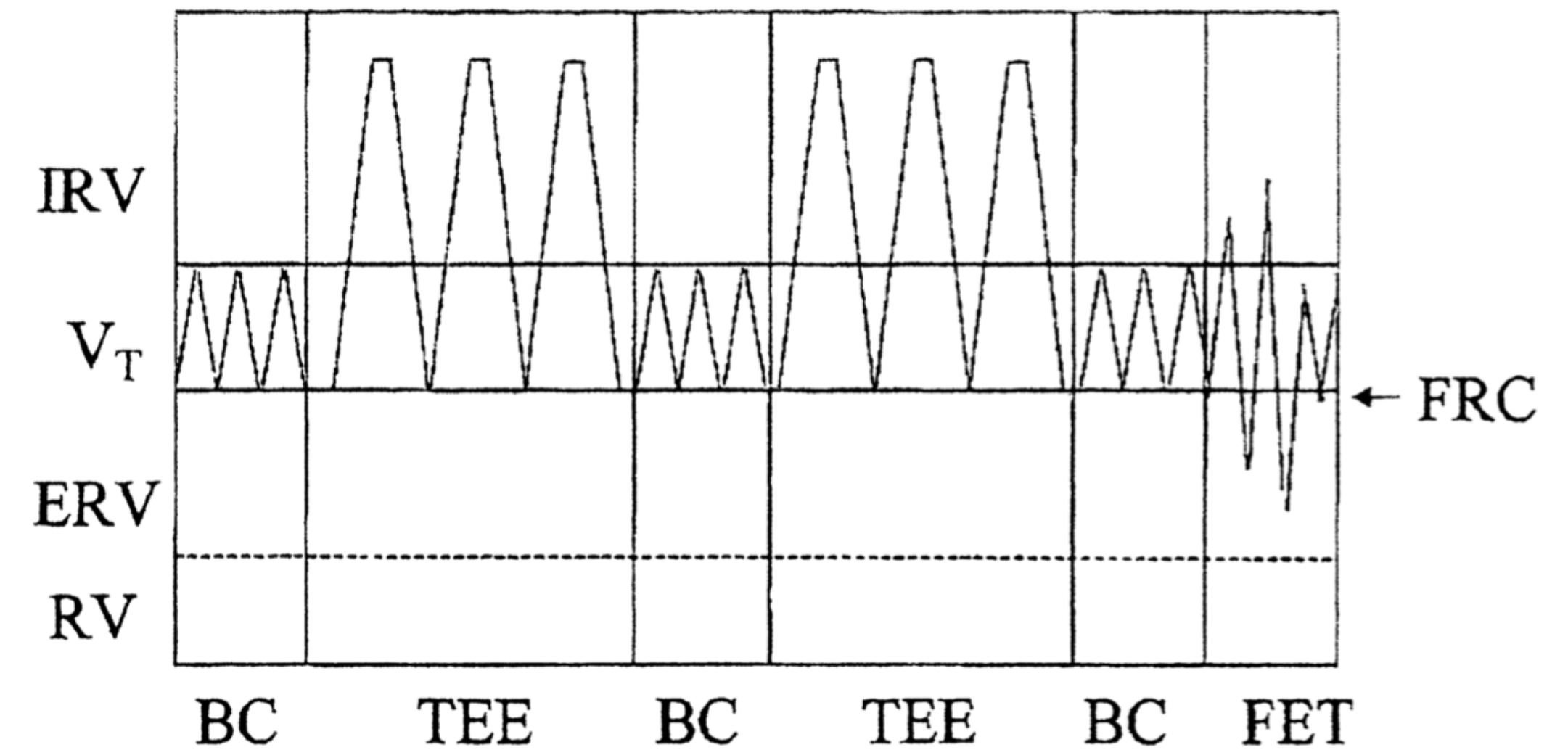
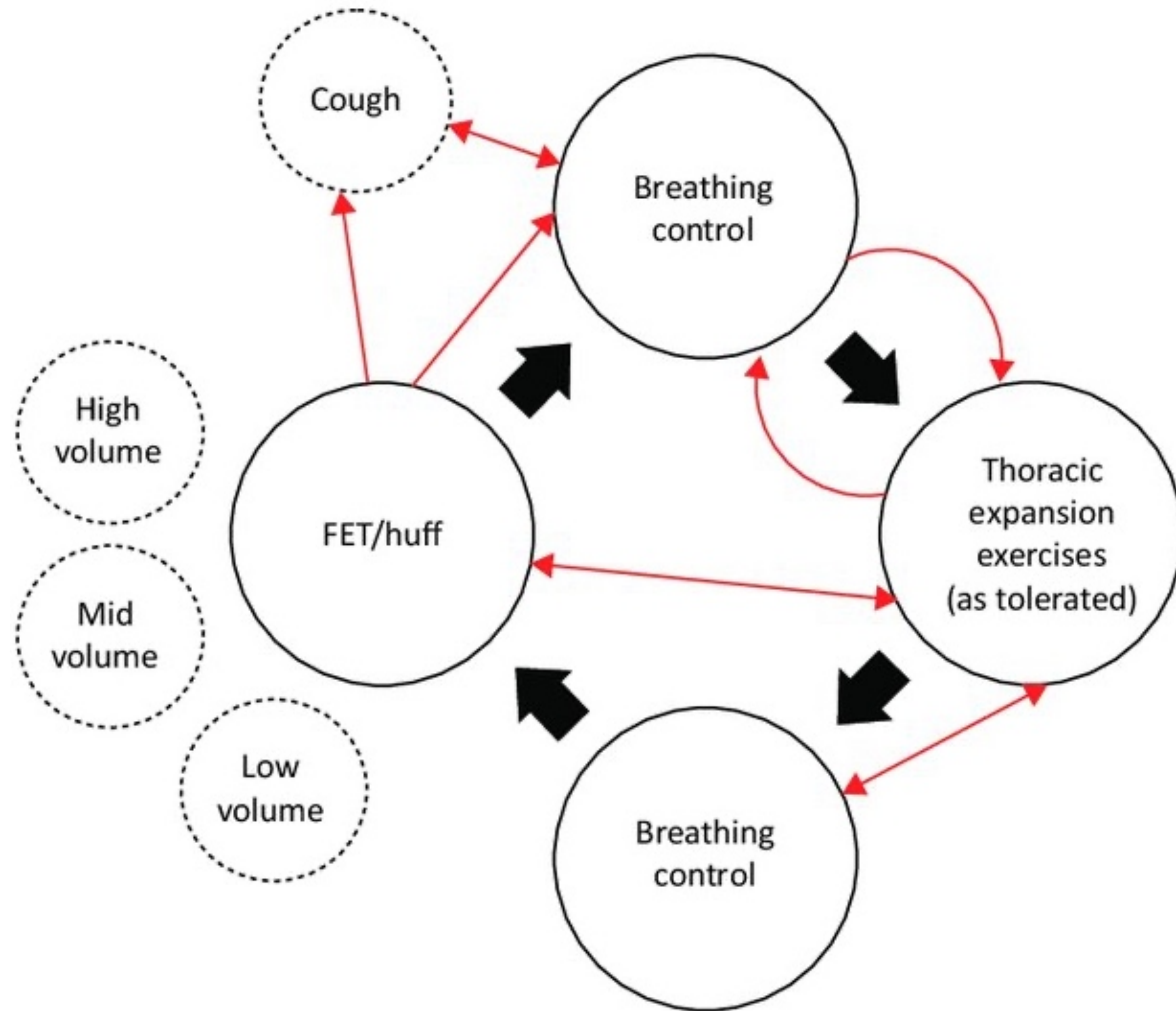
- **Breathing Control**
- **Thoracic Expansion Exercise**
- **Forced Expiration - Huff**

Active Cycle of Breathing Techniques



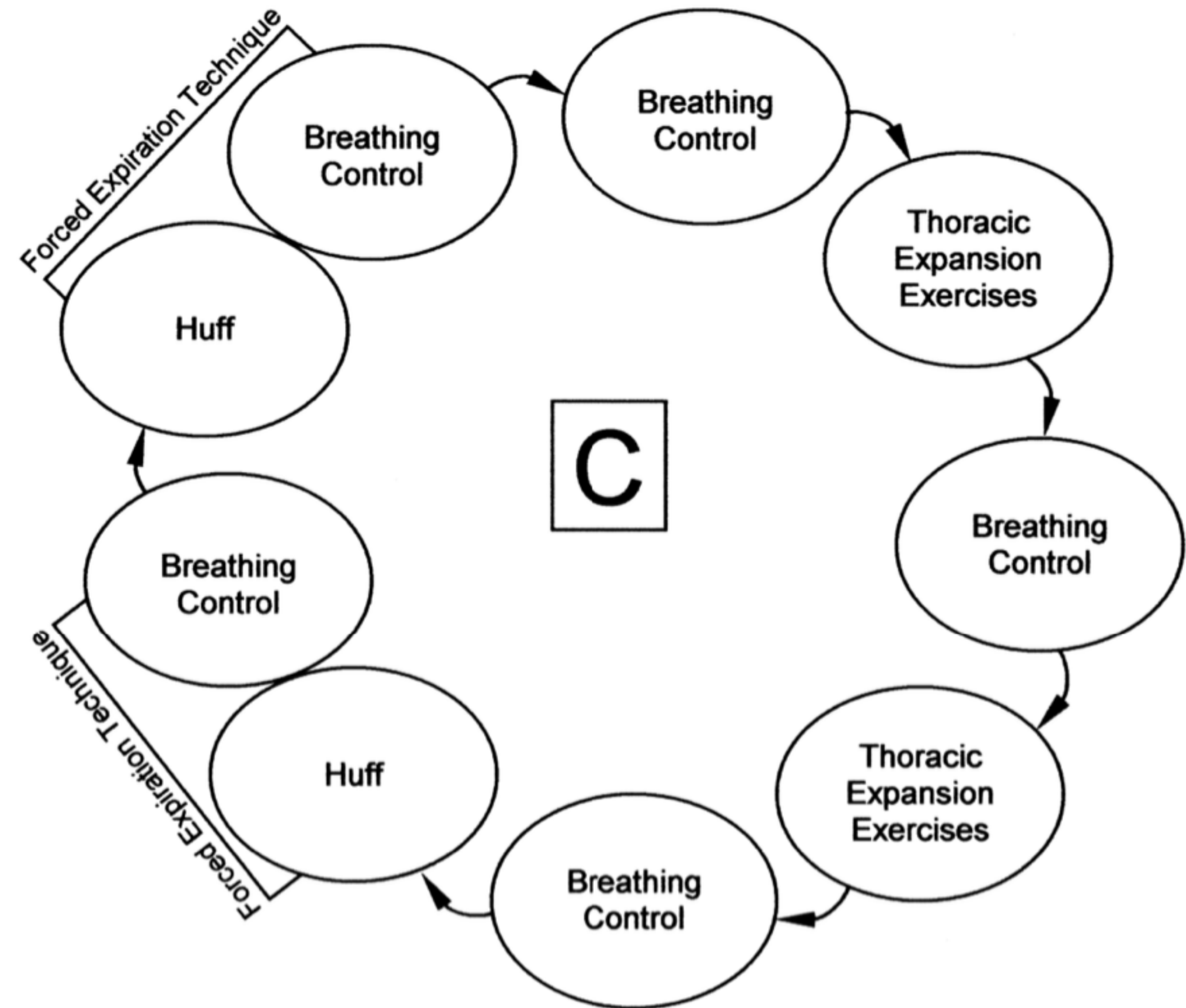
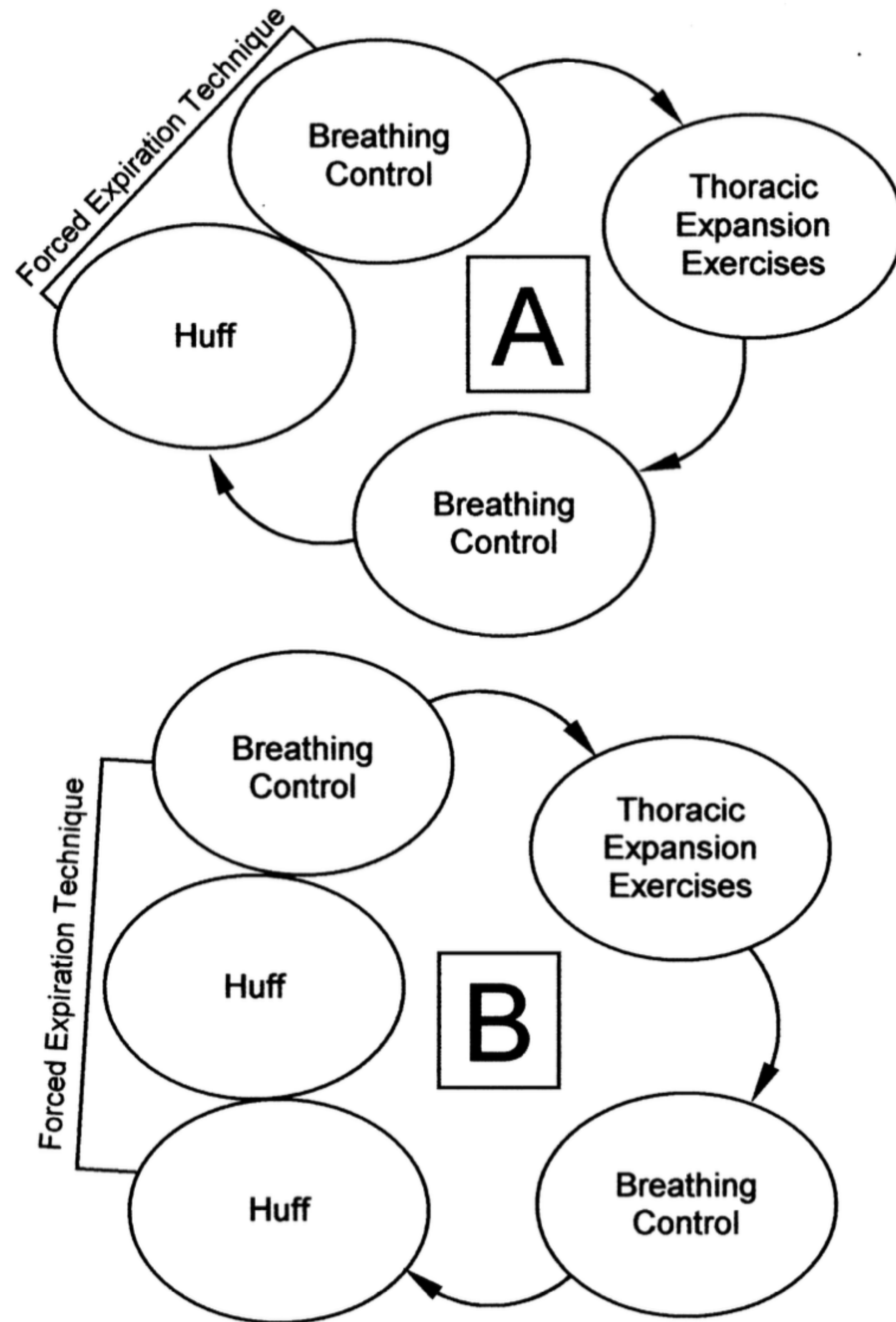
- **Breathing Control**
- **Thoracic Expansion Exercise**
- **Forced Expiration - Huff**

Active Cycle of Breathing Techniques



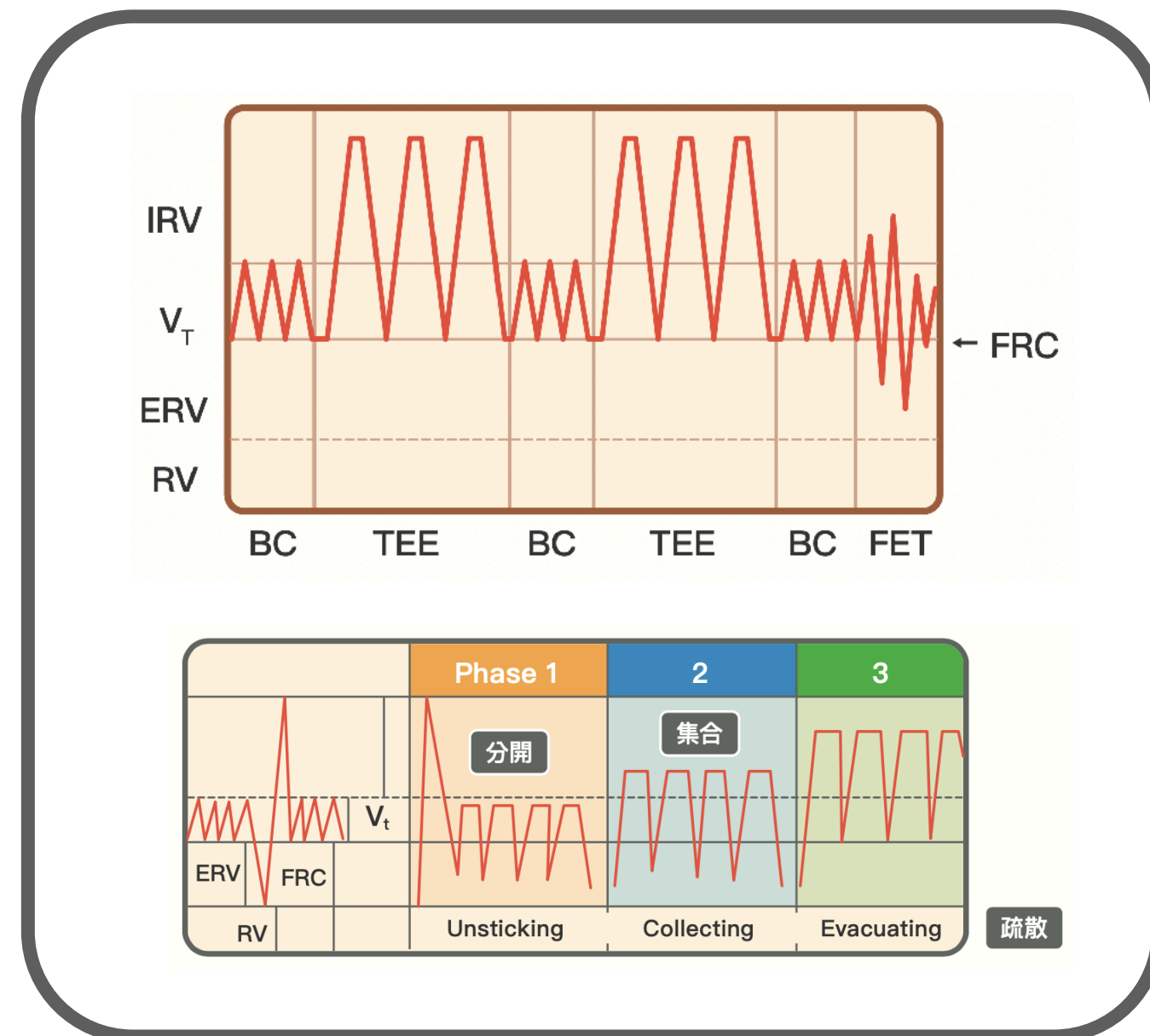
- **Breathing Control**
- **Thoracic Expansion Exercise**
- **Forced Expiration - Huff**

