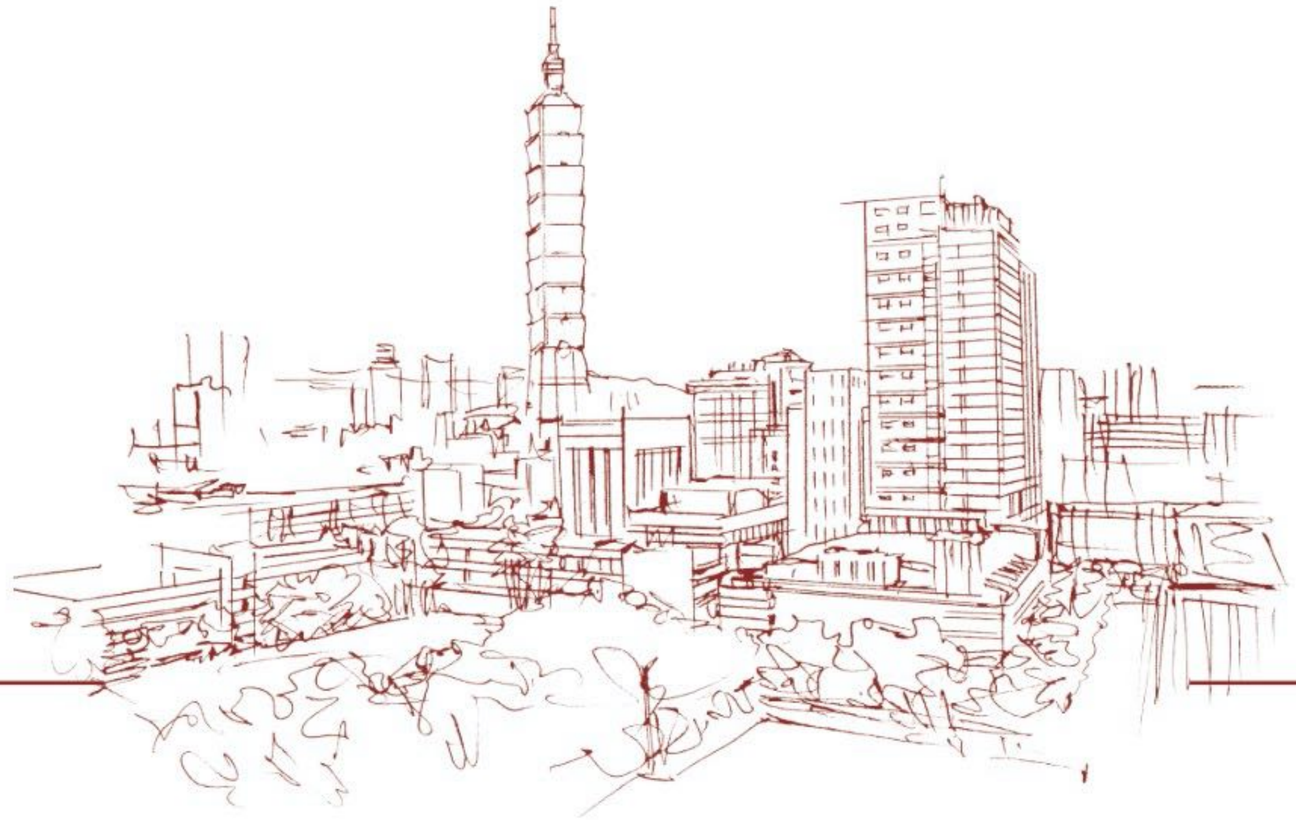

Smart Healthcare for Pulmonary Rehabilitation

智慧醫療在肺復原的應用

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萬芳醫學中心 WANFANG MEDICAL CENTER

TMU SHH 2008 臺北醫學大學・雙和醫院 Taipei Medical University - Shuang Ho Hospital

全面性肺部復健計畫

教育課程
Educational sessions

共同性自我管理
Collaborative self-management

職能治療
Occupational therapy

疾病專門知識增加
Disease-specific knowledge

自我管理技巧增加
Self-management Skills

體力維持技巧增加
Energy-conservation techniques

心理諮詢
Psychological counseling

物理活動指導
Physical activity coaching

運動訓練
Exercise training

營養調整
Nutritional modulation

焦慮症狀
Symtoms of anxiety

憂鬱症狀
Symtoms of depresslon

適應能力限制
Adaptation to limitations

自我效果評估上升
Self-efficacy

四肢肌肉功能增加
Limb muscle function

動態過度充氣下降
Dynamic hyperinflation

運動引起症狀下降
Exercise-induced symptoms

行為改變
Behavior change

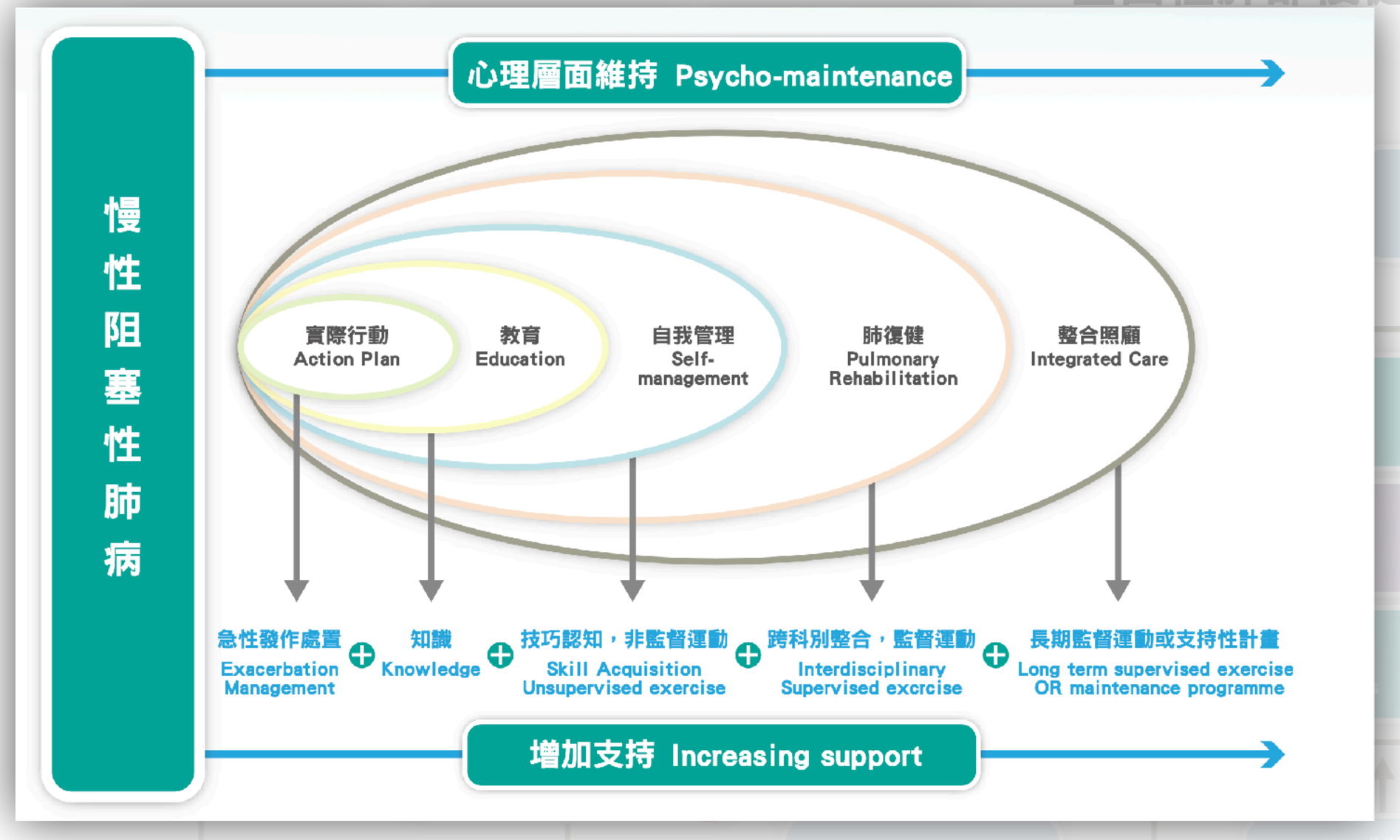
低強度物理活動能力上升
Light intensity physical activities

自主活動上升
Active living

選擇性藥物治療
Optimal phamacological therapy (including comorbidities)

戒菸
Smoking cessation

急性發作或住院率下降
Exacerbation and/or hospitalization



Feasible for most hospitals?

Differences in content and organizational aspects of pulmonary rehabilitation programmes

First global survey: PR in 2011

Returned surveys

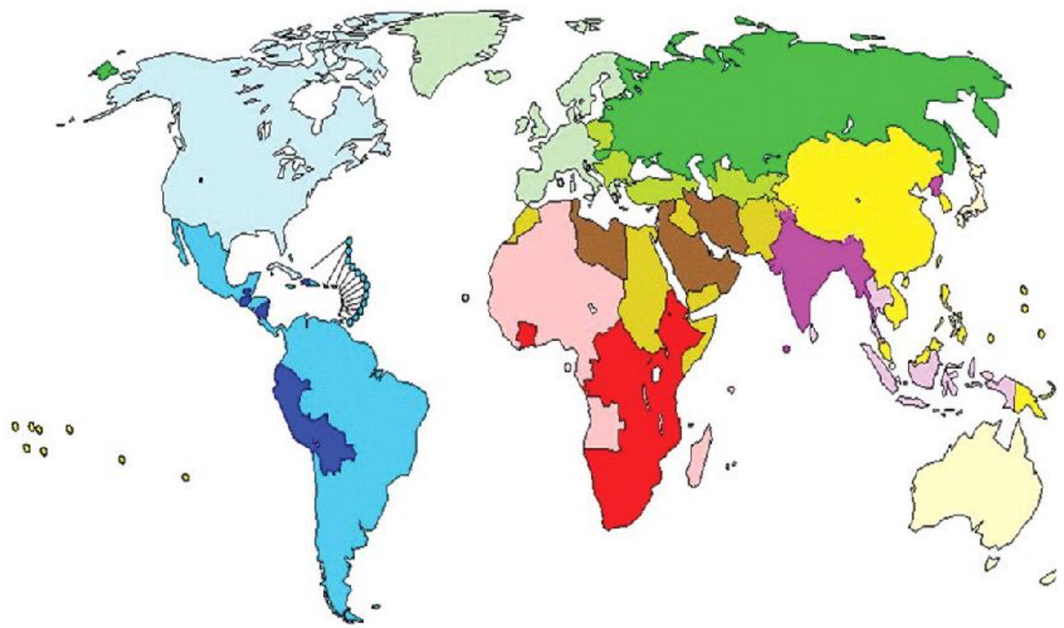
(n=481)

