



社團法人新北市呼吸治療師公會
會員大會暨繼續教育研討會

睡眠呼吸中止症與智慧醫療

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衛生福利部雙和醫院 睡眠中心/胸腔內科 專任主治醫師

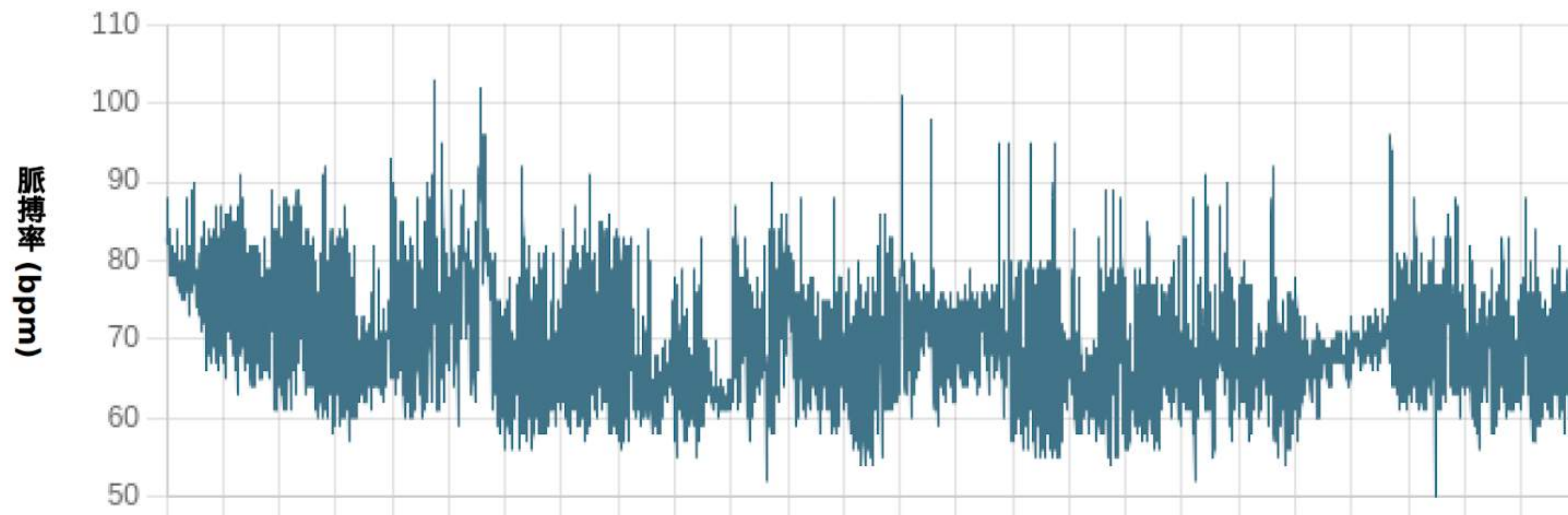
e-mail: lion5835@gmail.com

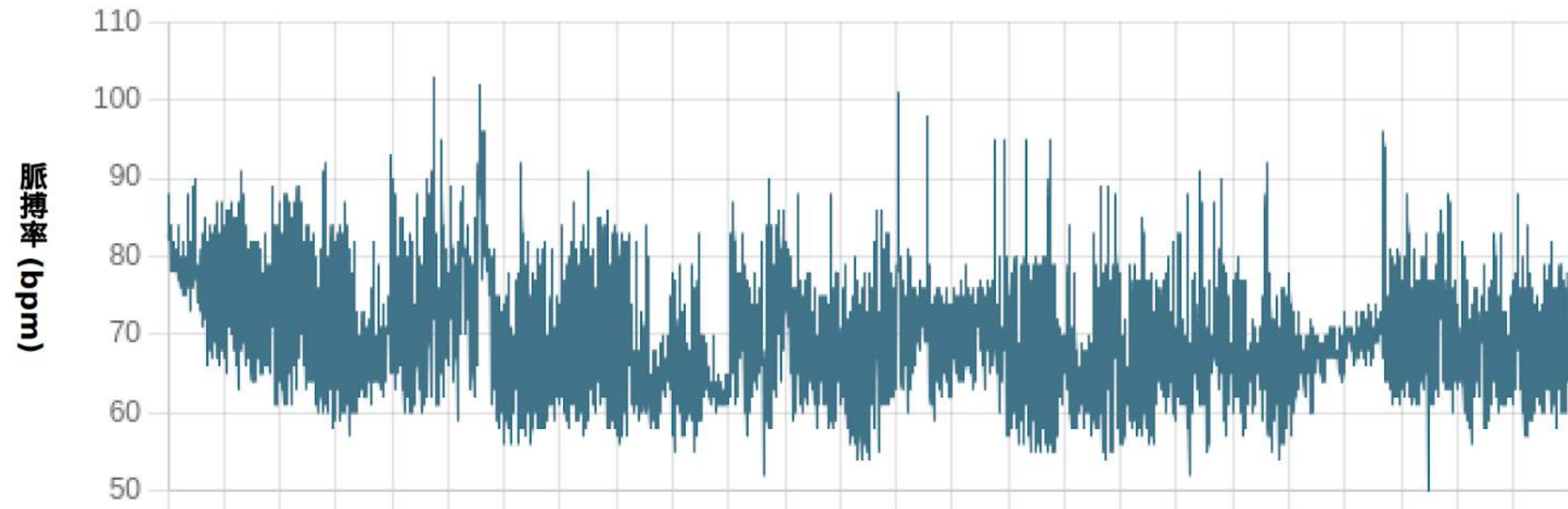
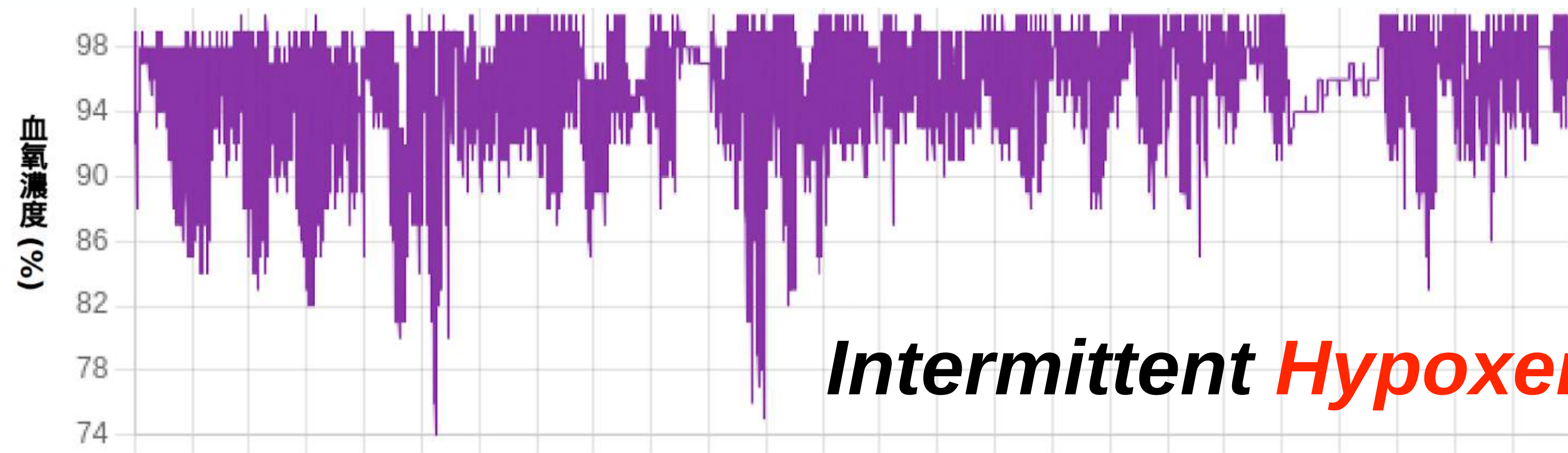
Which one looks more handsome?



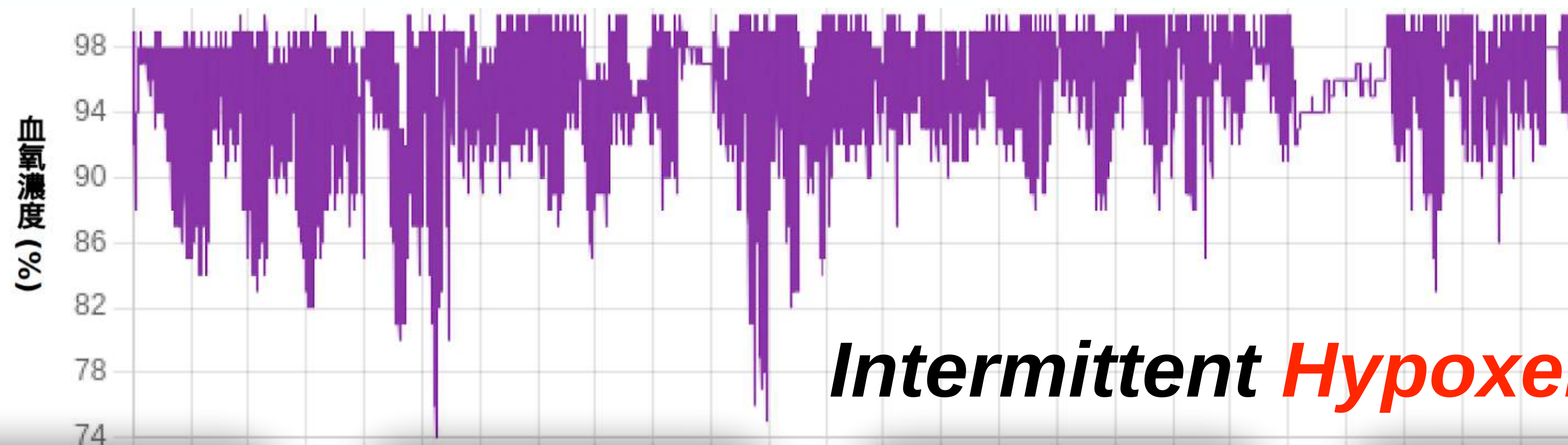
這是一個人的心跳變化，發生了什麼事？

A ICU patient with sepsis? COPD AE?





這其實是一個人在**睡覺期間的心率變化**，您會不會很驚訝？



Intermittent Hypoxemia



心血管併發症



代謝障礙



神經認知

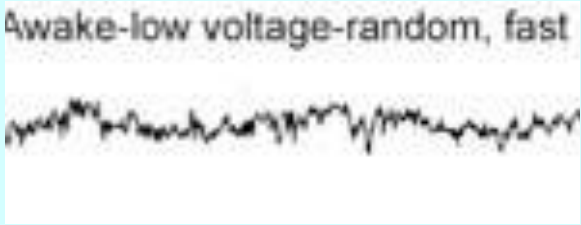
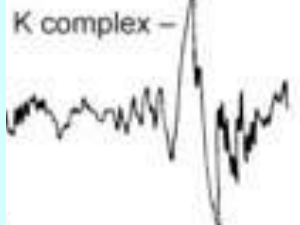
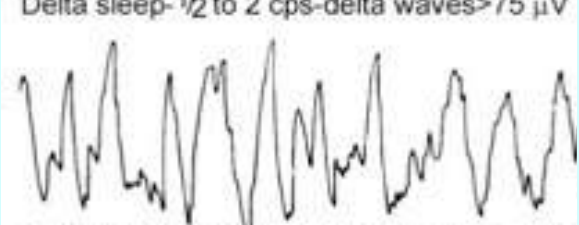
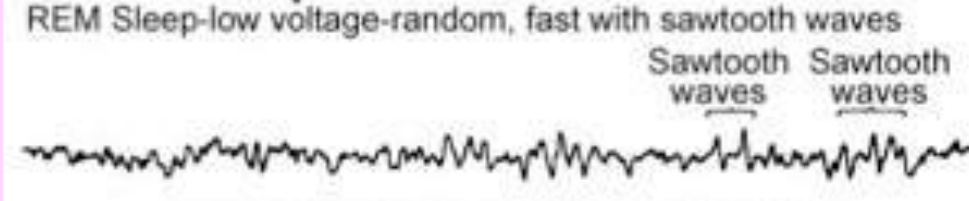


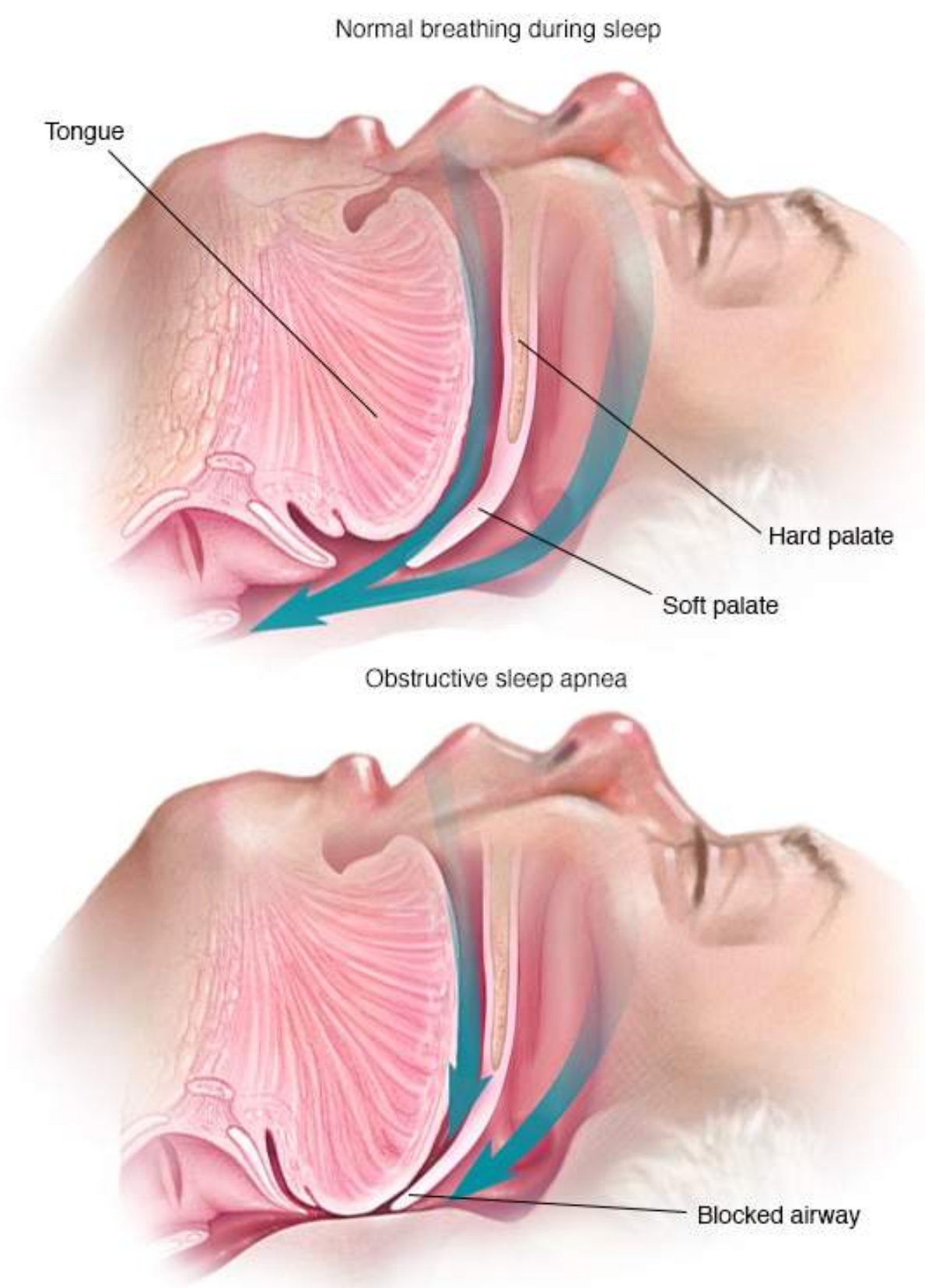
COMISA

無感但危險

睡眠呼吸障礙

有感卻難解

pattern	NREM			REM
period	5-10%	40-50%	25%	25% (increasing with each cycle)
Stage	Stage 1	Stage 2	Stage 3	
EEG	Low-amplitude 	K-complexes Sleep spindles  	Delta wave High voltage 	Alpha-like, low-voltage Random ,High-frequency 
Muscles	exhibit tone and movement			paralyzed
temperature	maintained			Loss of regulation
respiration	Respiratory rate slows , tidal volume decreases, minute ventilation (13-15%↓) , PaCO2 ↑2-4 mmHg			Upper airway resistance increase minute ventilation ↓ ↓
Systemic BP	↓5-10 %		↓8-14 %	variability and elevated (risk↑)
Clinical	Awake to sleep 2-10 minutes		Very low level of responsiveness GH release	Dreaming; Heart rate variability; Arrhythmias;



阻塞型睡眠呼吸中止症

睡眠呼吸中止症：

阻塞型 90%

中樞型 10%

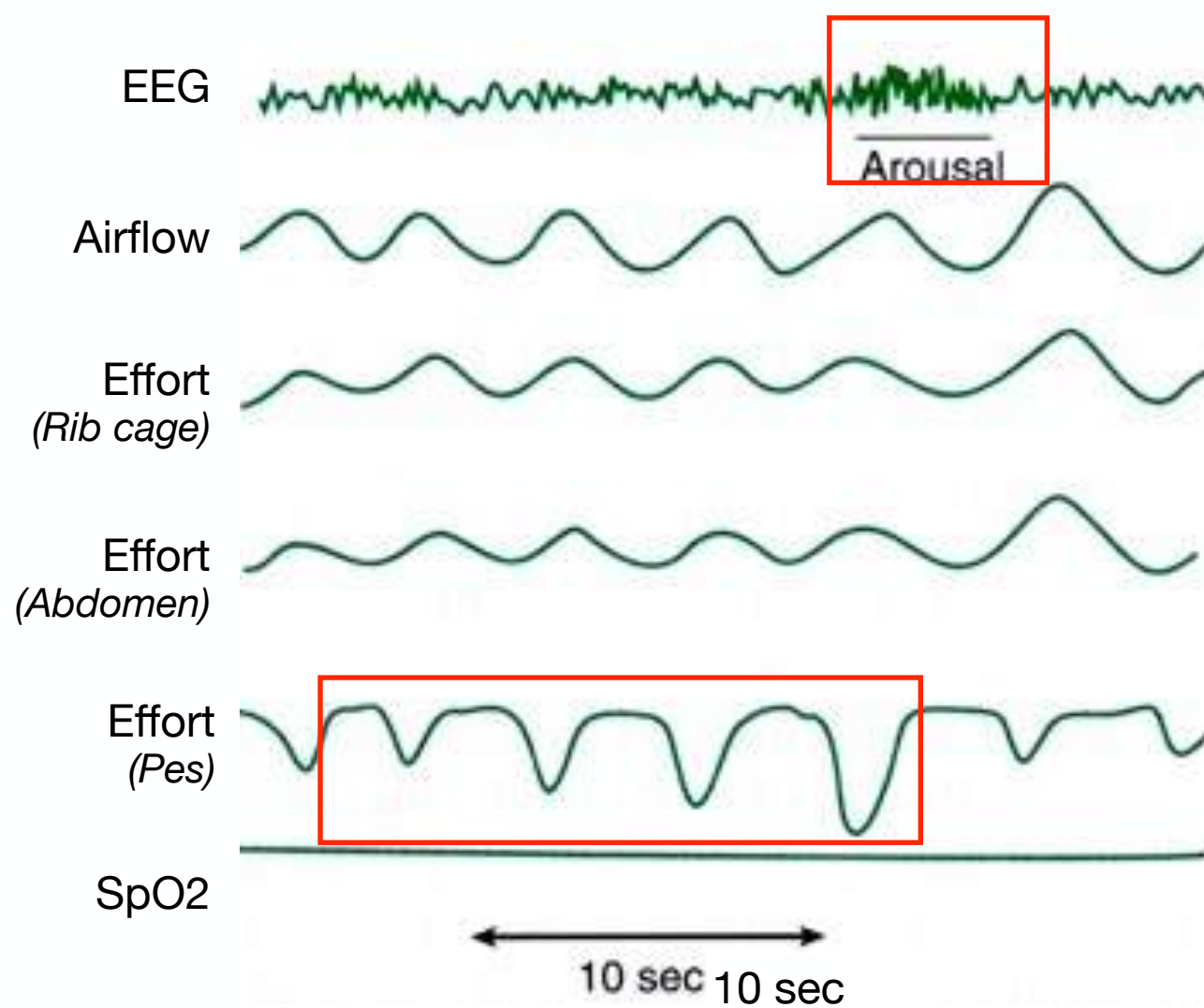
睡眠時發生的不正常呼吸

Sleep related breathing disorders

RERAs

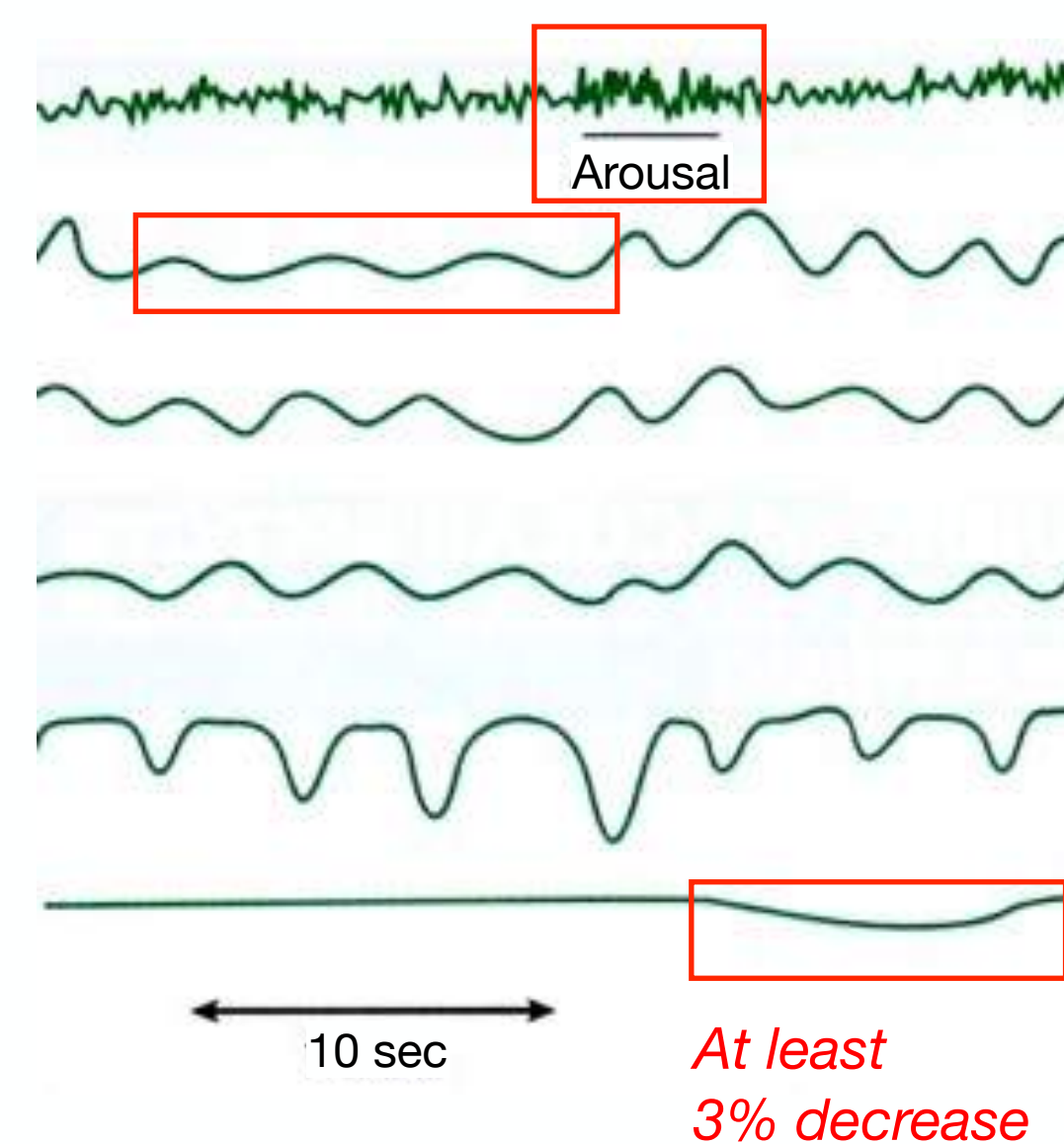
(Respiratory Effort-Related Arousals)

呼吸費力而覺醒)



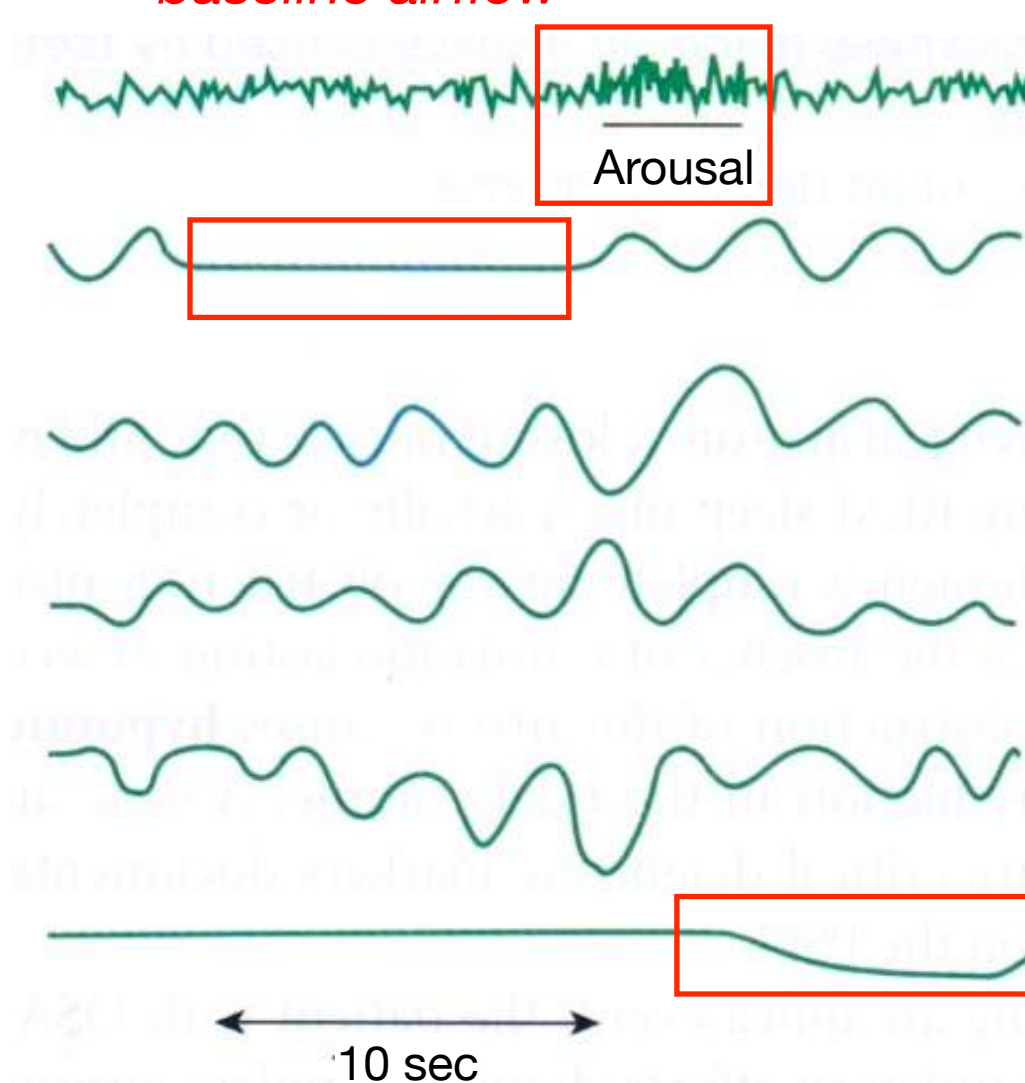
Hypopnea (淺呼吸)

10~70% of
baseline airflow

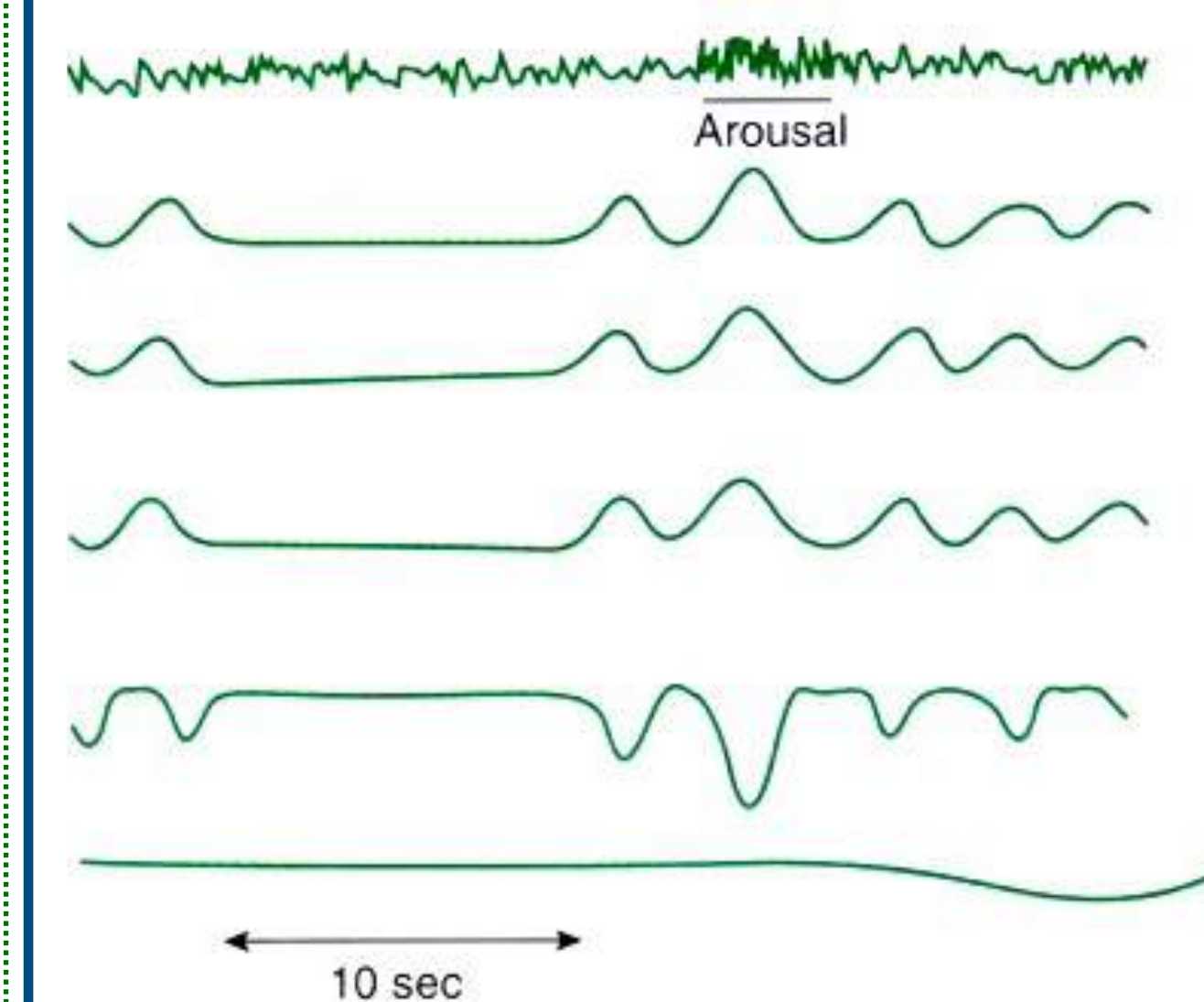


Apnea (呼吸暫停)

< 10% of
baseline airflow



Central Sleep Apnea



- **Apnea-Hypopnea Index, AHI:**
 - (Events of Apnea and Hypopnea)/hour
- **Respiratory Disturbance Index, RDI:**
 - (Events of Apnea, Hypopnea and RERAs)/hour

Sleep apnea severity

< 5	Normal
5-14.9	Mild
15-29.9	Moderate
≥30	Severe

Obstructive Sleep Apnea



男性的罹患機率是女性的2~8倍，但女性更年期後則與男性機率一樣高



年紀增長會增加呼吸中止症的風險



肥胖，使呼吸道容易阻塞，是呼吸中止症的一個重要原因



顱顏異常，鼻中膈彎曲、下顎後縮或過小，也容易使呼吸道阻塞

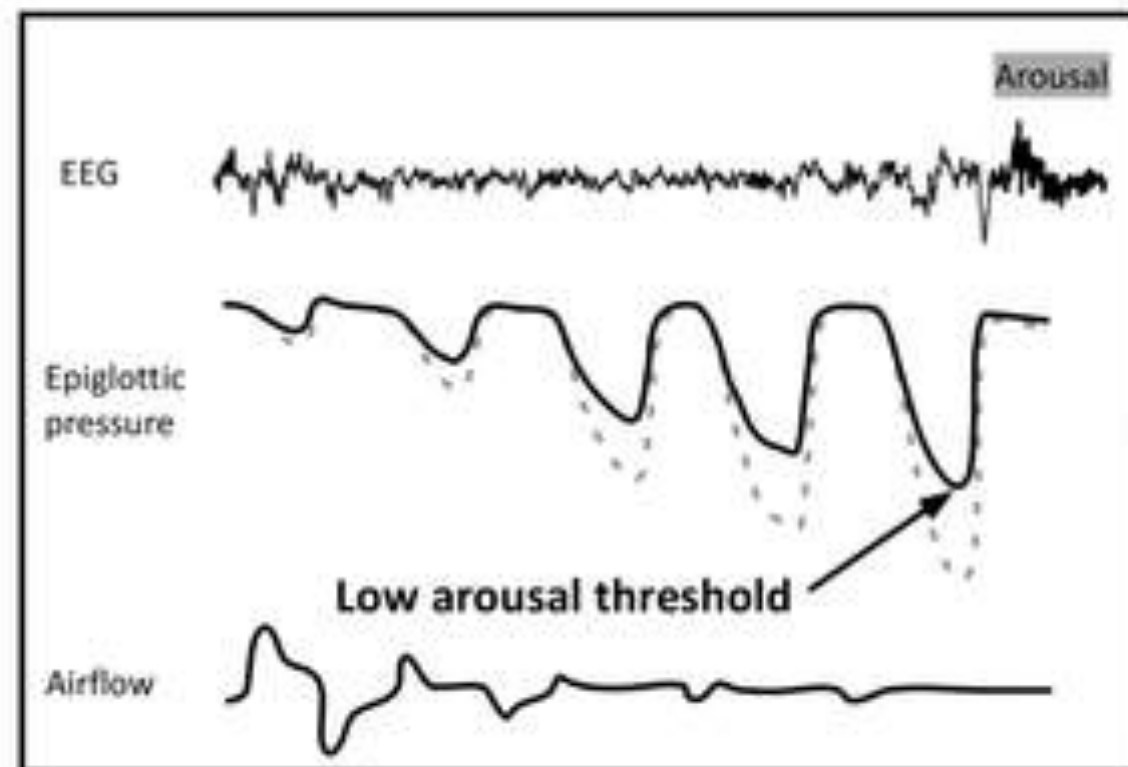


扁桃腺或舌頭肥大，也會使呼吸道容易阻塞

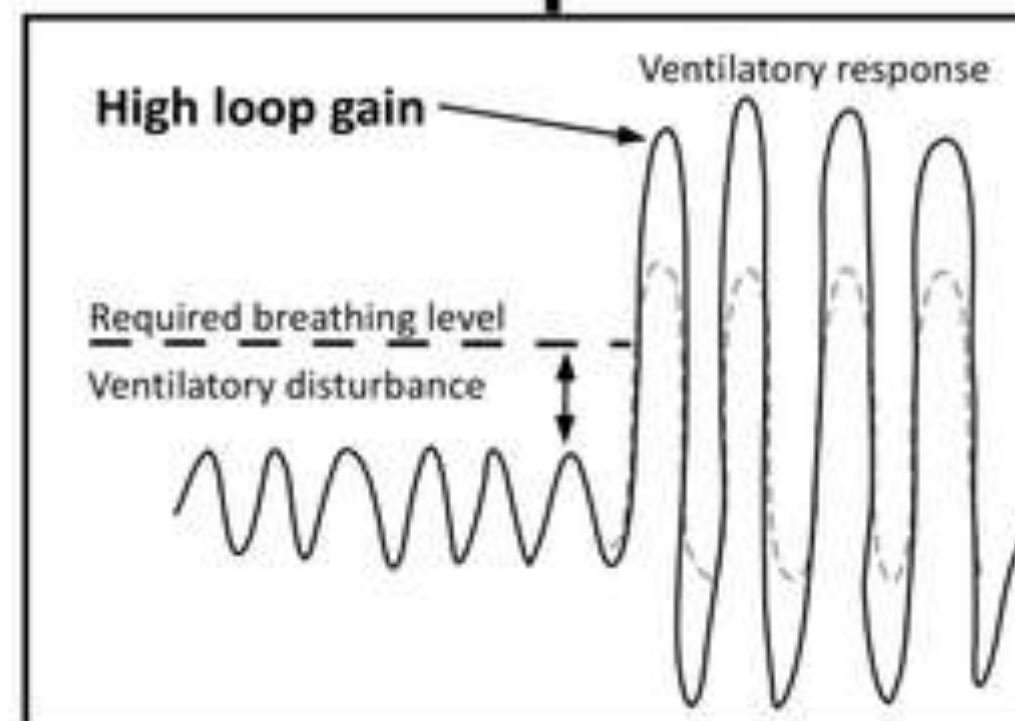


Obstructive Sleep Apnea: Phenotype

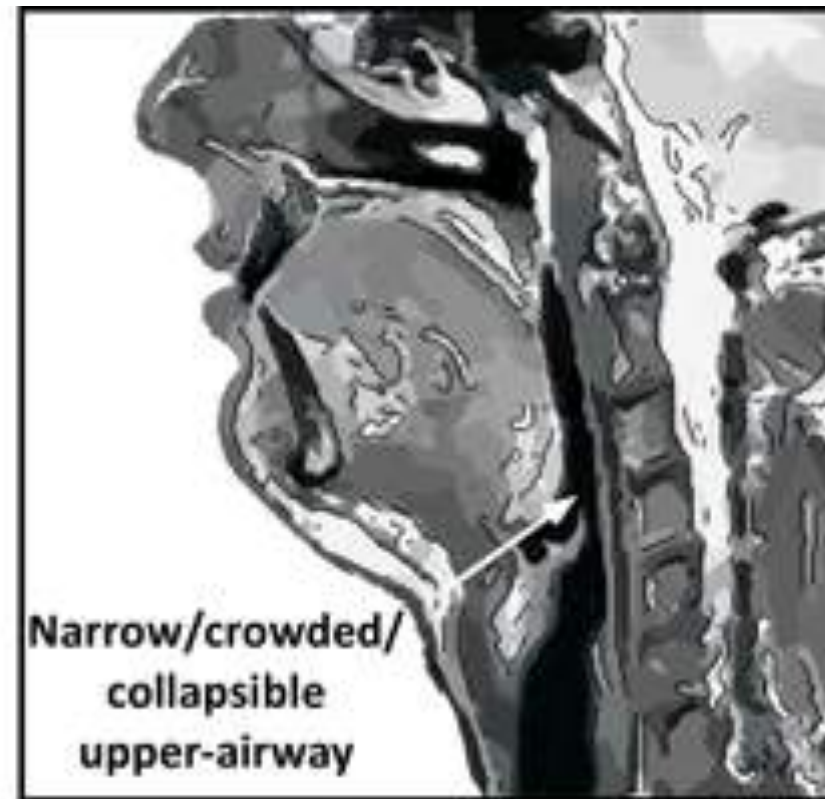
Arousal



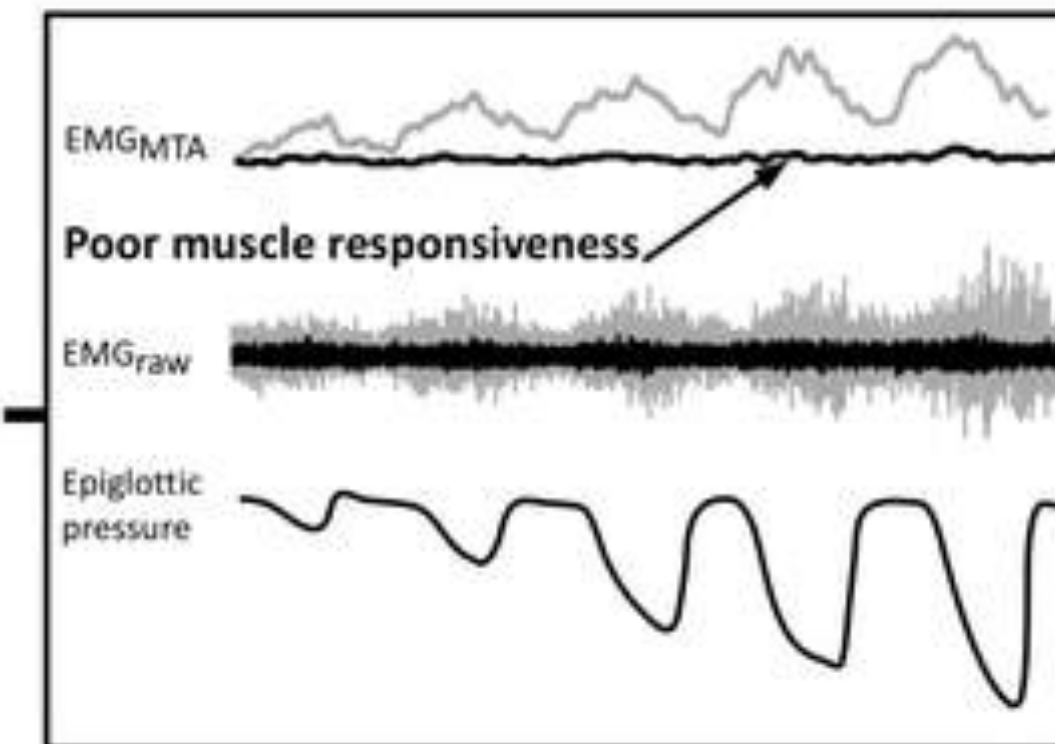
High Loop Gain



Anatomy/Structure



Muscular

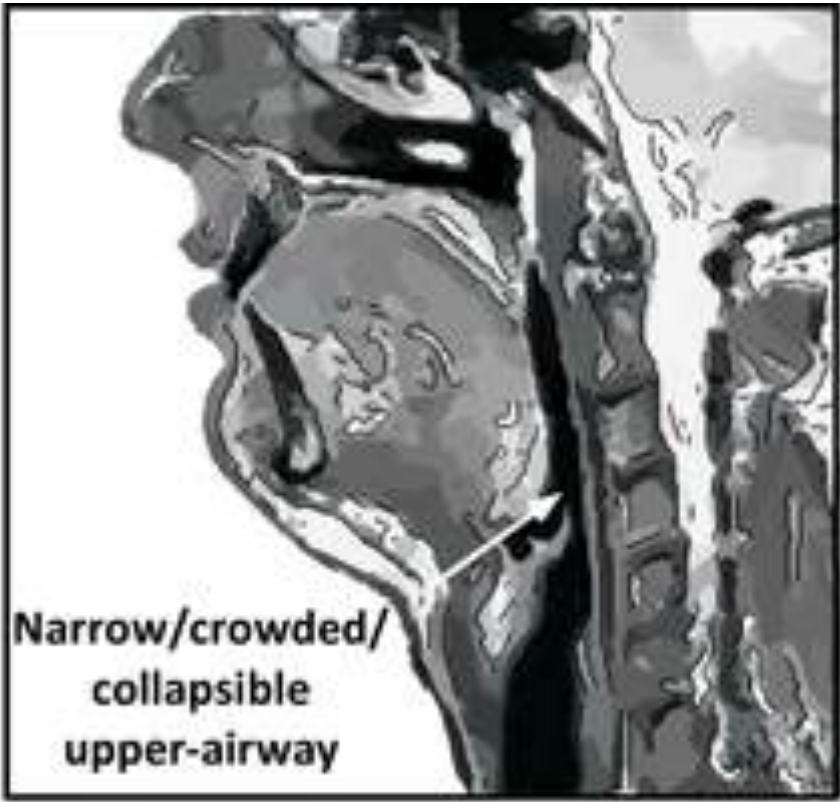


OSA

Obstructive Sleep Apnea: Phenotype

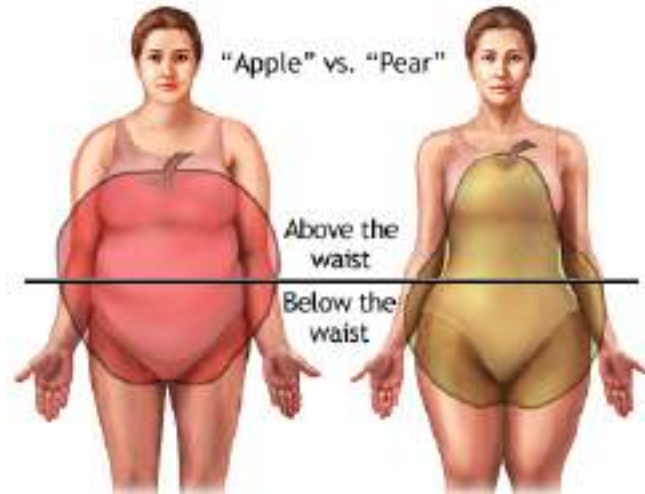


Craniofacial factors
(Nasal/Dental problems)
(Hypothyroidism)
(Down syndrome)
(Acromegaly)



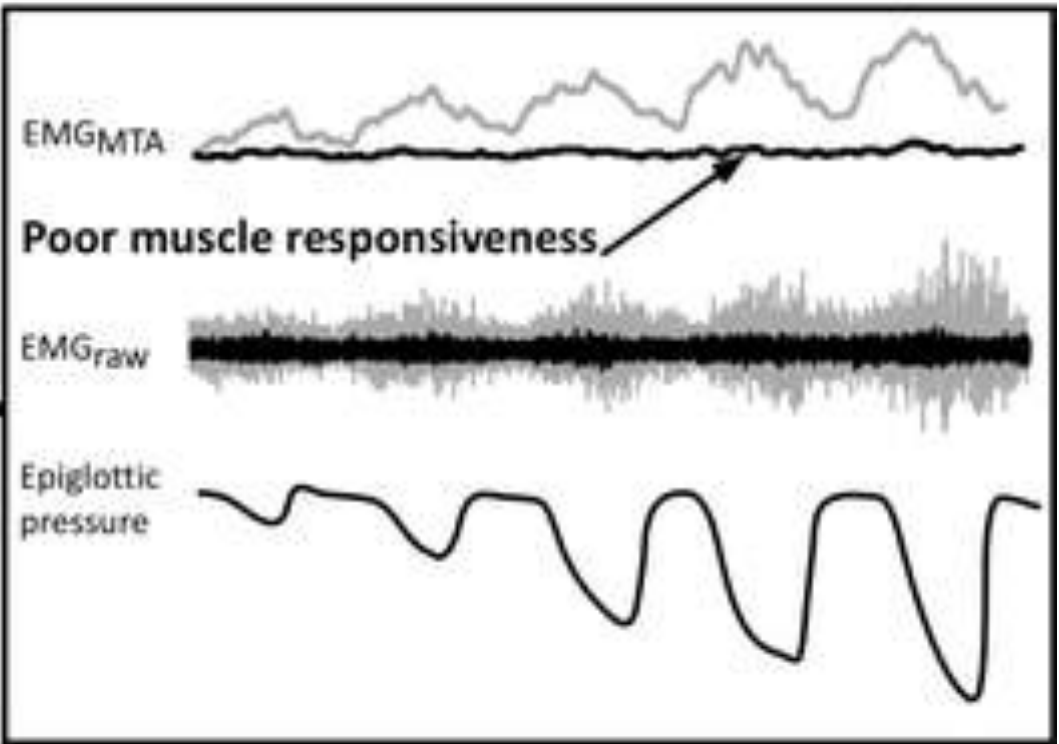
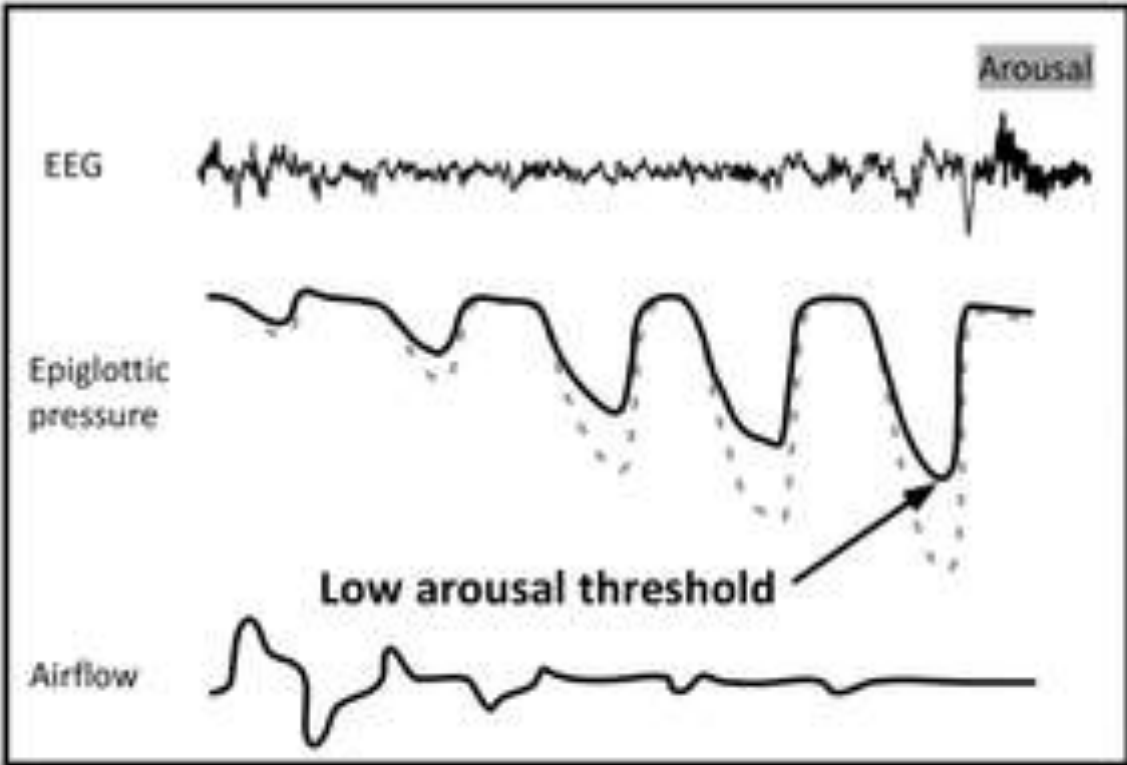
Narrow/crowded/
collapsible
upper-airway

Anatomy/Structure



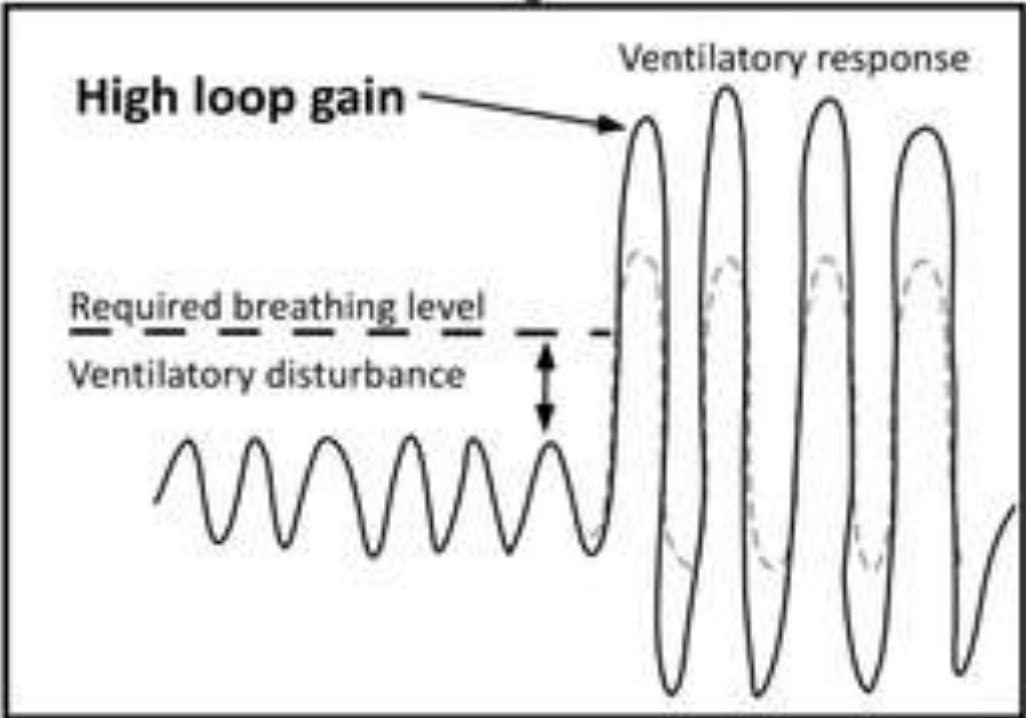
Obesity

Arousal



OSA

High Loop Gain

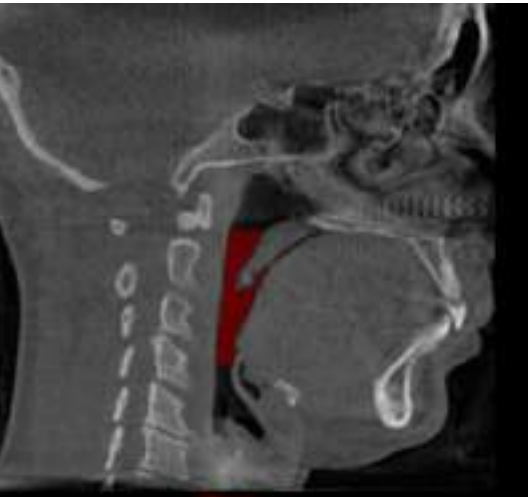
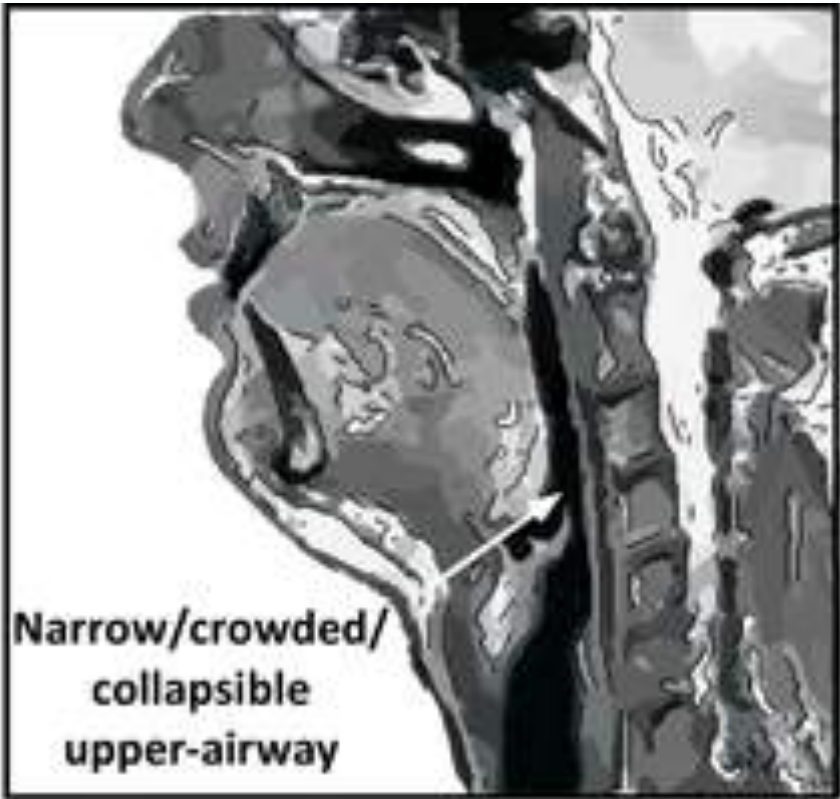


Obstructive Sleep Apnea: Phenotype



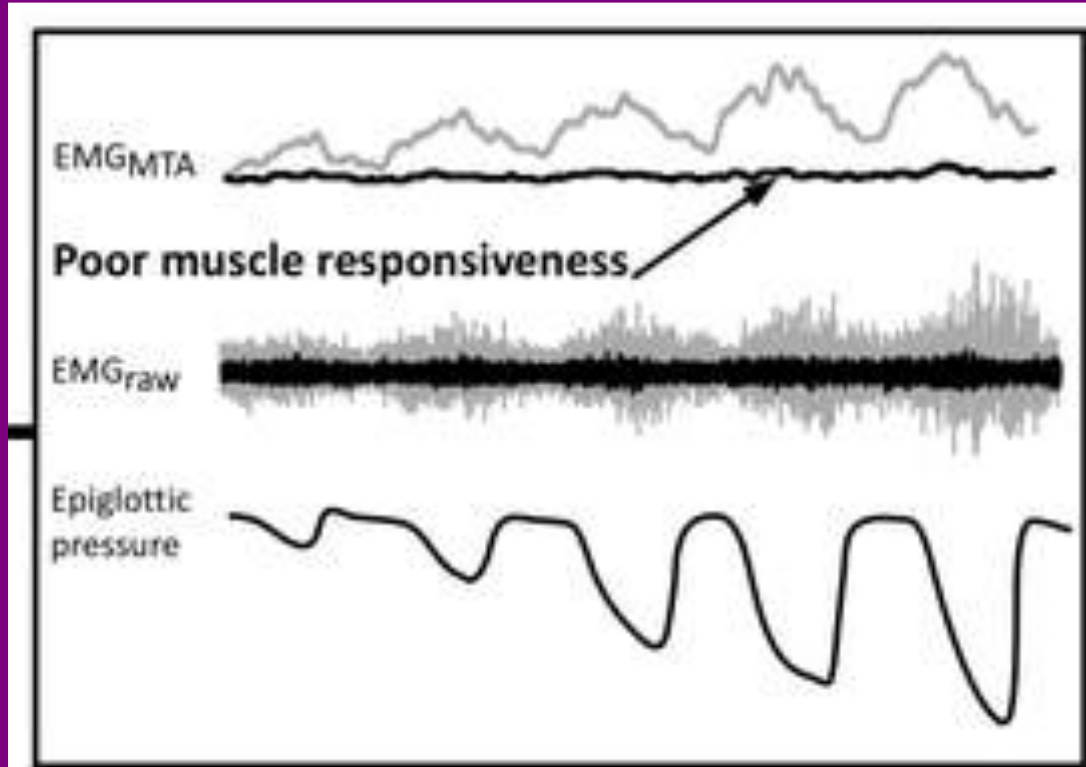
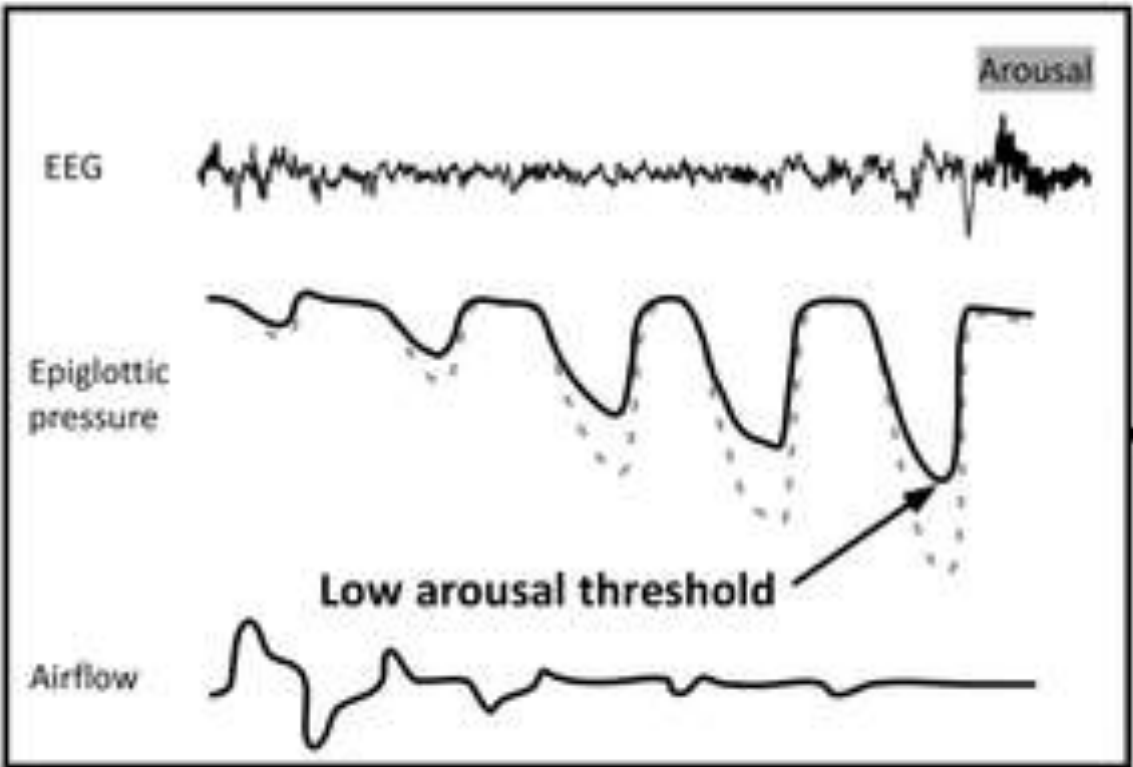
Craniofacial factors
(Nasal/Dental problems)
(Hypothyroidism)
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(Acromegaly)

Anatomy/Structure



Obesity

Arousal

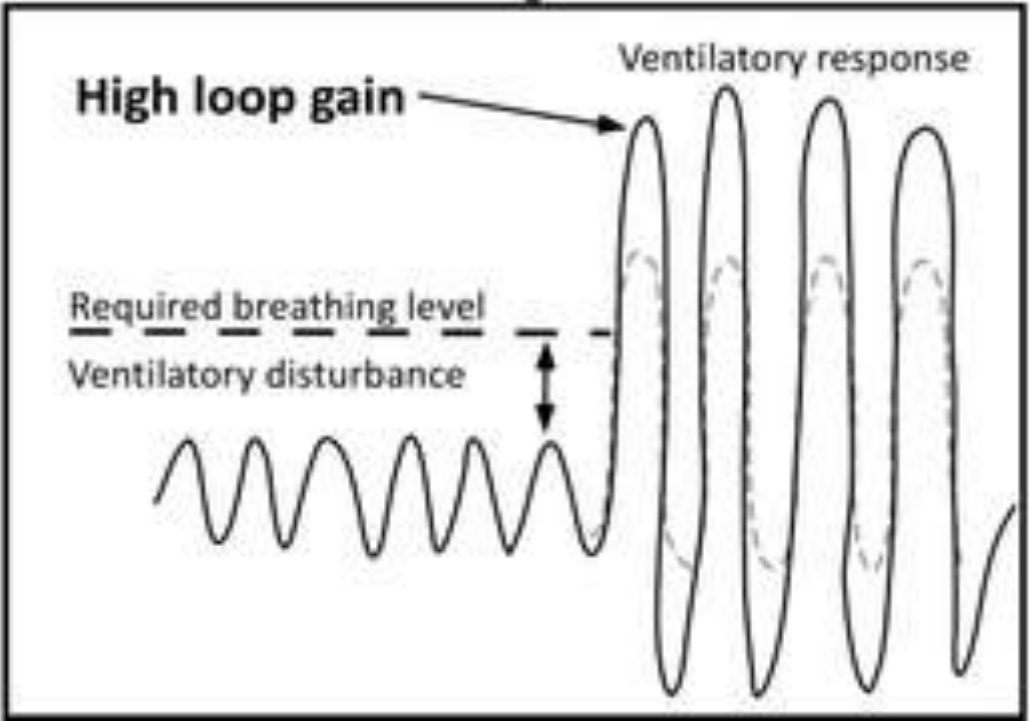


Muscular



OSA

High Loop Gain

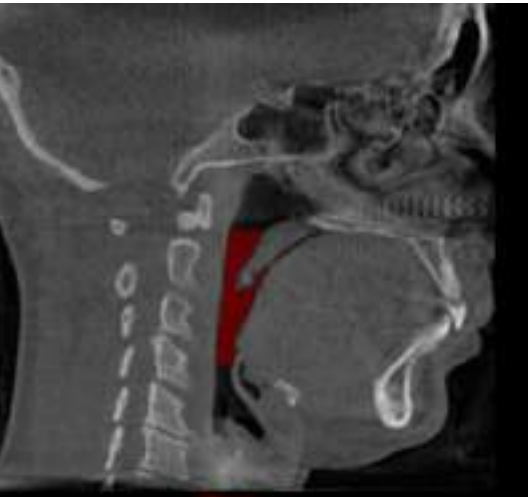
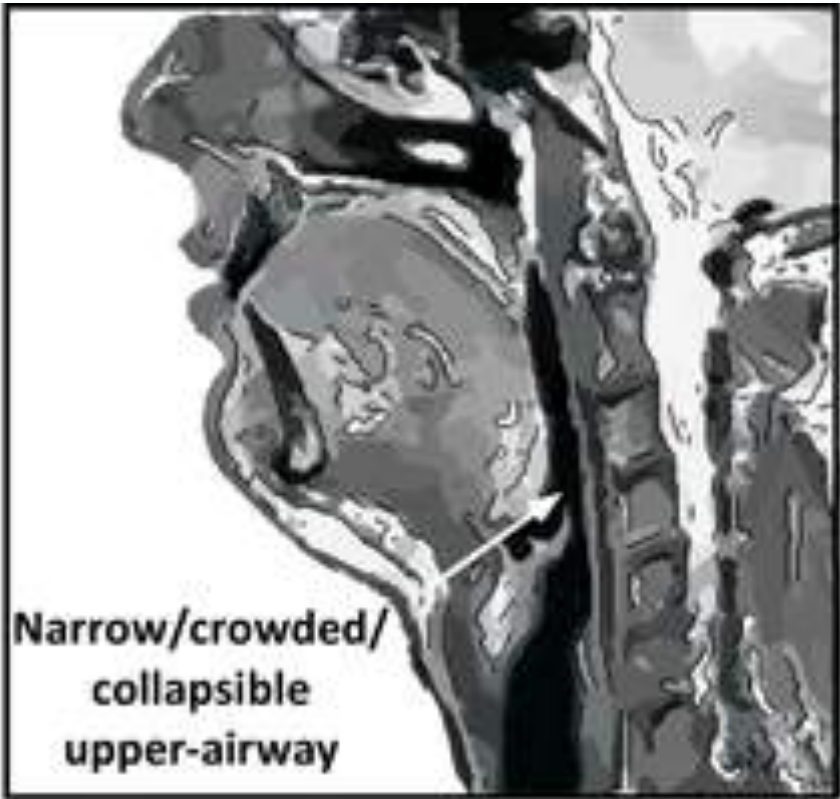


Obstructive Sleep Apnea: Phenotype



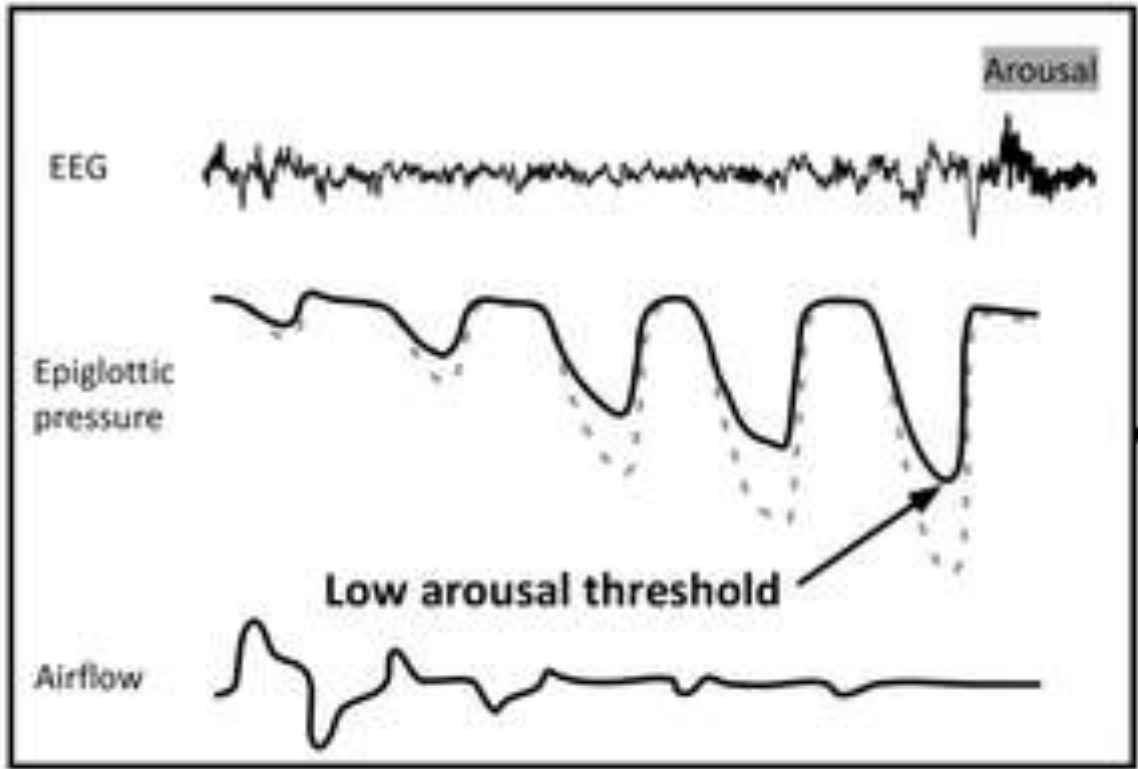
Craniofacial factors
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Anatomy/Structure



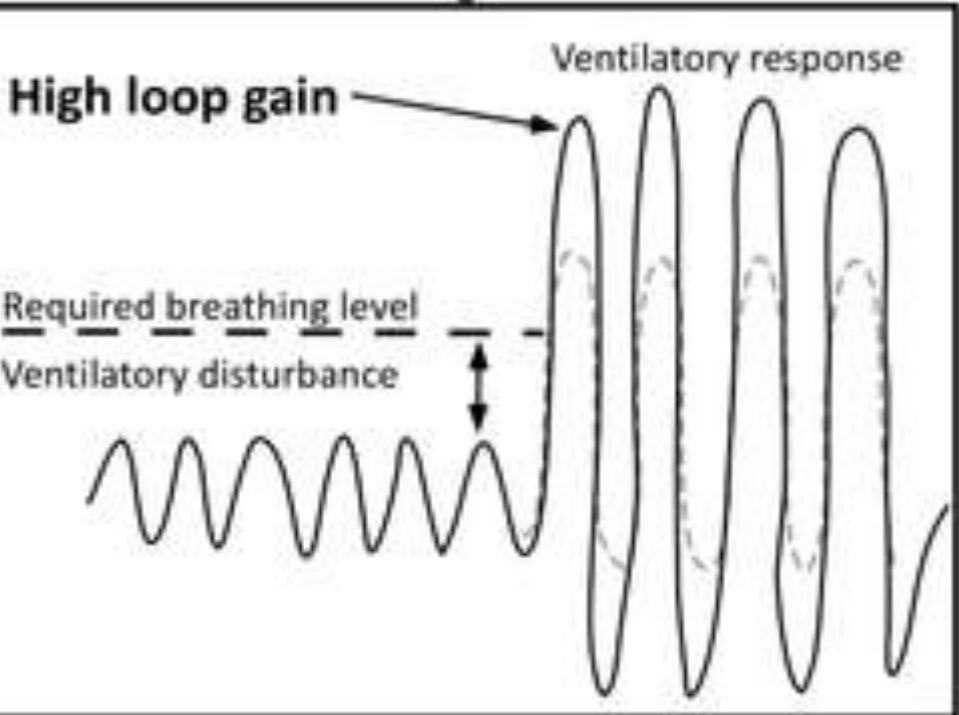
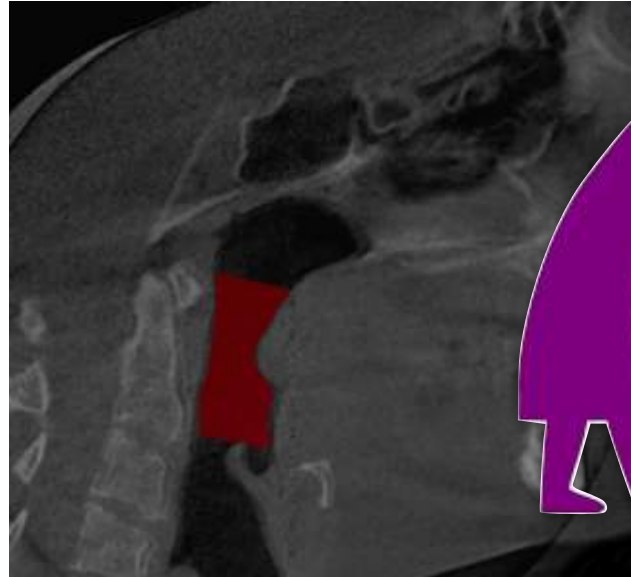
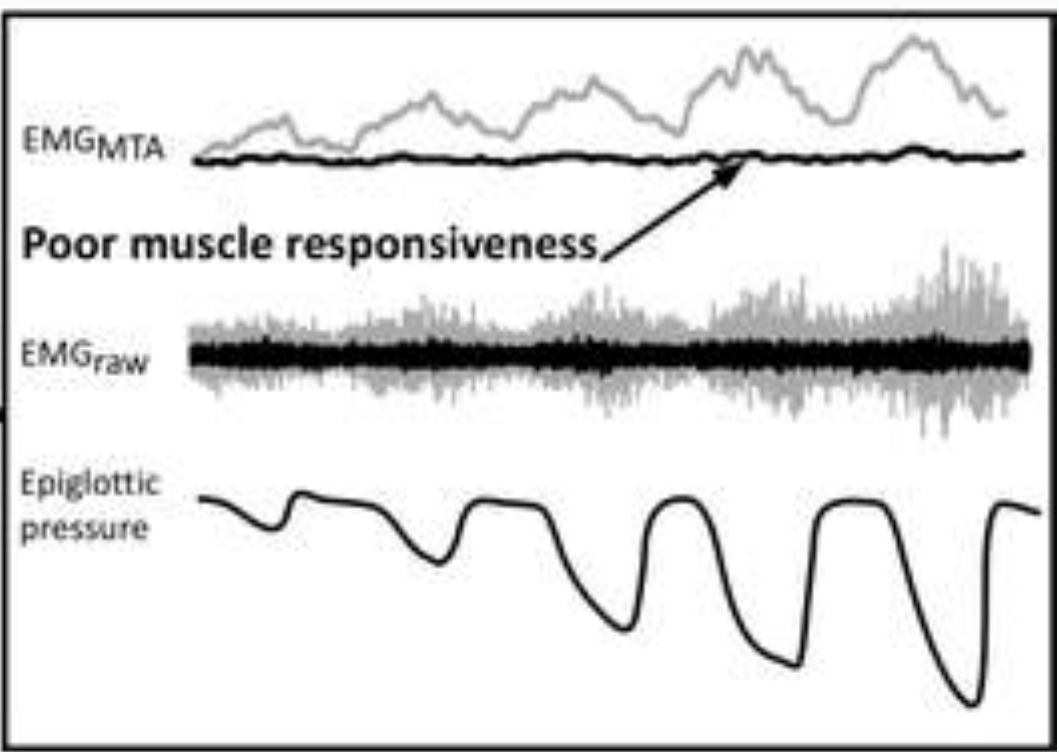
Obesity