Active Cycle of Breathing Techniques

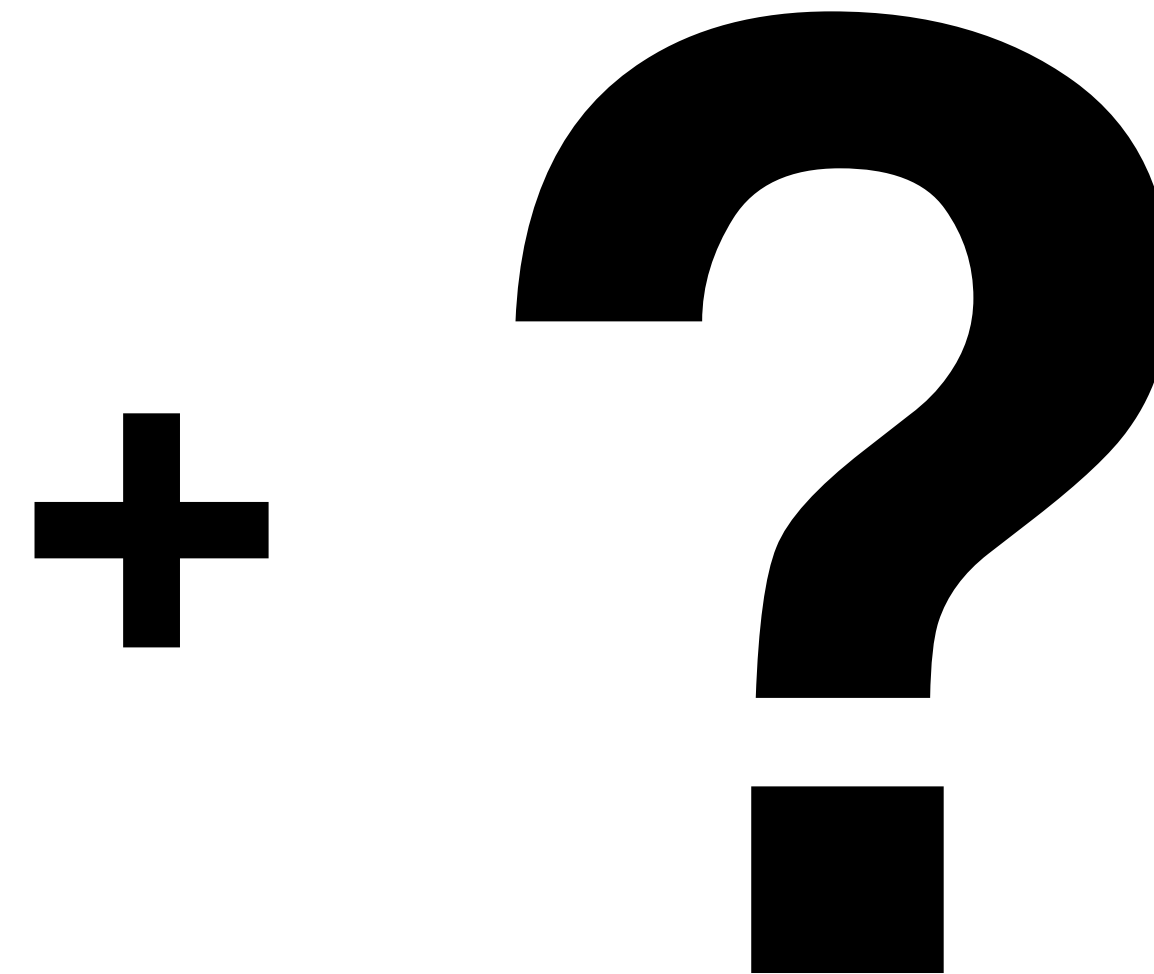


Airway Clearance Techniques

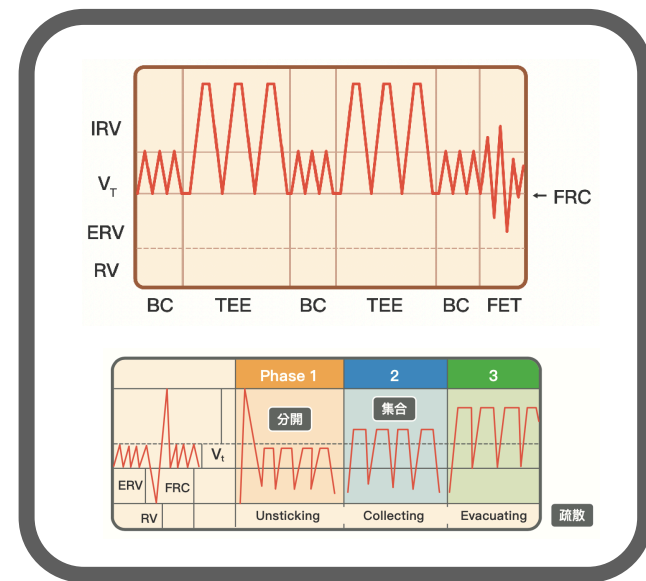
Active Cycle of Breathing Techniques



FET, Autogenic Drainage

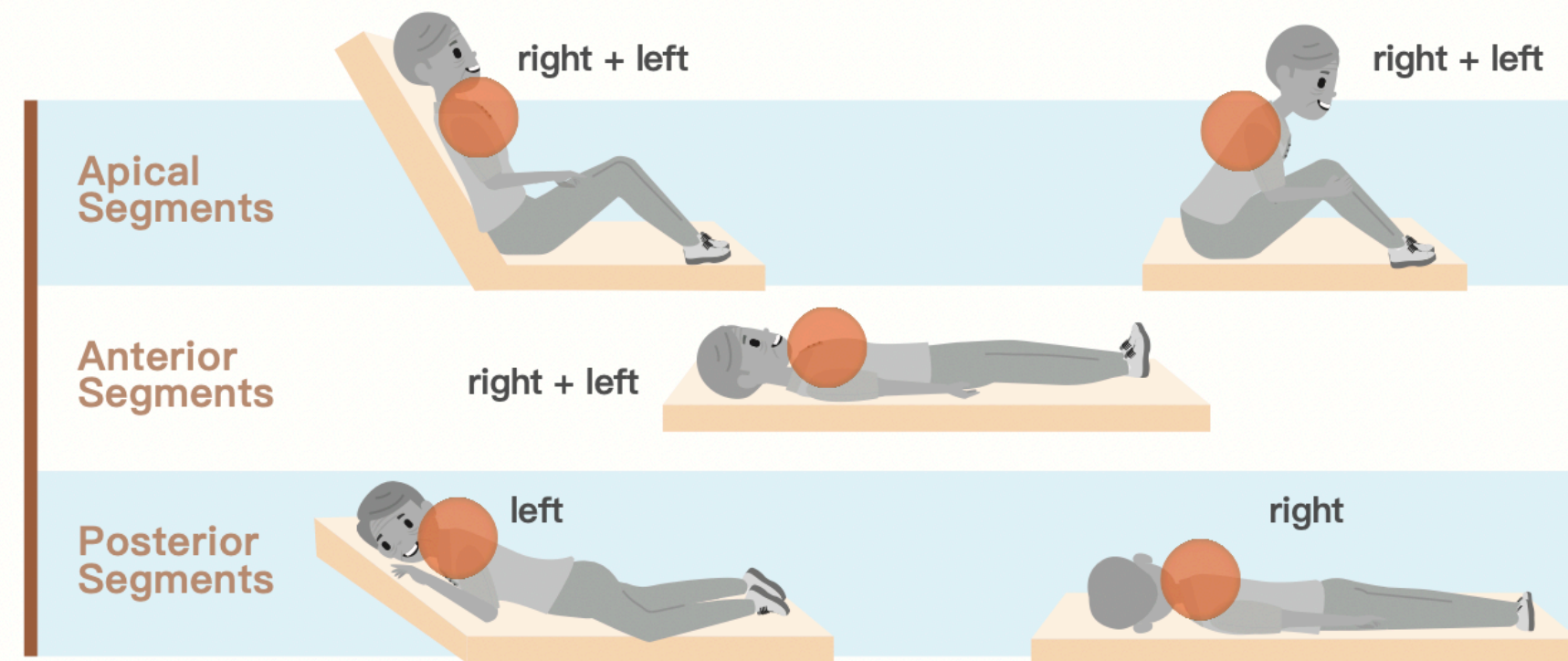


Gravity: Postural Drainage

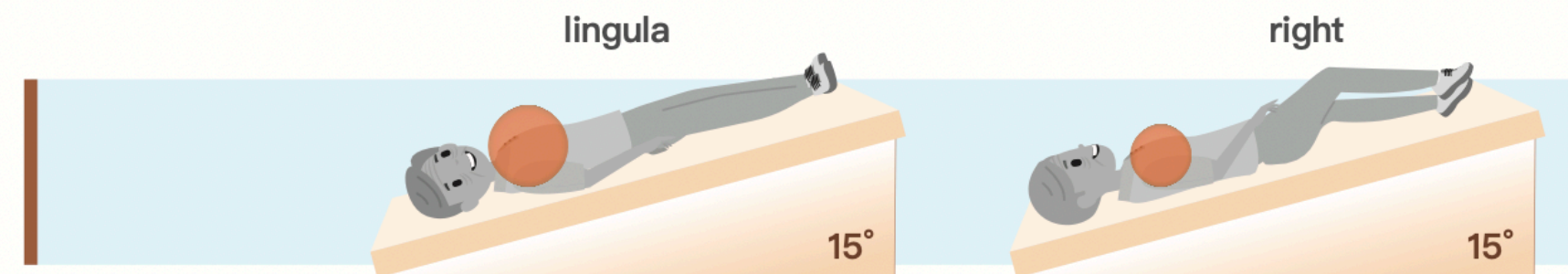


+

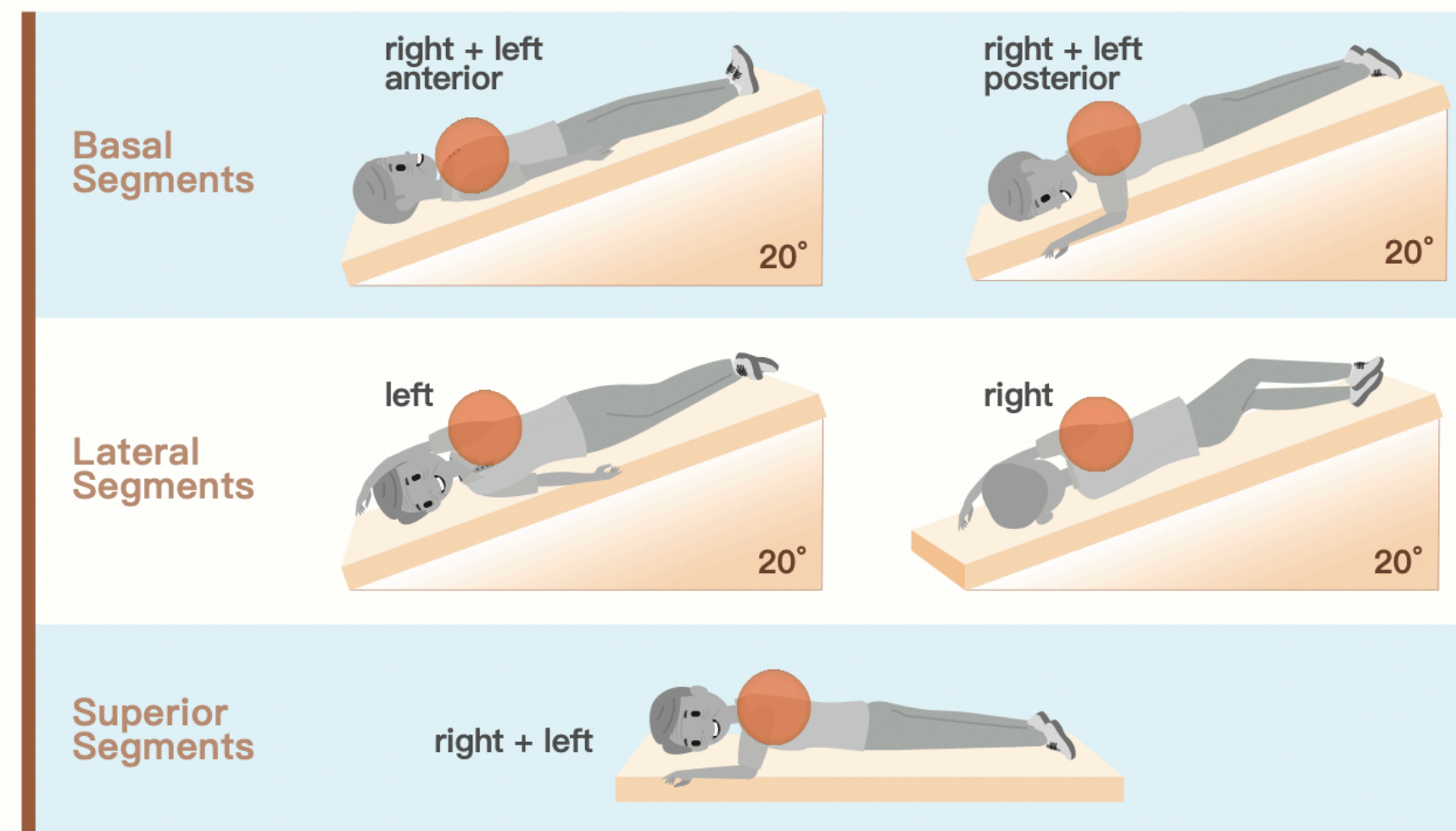
UPPER LOBES



MIDDLE LOBES



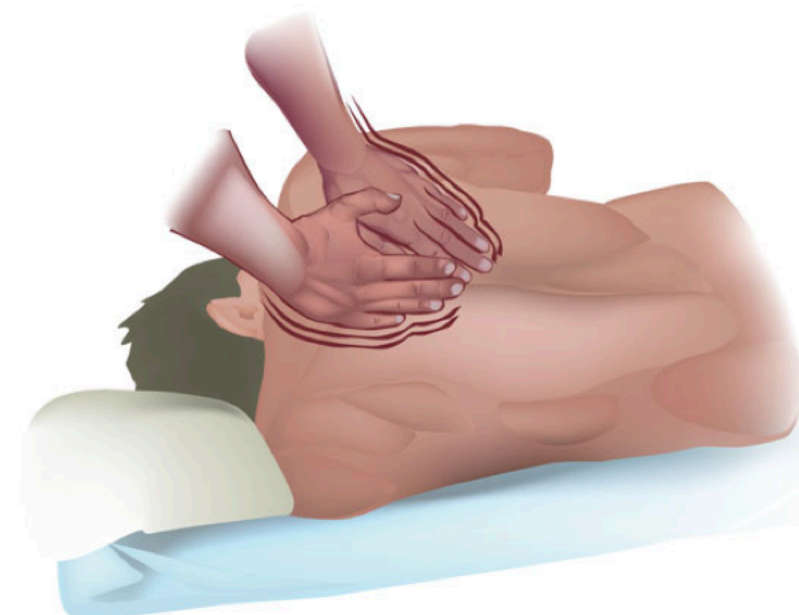
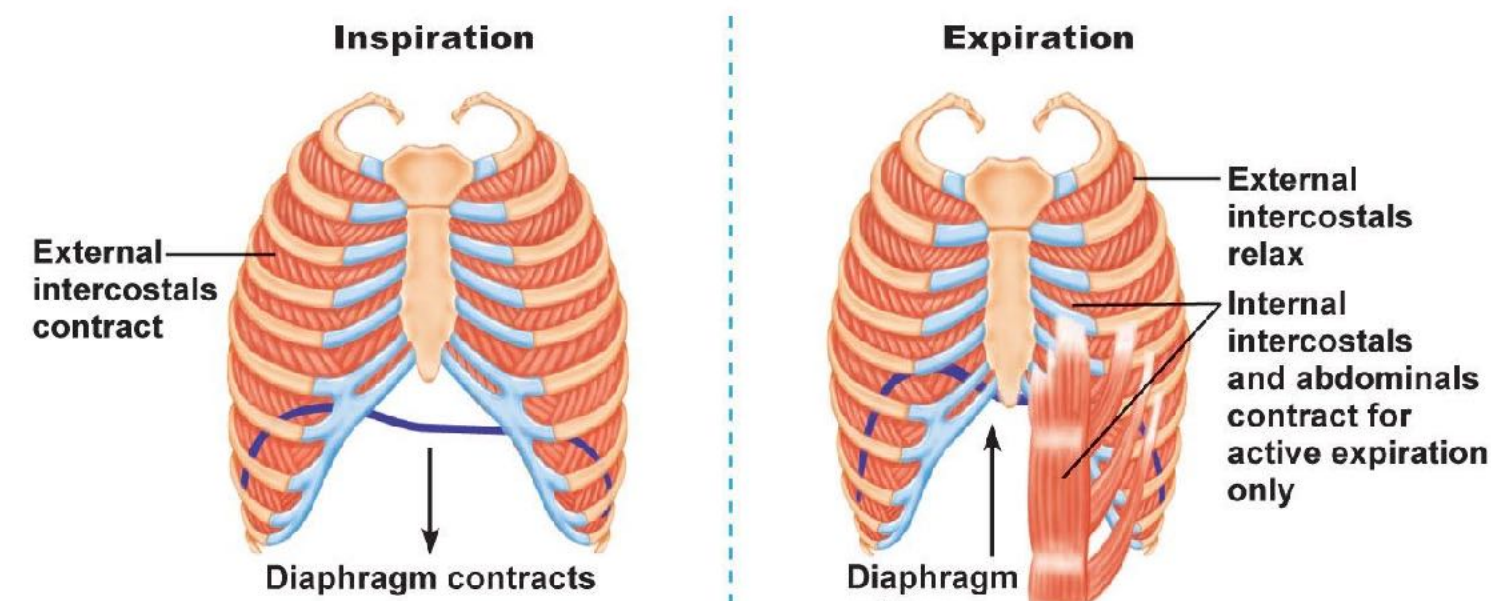
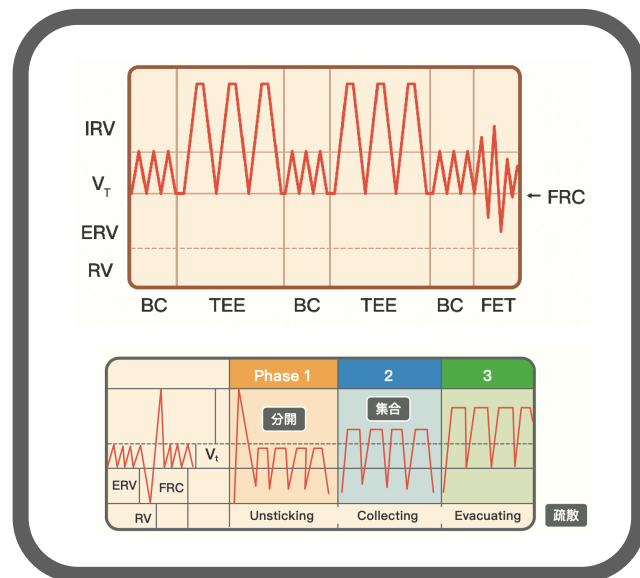
LOWER LOBES



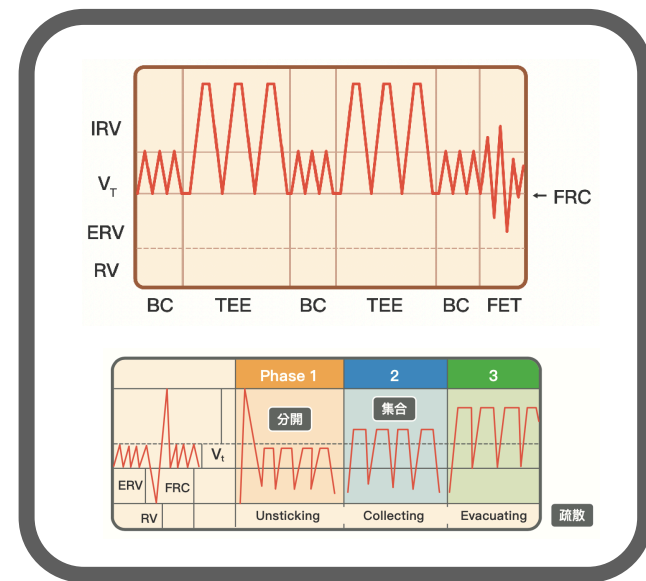
- 10-15m, 3-4/day
- 0.5-1h / eating / 1-1.5h
- Upper then Lower lobes
- 痰液允許吞嚥或抽吸

Force: Clapping, Vibration, Shaking

- Manual: 3-5 /s
- 拍痰機: 20-50 /s
- 3-5m each part
- Avoid:
 - Wound, Catheters
 - Breasts, Spine, Abdomen
 - Stomach, Liver, Kidney
- Should be painless
- **In-phase vibration**



***Force:* High frequency chest wall oscillation, HFCWO**

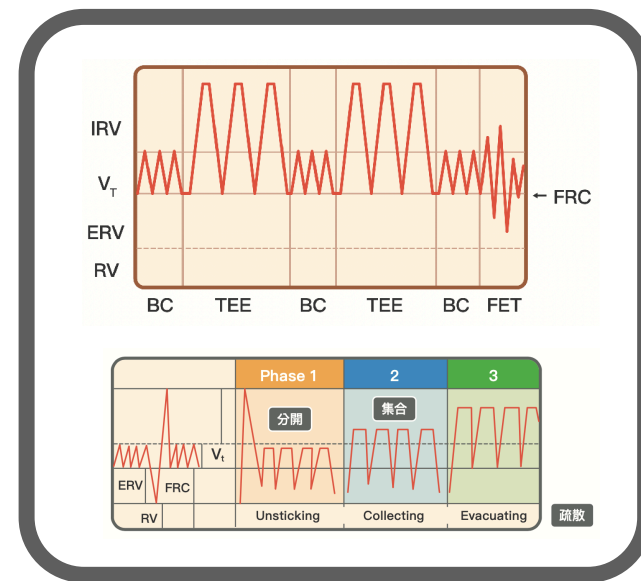


+



- 30m, 1-6 /day
- COPD: 10-15Hz
- Bronchiectasis: 12-25Hz
- Absolute contraindication:
 - Head & neck injured
 - Hemodynamic unstable

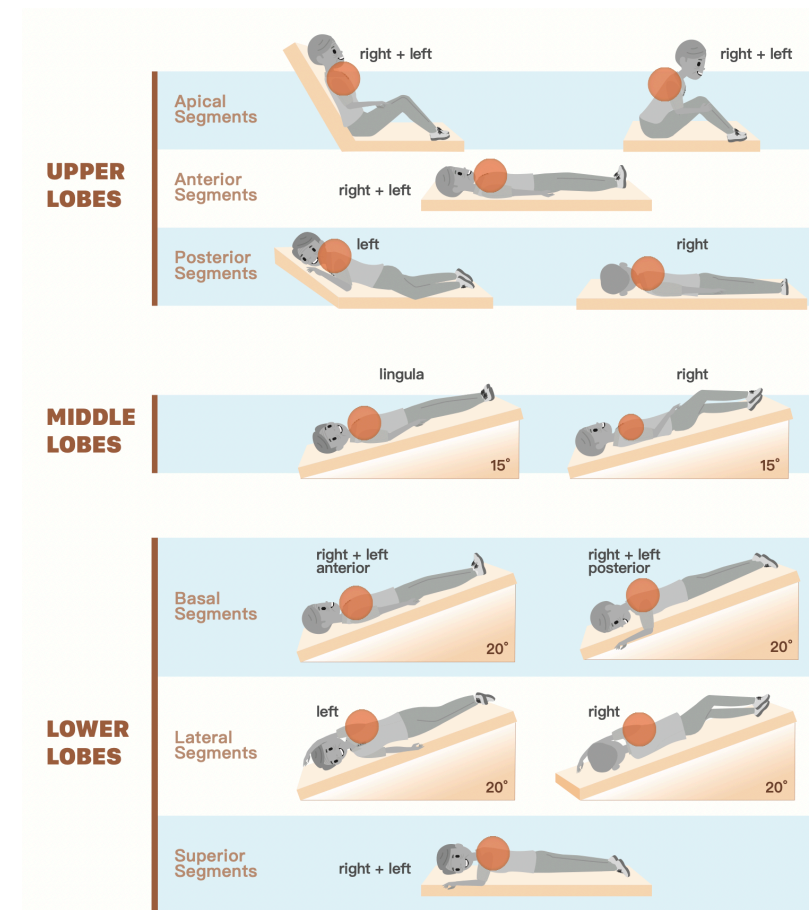
Airway intact: **Positive Expiratory Pressure, PEP**



+



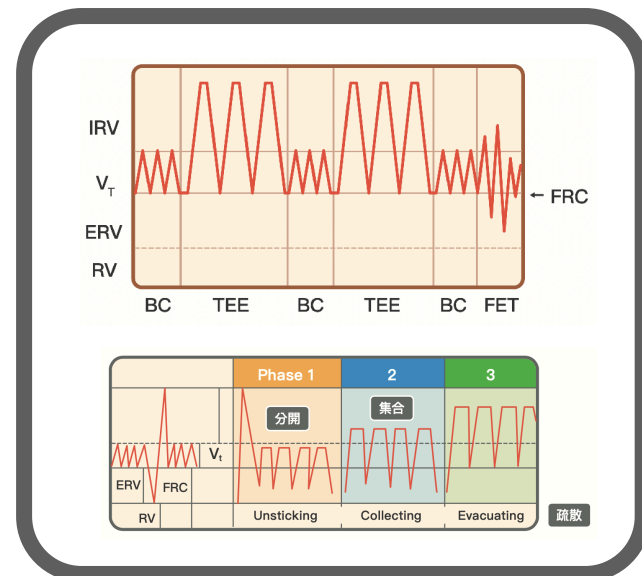
Postural Drainage



Clapping, Vibration, Shaking



Oxygen



+

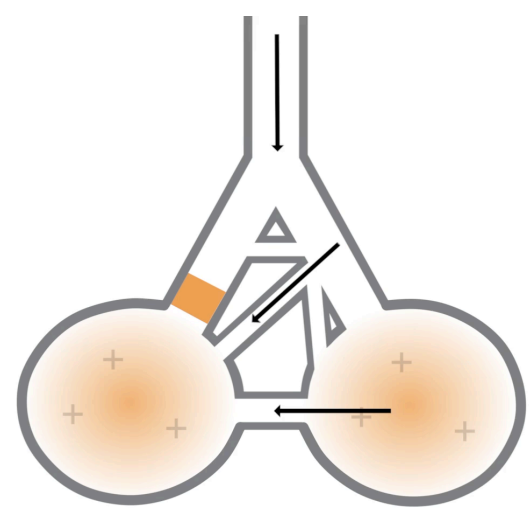
HFCWO (oscillation)



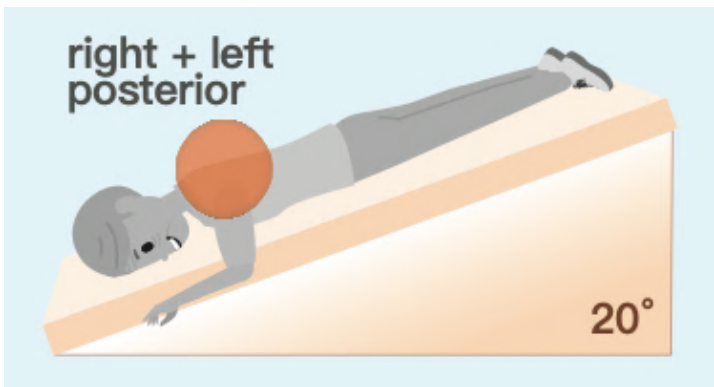
Positive Expiratory Pressure (& Oscillation)



Airway clearance techniques



Volume, Airflow



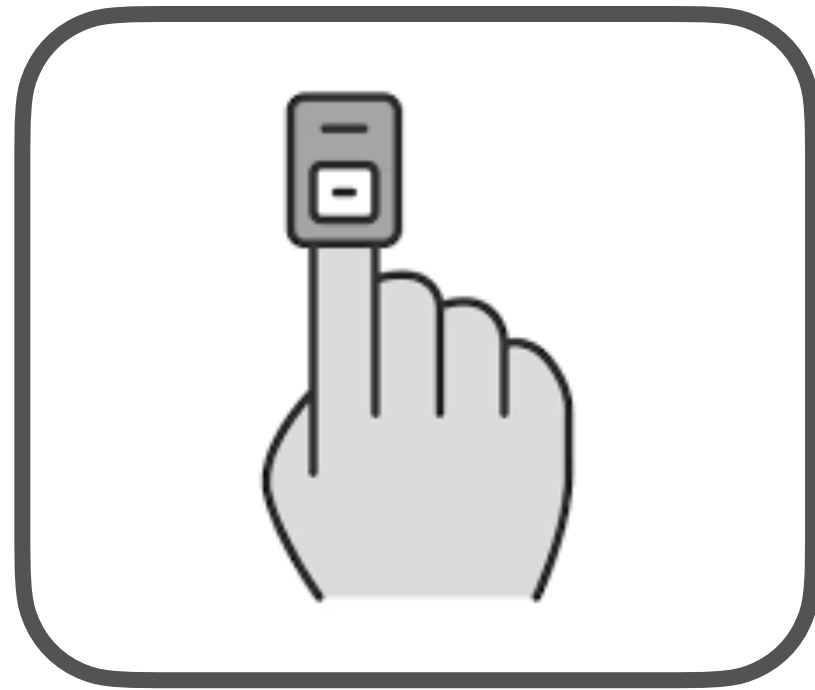
Gravity



Oscillation, Vibration

GRADE 建議等級	臨床建議內容
1B 強建議 證據等級中	● 利用 呼吸咳痰技巧 可以改善支氣管擴張症或囊性纖維化病人痰液清除，促進痰液清除能力。
	● 支氣管擴張症或囊性纖維化病人執行 胸腔物理治療 對痰液的排除成效皆優於不使用胸腔物理治療或自發性咳嗽方式。
	● 支氣管擴張症或囊性纖維化病人執行 姿位引流配合震顫、背部扣擊及呼吸咳痰技巧 ，操作方便不需器材，是臨床上較適合的選擇。
1C 強建議 證據等級低	● 採用 姿位引流 能顯著改善支氣管擴張症病人咳痰困難度、增進肺瀰散量及增加六分鐘走路距離。
2C 弱建議 證據等級低	● 使用 高頻胸腔振動 可幫助痰液清除，進而可能進一步改善肺功能及生活品質，對於痰液較多之肺阻塞、支氣管擴張症的效果較為顯著。
	● 使用 震動吐氣末正壓裝置 對肺阻塞及支氣管擴張症，可幫助痰液清除，進而可能進一步改善肺功能及生活品質。若合併吸入性支氣管擴張劑使用，可增加支氣管擴張的效果。