Excluded surveys (total: n=51):

- Missing data for one or more questions (n=37)
- Two or more surveys from same pulmonary rehabilitation programs (n=11)
- Pulmonary rehabilitation program started only in 2012 (n=3)

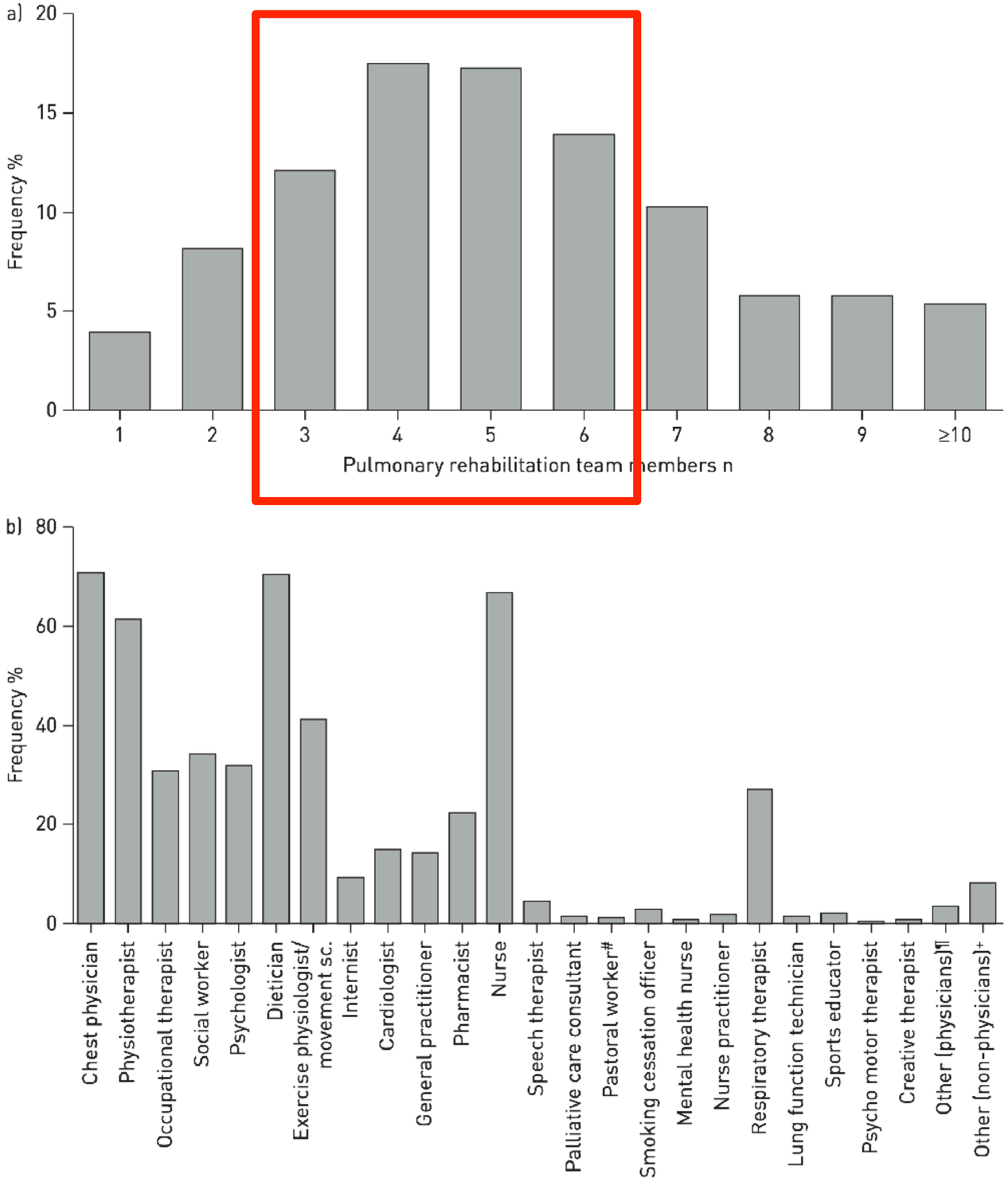
Analysed surveys (n=430)

- Africa (n=1)
- Asia (n=10)
- Europe (n=188)
- North America (n=187)
- Oceania (n=36)
- South America (n=8)



Eur Respir J 2014; 43: 1326–1337

Heterogeneity of COPD & Pulmonary Rehabilitation

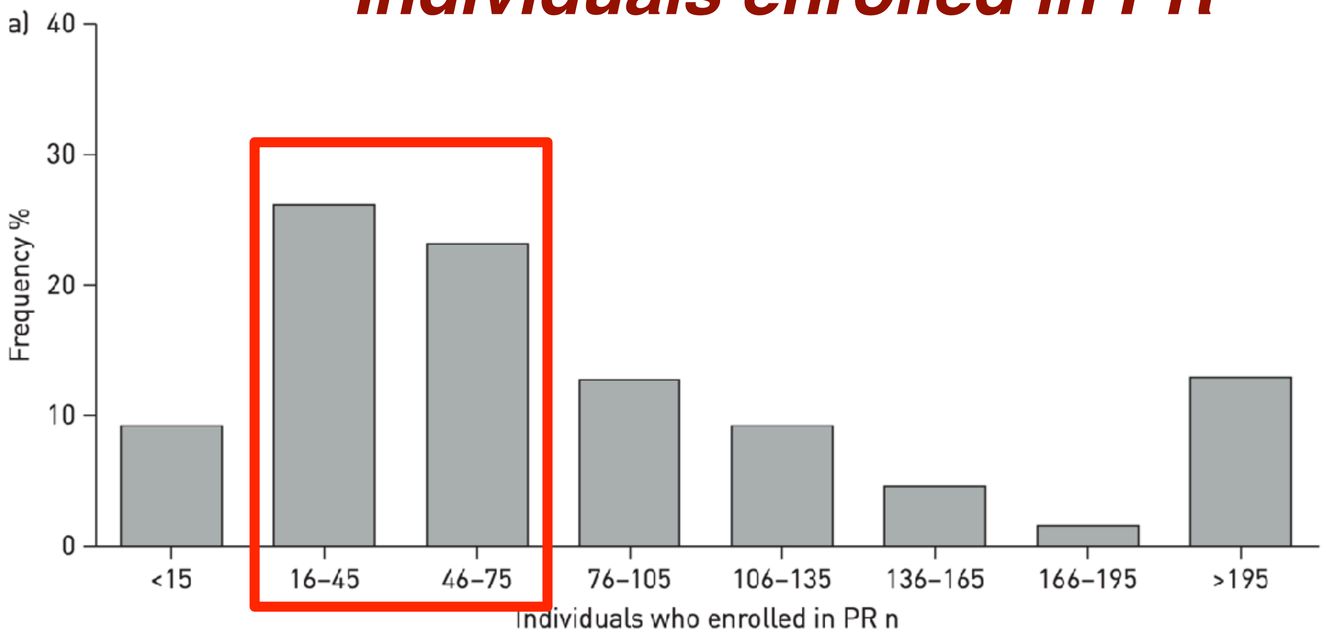


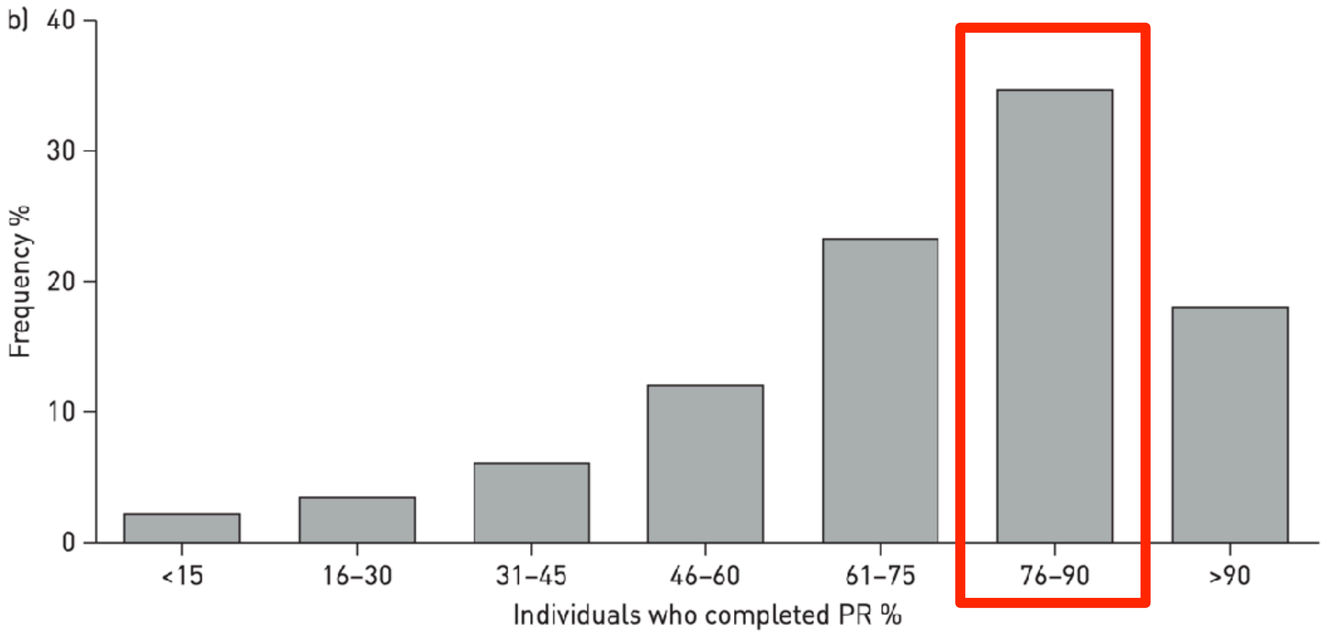
Chest physician
Dietician
Nurse
Physiotherapist
Exercise physiologist
Respiratory therapist