Arousal



OSA

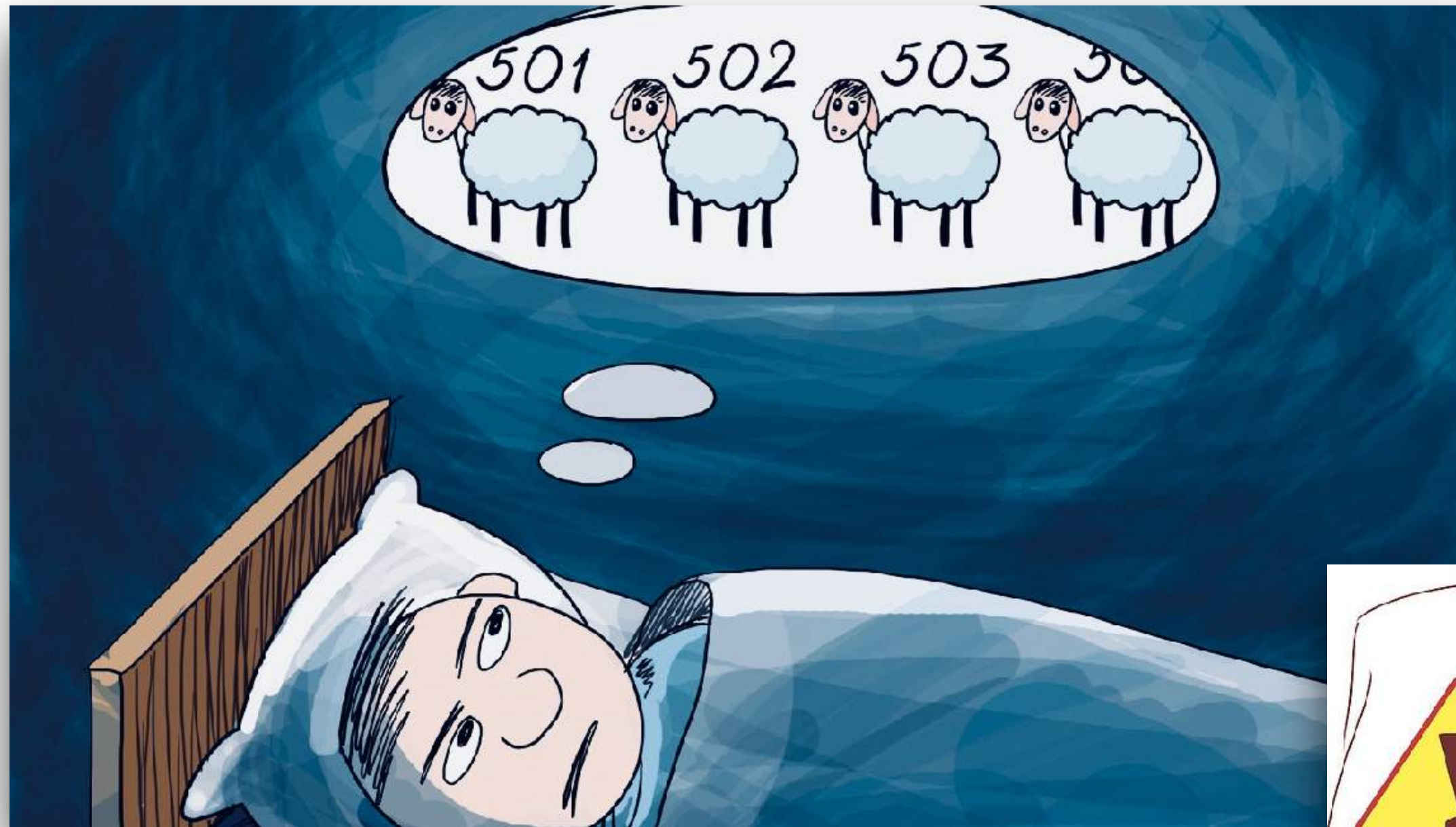
Muscular



High Loop Gain

最常見的睡眠疾病

Co-Morbid **I**nsomnia and **S**leep **A**pnea: **COMISA**



失眠

29%~67% having OSA

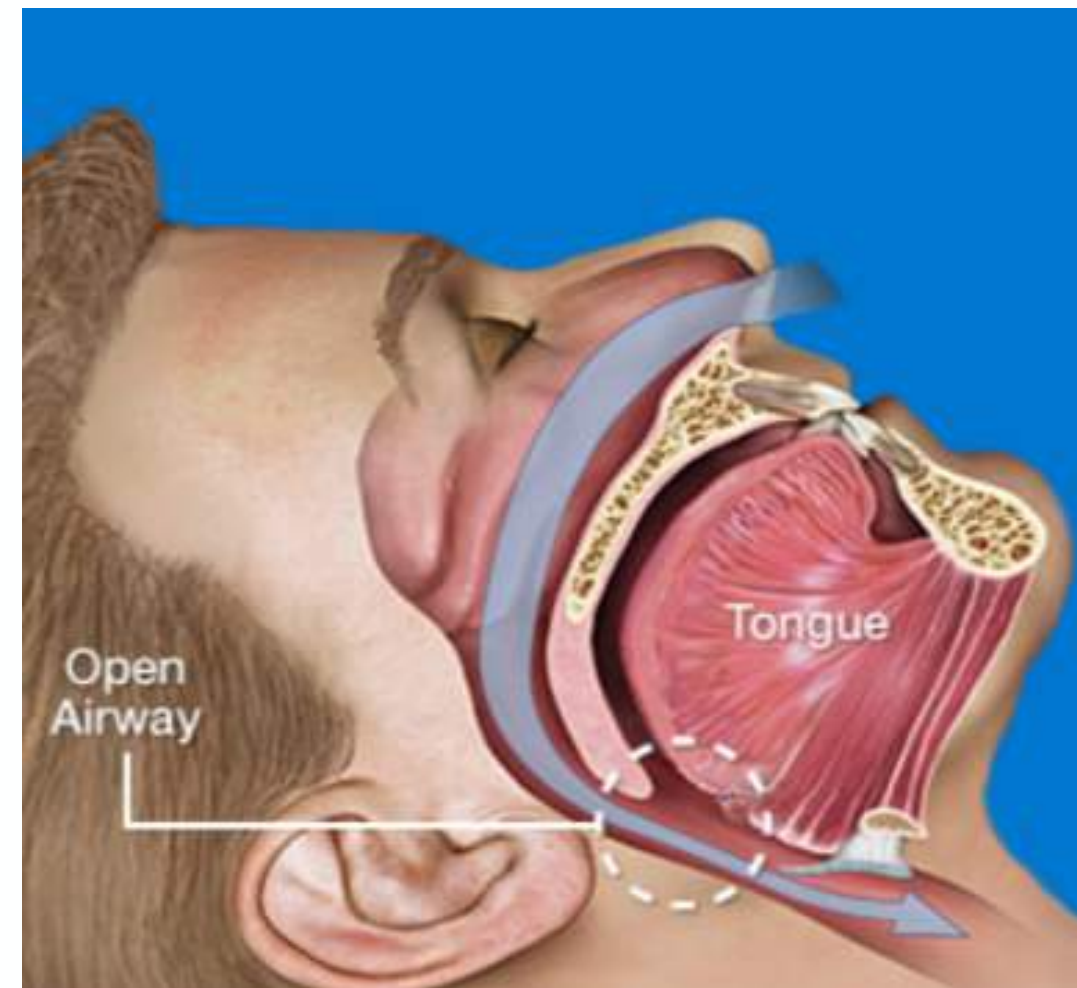
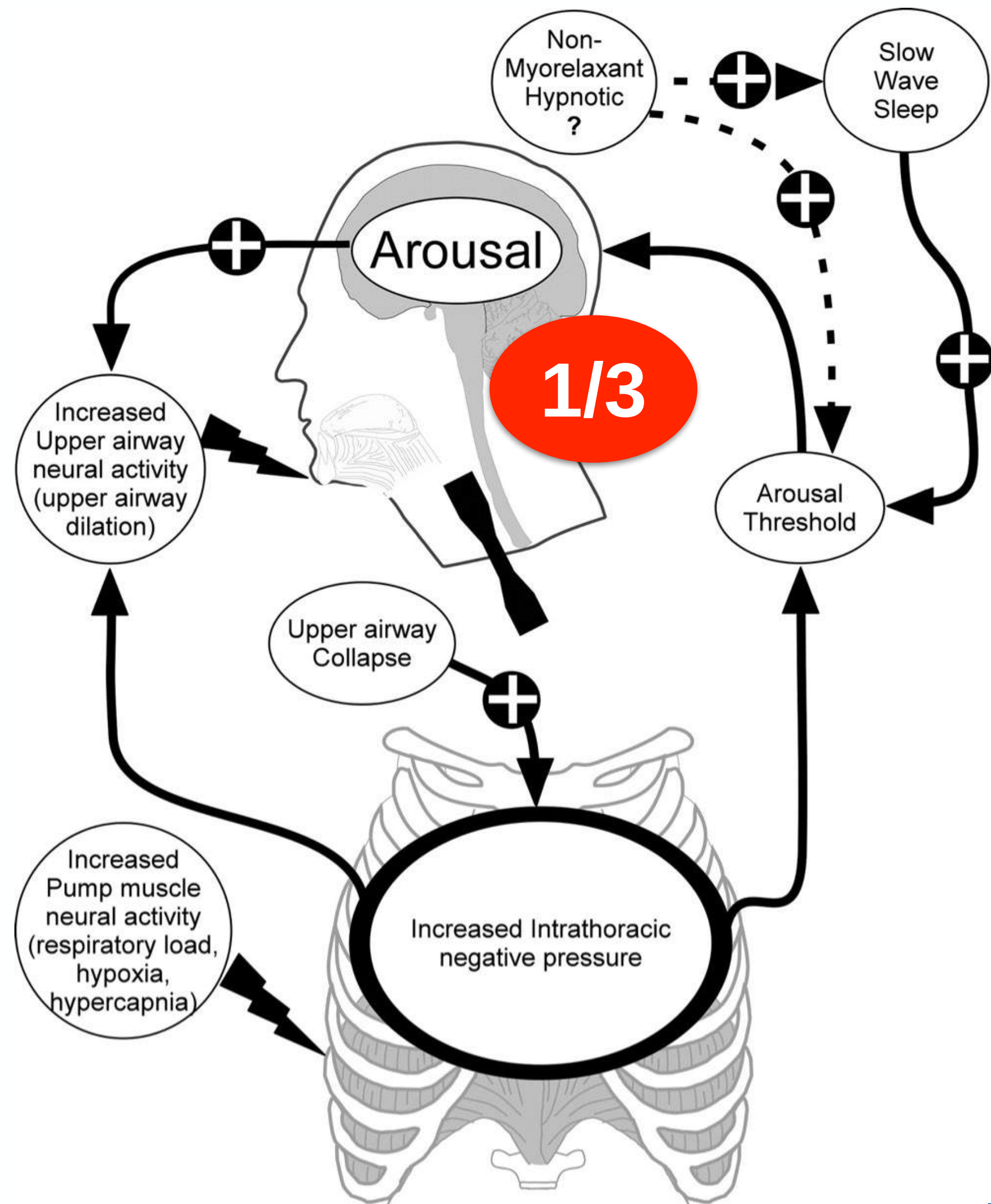
睡眠呼吸中止症

39%~58% having Insomnia



Low arousal threshold OSA

容易覺醒的阻塞型睡眠呼吸中止症



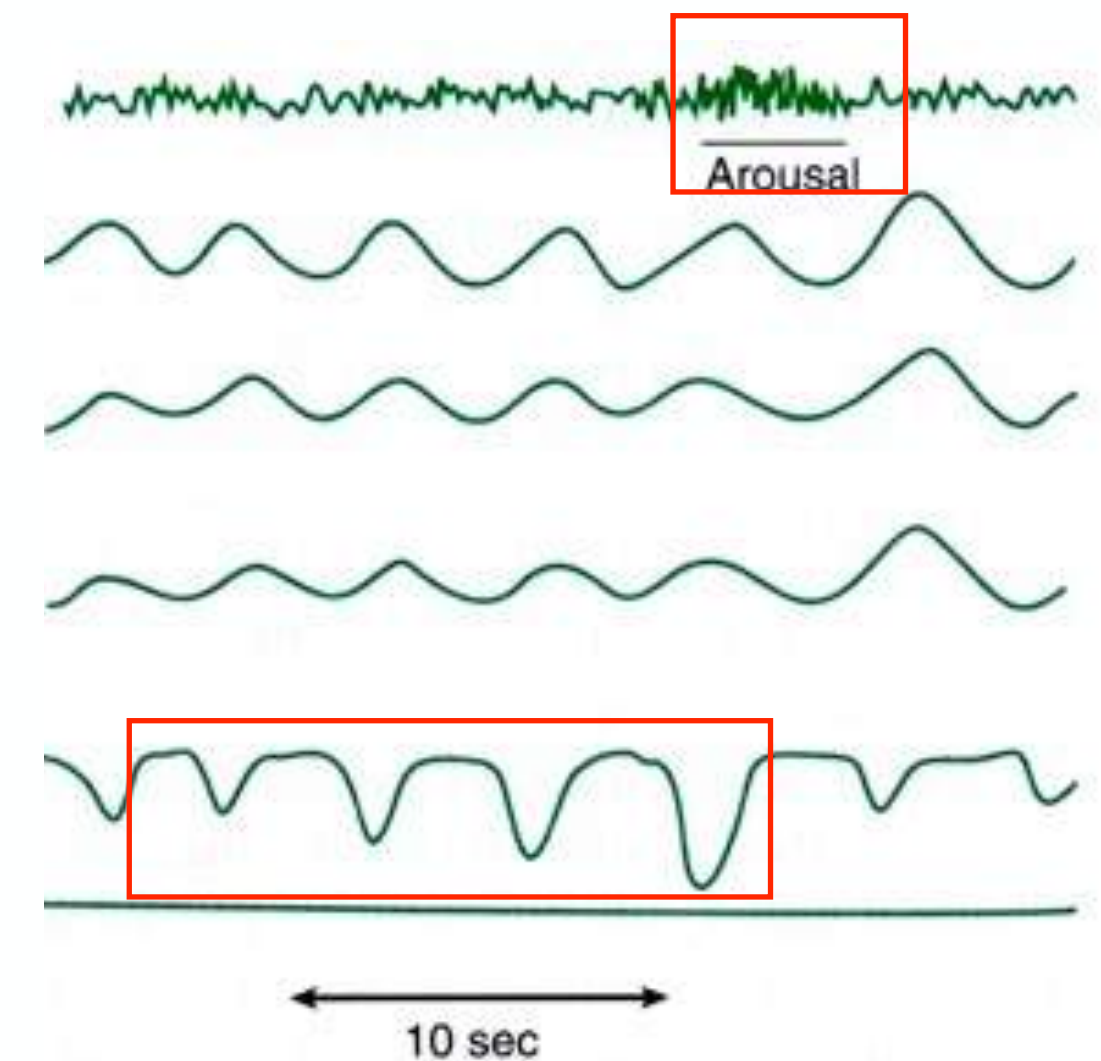
- **AHI < 30/hr**
- **Minimal SpO2 > 82.5%**
- **Hypopnea > 58.3% AHI**
(Hypopnea/Apnea+Hypopnea)

At least Two above

RERAs

(Respiratory Effort-Related Arousals)

呼吸費力而覺醒)



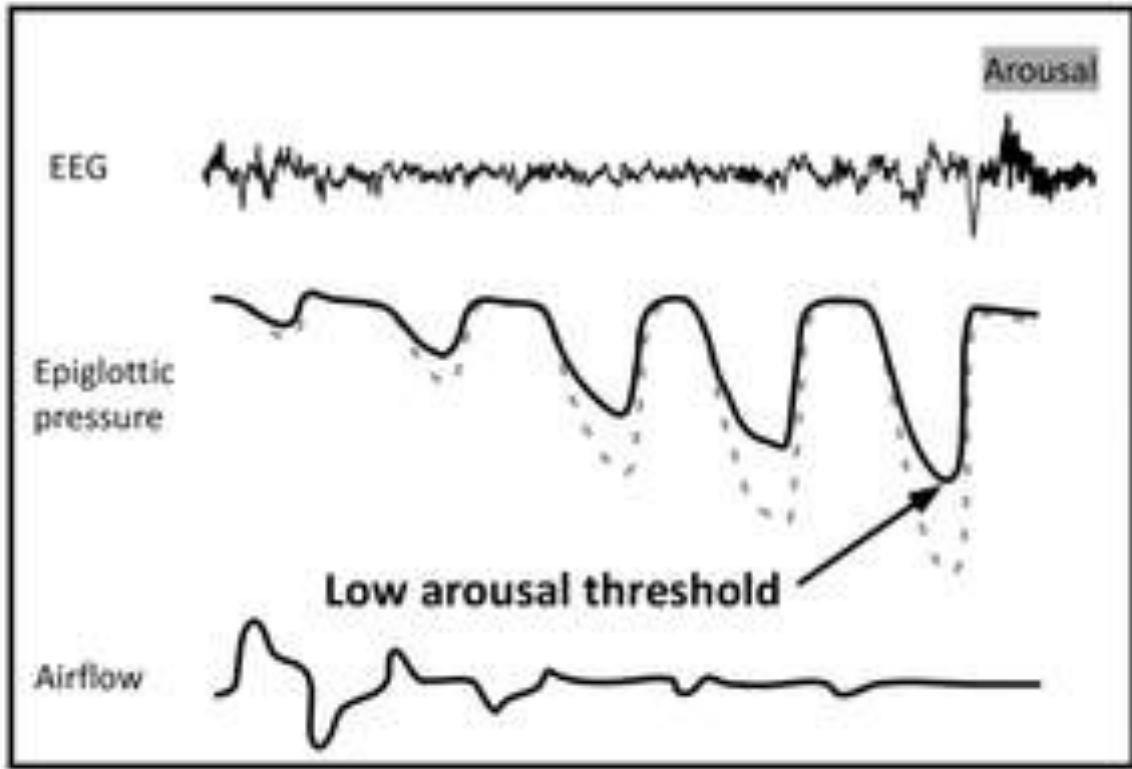
Obstructive Sleep Apnea: Phenotype

RERAs

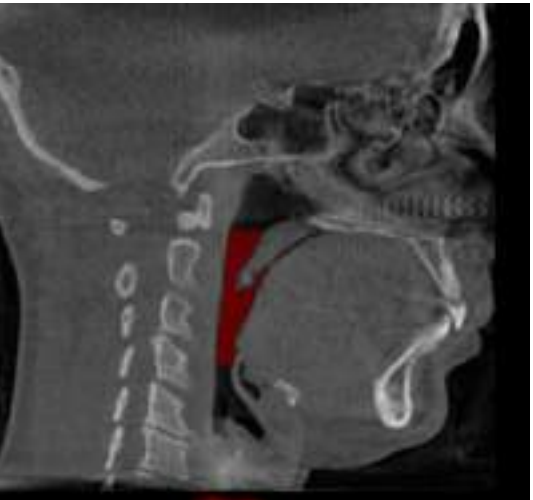
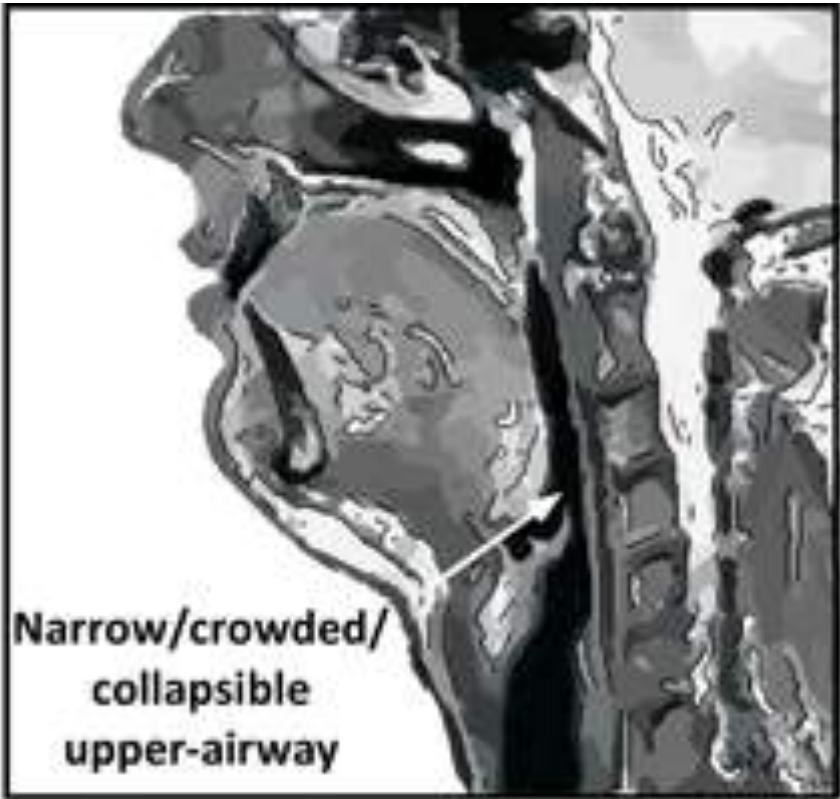
(Respiratory Effort-Related Arousals)

呼吸費力而覺醒)

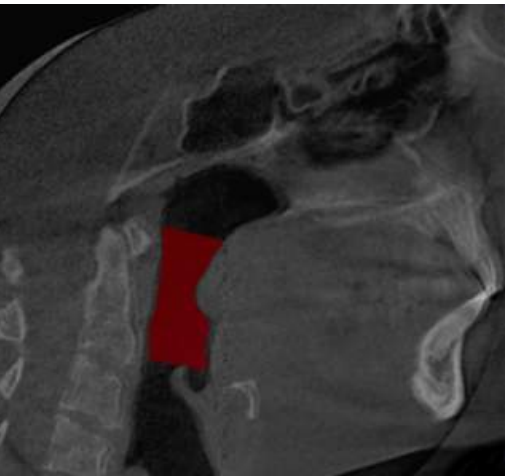
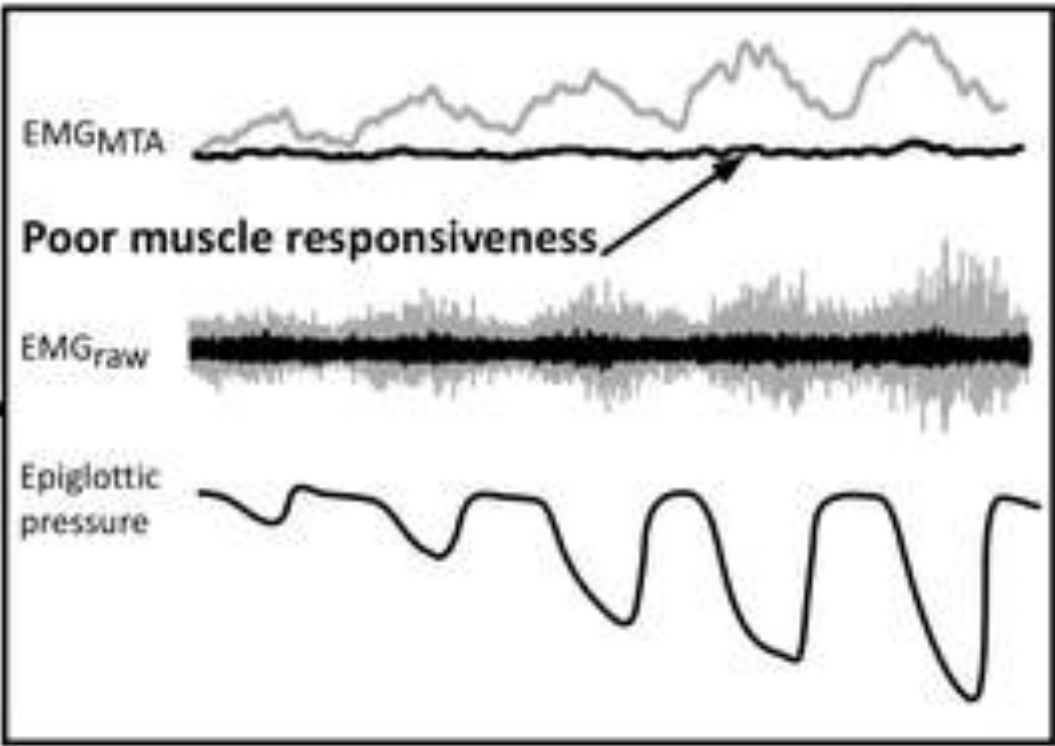
Arousal



Anatomy/Structure

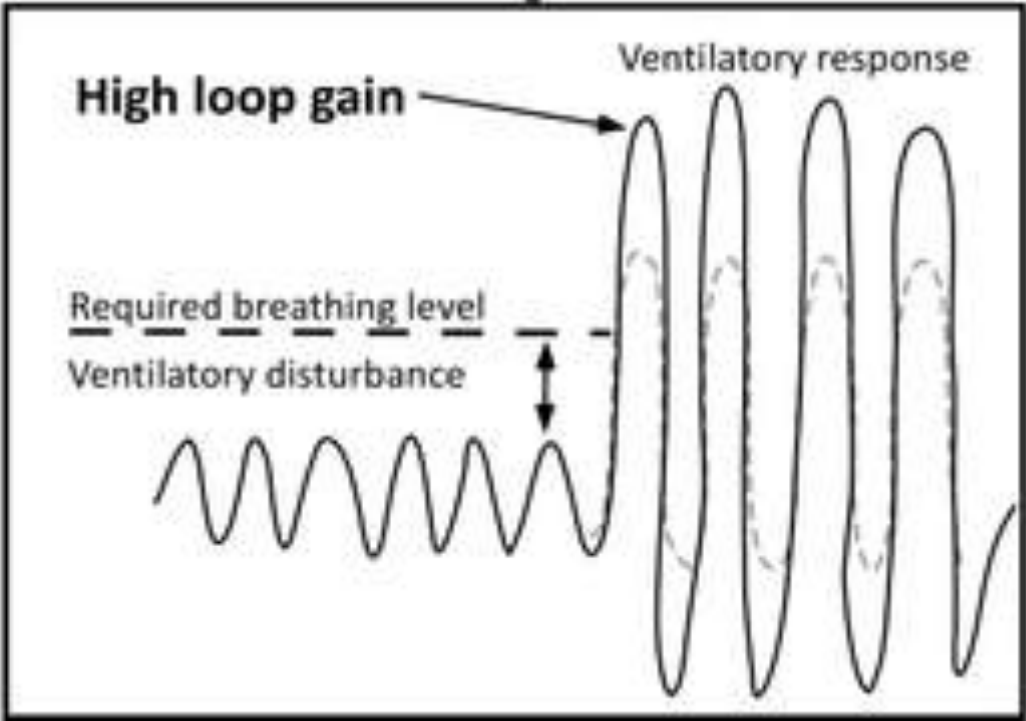


Muscular



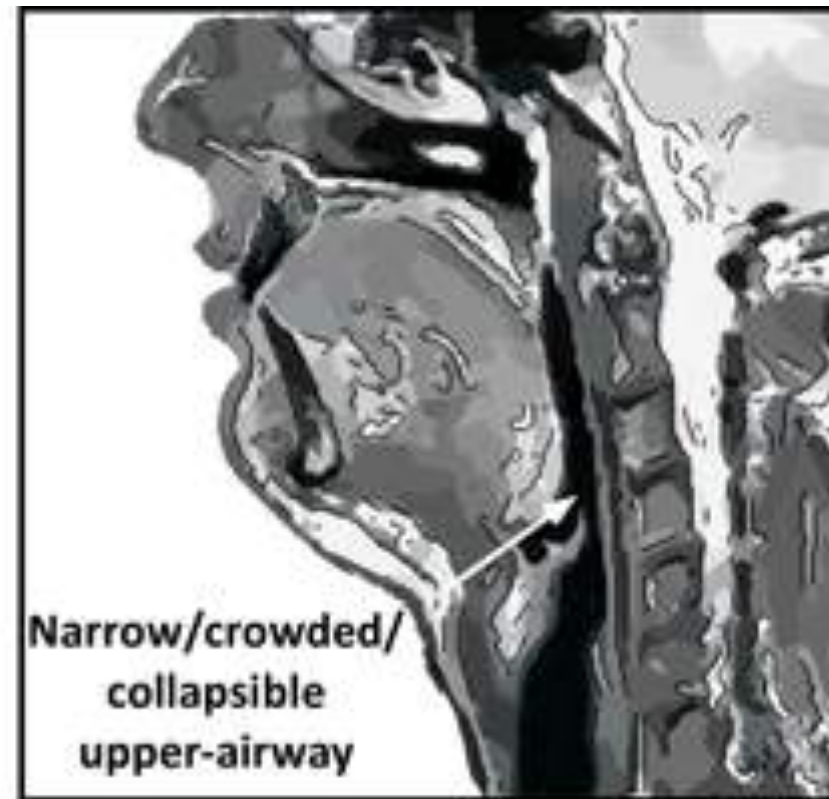
OSA

High Loop Gain

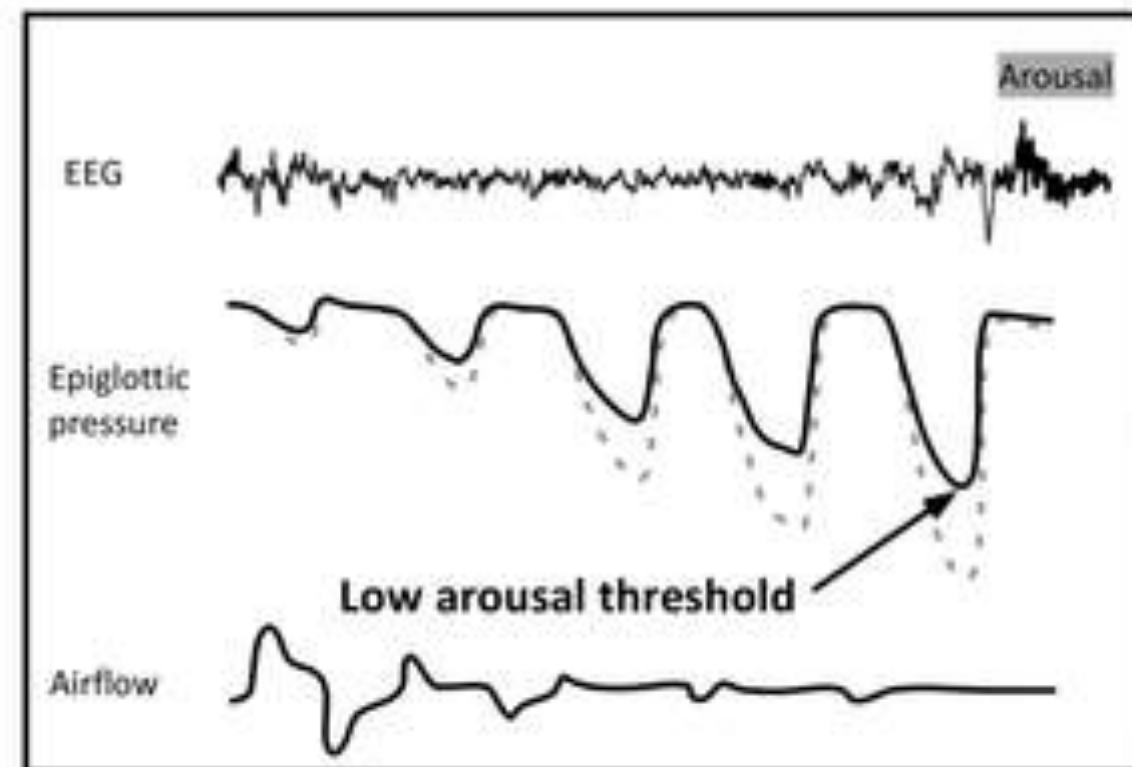


Obstructive Sleep Apnea: Phenotype

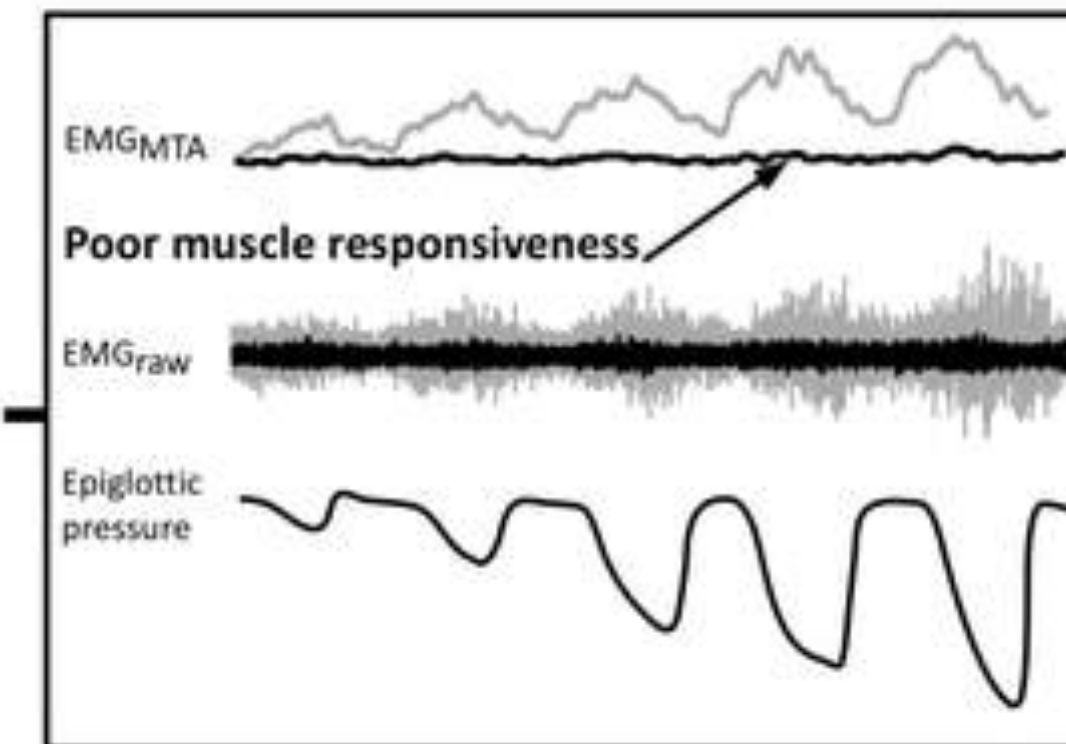
Anatomy/Structure



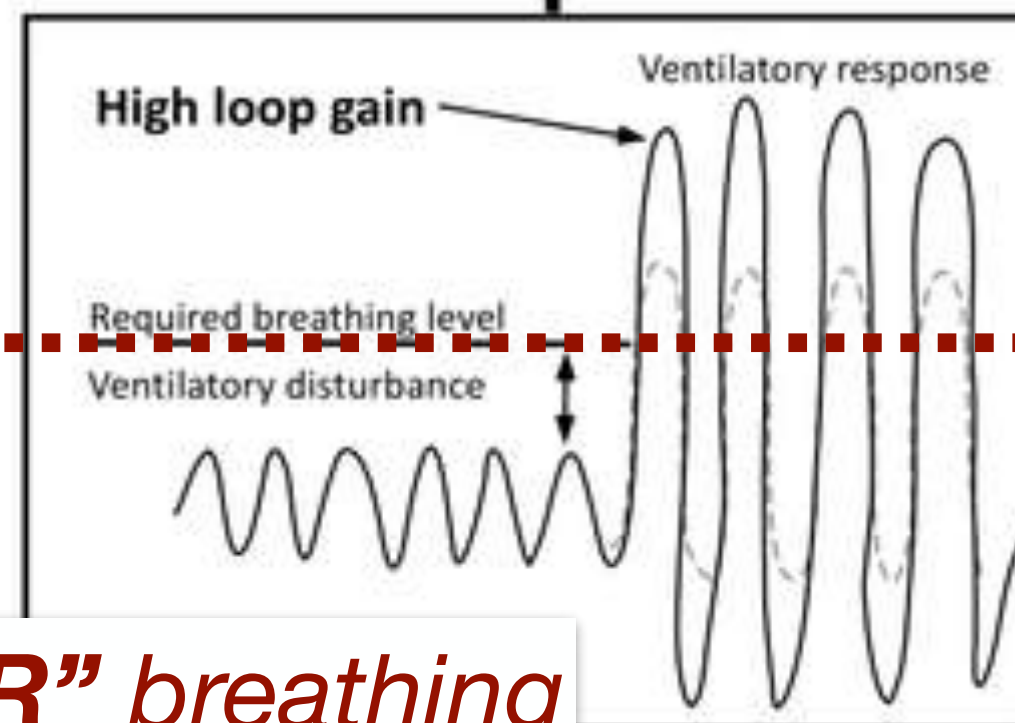
Arousal



Muscular



OSA



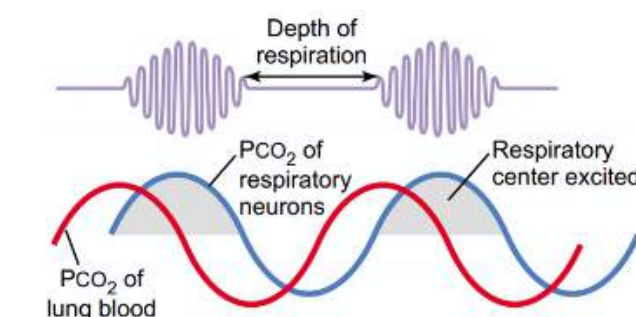
Over-Response

Under-Response

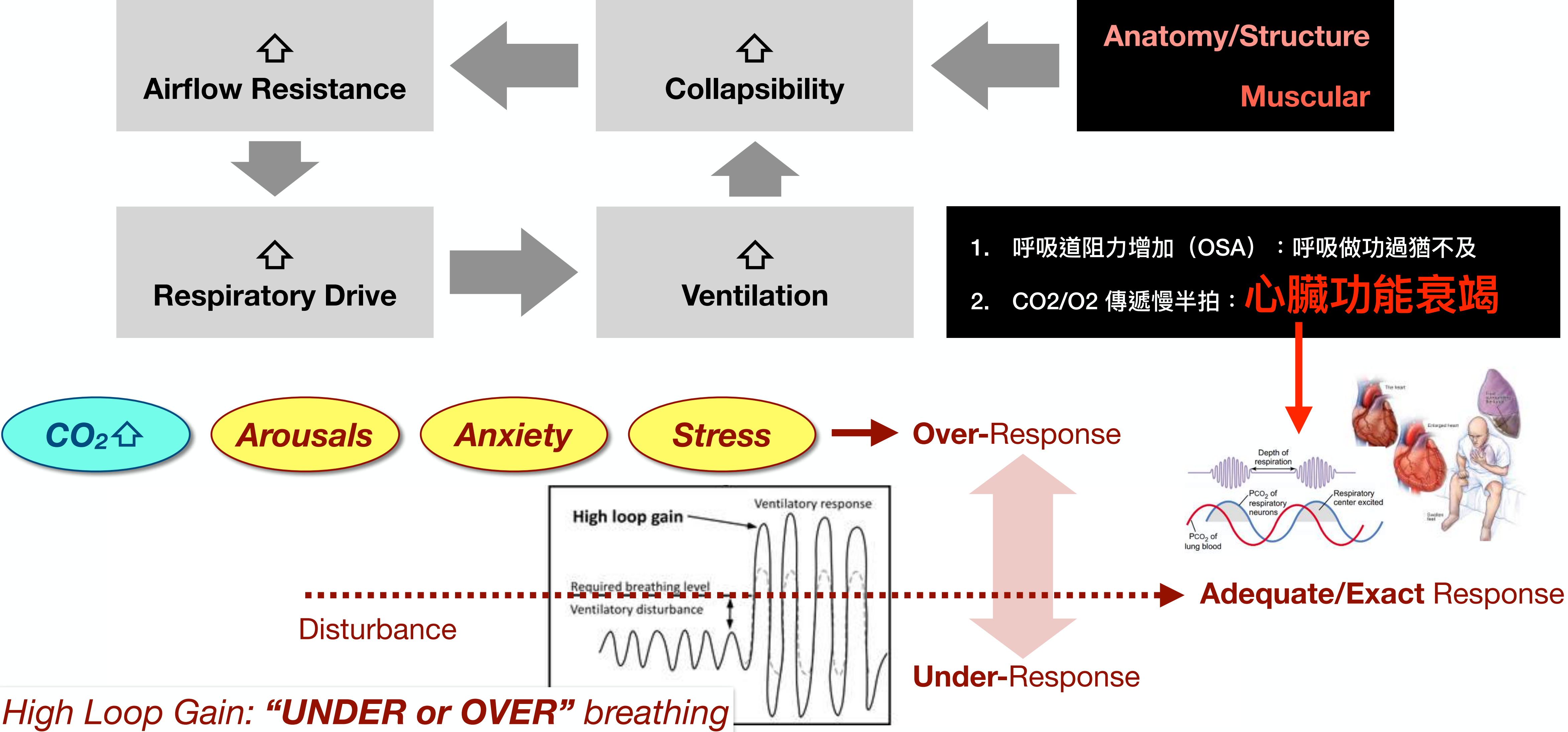
Adequate/Exact Response

Disturbance

High Loop Gain: **“UNDER or OVER”** breathing



Obstructive Sleep Apnea: Phenotype



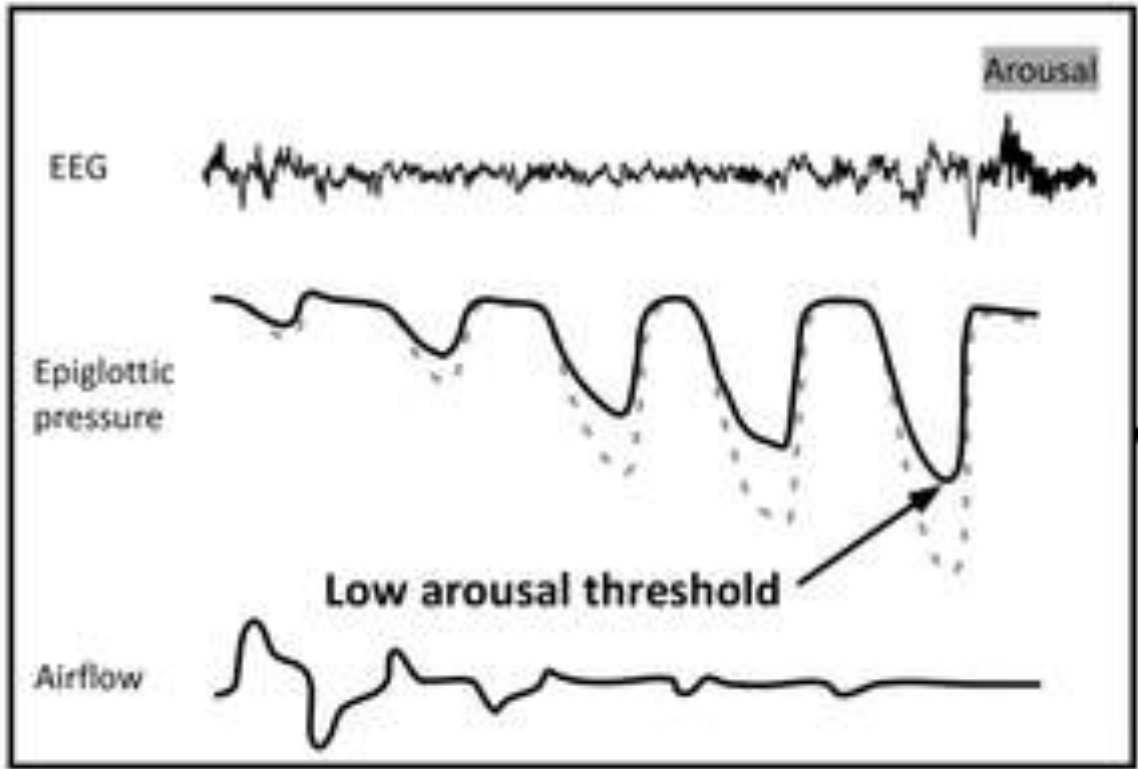
Obstructive Sleep Apnea: Phenotype

RERAs

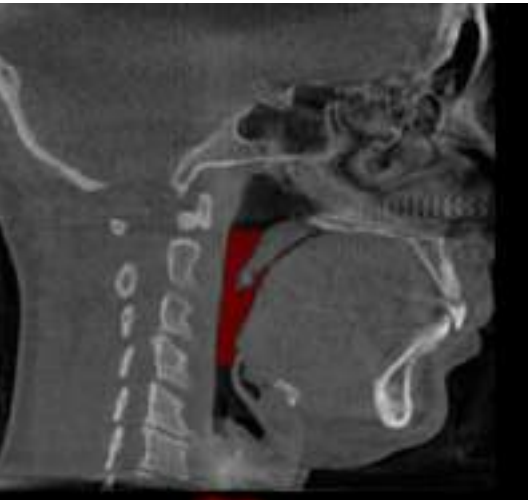
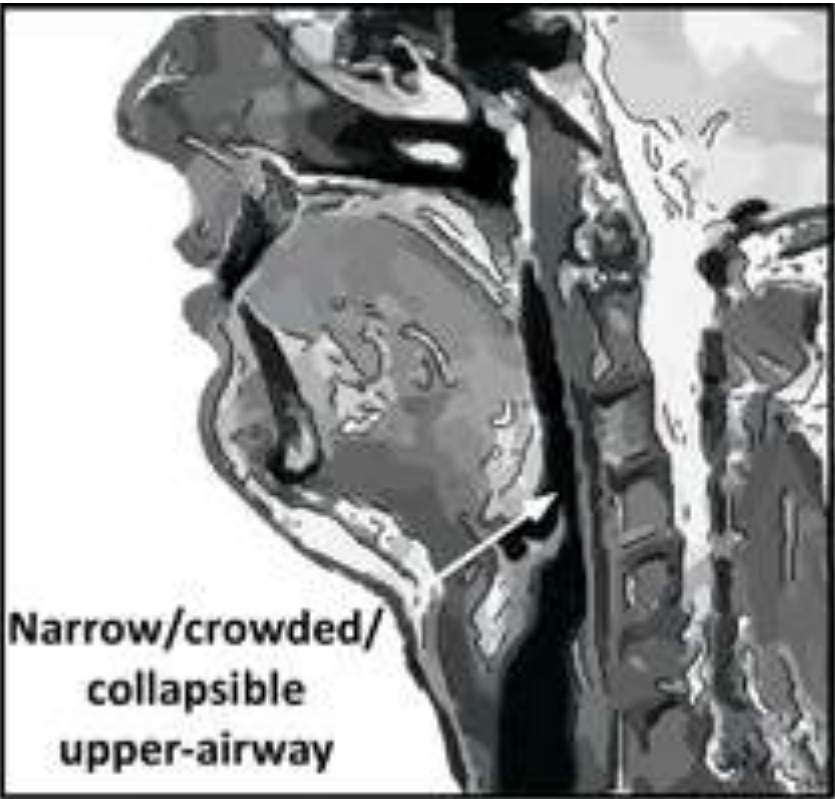
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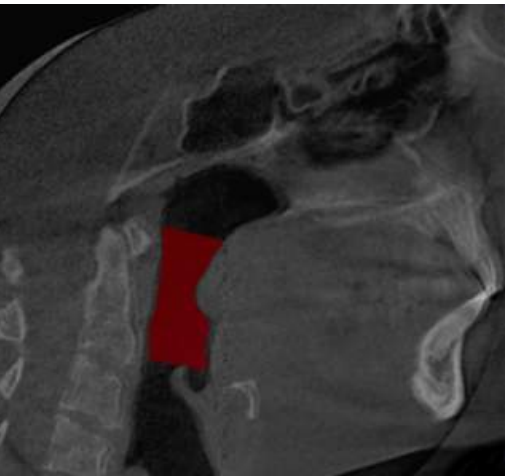
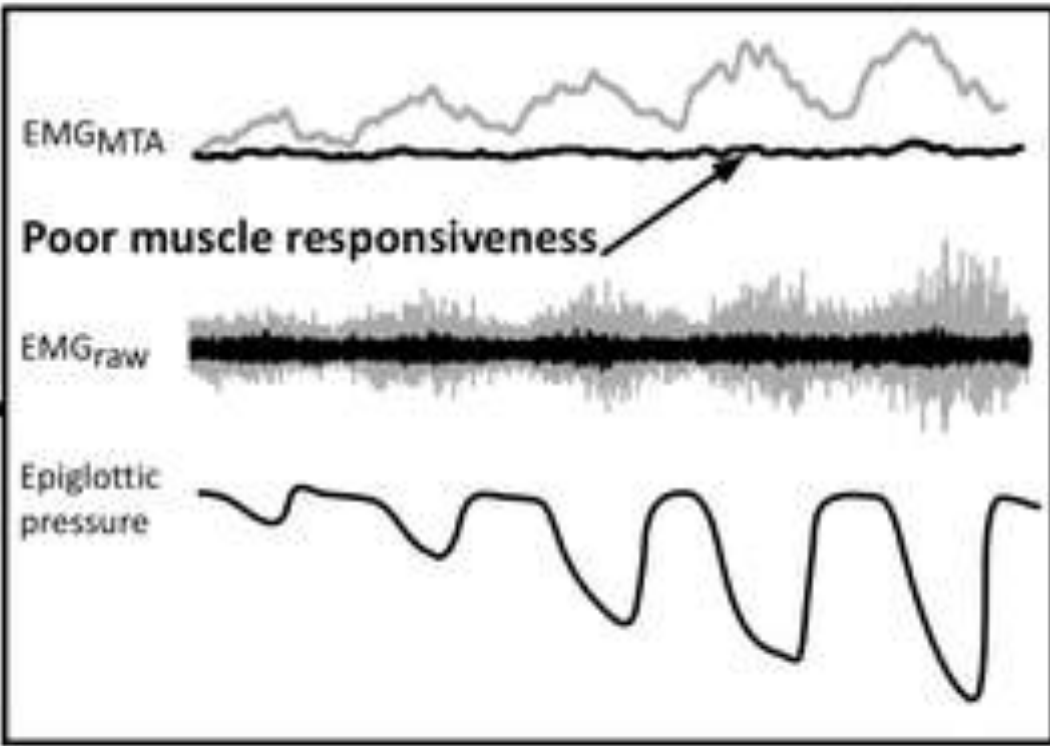
Arousal



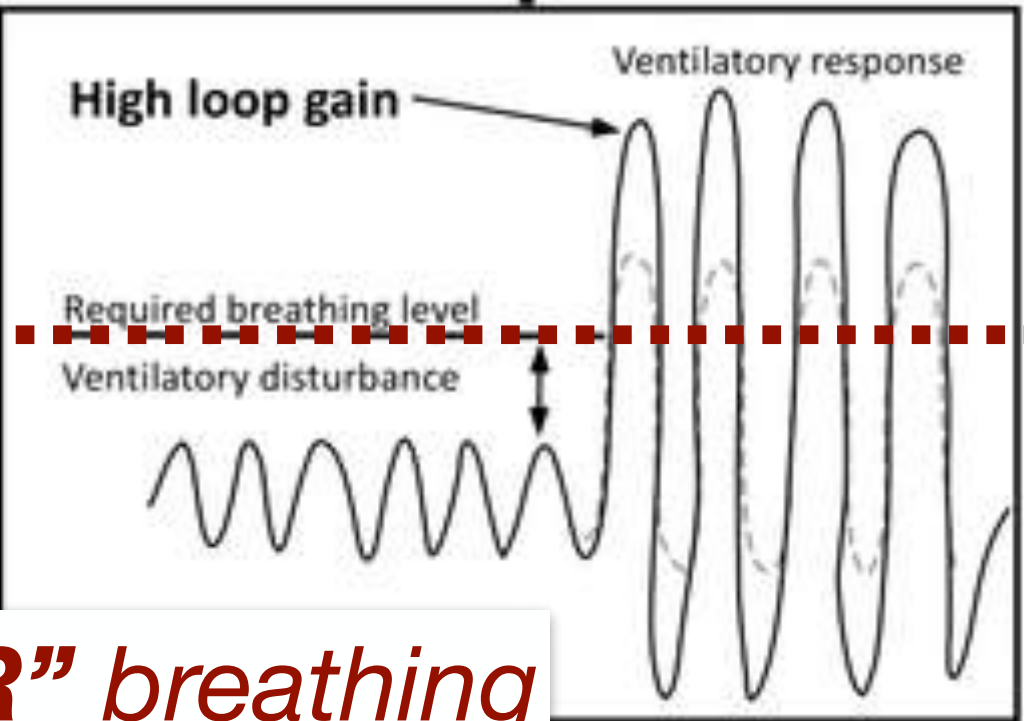
Anatomy/Structure



Muscular



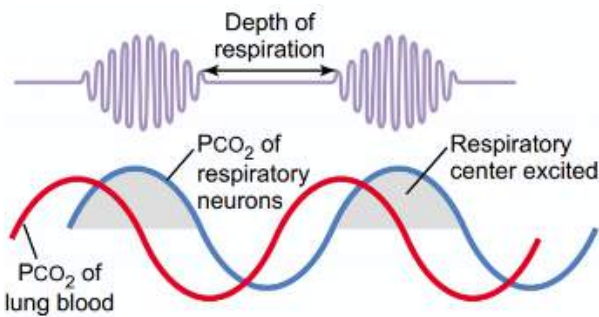
OSA



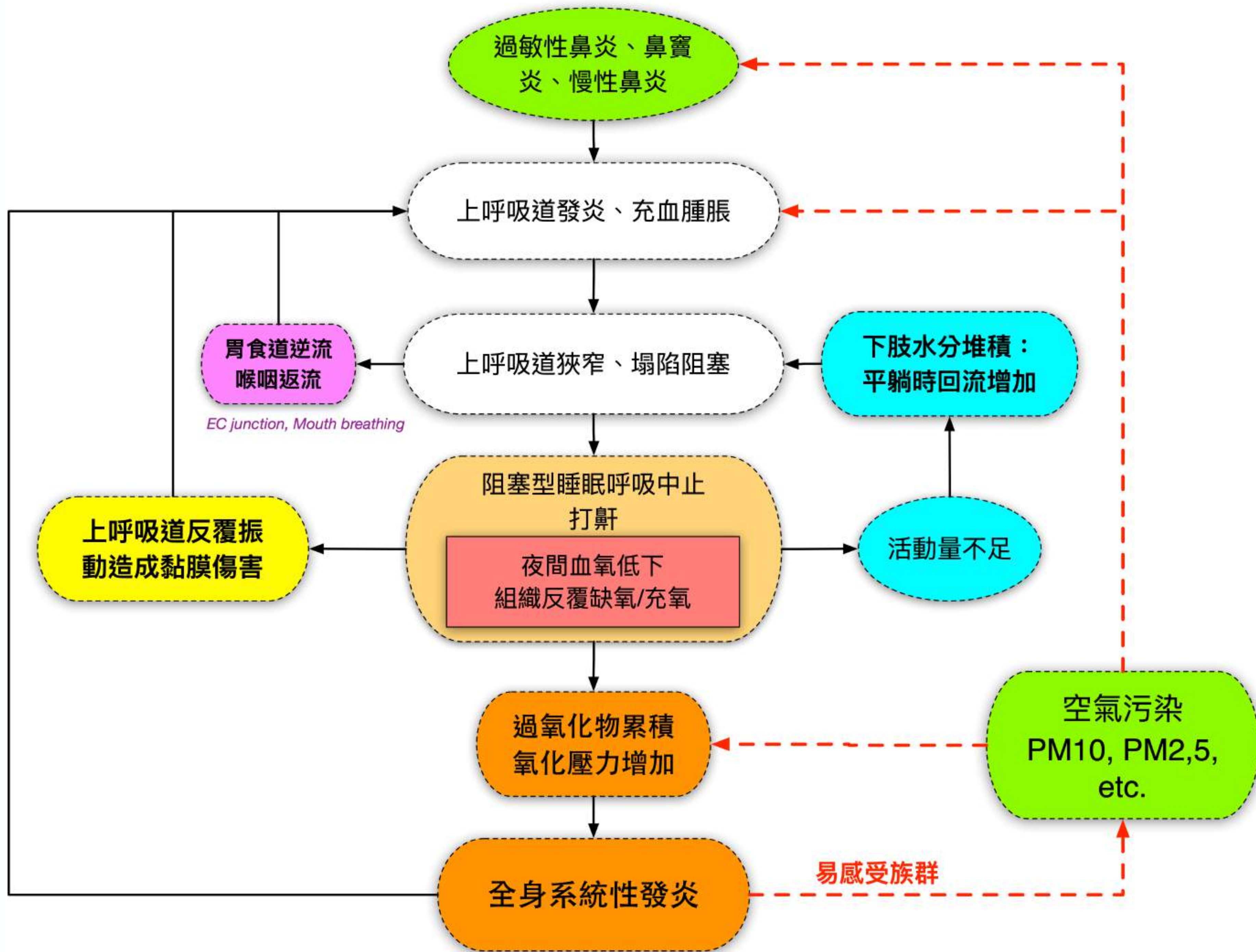
Over-Response

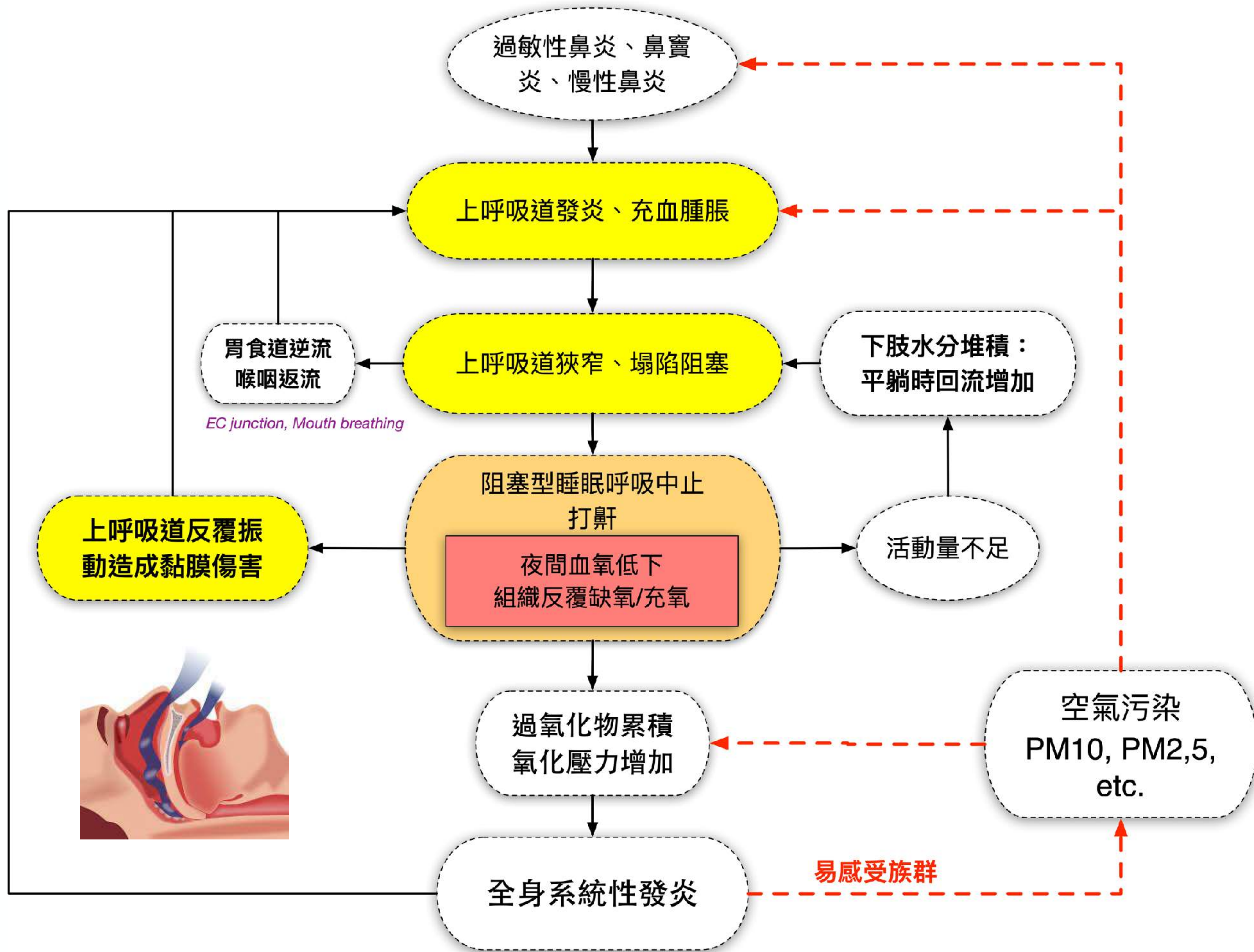
Under-Response

Adequate/Exact Response

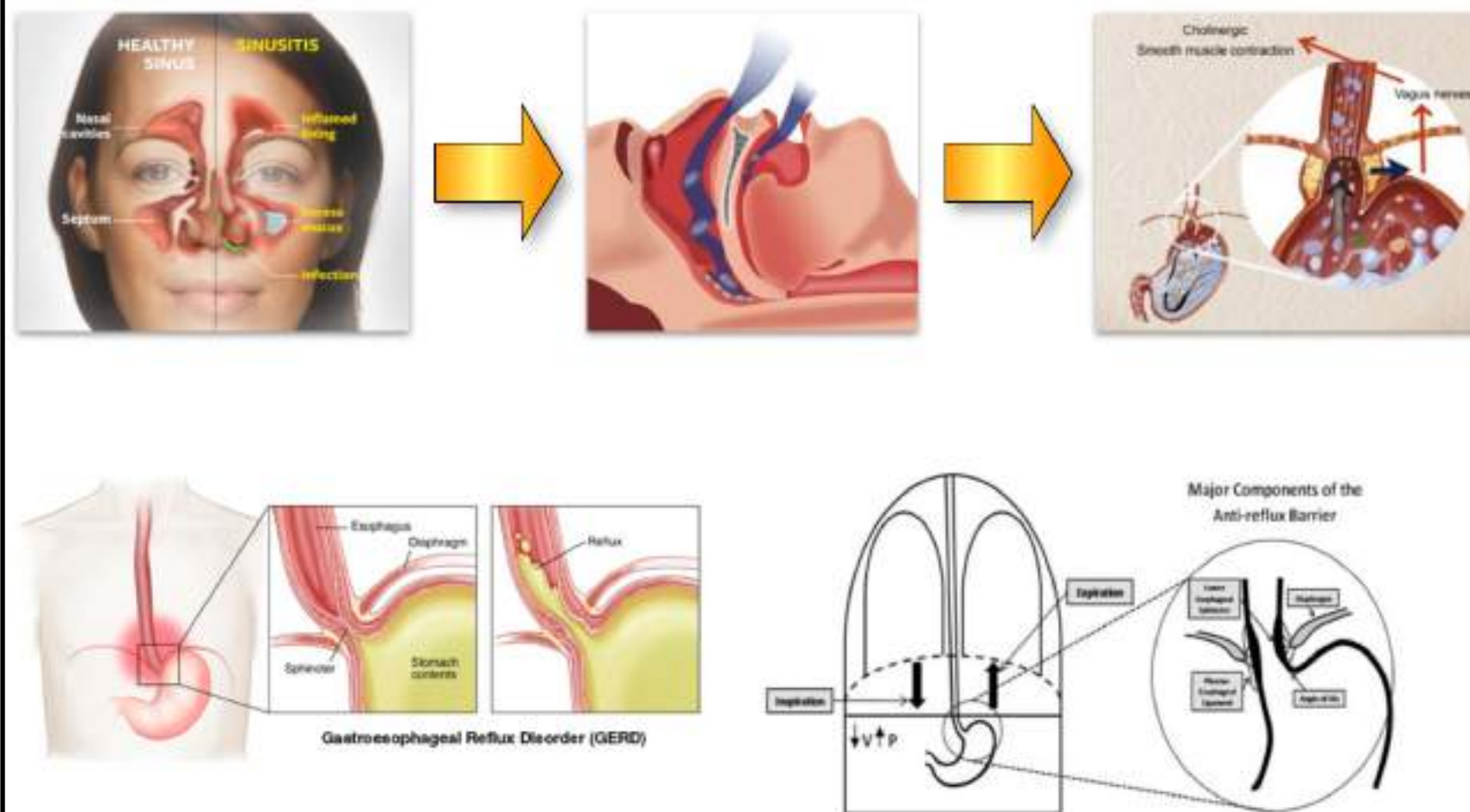


High Loop Gain: “**UNDER** or **OVER**” breathing





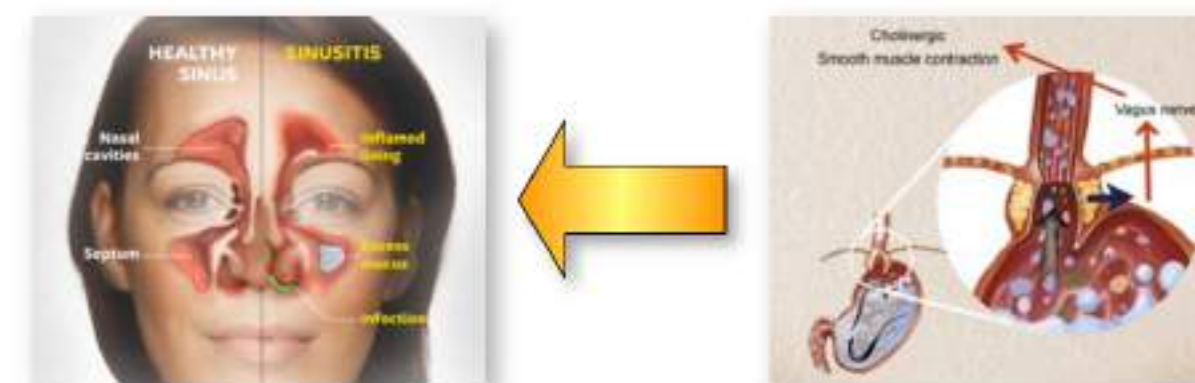
OSA and Associated Manifestations



GERD: Gastroesophageal reflux disease

Vibration Trauma

GERD vs Chronic Sinusitis

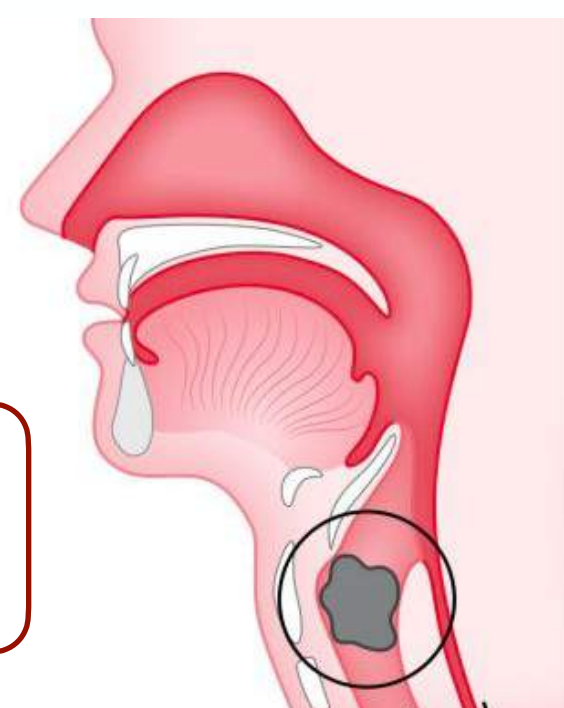


- Treatment of GERD could improve Chronic Rhinitis and Post Nasal Drips
- However, no reflux contents found in Nasal Cavity
- Gastroesophageal “**REFLEX**” (instead of REFLUX): nasal congestion, irritation and increased secretion