居家呼吸困難及喘的處理



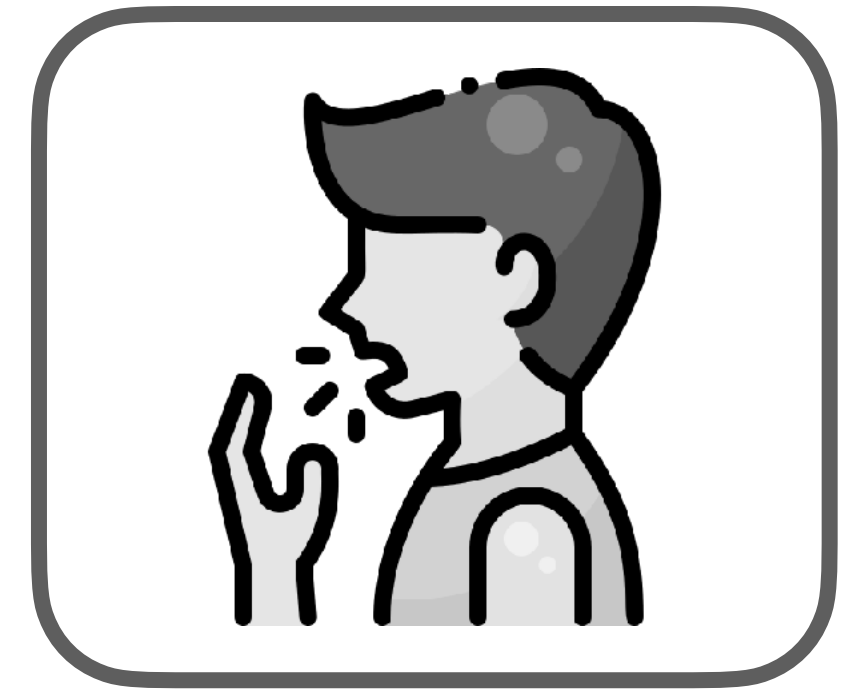
缺氧



喘



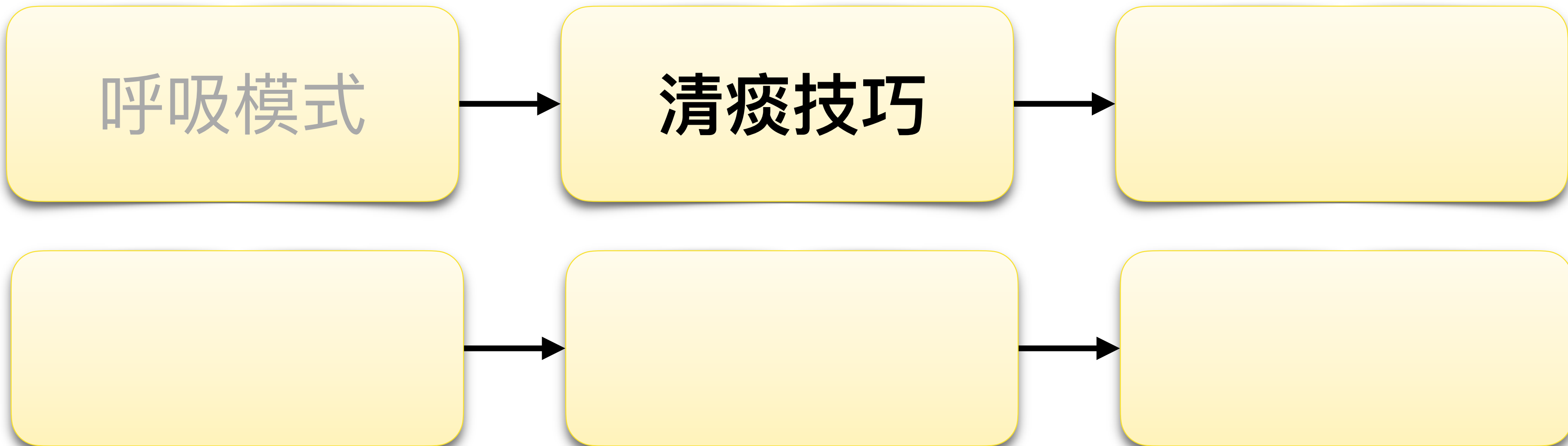
多痰

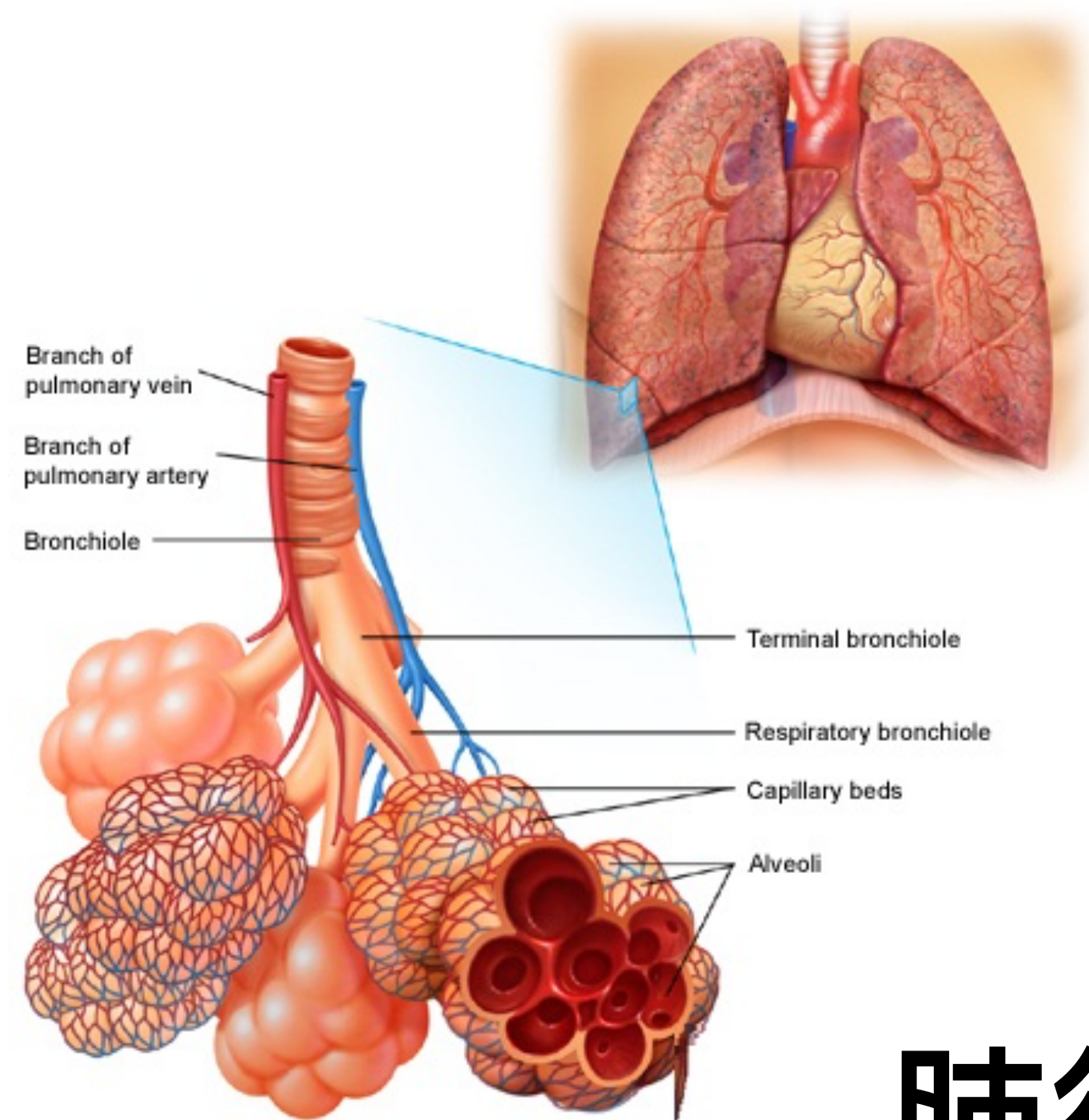


咳嗽

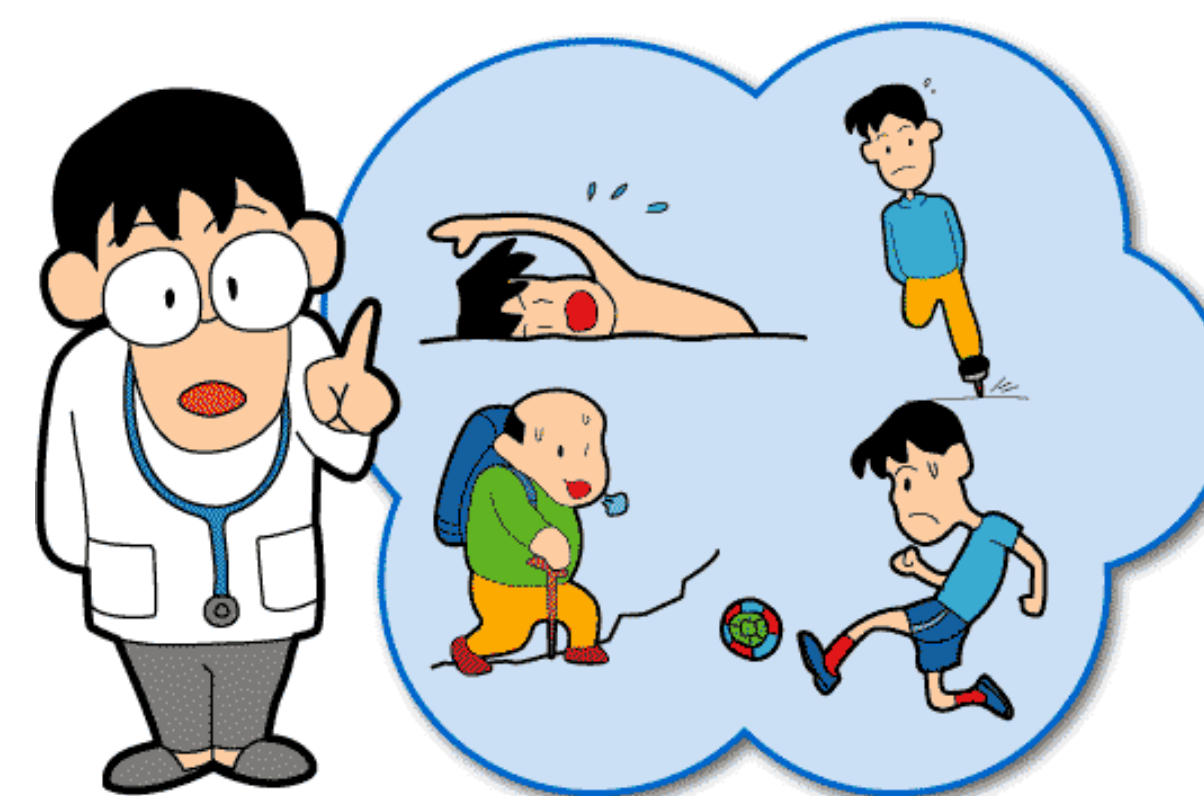
呼吸模式

清痰技巧





肺復原相關運動



要持續運動多久呢？



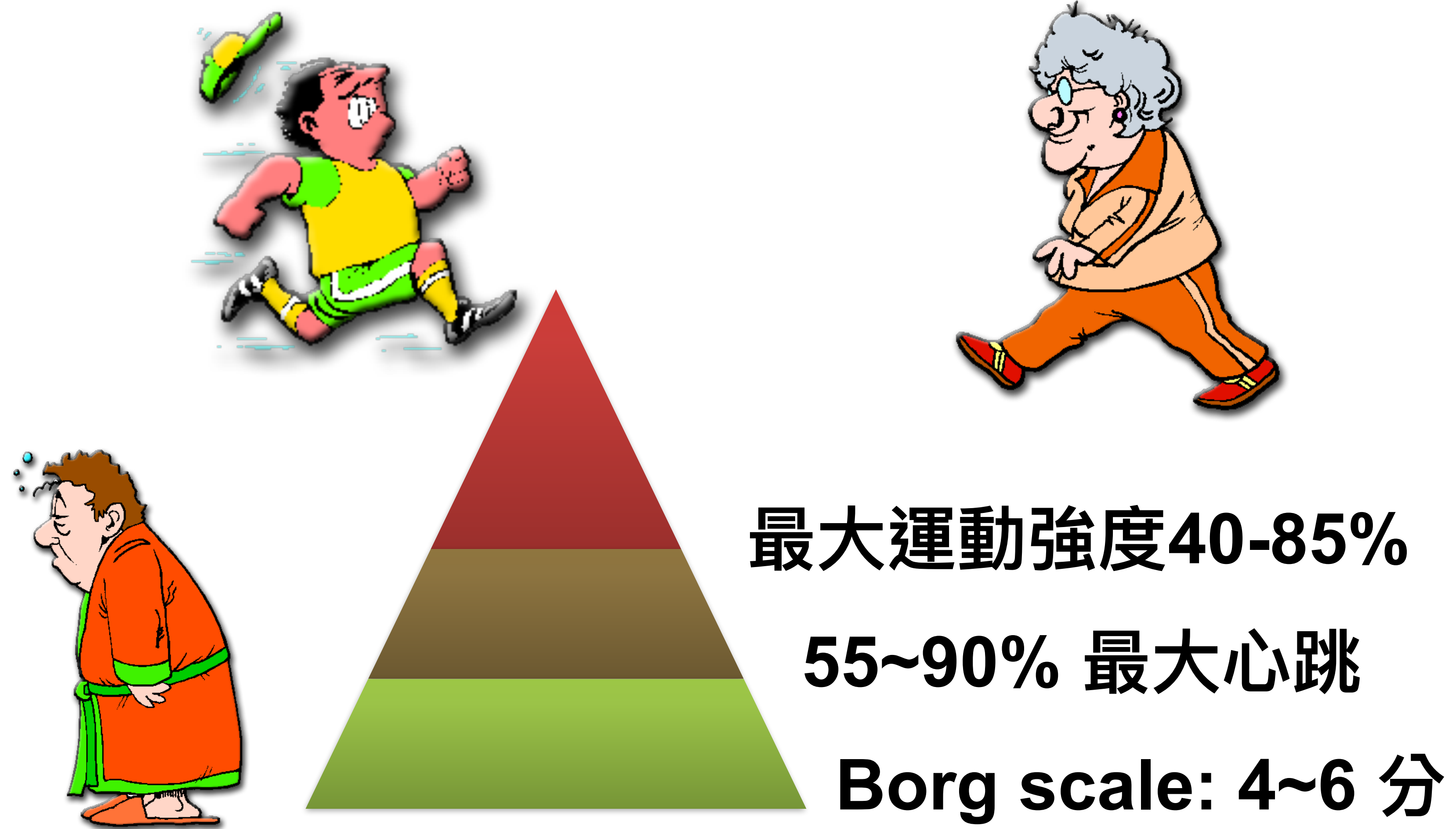
約持續八至十二週

至少二十回



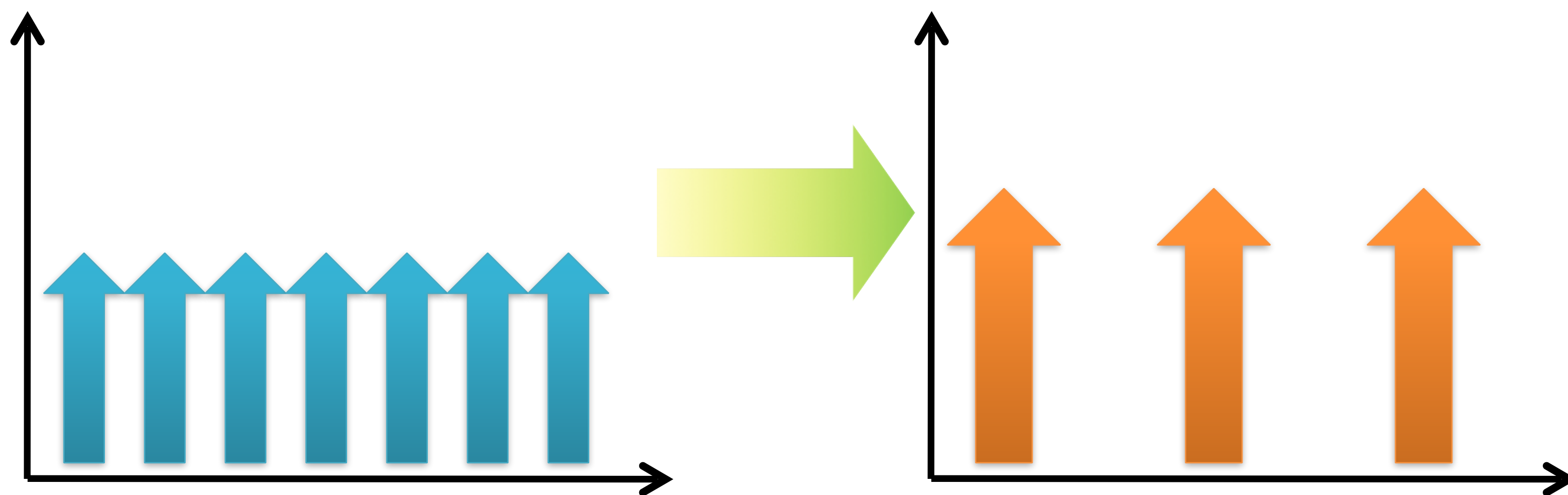
A cartoon illustration of a man with grey hair, glasses, and a large nose, wearing an orange cardigan and brown trousers. He is walking and looking back over his shoulder with a question mark floating behind him.

間隔多久需運動呢？



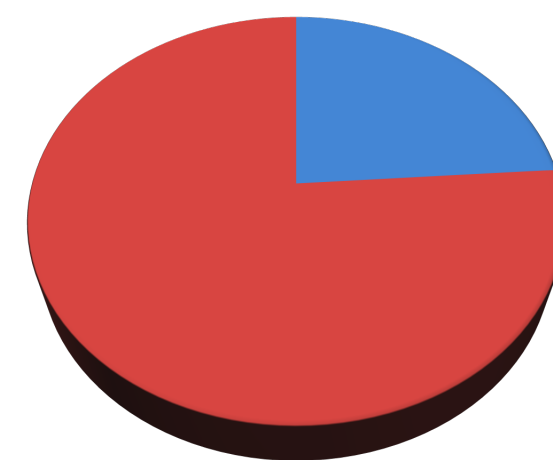
運動訓練的強度如何？

訓練時間：20~60 分鐘



採用間歇式運動訓練可減少症狀

大於60%
運動強度



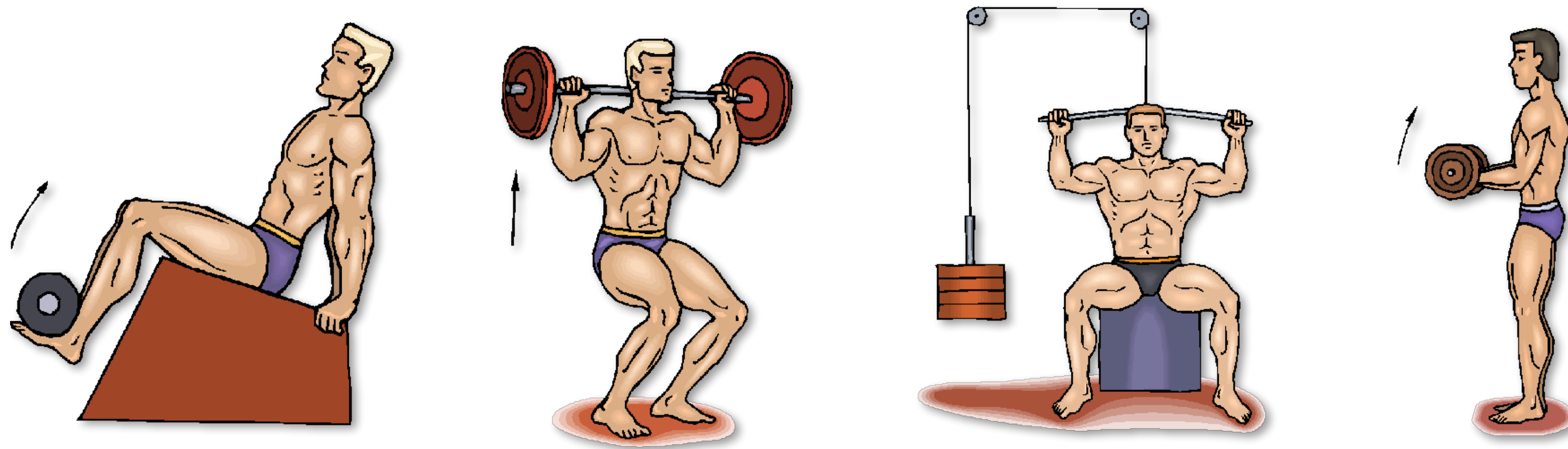
騎腳踏車



步行



每次至少30
分鐘



增強肌力(阻力訓練):