Eur Respir J 2014; 43: 1326–1337

Heterogeneity of COPD & Pulmonary Rehabilitation

Individuals enrolled in PR





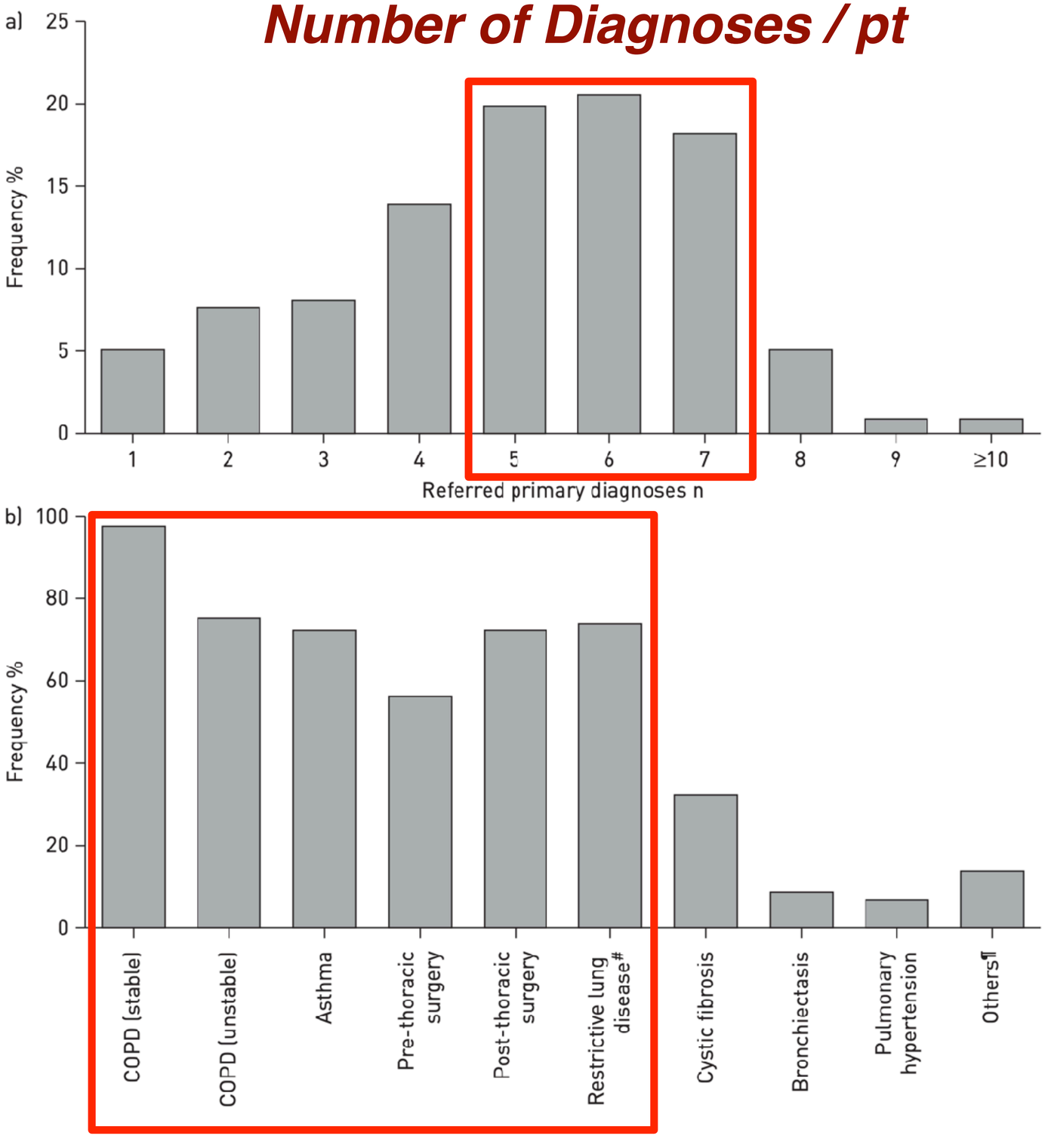
Median: ***40-75*** */program*

Median proportion of completed: ***75-90%***

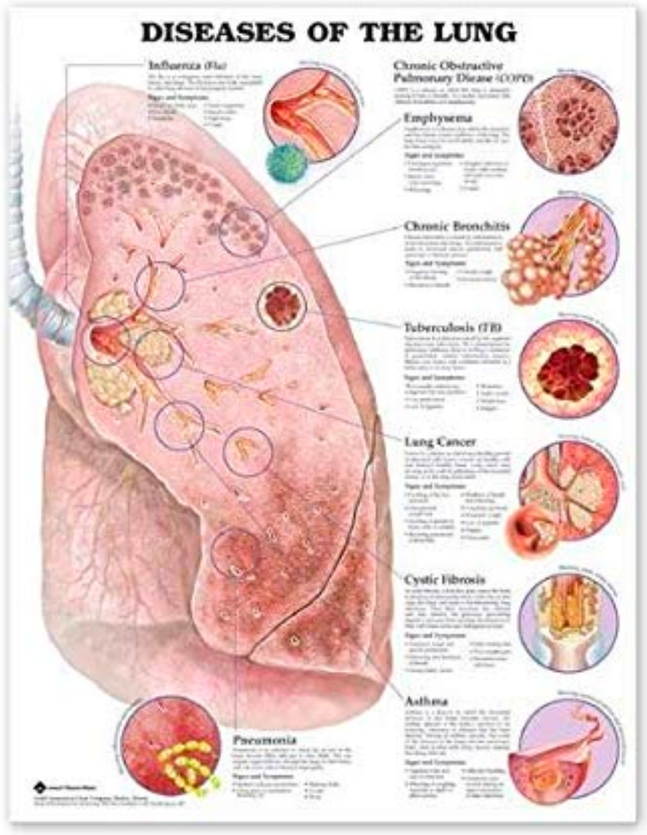
Eur Respir J 2014; 43: 1326–1337

Heterogeneity of COPD & Pulmonary Rehabilitation

Number of Diagnoses / pt



Primary diagnosis: % of 430 programs



Stable COPD: ***97.4%***

Unstable COPD: ***74.9%***

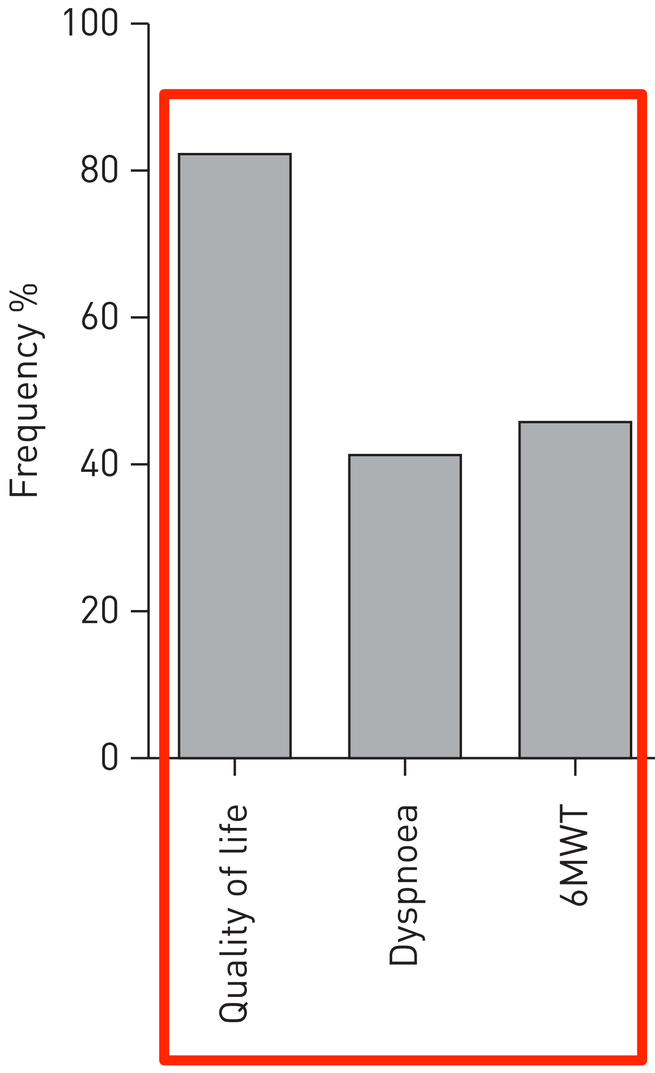
Restrictive lung dx: ***73.7%***

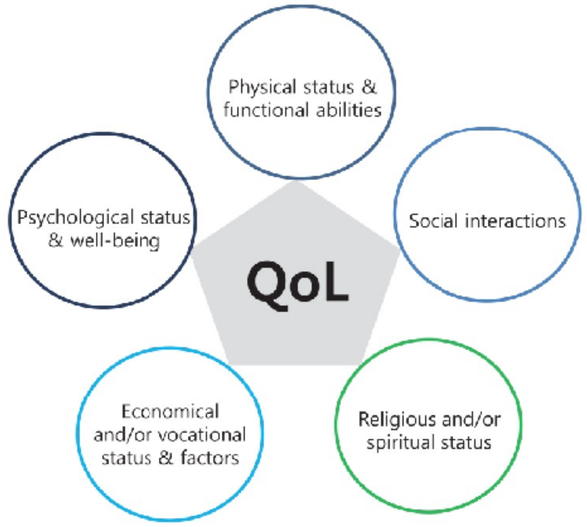
Asthma: ***71.9%***

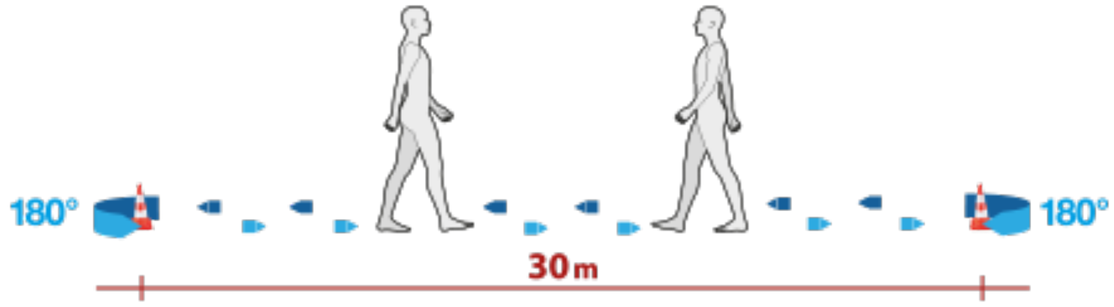
Post surgery: ***71.9%***

Eur Respir J 2014; 43: 1326–1337

Heterogeneity of COPD & Pulmonary Rehabilitation



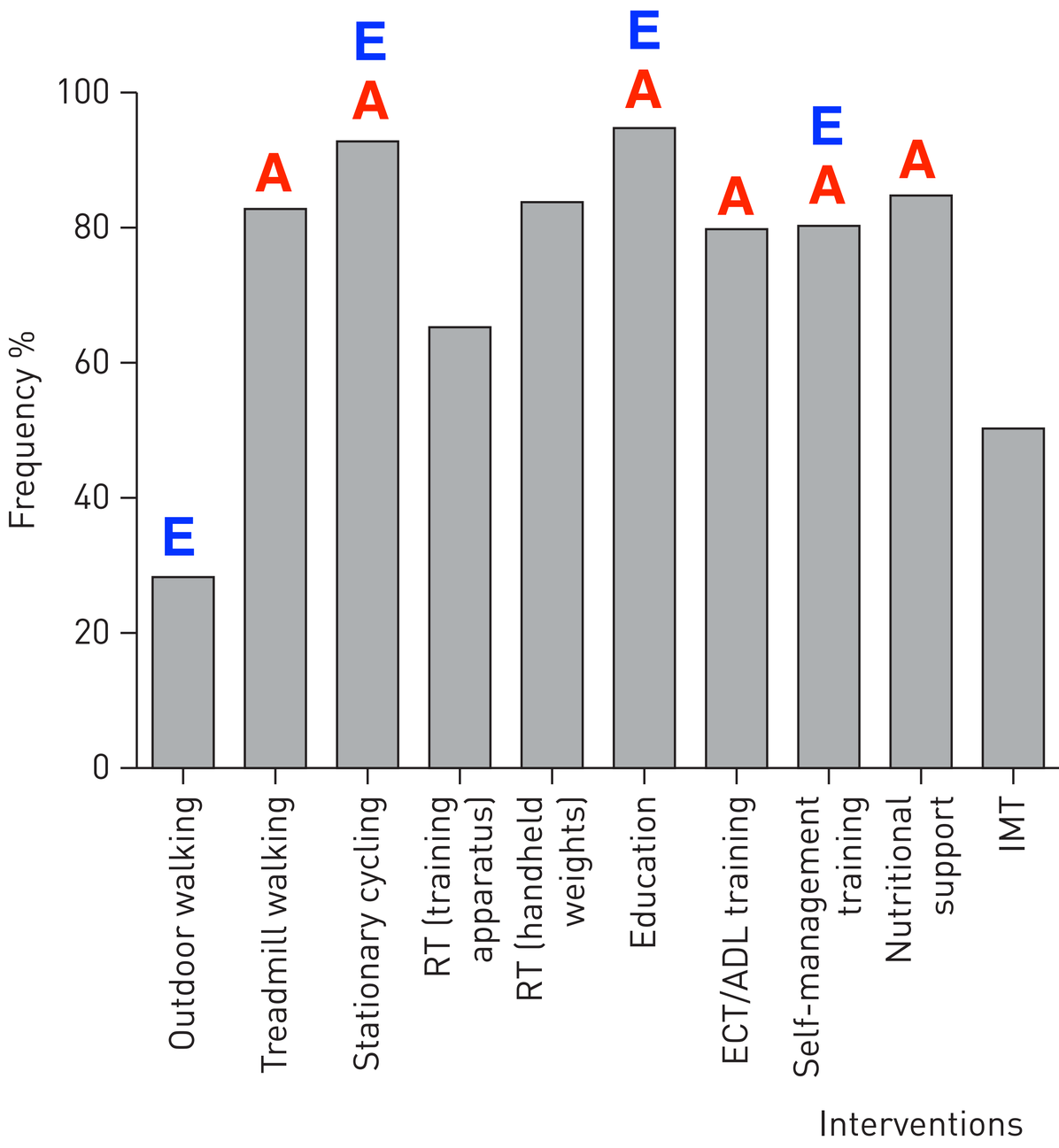


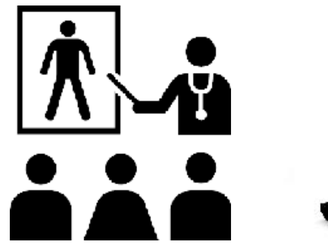


Quality of life / Dyspnea / 6MWT

Eur Respir J 2014; 43: 1326–1337

Heterogeneity of COPD & Pulmonary Rehabilitation

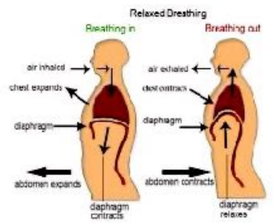




Education

Treadmill

Cycling



Breathing

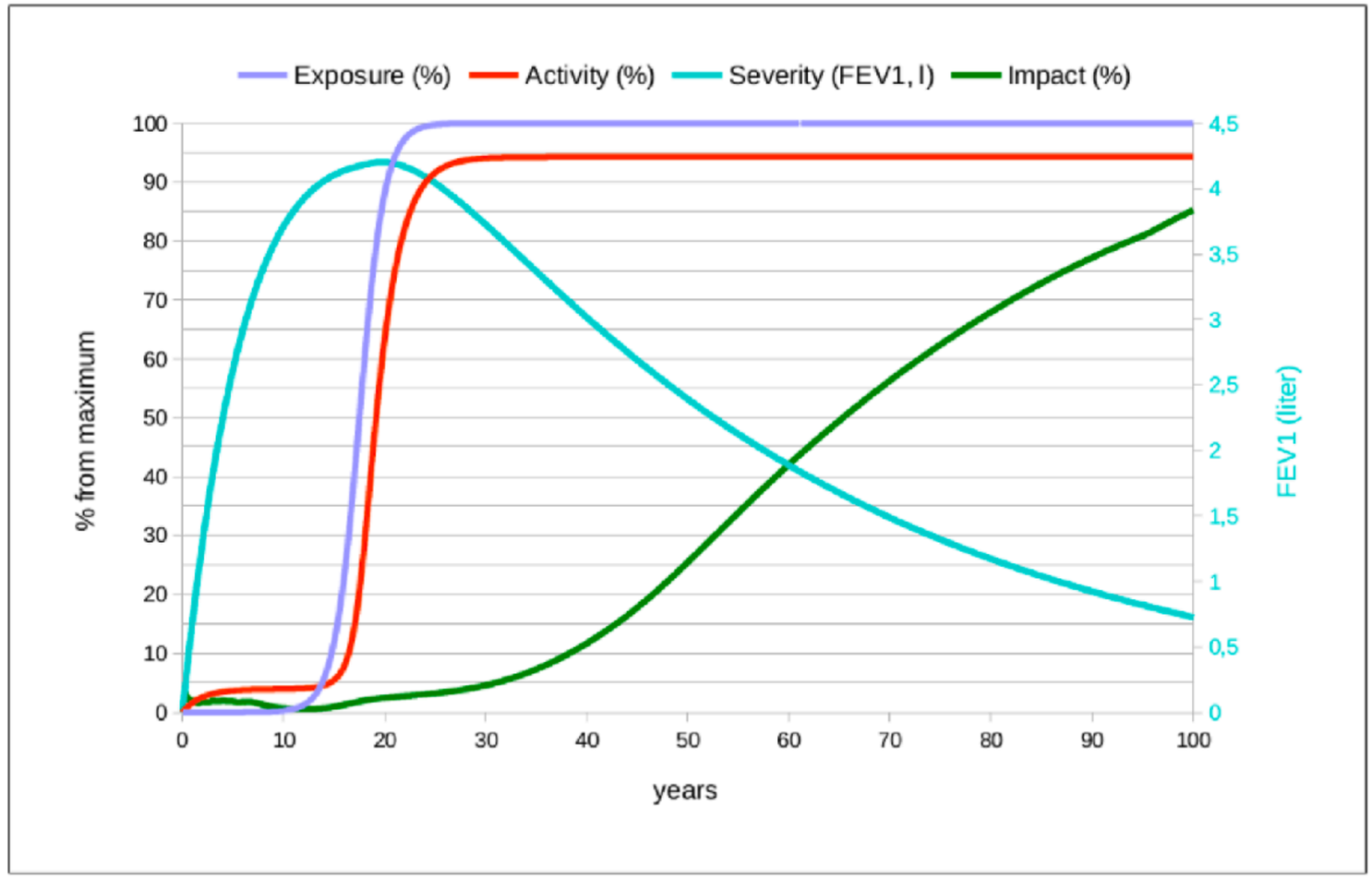
Nutrition