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

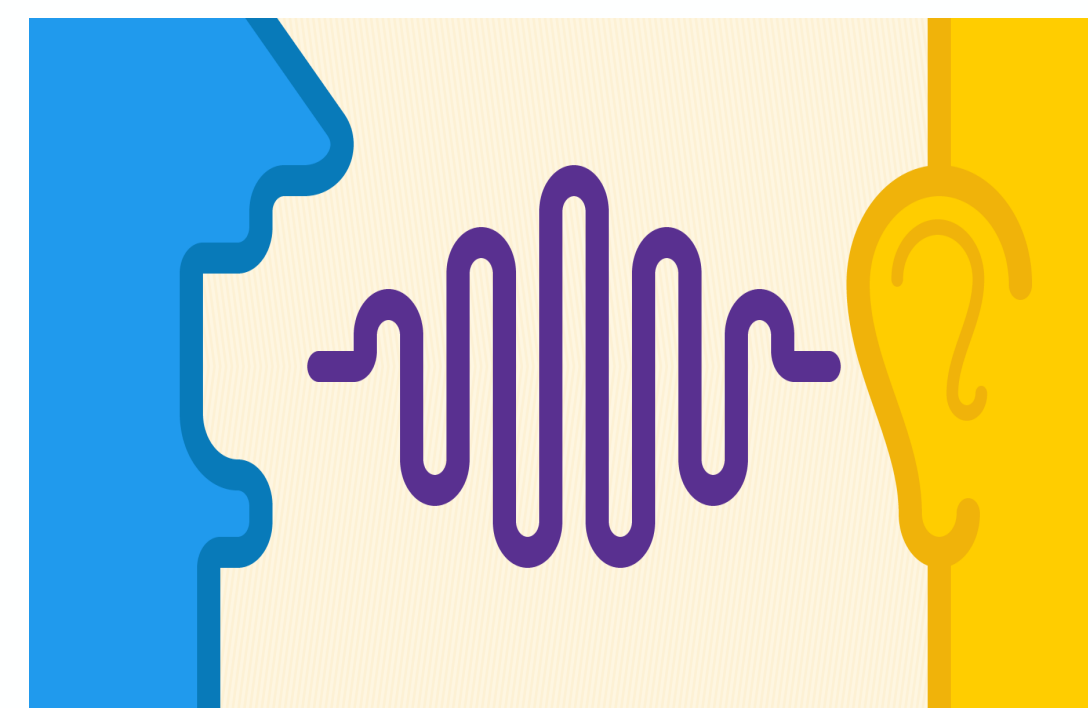
容易噎到



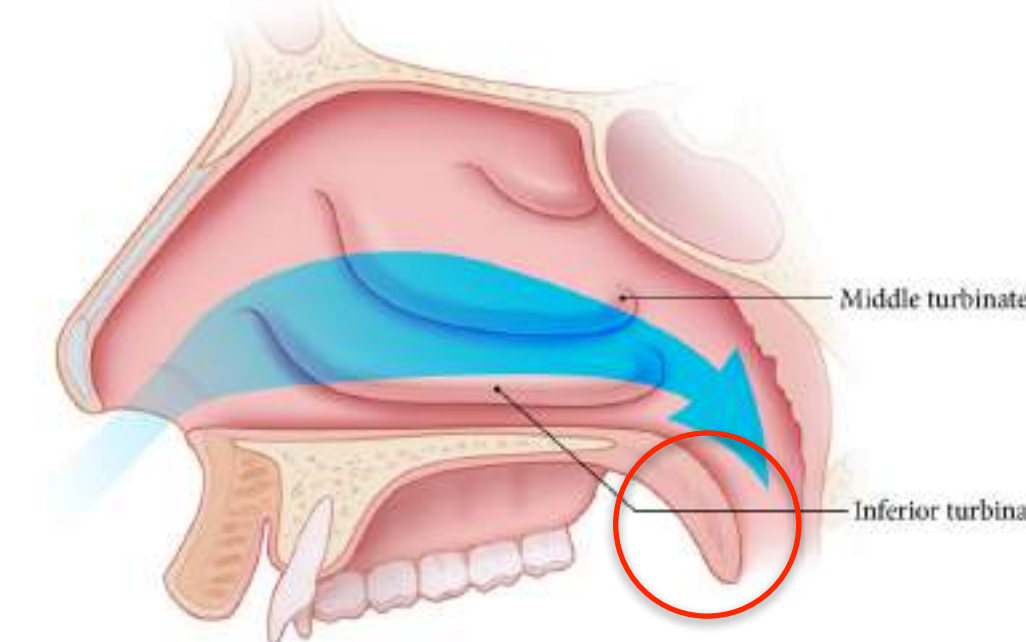
吞嚥反射受影響
吞嚥後吸氣延遲時間縮短



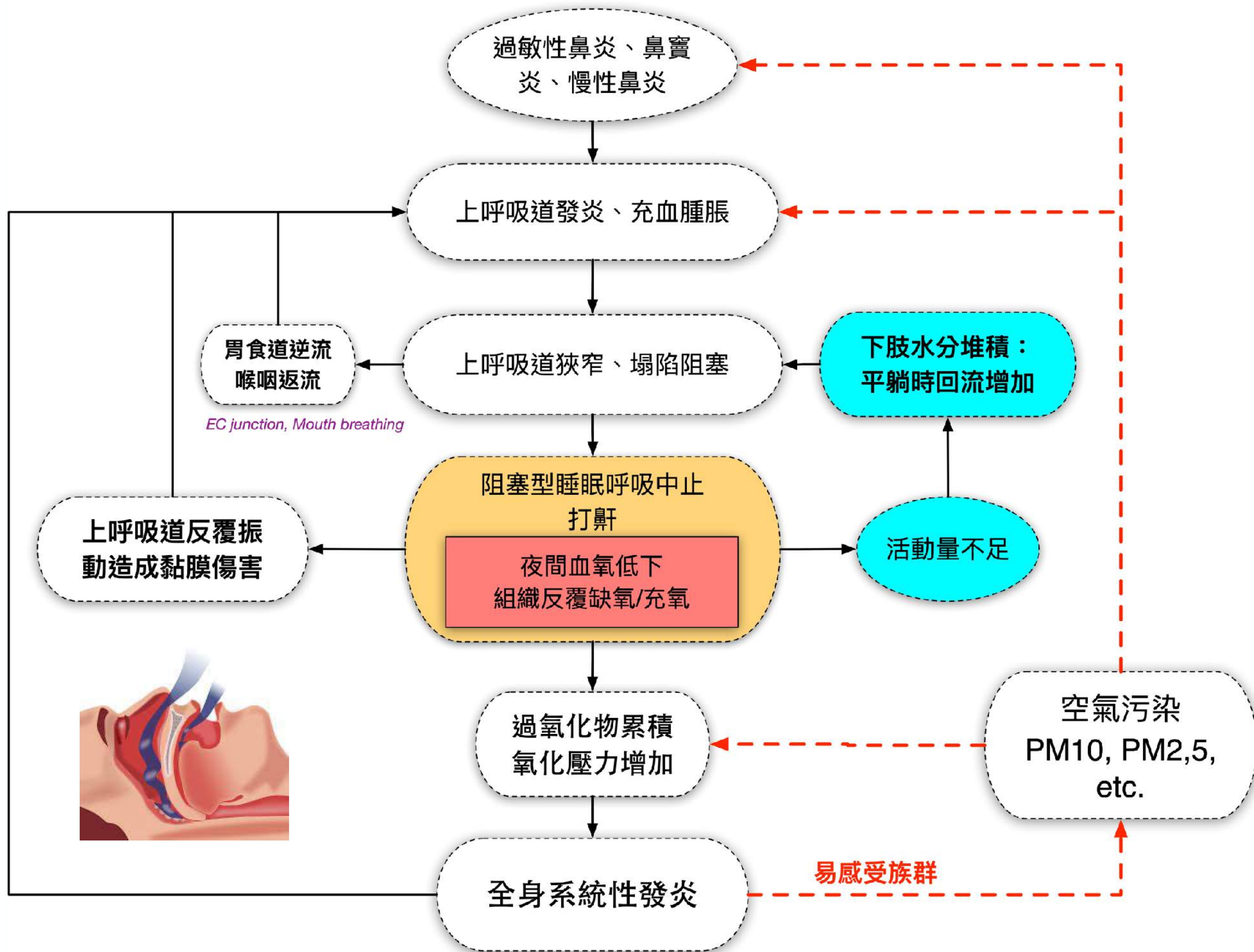
黏膜振動產生的
慢性咽喉炎

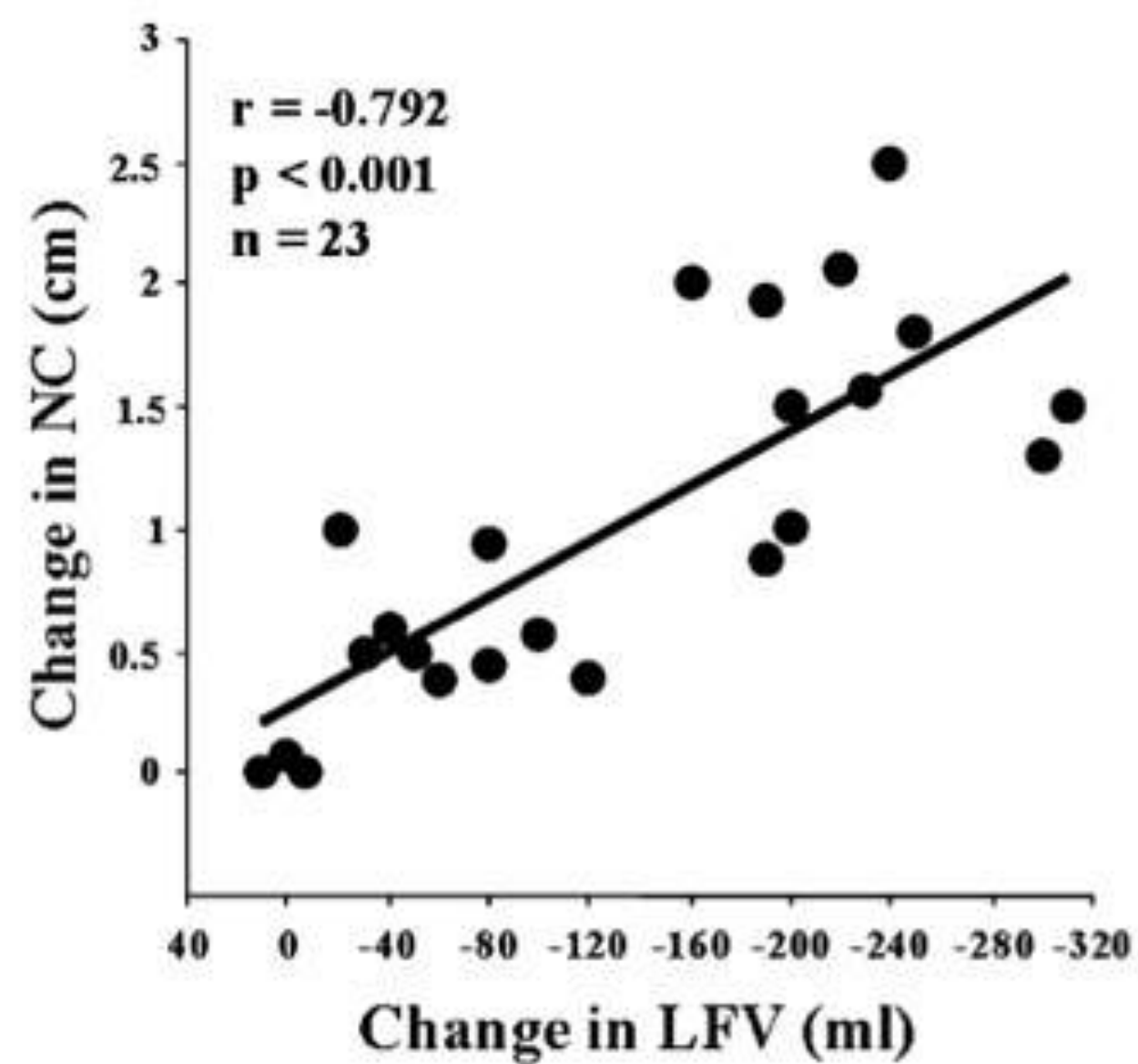
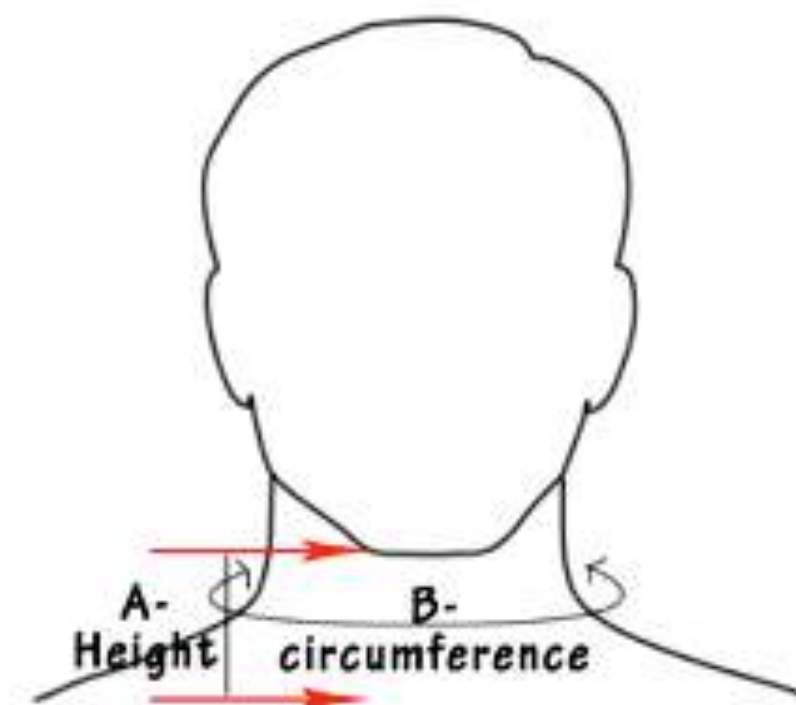
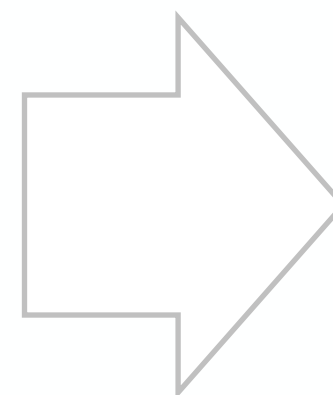


神經受損影響發聲
與說話的清晰度

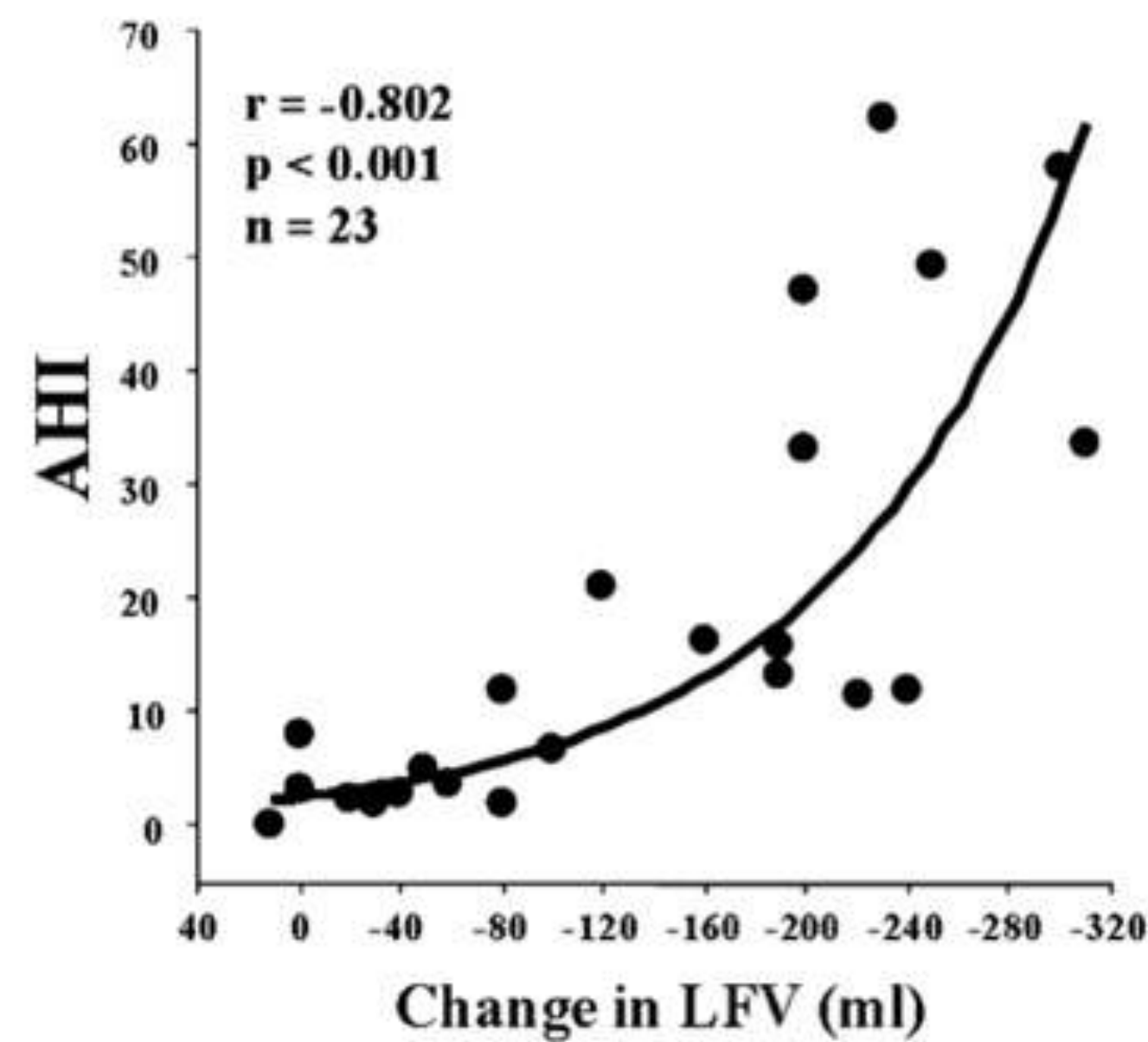


呼吸道氣流感受減弱，
感覺氣悶

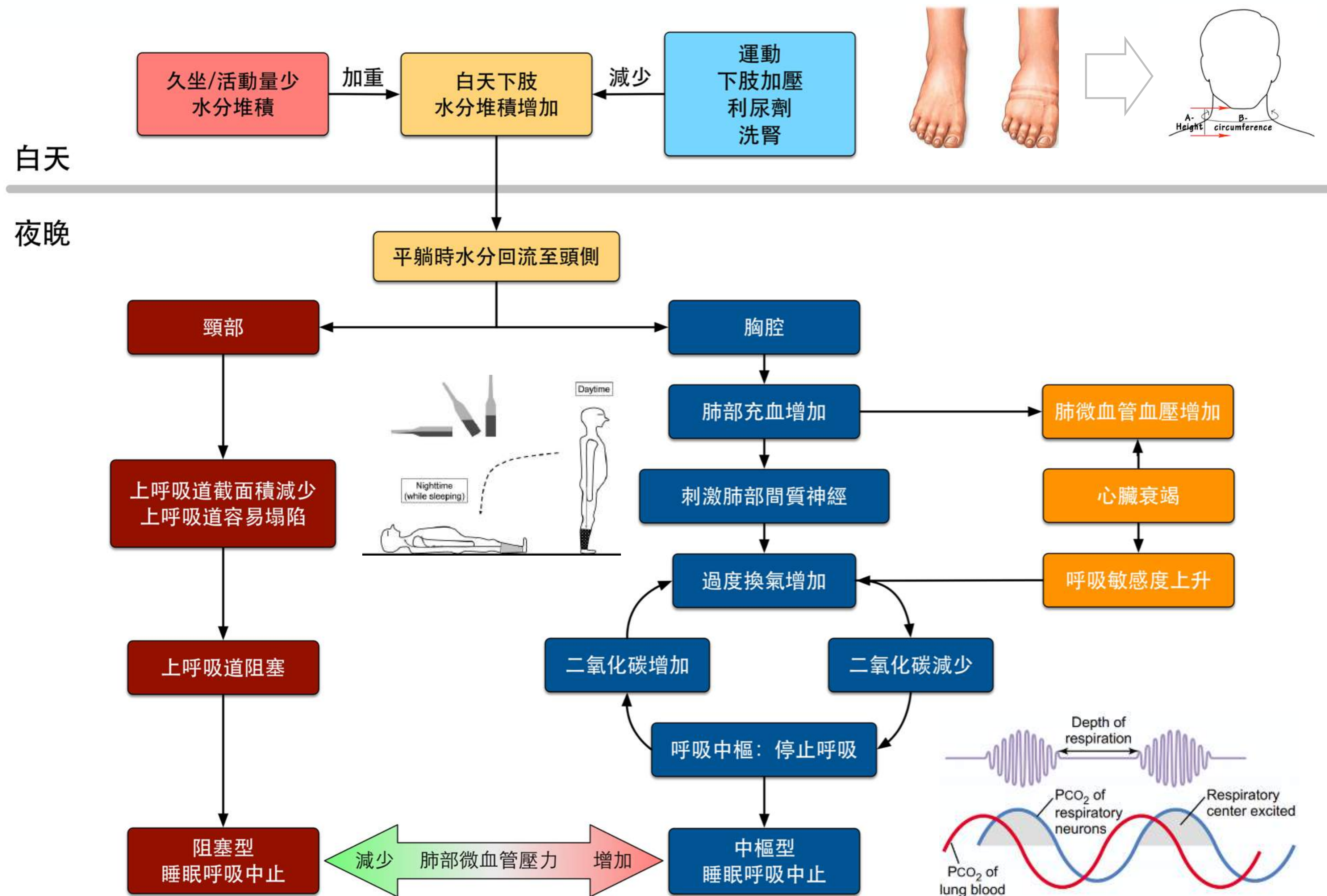




下肢水分回流至上半身
導致頸圍明顯增加



下肢水分回流至上半身
導致呼吸中止惡化



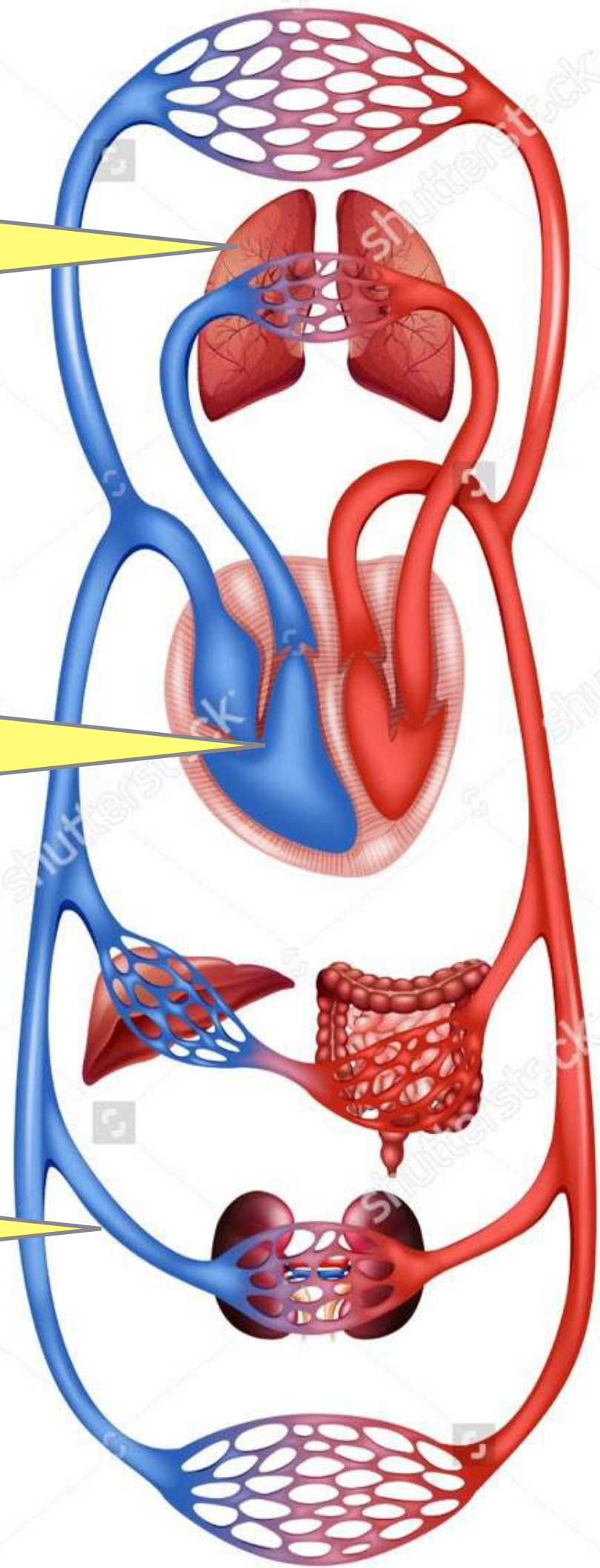
阻塞型睡眠呼吸中止症的合併症狀

呼吸暫停：

缺氧導致
肺臟血管收縮

**右心壓力
與體積增加：**
產生**心房利納素**

用力吸氣：
增加回流
心臟的血流量

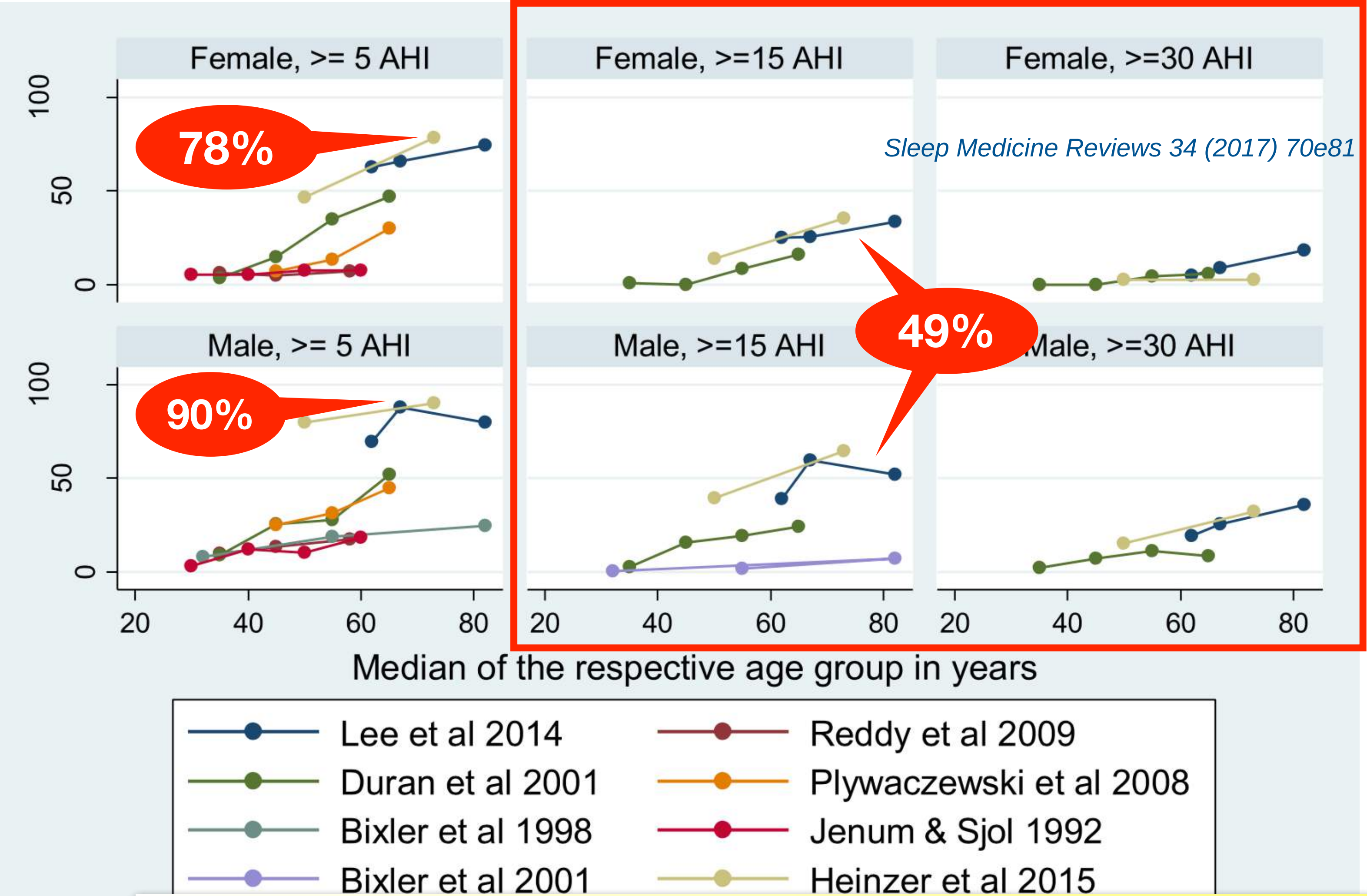


夜間多尿



- 喝太多水？
- 膀胱功能異常？
- 腎功能不好？
- 攝護腺肥大？

睡眠呼吸中止症的盛行率是多少呢？超乎我們想像！

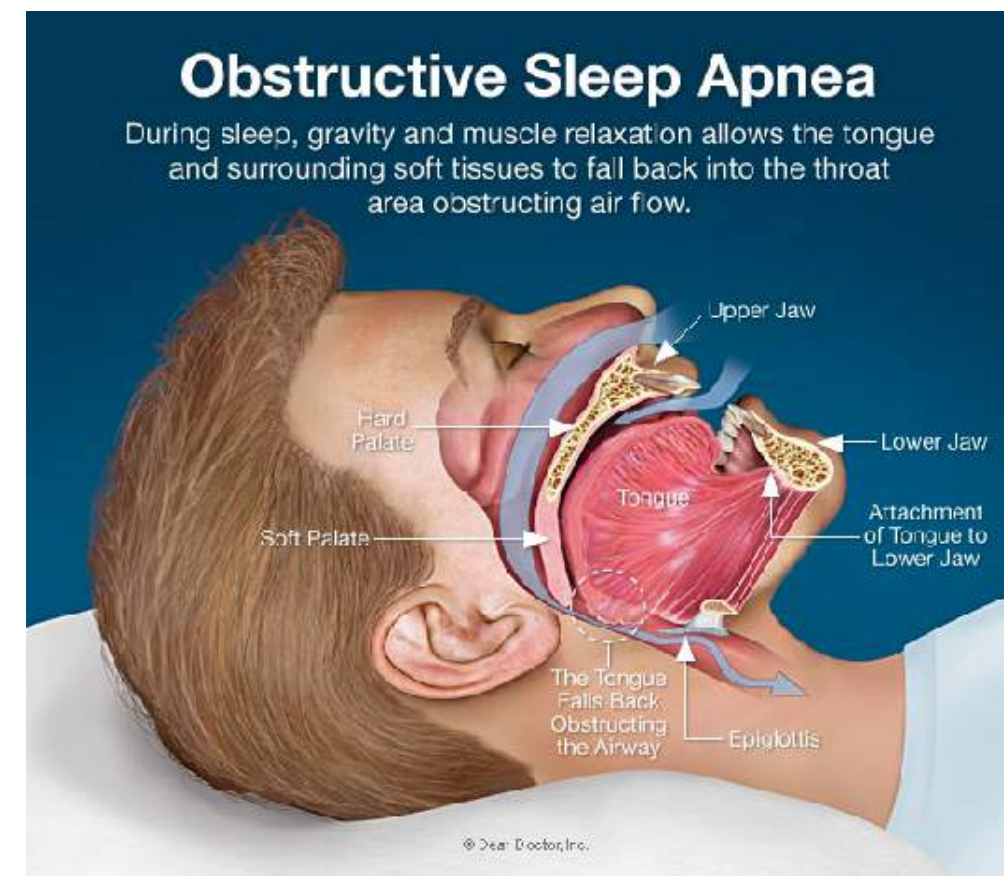
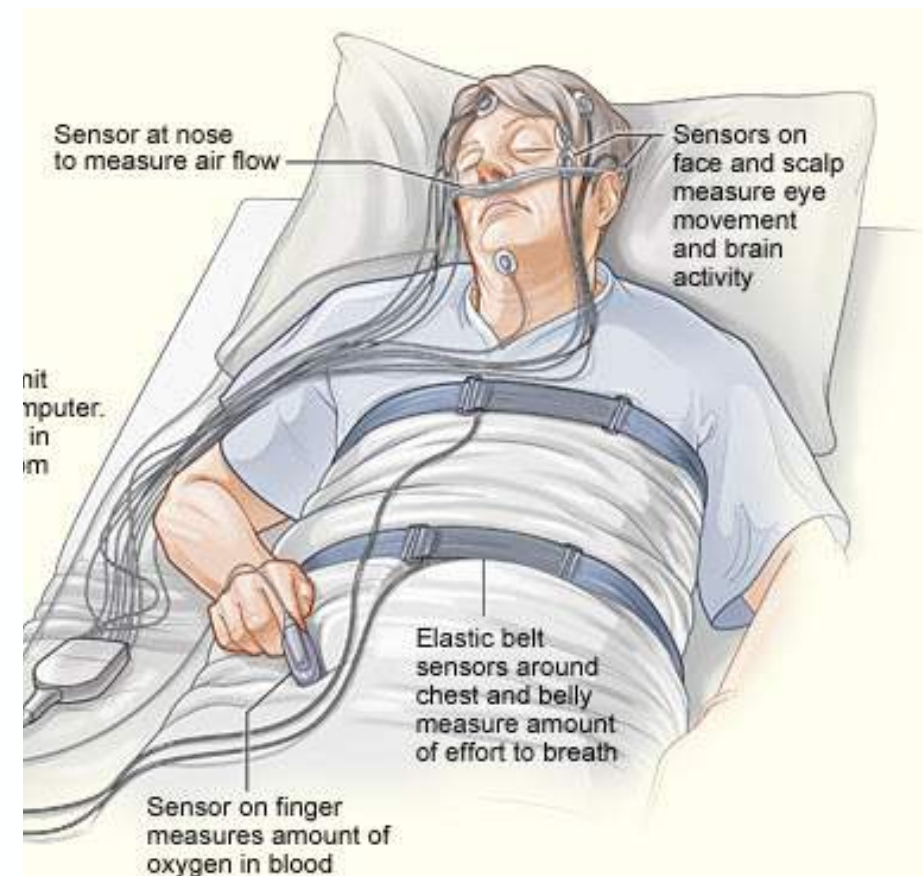


藥物治療不佳的高血壓	80%
心臟衰竭	50-80%
心房顫動	50-70%
冠狀動脈心臟病	30-40%
中風	30-80%
慢性腎病	50%
夜尿	50%
糖尿病（第二型）	35%
病態性肥胖	50-90%
代謝症候群	50%
失眠	30-70%
長期使用安眠藥患者	50%
減肥手術	70-80%

60歲以上：男性超過一半，女性超過1/3 為中度以上

大多數慢性疾病

阻塞型睡眠呼吸中止症：評估與治療模式 現狀



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？

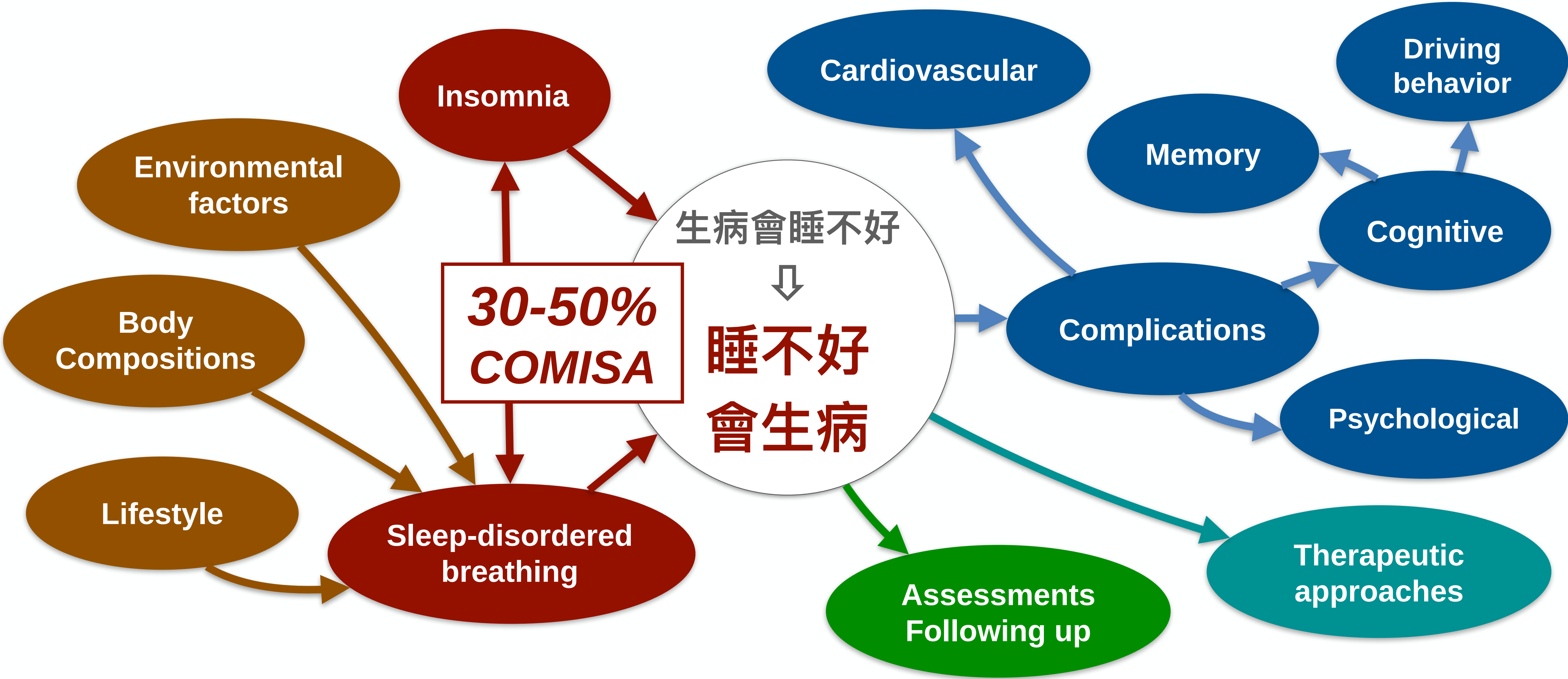
Unmet Needs:

表型分類

睡眠呼吸照護平台

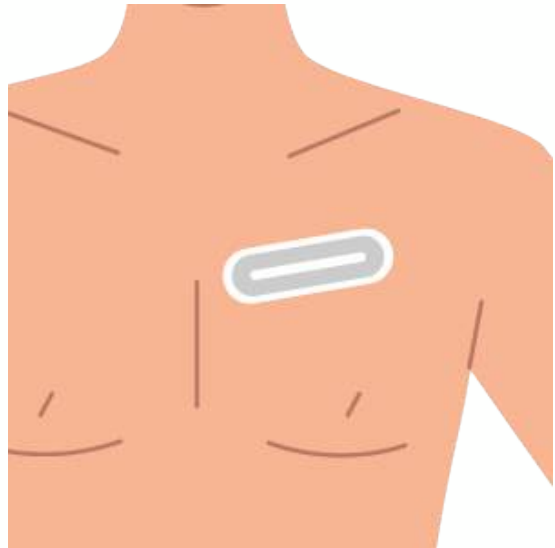
大規模篩檢

個人居家長期追蹤



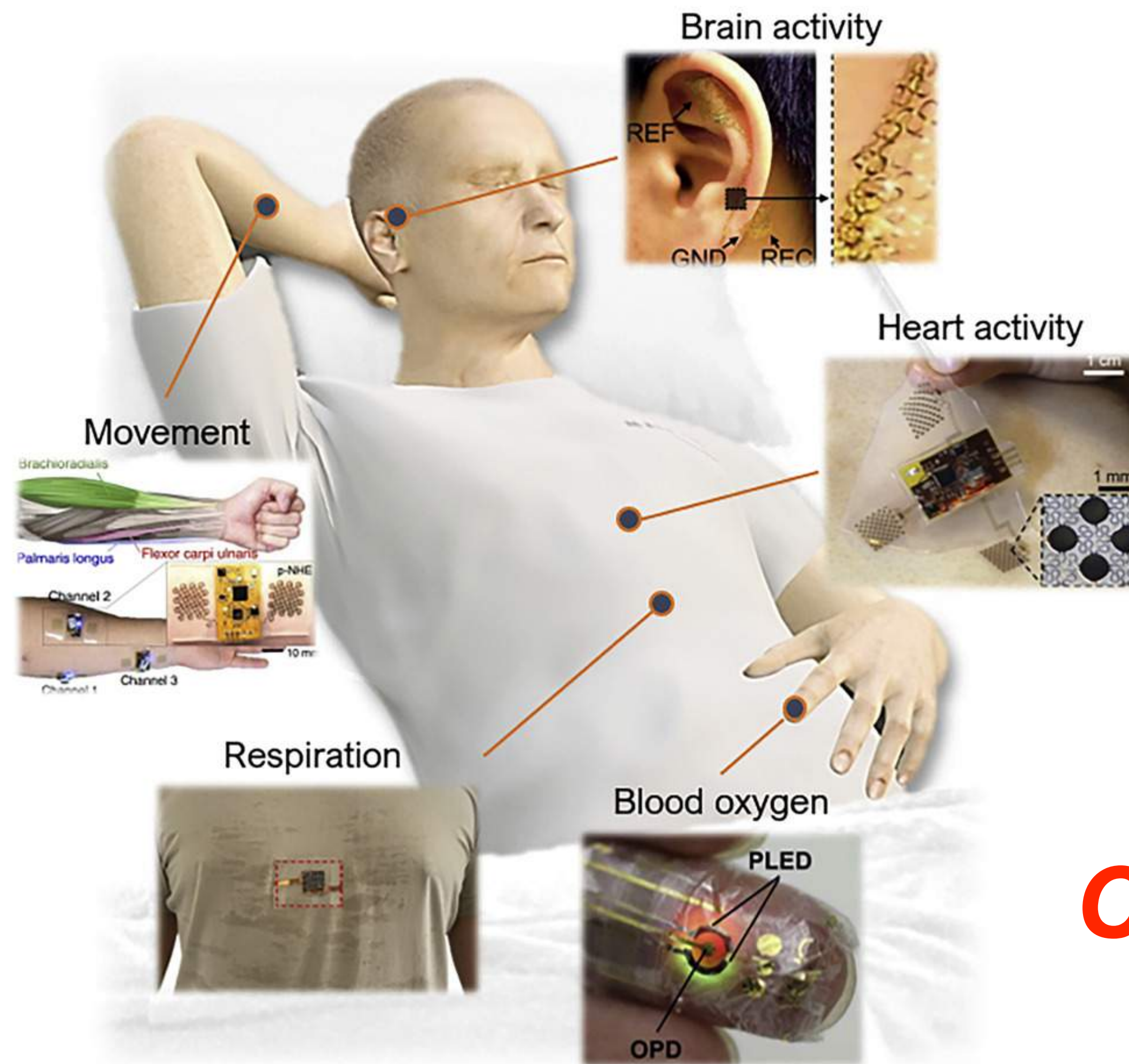
COMISA: CO-Morbid Insomnia and Sleep Apnea

現有睡眠呼吸中止症檢測方式比較

	睡眠多項檢查(PSG)	居家睡眠檢測(HST)	指尖式血氧儀	ECG貼片
				
檢測項目	所有睡眠疾病	針對睡眠呼吸中止症	針對睡眠呼吸中止症	針對睡眠呼吸中止症
檢測點數	20條檢測線或以上	3條檢測線	1個，配戴於手指	1個，黏貼於胸口
測試地點	醫院之睡眠中心	居家檢測	居家檢測	居家檢測
等待檢查時間	長，約1~2個月	短，約1週	短，立即檢測	短，立即檢測
多日偵測	X	X	7~14天	7~14天
舒適度	★☆☆☆☆ 配戴不適	★☆☆☆☆ 配戴不適	★★☆☆☆ 配戴不適	★★★☆☆ 易過敏

Type I: Attended, Type II: Unattended

Wearable sensors for sleep monitoring



Could Non-wearable possible?

iScience. 2021 Apr 21;24(5):102461.

Non-Wearable sensors for sleep, respiration and others



1. **Sleep-related breathing** disorders



2. Prediction of Upcoming **Heart Failure**



3. Detection of **Preceding** Sleep Apnea



4. Respiratory Sinus Arrhythmia: **Coupling**

Non-Wearable sensors for sleep, respiration and others



1. **Sleep-related breathing** disorders



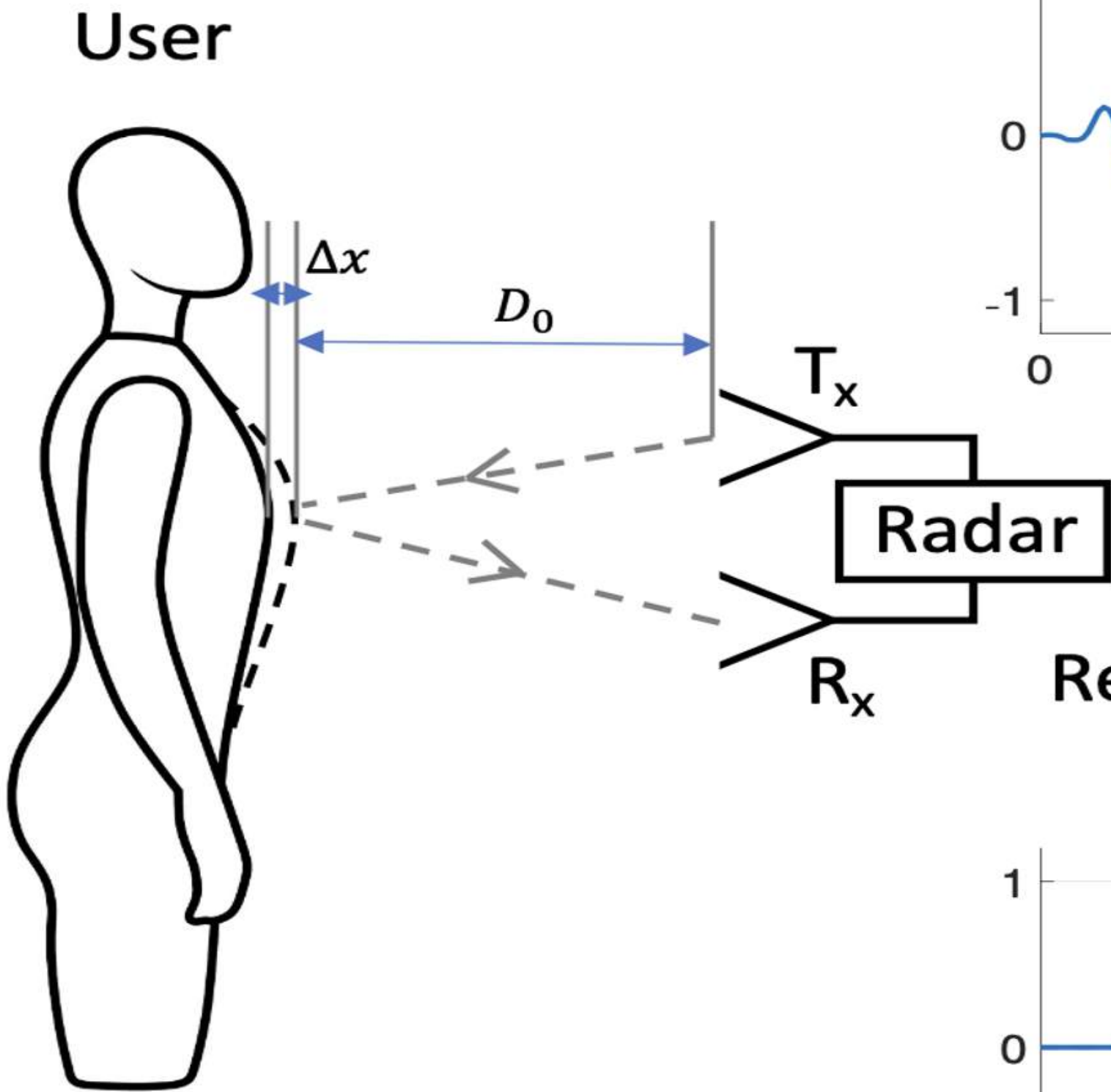
2. Prediction of Upcoming **Heart Failure**



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4. Respiratory Sinus Arrhythmia: **Coupling**

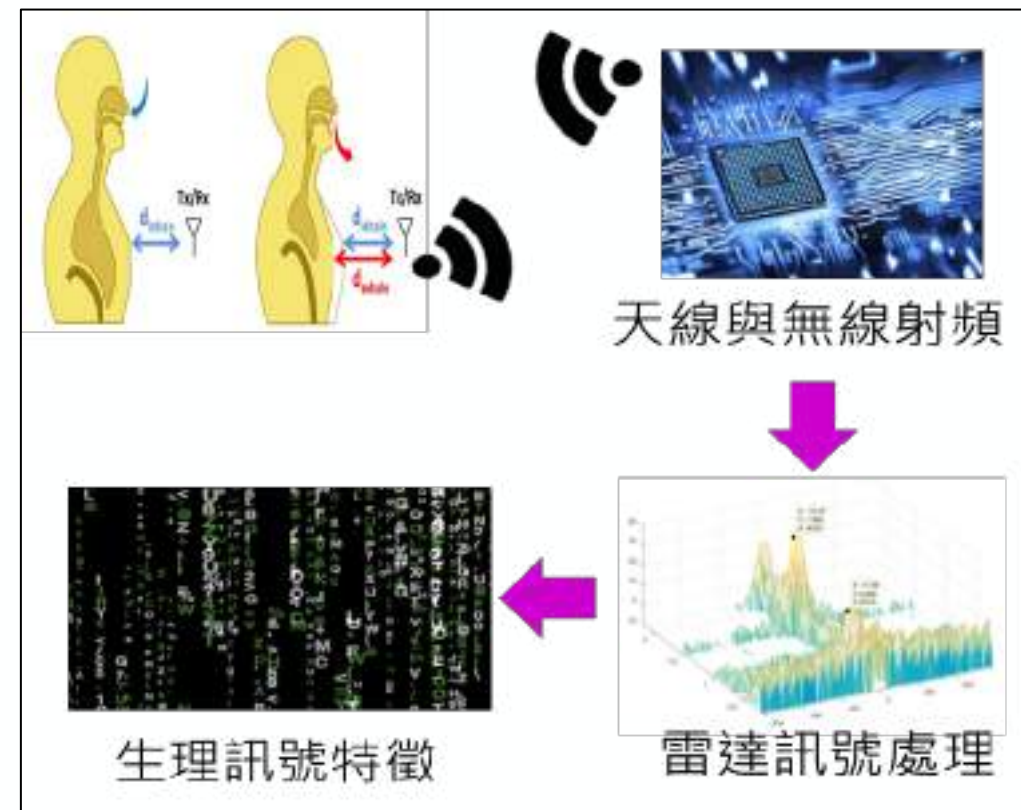




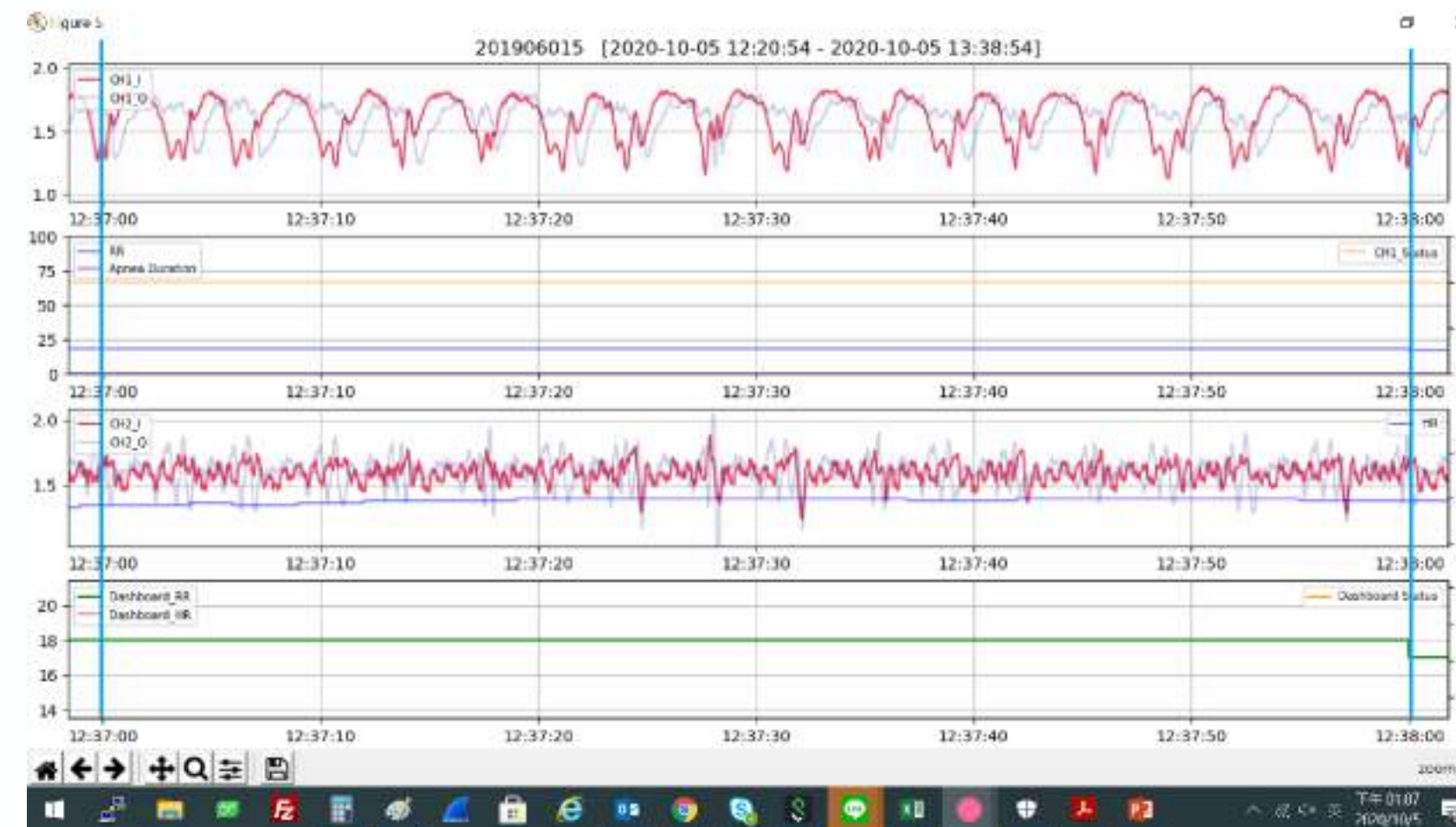
以毫米波雷達分析睡眠期間呼吸模式及心率之變化

擴大篩檢
潛在族群

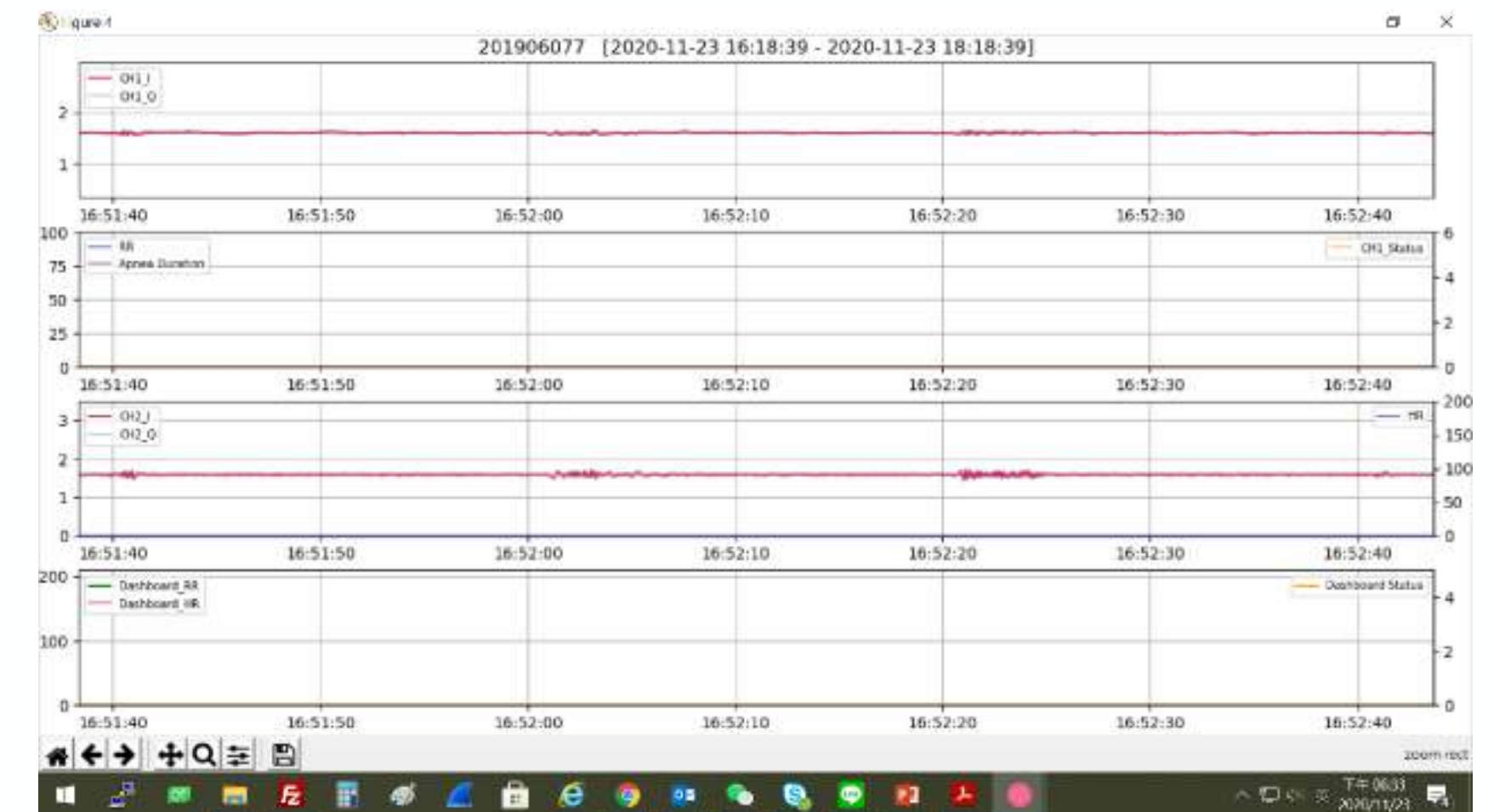
24GHz 毫米波
零接觸



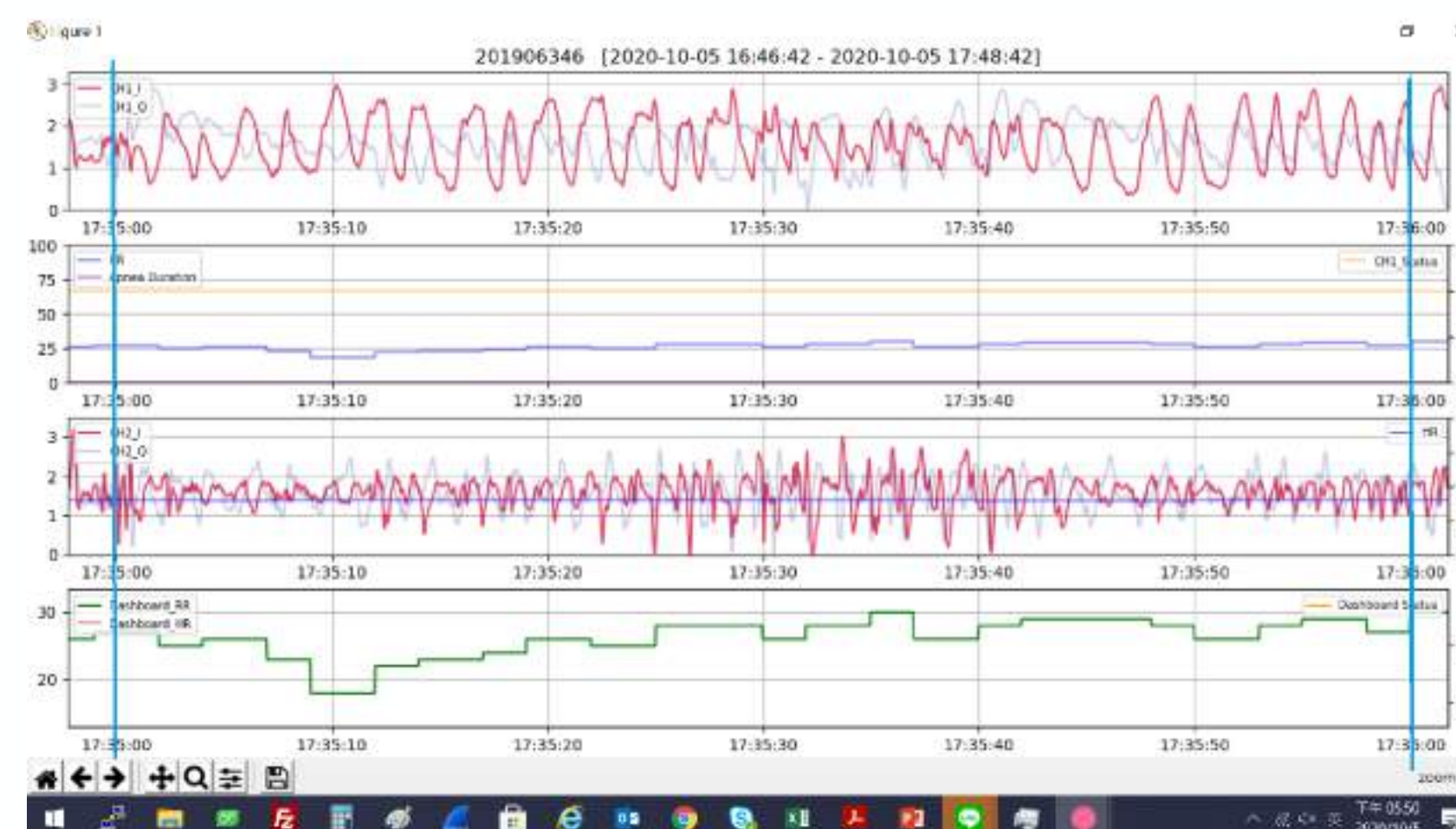
正常呼吸 每分鐘17下



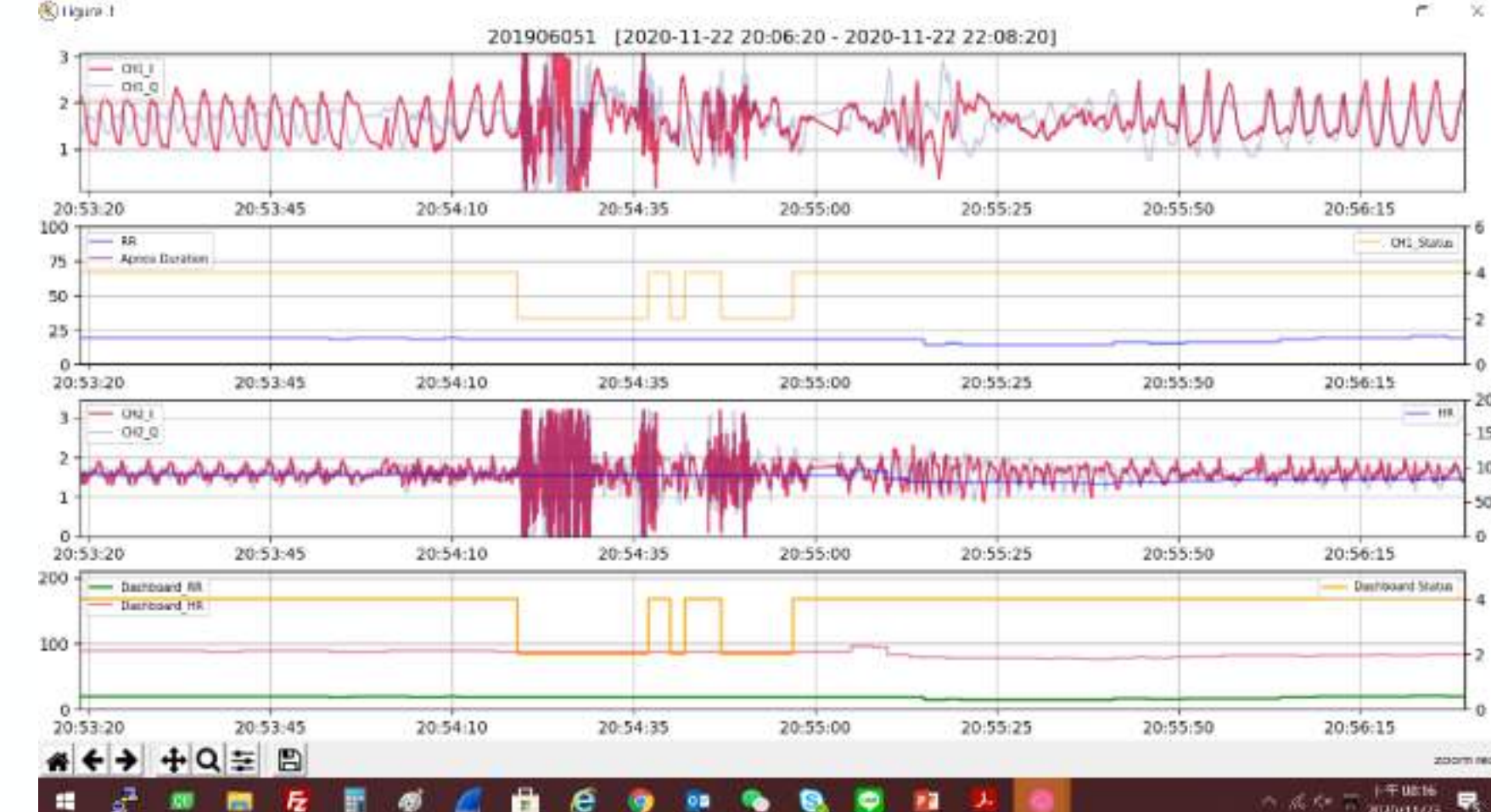
離床 無訊號



呼吸急促 每分鐘30下



非睡眠狀態 活動中



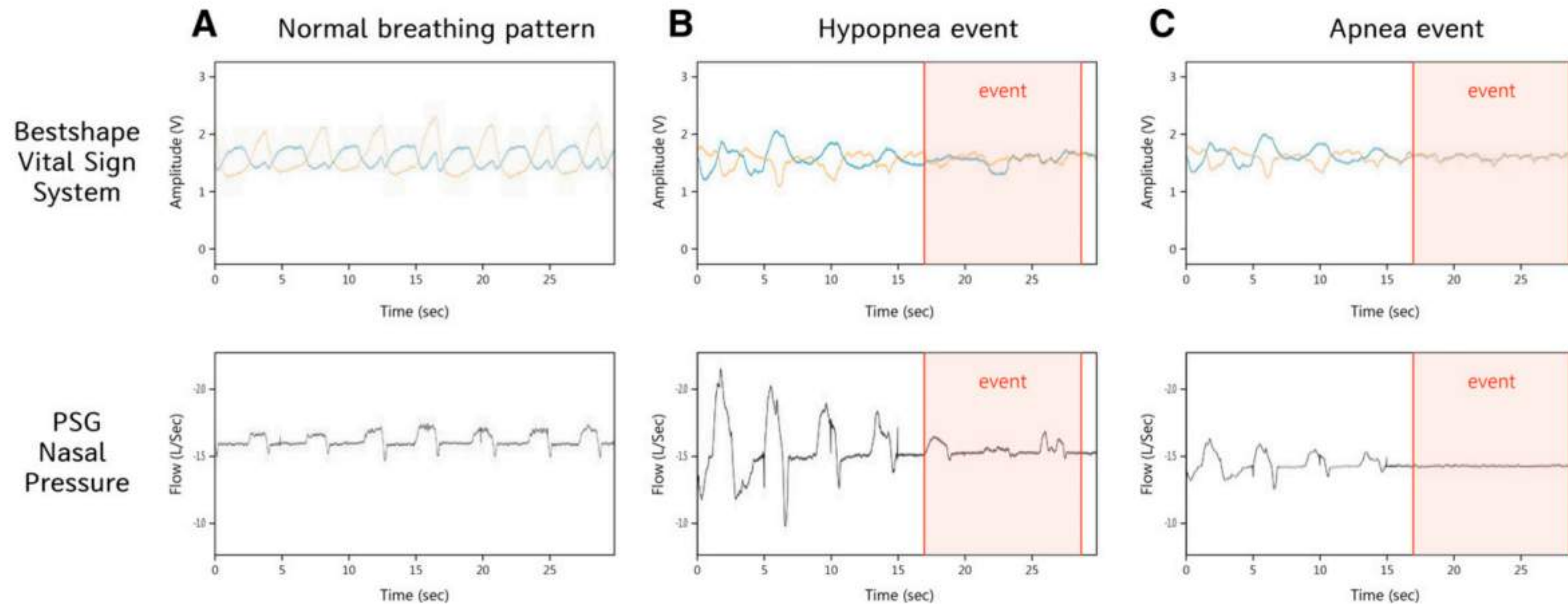


毫米波雷達偵測生理訊號
實際使用實景

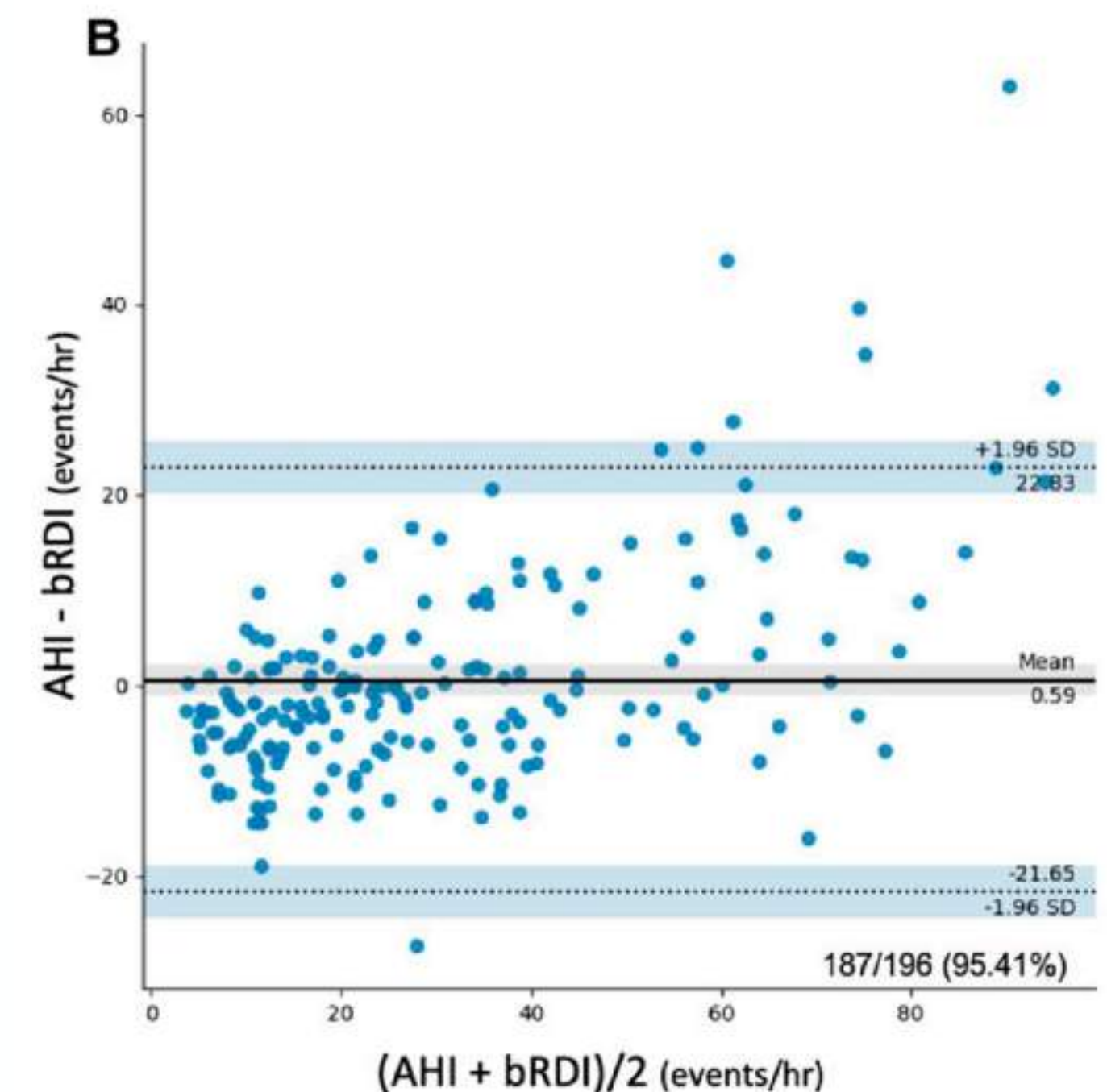
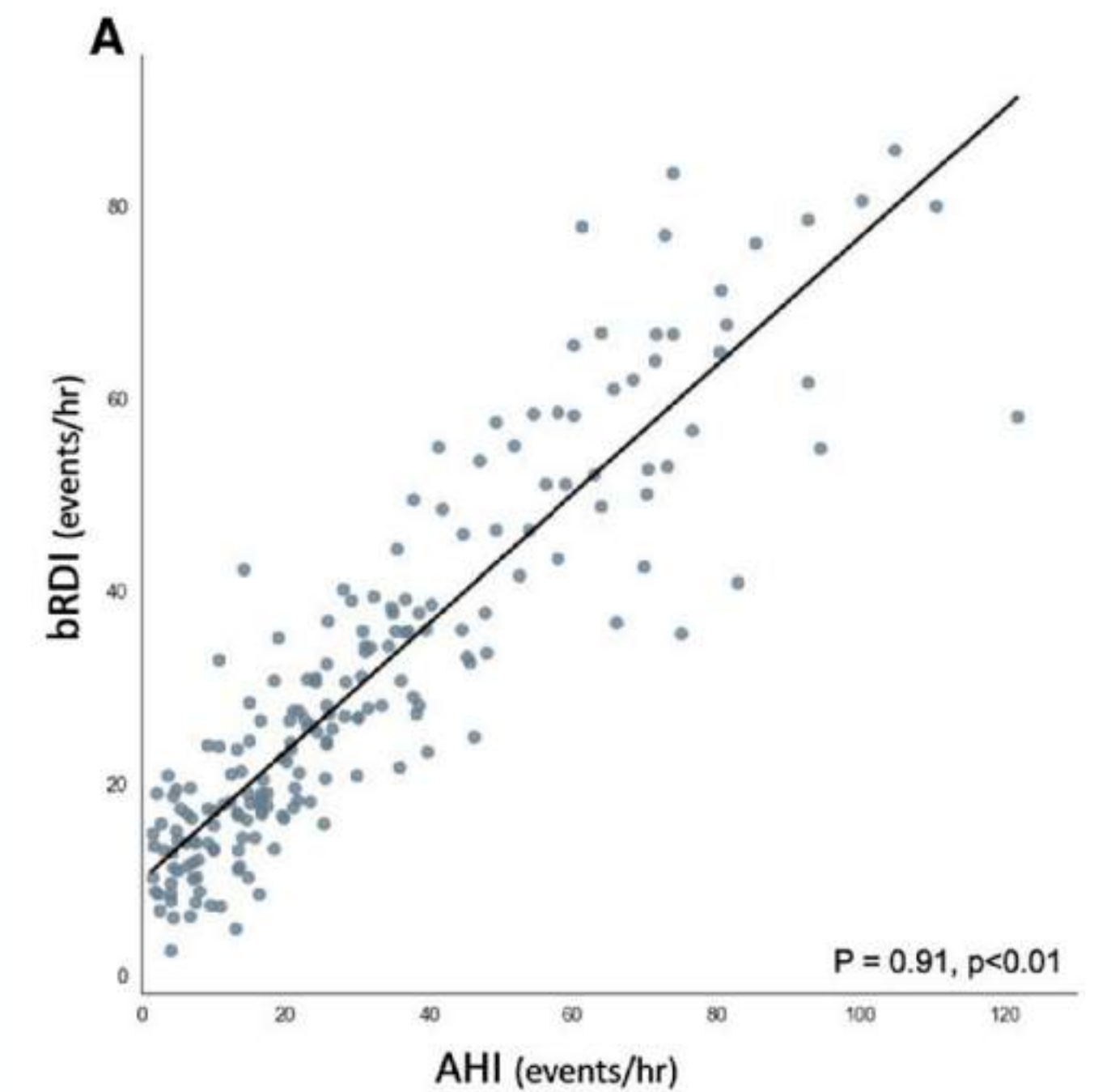
Combining a wireless radar sleep monitoring device with deep machine learning techniques to assess obstructive sleep apnea severity

Shang-Yang Lin, PhD¹; Cheng-Yu Tsai, PhD^{2,3}; Arnab Majumdar, PhD²; Yu-Hsuan Ho, PhD⁴; Yu-Wen Huang, MS⁴; Chun-Kai Kao, MS⁵; Shang-Min Yeh, MS⁴; Wen-Hua Hsu, MS¹; Yi-Chun Kuan, MD^{6,7,8,9}; Kang-Yun Lee, MD, PhD³; Po-Hao Feng, MD, PhD³; Chien-Hua Tseng, MD, PhD³; Kuan-Yuan Chen, MD³; Jiunn-Horng Kang, MD, PhD^{10,11,12}; Hsin-Chien Lee, MD¹³; Cheng-Jung Wu, MD, PhD¹⁴; Wen-Te Liu, MD, PhD^{1,3,6,10}

Figure 3—Signal waveforms of various respiratory events as obtained through polysomnography and wireless radar framework (Bestshape vital sign system).