2-3 回/週

50-85%
最大肌力

×

8-15 下

×

1-3 次

每一回肌力訓練



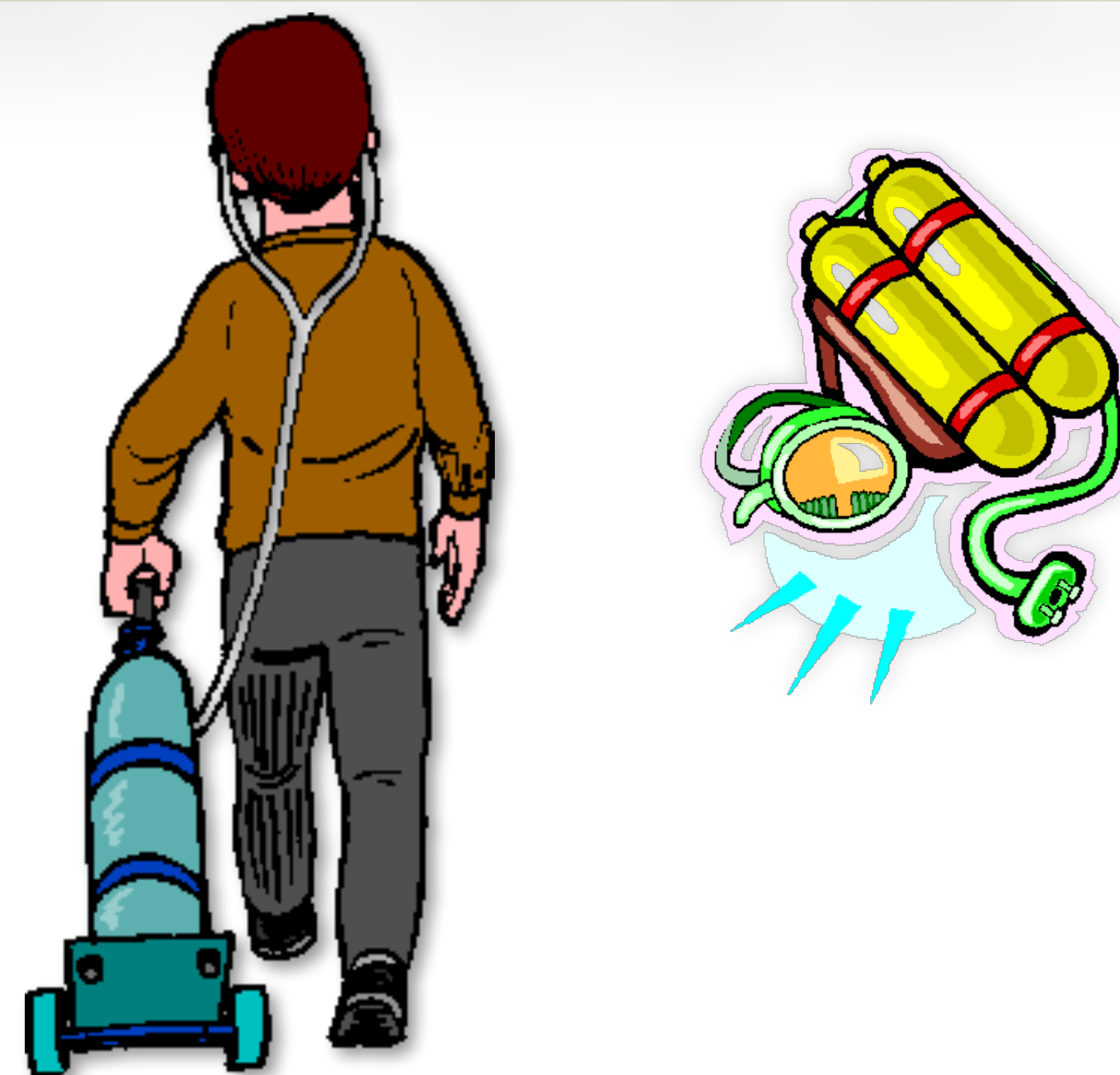
除了運動，其他有哪些要注意的？



藥物治療已達到
最佳效果！



供給氧氣，可提
高訓練成果，減
輕呼吸症狀

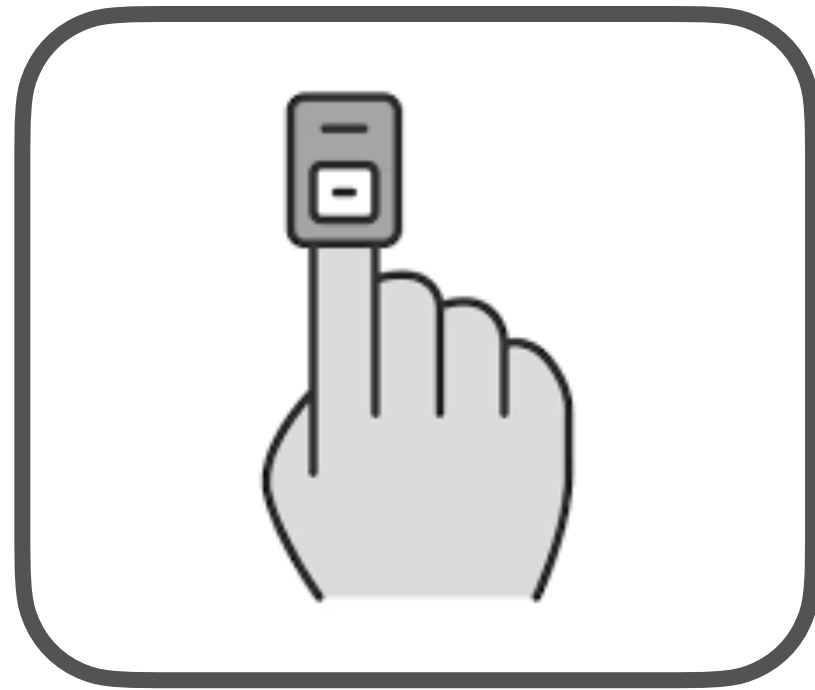




特殊情況下，可
使用非侵襲性正
壓呼吸器



居家呼吸困難及喘的處理



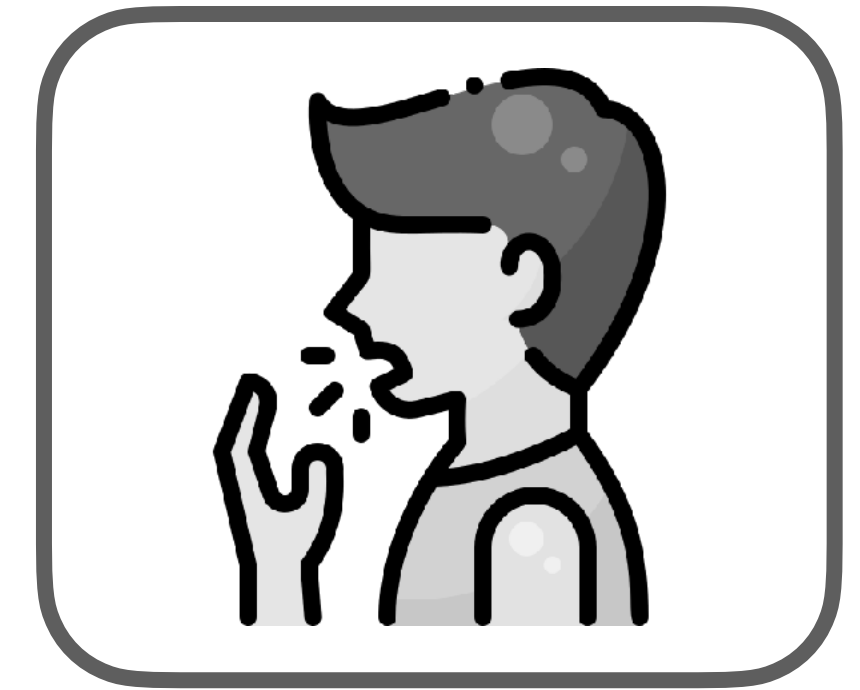
缺氧



喘



多痰

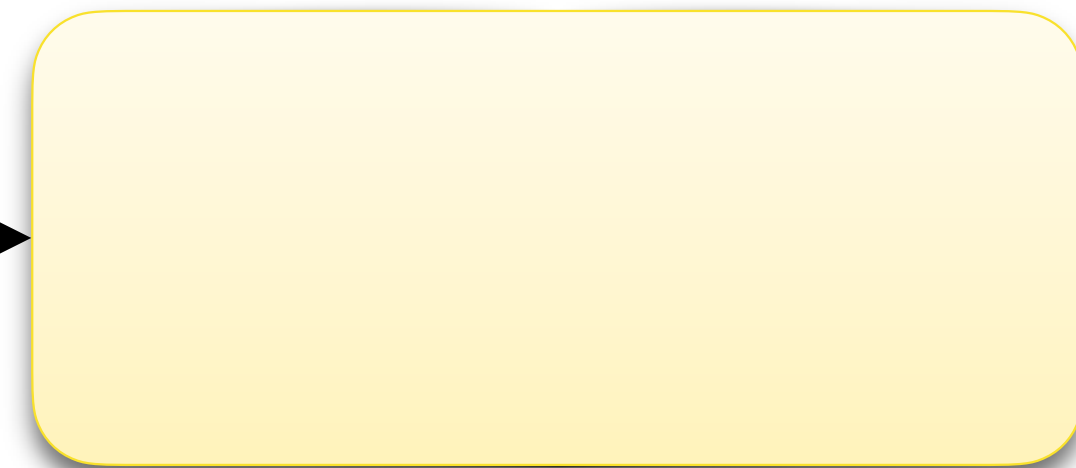
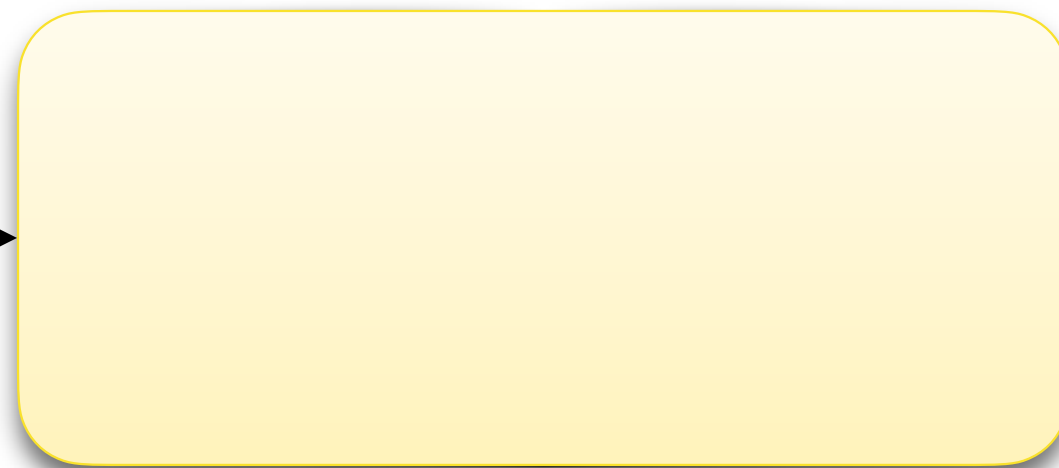
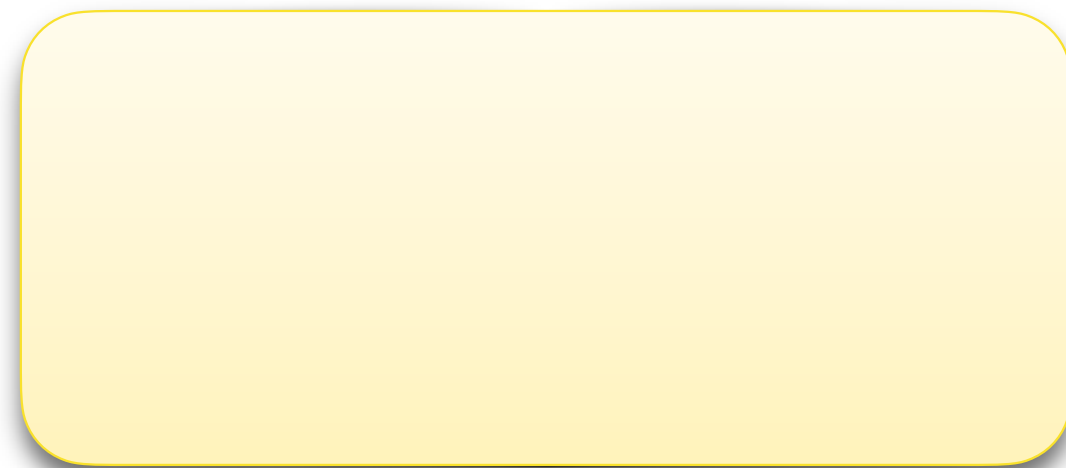


咳嗽

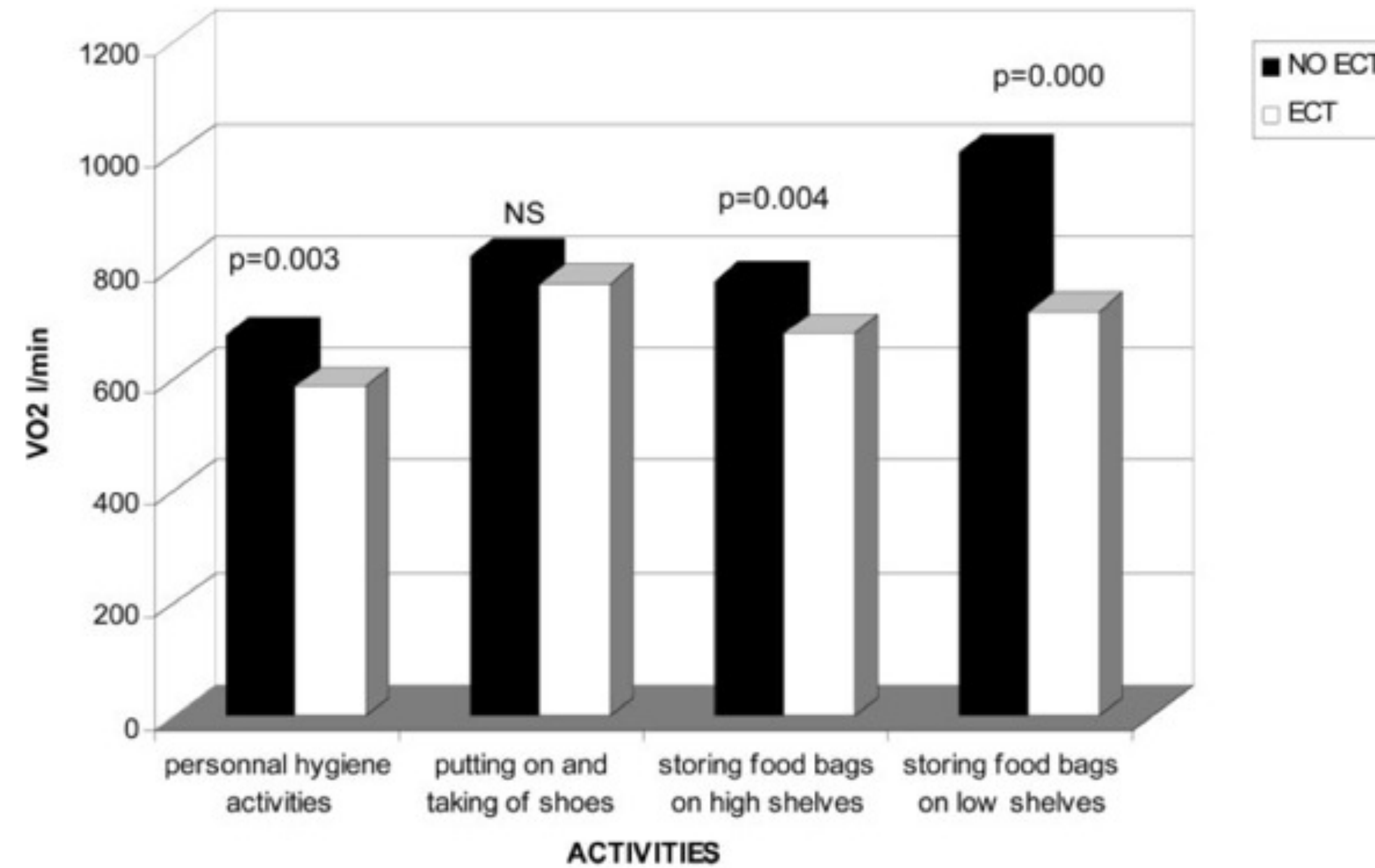
呼吸模式

清痰技巧

運動訓練



Study of Energy Expenditure During Activities of Daily Living Using and Not Using Body Position Recommended by Energy Conservation Techniques in Patients With COPD



Study of Energy Expenditure During Activities of Daily Living Using and Not Using Body Position Recommended by Energy Conservation Techniques in Patients With COPD

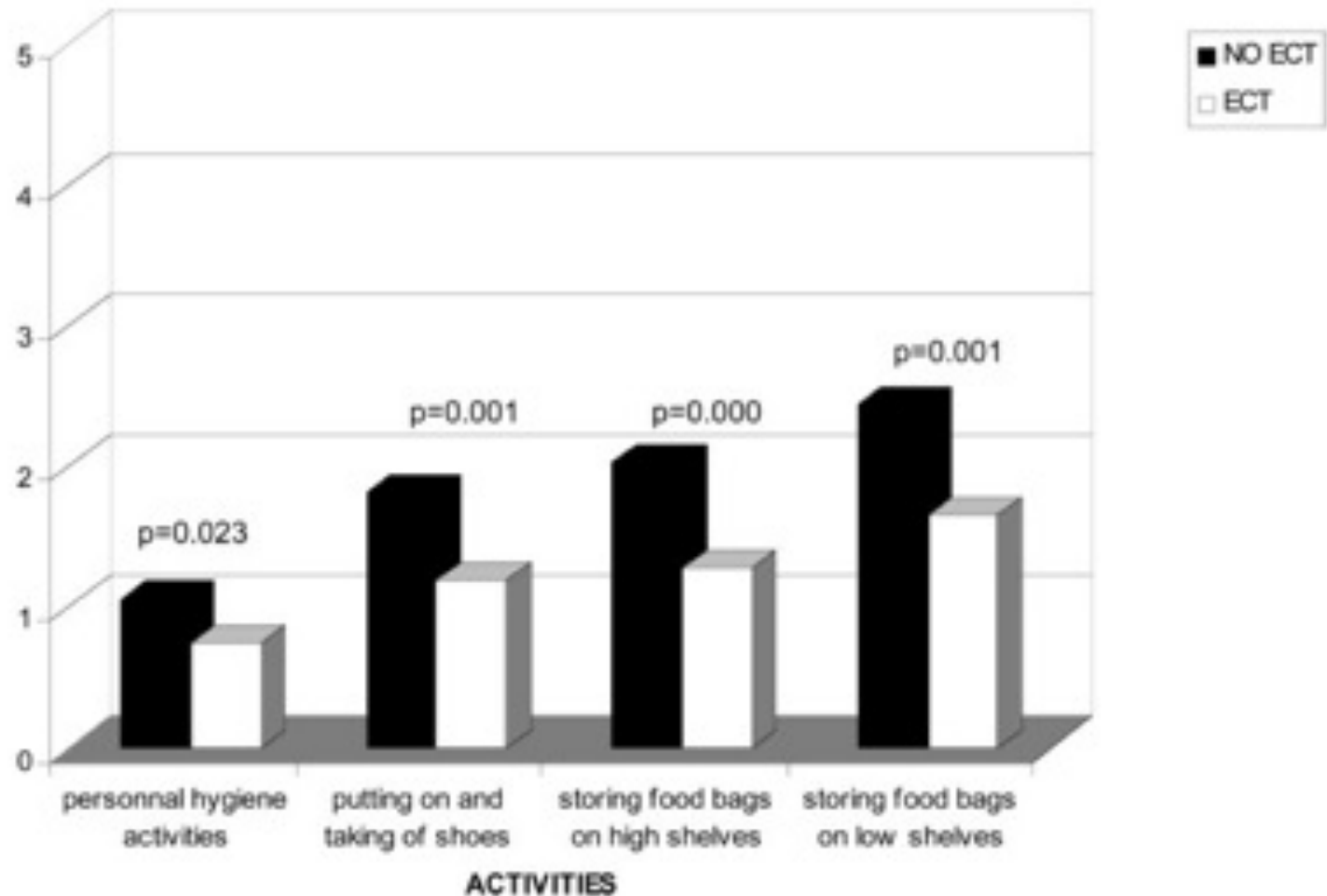
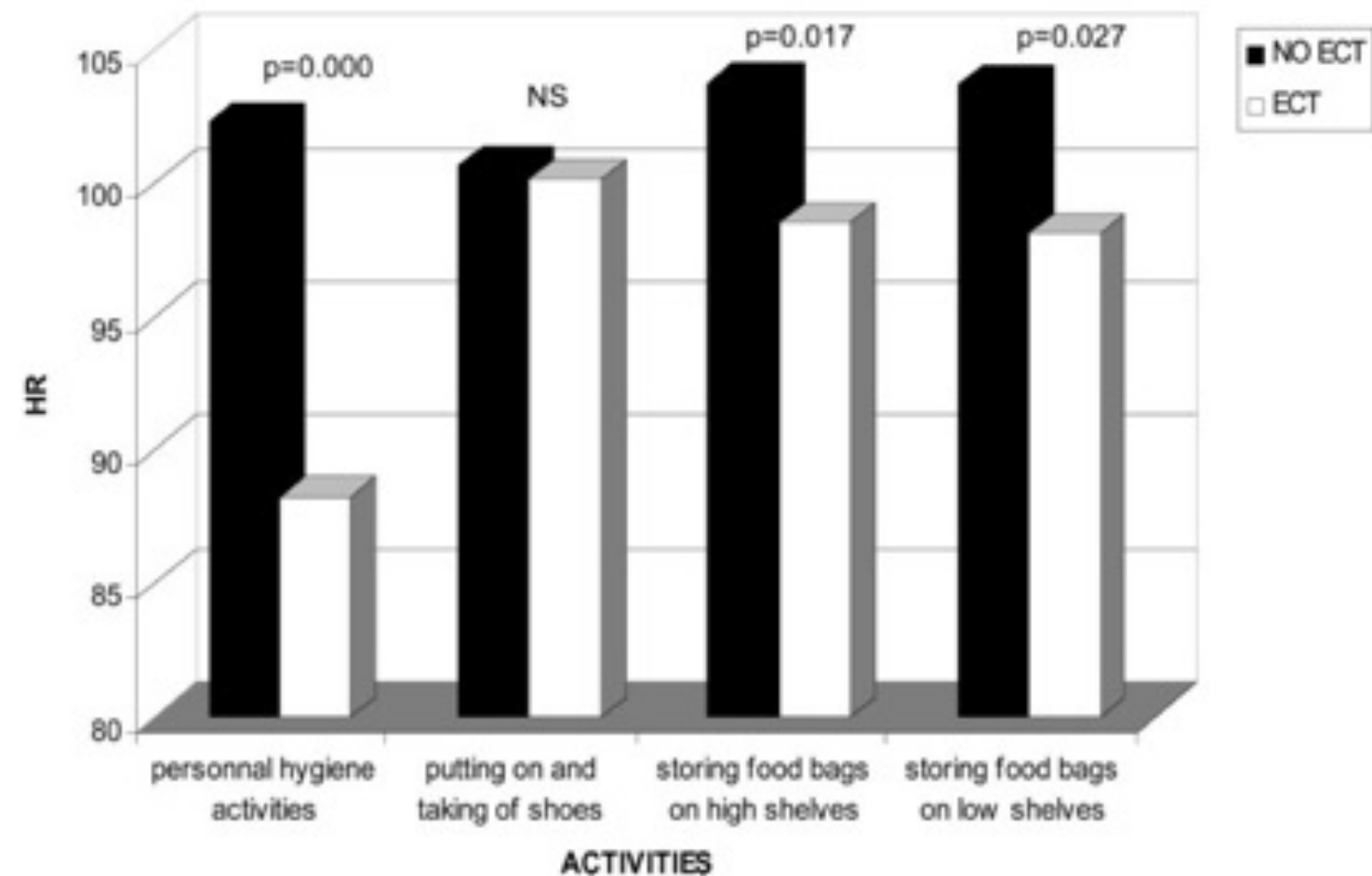
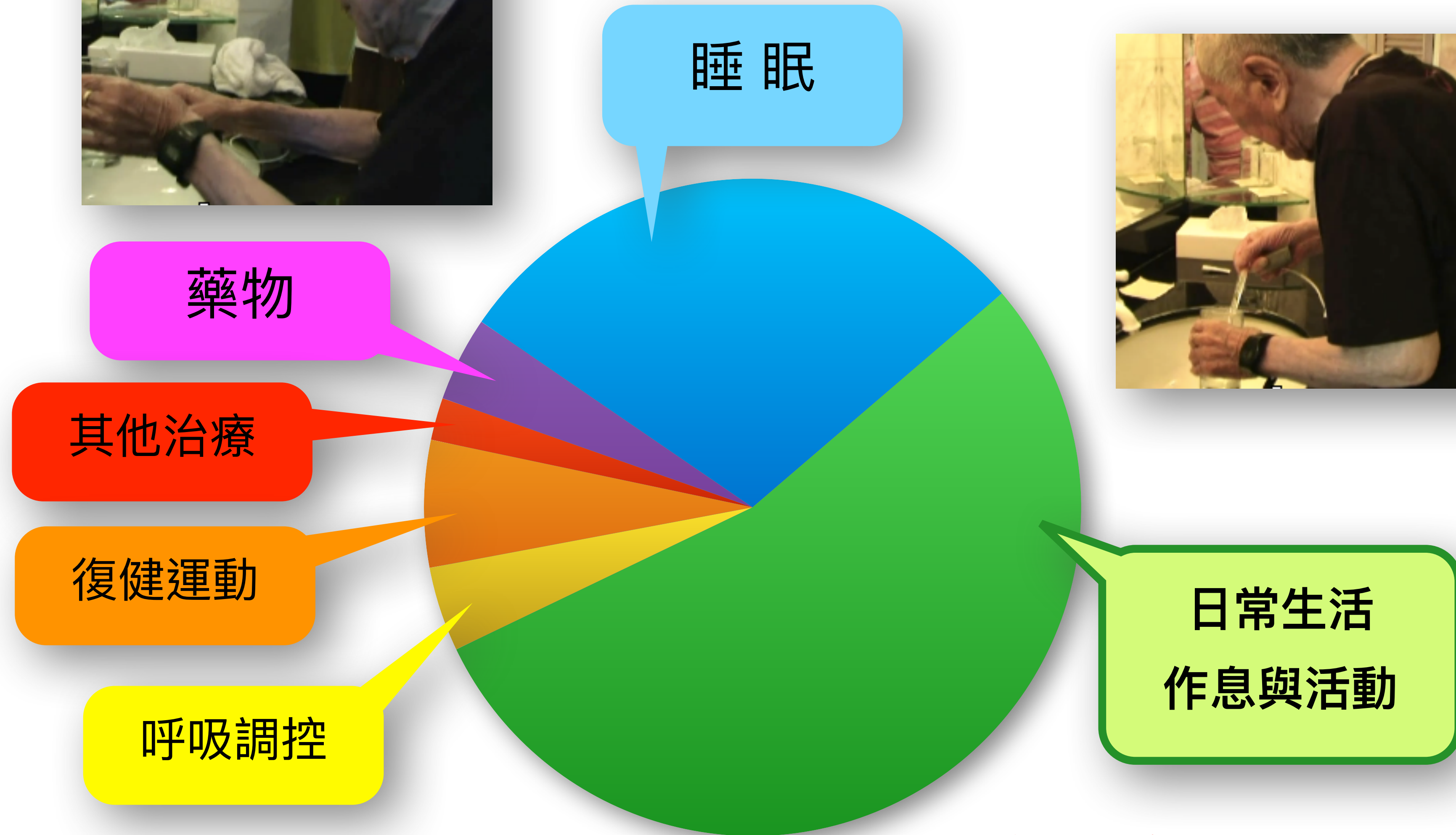


Table 2—Differences of Variables Evaluated With or Without the Patients Using ECTs*

Variables	Personal Hygiene	Putting Shoes On and Taking Shoes Off	Storing Food Bags on High Shelves	Storing Food Bags on Low Shelves
Δ RR breaths/min	− 2.3 (0.15 to − 4.7)	− 1.7 (1.9 to − 5.3)	− 1.3 (0.5 to − 3.10)	− 1.5 (0.4 to − 3.4)
$\Delta\dot{V}E$, L/min	− 1.26 (1.75 to − 3.21)	− 0.12 (3.17 to − 3.41)	− 0.77 (0.54 to − 2.08)	− 3.21 (− 1.4 to − 5.02)†
$\Delta\dot{V}O_2$, mL/min	− 91.3 (− 32.1 to − 150.5)†	− 47.7 (70.9 to − 166.4)	− 94.4 (− 36.5 to − 152.3)†	− 281.7 (− 215.6 to − 347.8)†
$\Delta\dot{V}CO_2$, mL/min	− 72.0 (− 23.4 to − 120.6)†	− 36.6 (66.2 to − 13.4)	− 61.7 (− 15.8 to − 107.6)†	− 190.4 (− 123.8 to 256.9)†
Δ Respiratory quotient	0.01 (0.04 to − 0.02)	0.01 (0.04 to − 0.02)	0.03 (0.06 to 0.00)	0.03 (0.06 to 0.00)
Δ HR, beats/min	− 14.1 (− 8.0 to − 20.2)†	− 0.6 (2.52 to 3.72)	− 5.3 (− 2.4 to − 8.2)†	− 5.6 (0.82 to − 12.02)†
$\Delta\dot{V}O_2$ /HR mL/beats per min	0.20 (0.93 to 0.53)	− 0.28 (1.04 to − 1.6)	− 0.50 (0.1 to − 1.1)	− 2.36 (− 1.32 to − 3.4)†
Δ Borg score	− 0.31 (− 0.08 to − 1.86)†	− 0.63 (− 0.28 to − 0.98)†	− 0.75 (− 0.45 to − 1.05)†	− 0.78 (− 0.27 to − 1.29)†

*Data are presented as mean (95% confidence interval).
†p < 0.05; negative values mean a reduction in the variable.