ECT/ADL: energy conservation techniques/activities of daily life
BE/PLB: breathing exercise/pursed lips breathing

Eur Respir J 2014; 43: 1326–1337

The EASI model: A first integrative computational approximation to the natural history of COPD.

Exposure Module
1. Age of smoking onset, yrs.
2. Maximal exposure (packs/day)
3. Time to max. exposure, yrs.
4. Age of quitting, yrs.
5. Time to complete quitting, yrs.
Activity Module
6. Activity trigger, pack/day
7. Slope to maximal activity
8. Persistence after quitting, % Activity
Severity Module
9. Normal rate of FEV_1 decline, ml/yrs.
10. Activity trigger, % epithelial apoptosis
11. Slope to maximal severity
12. Maximal rate of FEV_1 decline, ml/yrs.
13. FEV_1 at 20 yrs. of age, liters
Impact Module
14. Impact trigger, % reference FEV_1
15. Slope to max. Impact

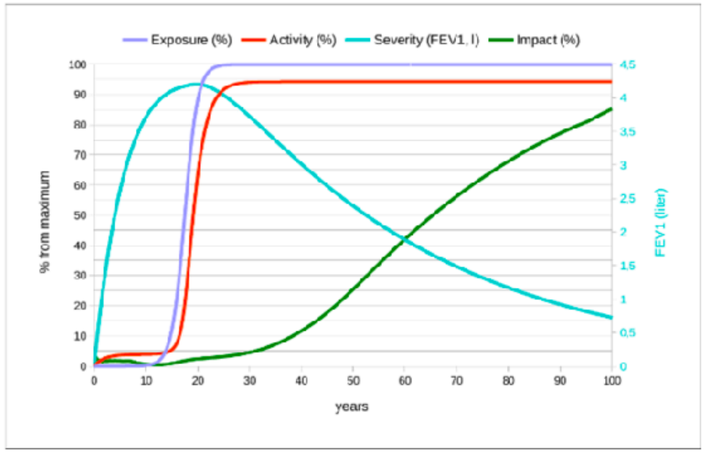


Cross-section at age	Exposure	Activity	Severity (FEV1, % ref)	Impact	Colour map
10	0%	4%	120%	1%	good
20	88%	63%	100%	2%	
30	100%	94%	92%	5%	
40	100%	94%	79%	12%	
50	100%	94%	68%	25%	
60	100%	94%	59%	42%	
70	100%	94%	52%	56%	
80	100%	94%	45%	68%	bad

PLoS One. 2017 Oct 10;12(10):e0185502.