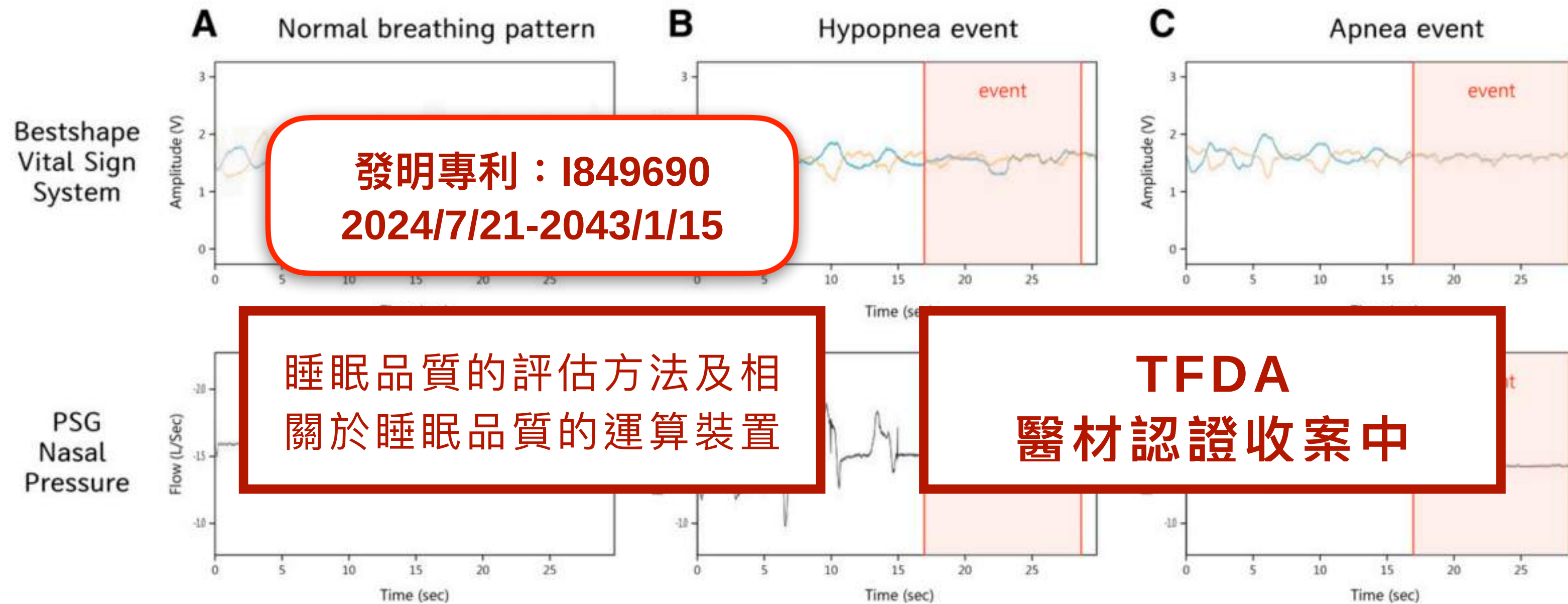
Signal waveforms corresponding to normal breathing patterns (A), hypopnea events (B), and apnea events (C).



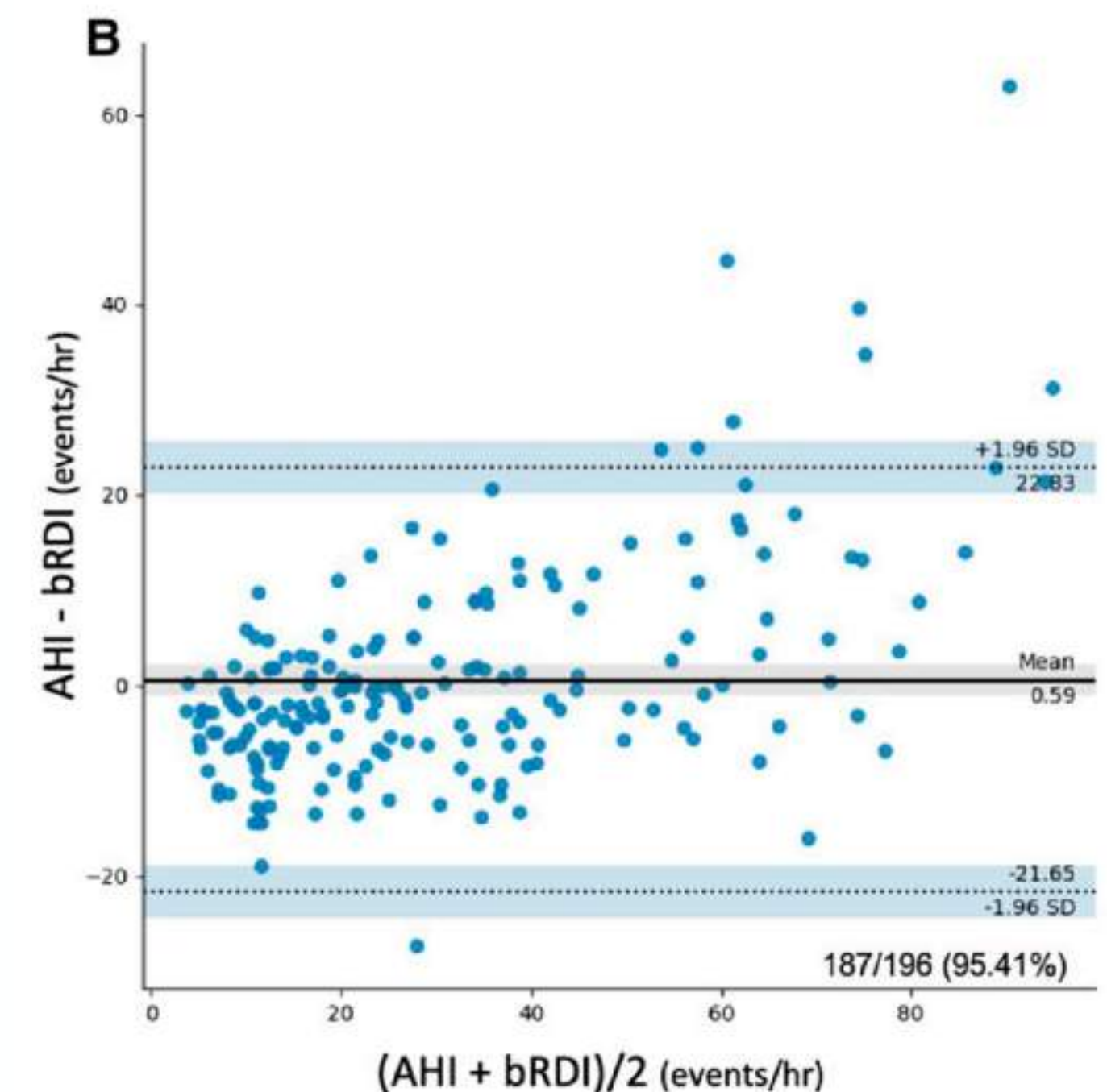
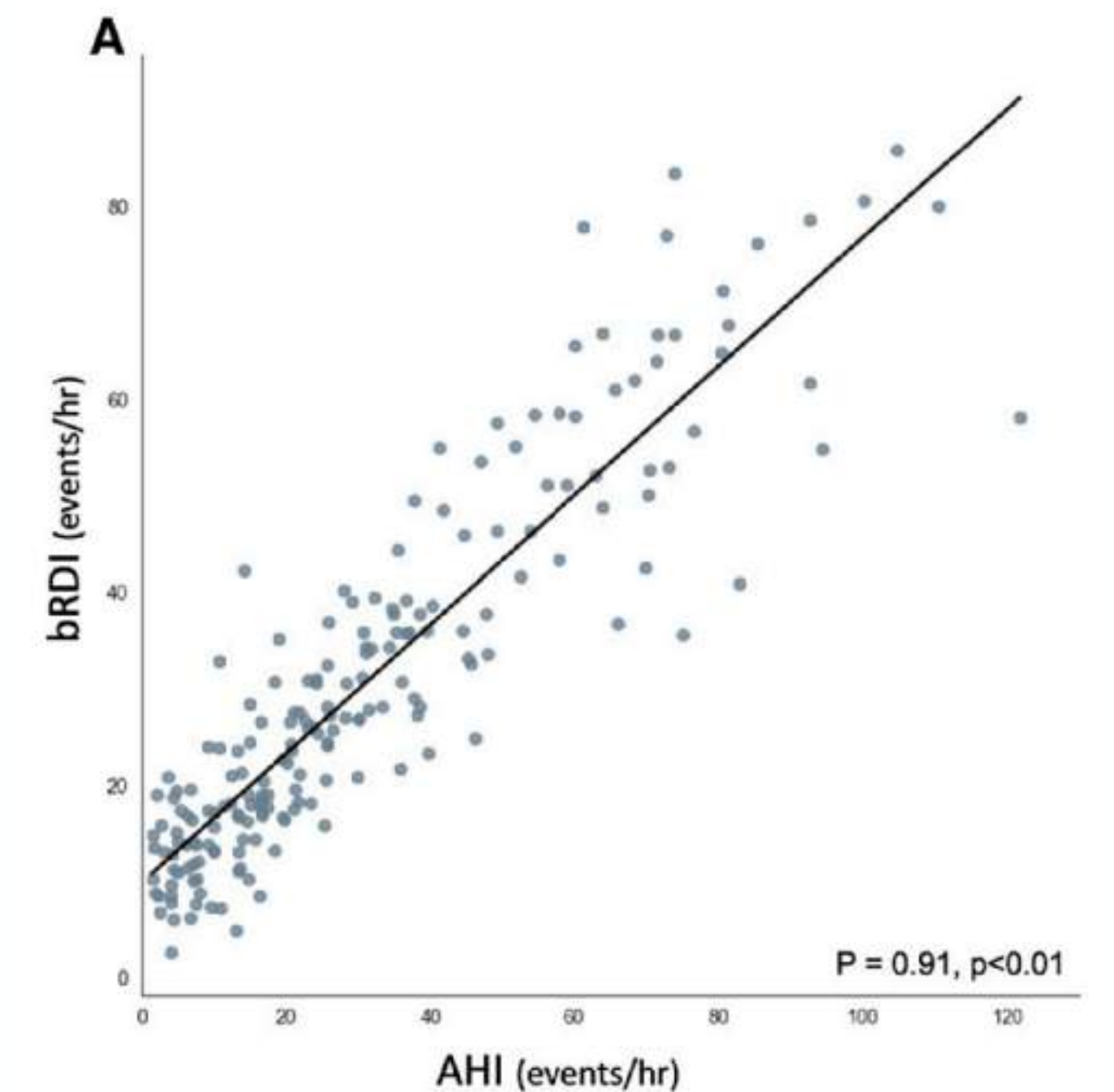
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Figure 3—Signal waveforms of various respiratory events as obtained through polysomnography and wireless radar framework (Bestshape vital sign system).

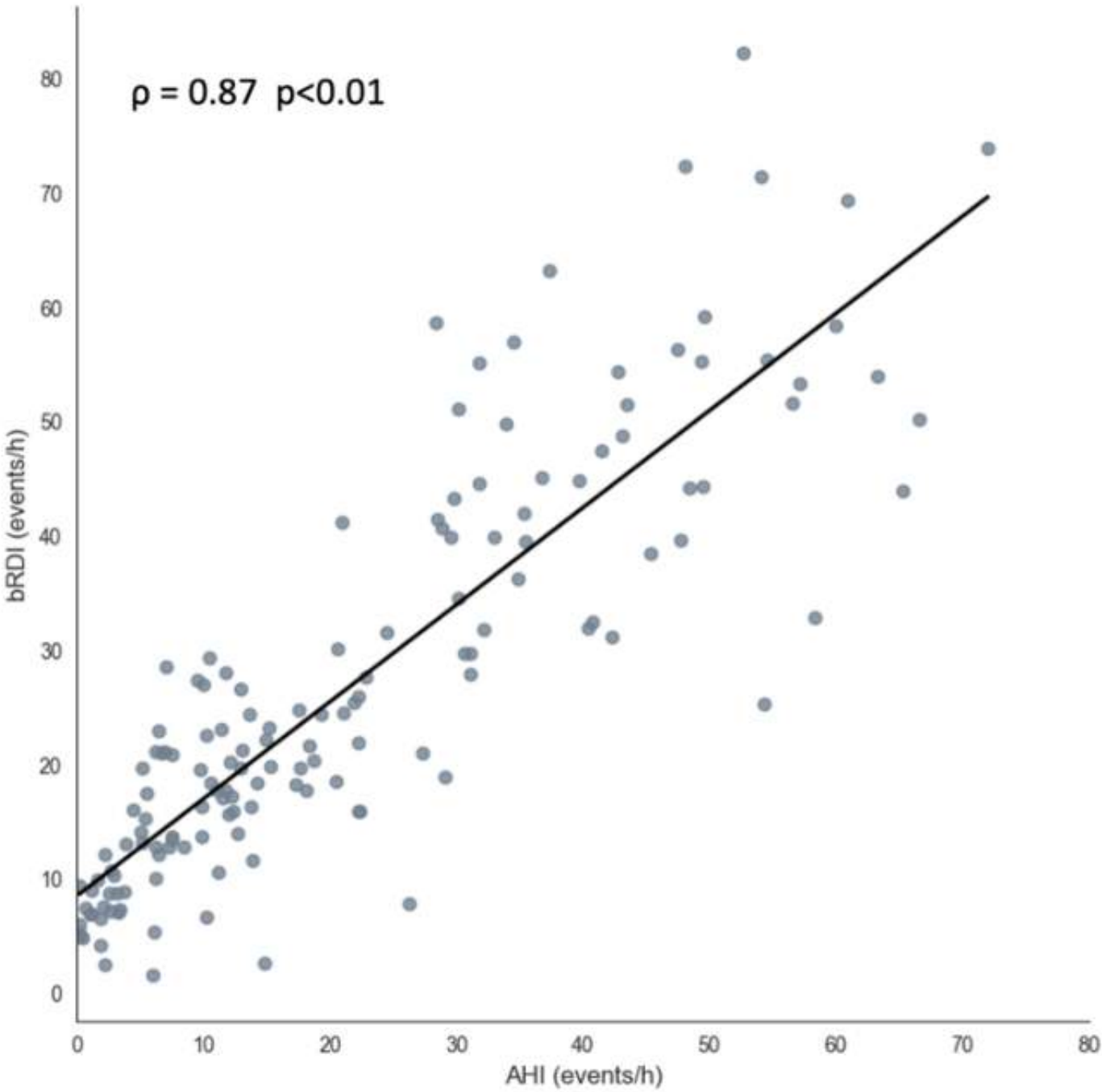
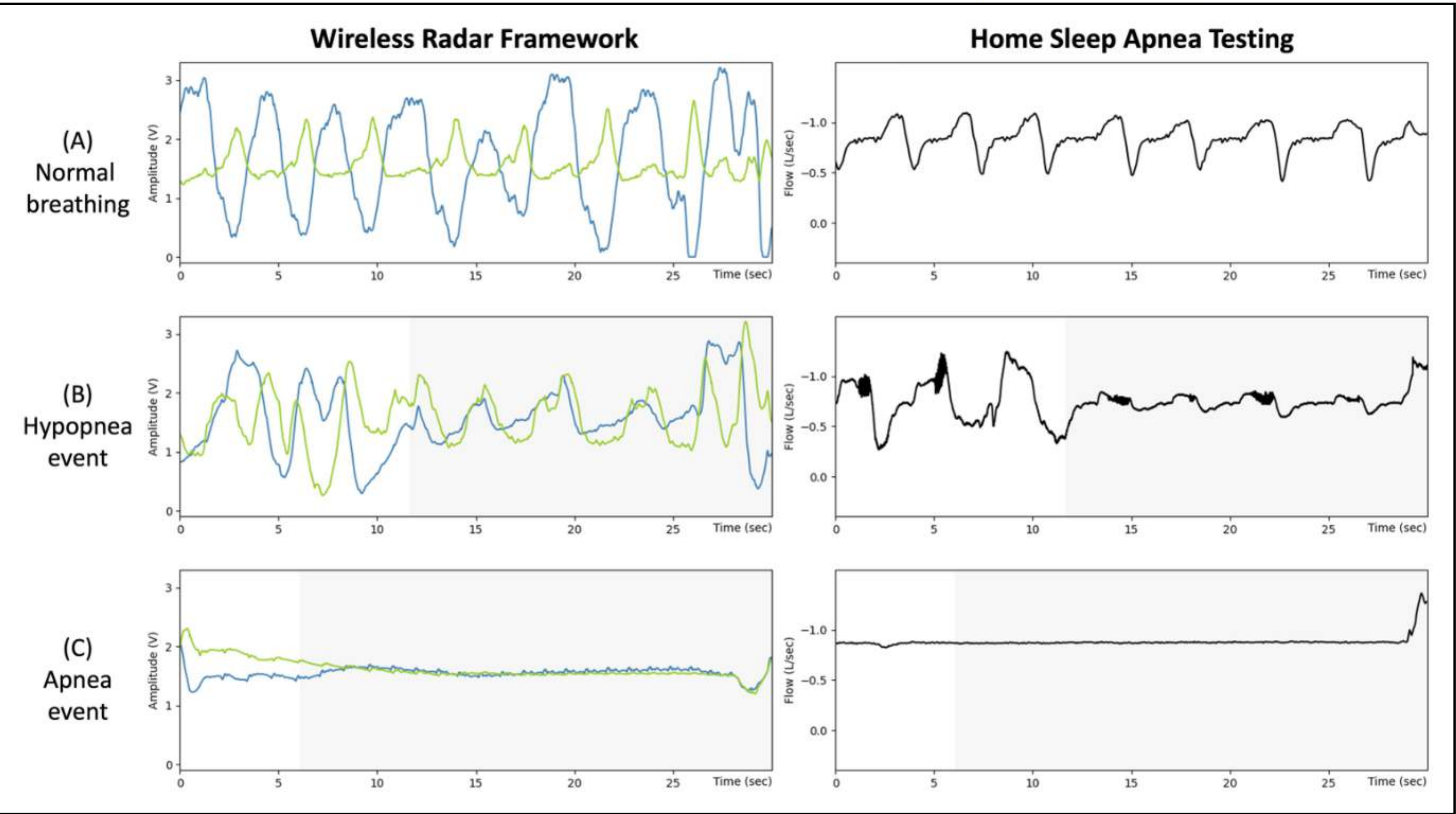
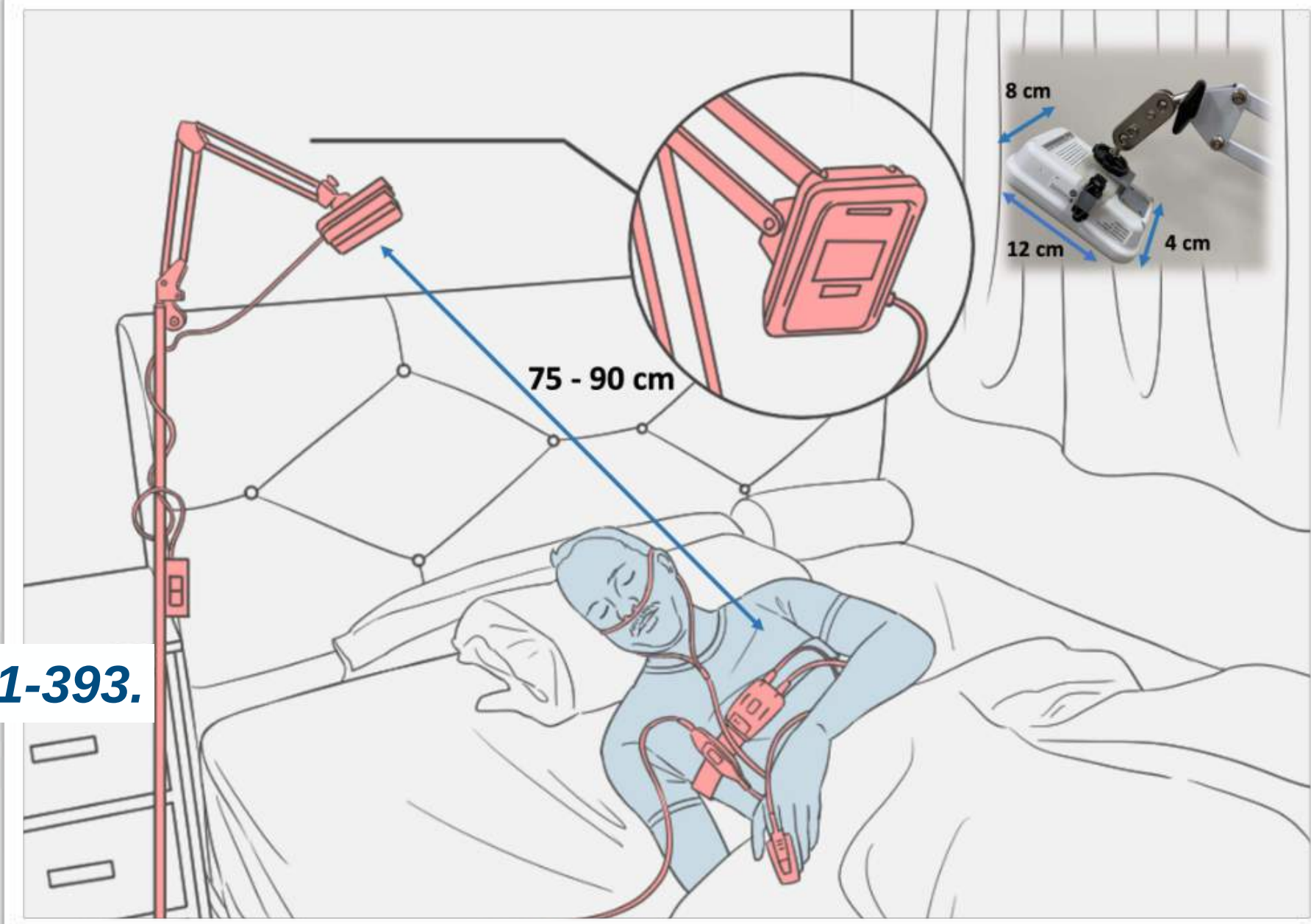


Signal waveforms corresponding to normal breathing patterns (A), hypopnea events (B), and apnea events (C).



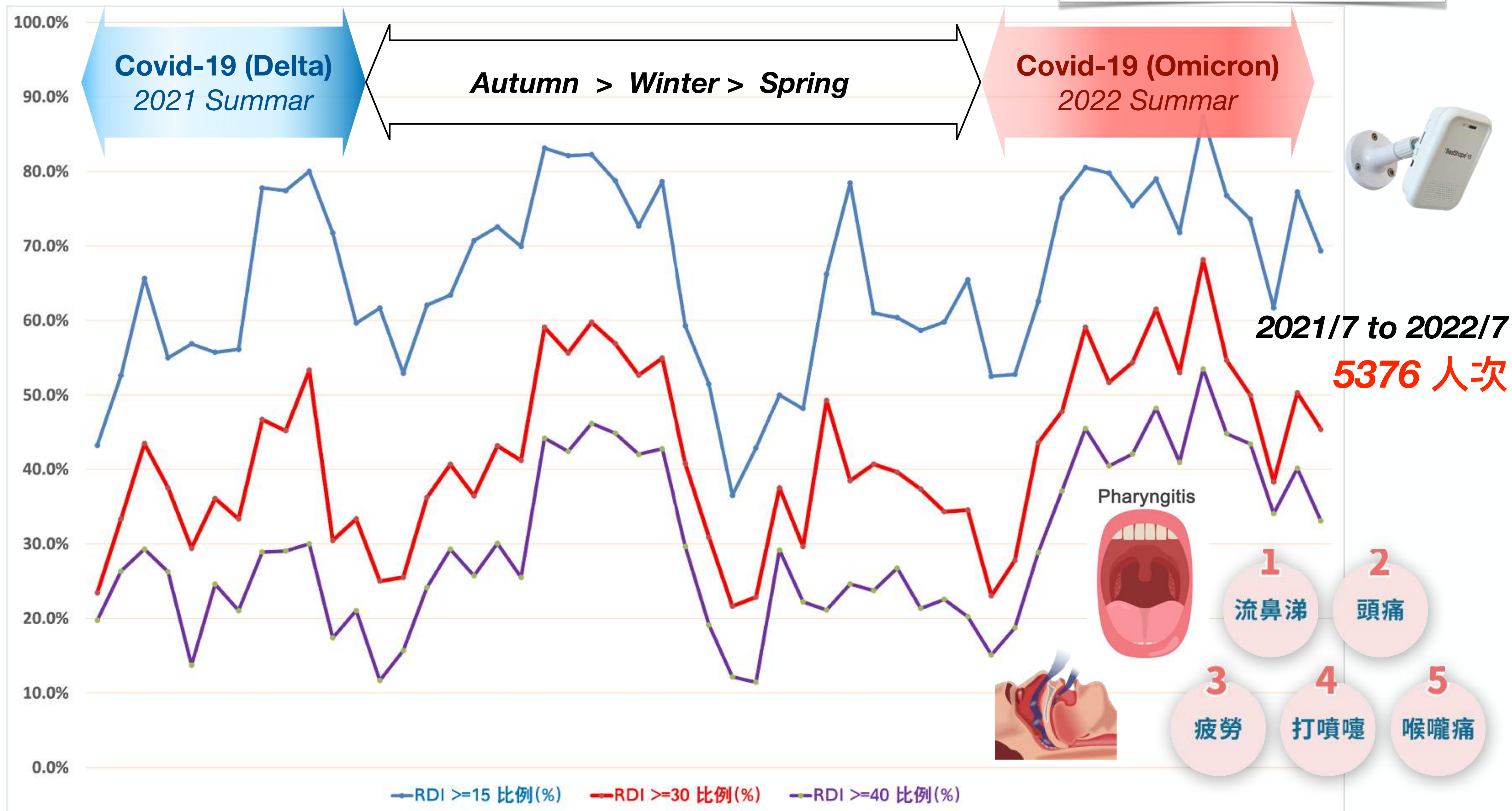
Utilizing a Wireless Radar Framework in Combination With Deep Learning Approaches to Evaluate Obstructive Sleep Apnea Severity in Home-Setting Environments

J Multidiscip Healthc. 2025 Jan 23;18:381-393.



睡眠呼吸障礙 & COVID-19：重症與死亡率提高 2.5–3倍

階層式零接觸生理監測呼吸照護平台
24th, SNQ國家品質標章認證



睡眠呼吸健康照護平台



衛生福利部雙和醫院
(委託臺北醫學大學興建經營)



離床過久，警報提醒

王○鈞 先生	102-1 李○傑 先生	102-2 黃○源 先生	103-1 吳○明 先生
呼吸: 20bpm, 36.8℃	心: 62, 呼吸: 37.2℃	心跳: 8, 呼吸: 17℃	

104-1 曾○興 先生	104-2 張○瑋 先生	105-1 江○財 先生	102-2 黃○源 先生
呼吸: 19bpm, 37.3℃	心: 140, 呼吸: 38.6℃	心跳: 8, 呼吸: 17℃	心跳: 8, 呼吸: 17℃

Dashboard
Line@notify

生理數值異常

訊息推播

Breath
呼吸

Heart Rate
心率

Movement
臥離床



2021 SNQ 國家品質標章

SNQ國家品質標章
全台傑出醫護團隊

衛生福利部雙和醫院

階層式零接觸生理監測呼吸照護平台



SNQ 國家品質標章，由國內百位醫院院長及權威臨床專家共同把關，審視醫療專科團隊品質流程、服務量與臨床成果，並參照國內外發表指標數據詳細評選，選拔出代表卓越品質之全台傑出醫護團隊。

國品字第：B01377 號

授權效期：2023年 12月 31日止

2022 NHQA 國家醫療品質獎



國家醫療品質獎

衛生福利部雙和醫院

〈委託臺北醫學大學興建經營〉

系統類 卓越中心組

睡眠中心

特色中心

國家醫療品質獎NHQA，為全國最具權威與專業性的醫療品質競賽，秉持著引領臺灣醫療品質的信念，協助醫界進行全面性的醫療品質提升與落實，選拔出的獲獎團隊均獲得國家級榮耀的肯定。



財團法人醫院評鑑暨醫療品質策進會

Non-Wearable sensors for sleep, respiration and others



1. Sleep-related breathing disorders



2. Prediction of Upcoming **Heart Failure**



3. Detection of **Preceding** Sleep Apnea



4. Respiratory Sinus Arrhythmia: **Coupling**

雷達偵測呼吸模式：心臟功能惡化之預警系統

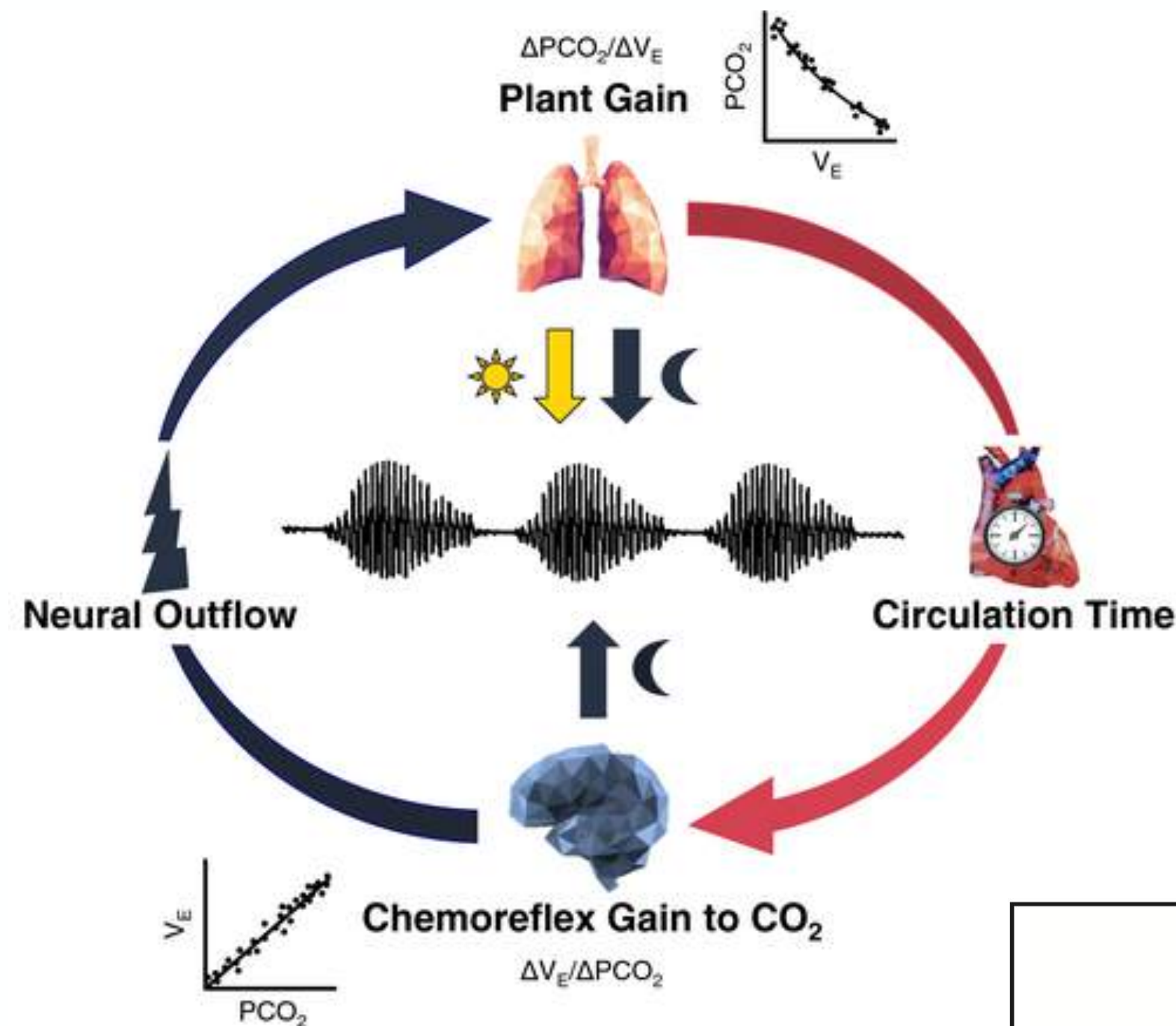
毫米波雷達



- 心臟衰竭風險高
- 與環境CO2含量有關

非快速動眼期為主：
呼吸模式異常

- *Cheyne-Stokes Respiration*
- *Periodic Breathing*



Congestive Heart Failure

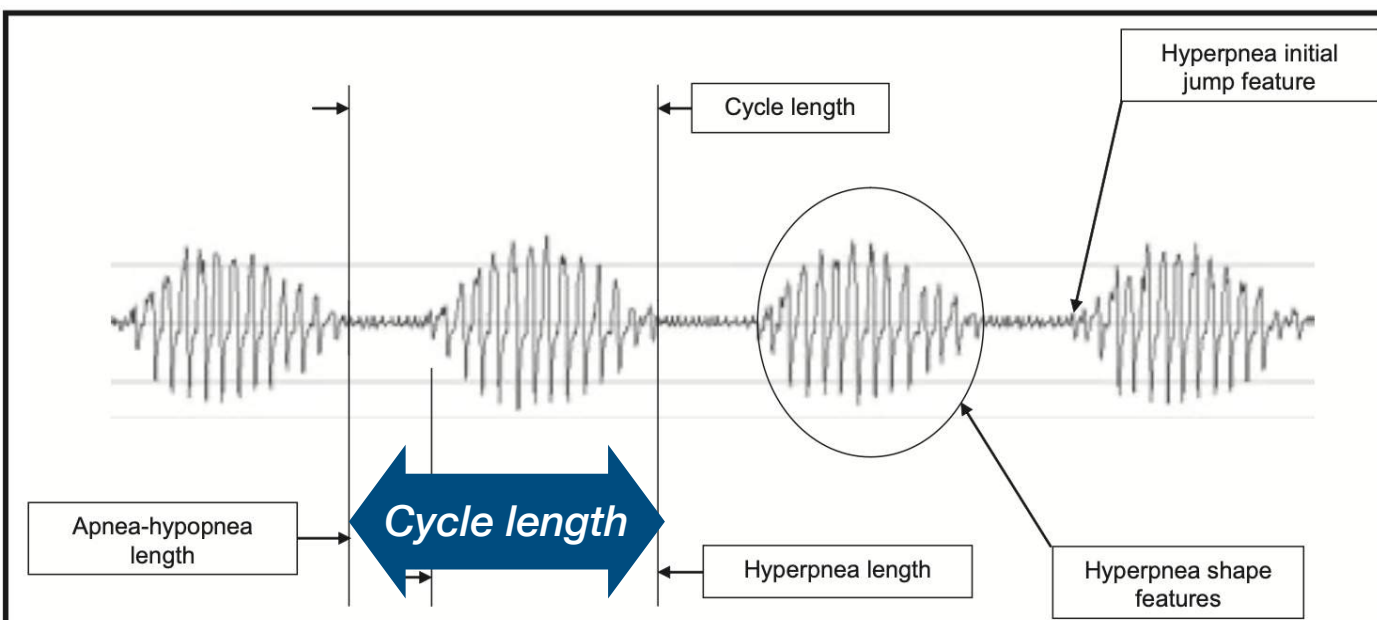
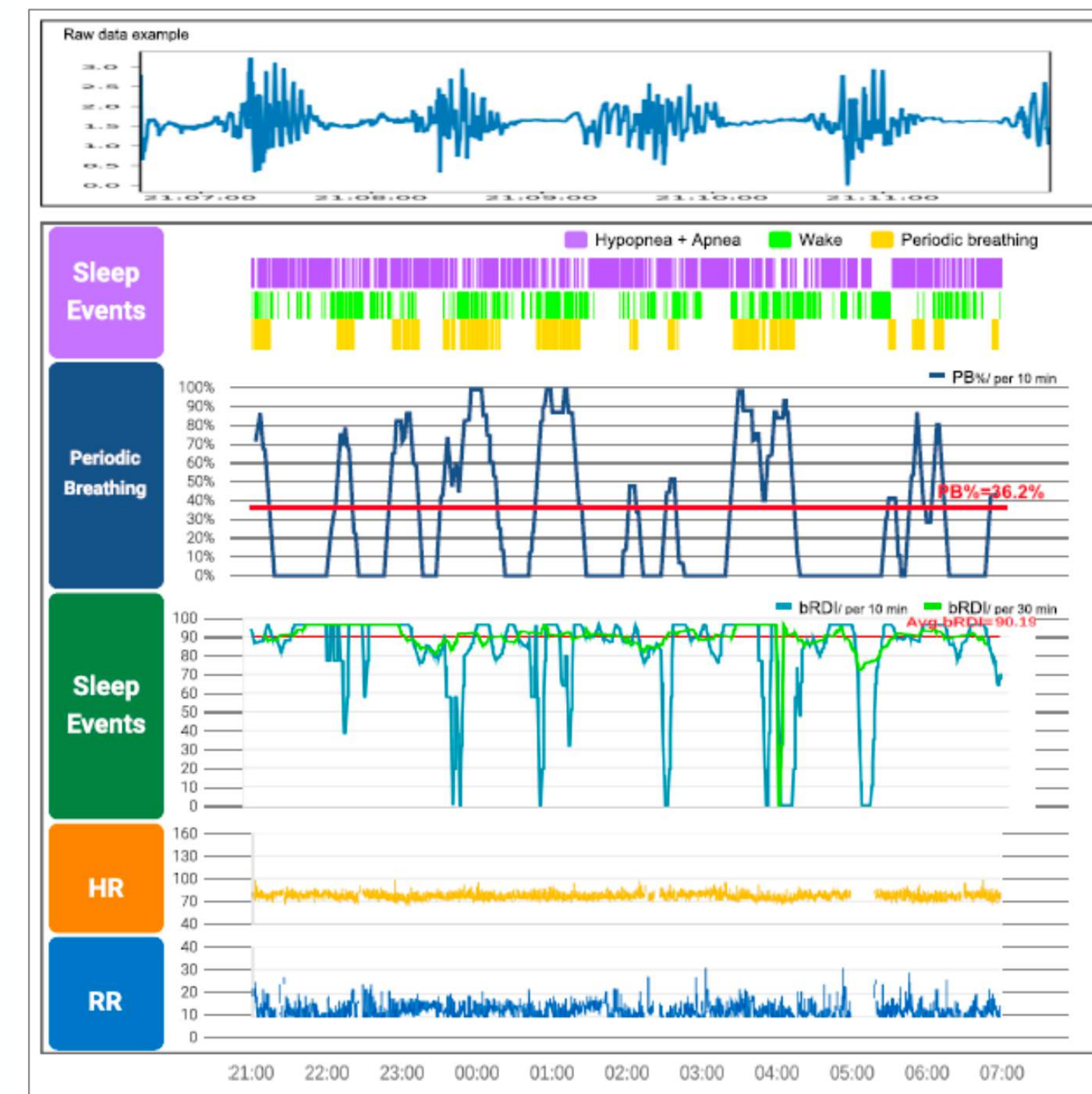
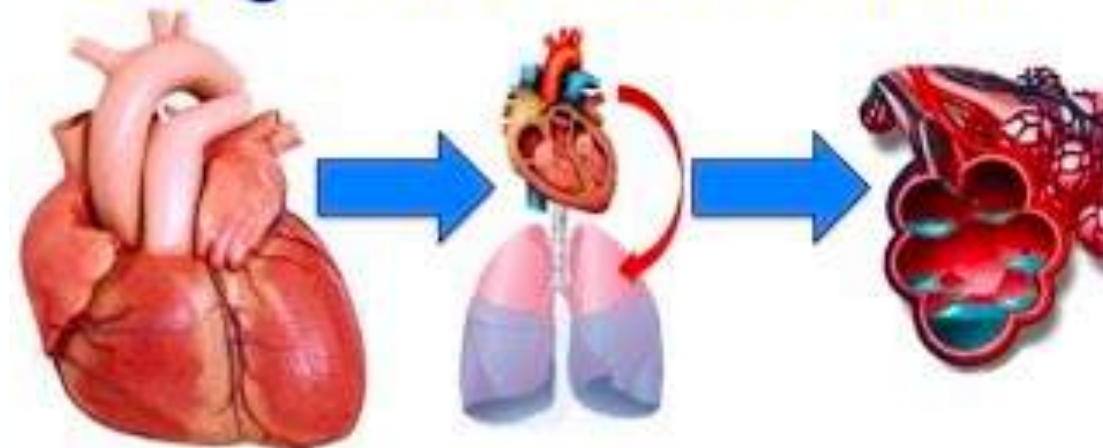
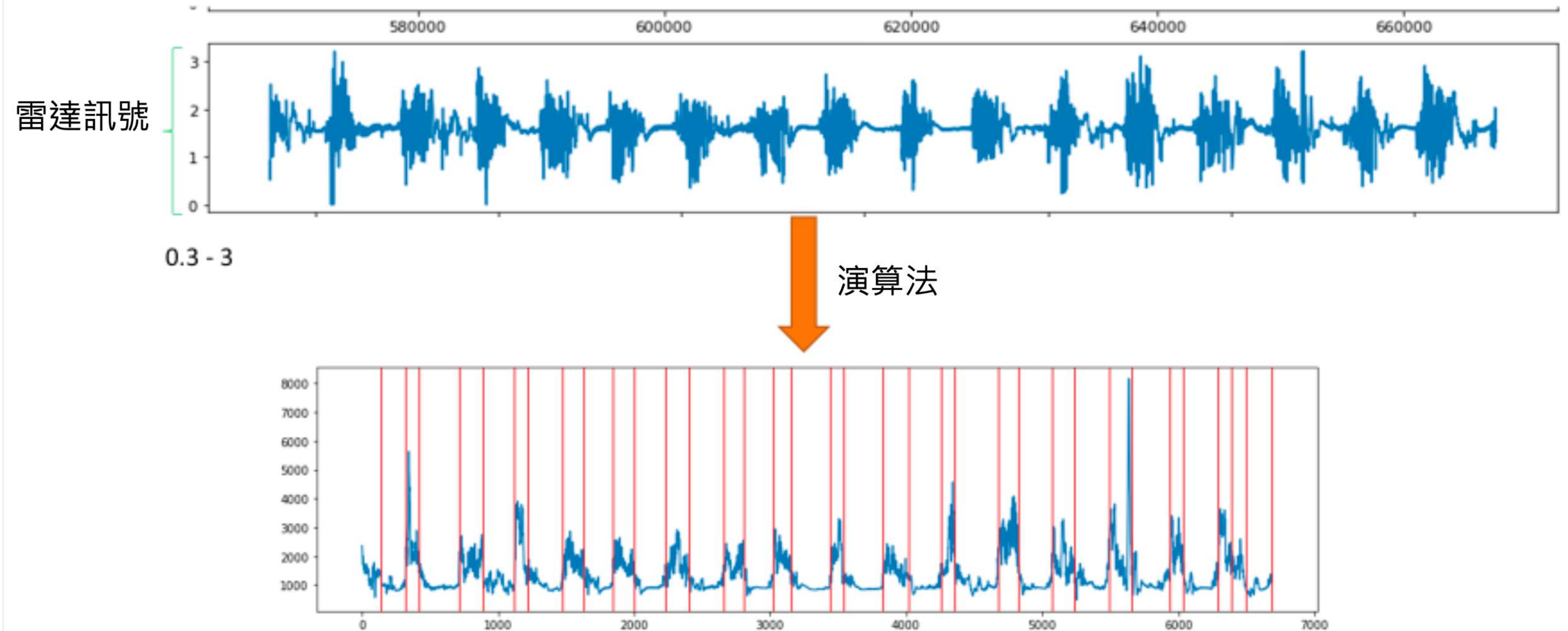


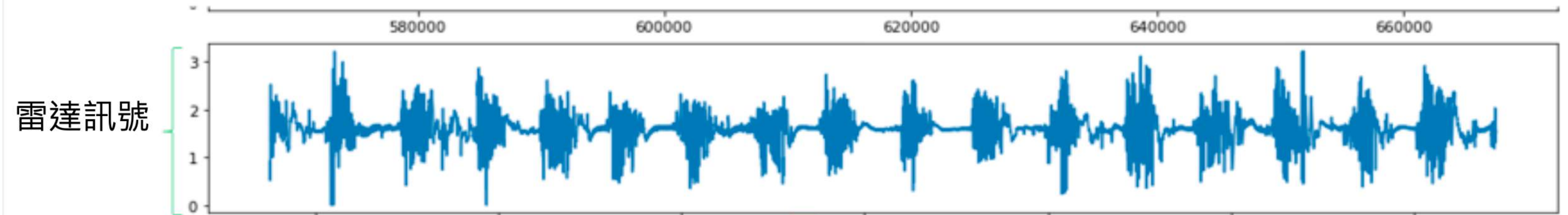
Figure 2—Classifier features of ApneaLink: apnea-hypopnea length, cycle length, hyperpnea length, hyperpnea shape, and hyperpnea initial jump feature.

潛在心臟衰竭
出院持續追蹤

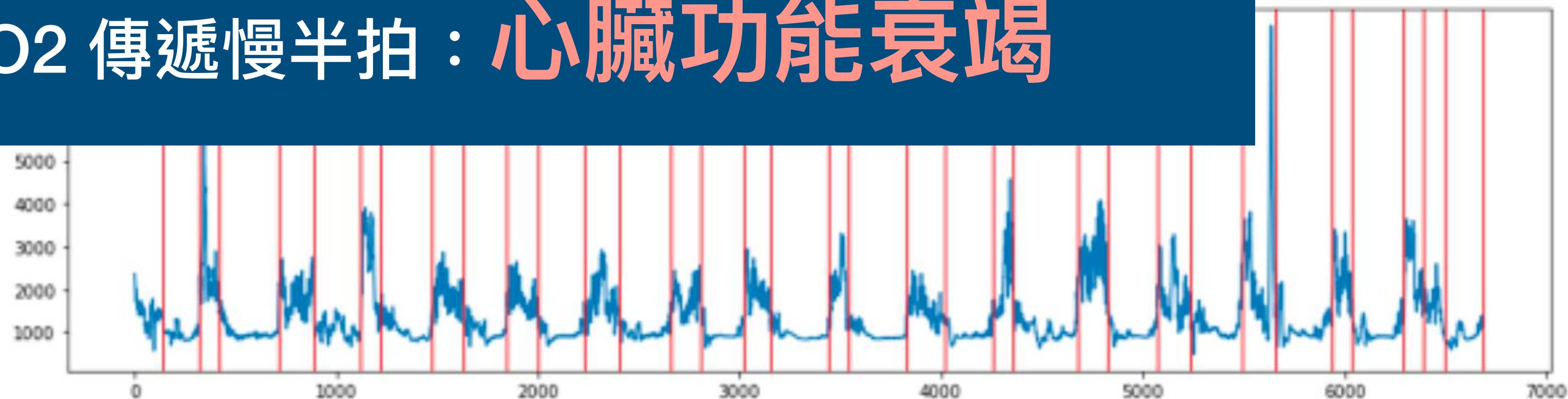
High Loop Gain: *Periodic Breathing (PB)*
Cheyne-Stokes Breathing (CSB)



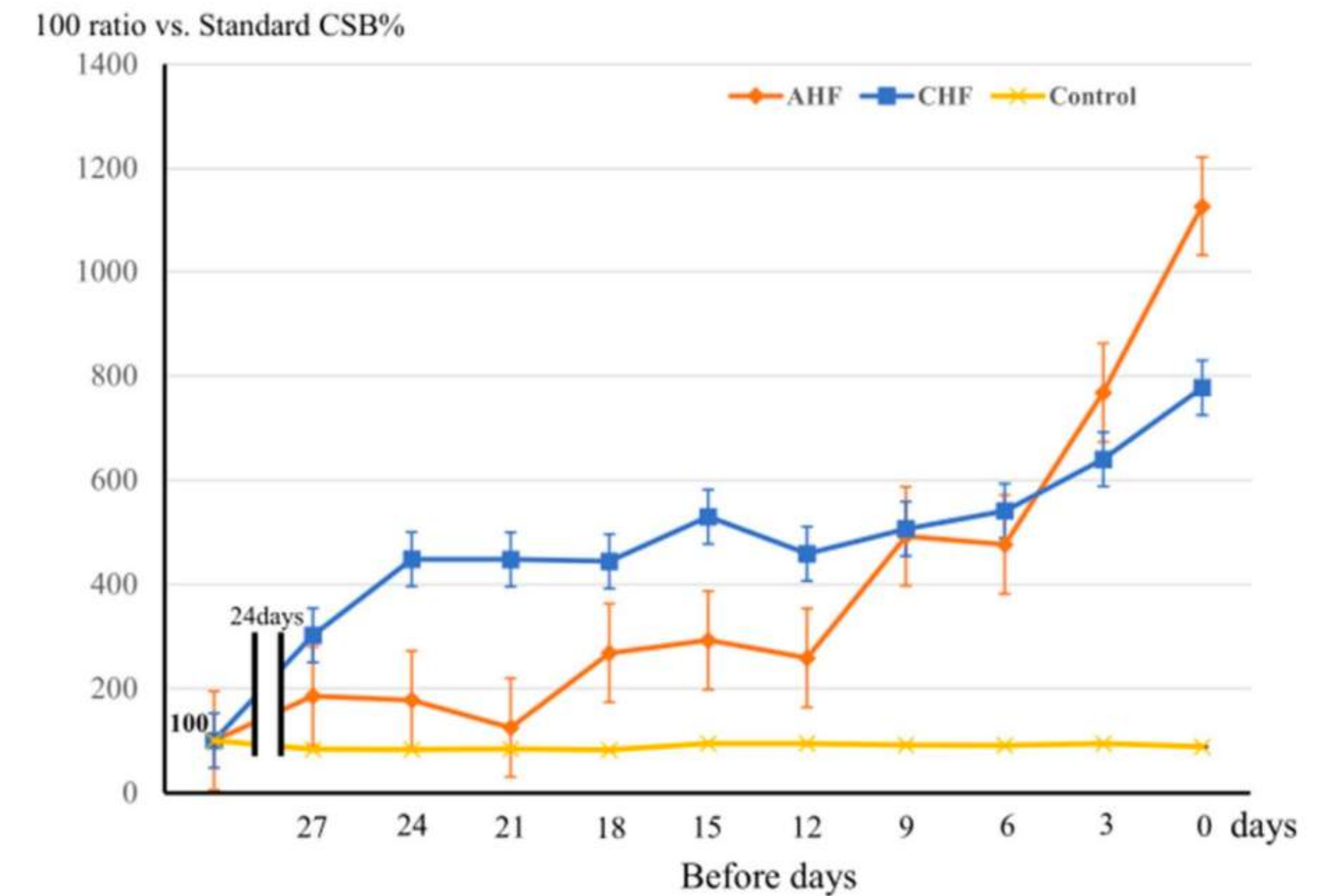
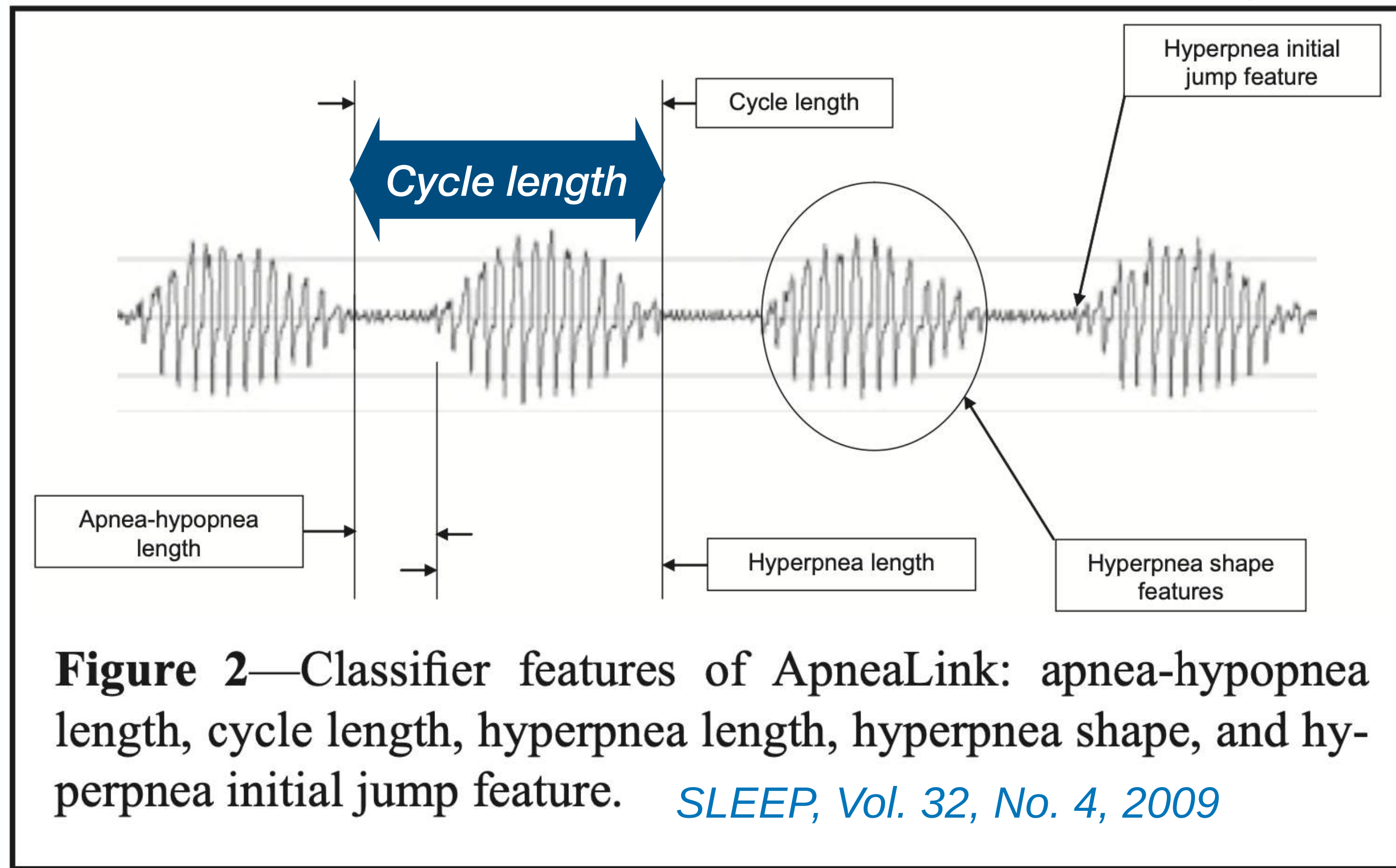
High Loop Gain: *Periodic Breathing (PB)* *Cheyne-Stokes Breathing (CSB)*



1. 呼吸道阻力增加 (OSA) : 呼吸做功過猶不及
2. CO₂/O₂ 傳遞慢半拍 : **心臟功能衰竭**



Cycle length / Apnea-hypopnea length / Hyperpnea length Hyperpnea shape / Hyperpnea initial jump feature



CPAP 測量 Cycle Length 增加幅度

急性心臟衰竭：11x

慢性心臟衰竭：8x

正常：1x

	LVEF (%)				
	> 50	40-49	30-39	20-29	< 20
Cycle length	49.1 ± 17.4	58.9 ± 13.4	60.5 ± 10.5	73.9 ± 16.2	85.7 ± 23.1

Data from Wedewardt et al.¹⁰⁶ Values are Mean ± SD in seconds. LVEF, left ventricular ejection fraction; SD, standard deviation.

每日bRDI、PB%快篩推播 & PB報告



LINE Notify

【Bestshape VS】

睡眠快篩報告

日期: 04.11 21 - 04.12 07

場域: RD Test Site (21-07)

受測人數: 4 位

bRDI $\geq$ 30人數: 0 位 (0%)

(bRDI與PB定義註記於群組記事本)

下列數值依序呈現：

bRDI / Sleep time / PB%/

PB events / Cycle-length avg.

床號: 0120

23/ 4.8H/ 15%/ 40/ 80.0

床號: 112

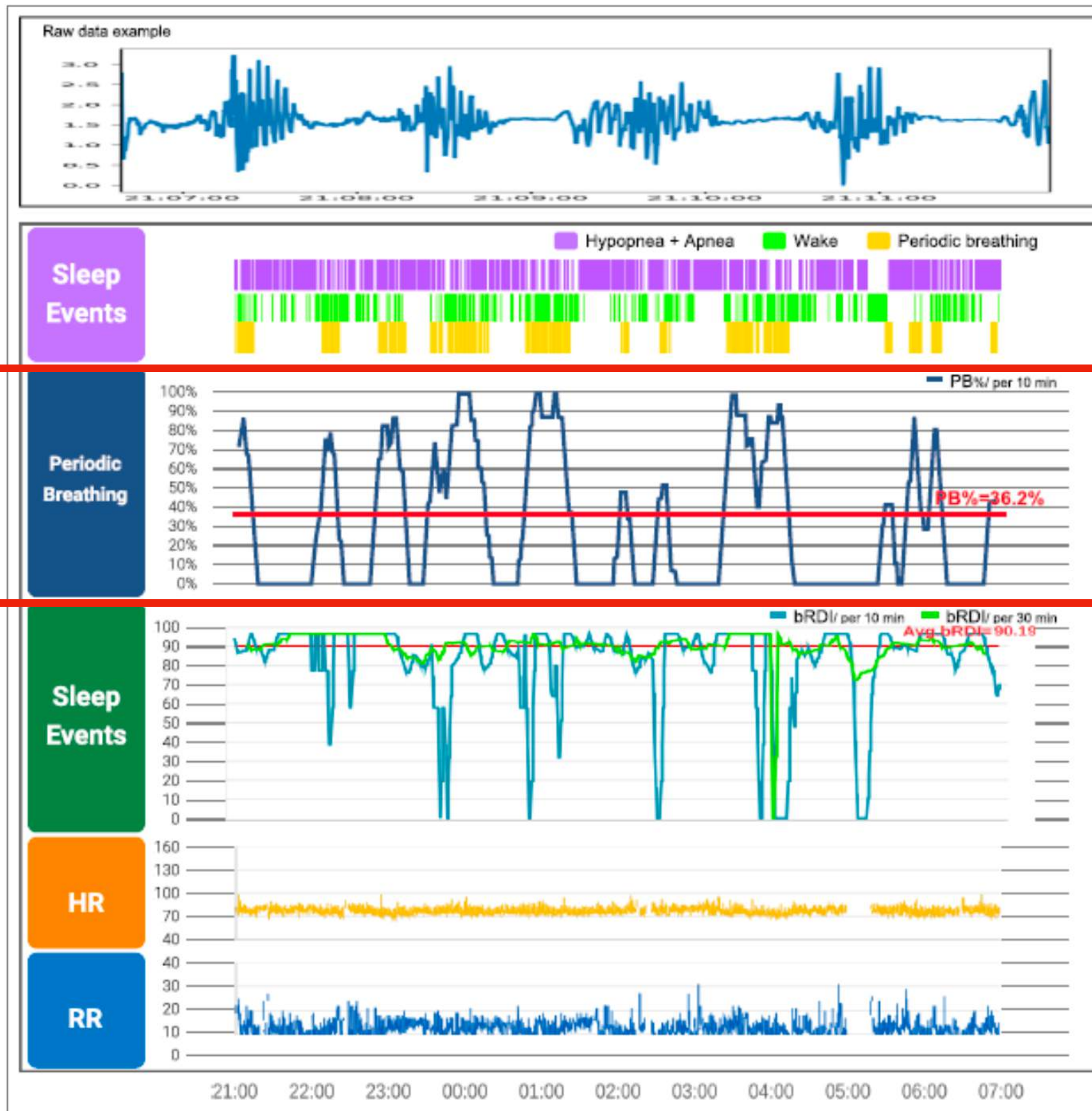
20/ 5.3H/ $\leq$ 5%/ -/ -

床號: 199

20/ 4.1H/ 16%/ 58/ 57.4

床號: 193

12/ 2.9H/ 9%/ 16/ 89.8



SNQ國家品質標章 全台傑出醫護團隊

衛生福利部雙和醫院

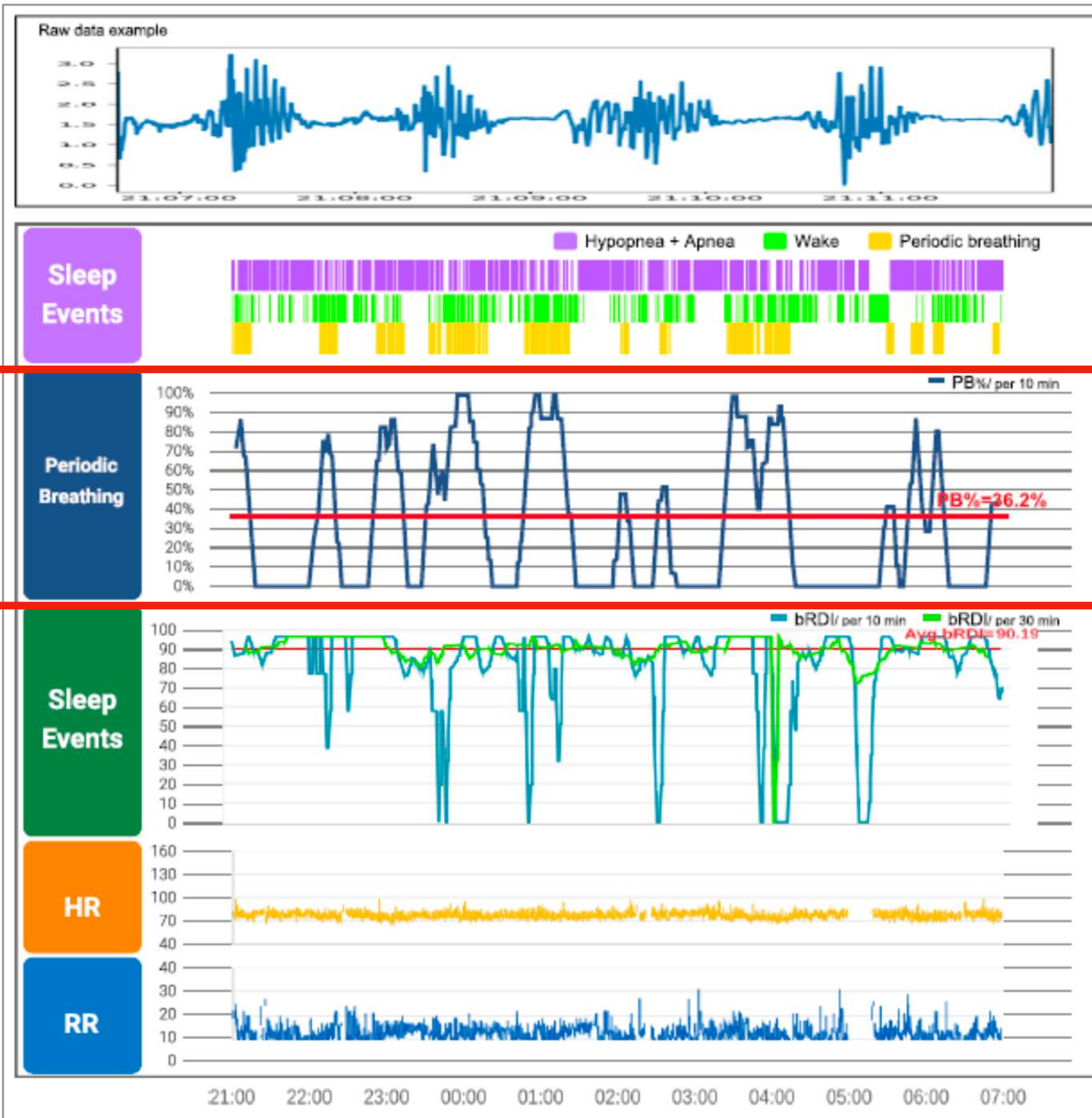
全心全力：
非侵入性多方位心臟功能評估整合照護模式



SNQ 國家品質標章，由國內百位醫院院長及權威臨床專家共同把關，審視醫護專科團隊品管流程、服務量能與臨床成果，並參照國內外發表指標數據詳細評選，選拔出代表卓越品質之全台傑出醫護團隊。

國品字第：S010724 號

授權效期：2025年12月31日止

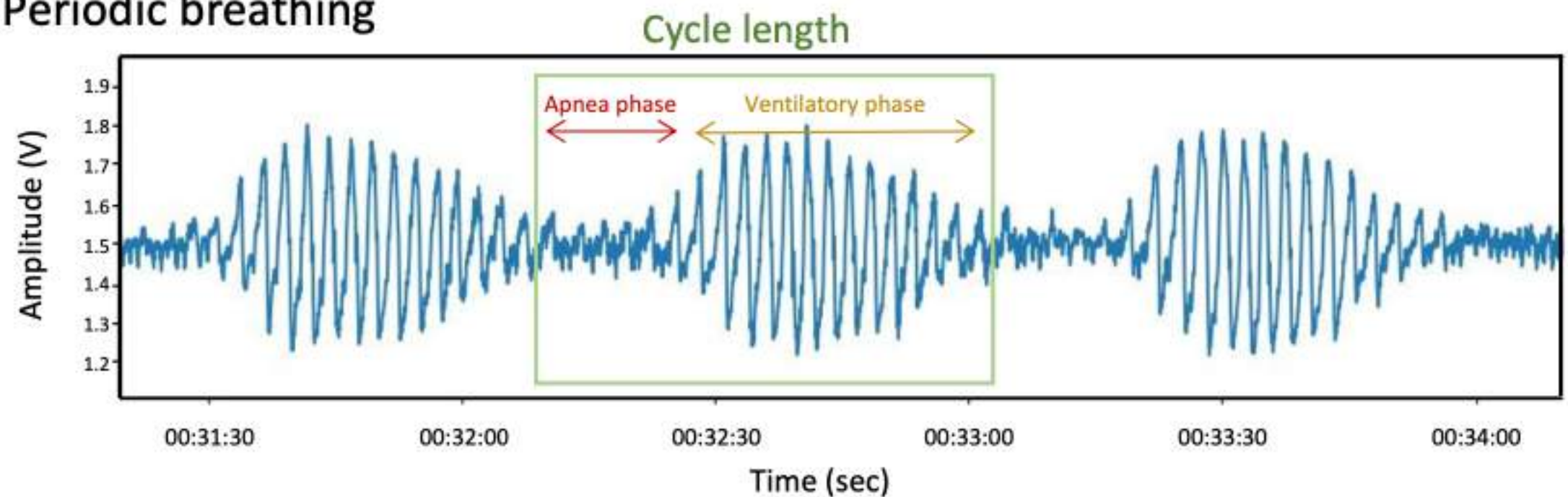


Evaluating Cardiac Impairment from Abnormal Respiratory Patterns: Insights from a Wireless Radar and Deep Learning Study

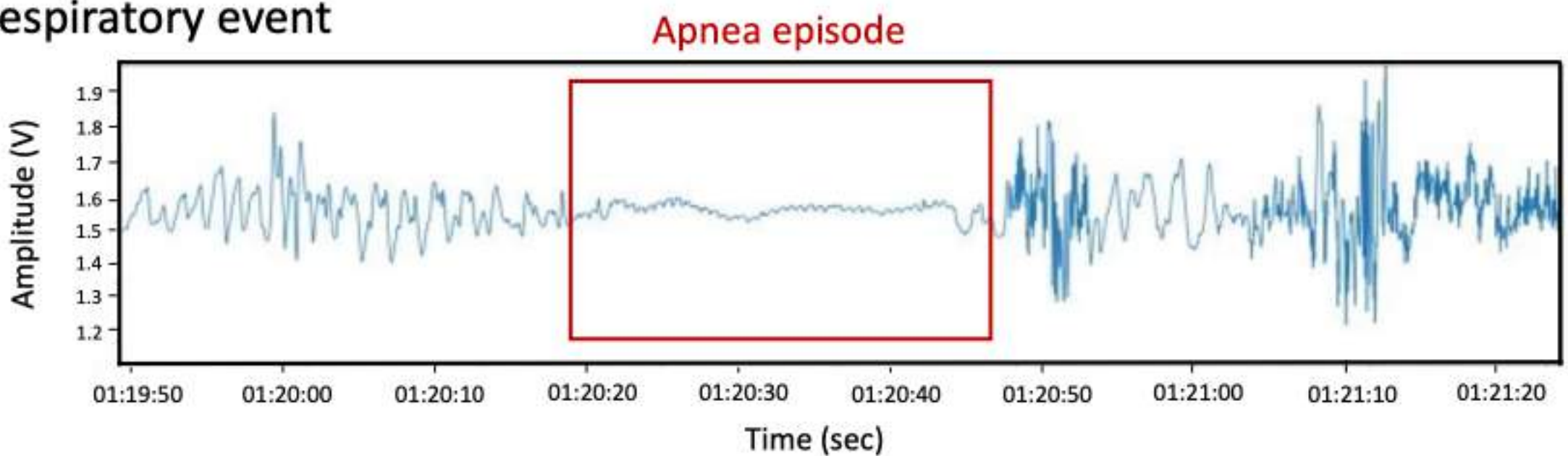
IEEE Journal of Translational Engineering in Health and Medicine, doi: 10.1109/JTEHM.2025.3588523.

Variable	LVEF > 50% (N = 47)	LVEF ≤ 50% (N = 25)	p value
Radar-based sleep parameters			
TST (min)	283.74 ± 101.13	213.88 ± 91.39	0.01
Sleep efficiency (%)	49.47 ± 17.35	36.64 ± 15.25	< 0.01
RDI (events/h)	31.91 ± 20.74	44.13 ± 20.76	0.02
PB cycle length (s)	14.72 ± 24.19	33.21 ± 29.85	0.01

Periodic breathing



Respiratory event



Evaluating Cardiac Impairment from Abnormal Respiratory Patterns: Insights from a Wireless Radar and Deep Learning Study

IEEE Journal of Translational Engineering in Health and Medicine, doi: 10.1109/JTEHM.2025.3588523.