不同的刷牙、漱洗方式



有那麼嚴重嗎？

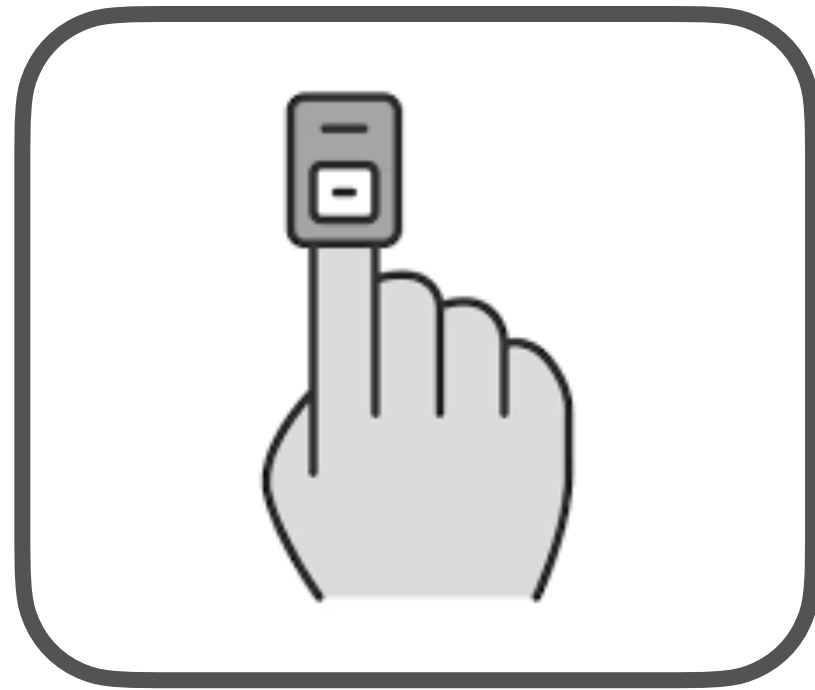
C O P D 居家節能技巧

一般原則

- **事先計畫**並盡量簡化生活上必須勞動的事務，**避免重複**費體力的事情
- 將需要體力活動的事務**分散**在一整天，分數次休息的間隔以避免過度消耗體力
- 在每次耗費體力的活動前後均需要**休息**一段時間
- **避免在用餐後**立即從事體力活動，最好休息20~30分鐘後才進行
- 充足的**睡眠**
- 日常生活的收拾工作、衛生盥洗等盡量採用**坐姿**以及**輔助器具**（如拐杖、助行器、浴室座椅等），避免久站
- **避免瞬間**劇烈活動或搬移重物等



居家呼吸困難及喘的處理



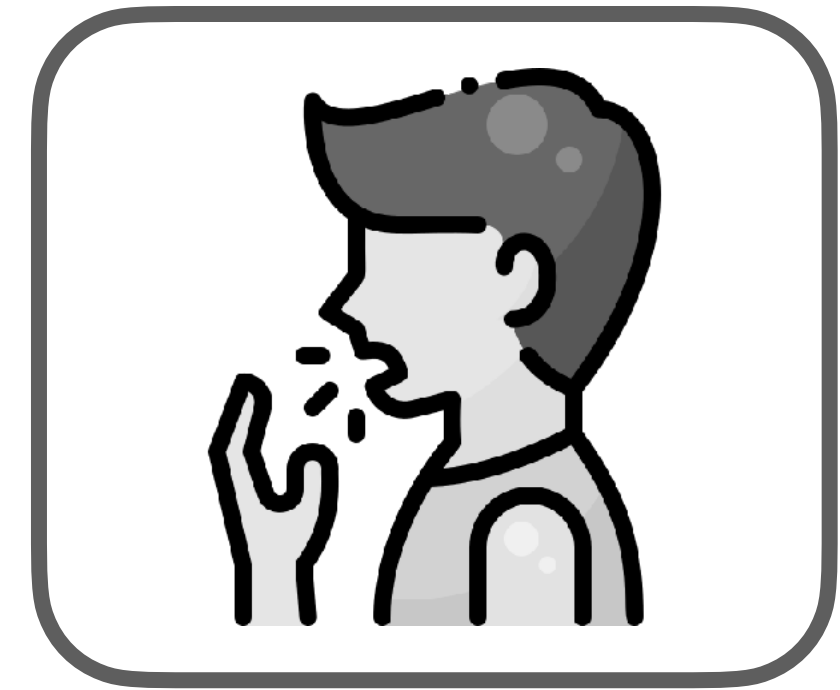
缺氧



喘



多痰



咳嗽

呼吸模式

清痰技巧

運動訓練

居家節能



夜間多尿、下肢水腫

Nocturnal polyuria, limb edema

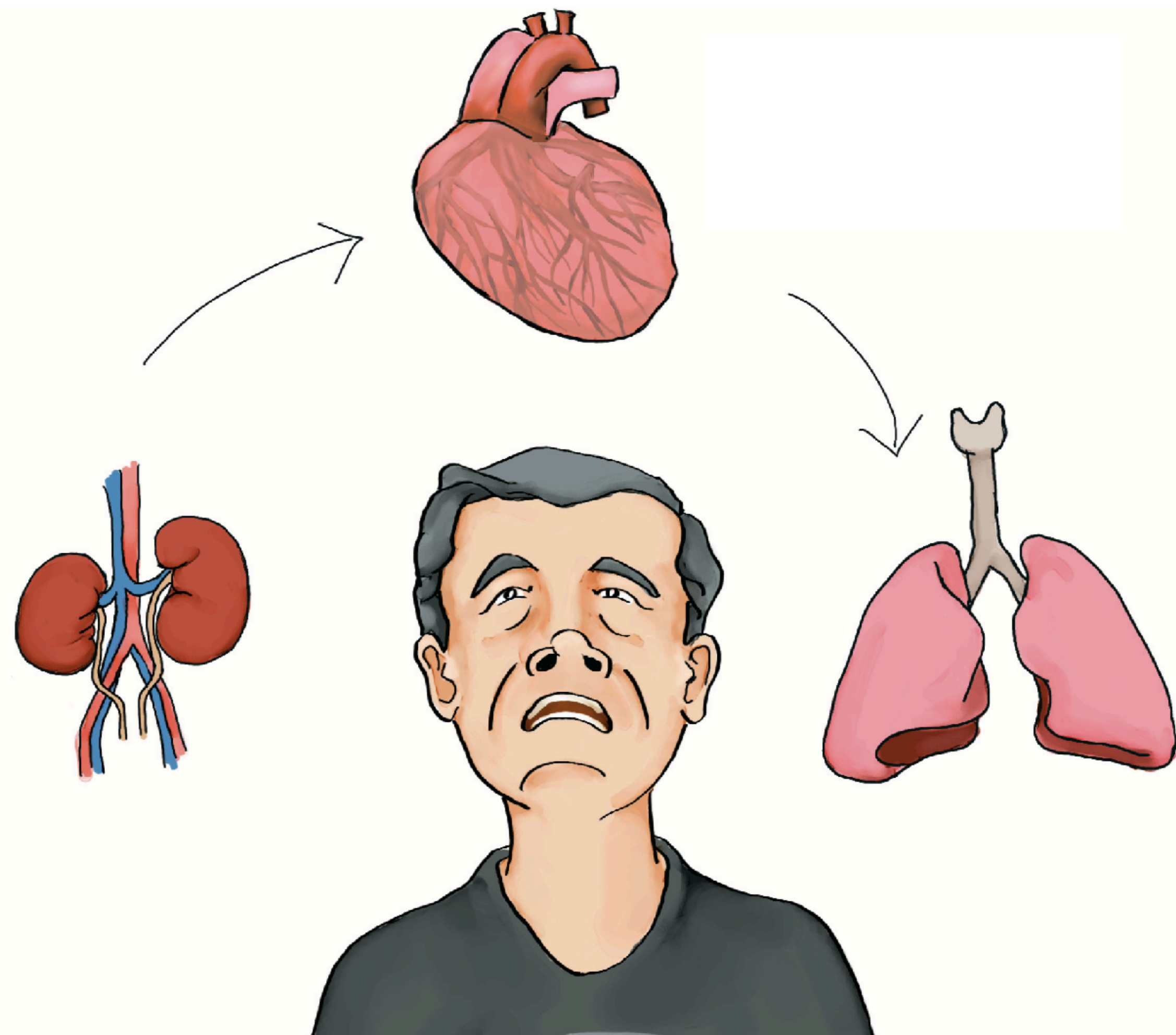




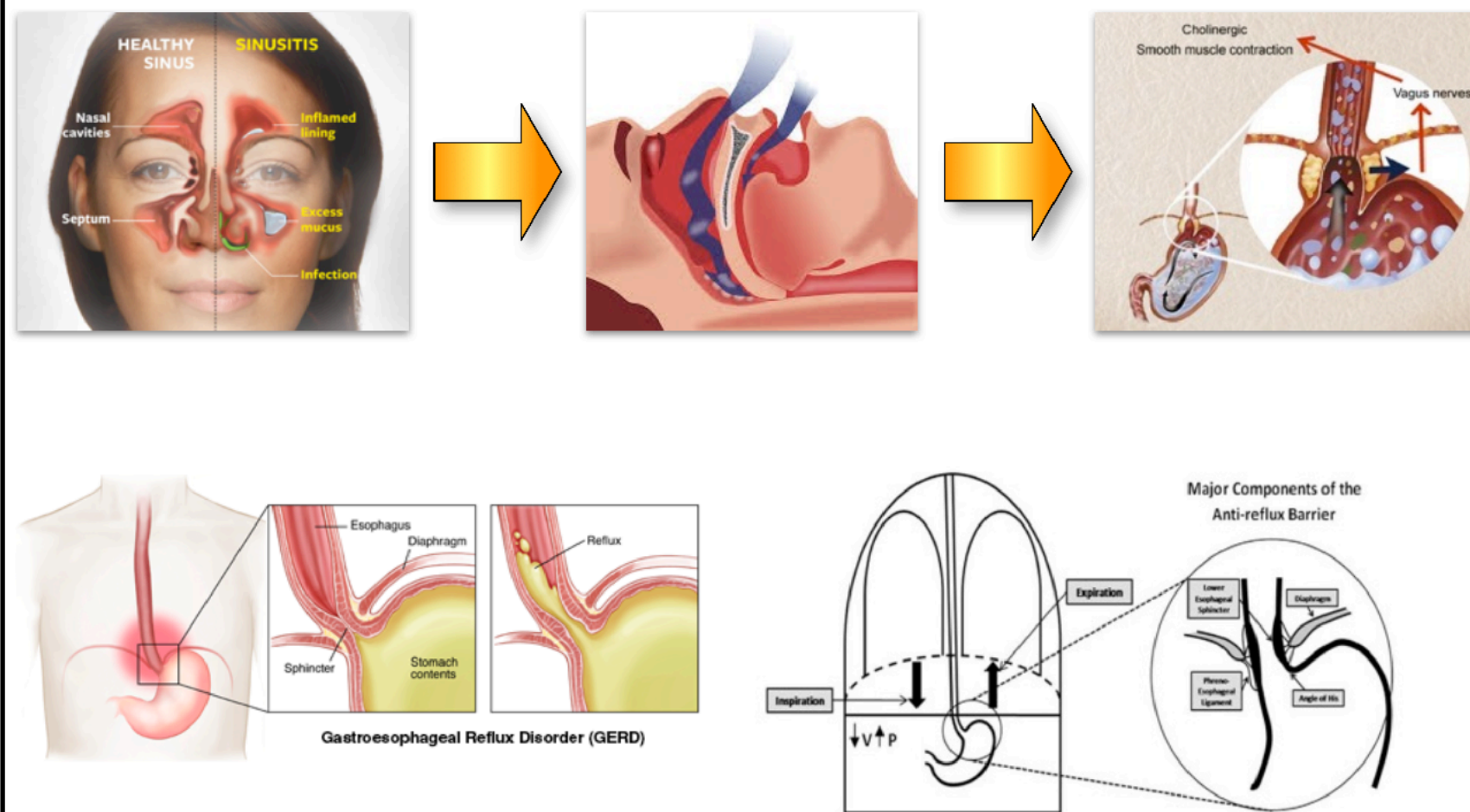
夜間多尿、下肢水腫

Nocturnal polyuria, limb edema

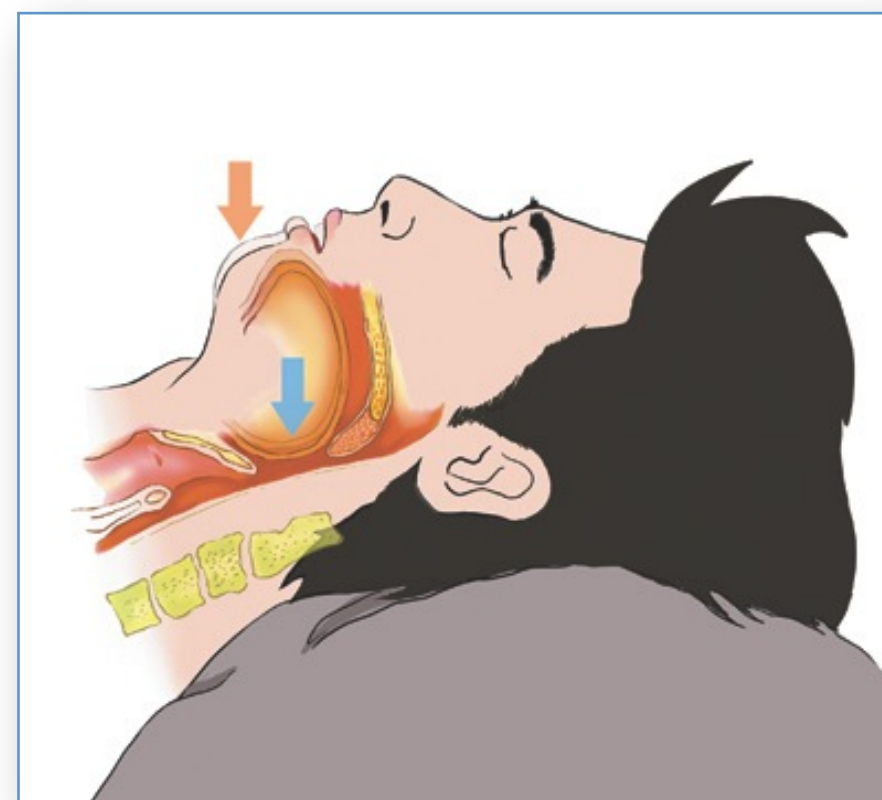
- 肺動脈高壓、右心衰竭
- 肺功能惡化不成比例
 - 肺動脈梗塞
 - 睡眠呼吸障礙
- 快速惡化



OSA and Associated Manifestations

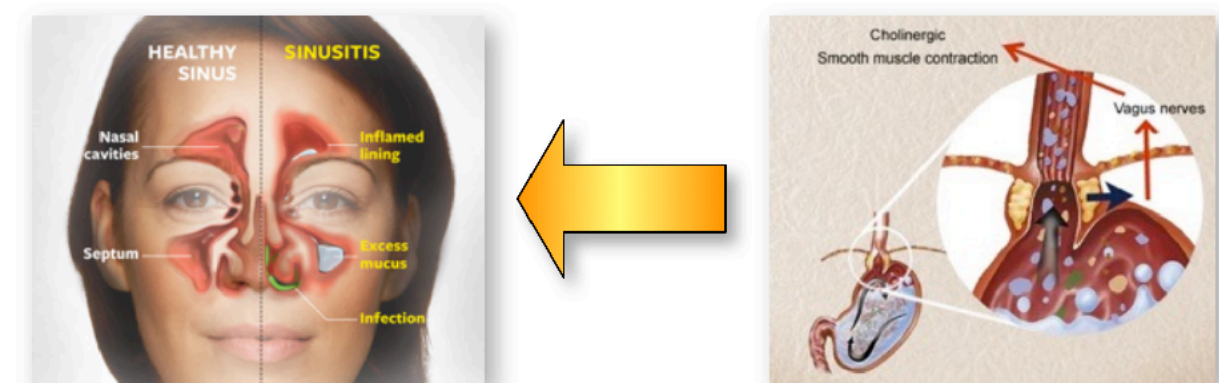


GERD: Gastroesophageal reflux disease

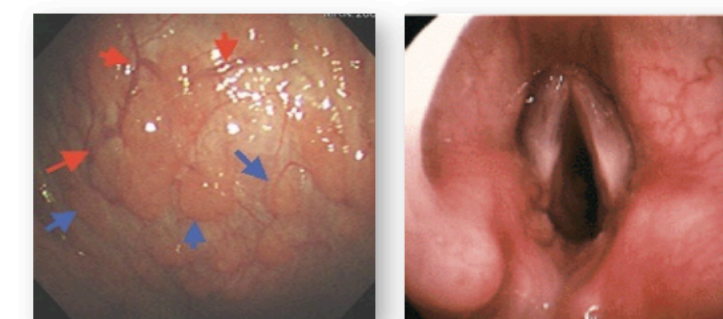


Vibration Trauma

GERD vs Chronic Sinusitis

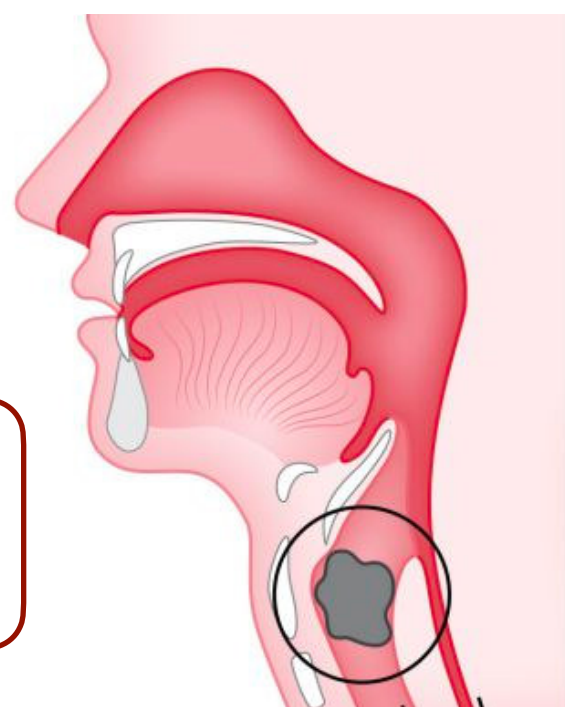


- Treatment of GERD could improve Chronic Rhinitis and Post Nasal Drips
- However, no reflux contents found in Nasal Cavity
- Gastroesophageal **"REFLEX"** (instead of REFLUX): nasal congestion, irritation and increased secretion



- H⁺ induced sensory neuropeptides
- Neurogenic inflammation
- reduced Cough receptor threshold