The EASI model: A first integrative computational approximation to the natural history of COPD.

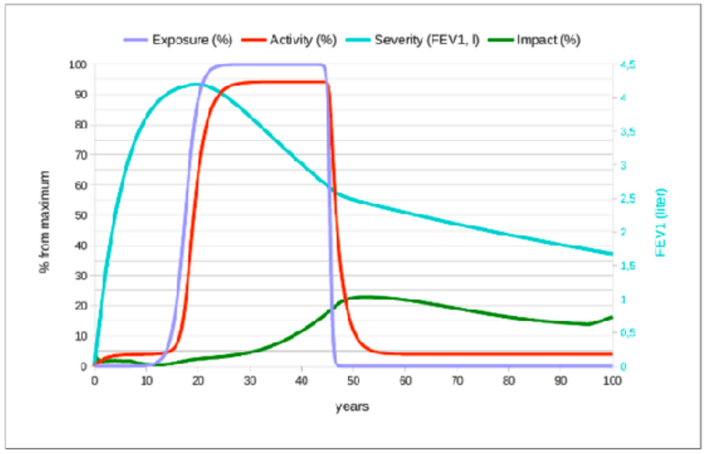
(1) Continuous smoker



Cross-section at age	Exposure	Activity	Severity (FEV1, % ref)	Impact
10	0%	4%	120%	1%
20	88%	63%	100%	2%
30	100%	94%	92%	5%
40	100%	94%	79%	12%
50	100%	94%	68%	25%
60	100%	94%	56%	42%
70	100%	94%	52%	56%
80	100%	94%	45%	68%

Colour map: good … bad

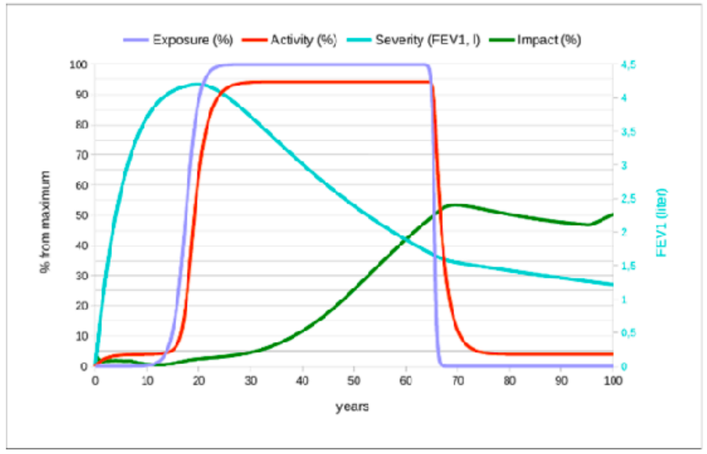
(2) Susceptible quitter @ 45 yrs.



Cross-section at age	Exposure	Activity	Severity (FEV1, % ref)	Impact
10	0%	4%	120%	1%
20	88%	63%	100%	2%
30	100%	94%	92%	5%
40	100%	94%	79%	12%
50	0%	13%	70%	23%
60	0%	4%	71%	22%
70	0%	4%	73%	19%
80	0%	4%	76%	16%

Colour map: good … bad

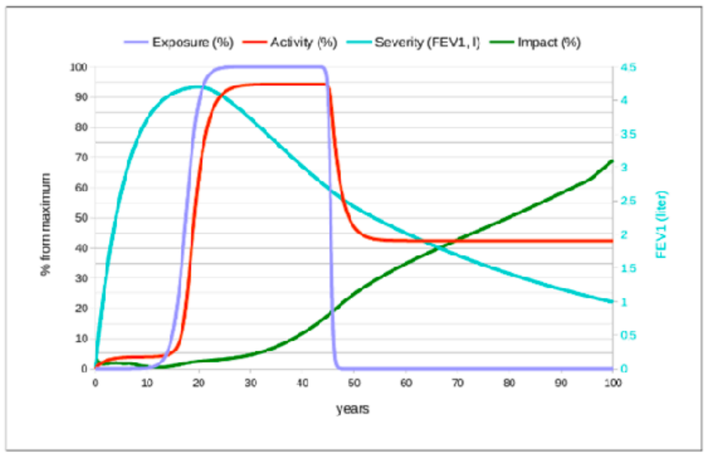
(3) Susceptible quitter @ 65 yrs.



Cross-section at age	Exposure	Activity	Severity (FEV1, % ref)	Impact
10	0%	4%	120%	1%
20	88%	63%	100%	2%
30	100%	94%	92%	5%
40	100%	94%	79%	12%
50	100%	94%	68%	25%
60	100%	94%	59%	42%
70	0%	13%	53%	53%
80	0%	4%	55%	50%

Colour map: good … bad

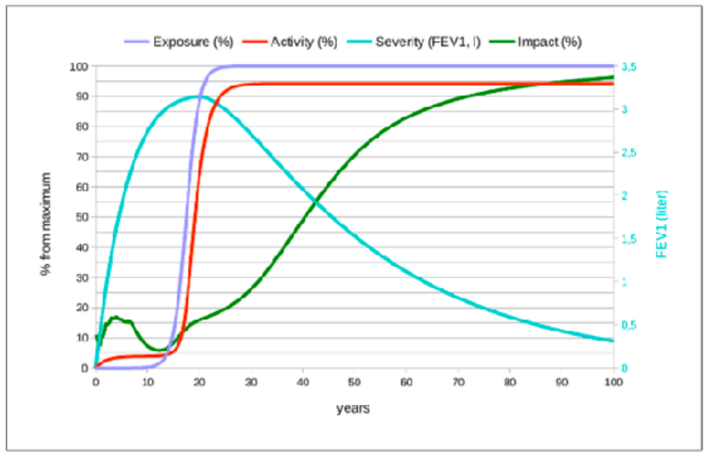
(4) Persistent inflammation after quitting



Cross-section at age	Exposure	Activity	Severity (FEV1, % ref)	Impact
10	0%	4%	120%	1%
20	88%	63%	100%	2%
30	100%	94%	92%	5%
40	100%	94%	79%	12%
50	0%	47%	59%	24%
60	0%	42%	53%	35%
70	0%	42%	59%	43%
80	0%	42%	55%	50%

Colour map: good … bad

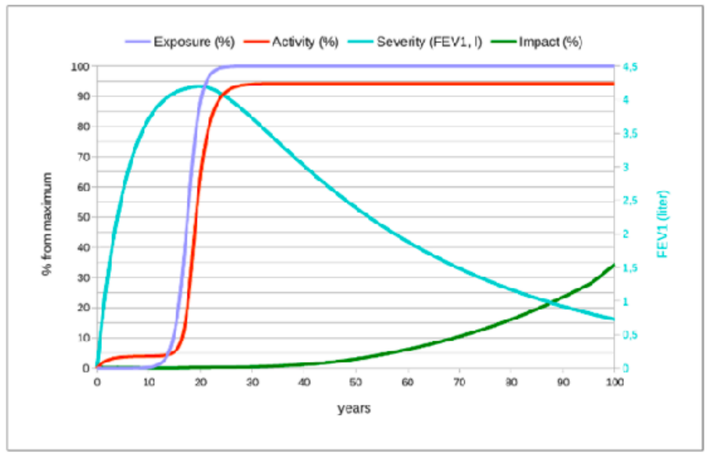
(5) Continuous smoker with abnormal lung development



Cross-section at age	Exposure	Activity	Severity (FEV1, % ref)	Impact
10	0%	4%	89%	7%
20	88%	63%	75%	16%
30	100%	94%	67%	26%
40	100%	94%	55%	40%
50	100%	94%	44%	70%
60	100%	94%	35%	83%
70	100%	94%	28%	89%
80	100%	94%	23%	93%

Colour map: good … bad

(6) Continuous smoker with poor perception of symptoms

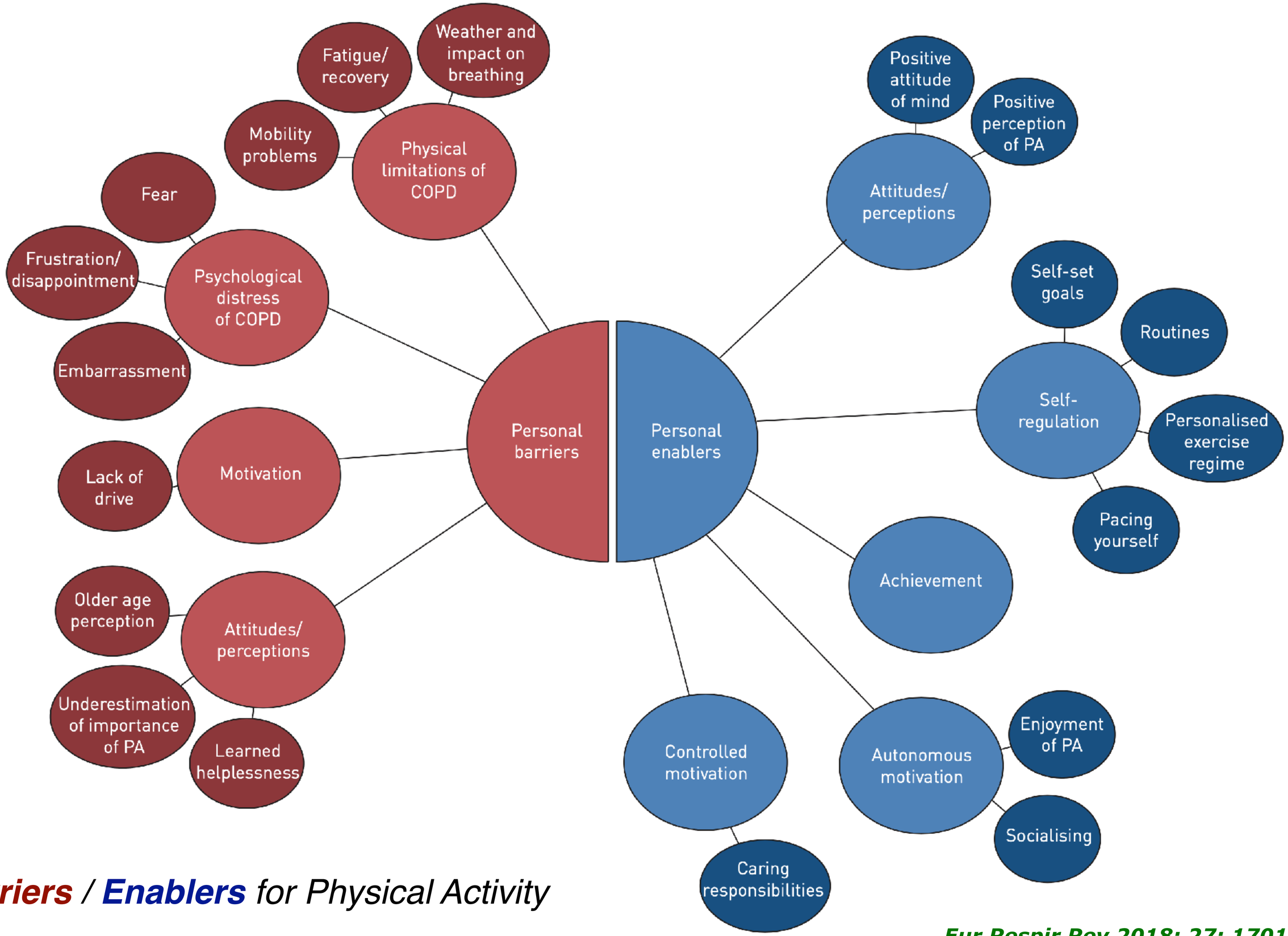


Cross-section at age	Exposure	Activity	Severity (FEV1, % ref)	Impact
10	0%	4%	120%	0%
20	88%	63%	100%	0%
30	100%	94%	92%	0%
40	100%	94%	79%	1%
50	100%	94%	68%	3%
60	100%	94%	59%	6%
70	100%	94%	52%	10%
80	100%	94%	45%	16%

Colour map: good … bad

PLoS One. 2017 Oct 10;12(10):e0185502.