- Associations of Radar-based parameters with Cardiac conditions

Variable	β coefficient (95% CI)	
	RDI (events/h)	PB cycle length (s)
NT-proBNP (pg/mL)	66.65 (-153.2 to 286.49)	158.49 (16.31 to 300.67) *
LVEF (%)	-0.22 (-0.41 to -0.03) *	-0.21 (-0.35 to -0.07) *
LVEDD (mm)	0.07 (-0.05 to 0.19)	0.11 (0.01 to 0.19) *
LVESD (mm)	0.14 (0.01 to 0.27) *	0.16 (0.06 to 0.25) **

- RDI increased 1/h:**
LVEF: decreased 0.22%
LVESD: increased 0.14 mm
- PB cycle length, increased 1s:**
NT-proBNP: increased 158.49 pg/mL
LVEF: decreased 0.21%
LVEDD: increased 0.11 mm
LVESD: increased 0.16 mm

- 50% Left Ventricular Ejection Fraction (LVEF) Threshold

Variable	Crude OR (95% CI) ^a	Adjusted OR (95% CI) ^b
RDI (events/h)	1.03 (1.01 to 1.05) *	1.04 (1.01 to 1.07) *
PB cycle length (s)	1.02 (1.01 to 1.04) **	1.03 (1.01 to 1.05) *

- (Age, Gender, BMI)
- RDI increased 1/h**
 - PB cycle length, increased 1s**

雷達偵測呼吸模式：心臟功能惡化之預警系統

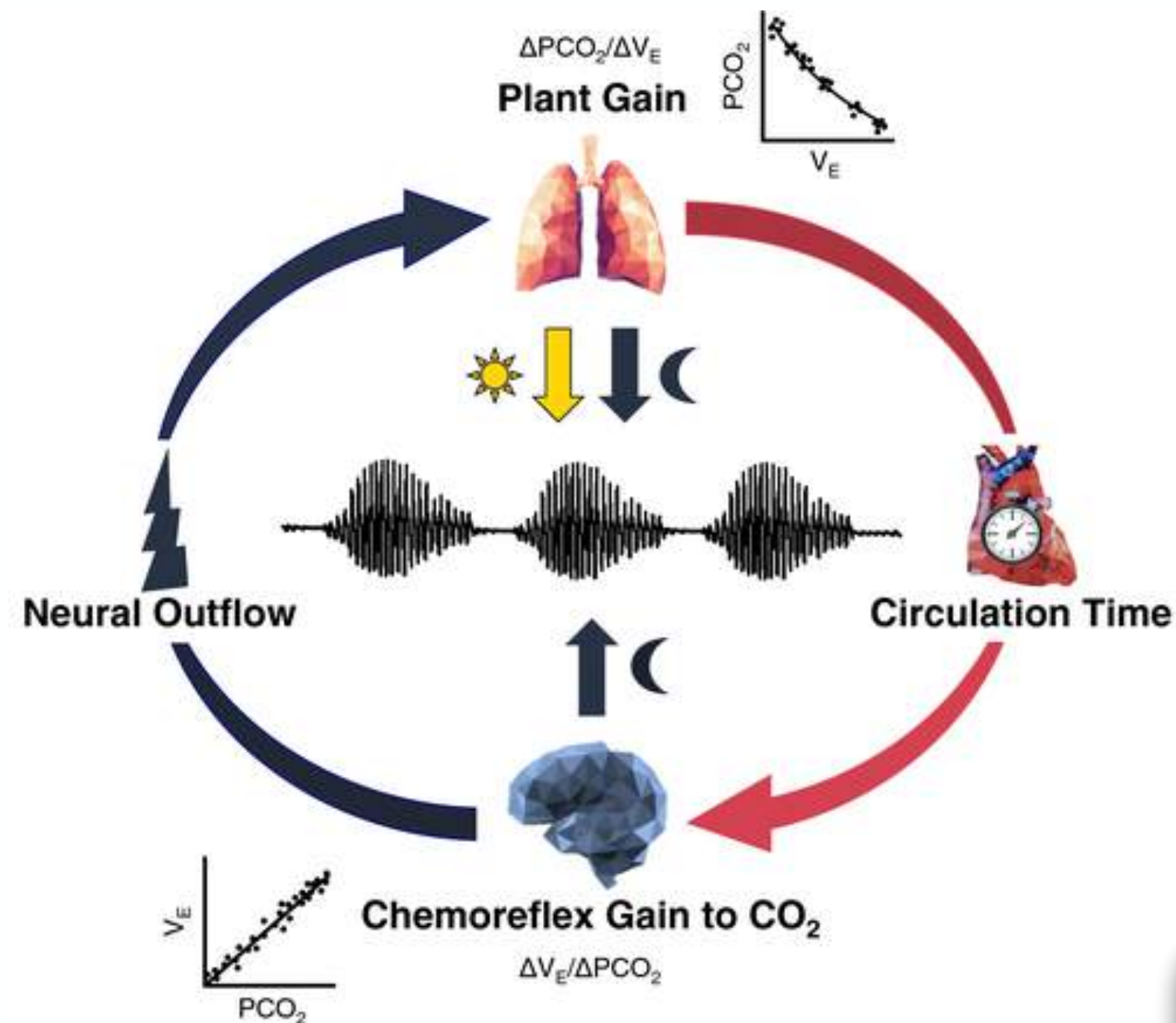
毫米波雷達



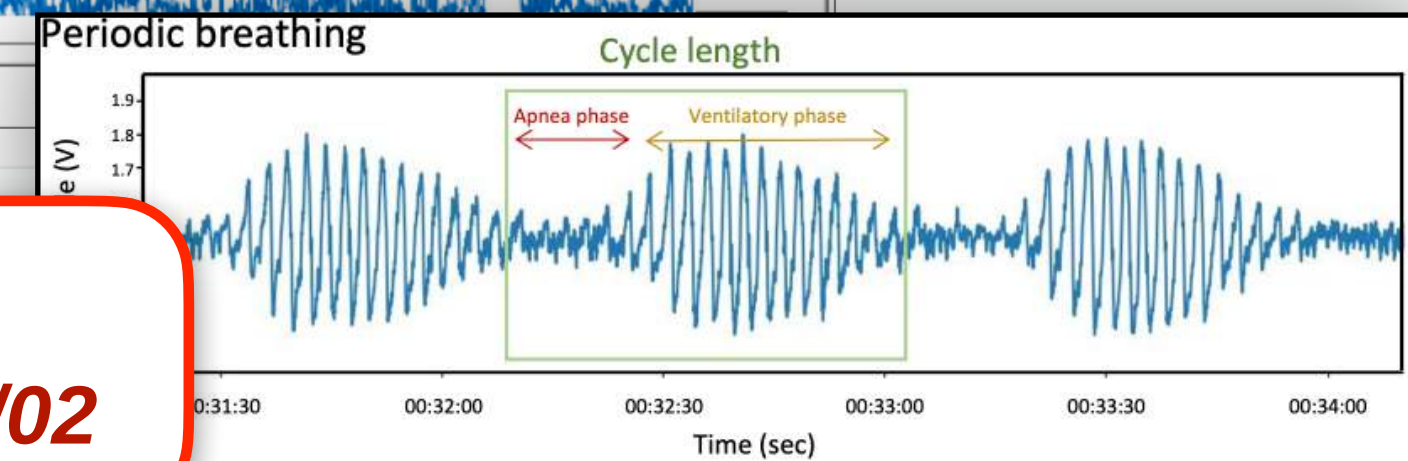
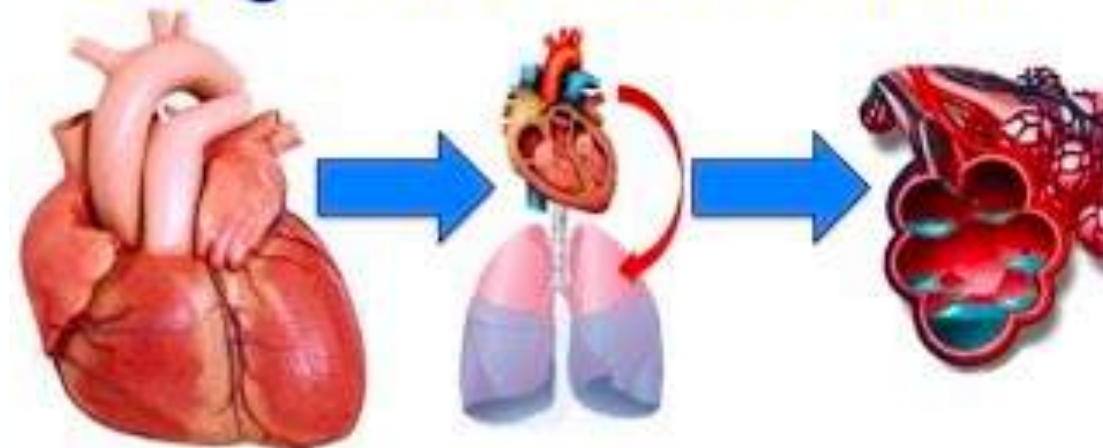
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非快速動眼期為主：
呼吸模式異常

- *Cheyne-Stokes Respiration*
- *Periodic Breathing*



Congestive Heart Failure



發明專利: I817809
2023/10/01~2042/11/02

心臟異常事件
預警系統以及方法

bRDI 88.2 + PB 37.8%

睡眠檢測報告

BestShape

姓名 零四一六

身高 - 公分

性別 M

體重 - 公斤

年齡 -

BMI -

測試時間

2025/03/11 21:00 - 2025/03/12 12:00

睡眠品質分析

參考

休息狀態

上床 03/11 21:36

> 7時

穩定休息 6 時 24 分, 91.4%

起床 03/12 05:18

睡眠醒醒 33 分, 7.9%

睡眠效率(睡眠時間/在床時間) 87.9%

≥ 85%

離床 1 次, 3 分, 0.7%

睡眠時間 6 時 46 分

翻動 12 次

睡眠狀態

參考文獻: 美國國家睡眠基金會 (National Sleep Foundation, NSF)

• 清醒 11 分, 2.7%

21-30%

• 快速動眼期 0 分, 0.0%

≤ 80%

• 淺眠 6 時 39 分, 95.6%

16-20%

• 深眠 7 分, 1.7%

< 30分

入睡耗時 30 分

睡眠呼吸指數

呼吸中止指數 88.2 事件/小時

低通氣呼吸 + 呼吸中止 427 事件

呼吸中止指數: 輕度=5 - 14.9, 中度=15 - 29.9, 重度=30以上

*呼吸中止指數為每個小時的呼吸中止事件次數

*呼吸中止指數, AHI ≥ 30/h 靈敏性: 92.08%, 專一性: 80.13%

5 輕度 15 中度 30 重度

88.2

生理數據

呼吸率

平均 13.2 次/分

標準差 1.7

心率

平均 62.4 次/分

標準差 8.8

血氧

缺氧指數 51.8 事件/小時

缺氧事件次數 268

*缺氧指數與缺氧事件為AI模型透過睡眠呼吸事件的時間與頻率預測產生

*缺氧指數準確度: ODI ≥ 10 靈敏性: 80.43%, 專一性: 66.66%

睡眠檢測報告

BestShape

姓名 零四一六

身高 - 公分

性別 M

體重 - 公斤

年齡 -

BMI -

測試時間

2025/03/11 21:00 - 2025/03/12 12:00

休息狀態

睡眠狀態

呼吸事件

呼吸中止指數

呼吸

心率

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

W REM L D

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

呼吸中止指數/每30分鐘 呼吸中止指數/每10分鐘 平均呼吸中止指數

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

2

測試設備: 訊感睡眠和 O(b)
版本: LTS v2.3

週期性呼吸分析

BestShape

測試時間 2025/03/11 21:00 - 2025/03/12 12:00

睡眠時長 6 時 46 分

週期性呼吸

睡眠氏呼吸

週期性呼吸發生率(週期性呼吸時間/睡眠時間) 37.8 %

睡眠氏呼吸發生率(睡眠氏呼吸時間/睡眠時間) - %

週期性呼吸/睡眠時間比例 - %

睡眠氏呼吸/睡眠時間比例 - %

週期性呼吸事件 21.1 事件/小時 148 事件

睡眠氏呼吸事件 - 事件/小時 - 事件

週期性呼吸時長 平均 64.0 秒 標準差 5.4 秒

睡眠氏呼吸時長 平均 - 秒 標準差 - 秒

週期性呼吸最大時長 85.5 秒

週期性呼吸 原始資料圖形

00:12:00 00:13:00 00:14:00 00:15:00 00:16:00 00:17:00 00:18:00 00:19:00 00:20:00

睡眠狀態

呼吸事件

週期性呼吸

呼吸中止指數

呼吸

心率

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

W REM L D

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

週期性呼吸/每10分鐘 平均週期性呼吸發生率

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

呼吸中止指數/每30分鐘 呼吸中止指數/每10分鐘 平均呼吸中止指數

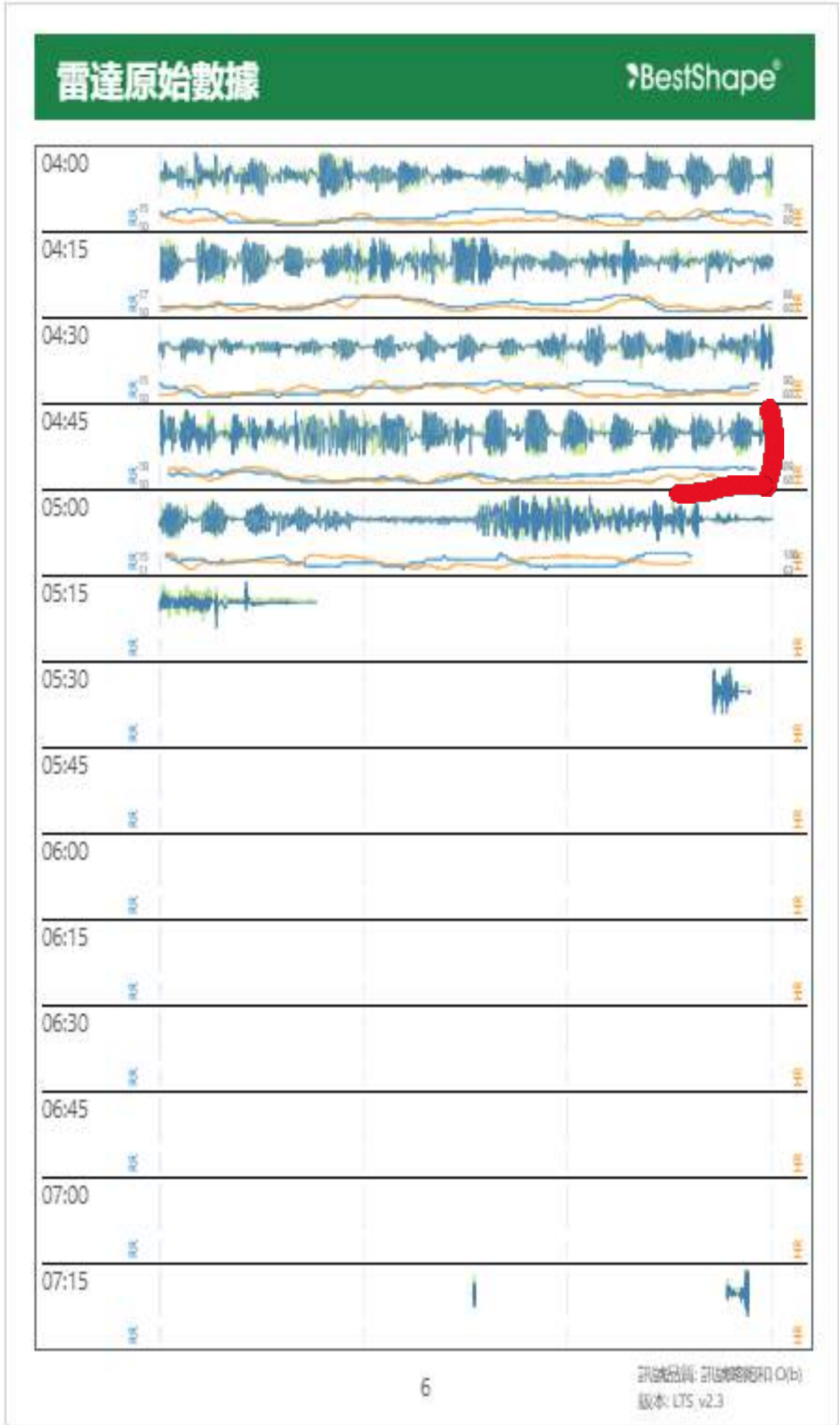
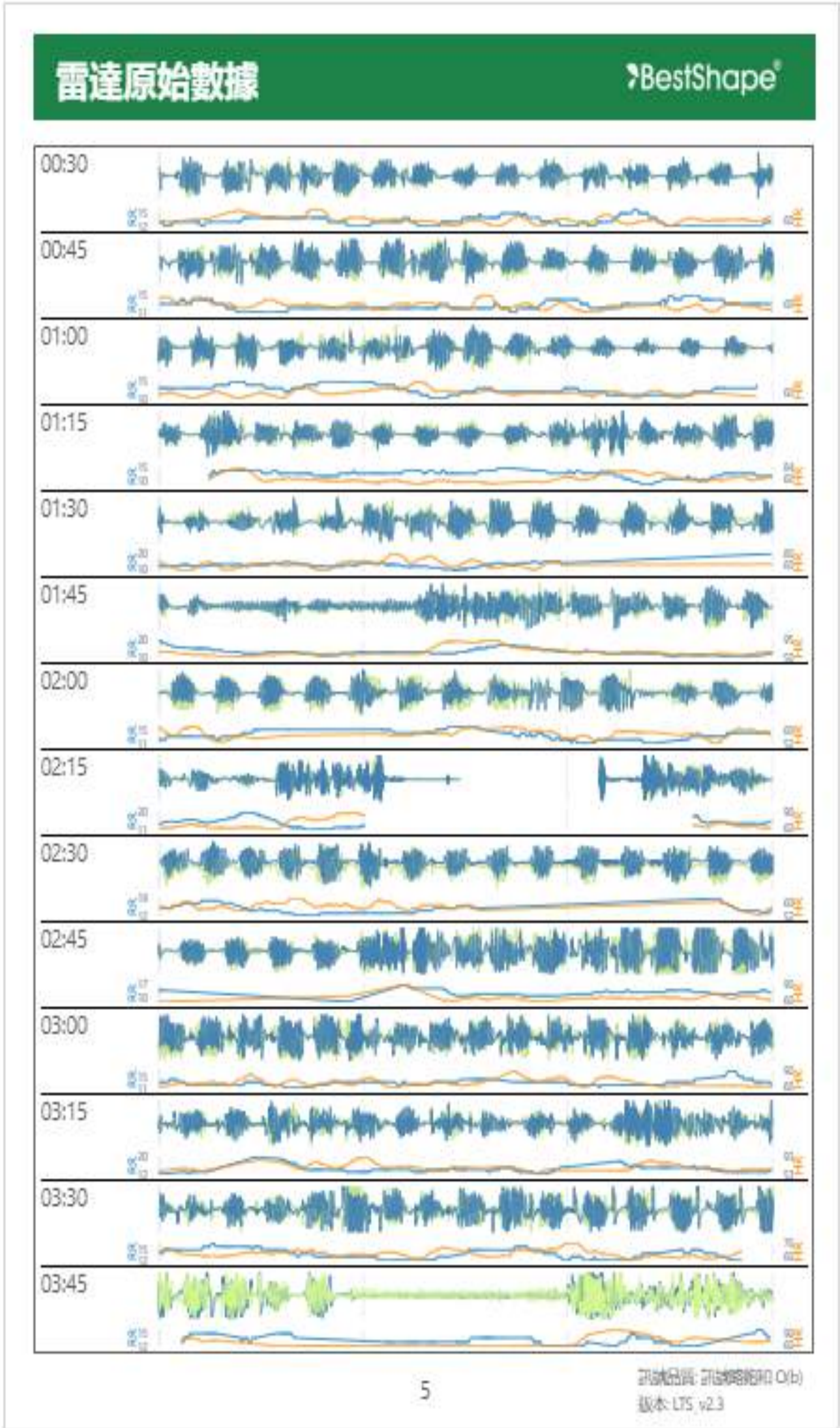
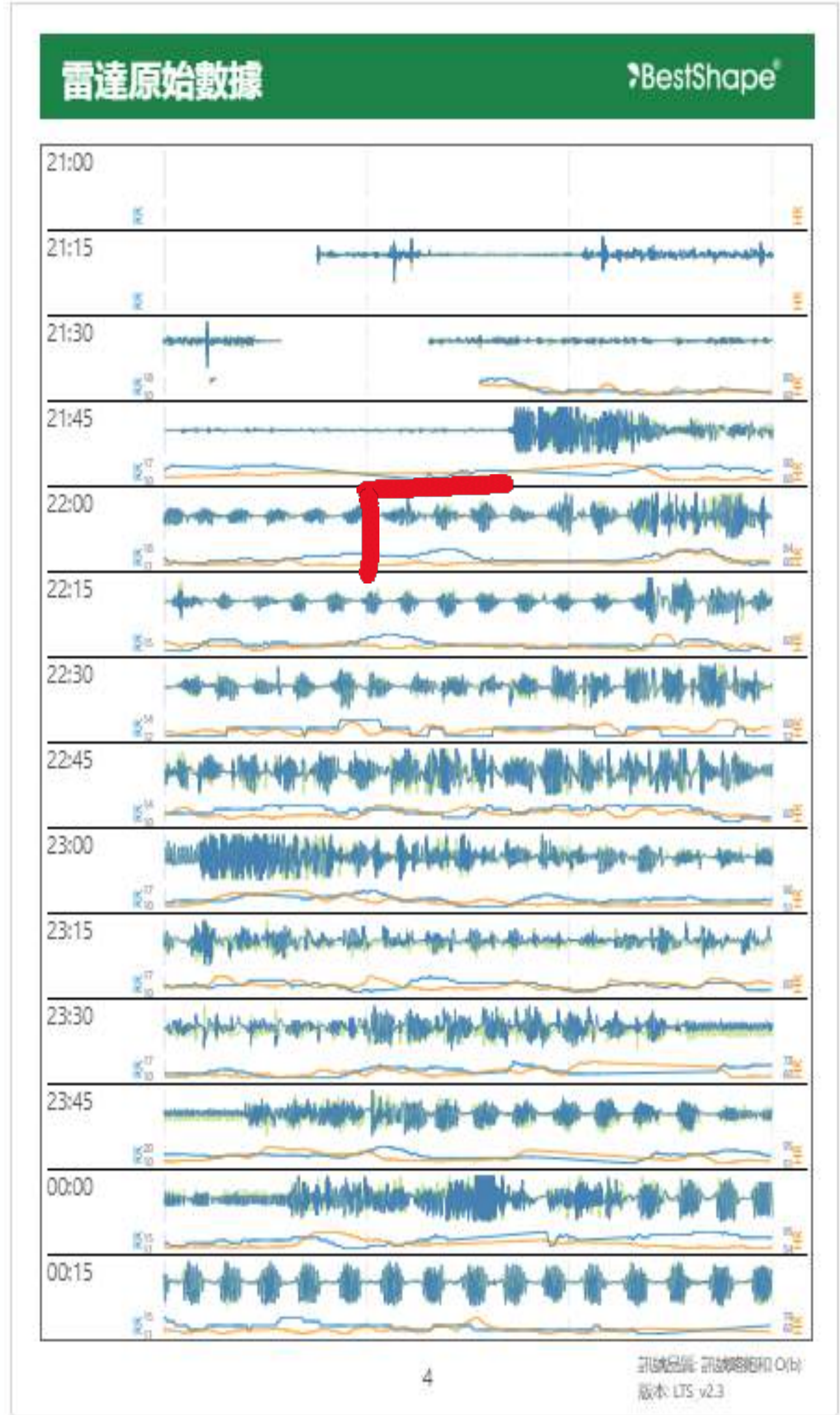
22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00

3

測試設備: 訊感睡眠和 O(b)
版本: LTS v2.3



Non-Wearable sensors for sleep, respiration and others



1. Sleep-related breathing disorders



2. Prediction of Upcoming Heart Failure



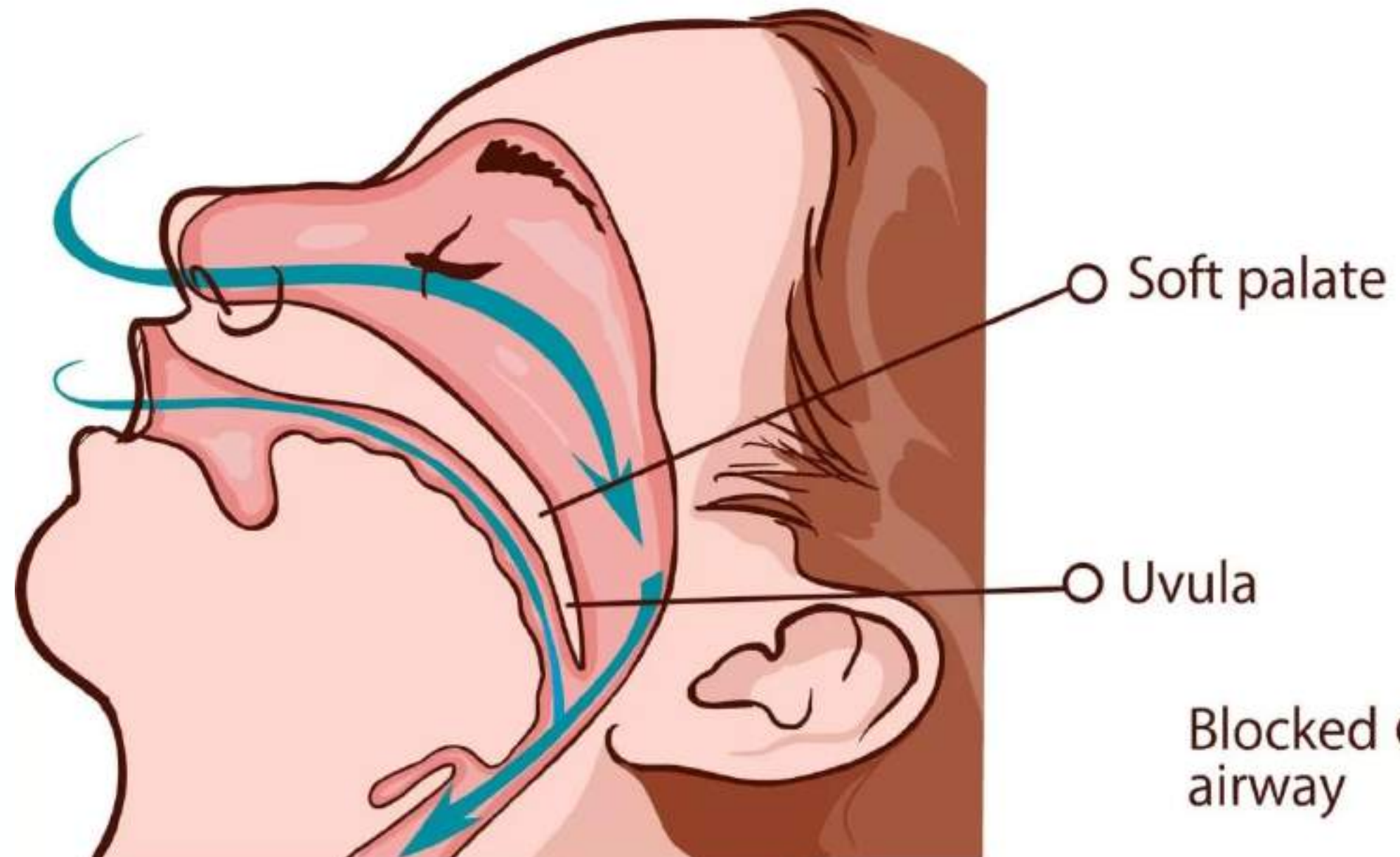
3. Detection of **Preceding** Sleep Apnea



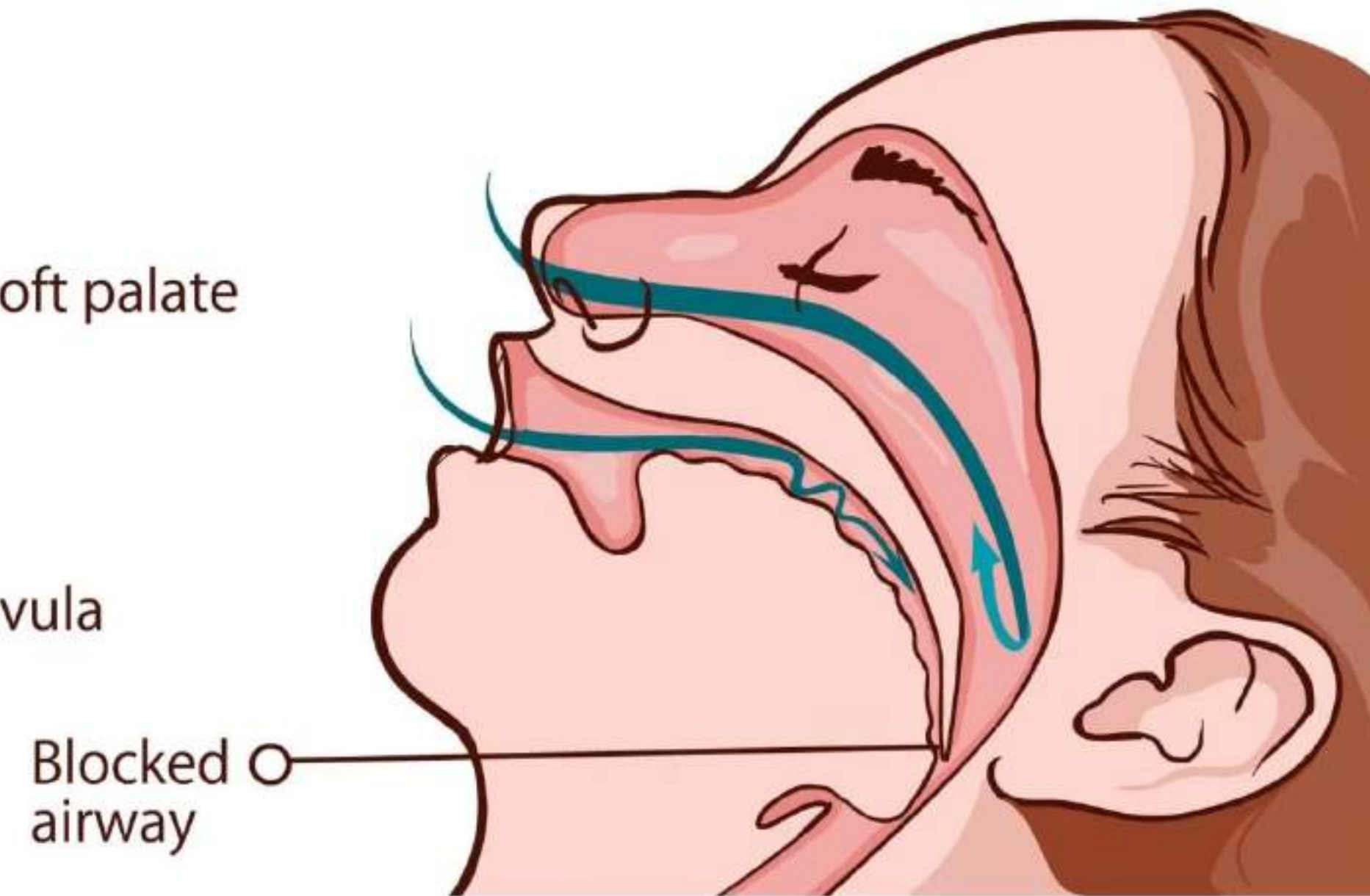
4. Respiratory Sinus Arrhythmia: **Coupling**

Detection of Preceding Sleep Apnea

Normal airway

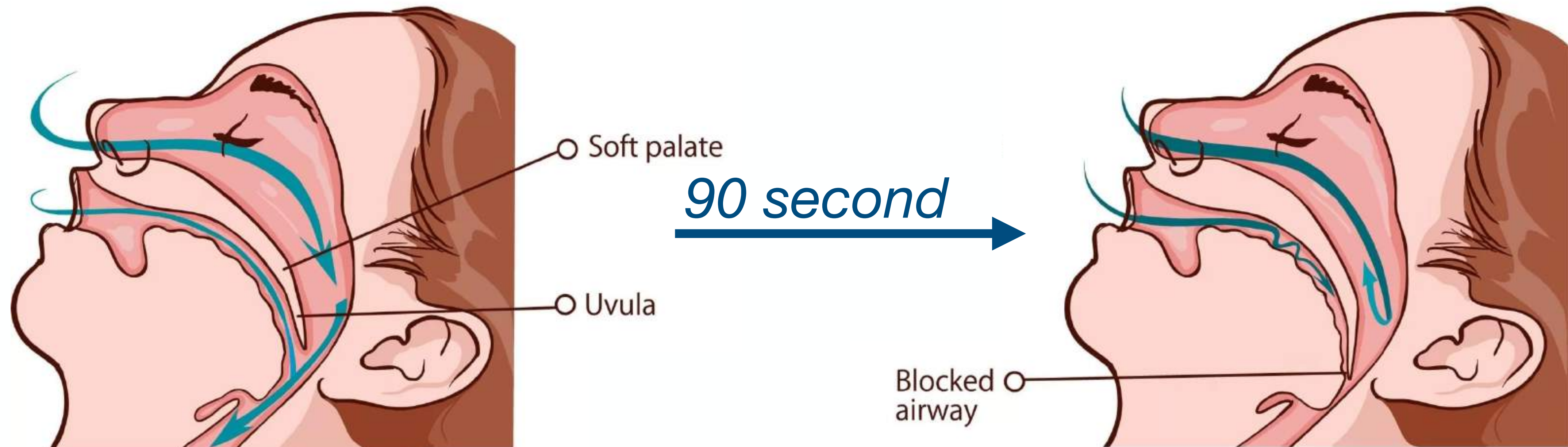


Sleep apnea

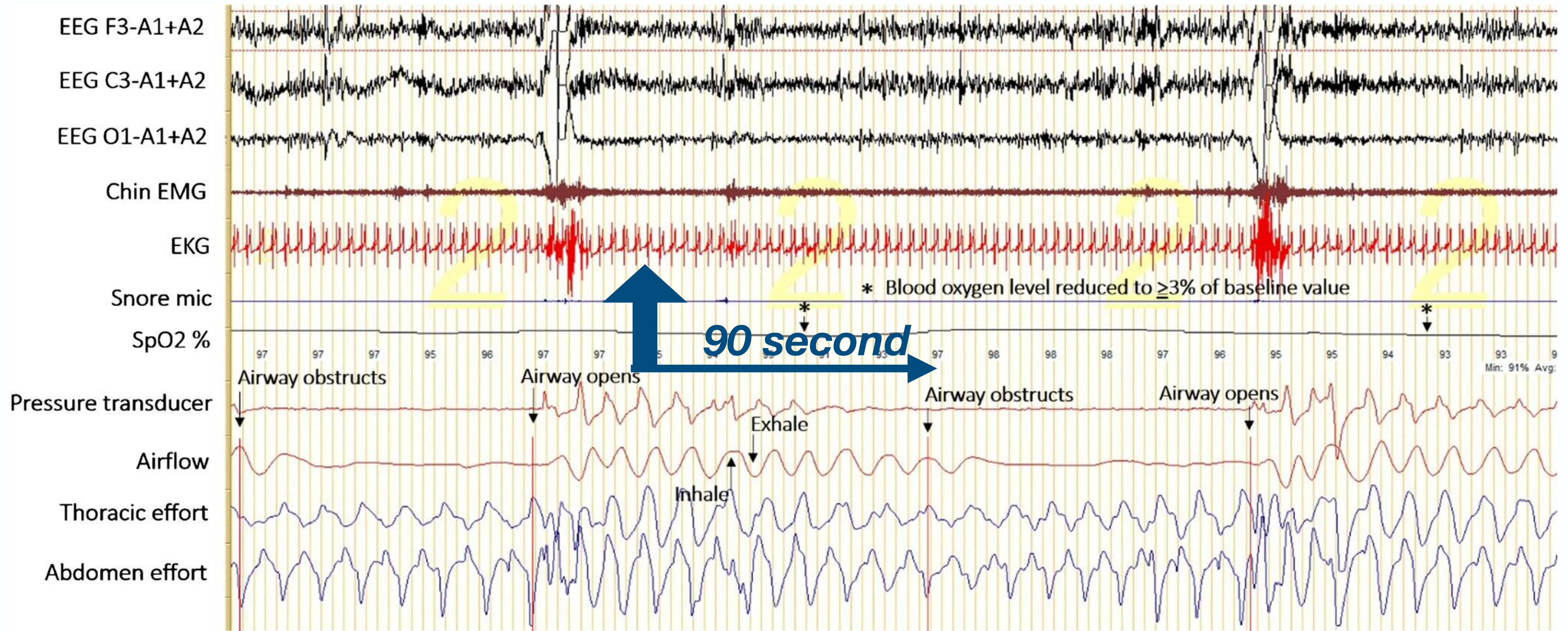


Detection of Preceding Sleep Apnea

Normal airway → 事前予測 → Sleep apnea



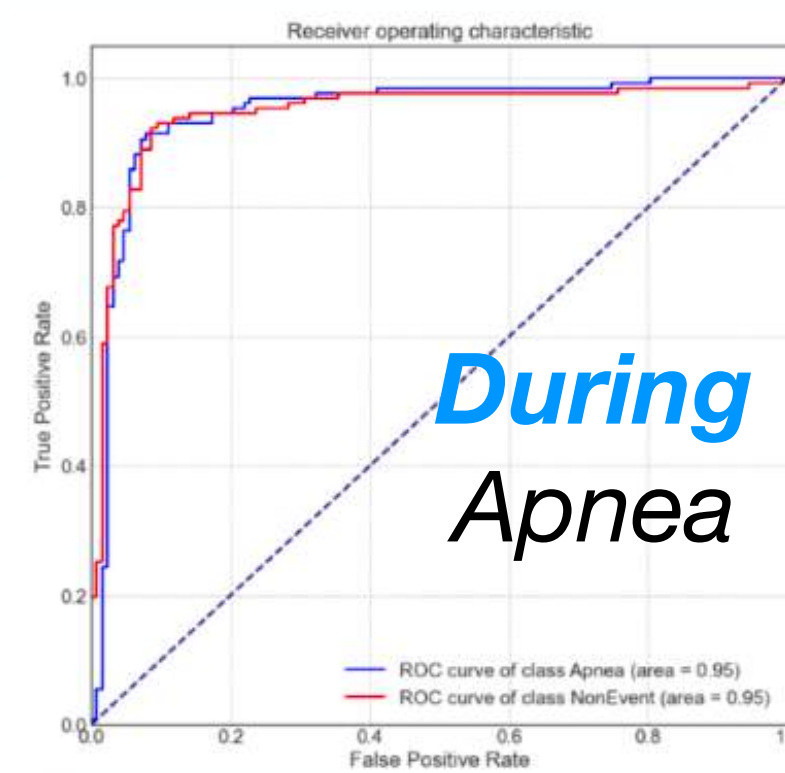
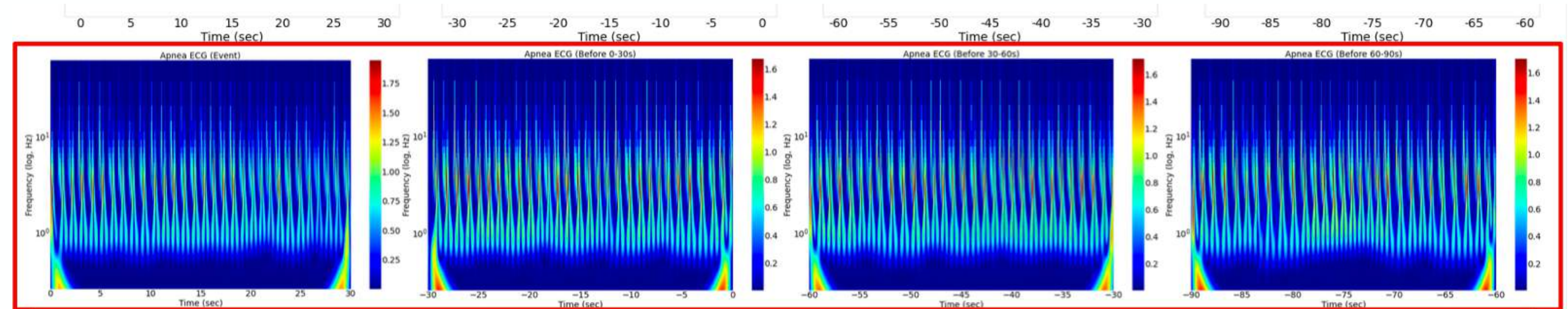
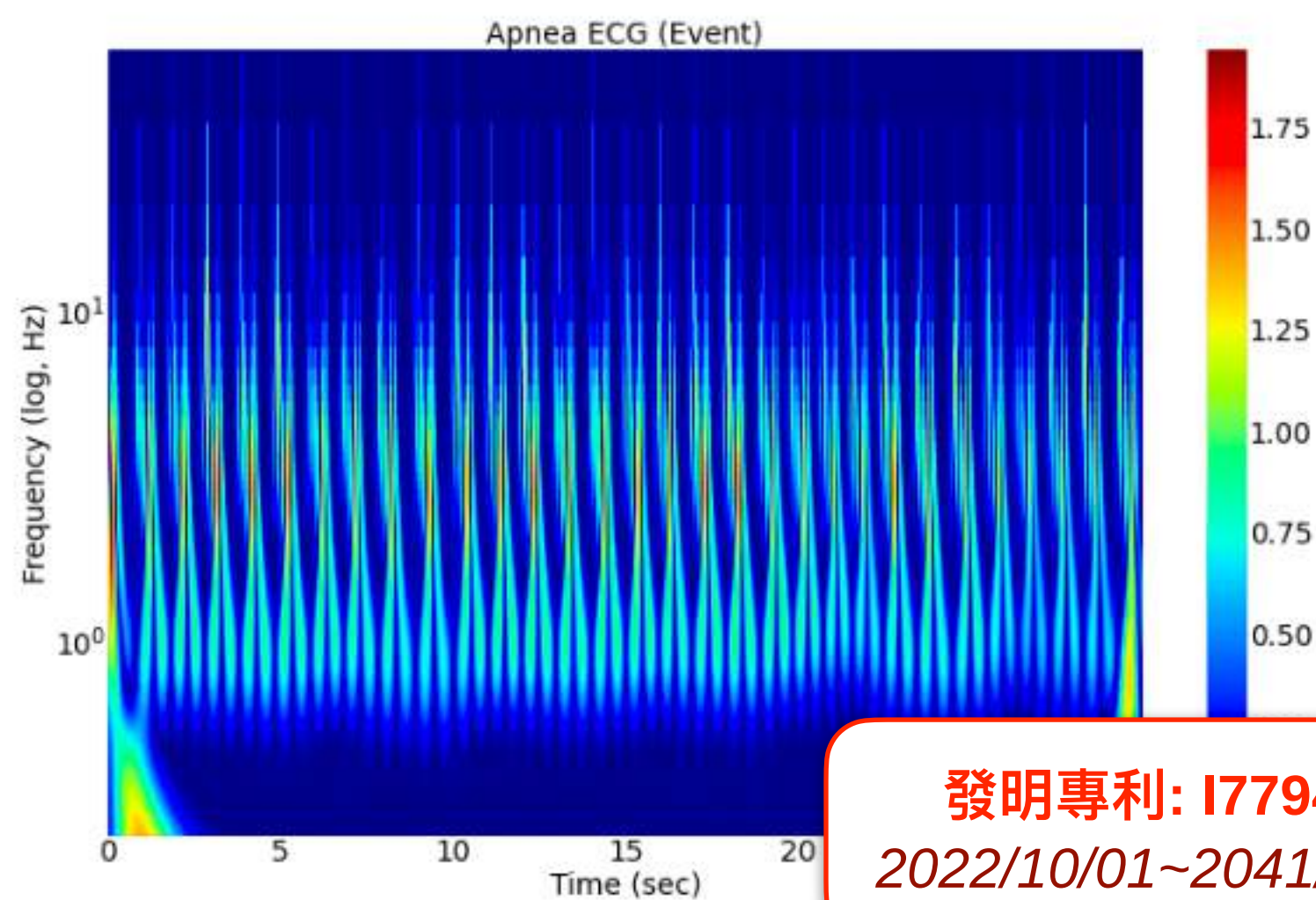
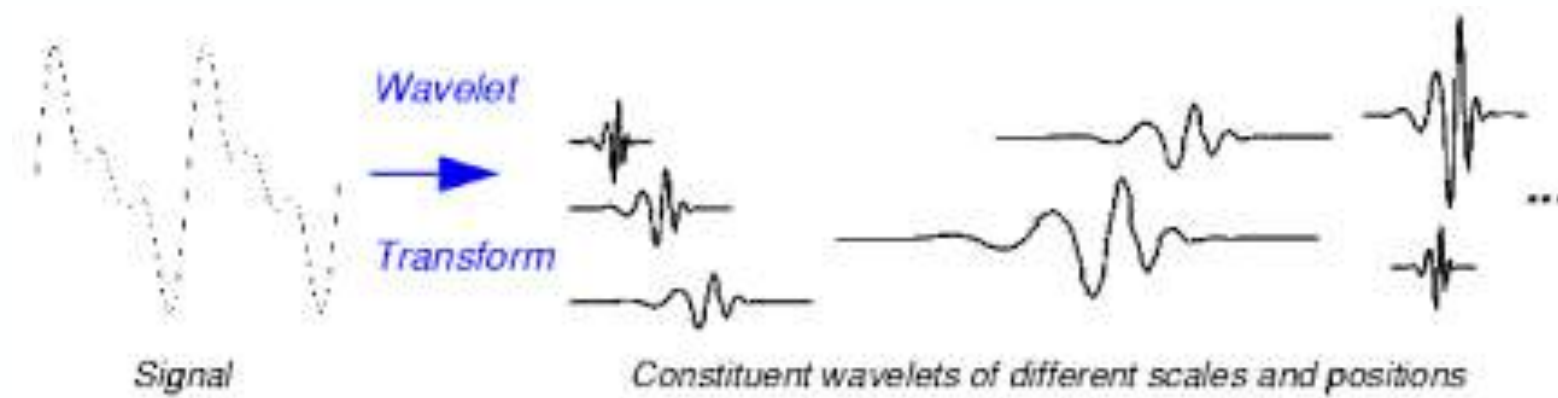
Detection of Preceding Sleep Apnea



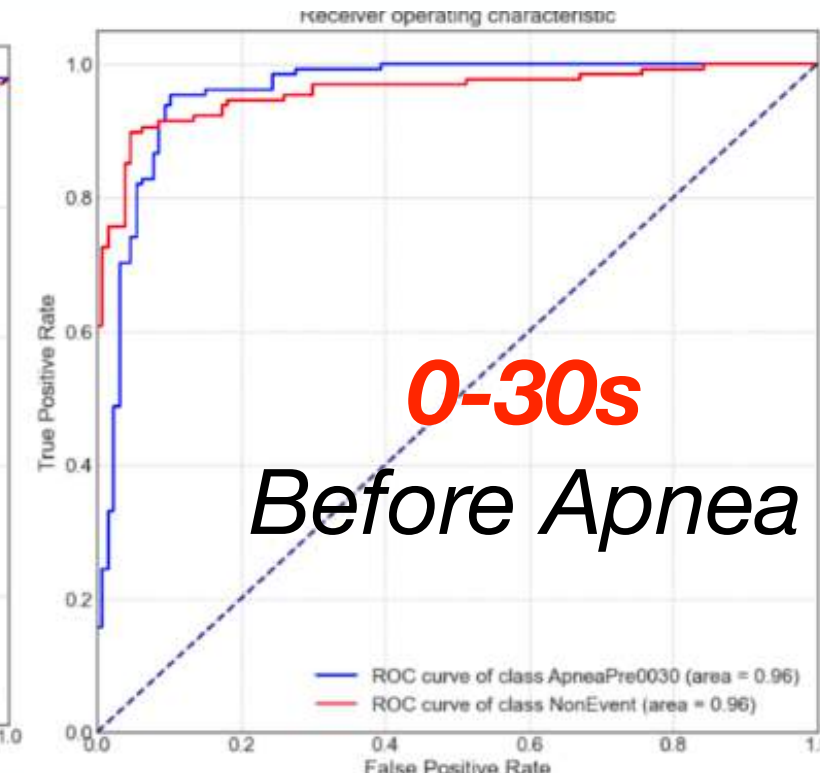
Prediction of Preceding Apnea/Hypopnea events

Continuous Wavelet Transform, CWT

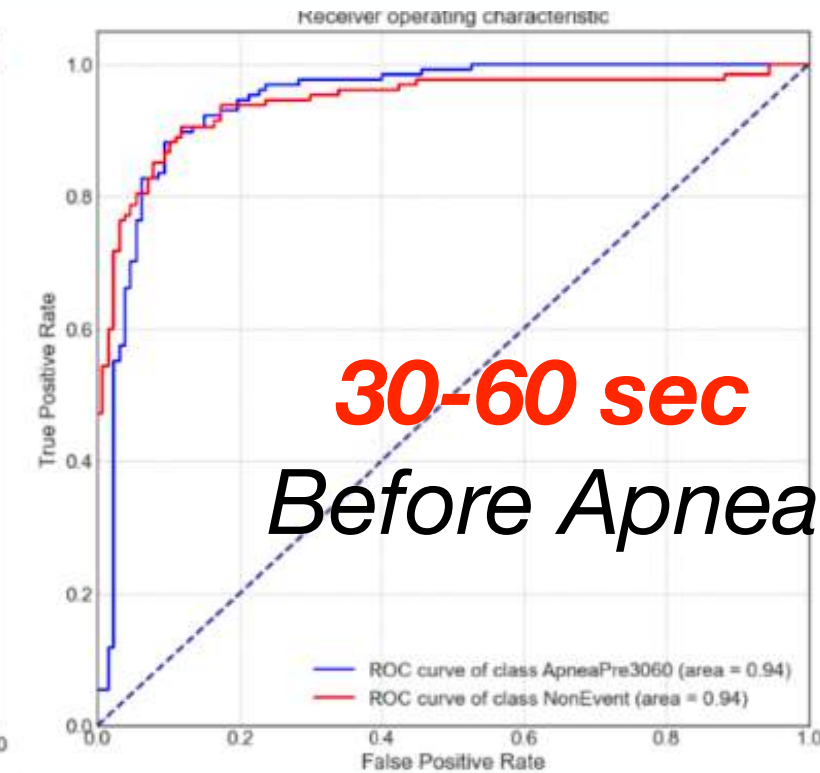
ECG/PPG: Scalogram



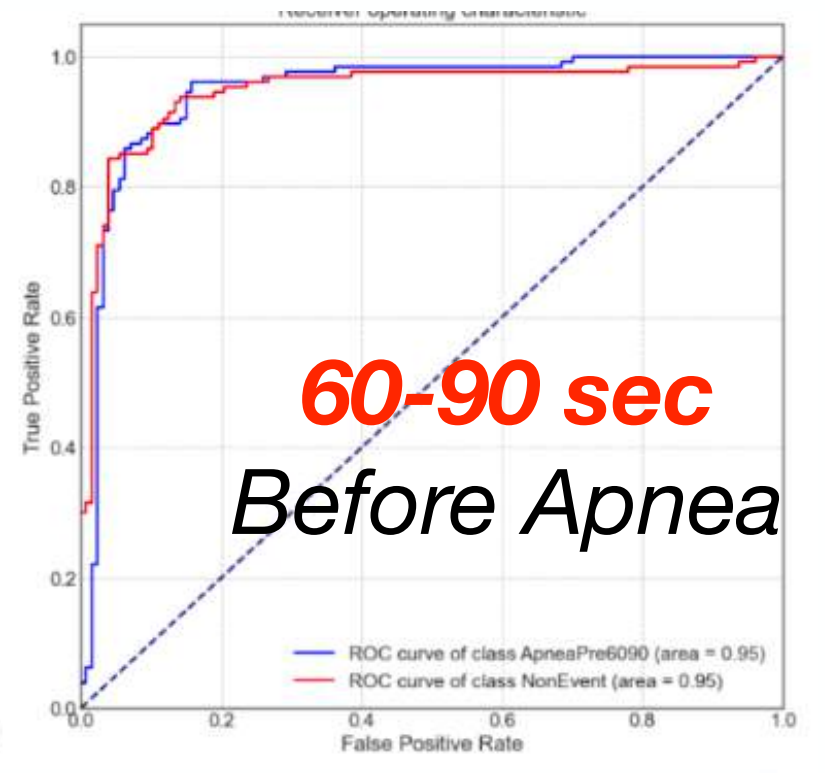
During
Apnea



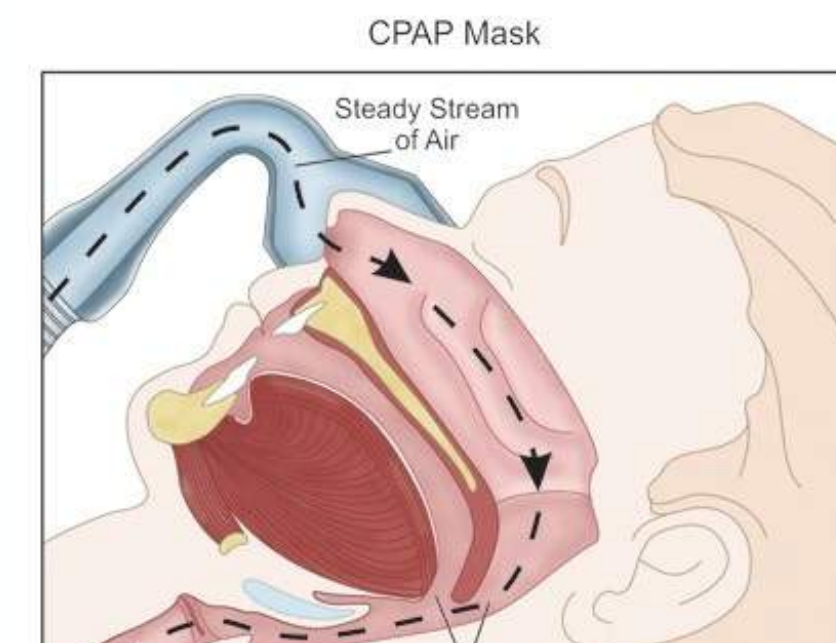
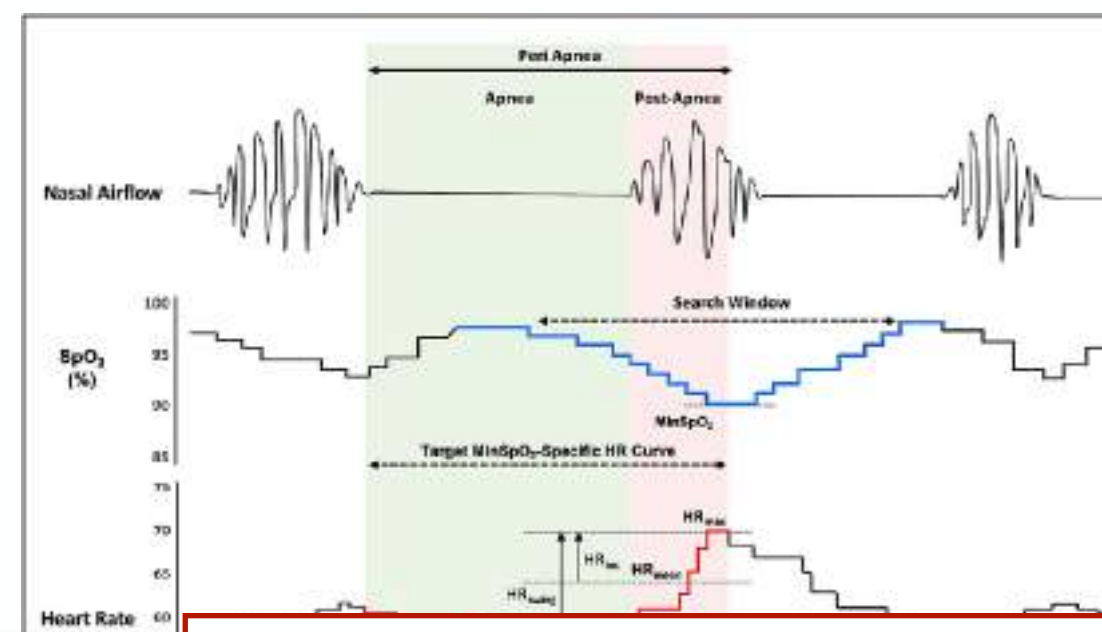
0-30s
Before Apnea



30-60 sec
Before Apnea



60-90 sec
Before Apnea



CPAP for OSA

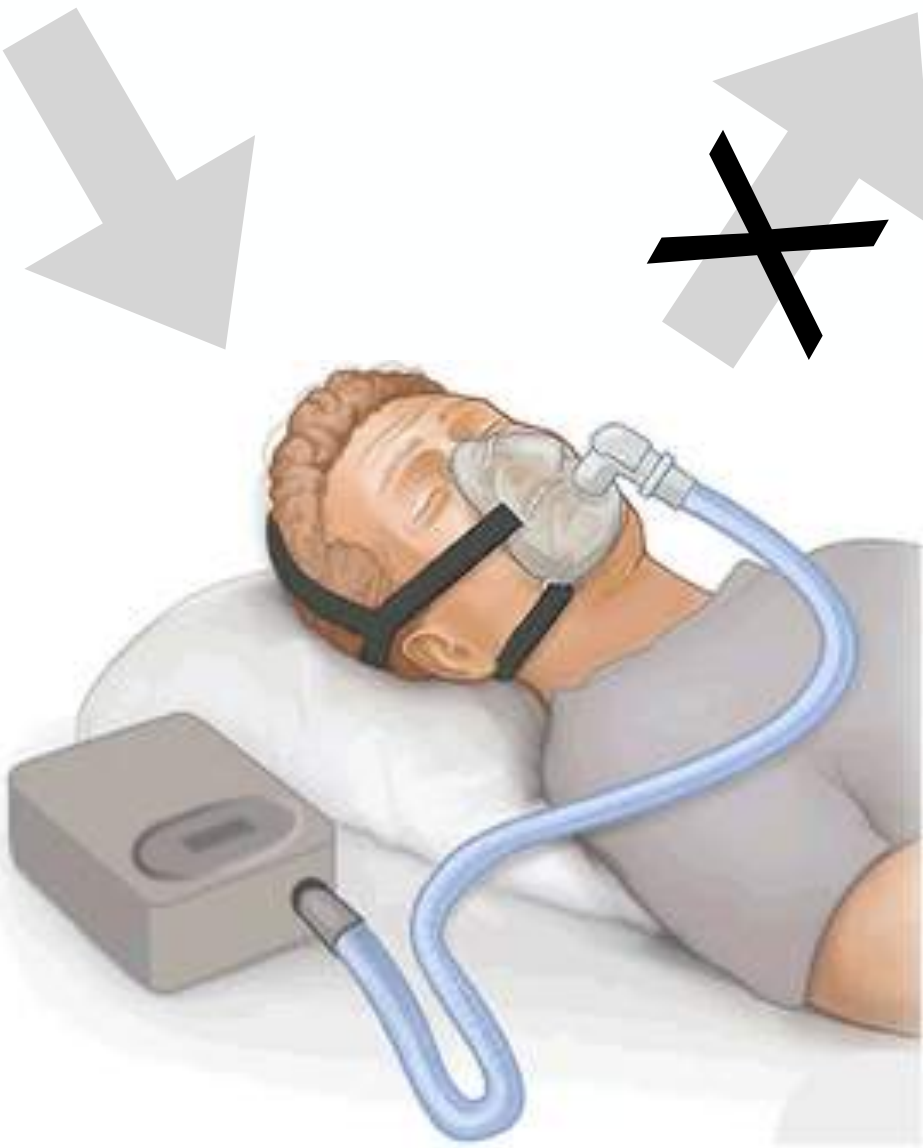
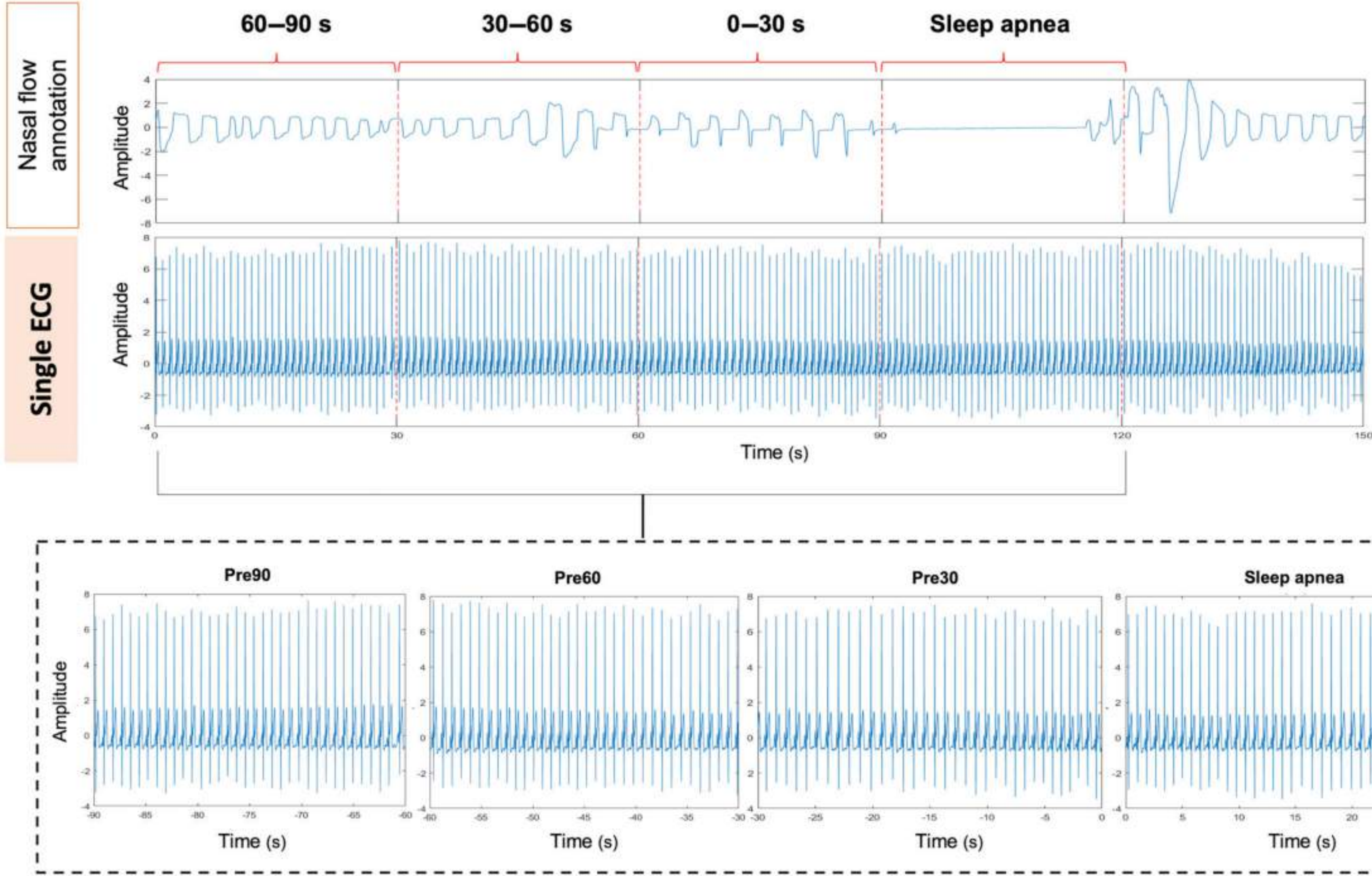
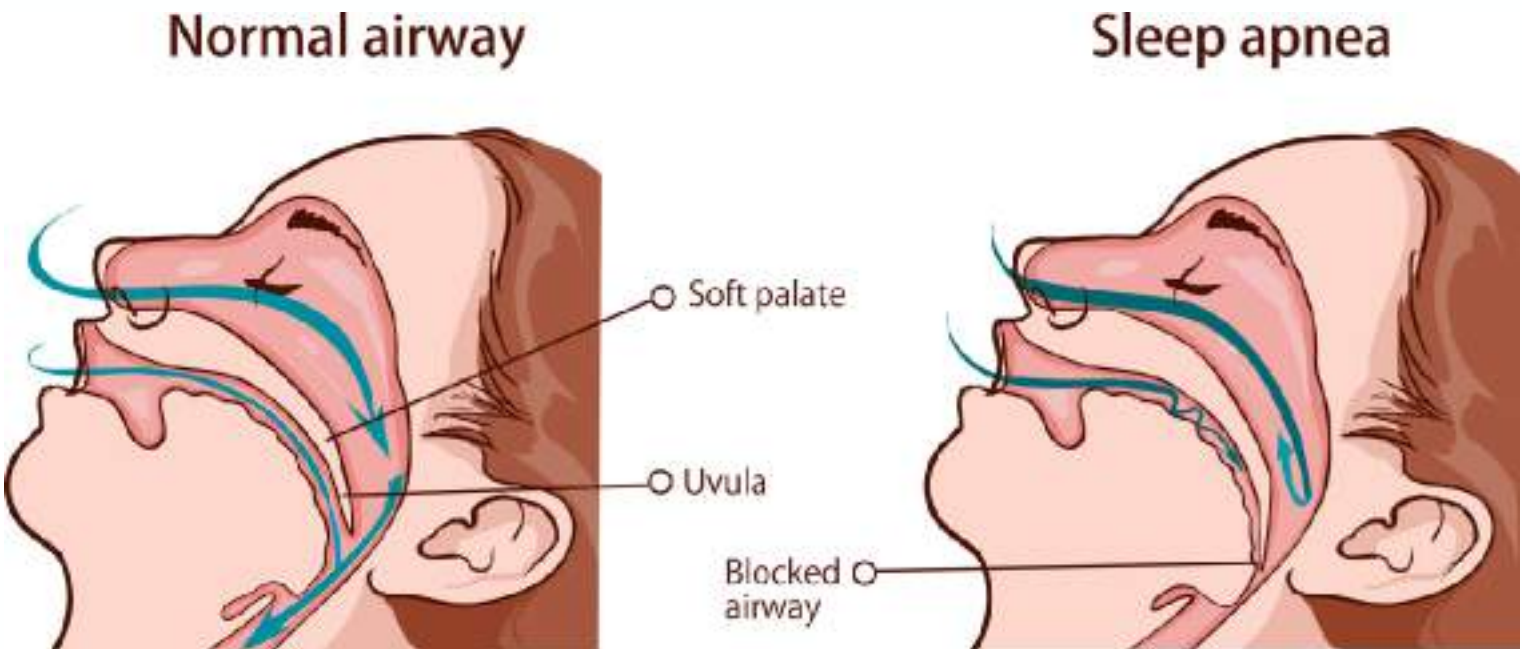
Elevating Pressure
BEFORE
Apnea / Hypopnea
developed

發明專利: I779486
2022/10/01~2041/02/08

呼吸裝置以及呼吸裝置輸出氣流調整方法
BREATHING DEVICE AND METHOD FOR ADJUSTING
OUTPUT AIRFLOW OF BREATHING DEVICE

Detection of preceding sleep apnea using ECG spectrogram during CPAP titration night: A novel machine-learning and bag-of-features framework

J Sleep Res. 2023 Jul 4.

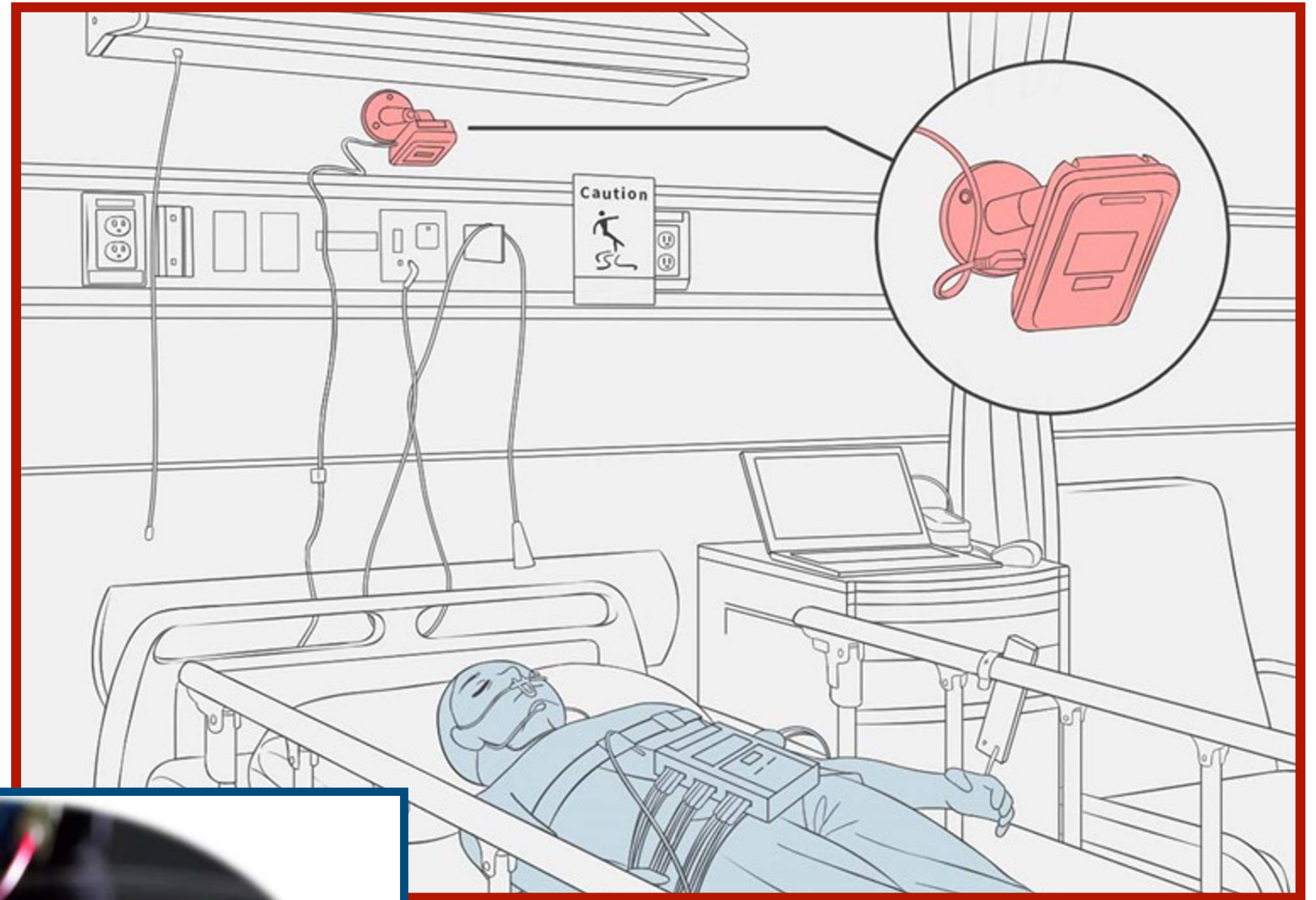


發明專利: I814663
2023/09/01~2042/12/11

睡眠異常呼吸事件預測及調控系統、方法以及呼吸器裝置
PREDICTION AND REGULATION SYSTEM AND
METHOD FOR ABNORMAL RESPIRATORY EVENT IN
SLEEP DURATION AND RESPIRATOR DEVICE

FIGURE 2 Feature preprocessing and segmentation.