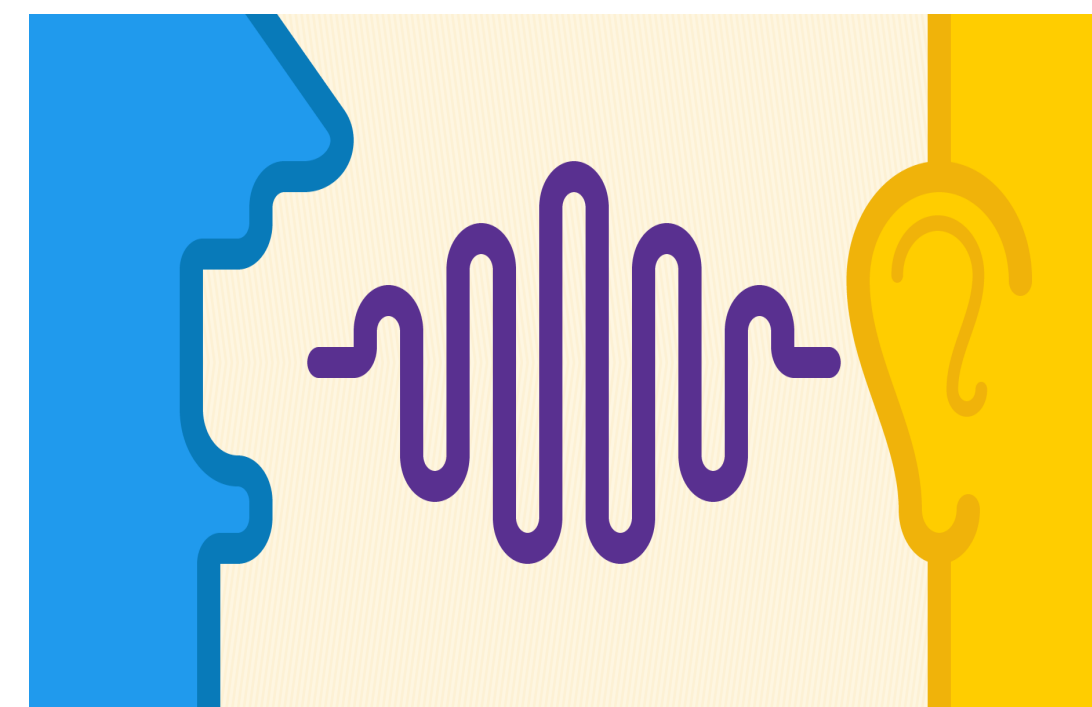
容易噎到



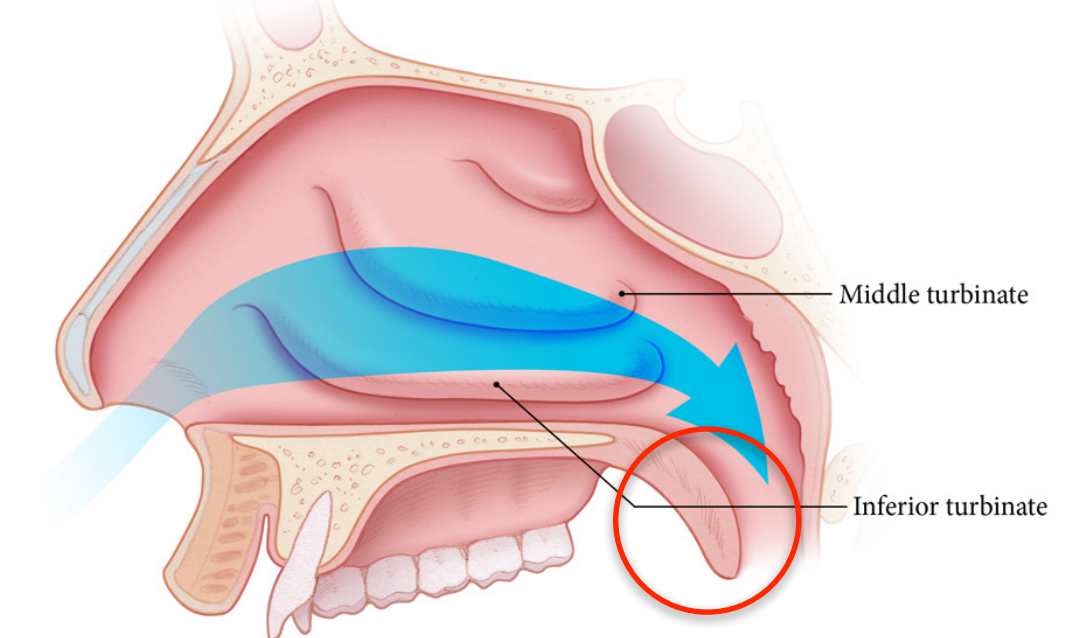
吞嚥反射受影響
吞嚥後吸氣延遲時間縮短



黏膜振動產生的
慢性咽喉炎

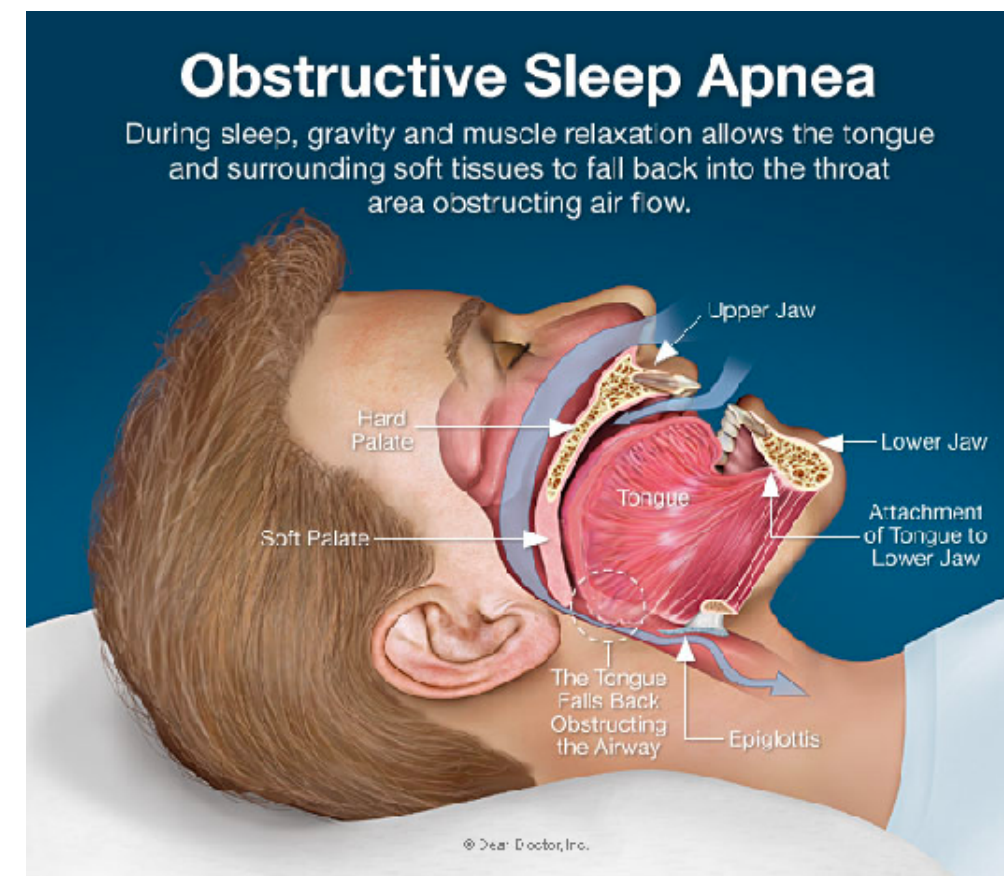
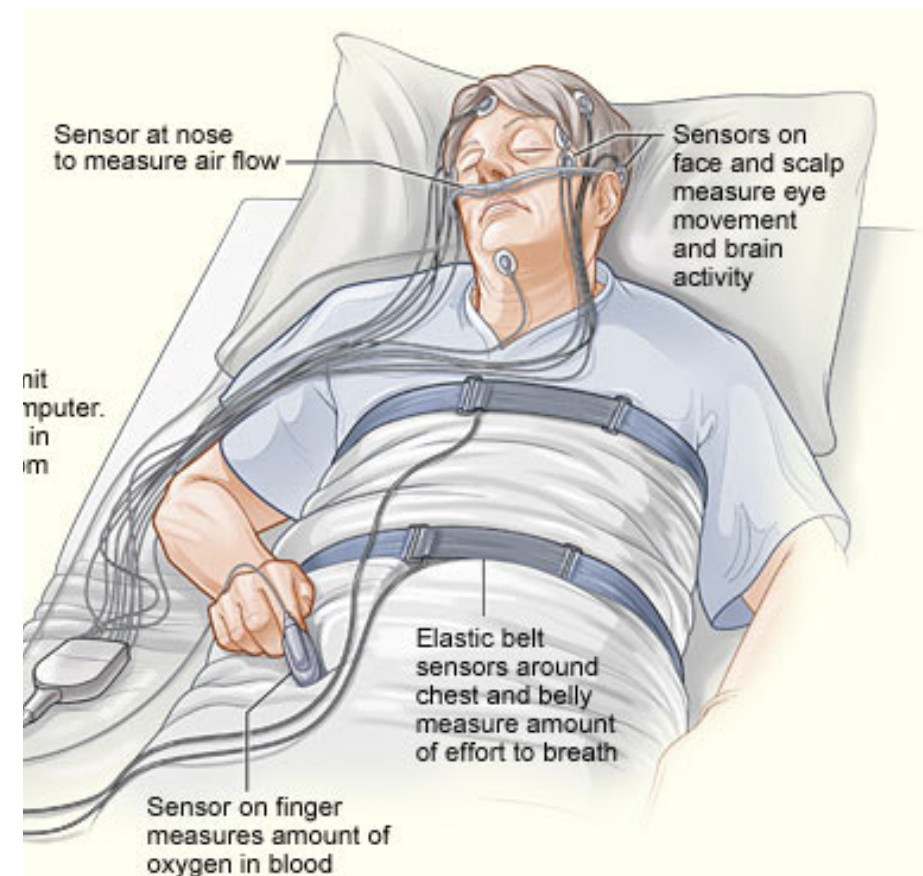


神經受損影響發聲
與說話的清晰度



呼吸道氣流感受減弱，
感覺氣悶

阻塞型睡眠呼吸中止症



診斷

生活習慣 + 病情追蹤

Oral appliance

able to breathe through the nose adequately
effective only in mild OSA



Positional Therapy

may be beneficial in mild sleep apnea

Snore Ball



Positional pillow



Surgical

- uvulopalatopharyngoplasty (UPPP)
- simple tonsillectomy/adenoidectomy in children
- midline glossectomy and lingualplasty
- maxillomandibular advancement (MMA)
- Radiofrequency tissue ablation (RFTA)
- tracheostomy

Airway Enlargement

Least invasive
- weight loss



UPPP

MMA

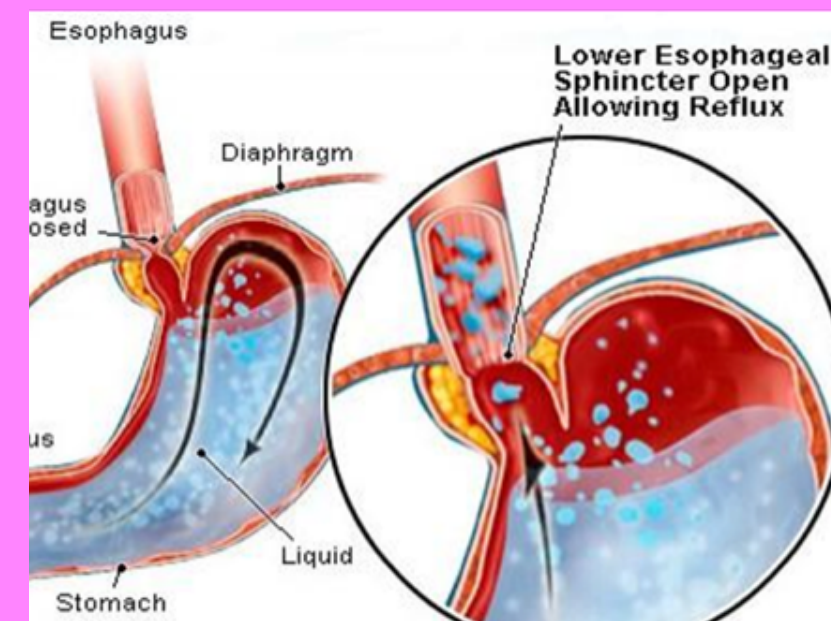
睡眠檢查、呼吸器、手術治療、牙套等，還有哪些可以做的？

阻塞型睡眠呼吸中止症：四個生活習慣

環境與慢性鼻炎



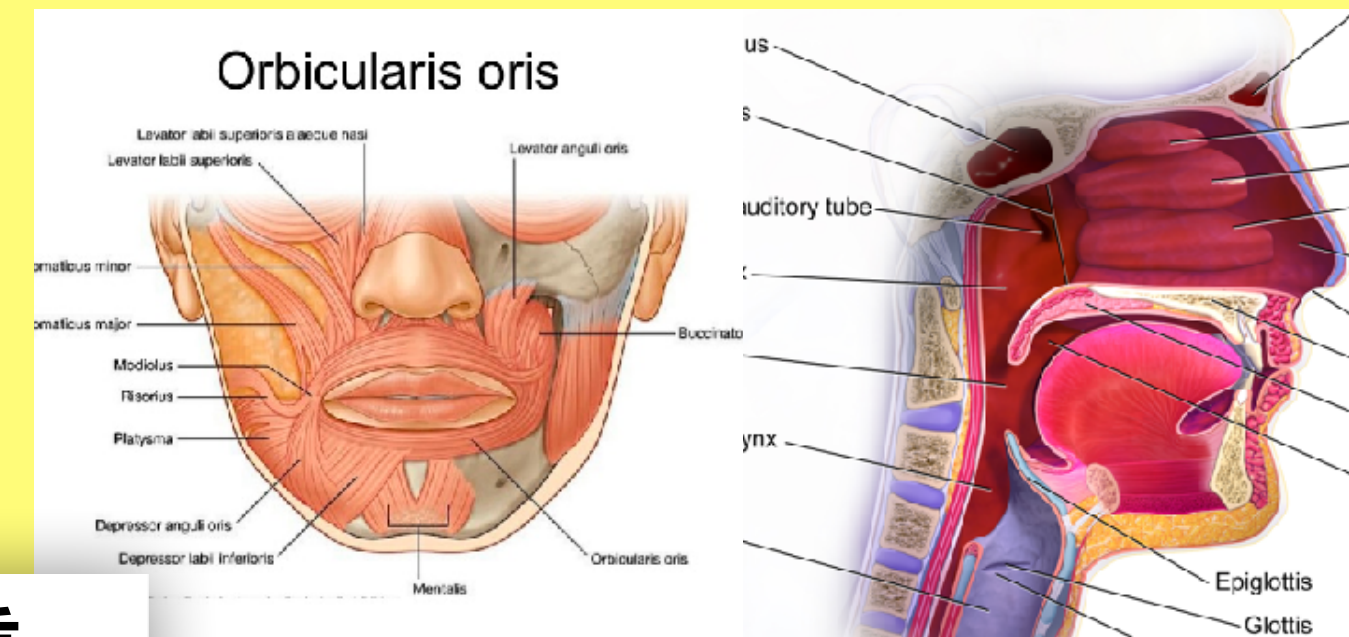
胃食道逆流



規律運動



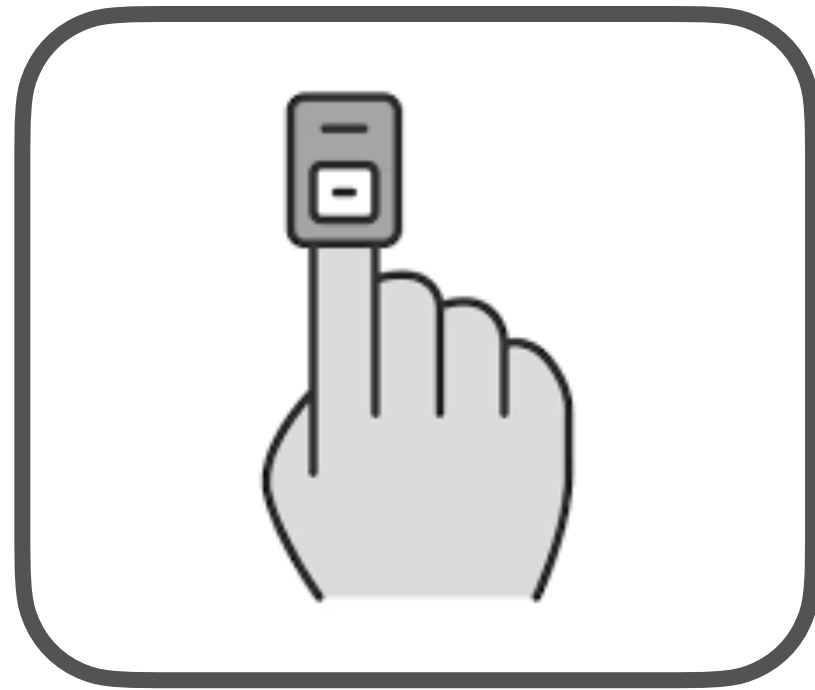
口腔舌咽肌肉訓練



控制體重



居家呼吸困難及喘的處理



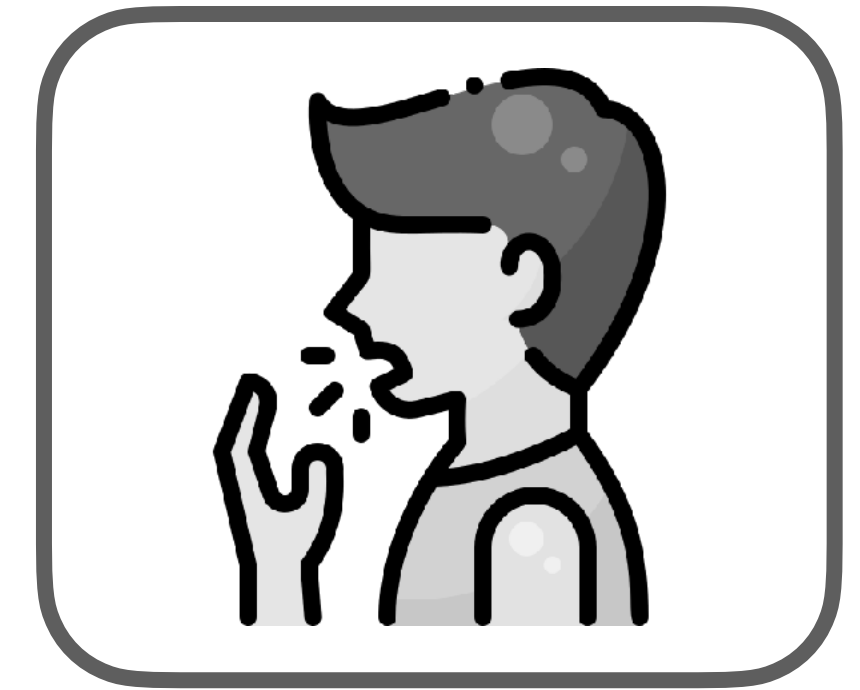
缺氧



喘



多痰



咳嗽

呼吸模式



清痰技巧

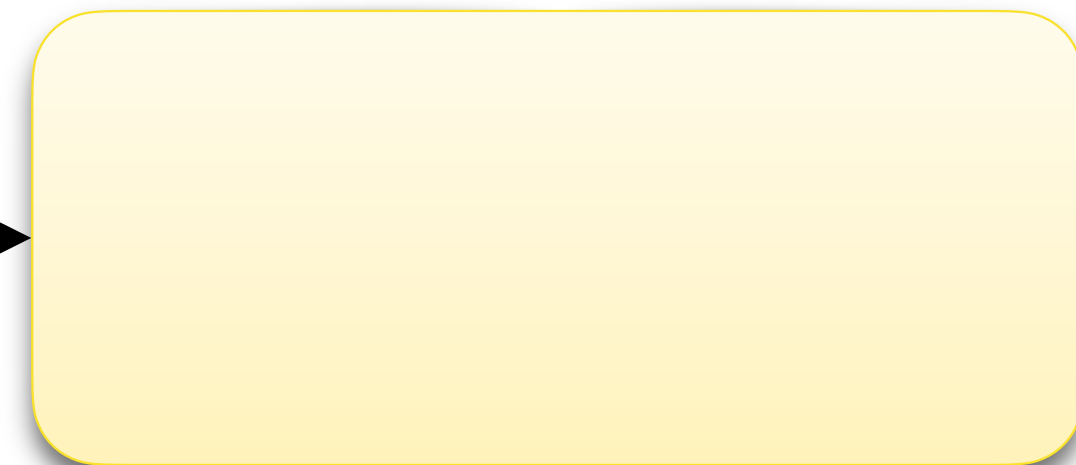


運動訓練

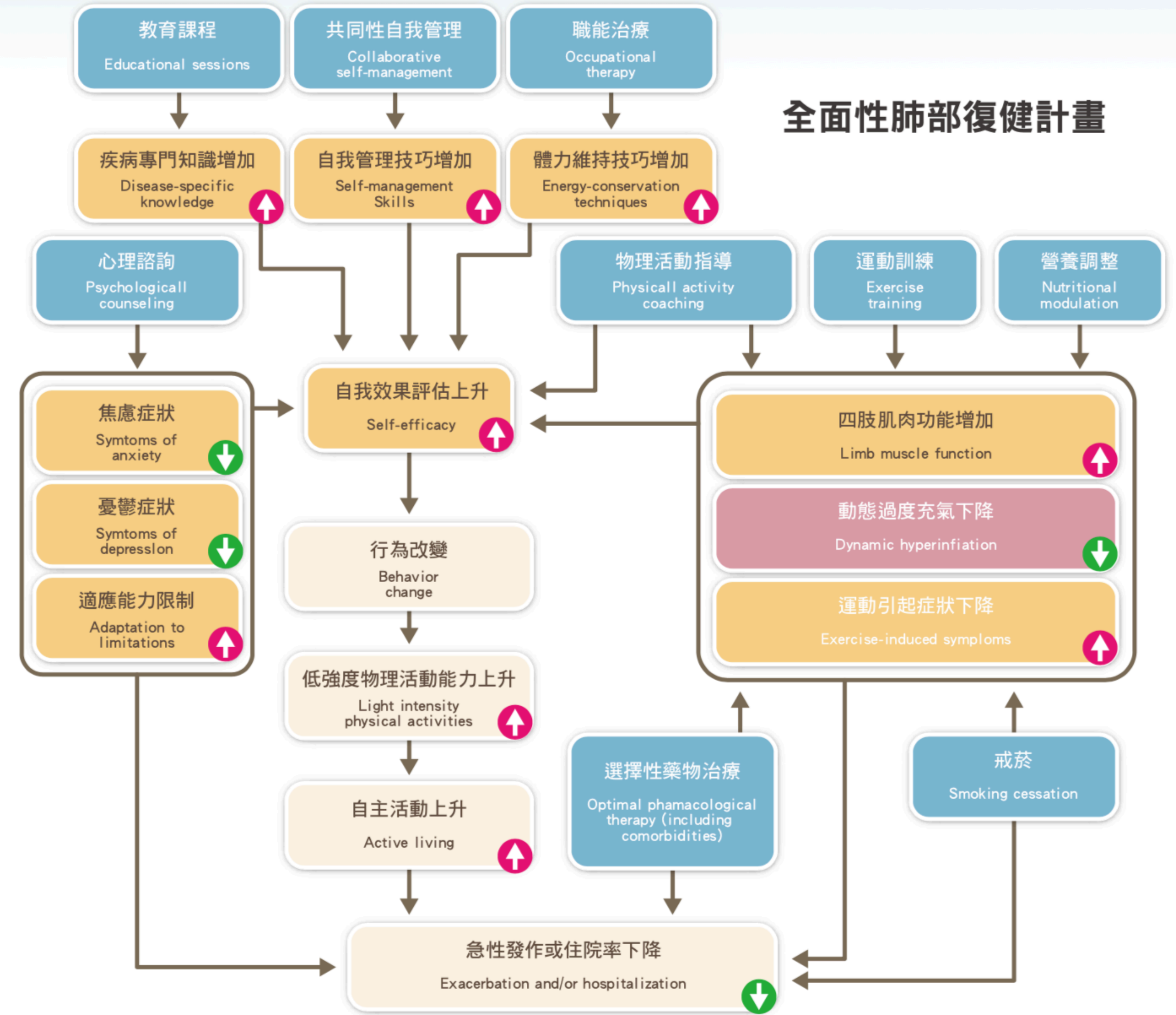
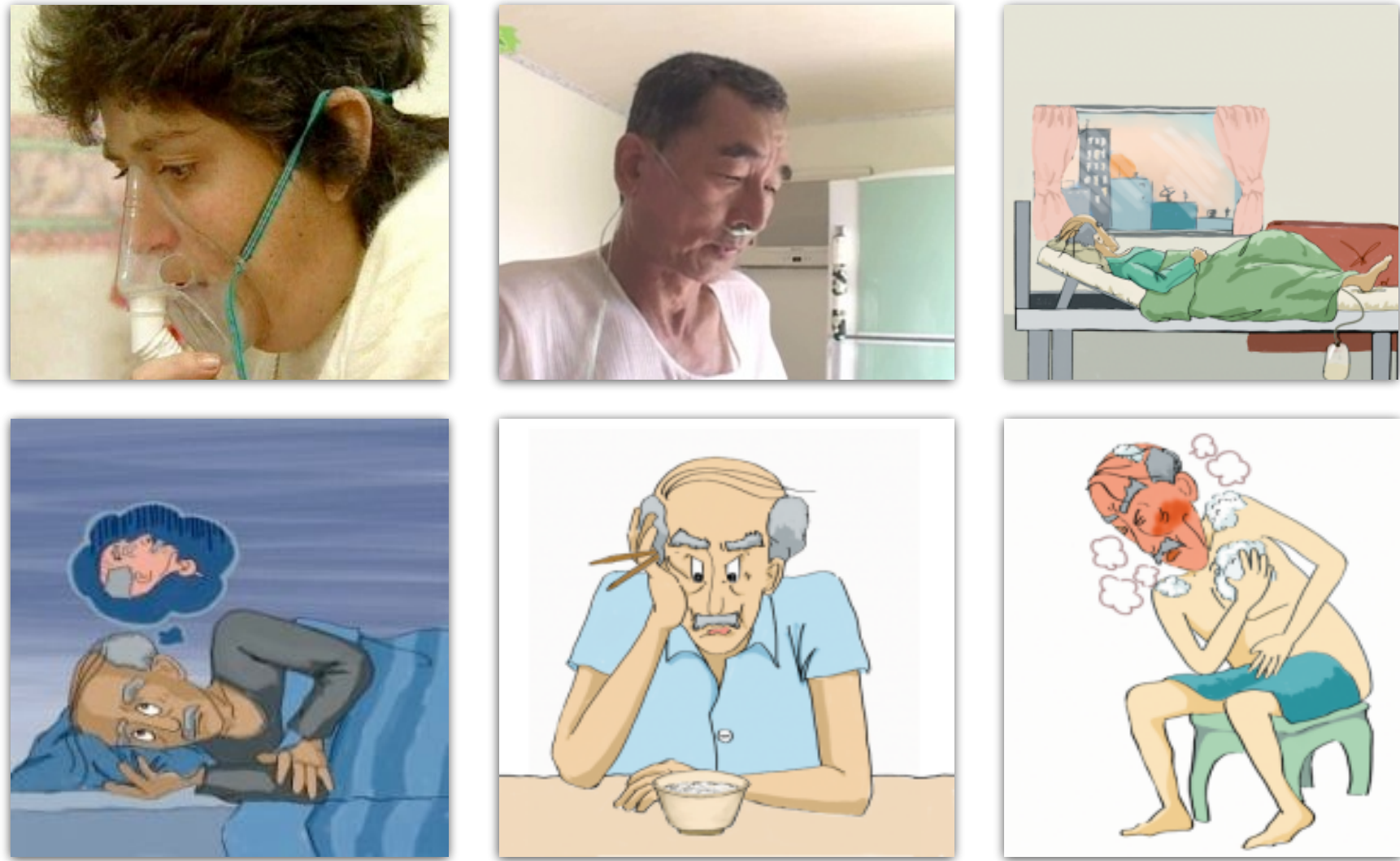
居家節能