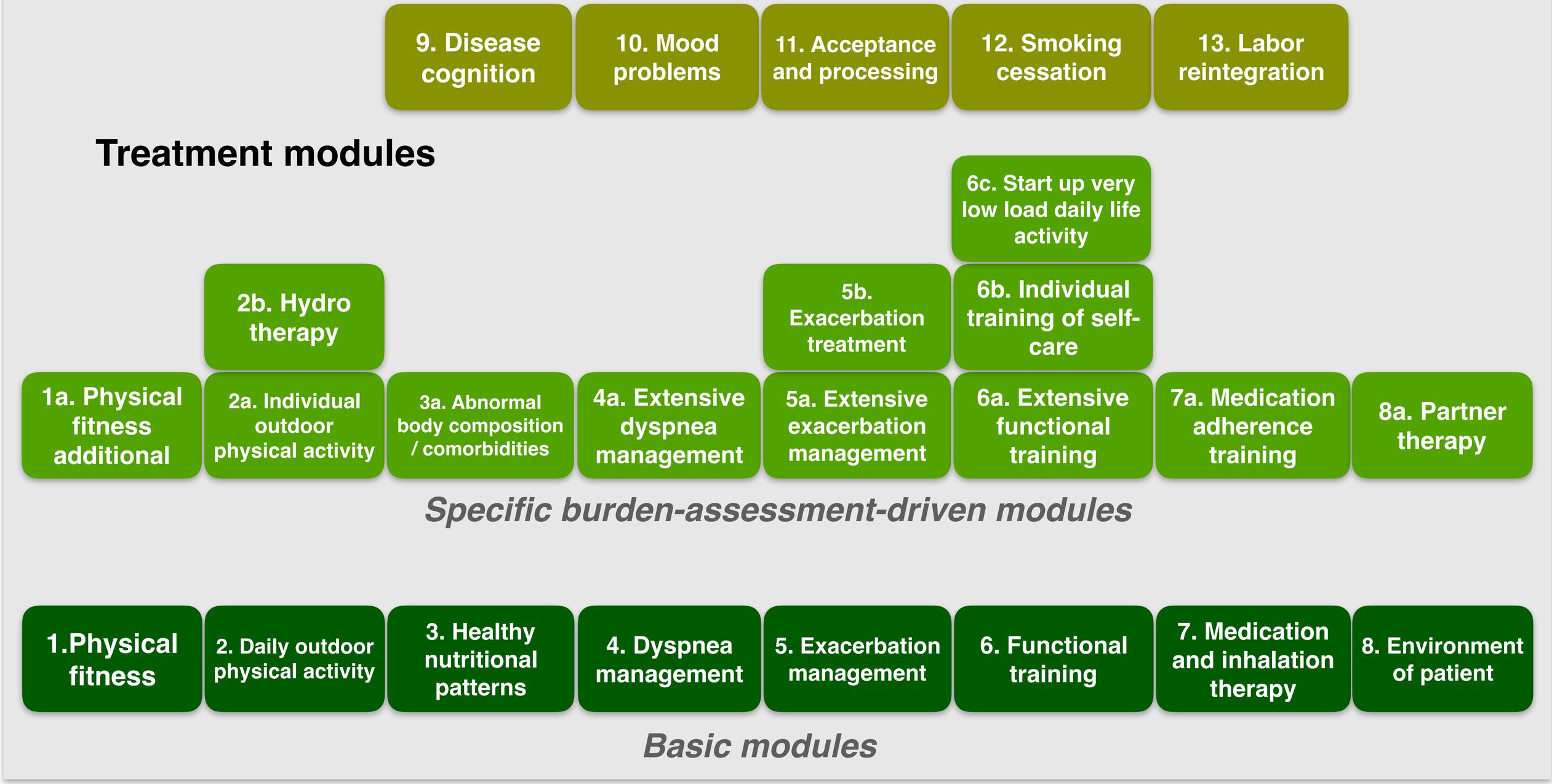
Personalised pulmonary rehabilitation in COPD



***Barriers** / **Enablers** for Physical Activity*

Eur Respir Rev 2018; 27: 170125

An Integrated Approach for Personalized Management of Patients with COPD

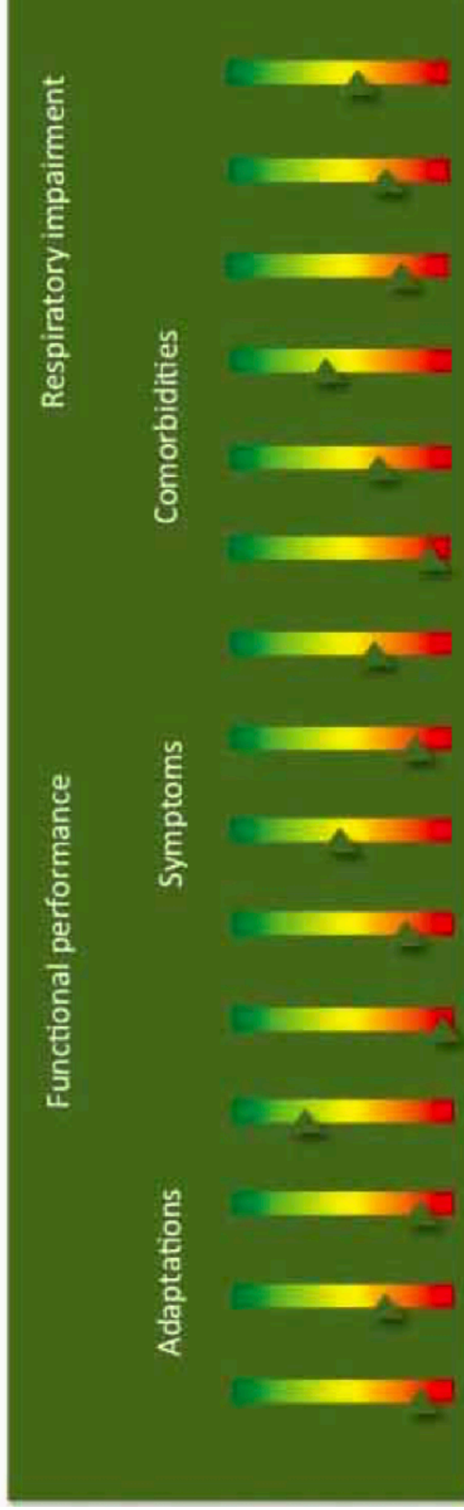


Clin Res Pulmonol, 2015. 3(2): 1034.

Personalised pulmonary rehabilitation in COPD

Baseline assessment

Determine degree of complexity



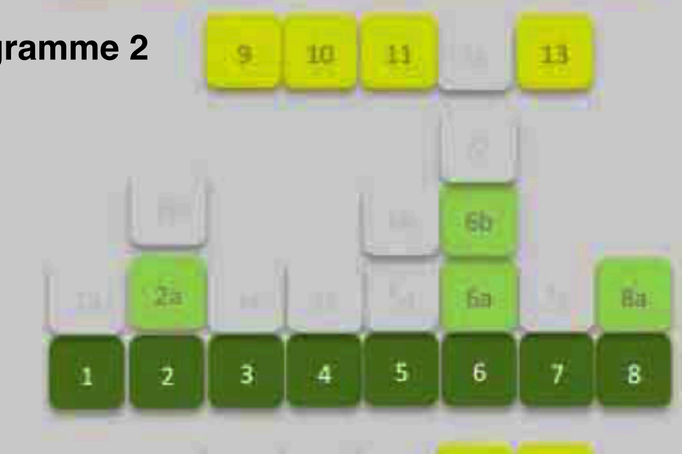
Shared decision making

Patient tailored programme

Determining the combination of treatment modules and consequently the required combination of therapies