毫米波雷達 生理監測技術

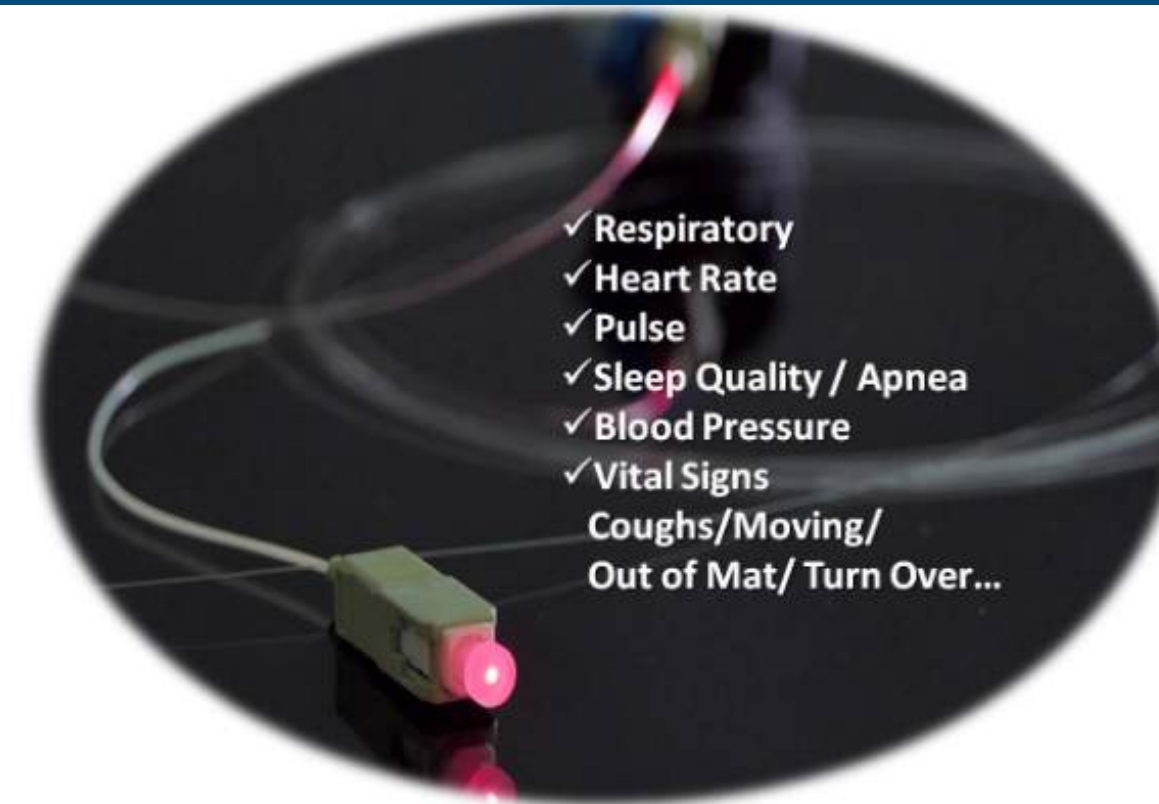
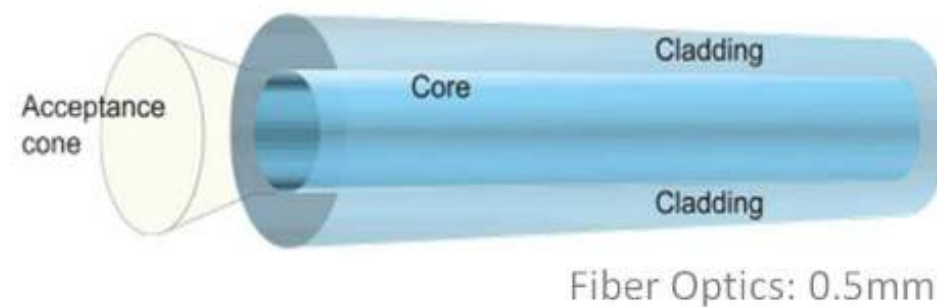


Technology
nFOPT®

Non-invasive
Fiber Optic
Physiological Monitoring
Technology



28 patents protected



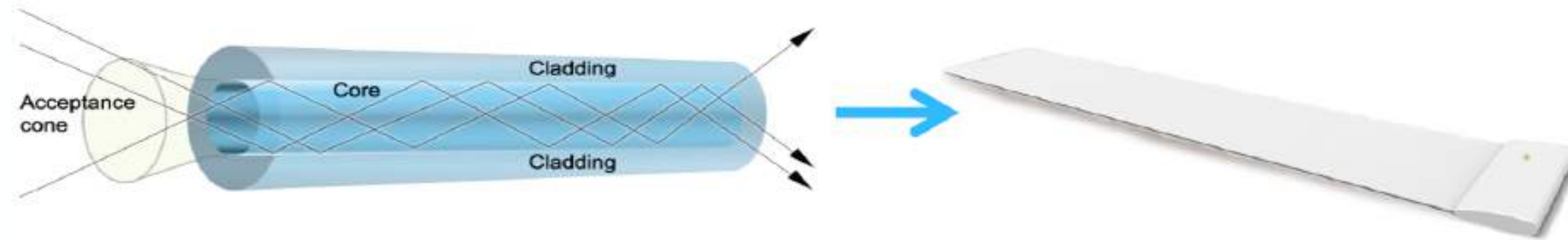
Smart Film Sensor: 2mm
Put under Pillow or Bed Cover



非侵入性 光纖生理監測技術

Core Technology – nFOPT

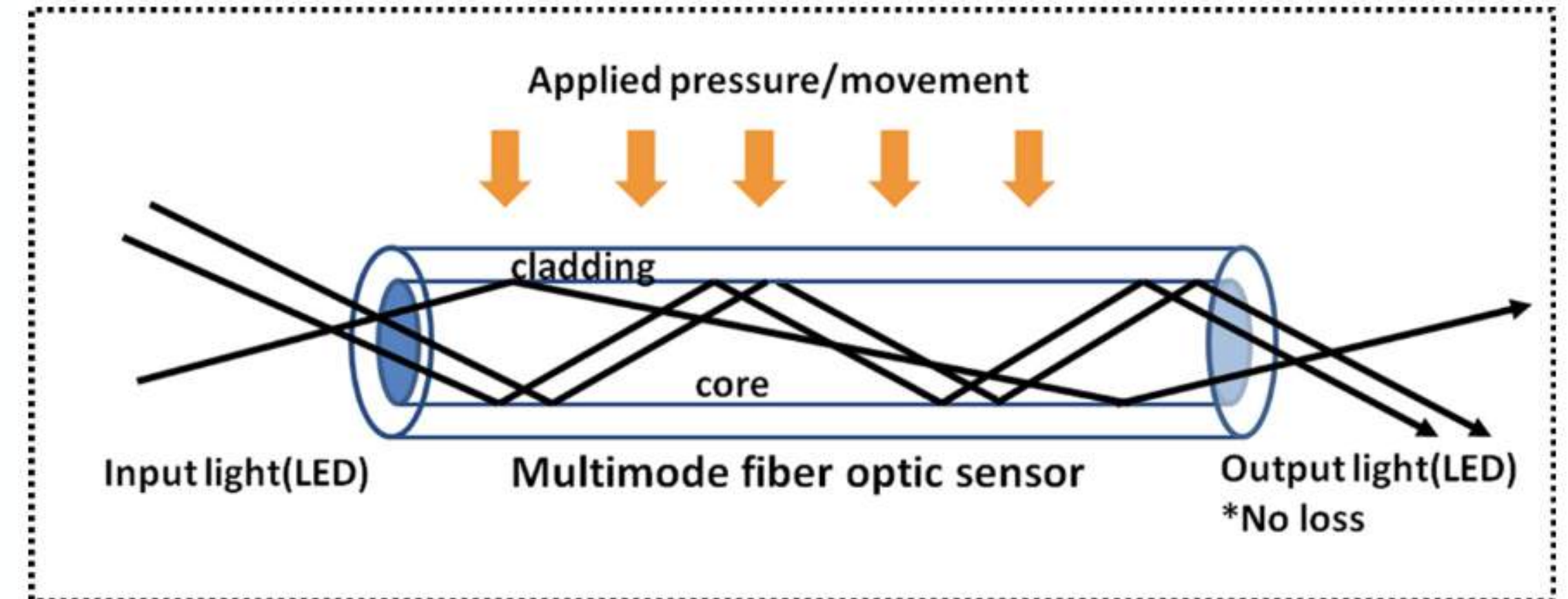
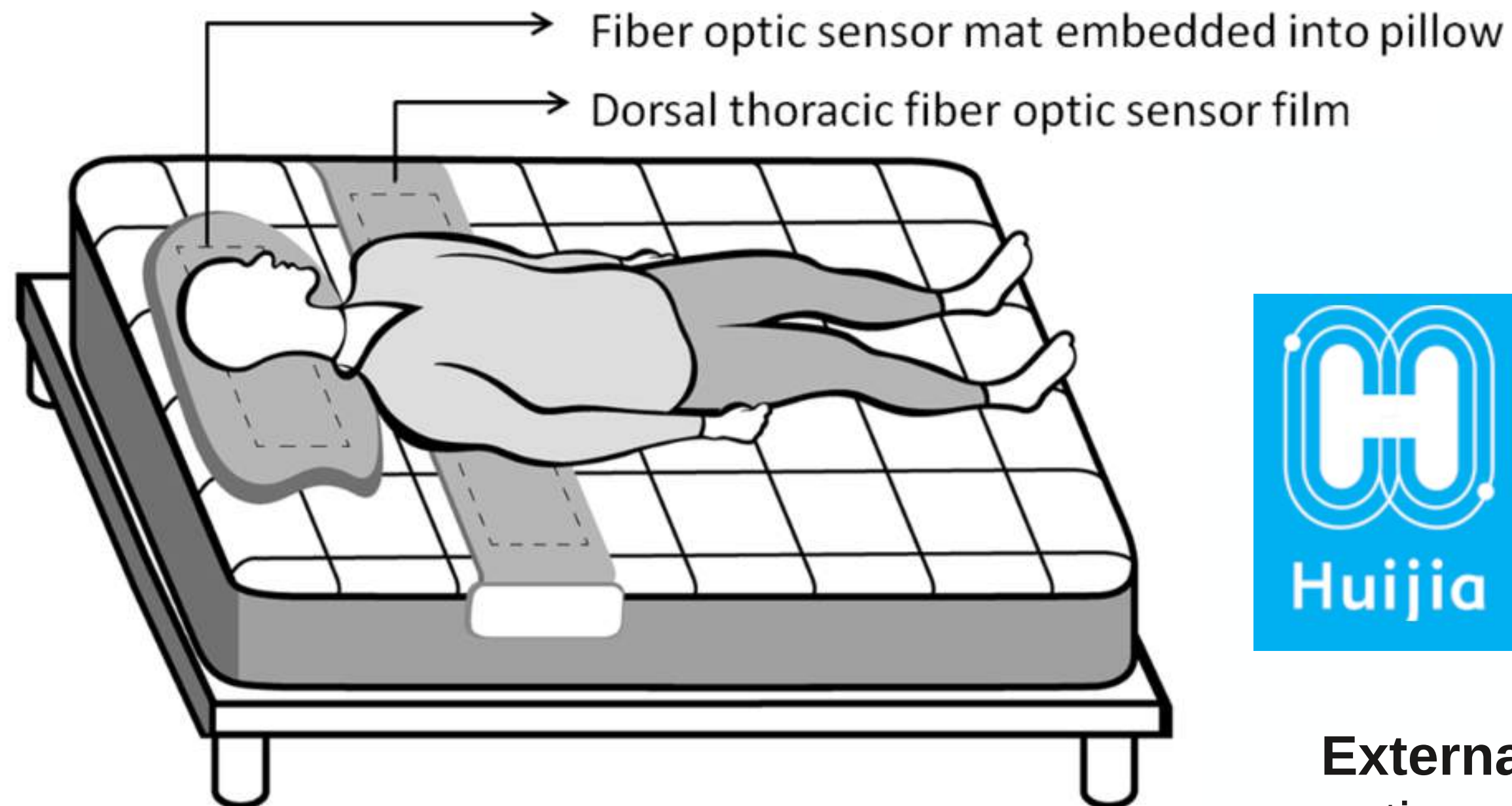
Non-invasive Fiber Optic Physiological Monitoring Technology



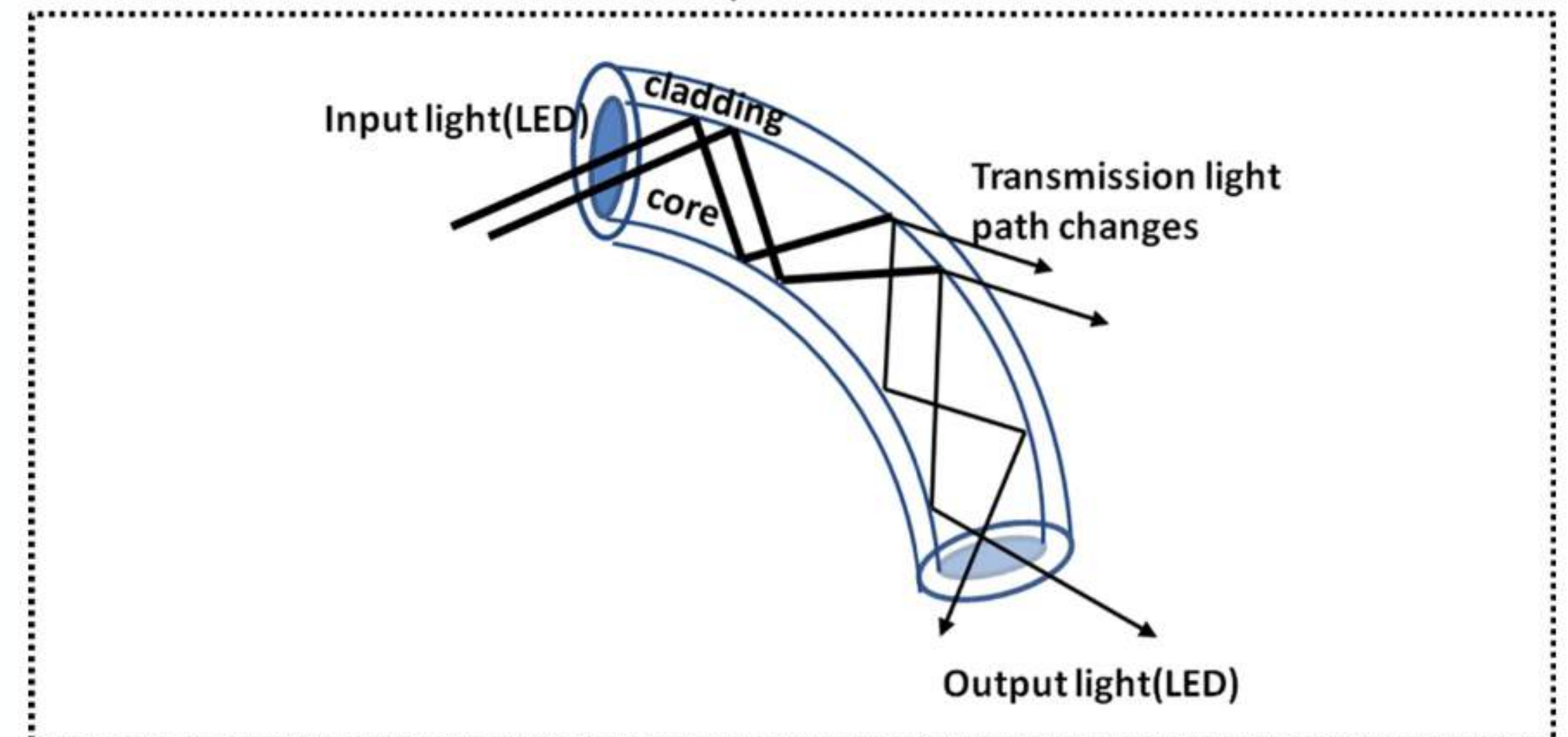
Total Reflection Principle

Fiber Optics: 0.5mm

Smart Film Sensor: 2mm
Put under Pillow or Bed Cover



↓ bending



External applied pressure or movement **BENDS** the multimode fiber optic so that the transmission light refracts through the cladding layer, thereby causing an **attenuation of optical intensity**.



第一健康
First HealthCare

華佗健康眠

睡眠管理 · 健康照護

智慧光纖感測薄墊 不穿不戴、貼心守護！

核心科技

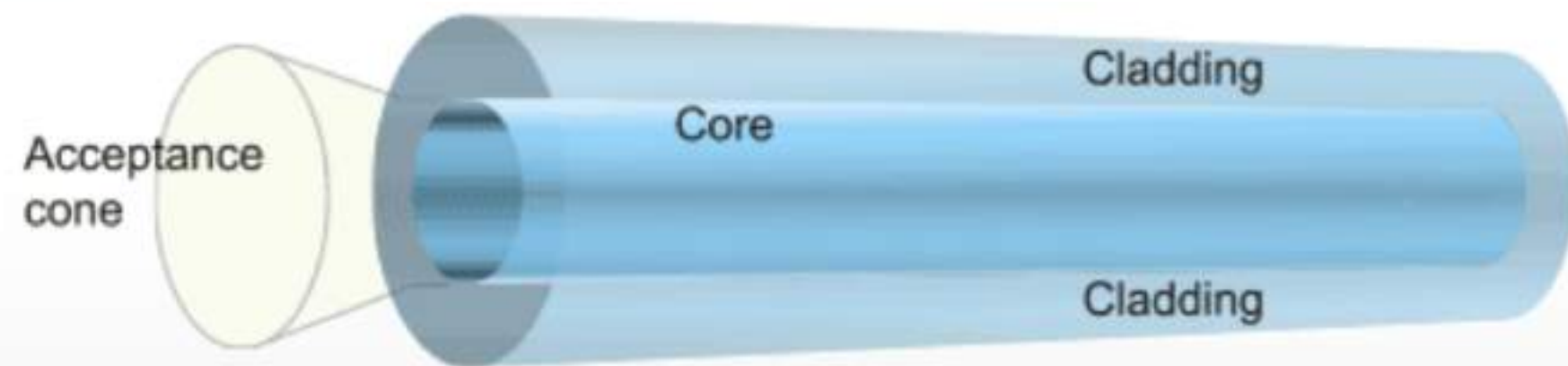
nFOPT®

非侵入性光纖生理監測技術

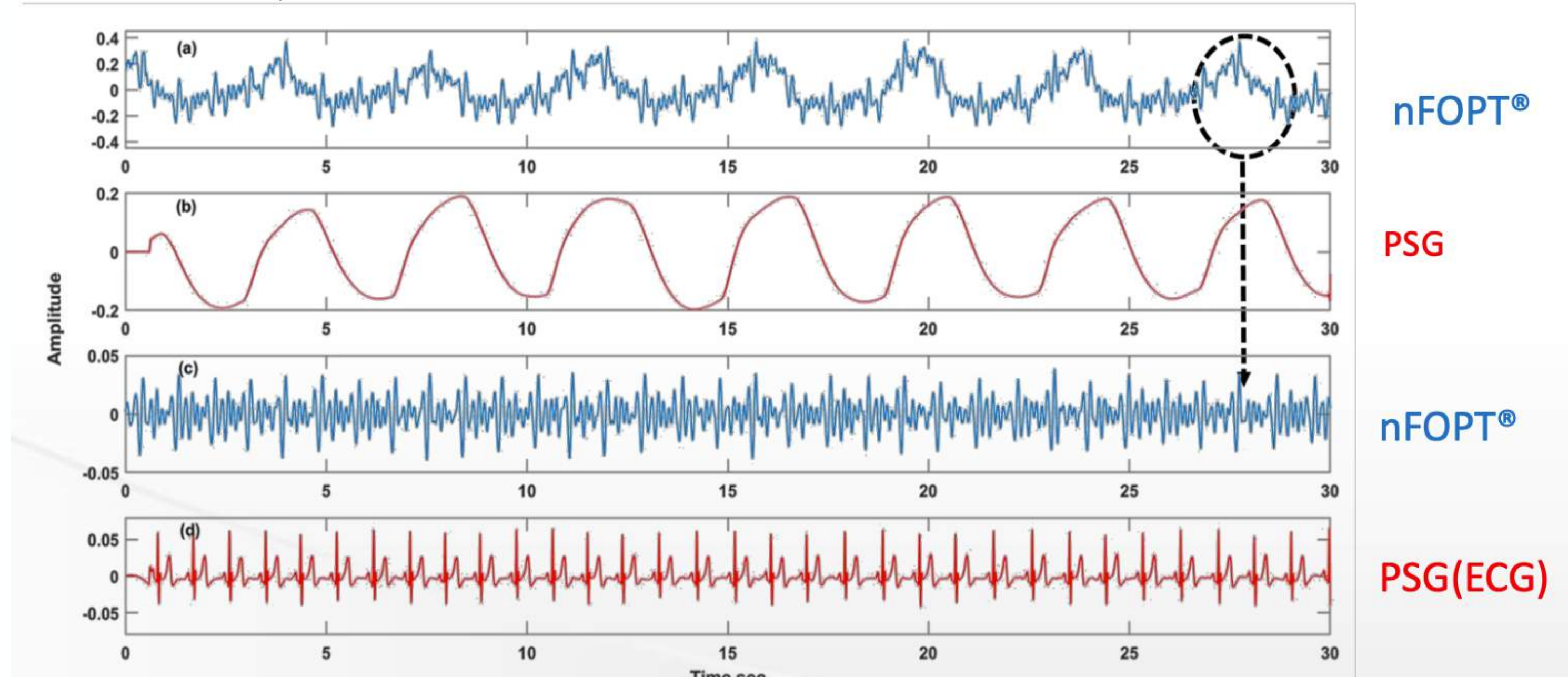
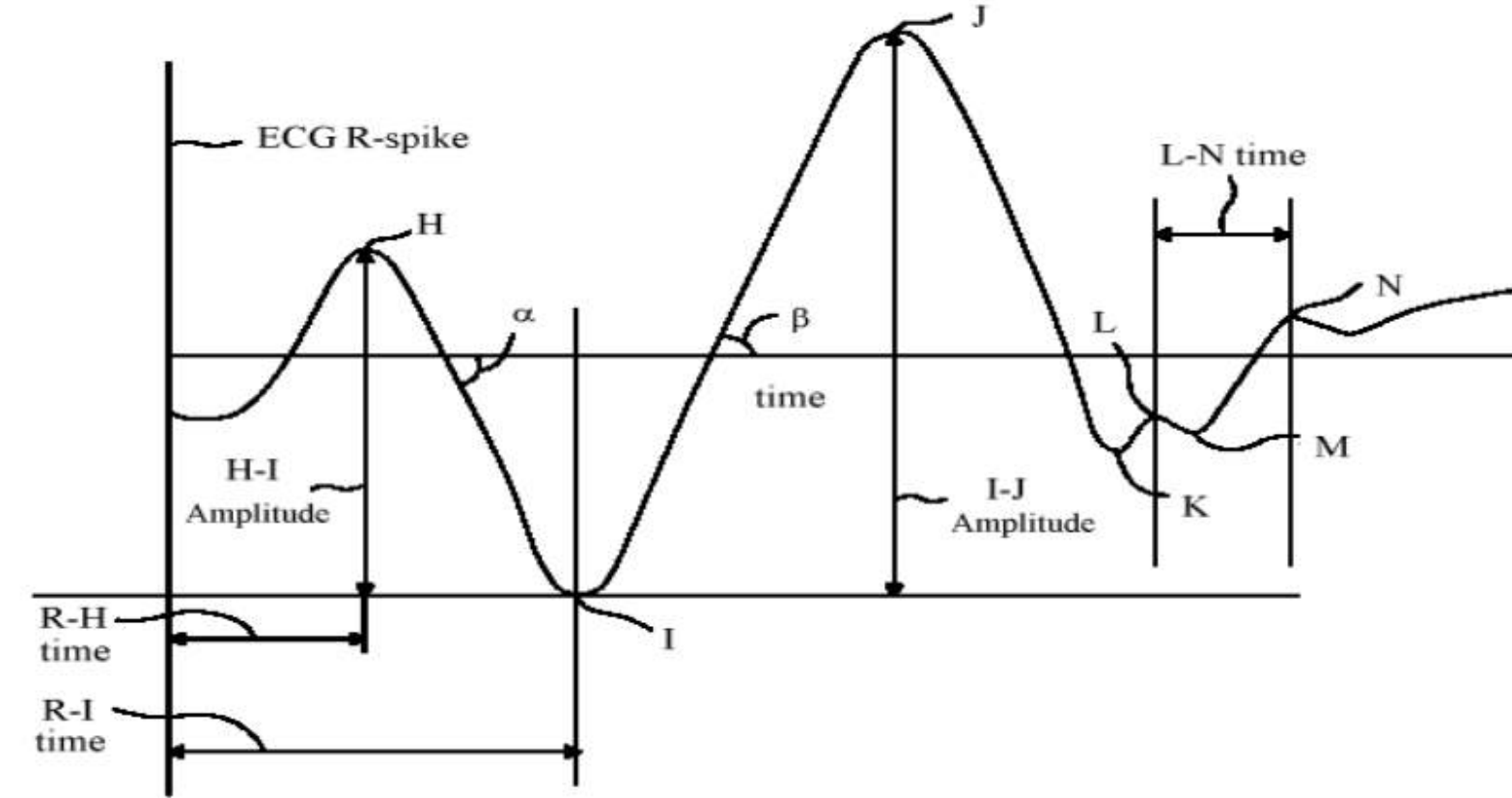
Non-invasive Fiber Optic Physiological Monitoring Technology



28 項專利

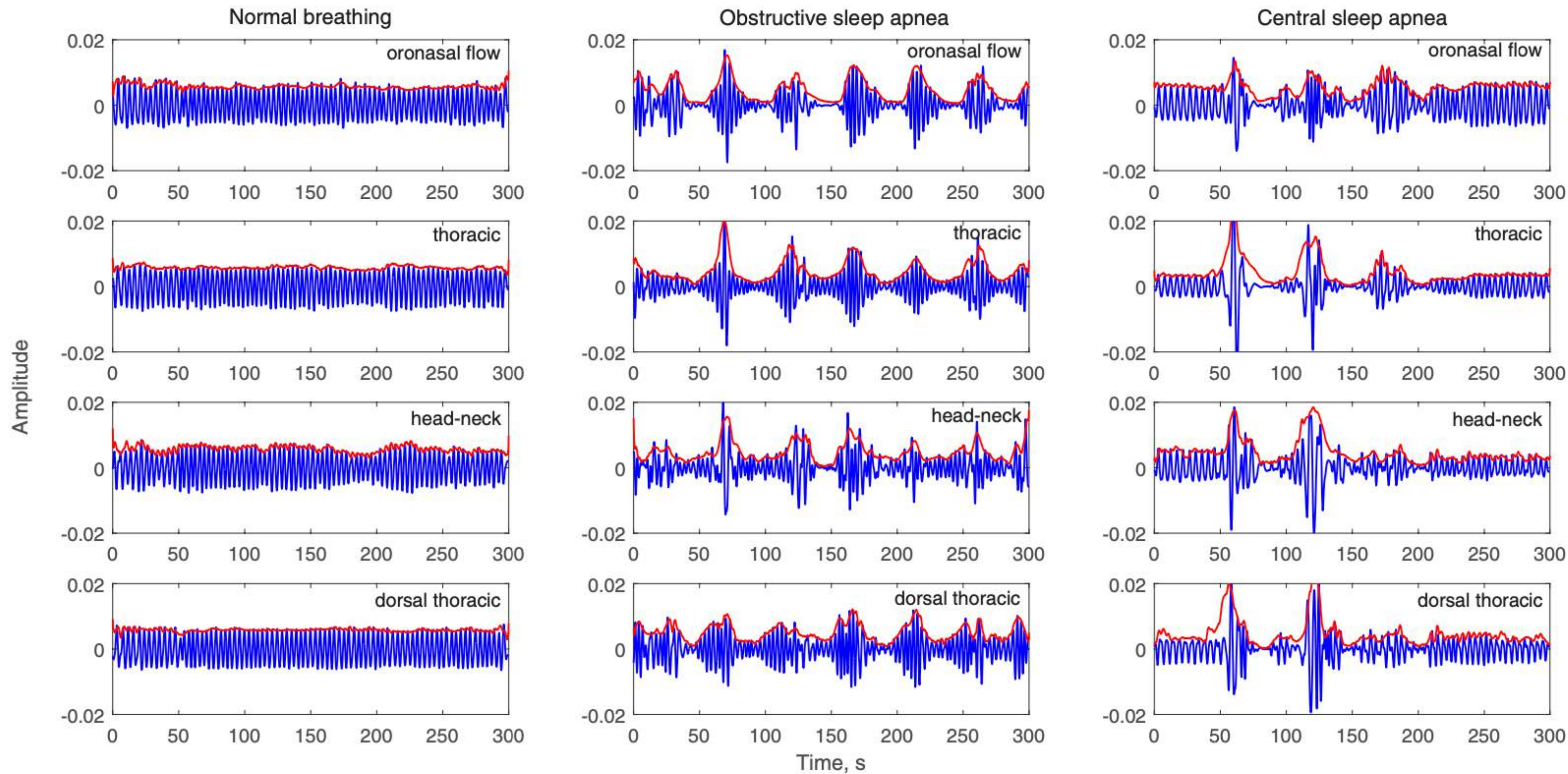


理論基礎: Ballistocardiography (BCG)

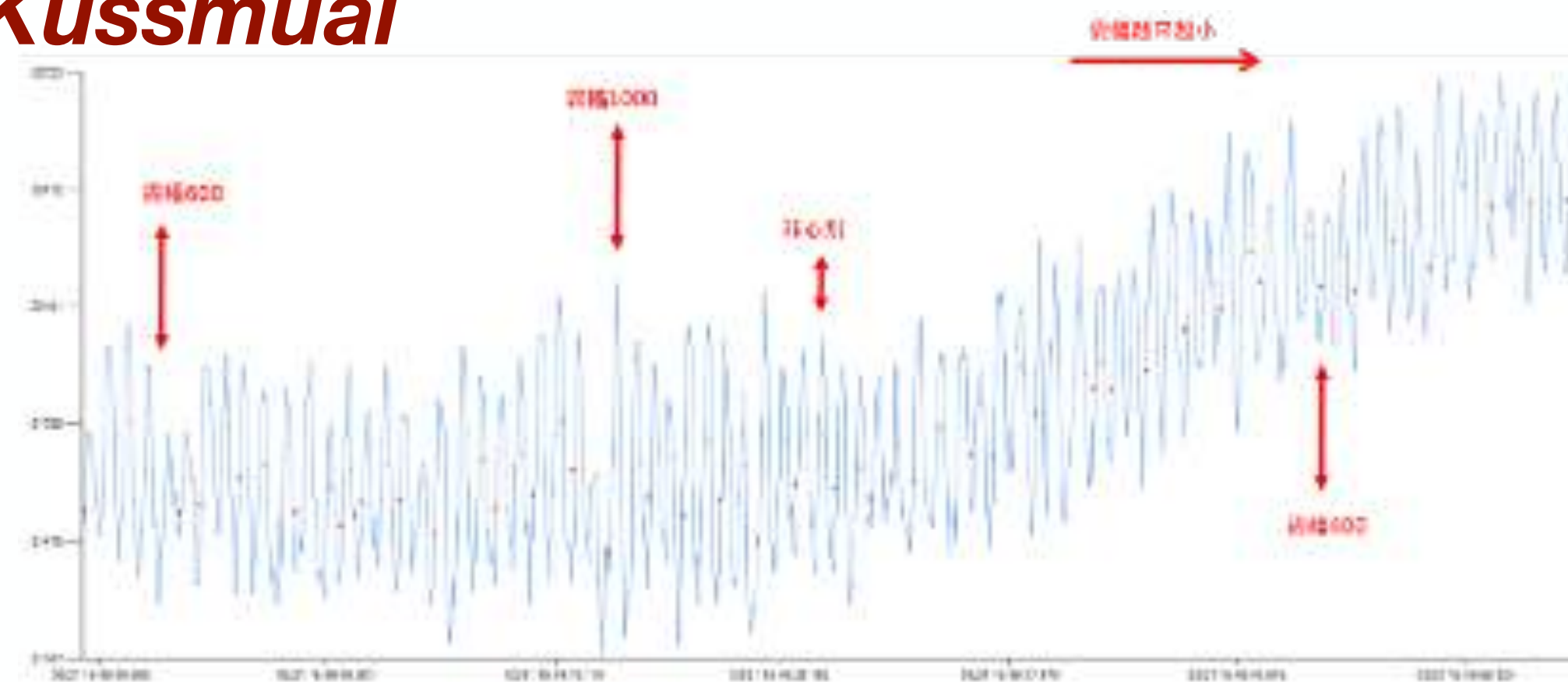


平均在床時間 06小時09分鐘			平均在床時間 06小時18分鐘			設定敏感度		高
紀錄說明 呼吸紀錄 活動紀錄			紀錄說明 呼吸紀錄 活動紀錄			設定遠端連線密碼		
						遠端連線密碼		

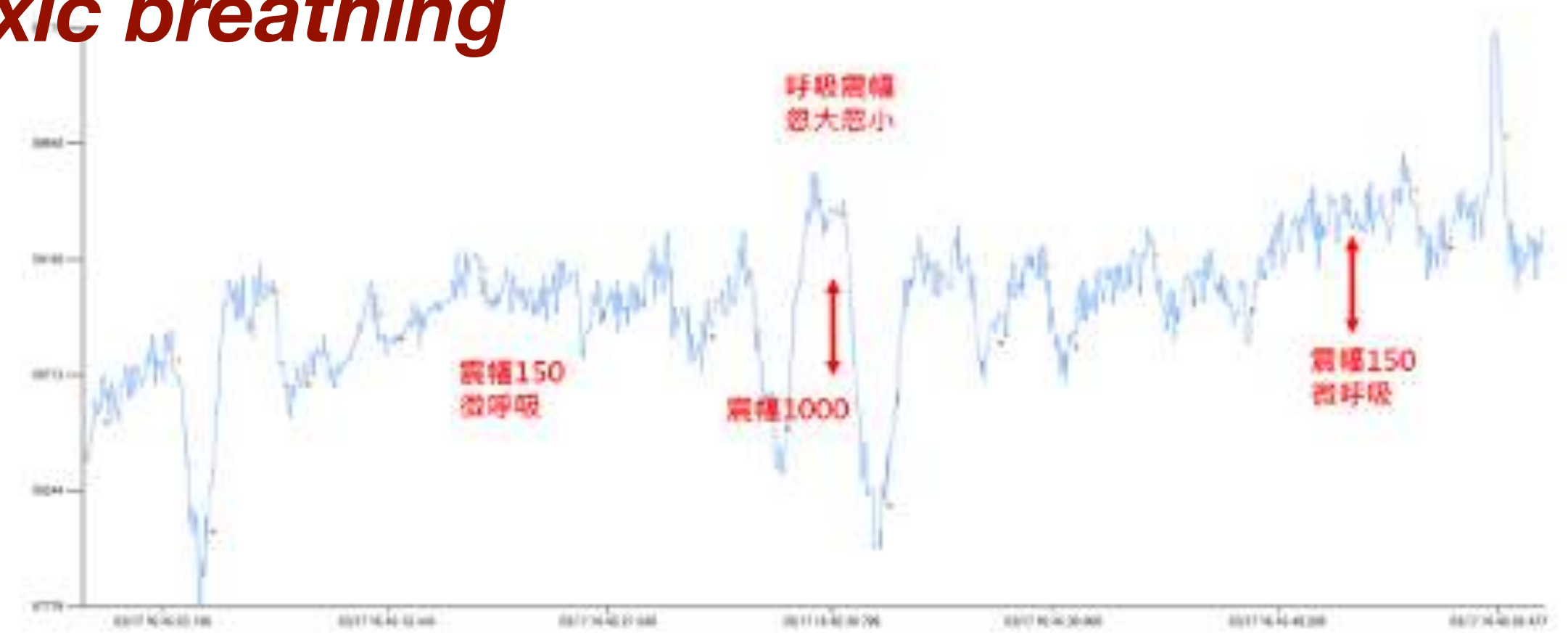
睡眠管理好輕鬆、圖表顯示超清晰、個人化警示設定



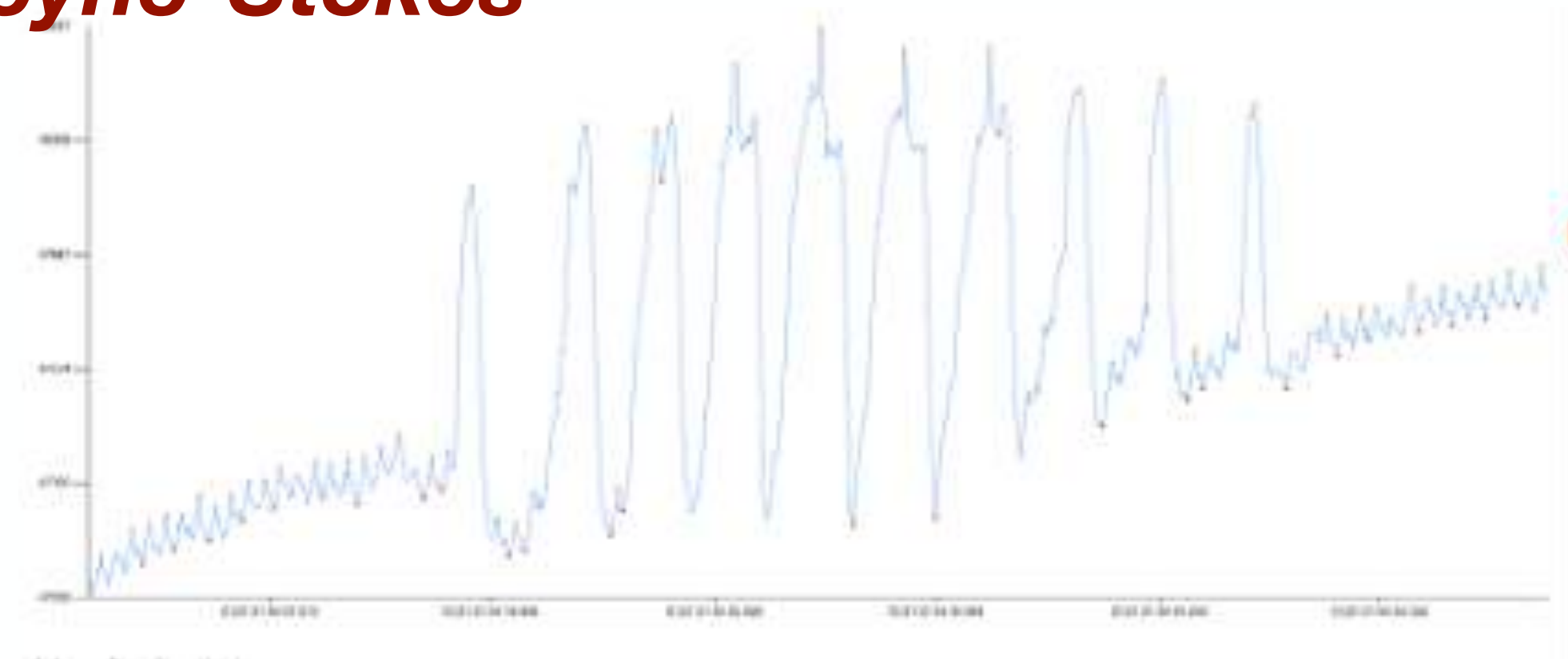
Kussmual



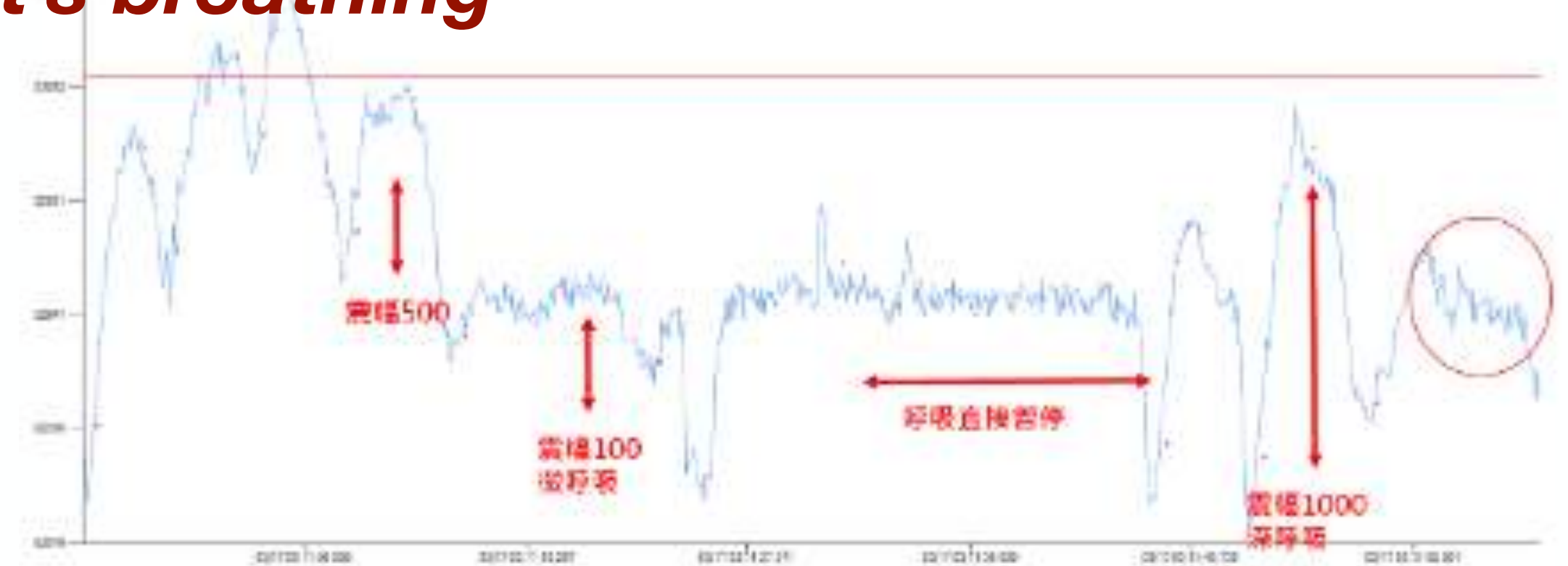
Ataxic breathing



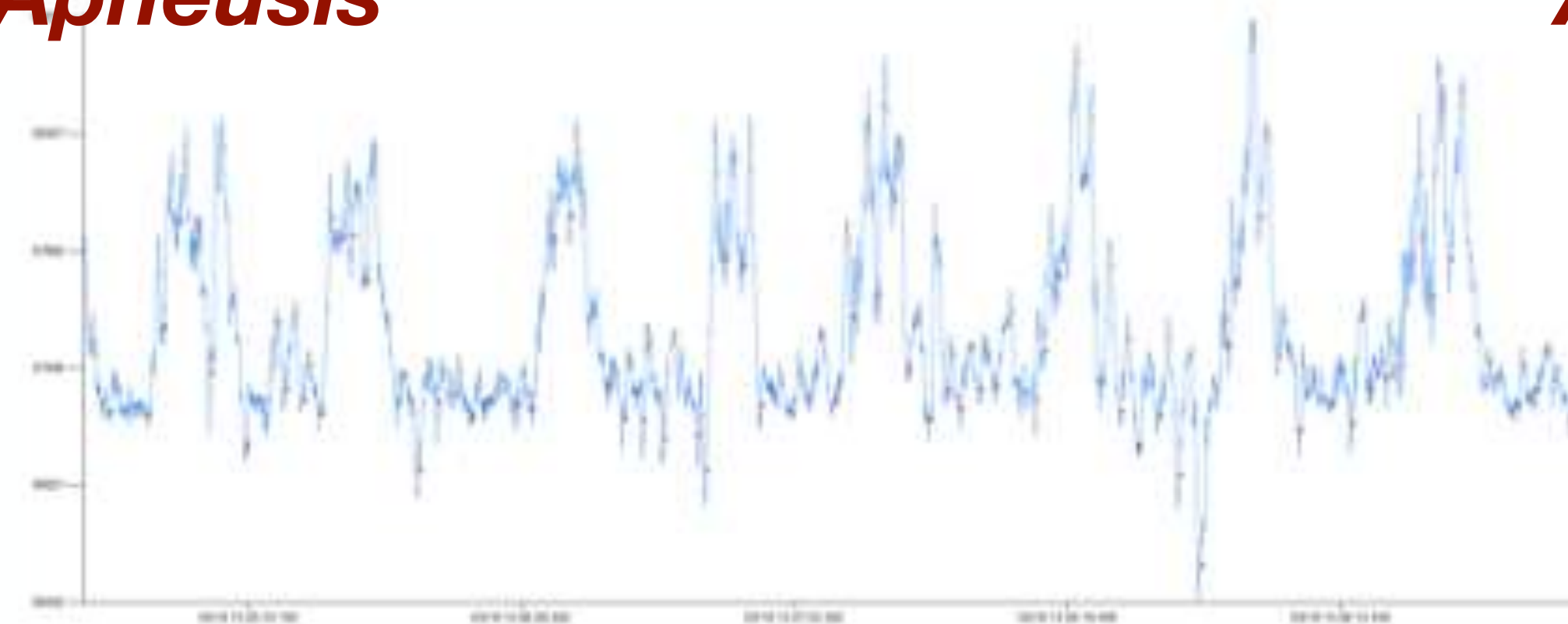
Cheyne-Stokes



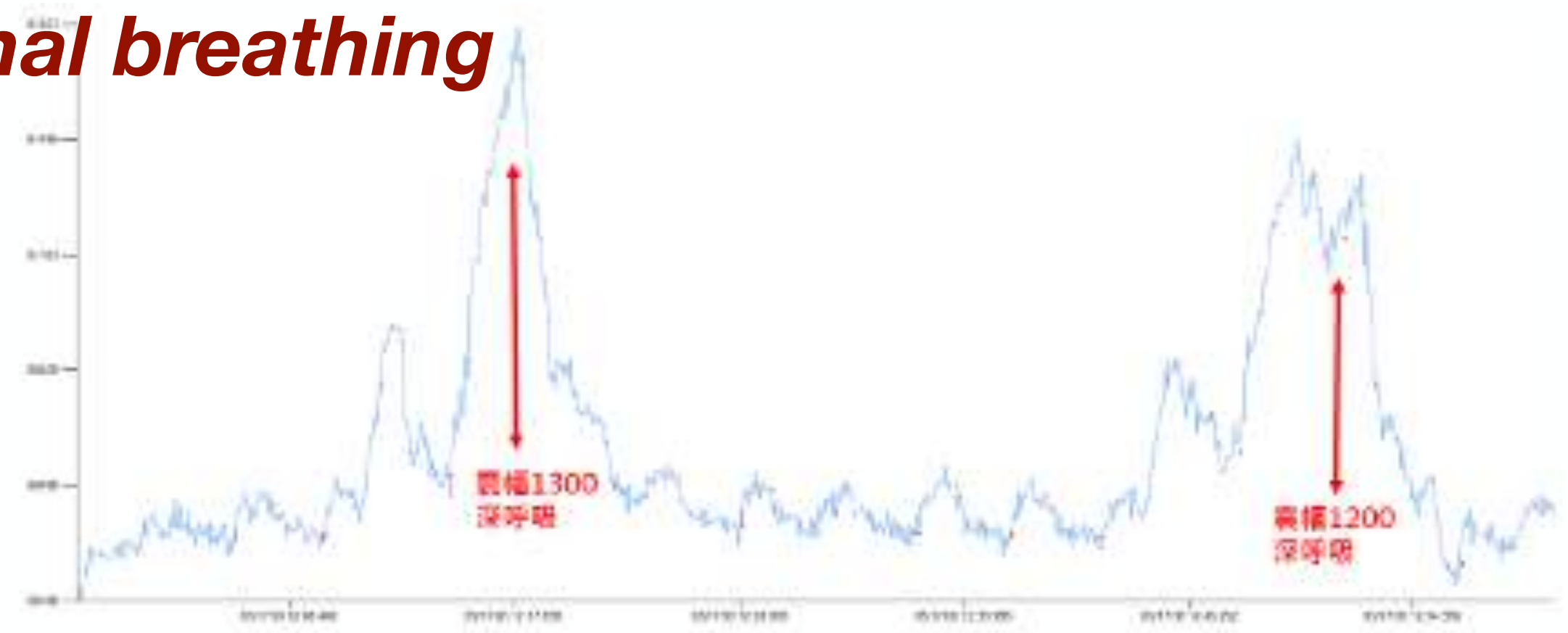
Biot's breathing



Apneusis



Agonal breathing



Non-Wearable sensors for sleep, respiration and others



1. Sleep-related breathing disorders



2. Prediction of Upcoming Heart Failure



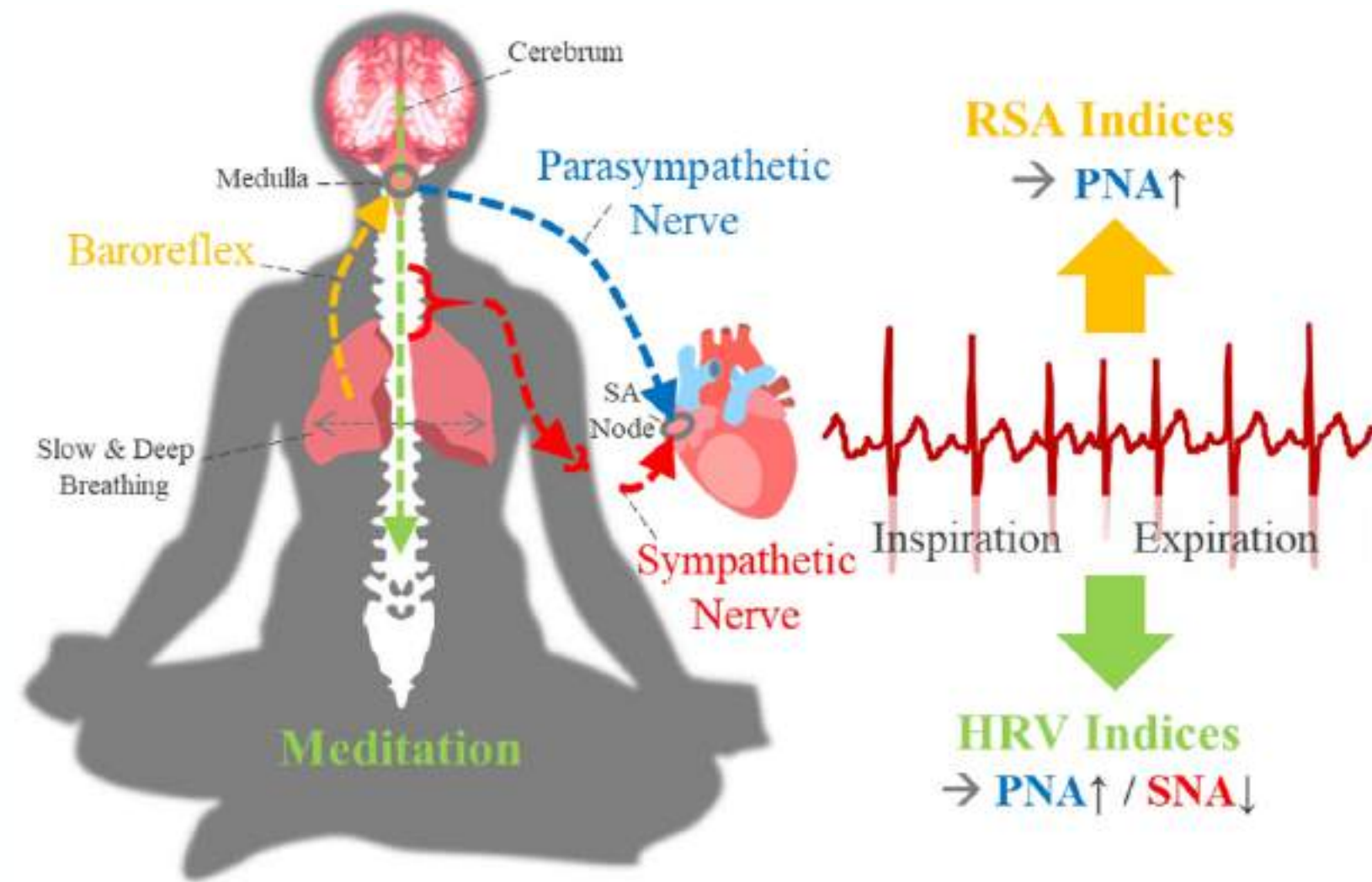
3. Detection of Preceding Sleep Apnea



4. Respiratory Sinus Arrhythmia: **Coupling**

Respiratory Sinus Arrhythmia Coupling

RSA coupling



RSA Indices

→ PNA↑



HRV Indices

→ PNA↑ / SNA↓

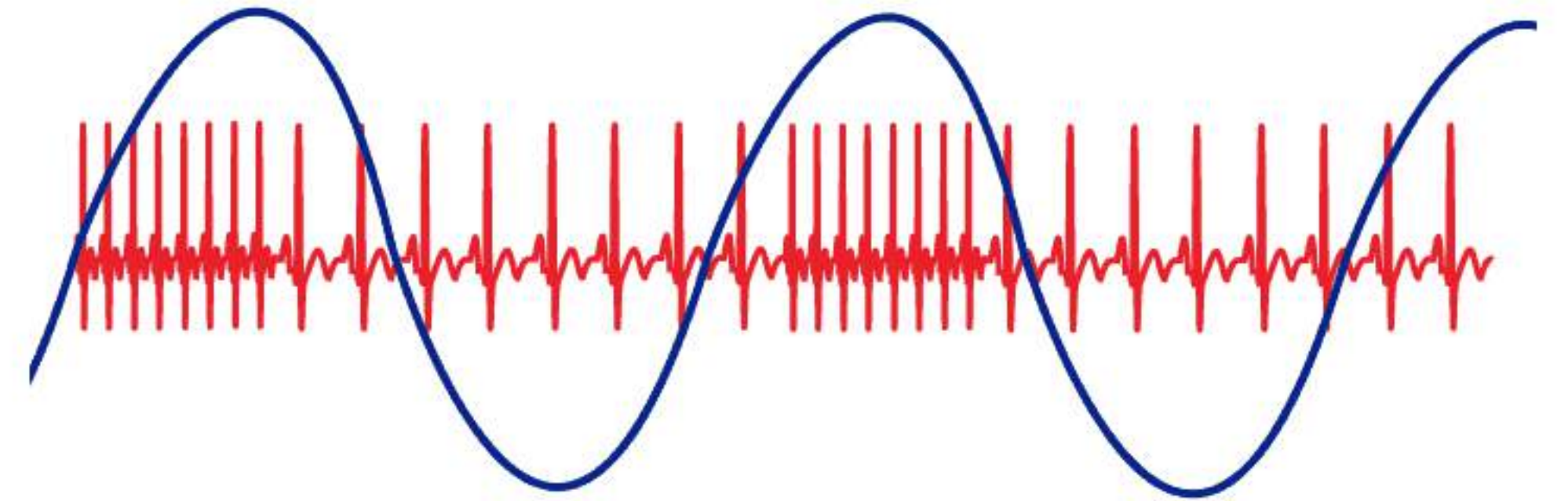


Anxiety

Agitation

Restless

Relation between ECG and Respiration Series



Visual Biofeedback for Patients with Emotional stress

— = ECG
— = Resp

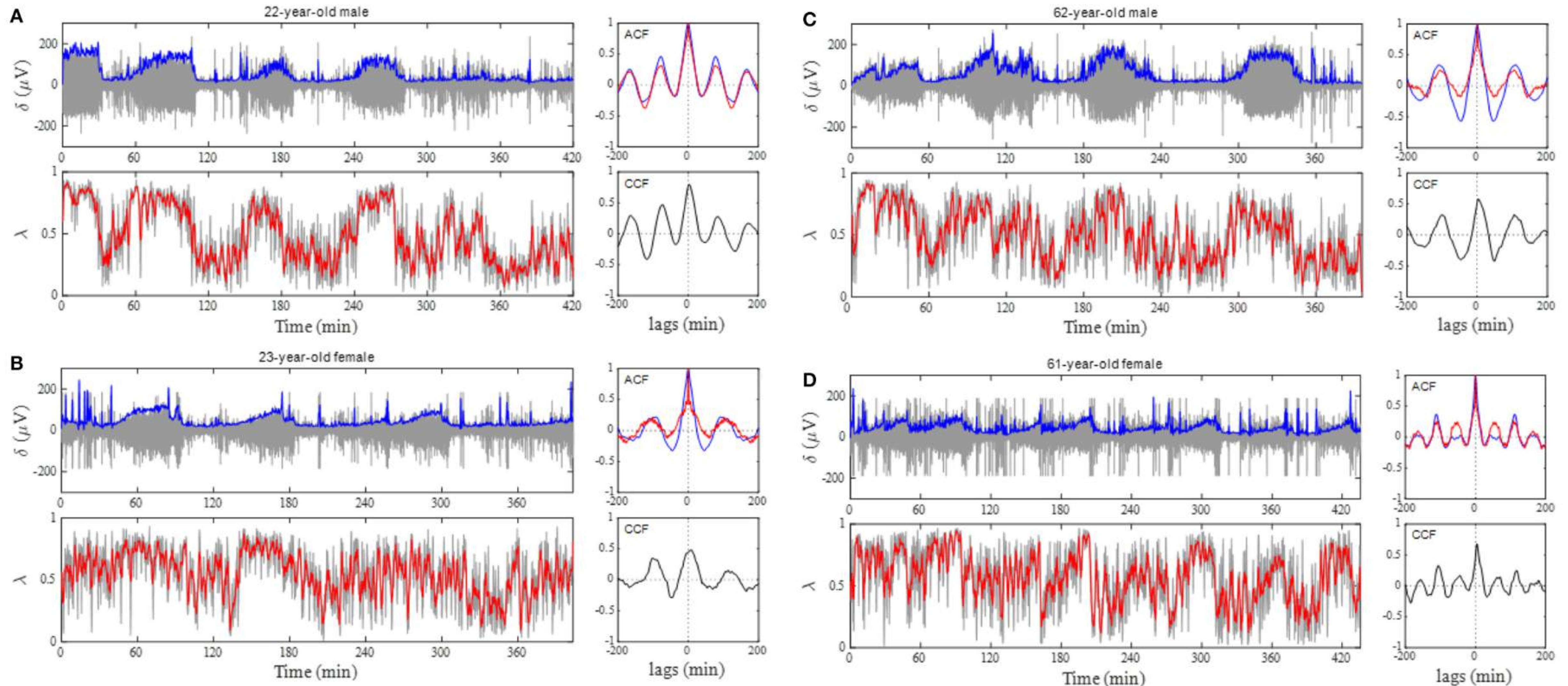


Respiration
+
Heart Rate

RSA coupling
心情溫度計

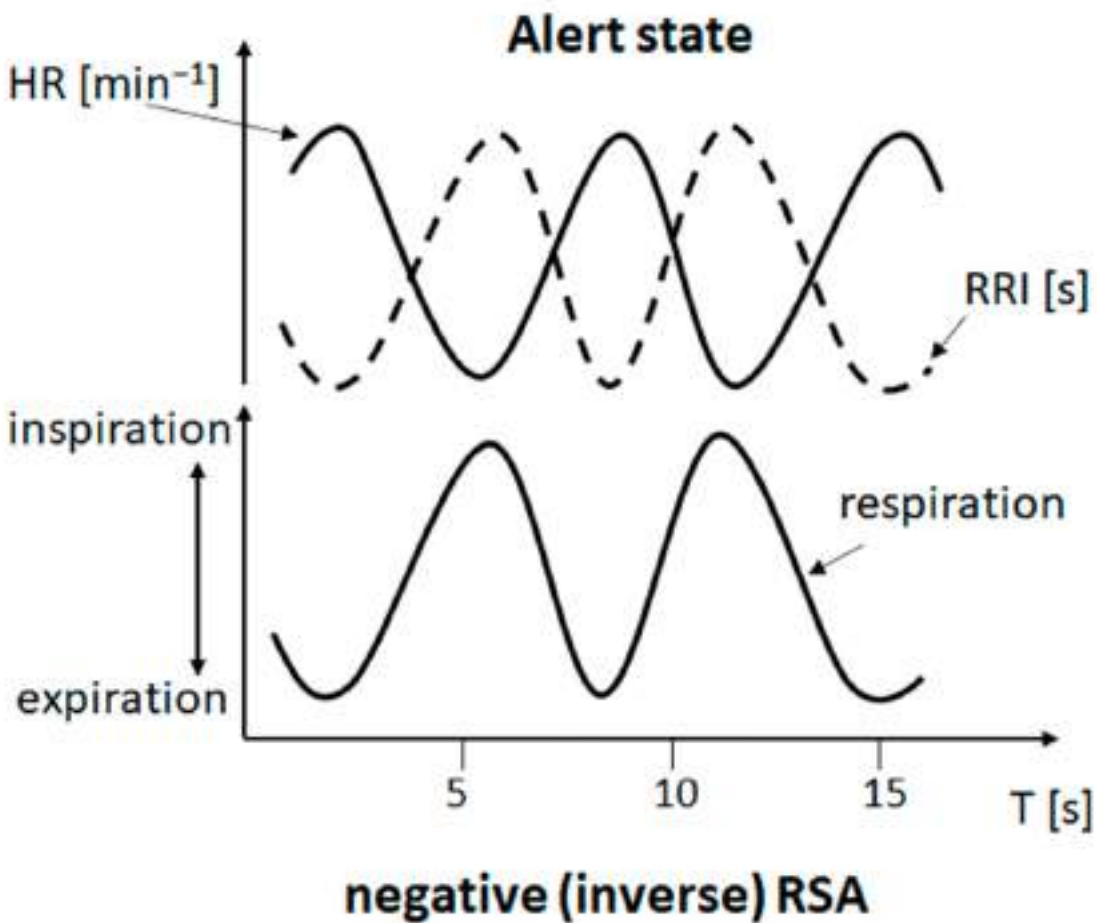
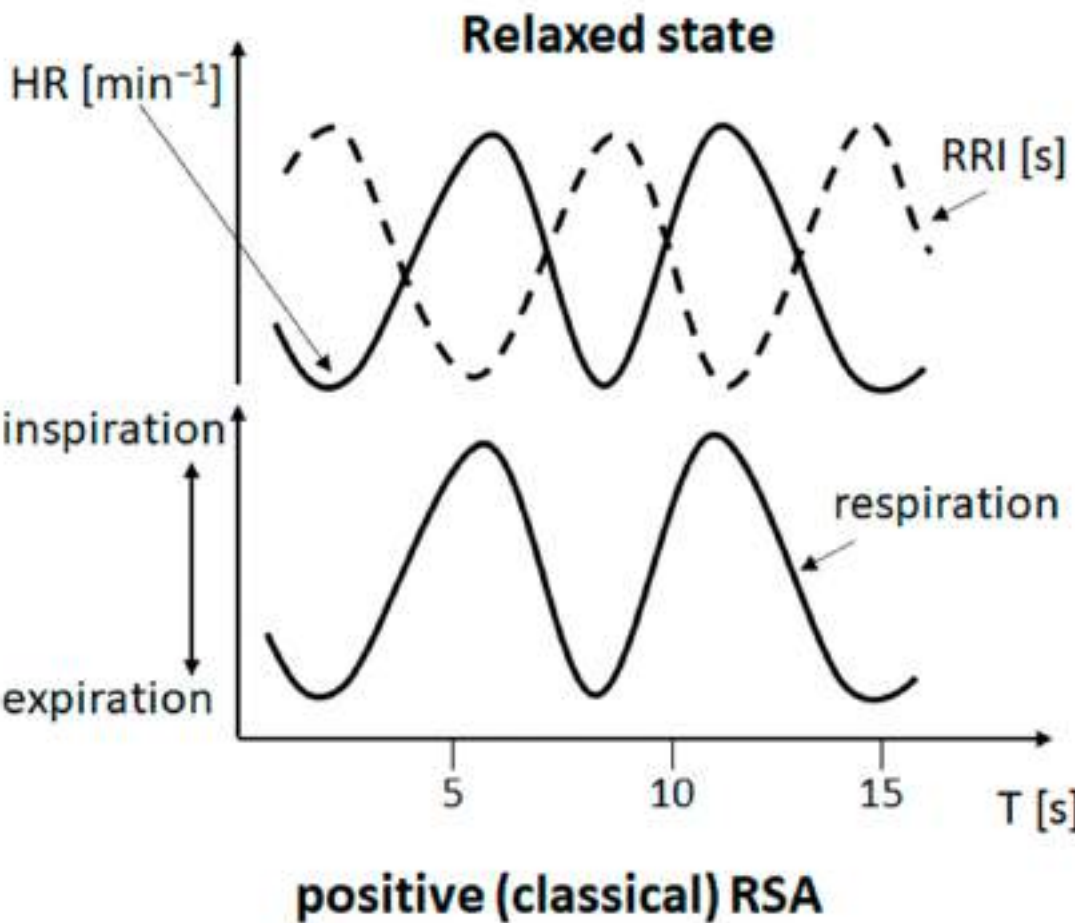
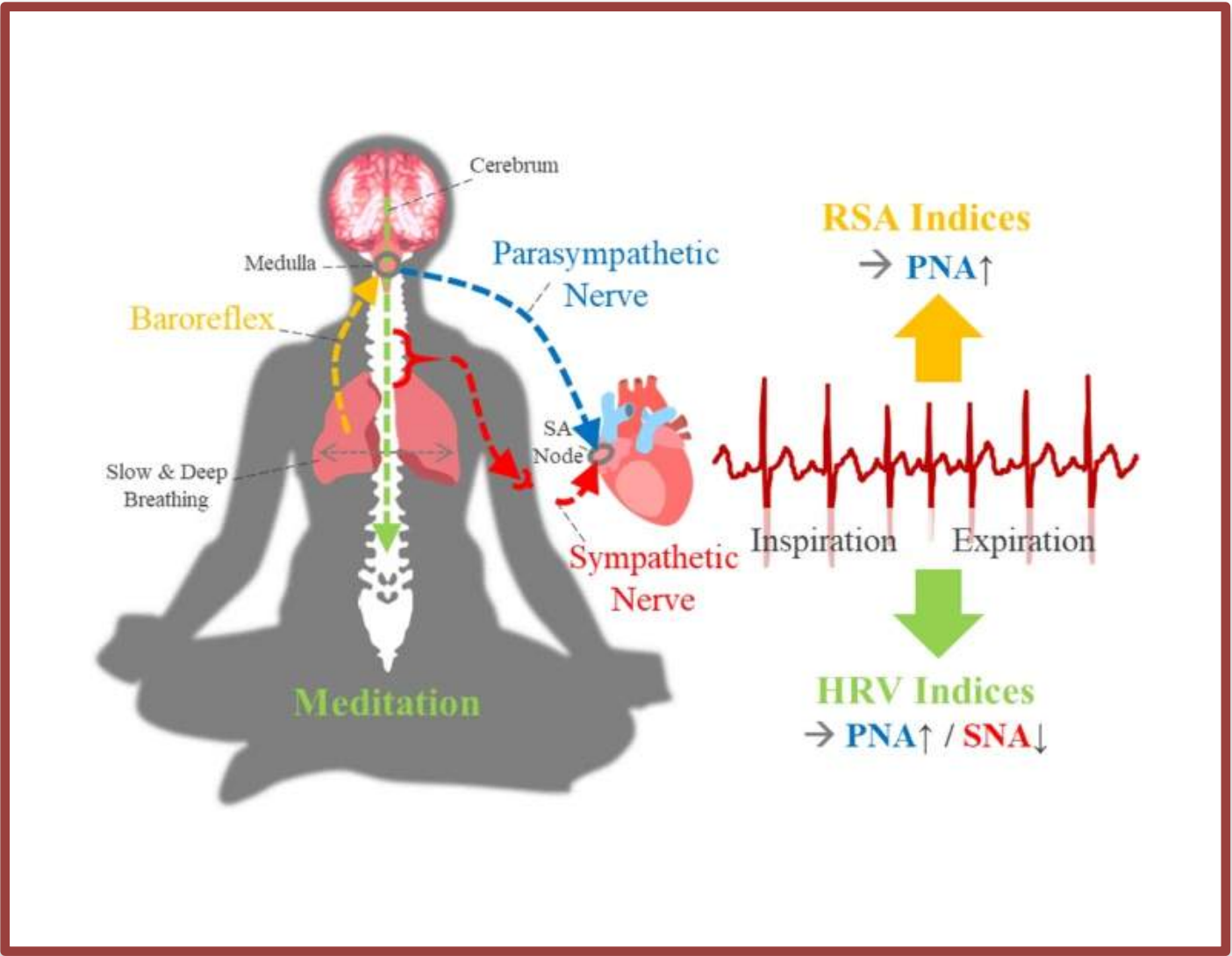


Association Between RSA coupling and Slow Wave Activity during Sleep



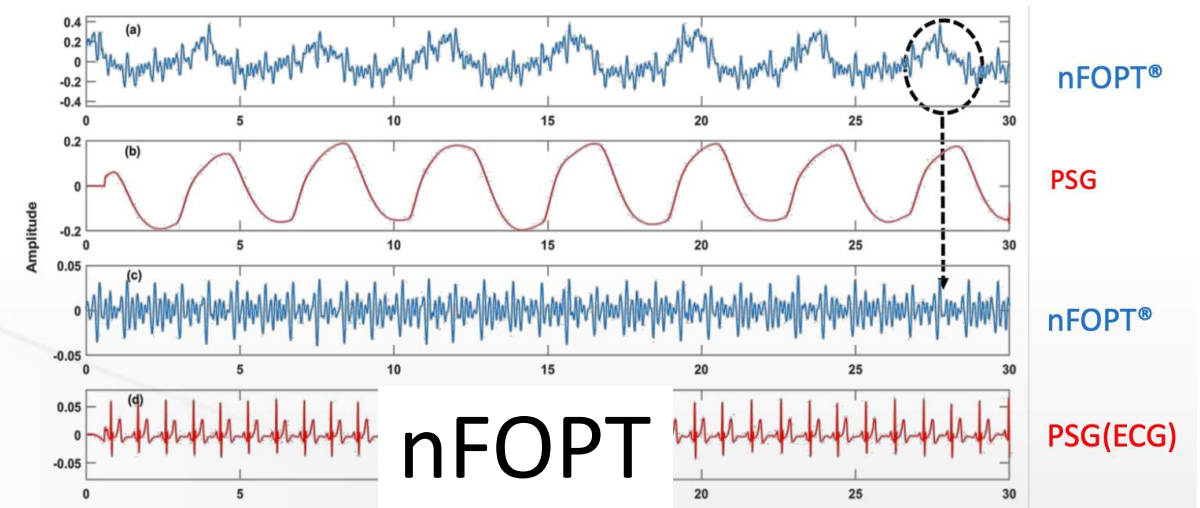
Non-wearable monitoring: Sleep/Mental states

Respiratory Sinus Arrhythmia (RSA) Coupling



Neuro-Cognitive:
Sleep stages, Mental

- (1) *Slow wave sleep*: RSA coupling
- (2) Psychological evaluation: *Anxiety*, Agitation, Restless



OR



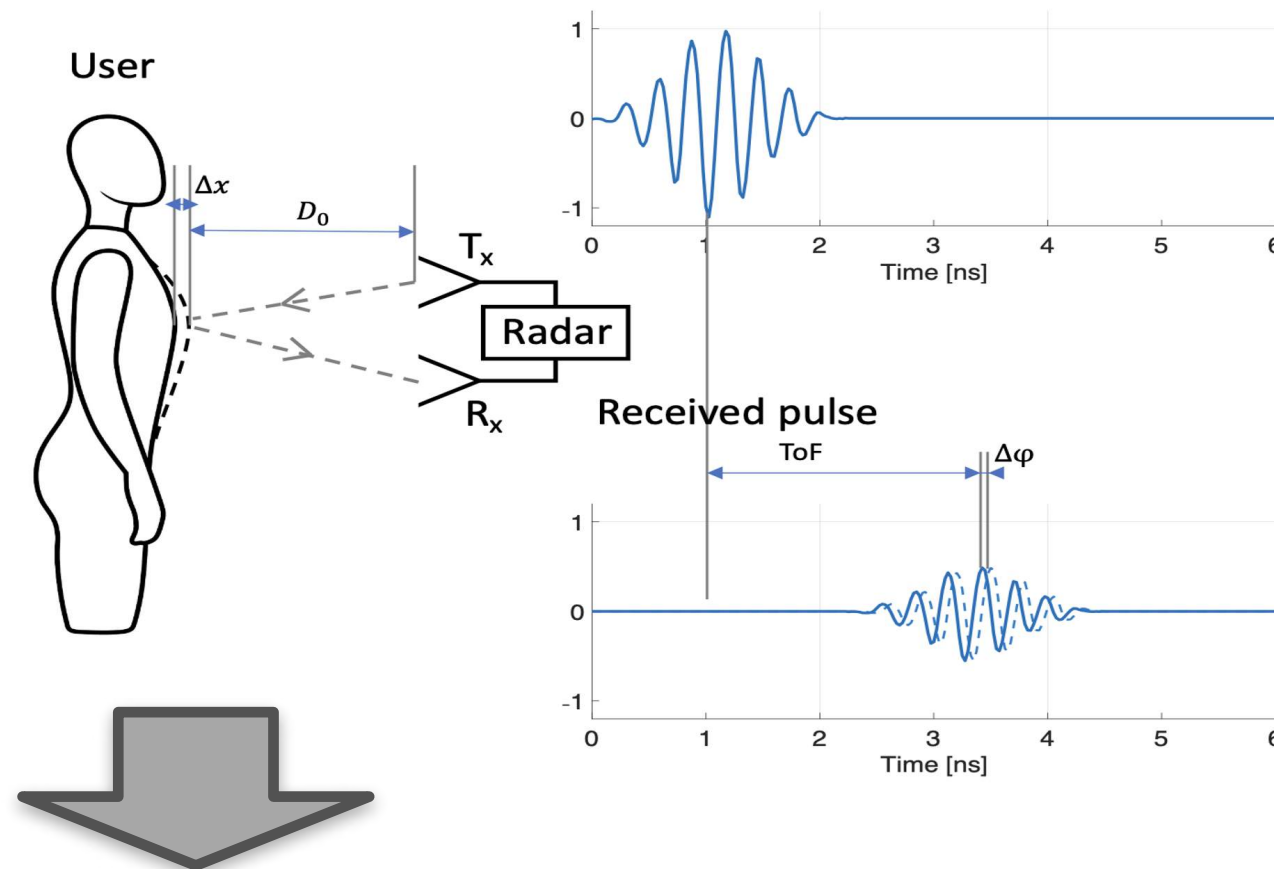
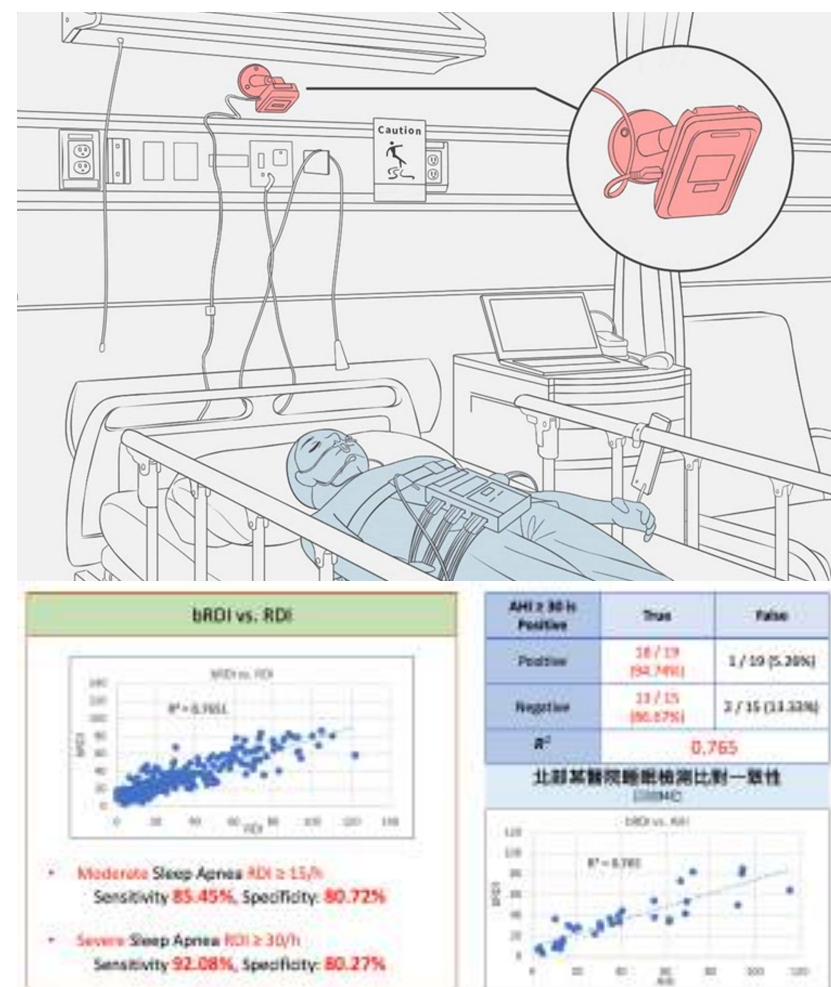
PATENT: I873034
2028/2/10-2044/05/09

(Mobile phone Application)
HEART RATE AND RESPIRATION
CALIBRATION SYSTEM AND METHOD