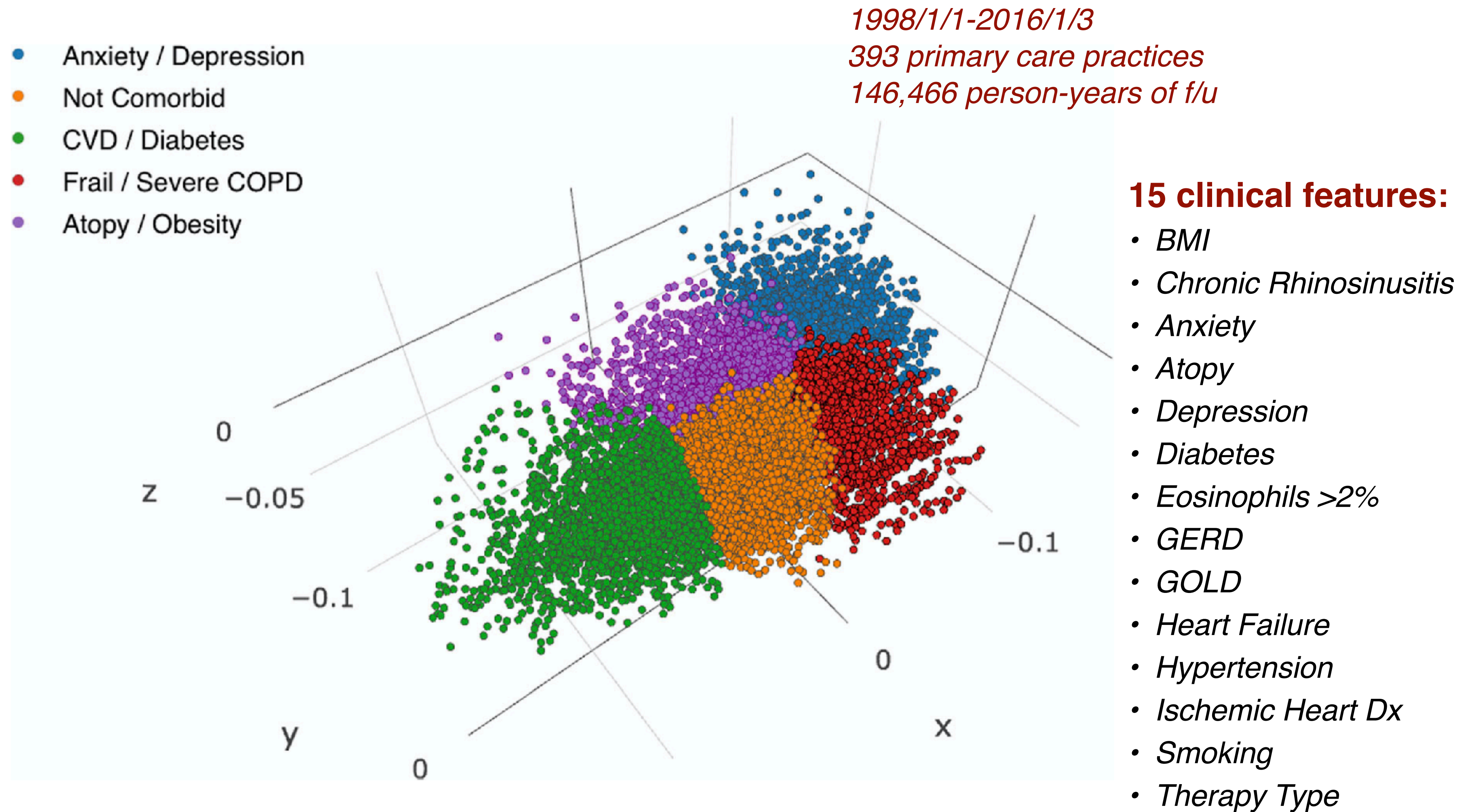
睡眠呼吸



還有什麼被忽略的？

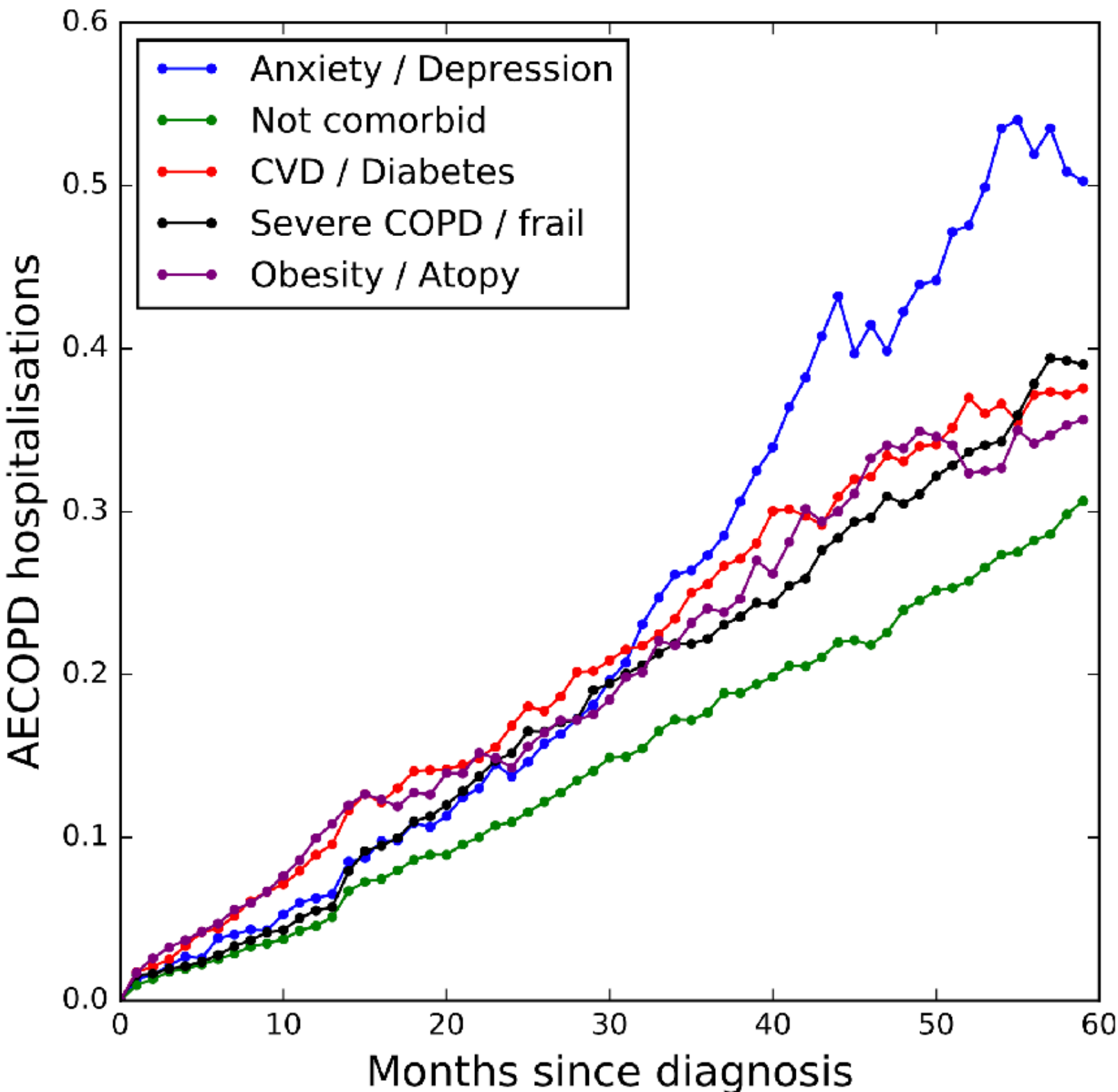
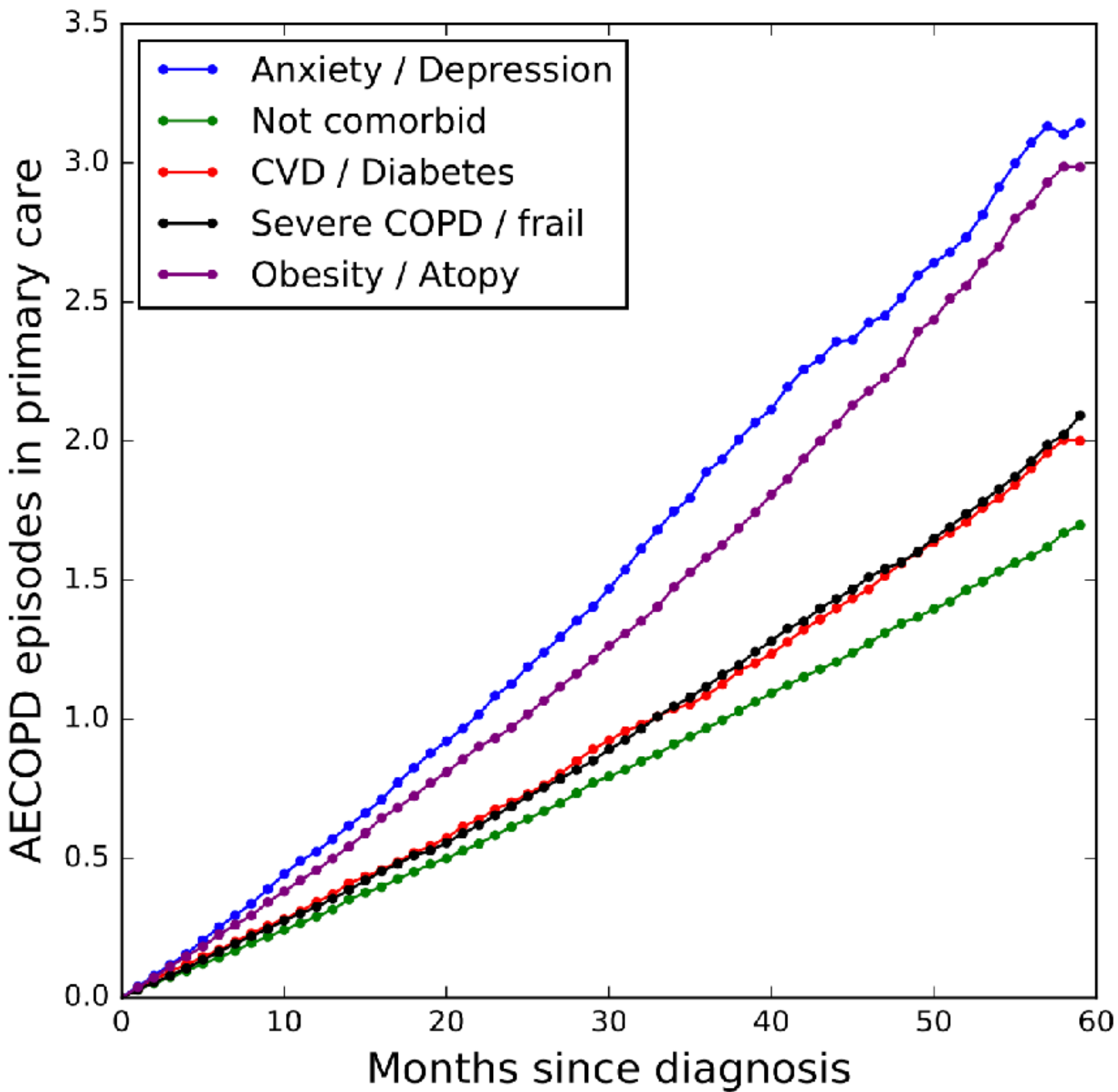


Identifying clinically important **COPD sub-types** using **data-driven approaches** in primary care population based electronic health records.



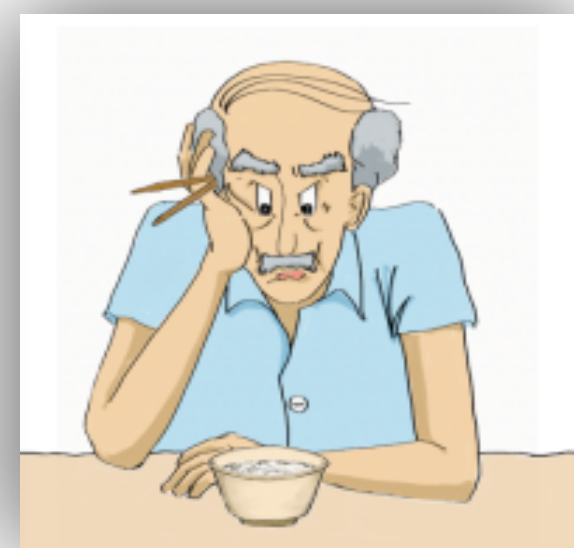
那一些因素最重要？

Identifying clinically important COPD sub-types using data-driven approaches in primary care population based electronic health records.



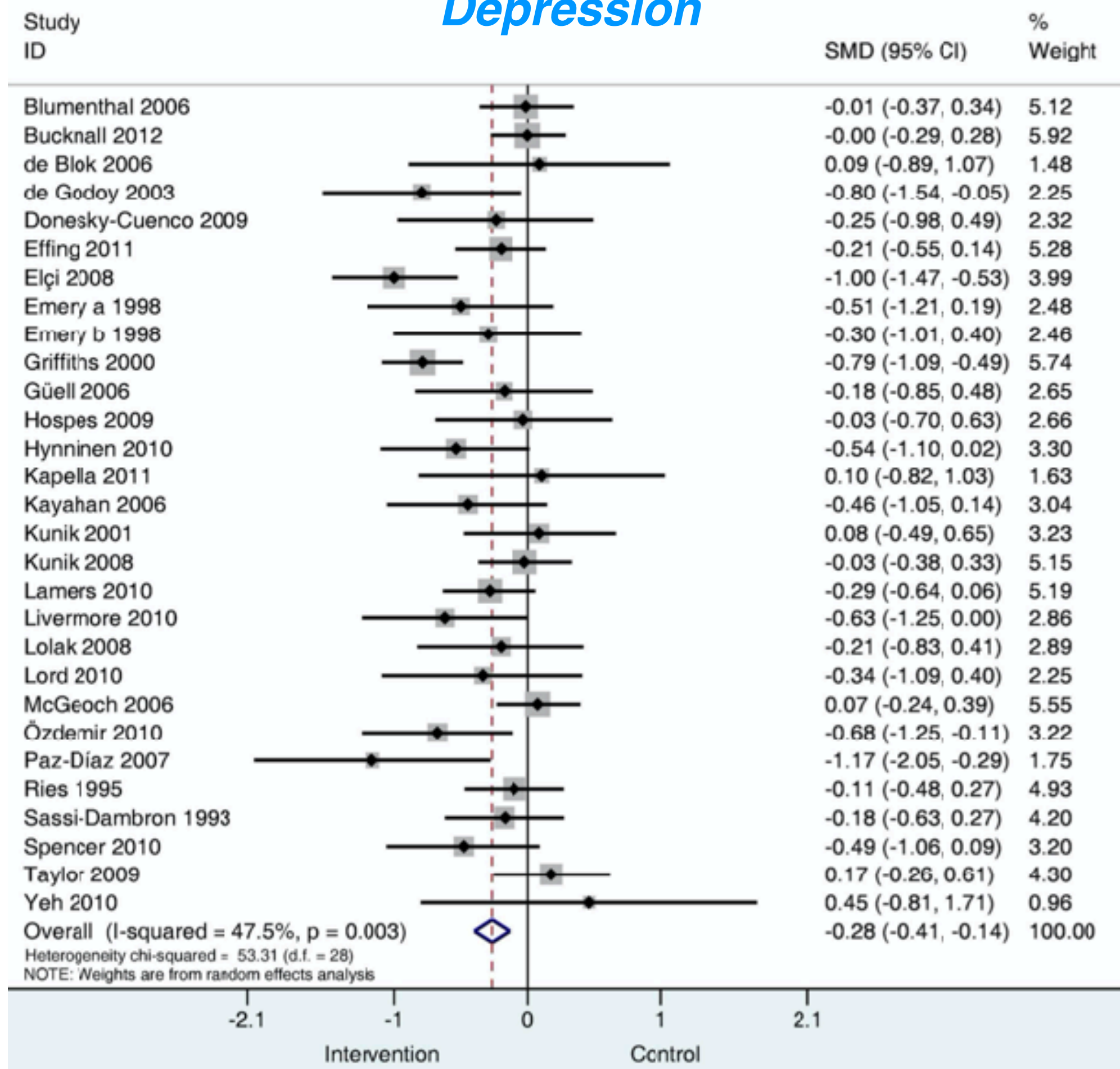
Characteristic	Hazard ratio
Age	1.08 [1.07–1.08]
Cluster	
Not comorbid	1
Anxiety / depression	1.28 [1.13–1.46]
CVD / diabetes	1.49 [1.38–1.60]
Severe COPD / frail	1.30 [1.20–1.40]
Atopy / obesity	1.15 [1.03–1.30]

1998/1/1-2016/1/3
393 primary care practices
146,466 person-years of f/u

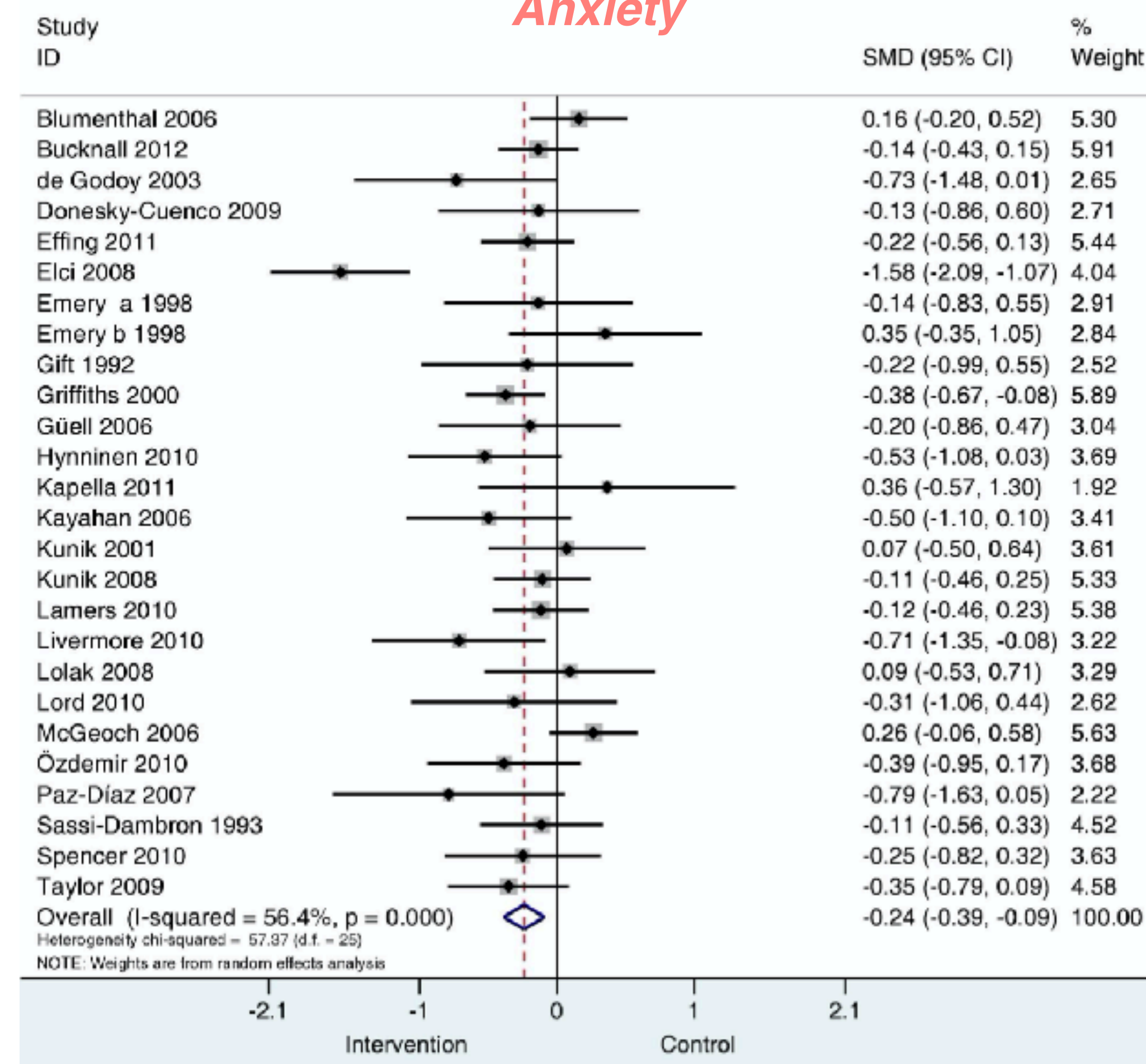


The Effect of **Complex Interventions** on **Depression and Anxiety** in Chronic Obstructive Pulmonary Disease

Depression

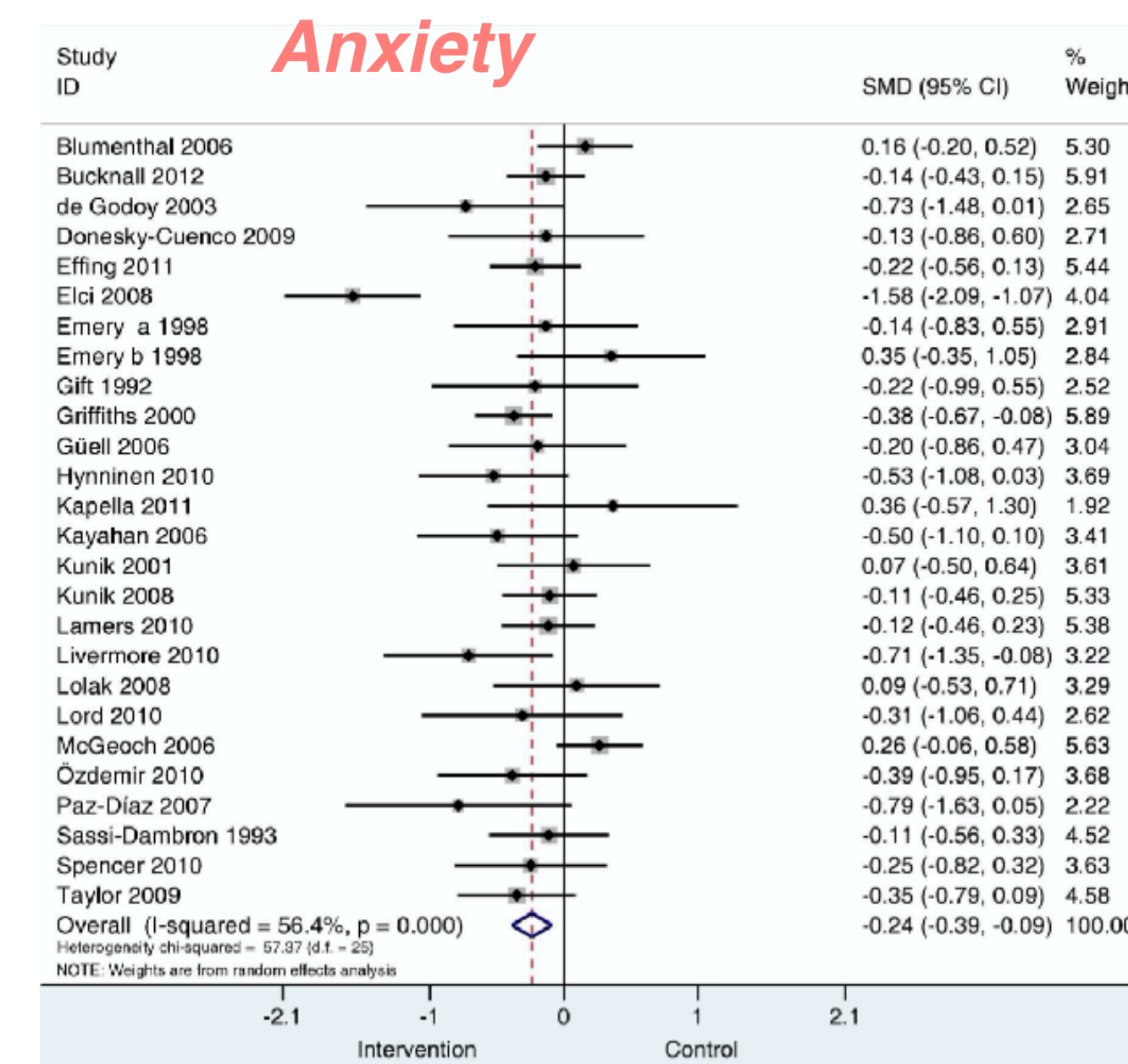
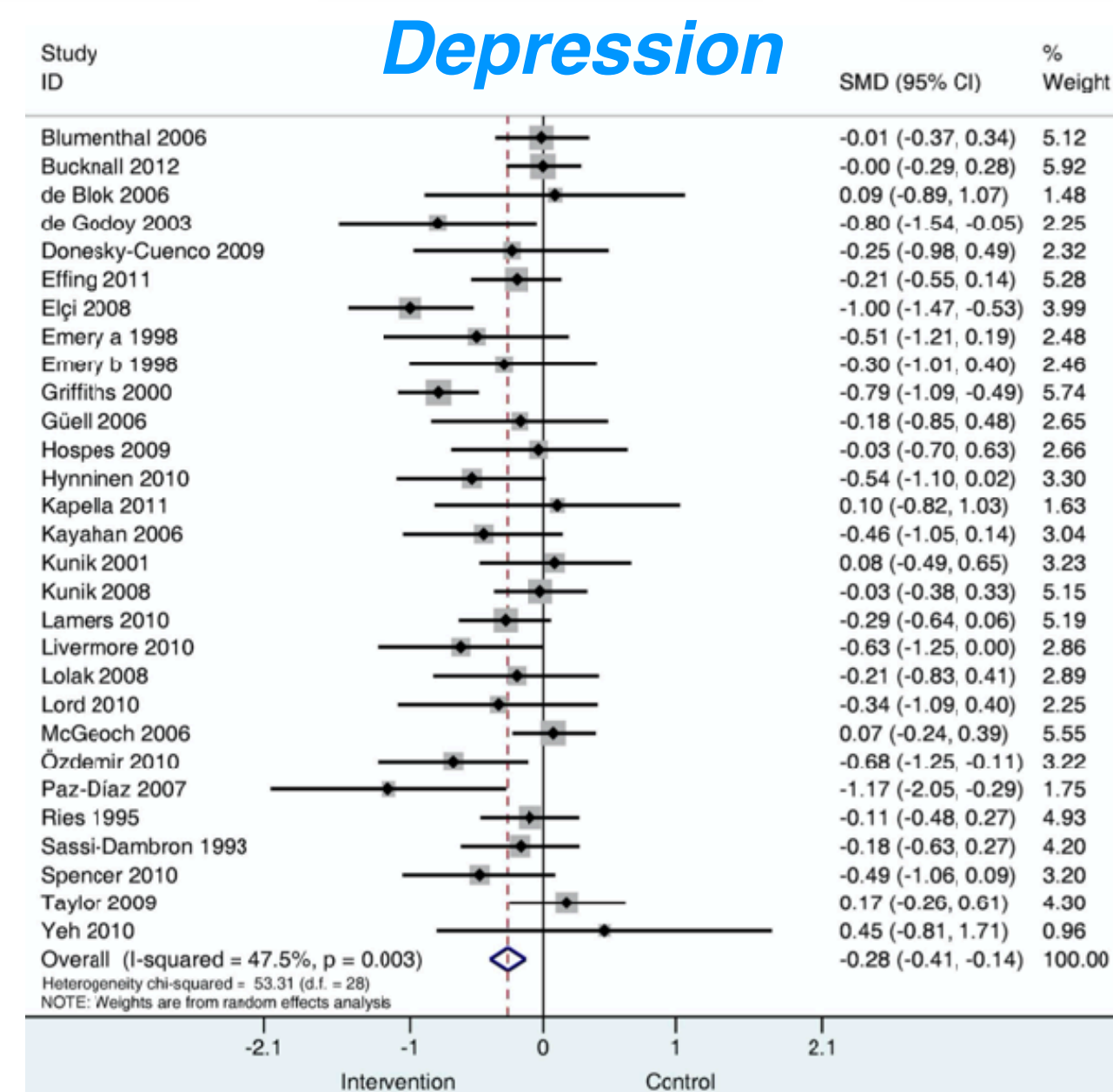


Anxiety





The Effect of **Complex Interventions** on **Depression and Anxiety** in Chronic Obstructive Pulmonary Disease

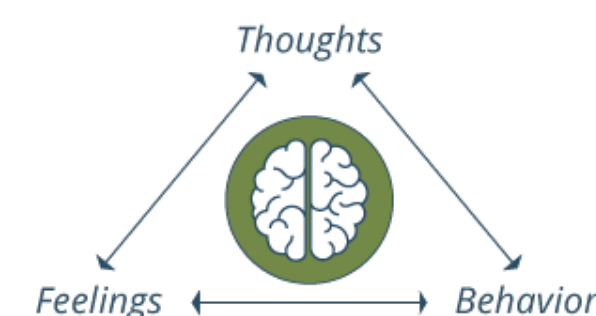


Exercise / Cognitive-Behavior / Self-Management / Relaxation: Which one is essential?