Programme 1
or

Programme 2
or



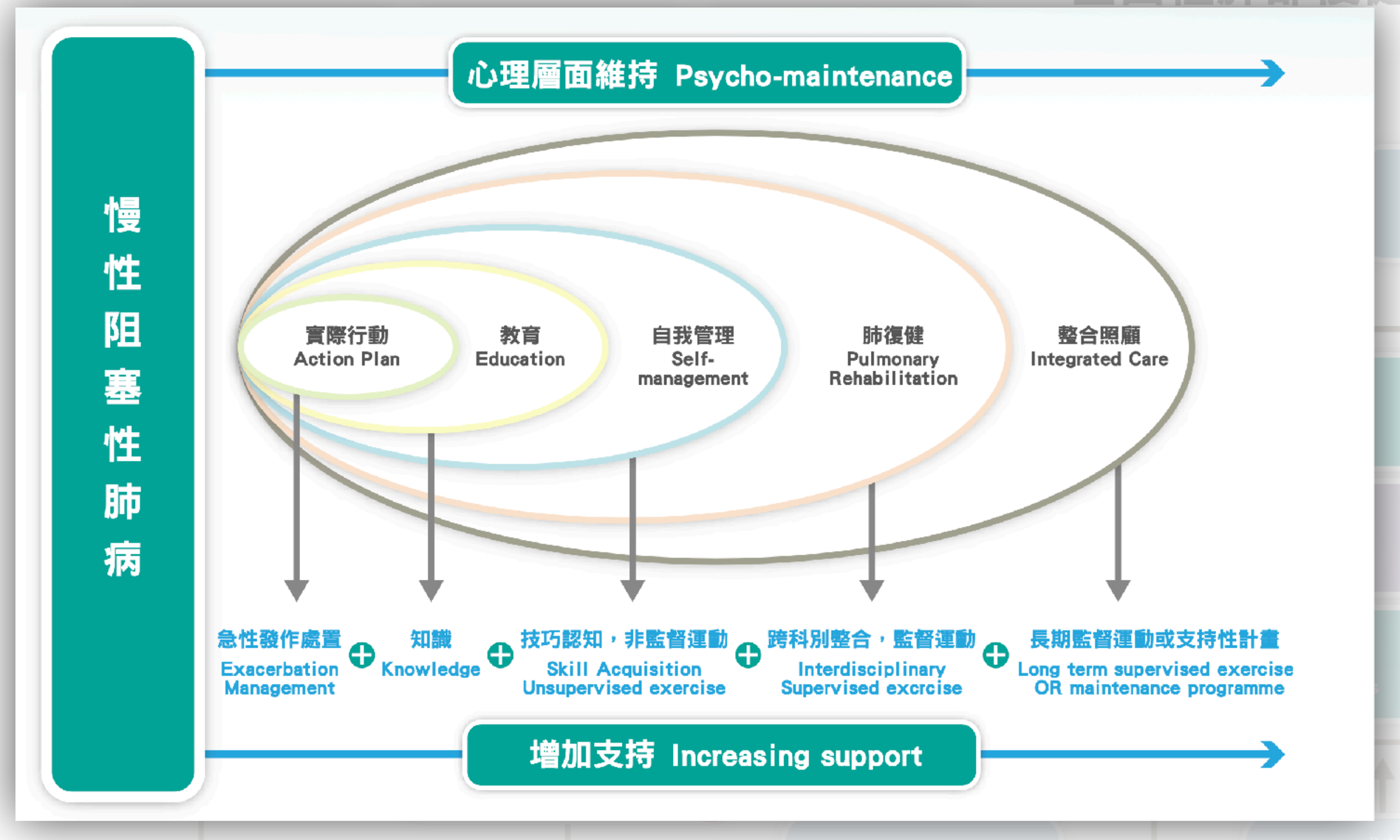
Programme 3
or

Programme …….

Outcome

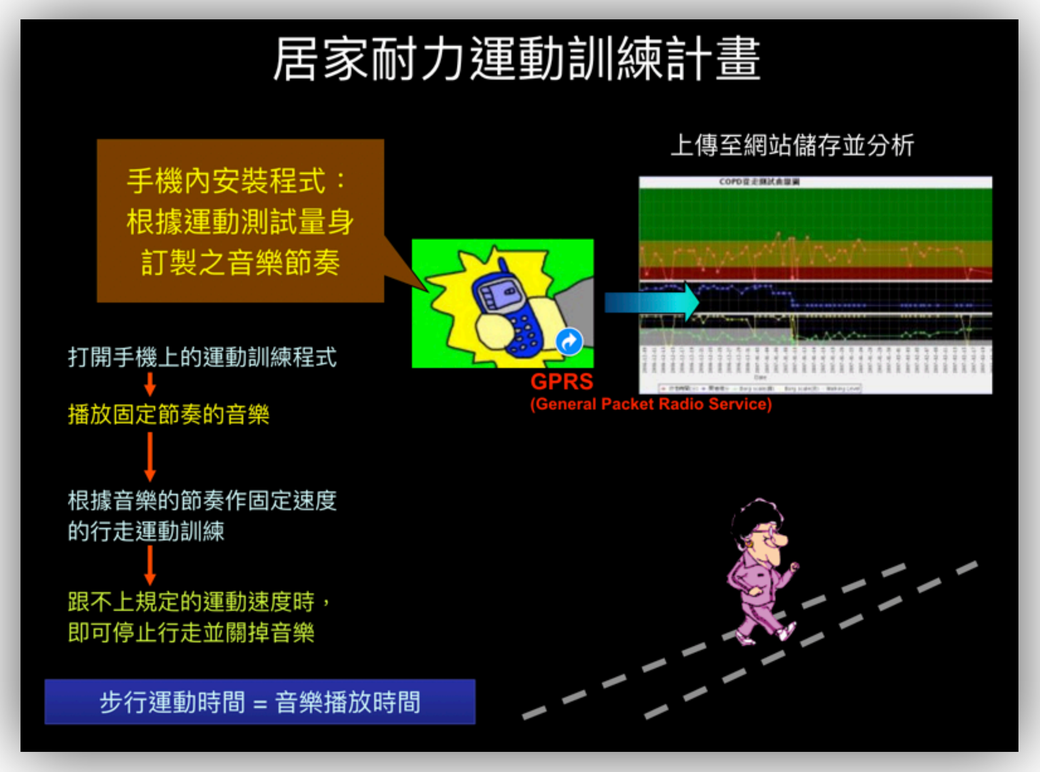
- Quality-of-life management
- Symptom evaluation
- Depression and anxiety
- Functional status
- Exercise performance
- Physical activities
- Knowledge and self-efficacy
- Outcomes in severe disease

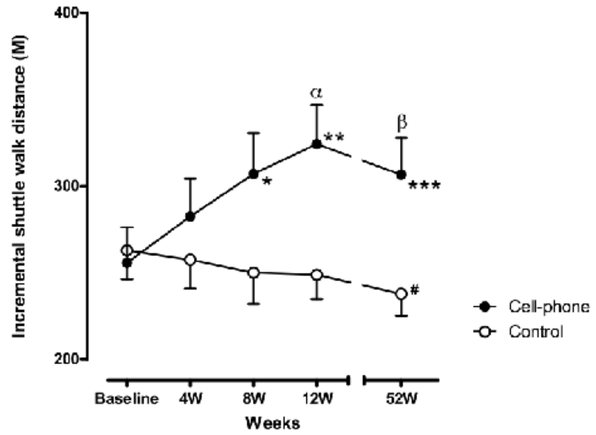
Eur Respir Rev 2018; 27: 170125



Feasible for most hospitals?

Efficacy of a cell phone-based exercise program for COPD





*p < 0.0001 (8w vs. baseline)

**p < 0.0001 (12w vs. baseline)

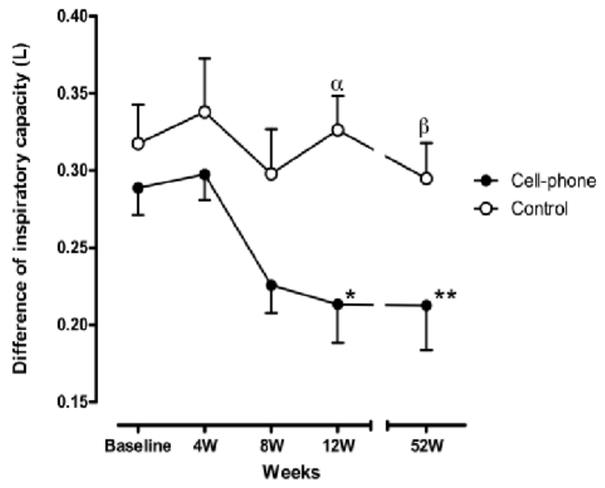
***p = 0.0003 (52w vs. baseline)

#p = 0.0257 (52w vs. baseline)

αp = 0.0095 (control vs. cell-phone, 12w)

βp = 0.0080 (control vs. cell-phone, 52w)

Liu WT, Eur Respir J. 2008 32(3):651-9.



*p = 0.0134 (12w vs. baseline)