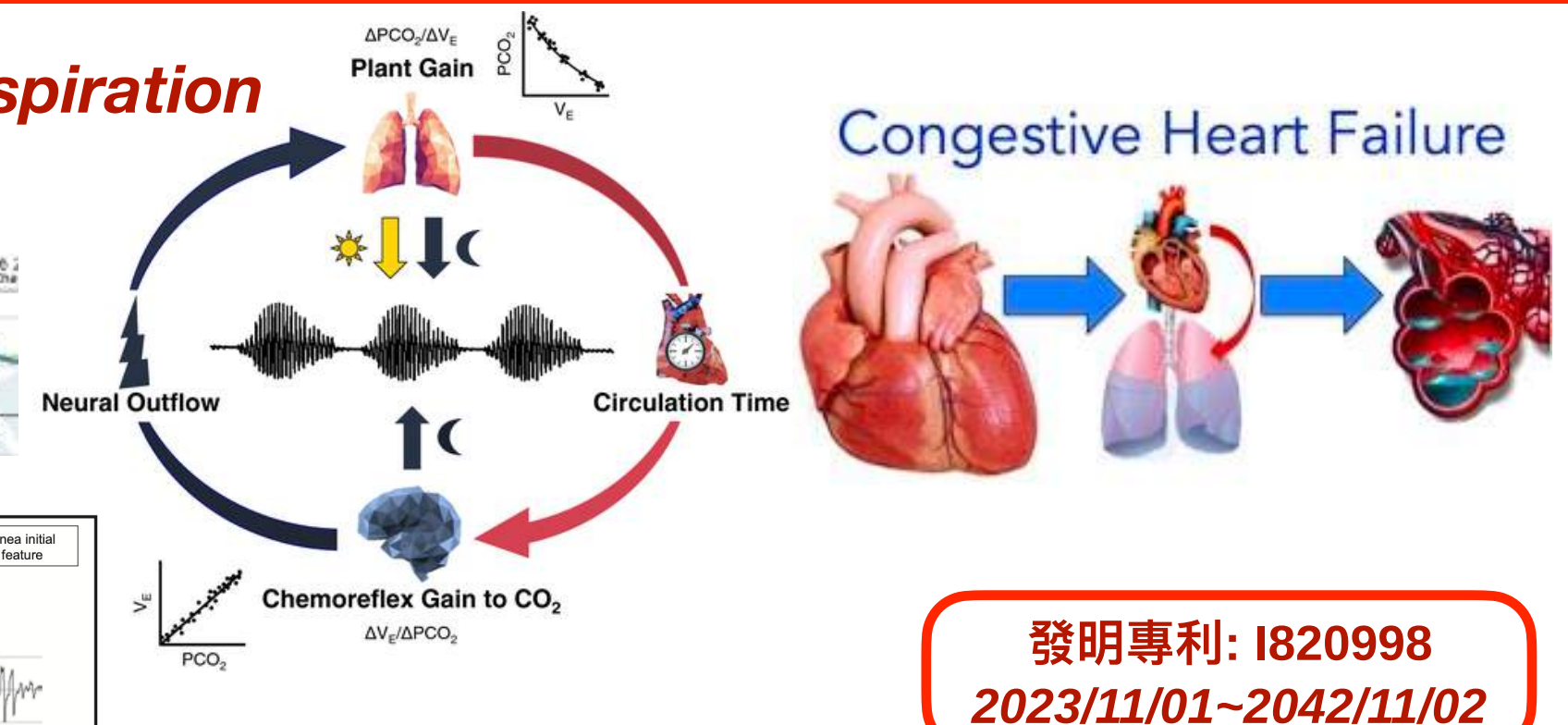
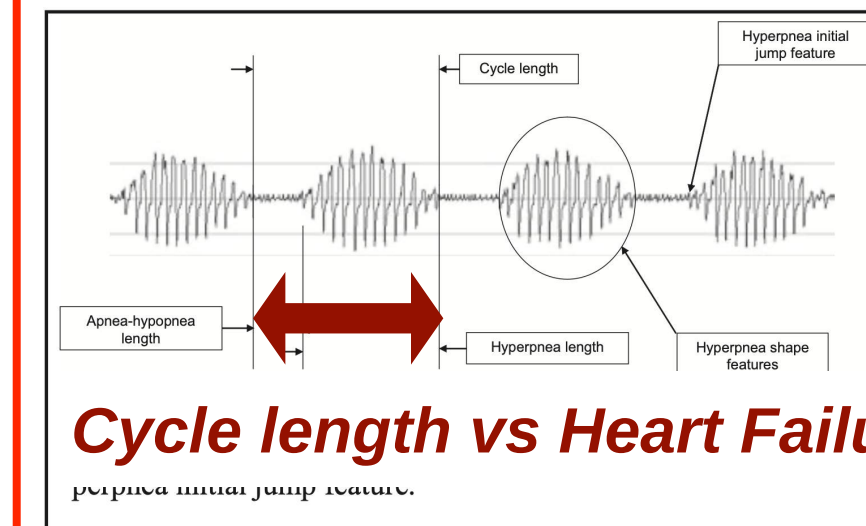
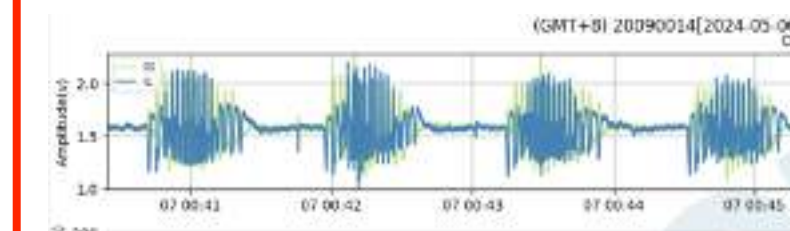
睡眠障礙 ➡ 心臟衰竭、活動方式、情緒、呼吸能力

Combining wireless radar sleep monitoring device with deep machine learning techniques to assess obstructive sleep apnea severity *J Clin Sleep Med. 2024*

緯創資通 產學合作：50% IP
(睡眠呼吸中止) TFDA取證中



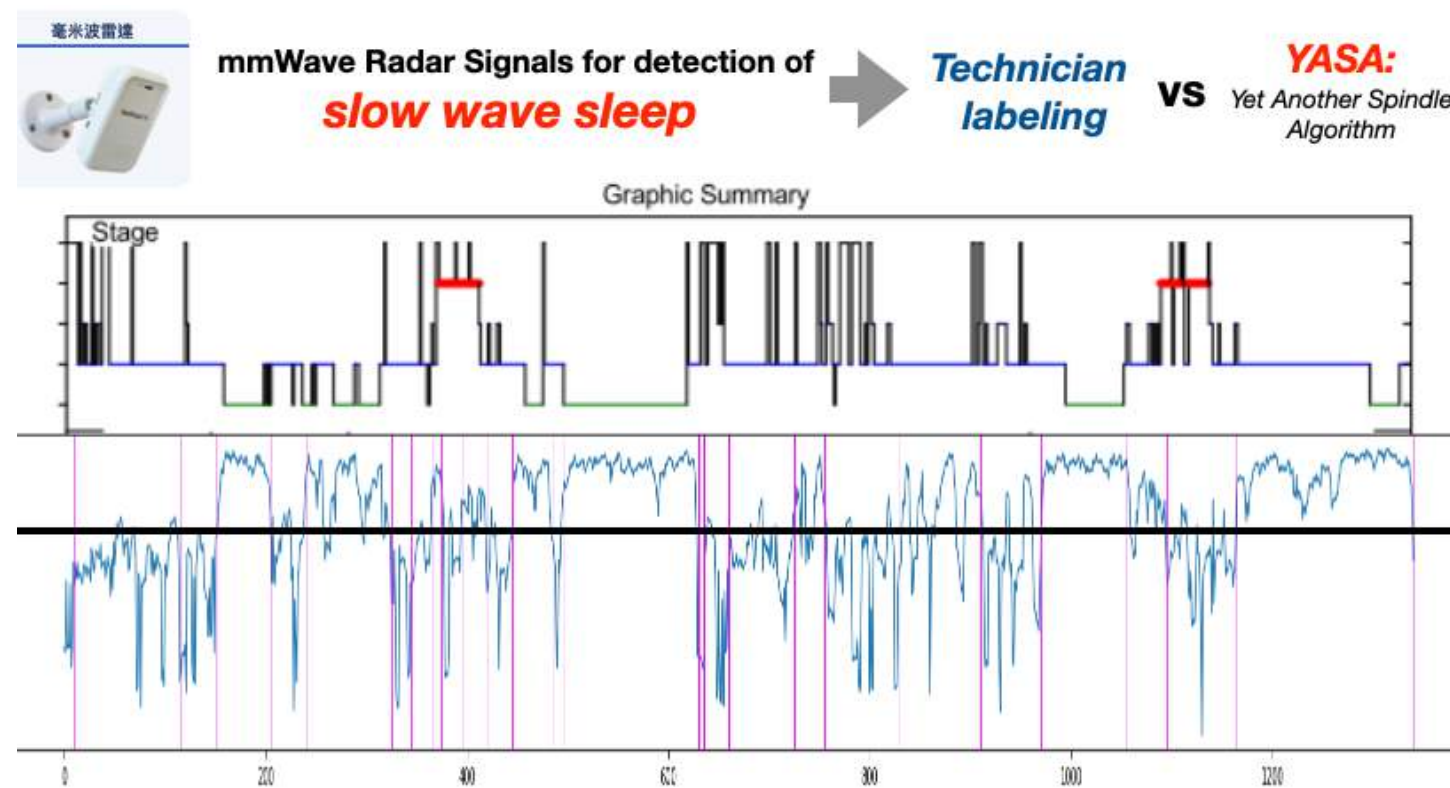
- *Cheyne-Stokes Respiration*
- *Periodic Breathing*



潛在心臟衰竭
出院持續追蹤

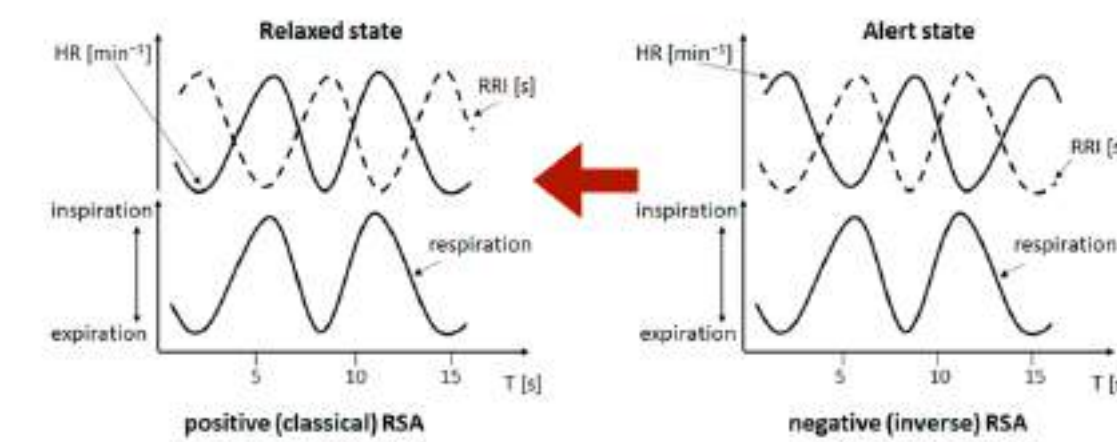
發明專利: I820998
2023/11/01~2042/11/02

心臟異常事件
預警系統以及方法

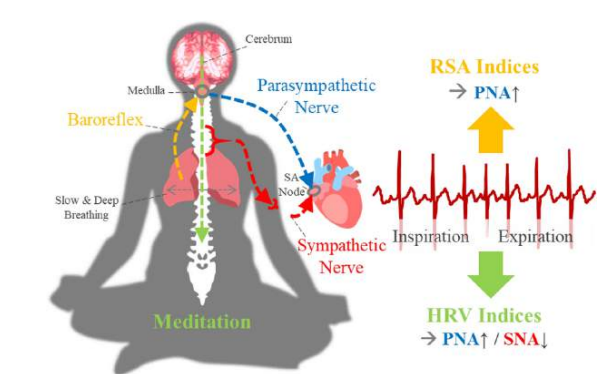


High Regularity
深睡期呼吸平穩
快速動眼期變異大
High Variability
↓
Sleep Stages

RSA Coupling: Respiratory Sinus Arrhythmia Coupling

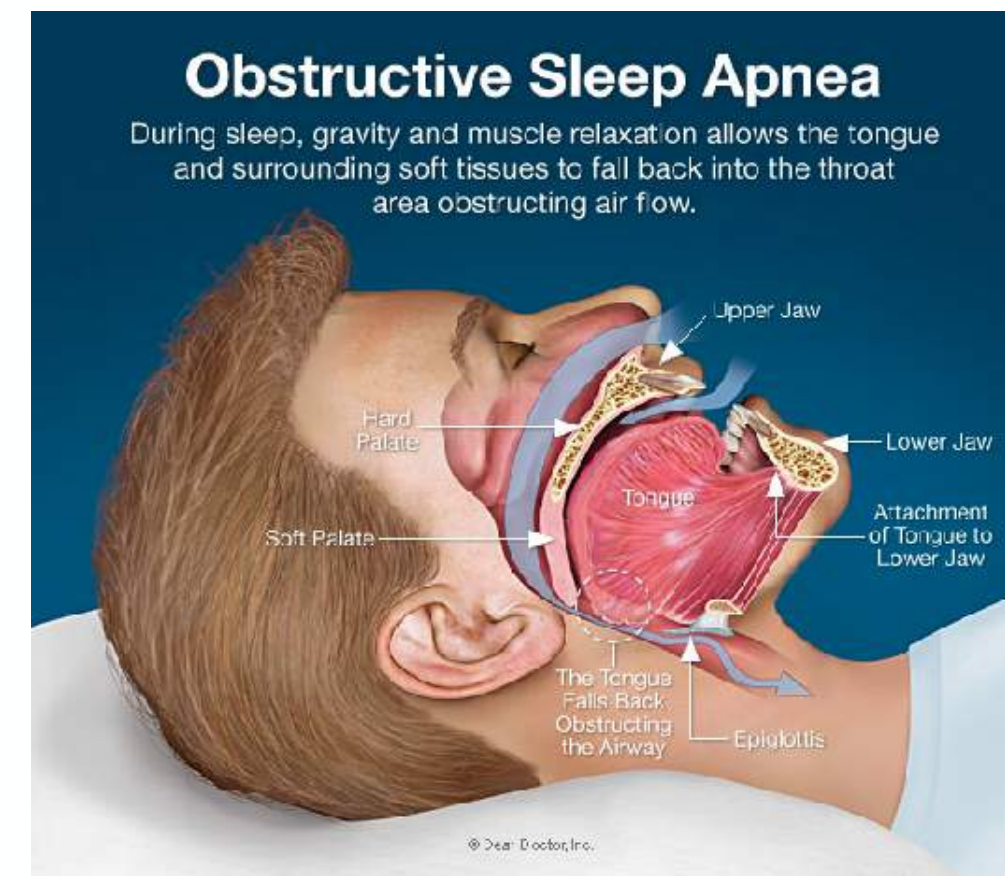
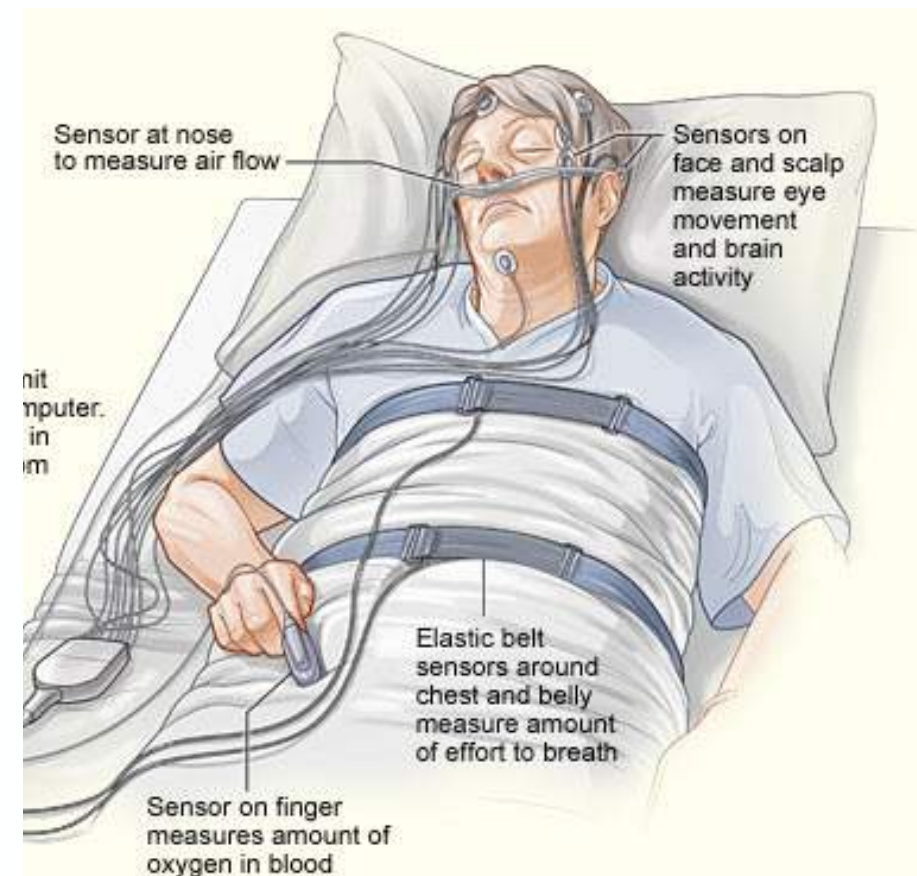


Visual Biofeedback for
Patients with Anxiety



發明專利: I873034
心率與呼吸校準系統及方法

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

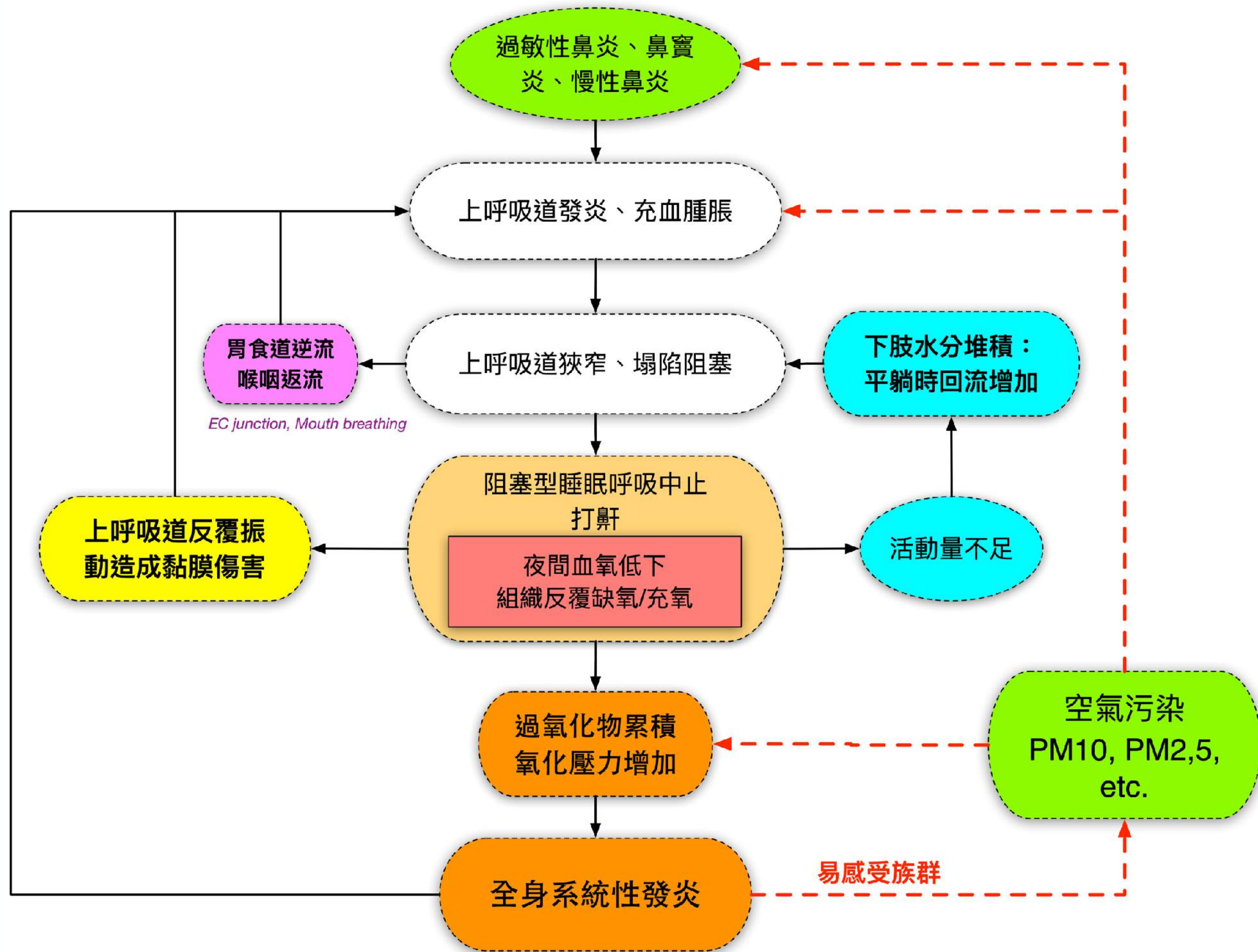
Least invasive
- weight loss



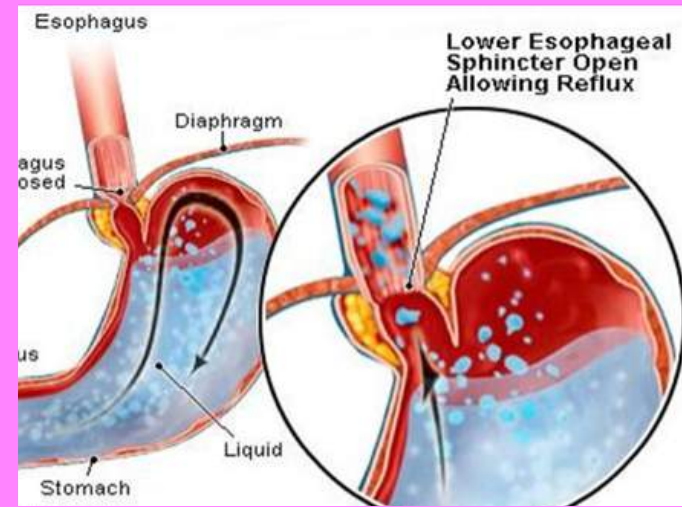
UPPP

MMA

睡眠檢查、呼吸器、手術治療、牙套等，還有哪些可以做的？



胃食道逆流



過敏性鼻炎、鼻竇炎、慢性鼻炎

上呼吸道發炎、充血腫脹

上呼吸道狹窄、塌陷阻塞

胃食道逆流
喉咽返流

EC junction, Mouth breathing

上呼吸道反覆振動造成黏膜傷害

阻塞型睡眠呼吸中止
打鼾

夜間血氧低下
組織反覆缺氧/充氧

下肢水分堆積：
平躺時回流增加

活動量不足

控制體重

過氧化物累積
氧化壓力增加

全身系統性發炎

環境與慢性鼻炎



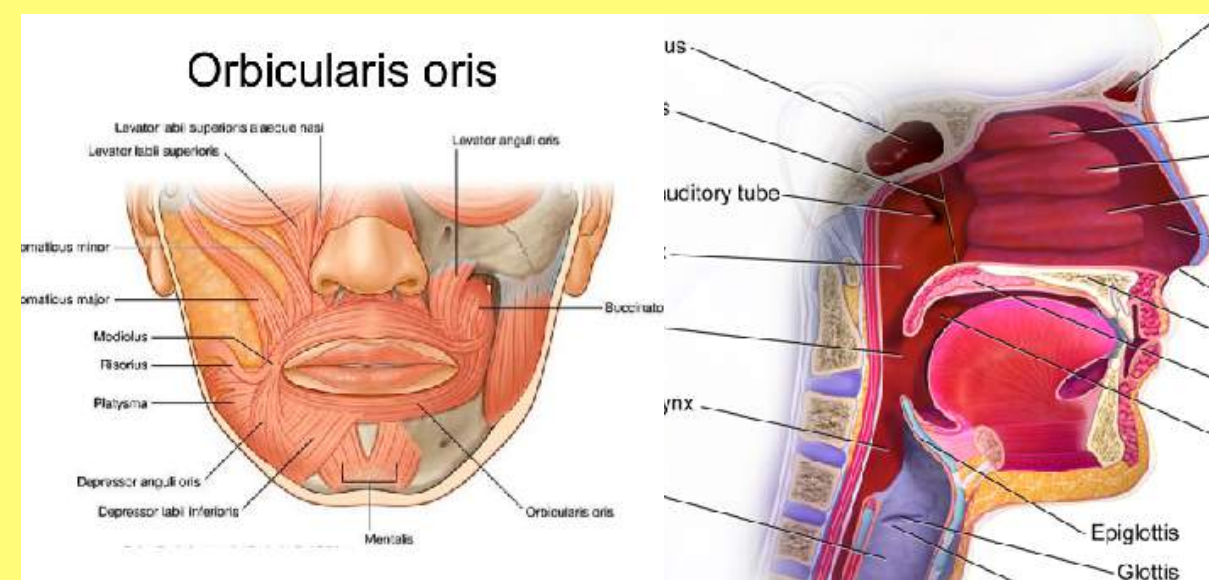
規律運動



空氣污染
PM10, PM2.5,
etc.

易感受族群

口腔舌咽肌肉訓練

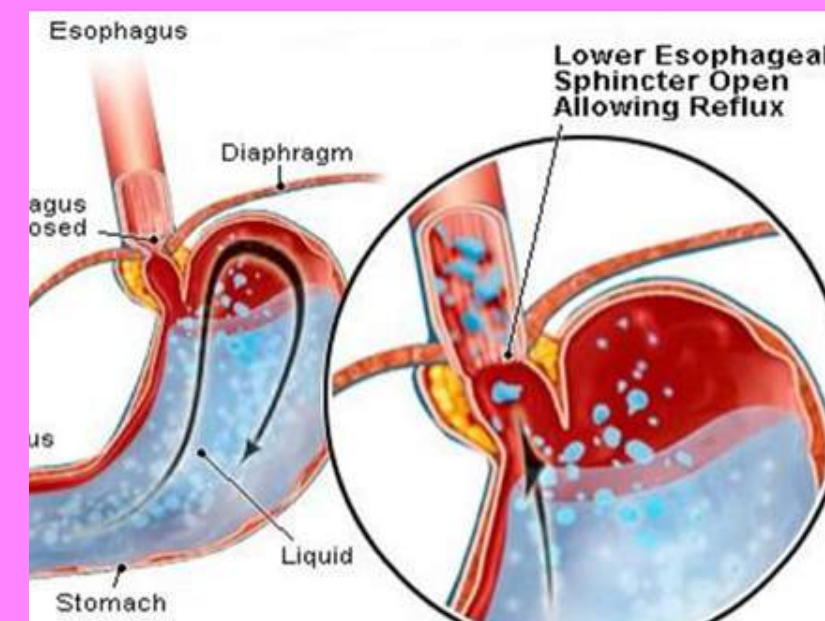


阻塞型睡眠呼吸中止症：四個生活習慣

環境與慢性鼻炎



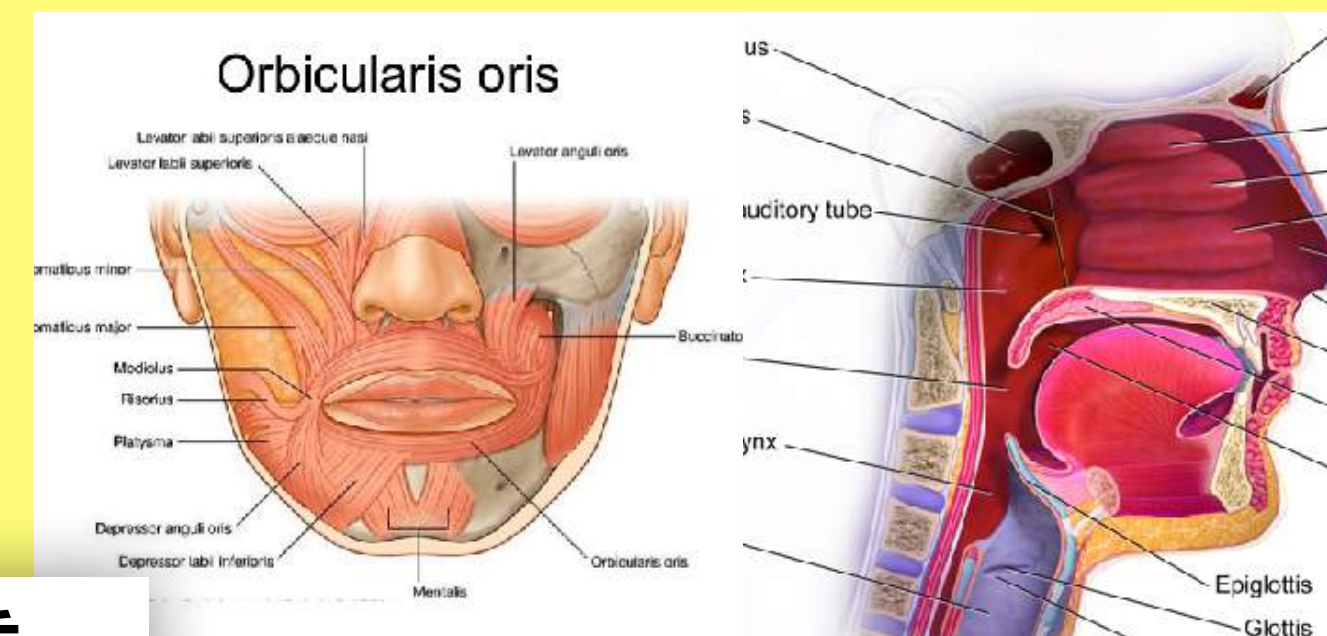
胃食道逆流



規律運動



口腔舌咽肌肉訓練



控制體重

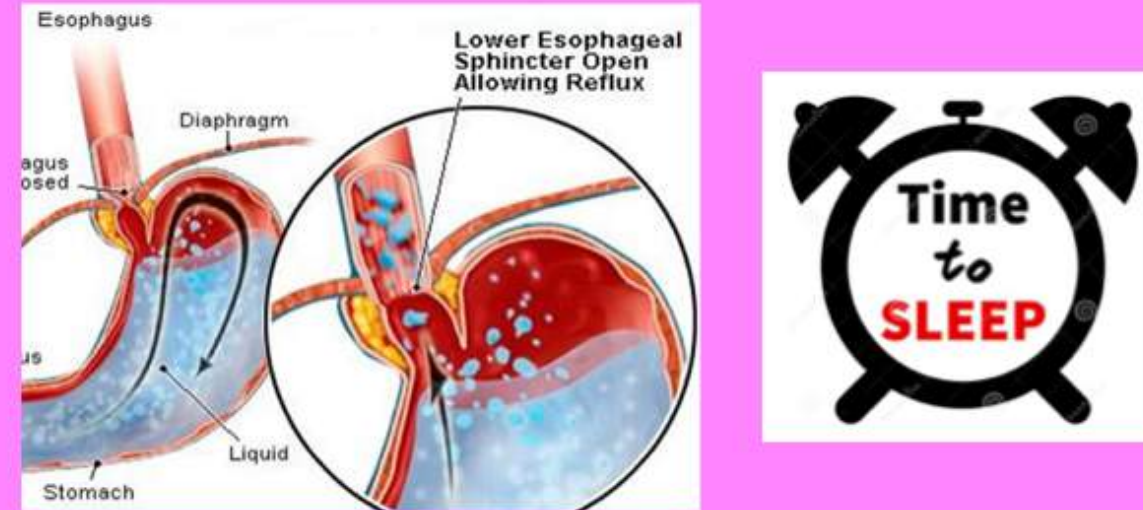


阻塞型睡眠呼吸中止症：四個生活習慣

環境與慢性鼻炎



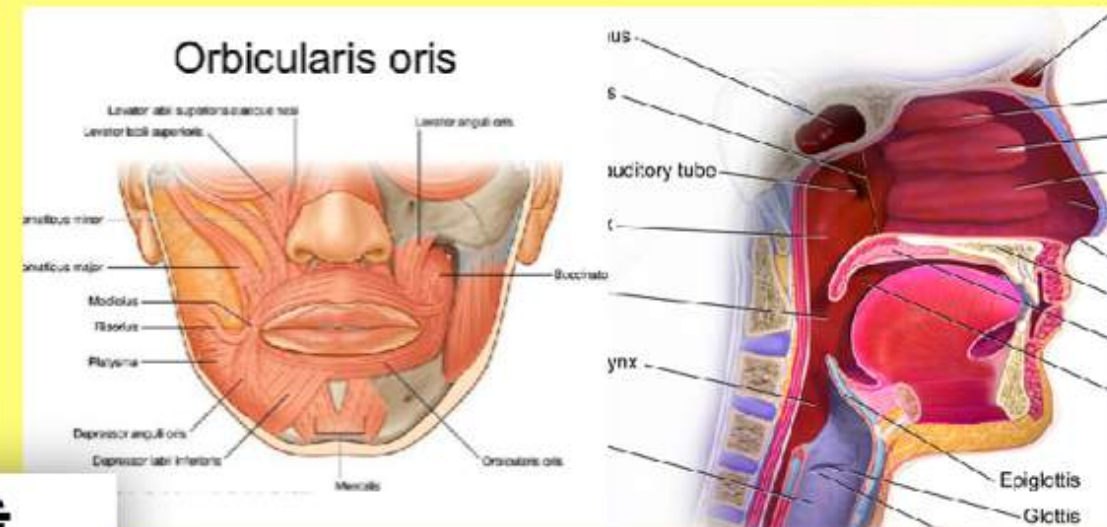
胃食道逆流



規律運動



口腔舌咽肌肉訓練



控制體重

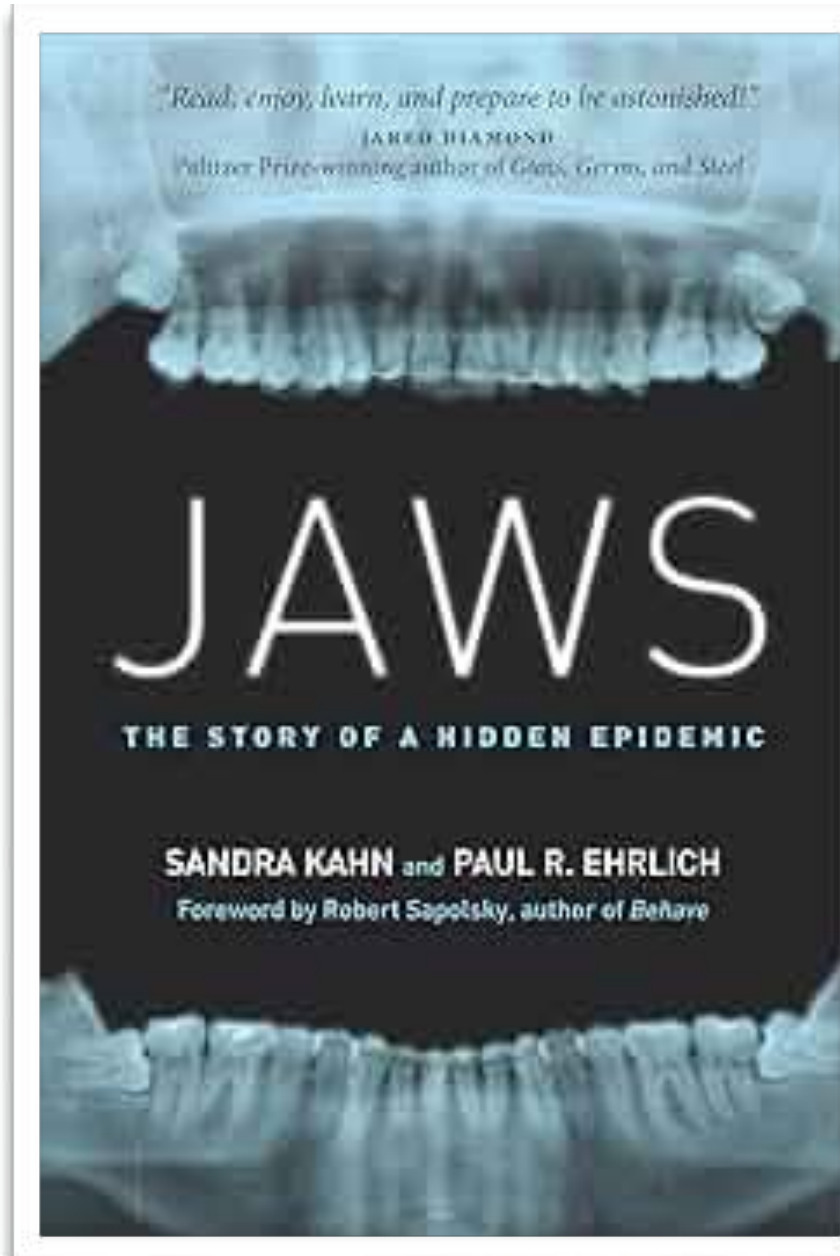


認真運動
控制體重
睡前不吃

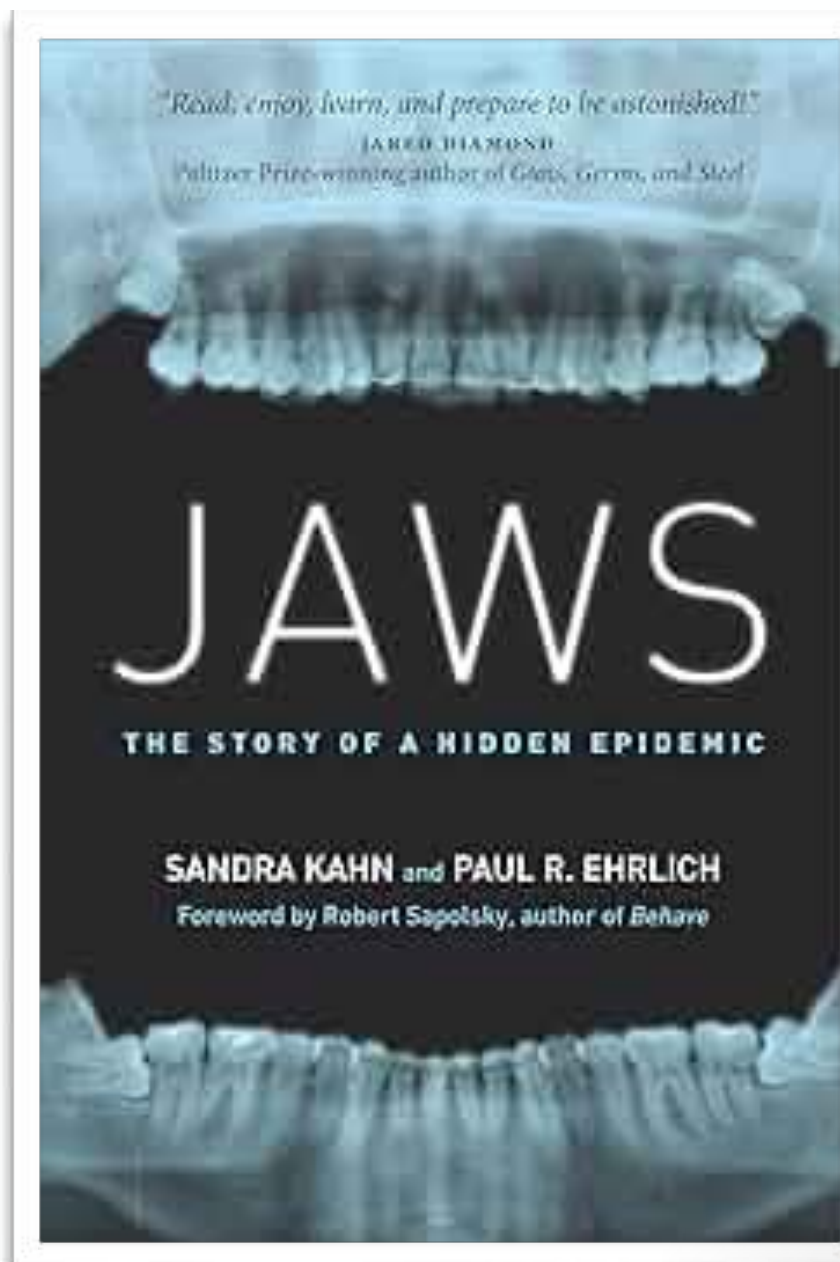
還是會打鼾、缺氧



400年前的人類，幾乎沒有 齒顎發育不良、上呼吸道狹窄的問題

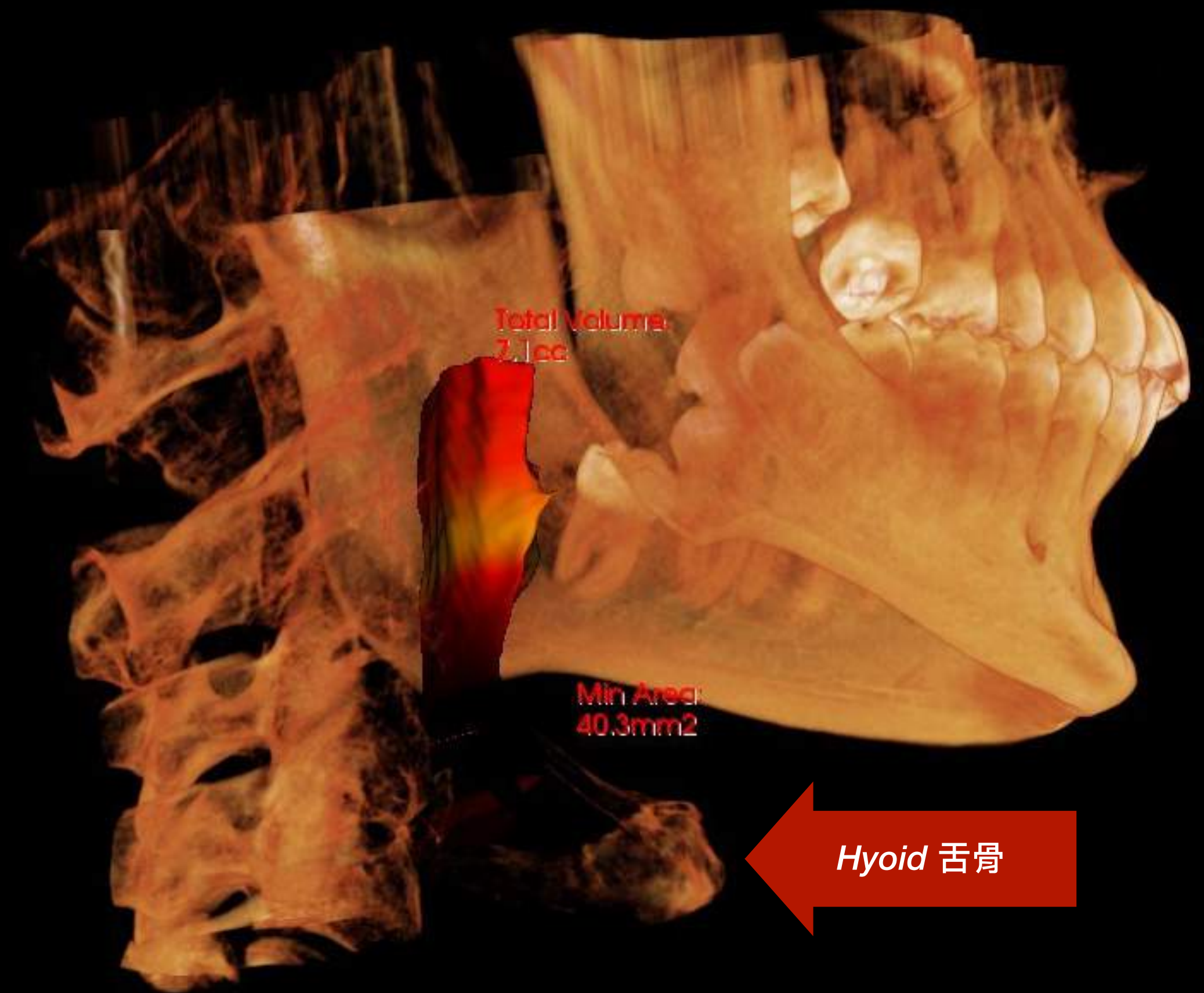
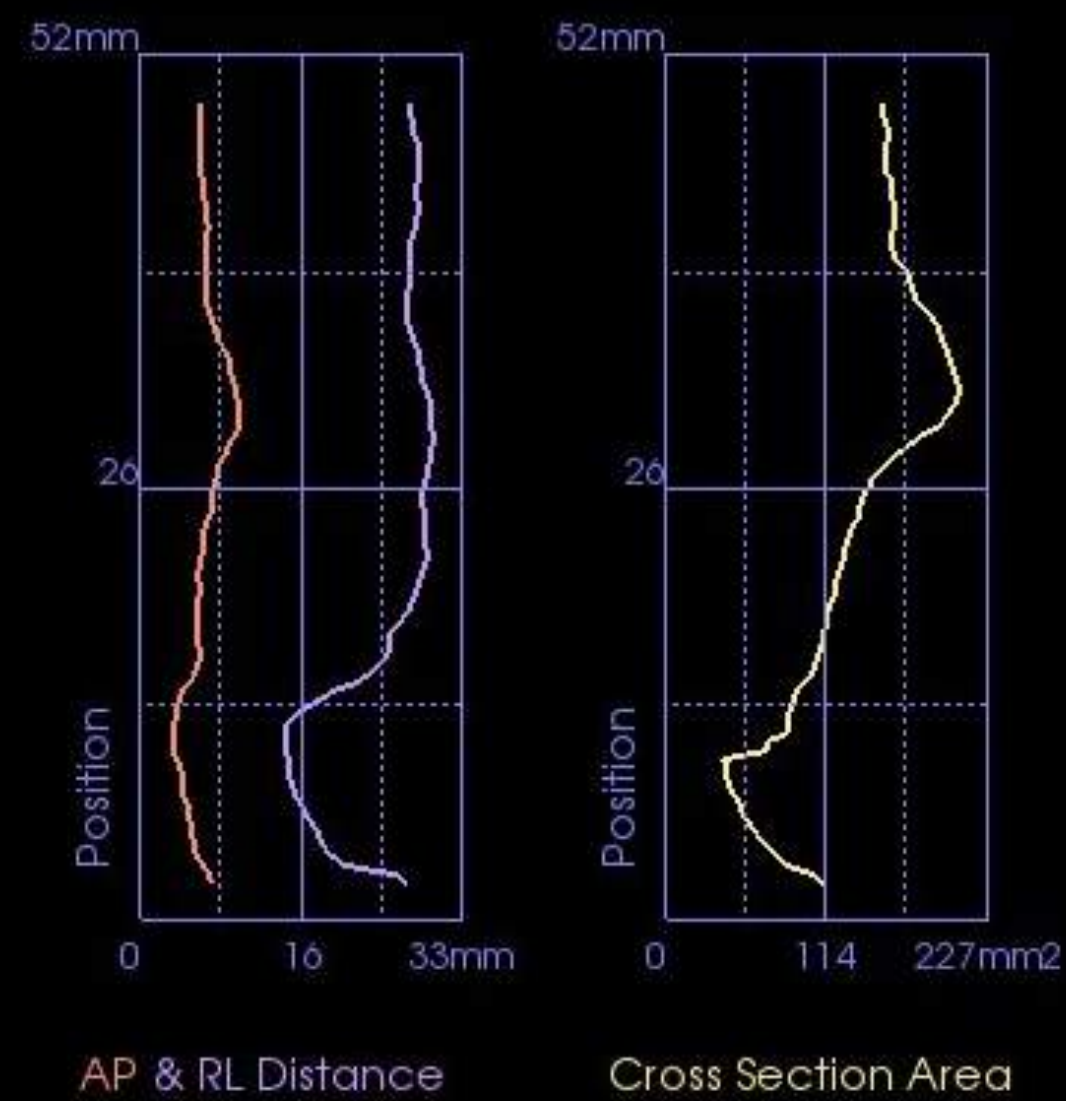
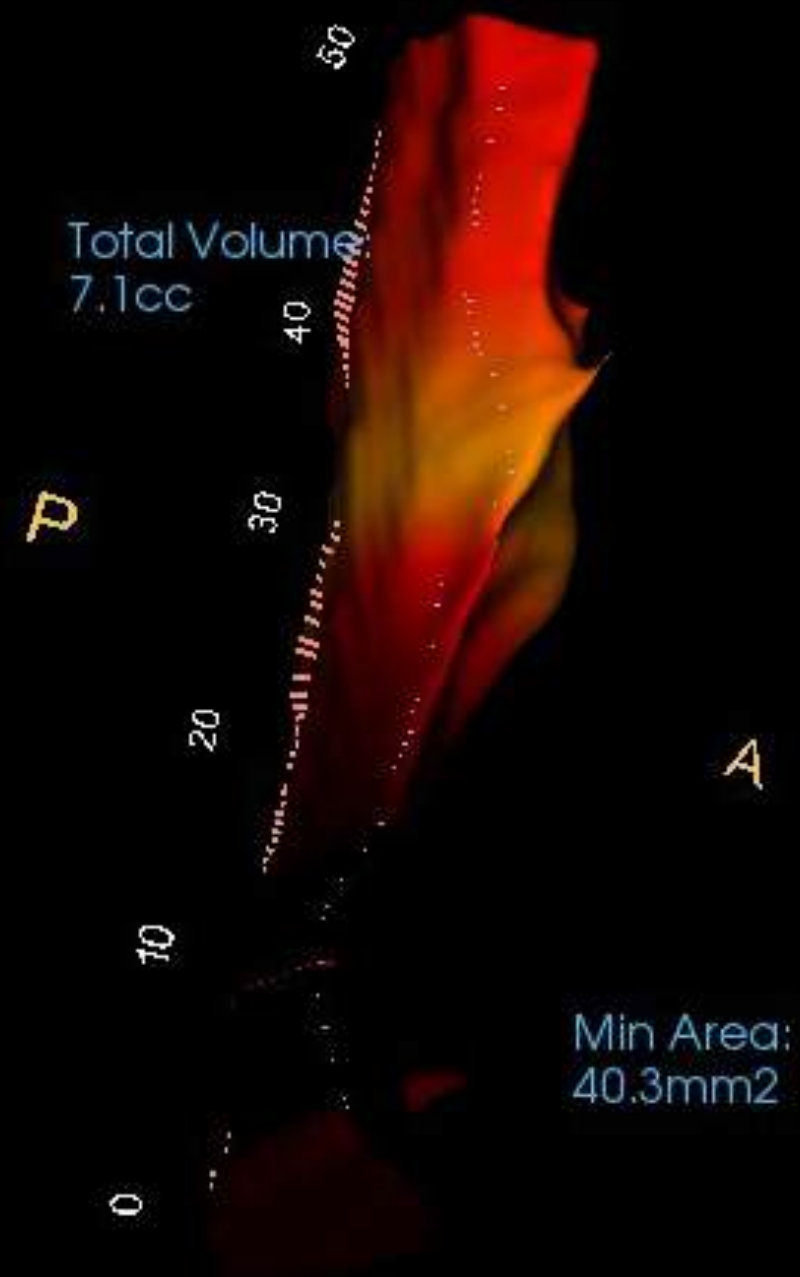
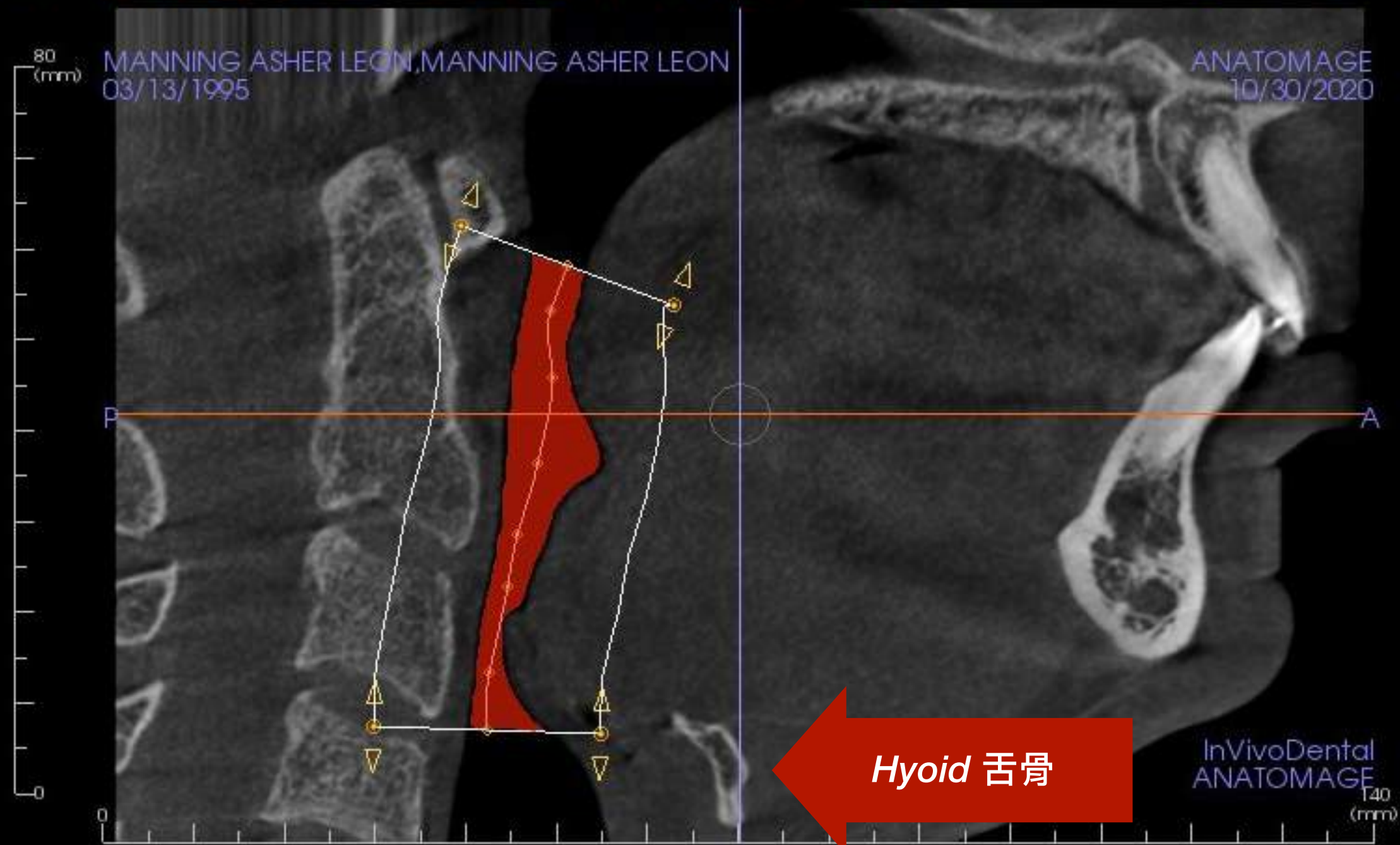


400年前的人類，幾乎沒有 齒顎發育不良、上呼吸道狹窄的問題



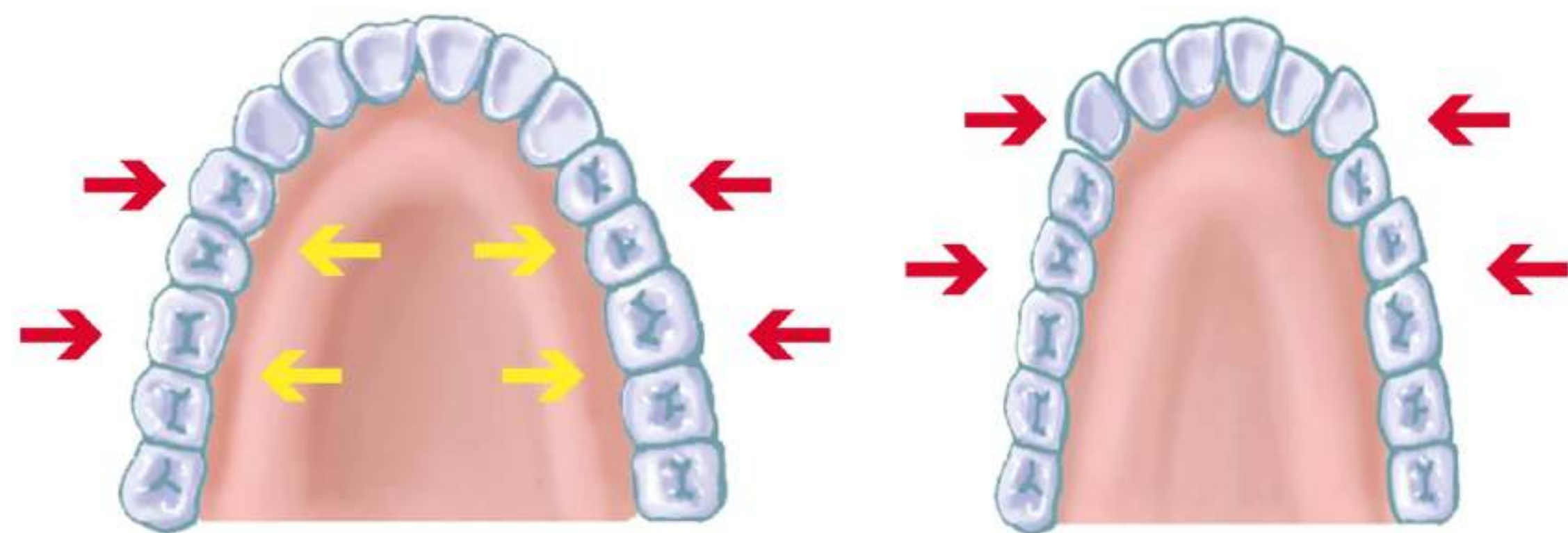
找回 治癒/自愈 的新觀念

常見的上呼吸道問題

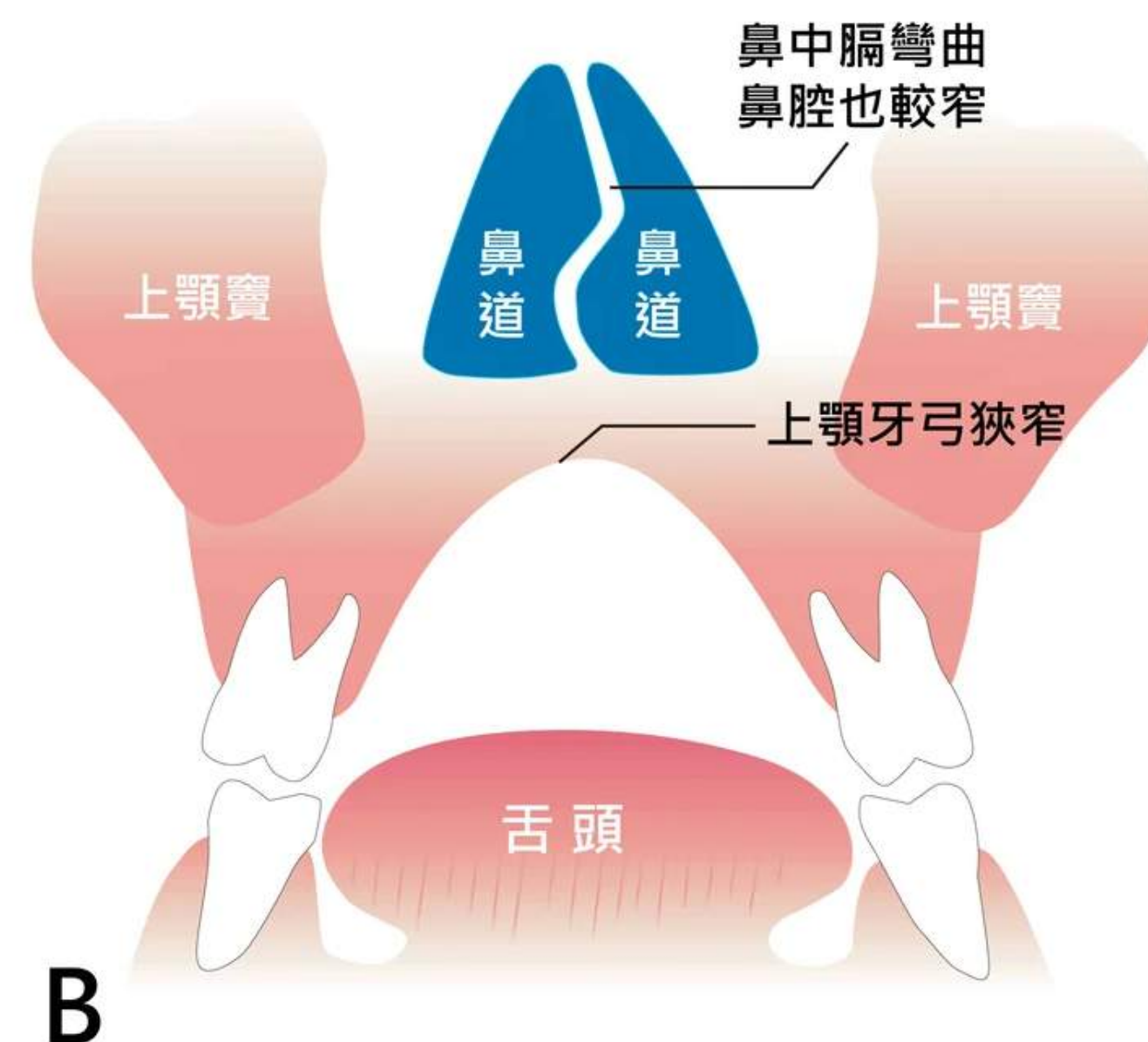
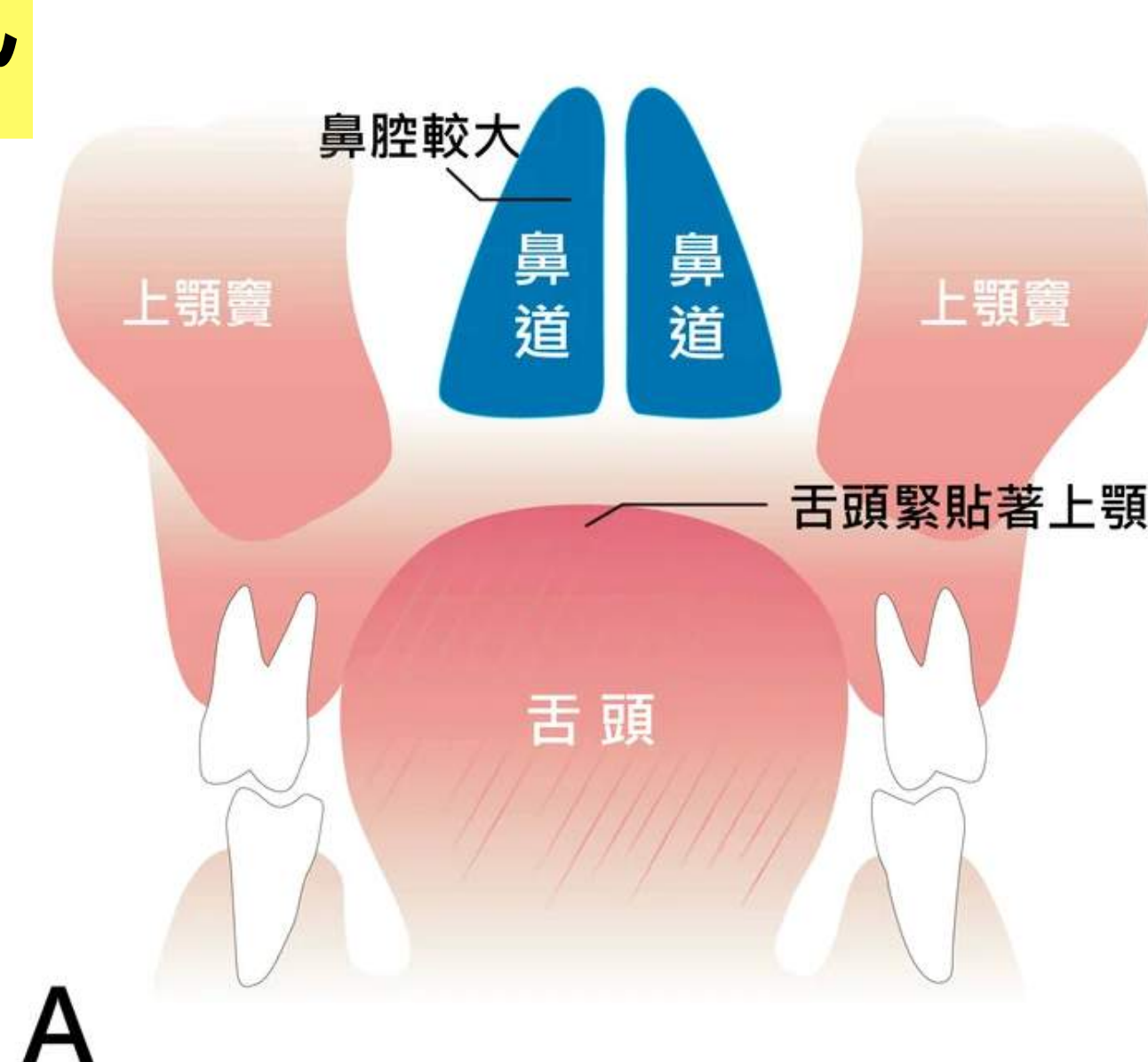




改善睡眠期間口呼吸的問題，
調整成「鼻呼吸」的睡眠模式



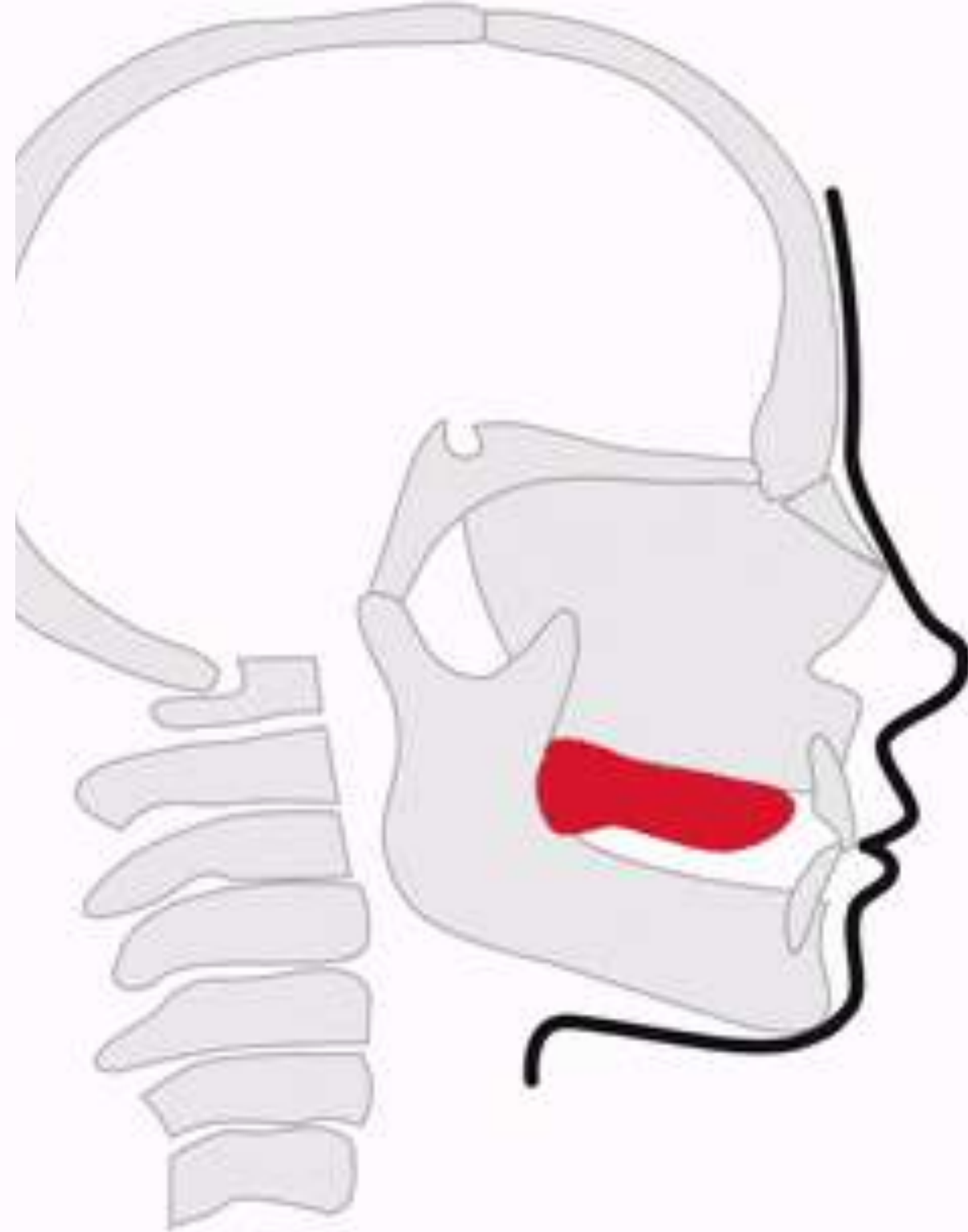
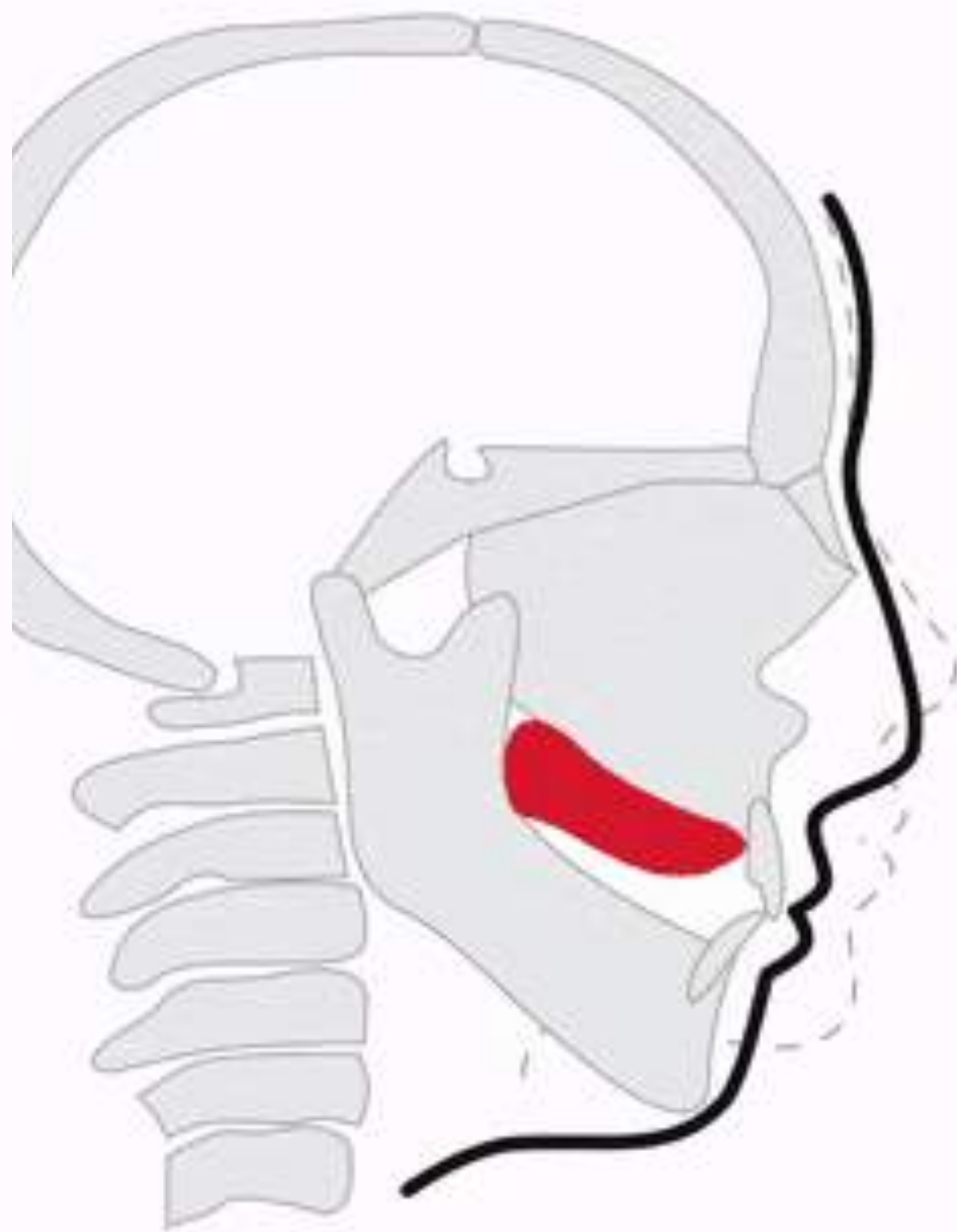
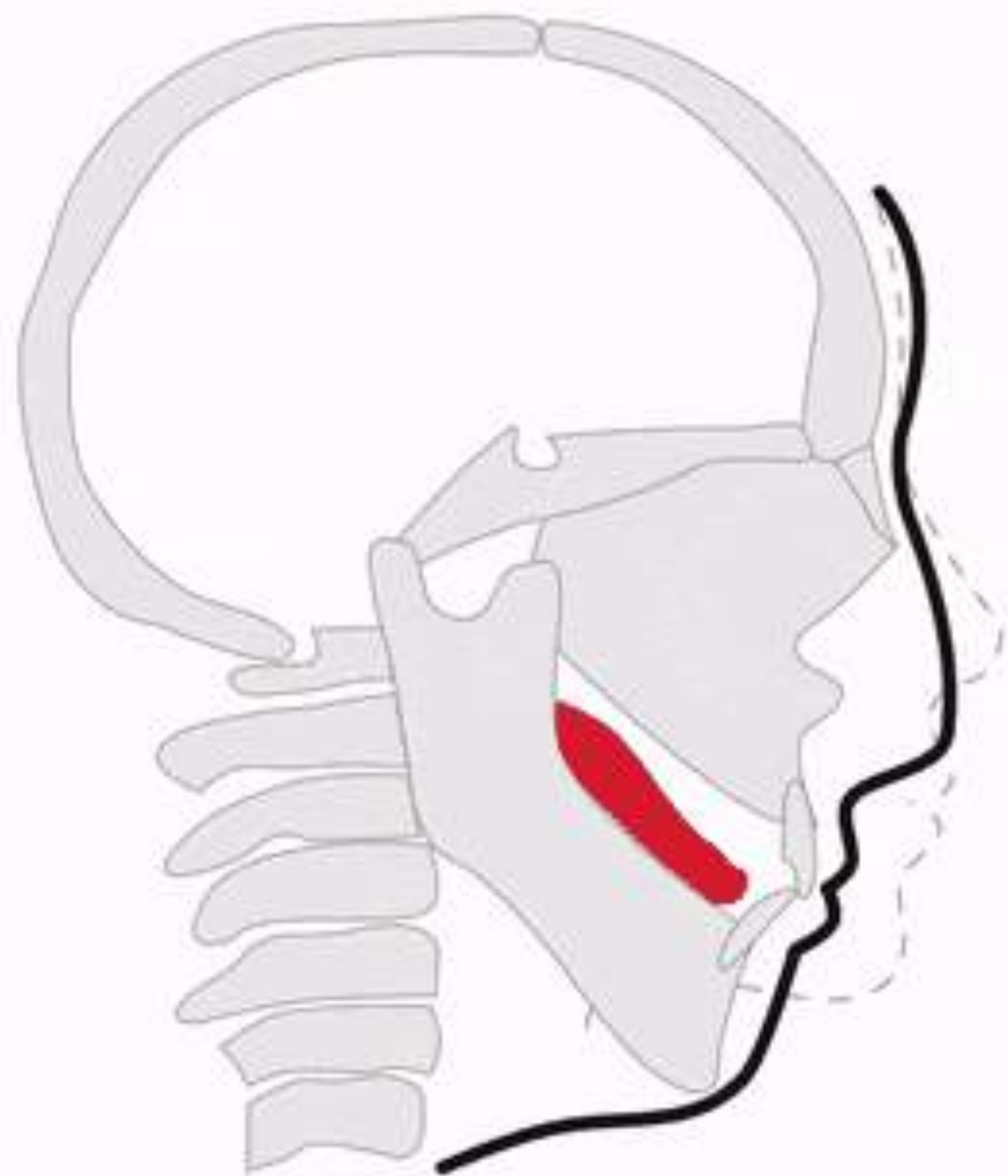
Myobrace 口腔肌功能訓練牙套