Multi-component Exercise Training



Cognitive behavior therapy



Self-management education

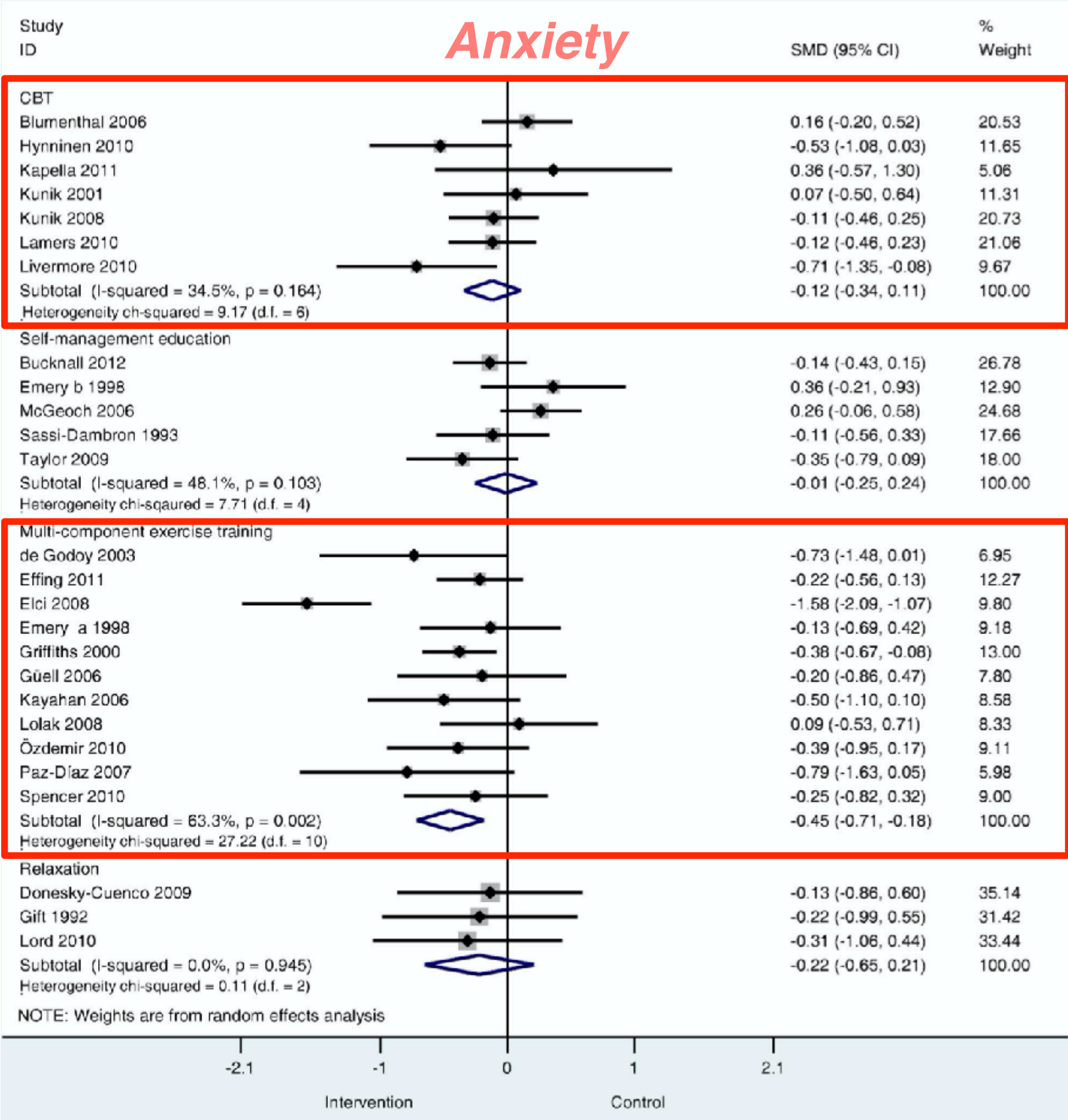
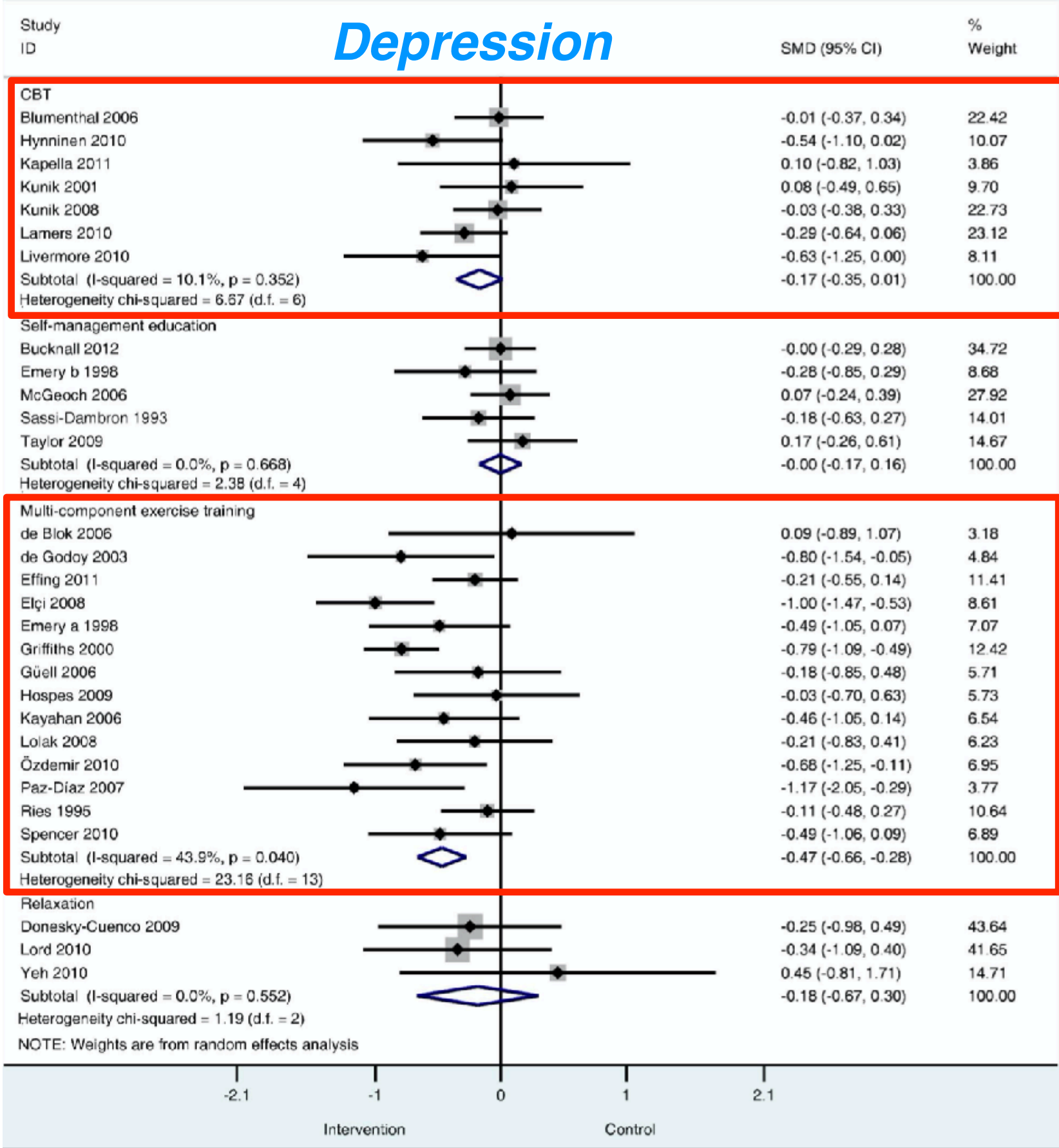


Relaxation



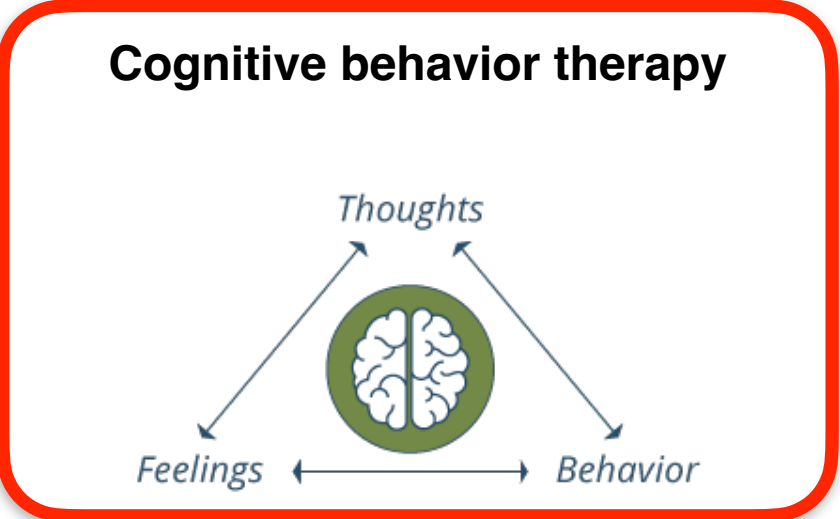
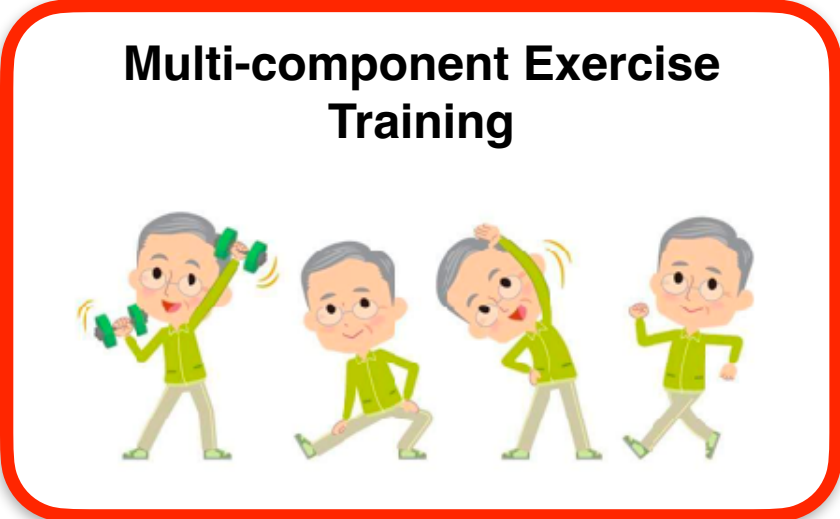
The Effect of **Complex Interventions** on **Depression and Anxiety** in Chronic Obstructive Pulmonary Disease

PLoS ONE 8(4), 2013: e60532. doi:10.1371

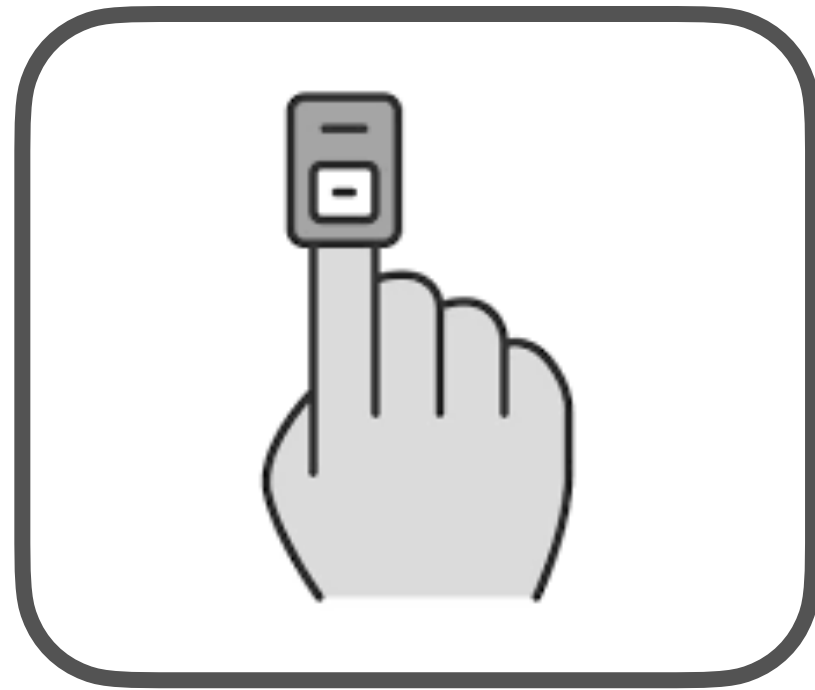


Cognitive Behavior Therapy

Multi-component Exercise Training



居家呼吸困難及喘的處理



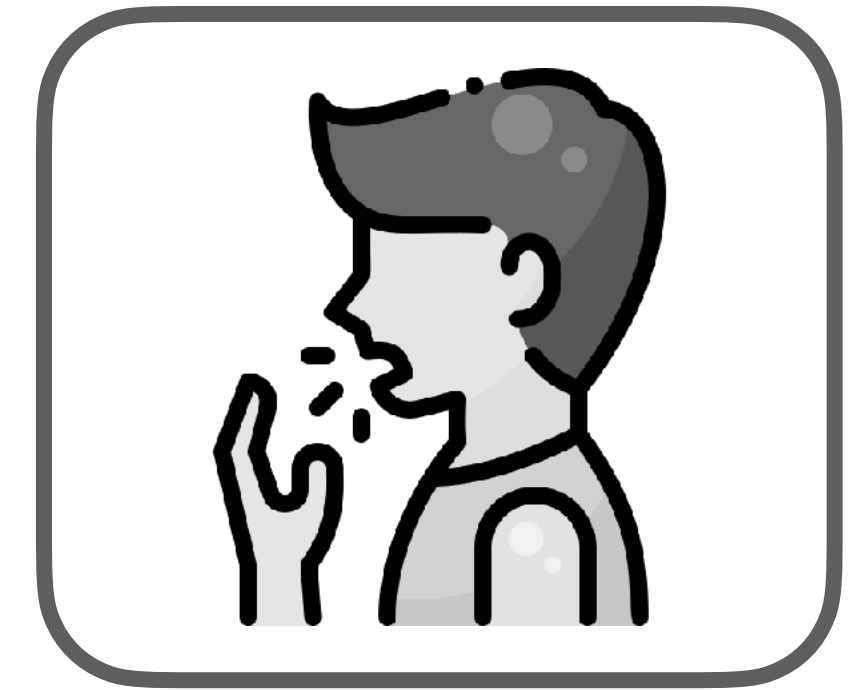
缺氧



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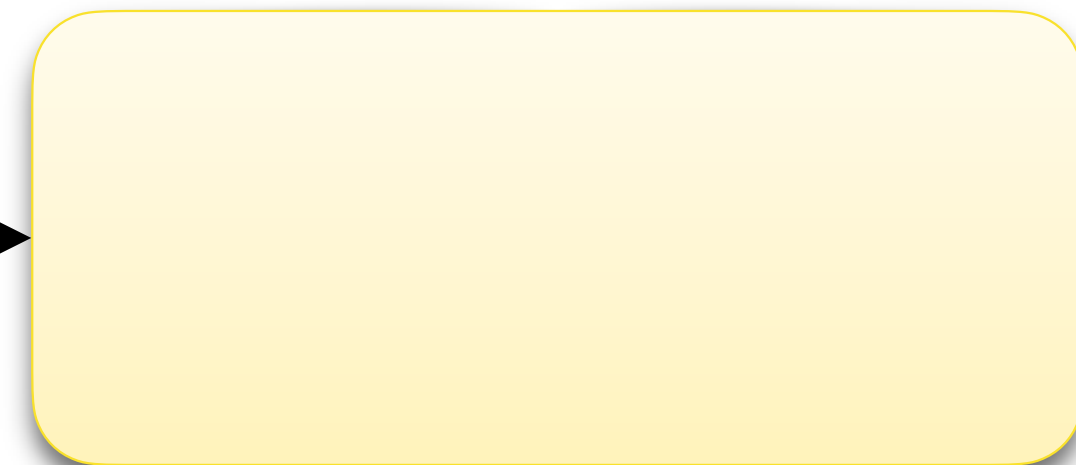


運動訓練

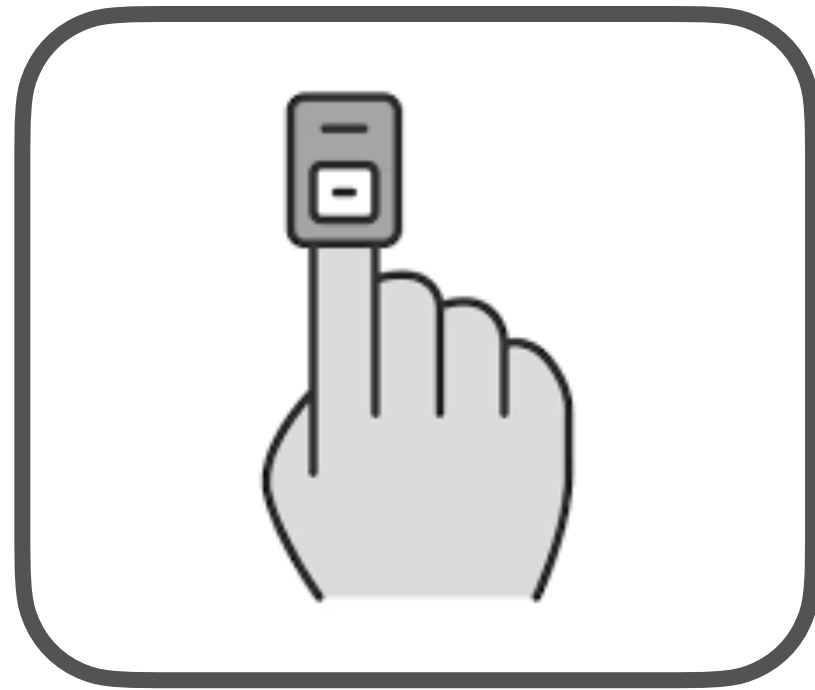
居家節能



睡眠呼吸



居家呼吸困難及喘的處理



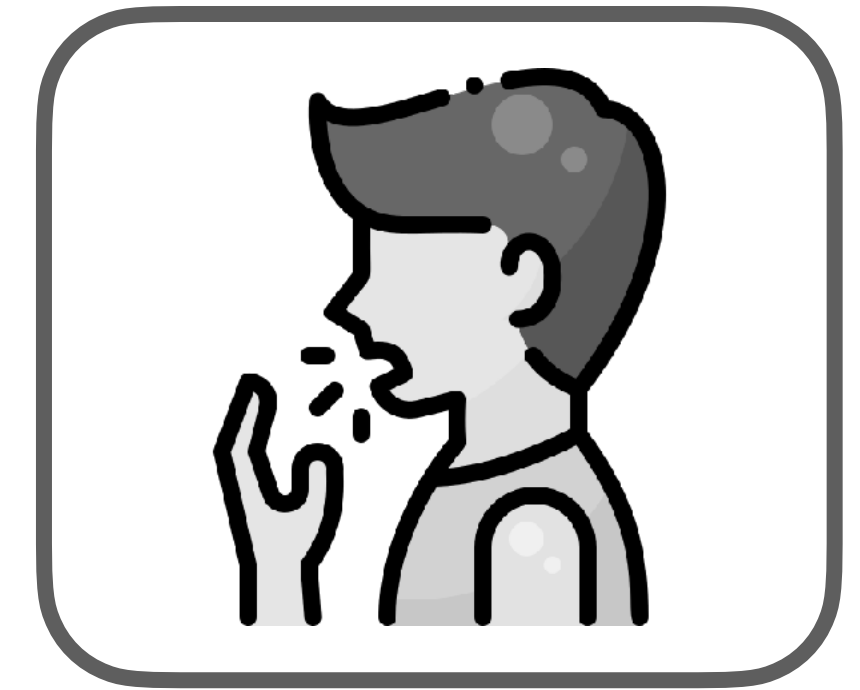
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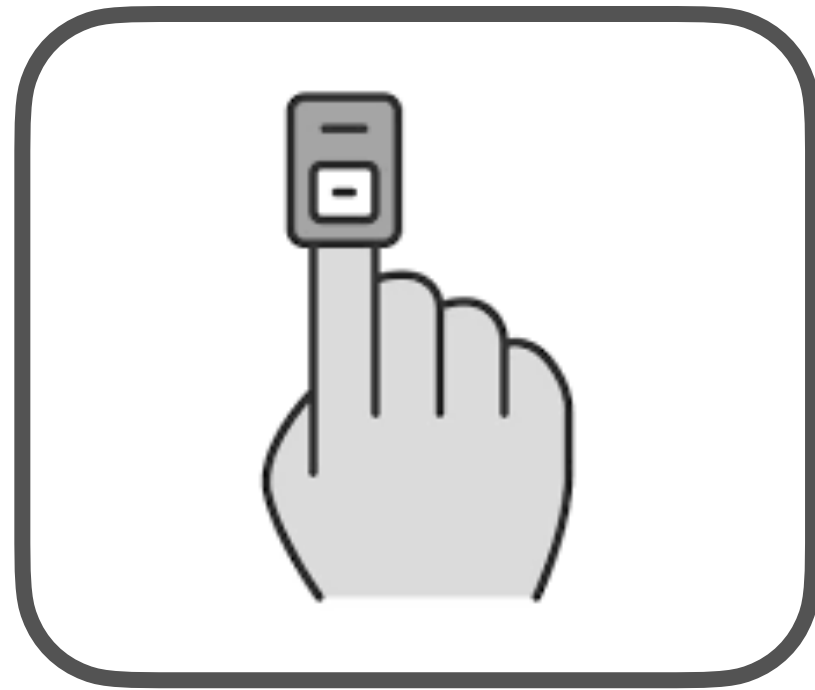


睡眠呼吸



焦慮憂鬱

居家呼吸困難及喘的處理



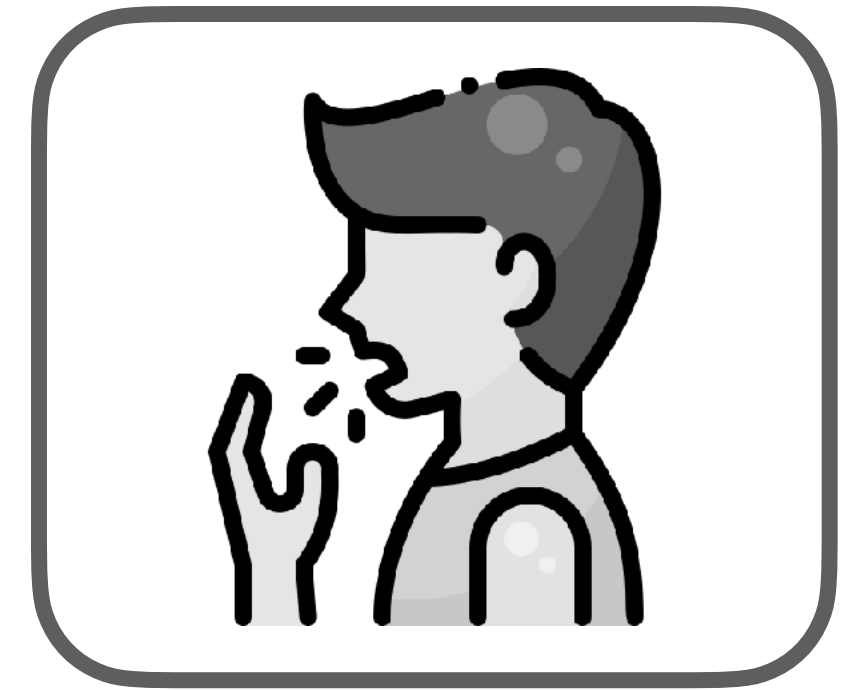
缺氧



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