Mike & John Mew

Orthotropics (Mewing)

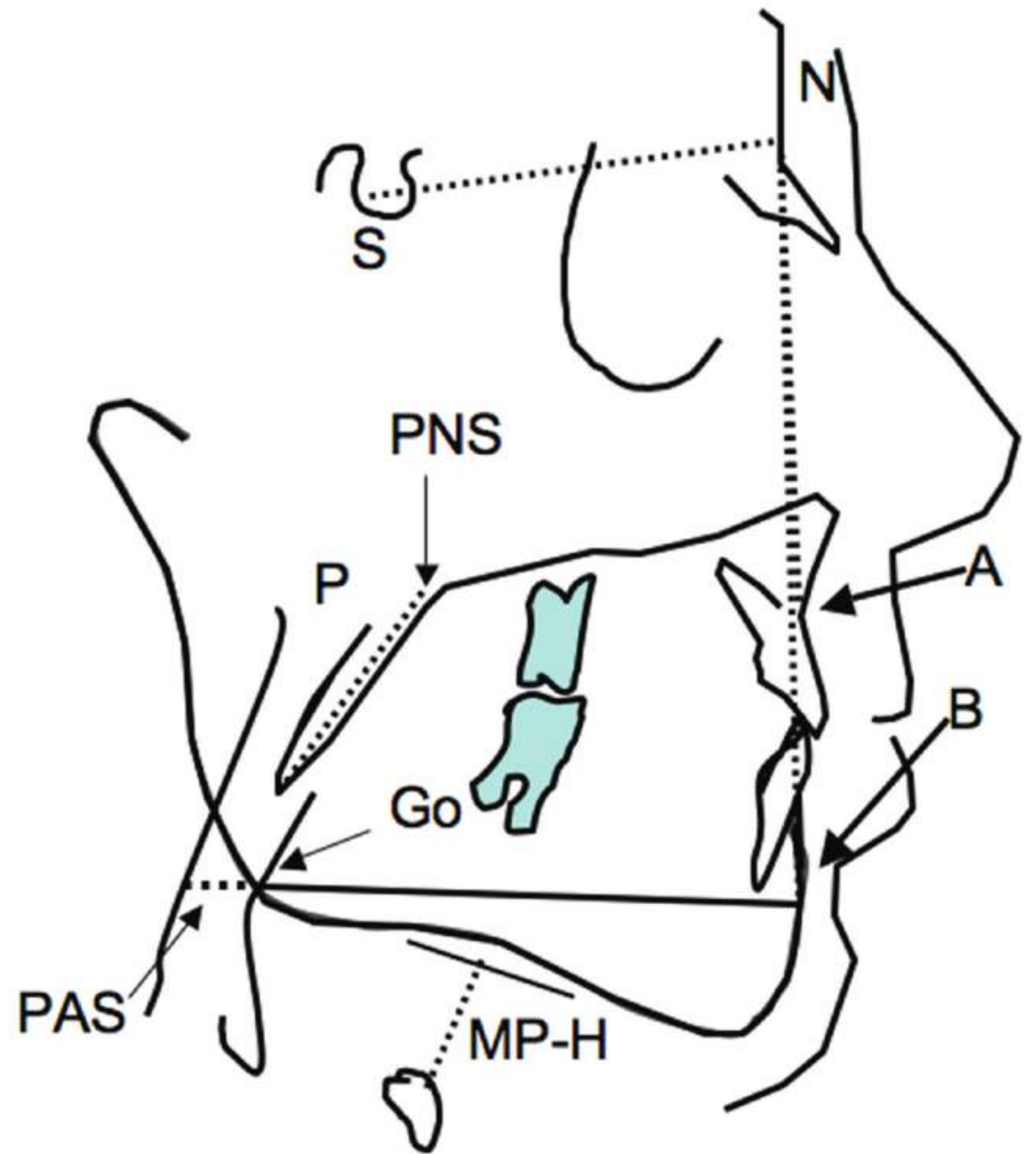
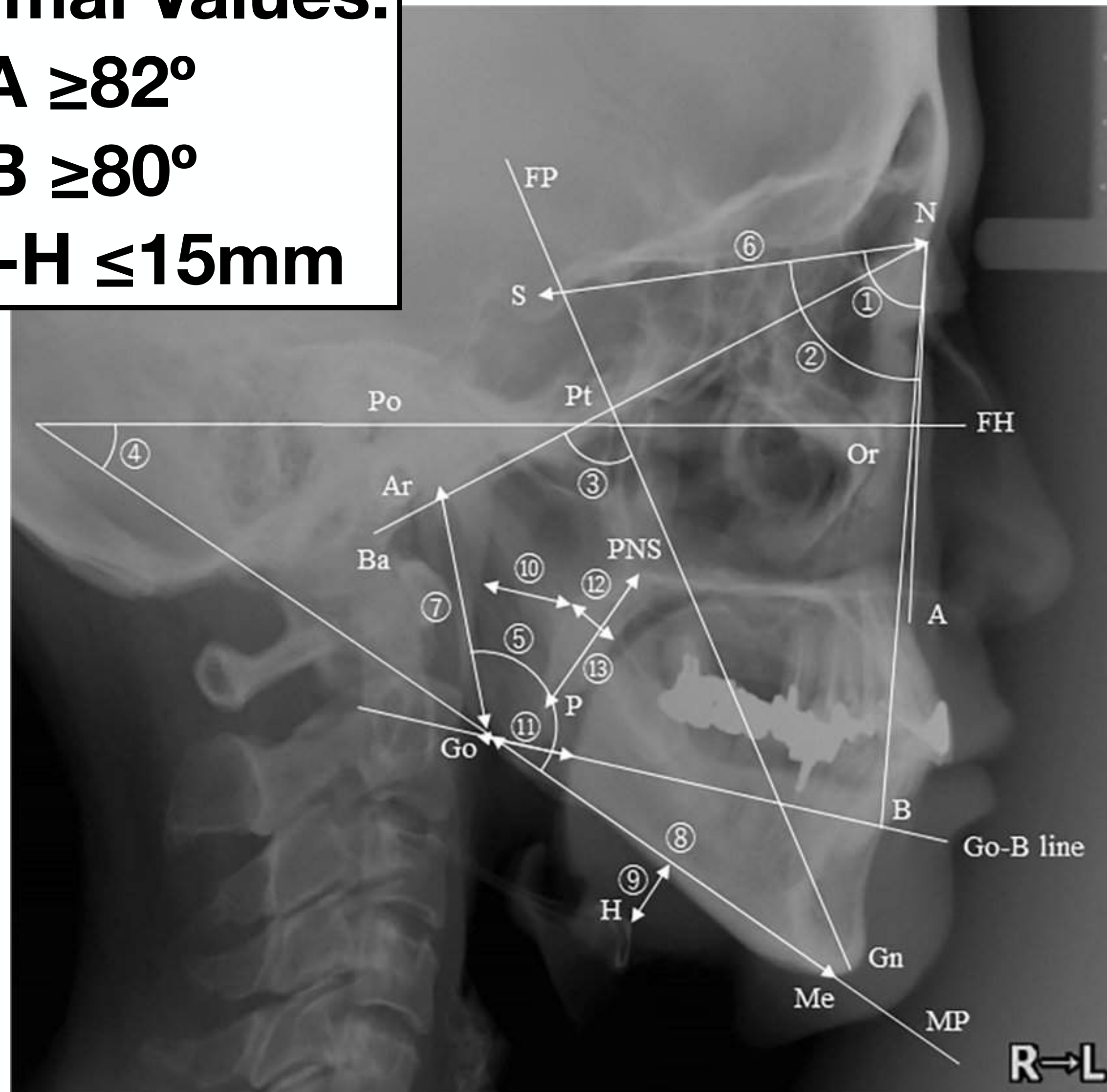


Normal Values:

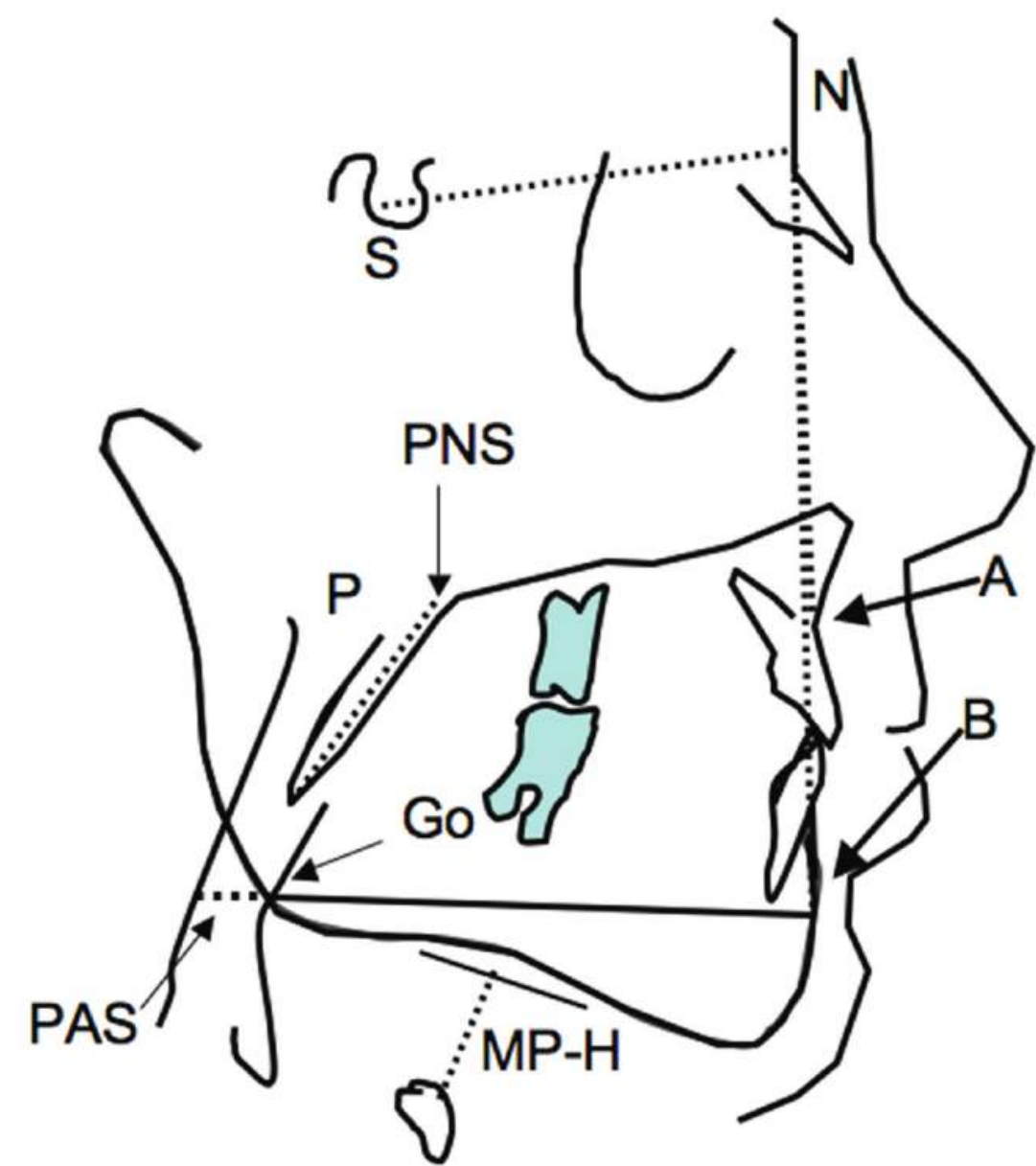
$SNA \geq 82^\circ$

$SNB \geq 80^\circ$

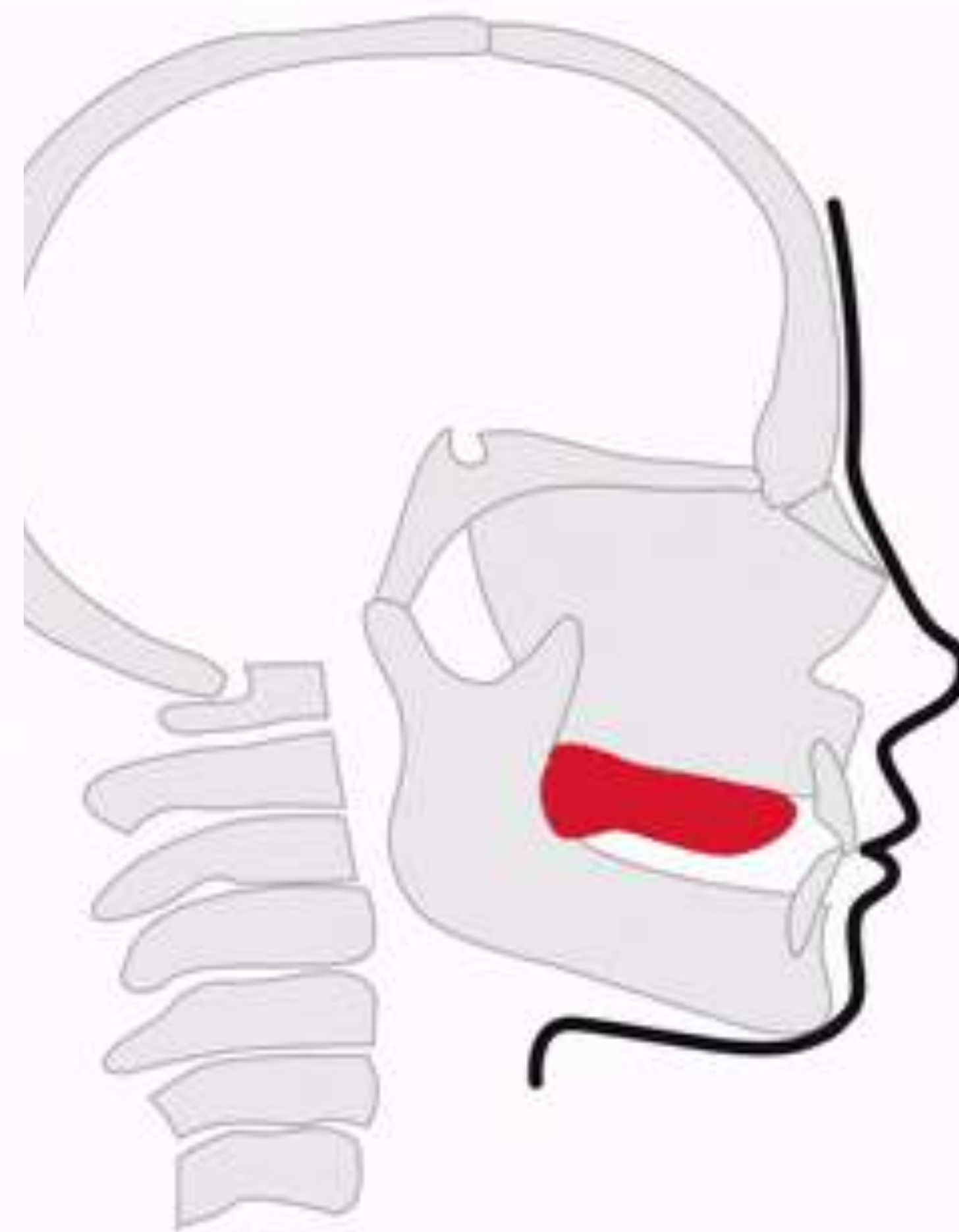
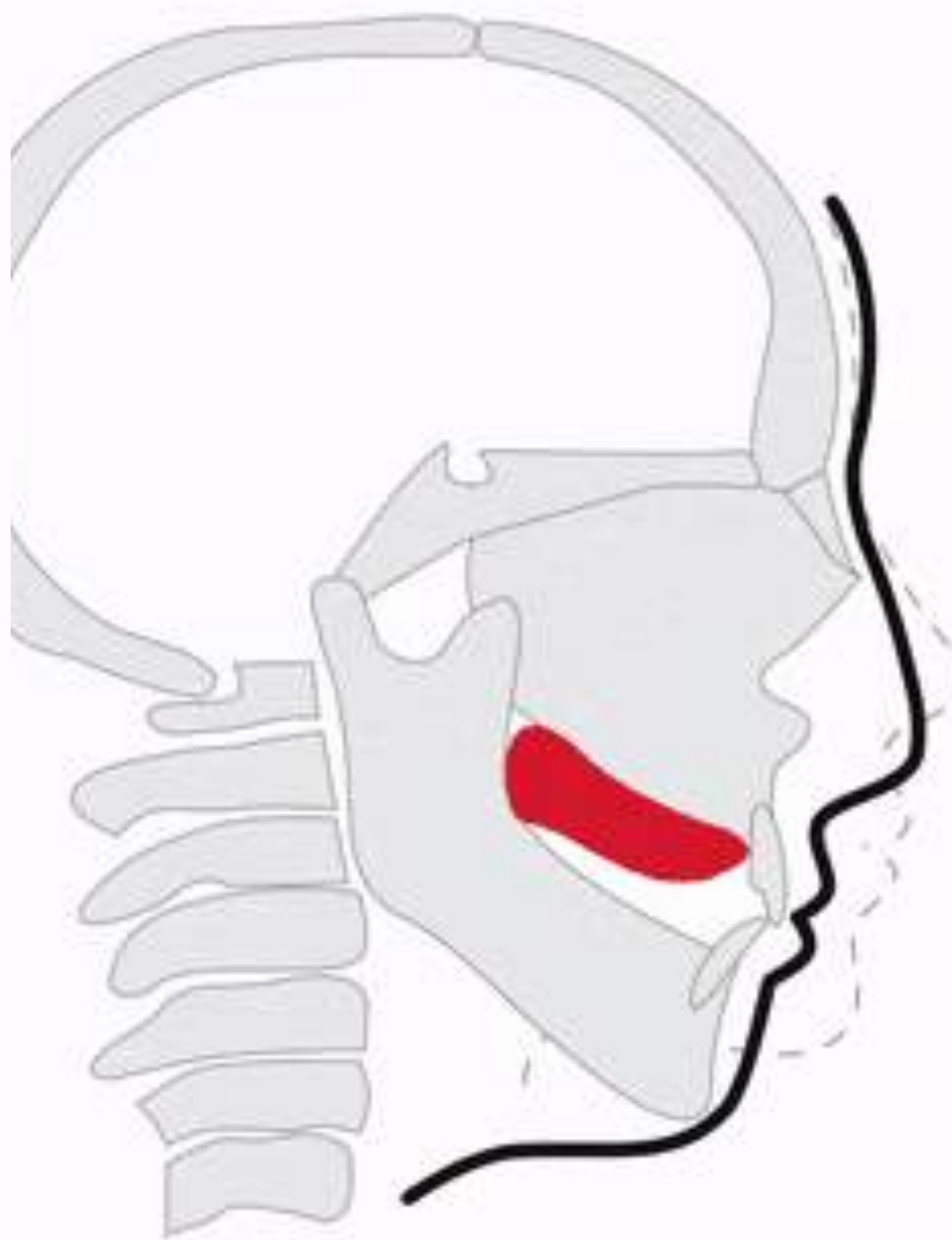
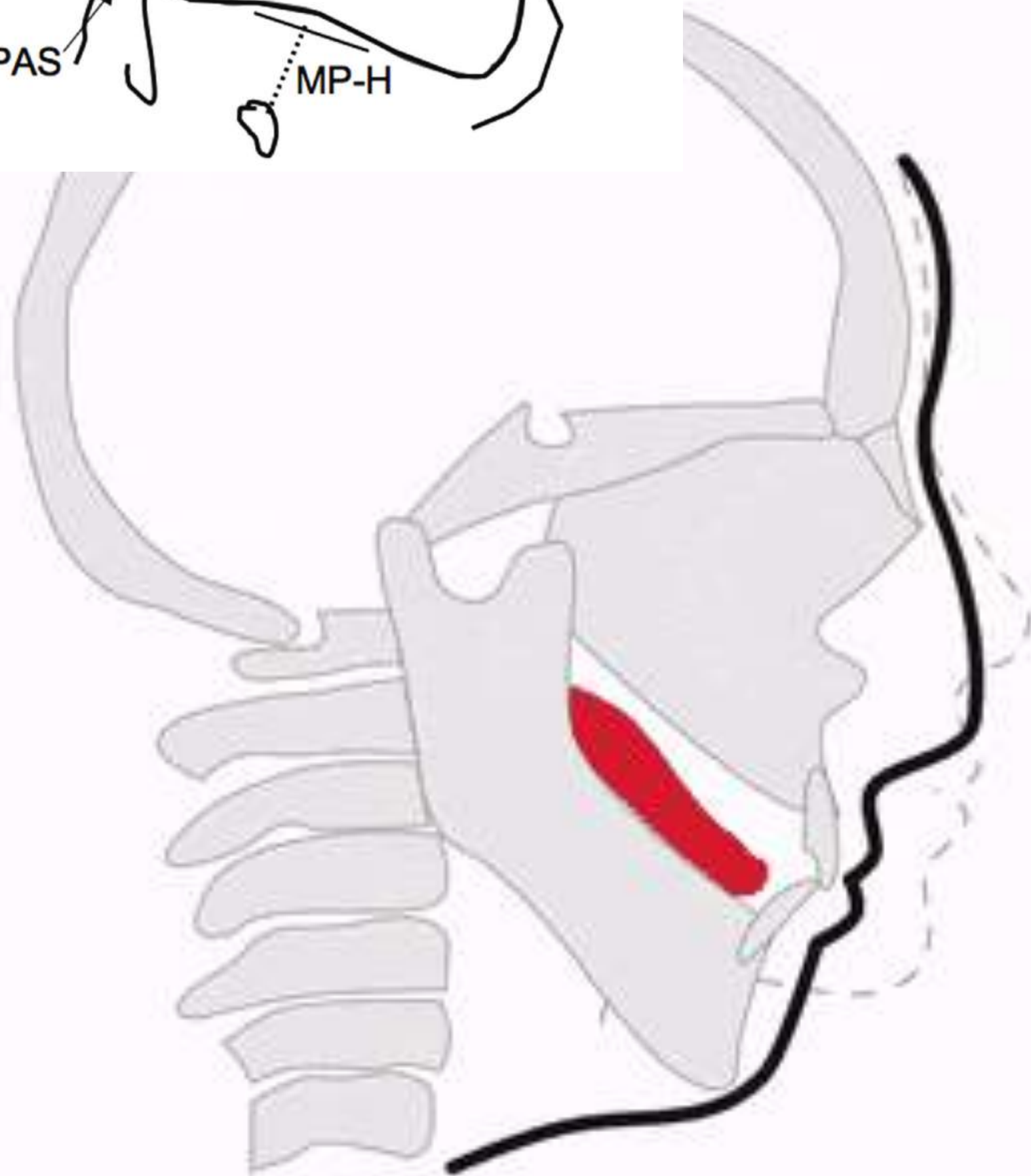
$MP-H \leq 15\text{mm}$



S: sella; N: nasion; A: subspinale; B: supramentale; MP: mandibular plane; H: hyoid



Normal Values:
SNA $\geq 82^\circ$
SNB $\geq 80^\circ$
MP-H $\leq 15\text{mm}$





Orthotropics

@Orthotropics · 49.3萬位訂閱者 · 381 部影片

The Founders of Mewing: Dive into the Authentic Guide to a Natural Jawline >

首頁 影片 SI



Before



After



Before



After

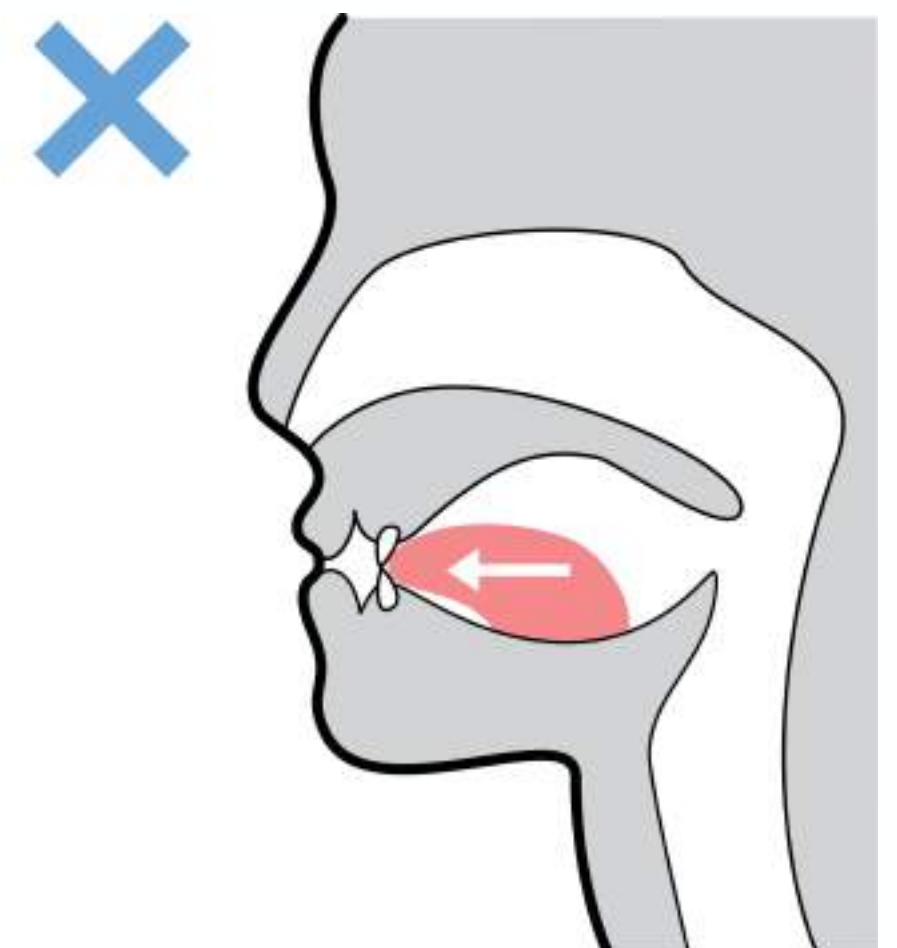
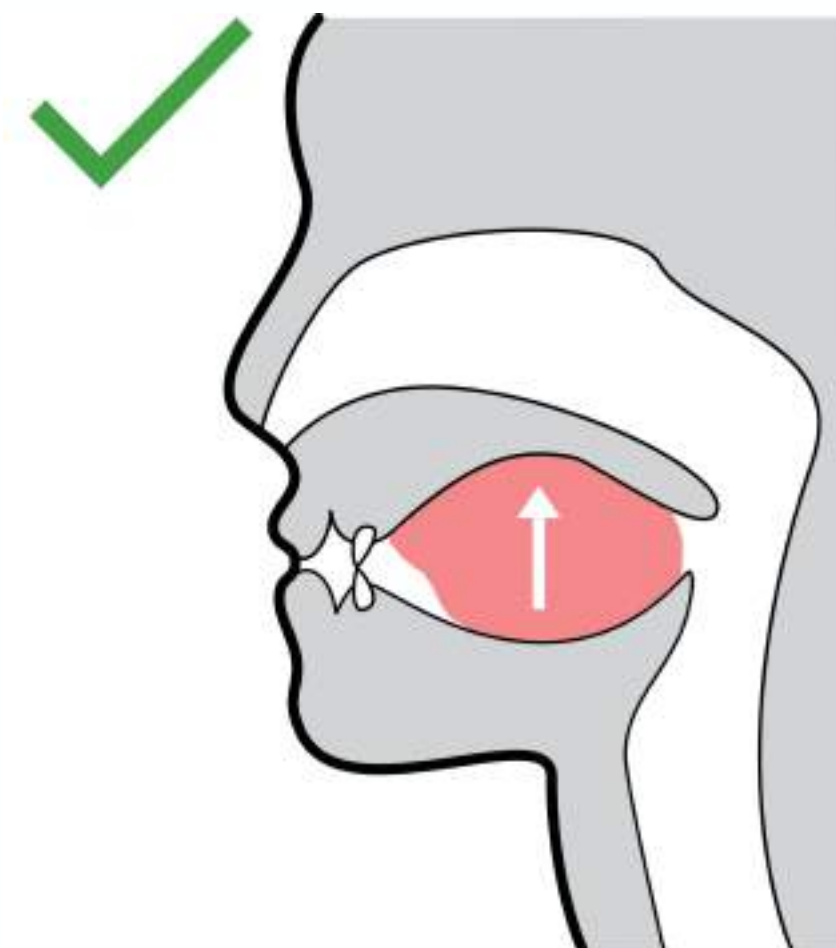
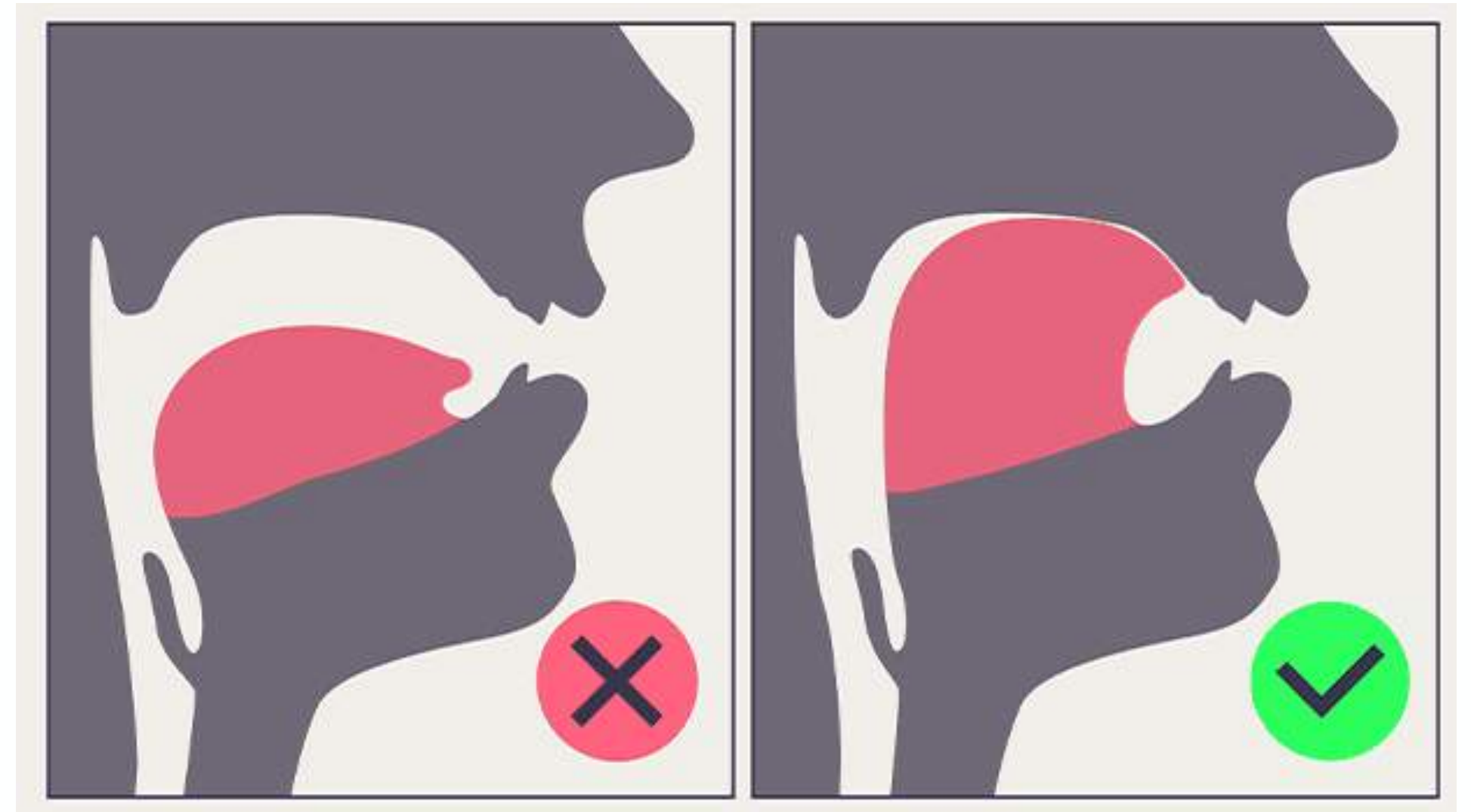


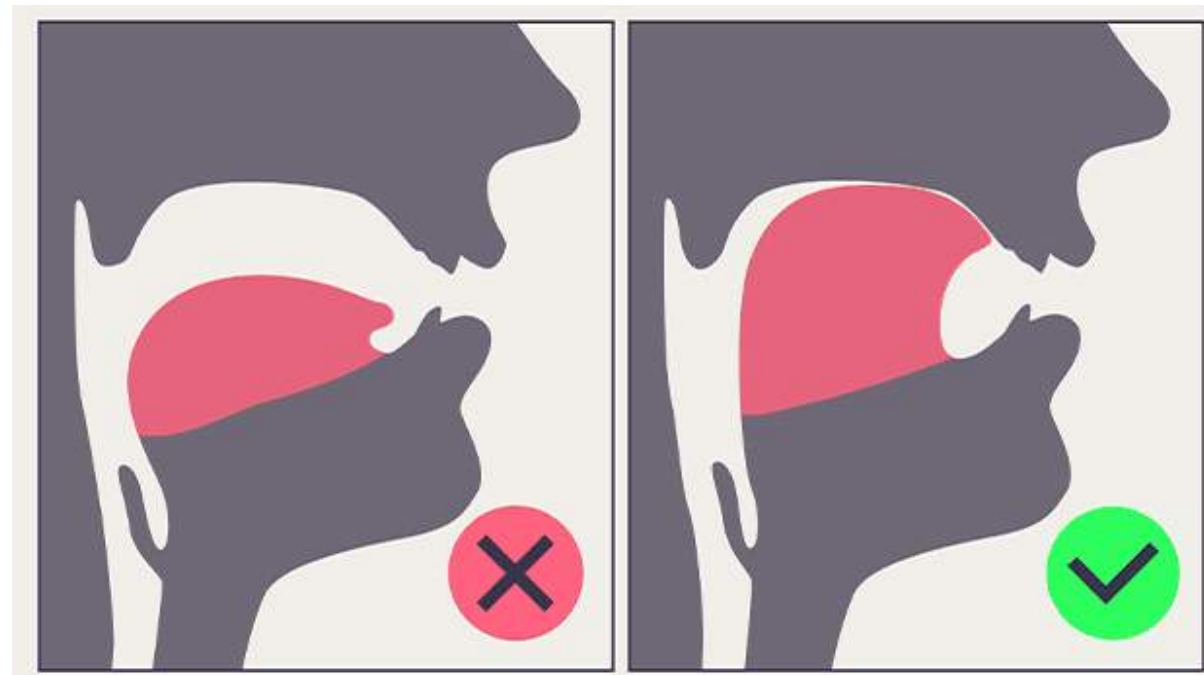
Before



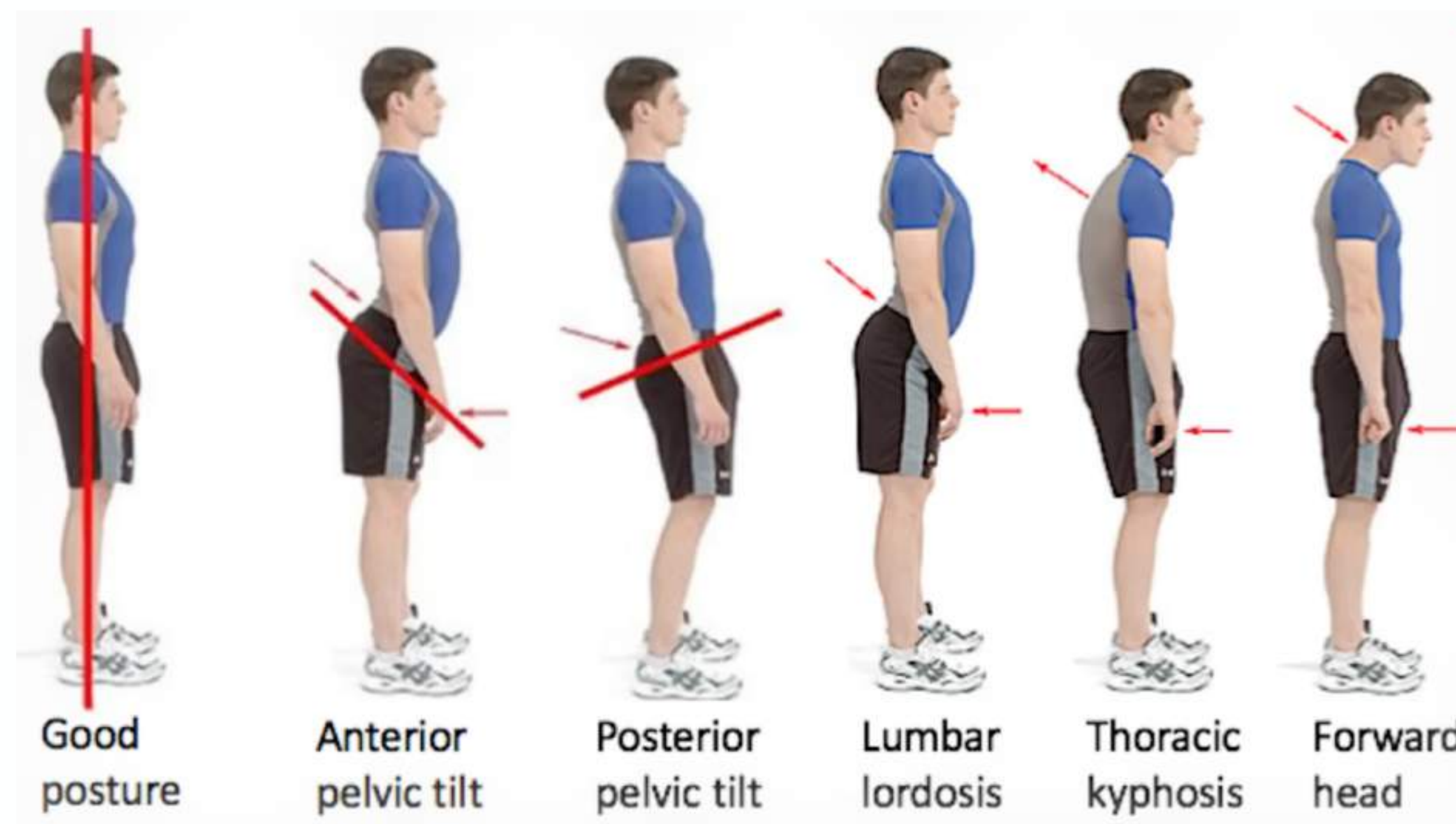
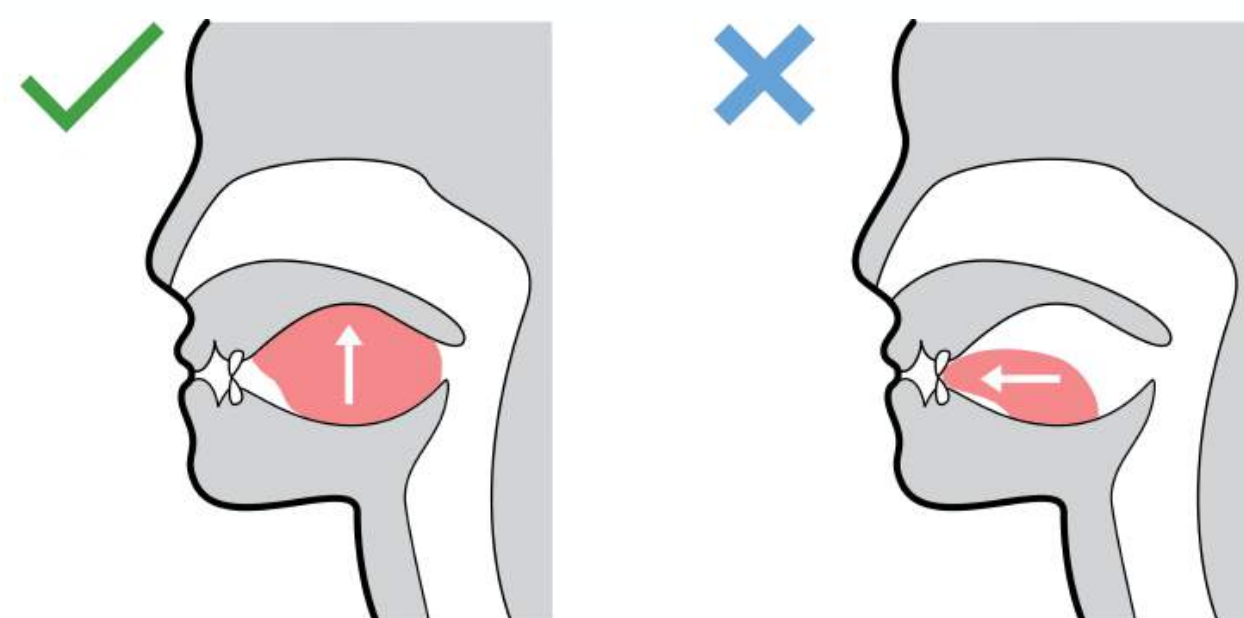
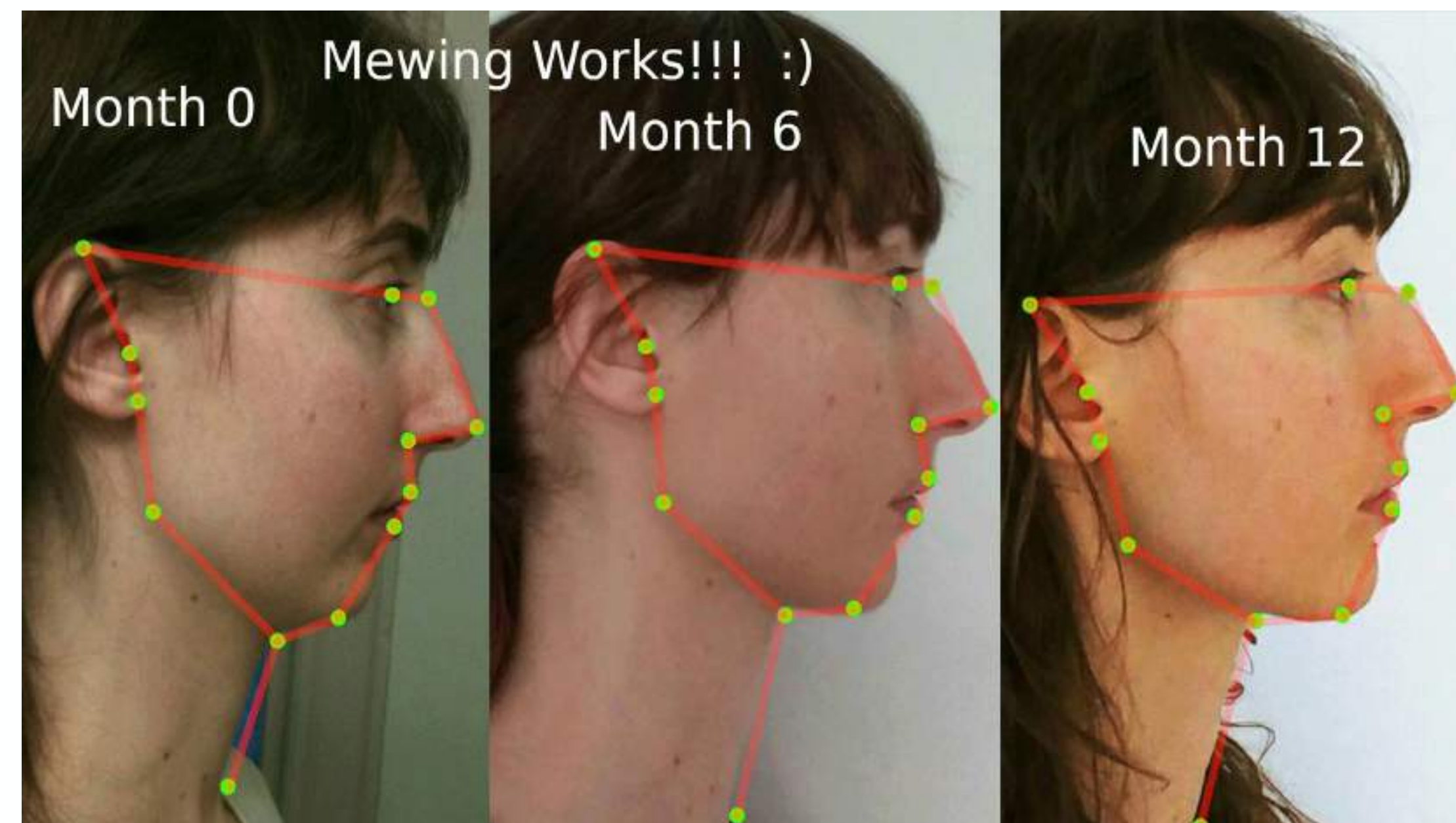
After

Mewing





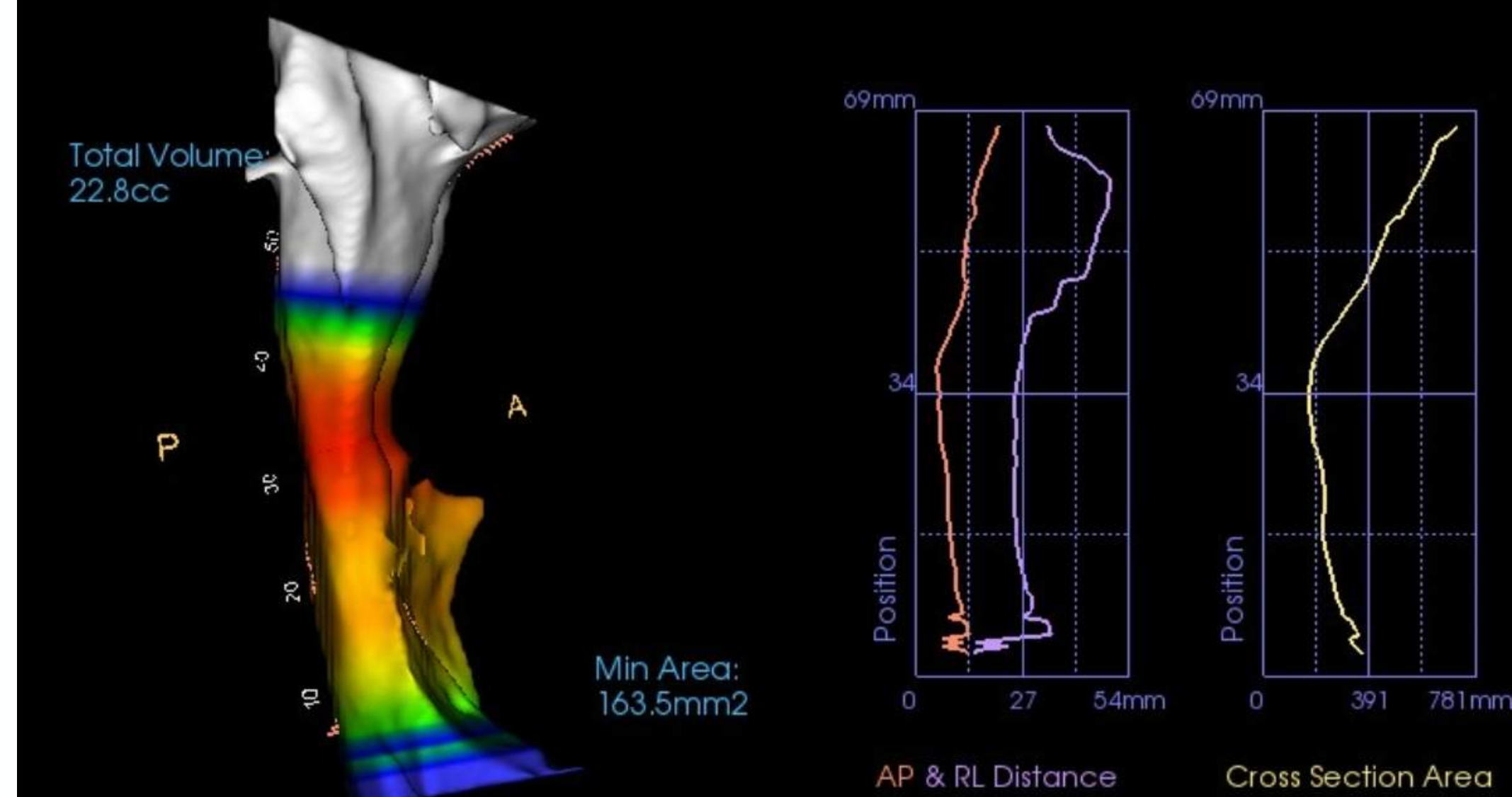
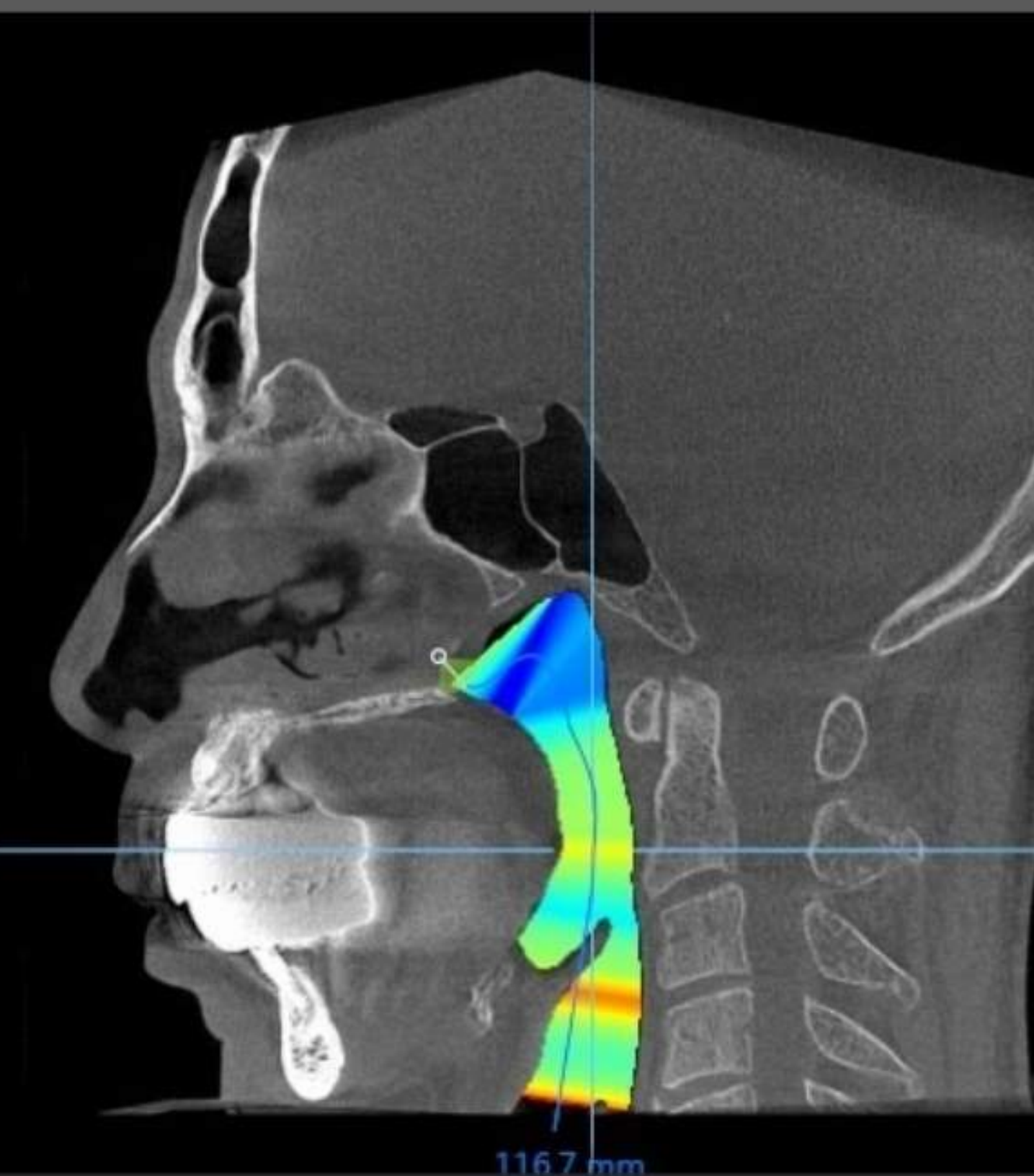
Mewing





10053
[M] 55
27
L

1614.8 mm²



Orthotropics (Mewing)
for 8 months



Orthotropics VS Orthodontist

Twins



Identical Twins

Age 8 **TRAIN TRACKS AND EXTRACTIONS.** Age 13



Ben's front teeth 'stuck out' 8mm.

He now needs to wear an appliance for the rest of his life to hold the teeth straight. Note the Vertical growth.



Age 8 **ORTHOTROPICS NO EXTRACTIONS** Age 13

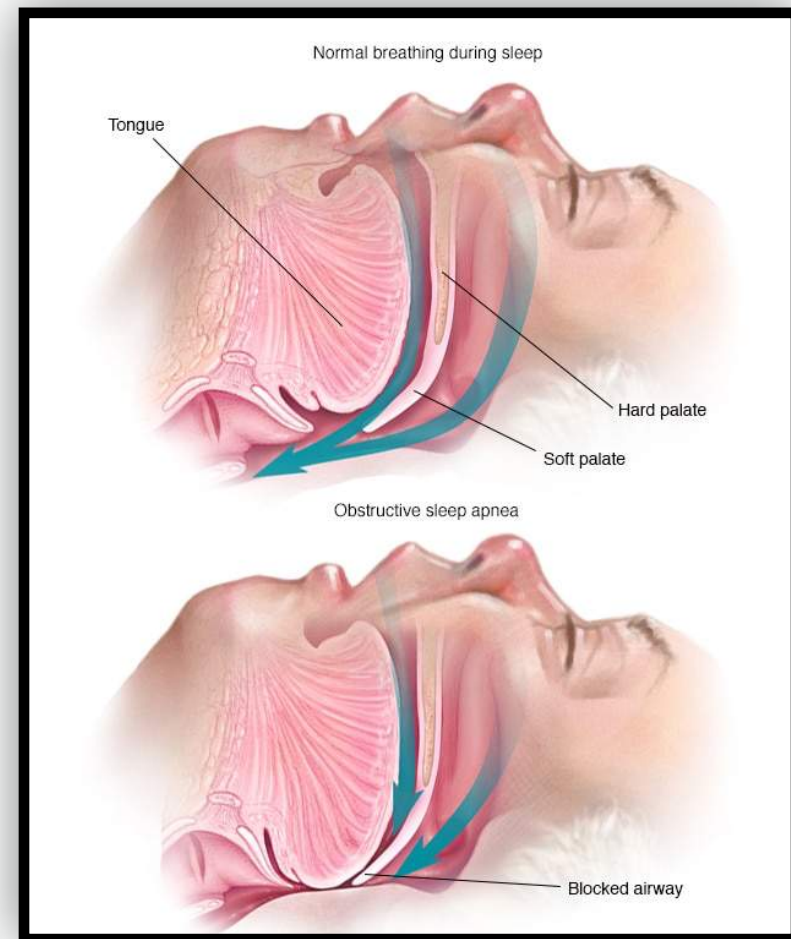


Quinton's front teeth 'stuck out' 9mm.

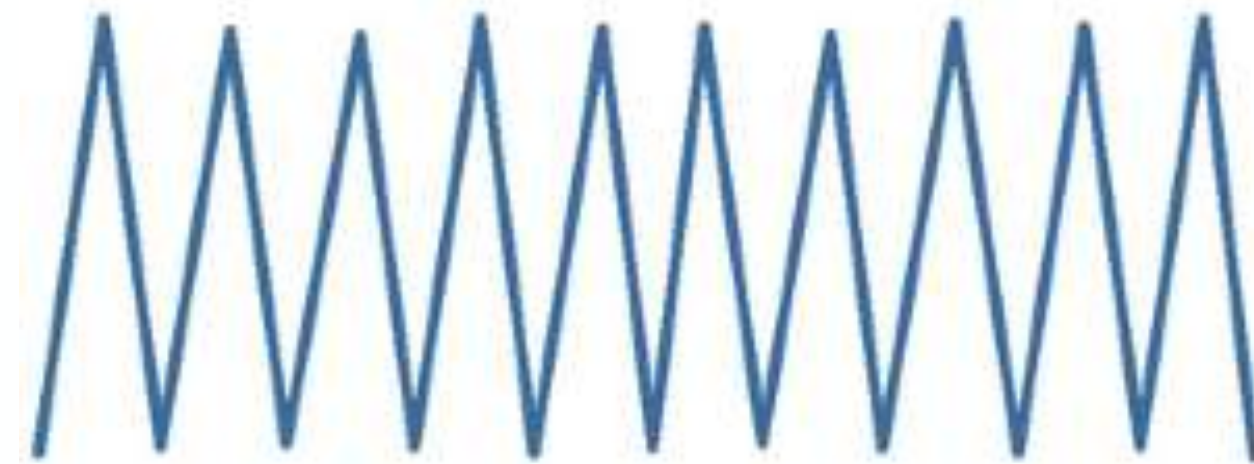
His upper jaw was taken forward 7mm and then his lower jaw brought forward to match. The teeth have stayed in place since then with no retainer.



MEWING: How to monitor?



Normal Respiration



Kussmaul Breathing



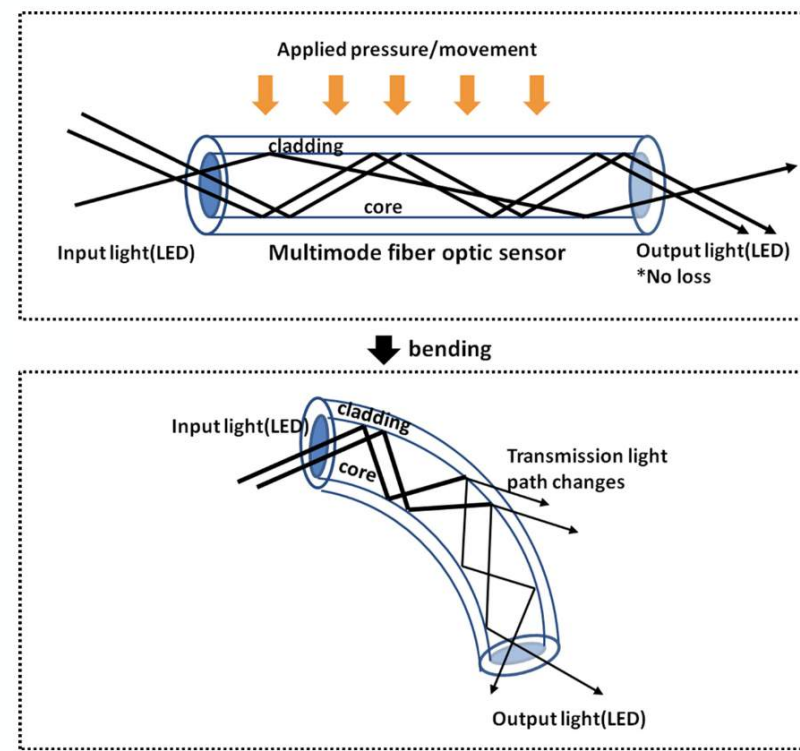
Cheyne-Stokes Respiration



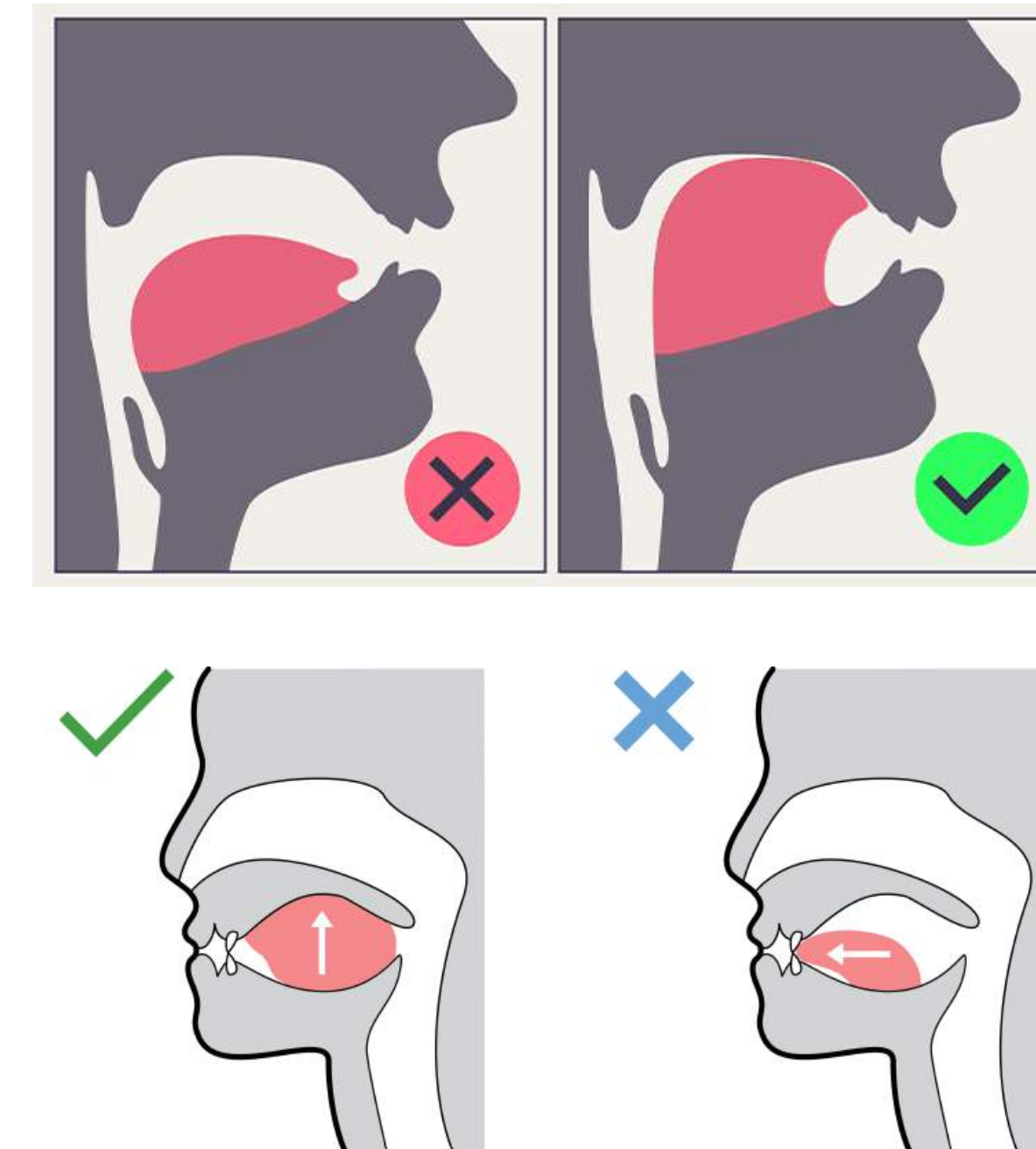
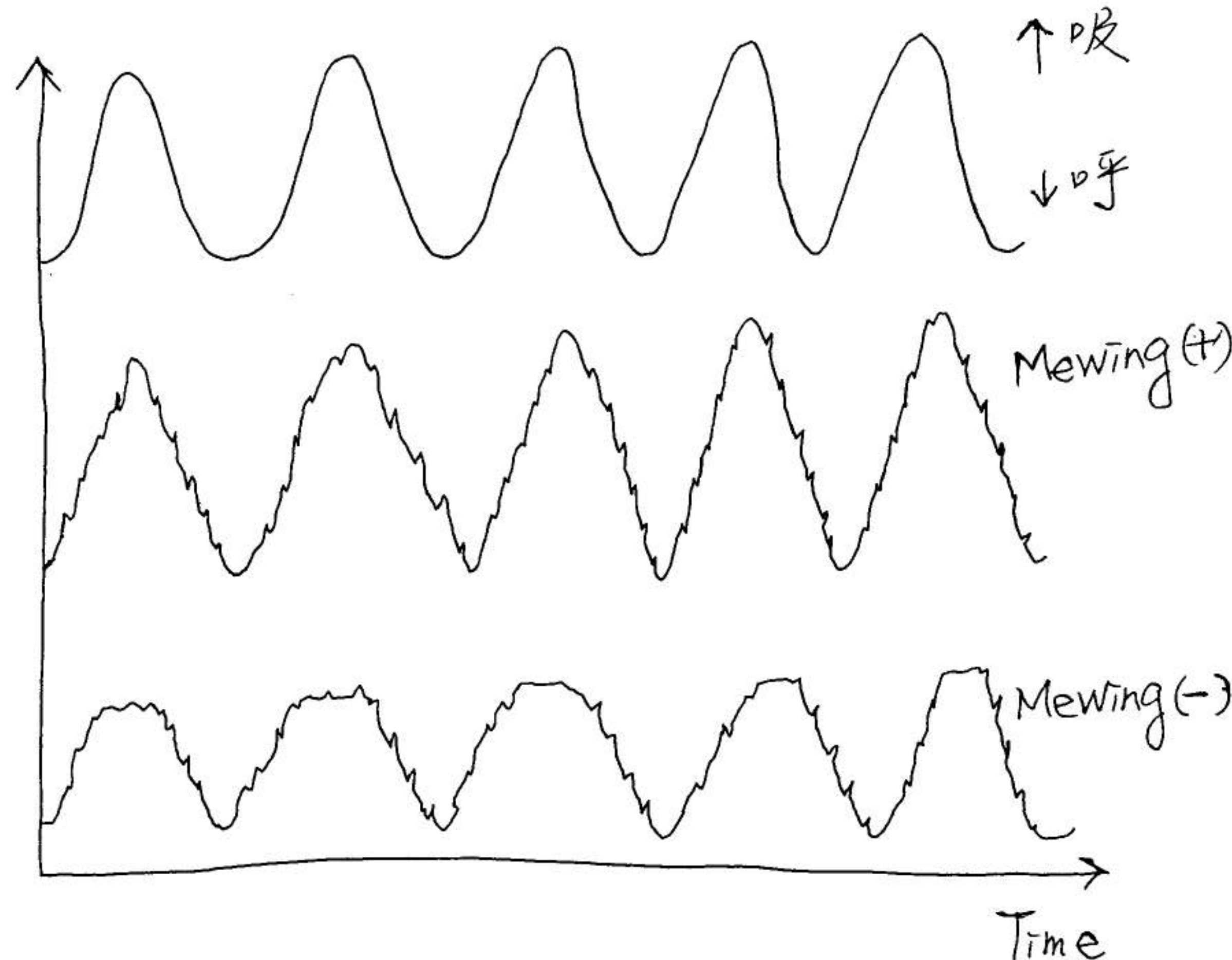
Periodic Breathing



Biot's Respiration

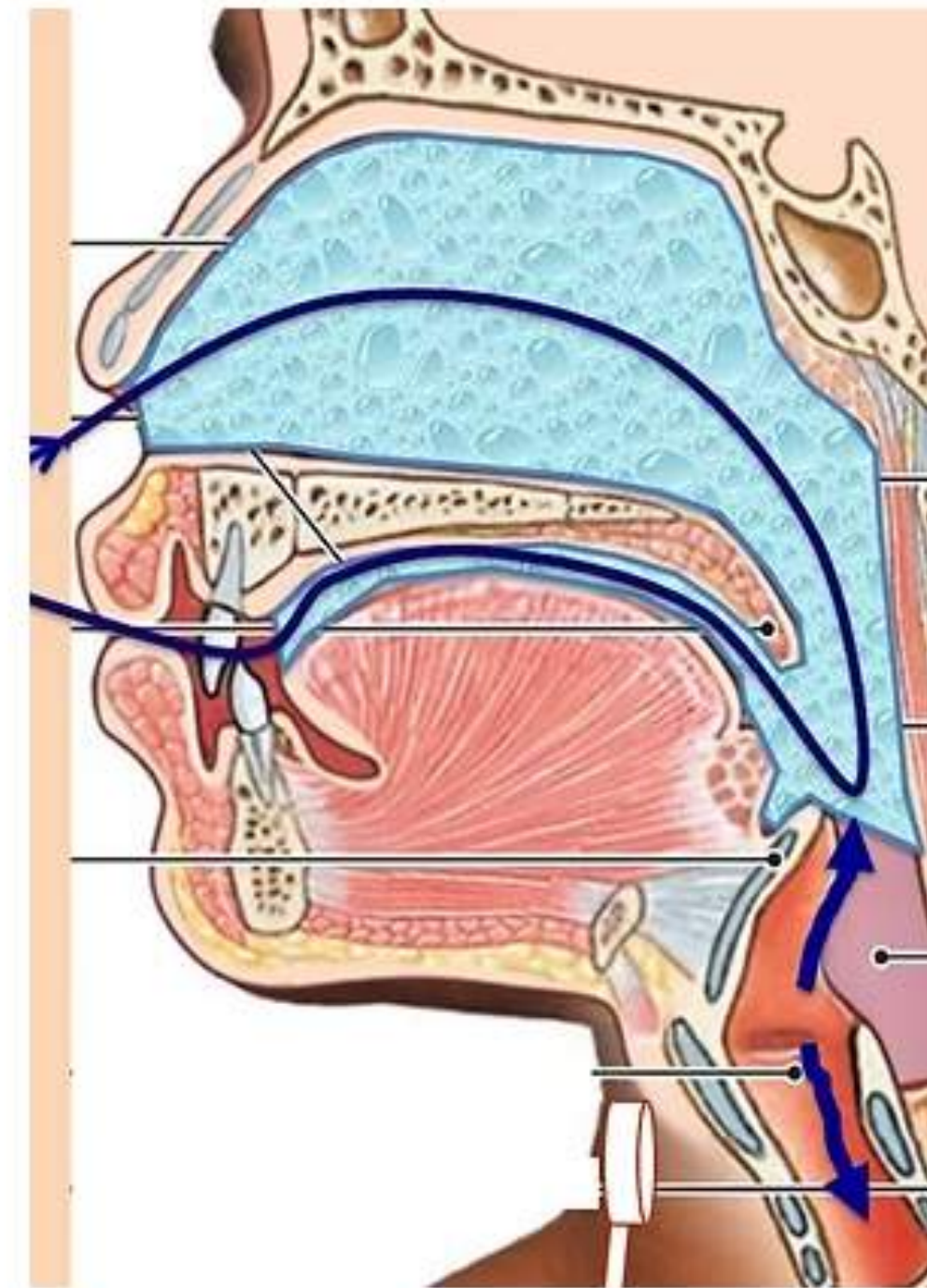


Orthotropics: Mewing (Dr. John Mew)

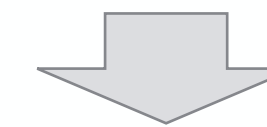


By nFOPT:

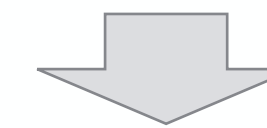
- **Mewing** : smaller airflow resistance leading to **entire** breathing phases detected (inhalation+exhalation)



Breathing Sound

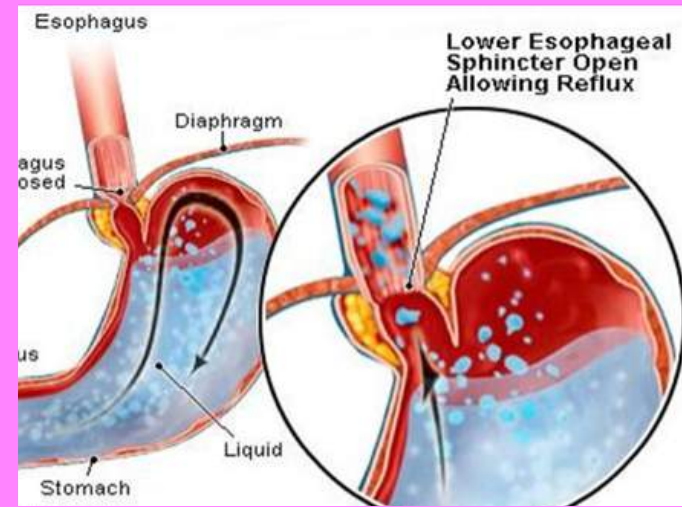


Mouth / Nasal Breathing



Mewing or Not

胃食道逆流



過敏性鼻炎、鼻竇炎、慢性鼻炎

上呼吸道發炎、充血腫脹

上呼吸道狹窄、塌陷阻塞

阻塞型睡眠呼吸中止
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氧化壓力增加

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下肢水分堆積：
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規律運動



活動量不足

控制體重



空氣污染
PM10, PM2.5,
etc.

易感受族群

口腔肌功能