60-80% maximal exercise capacity
= Endurance exercise training

先評估個人
運動
最大耐受力
→
以最大耐力
80% 為訓練
標準
→
量身訂製個人化的
音樂節奏
→
根據音樂節奏
實施居家運動訓練

漸進性運動能力
測試➔找出個人最大運動
強度

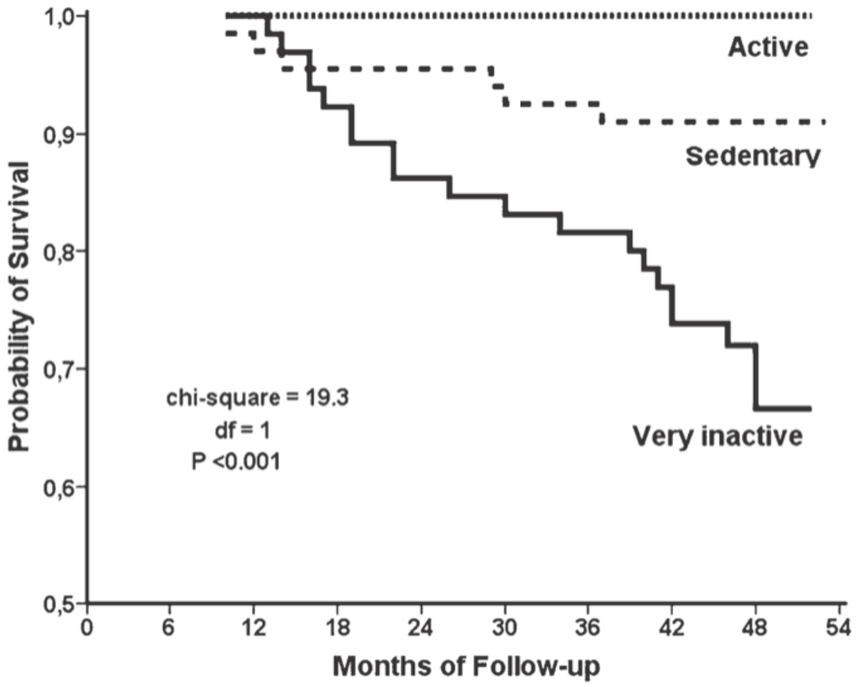
設計符合居家運動
強度與行走步伐的音樂節
奏

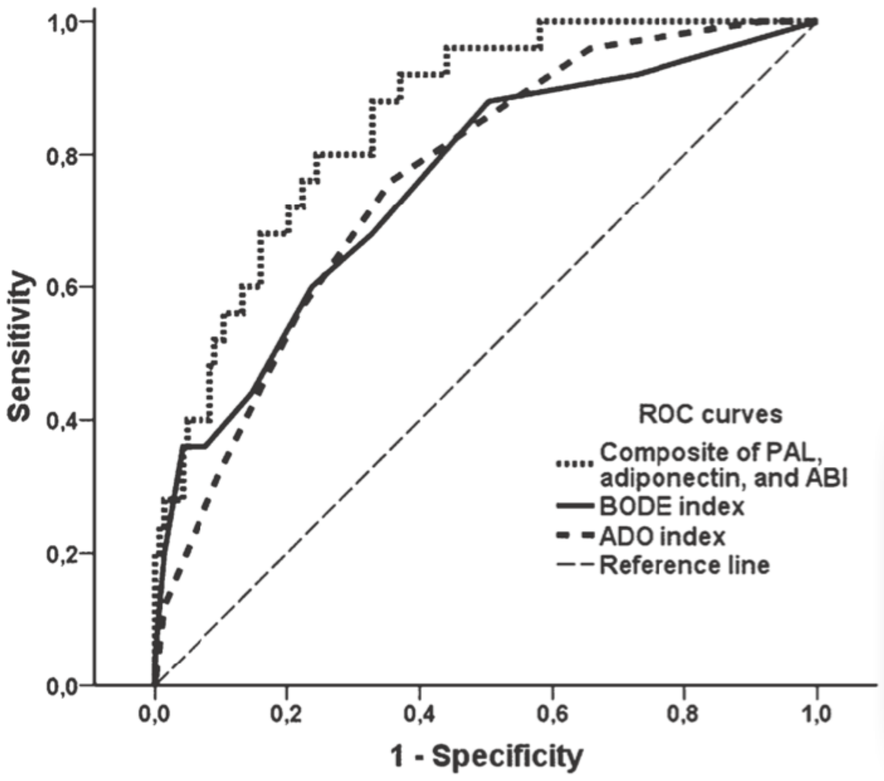
將安排好的音樂節奏
與運動設計安裝在手機上當
作居家訓練用

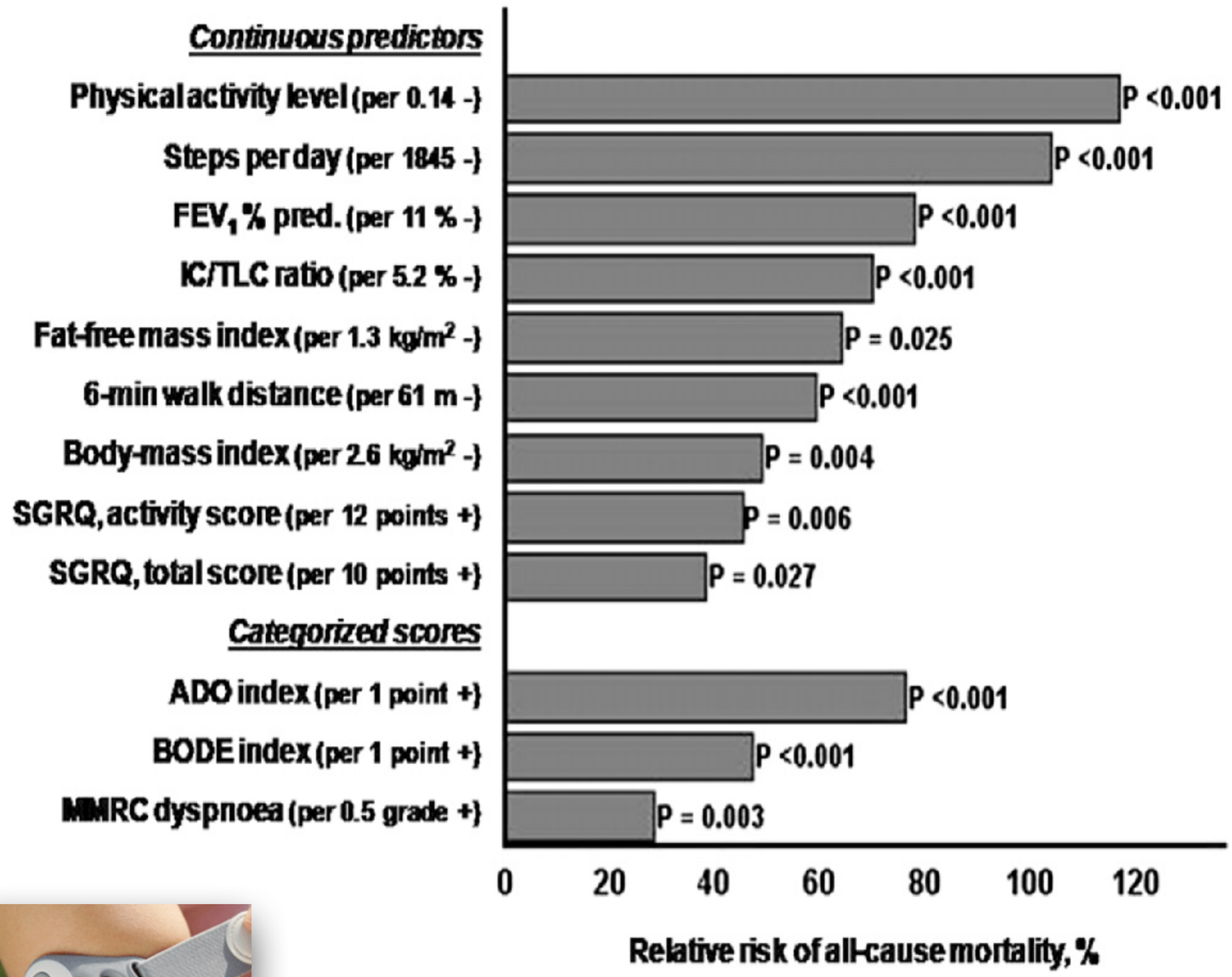
Liu WT, Eur Respir J. 2008 32(3):651-9.

Physical Activity Is the Strongest Predictor of All-Cause Mortality in Patients With COPD:

A Prospective Cohort Study



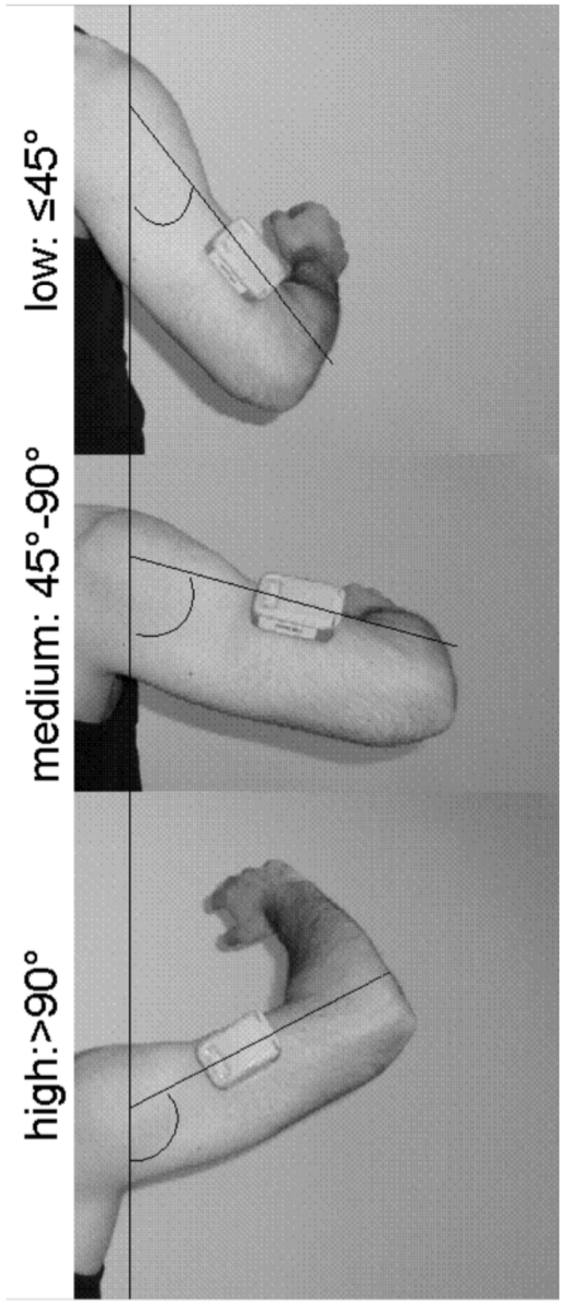


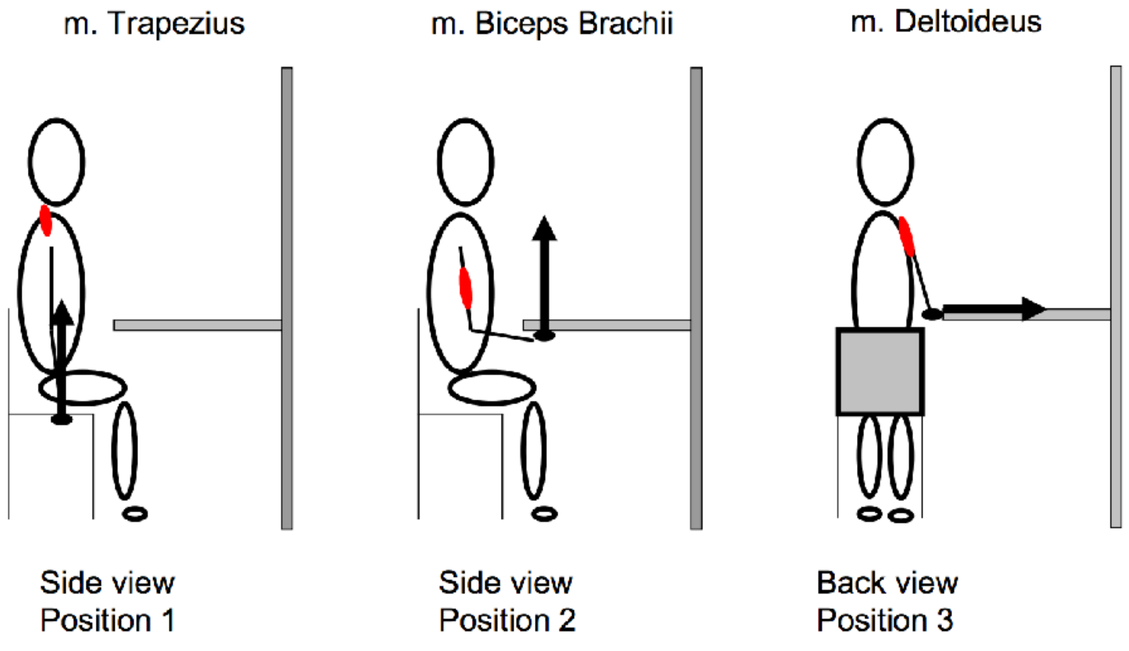


SenseWear Pro armband

Chest. 2011 Aug;140(2):331-42.

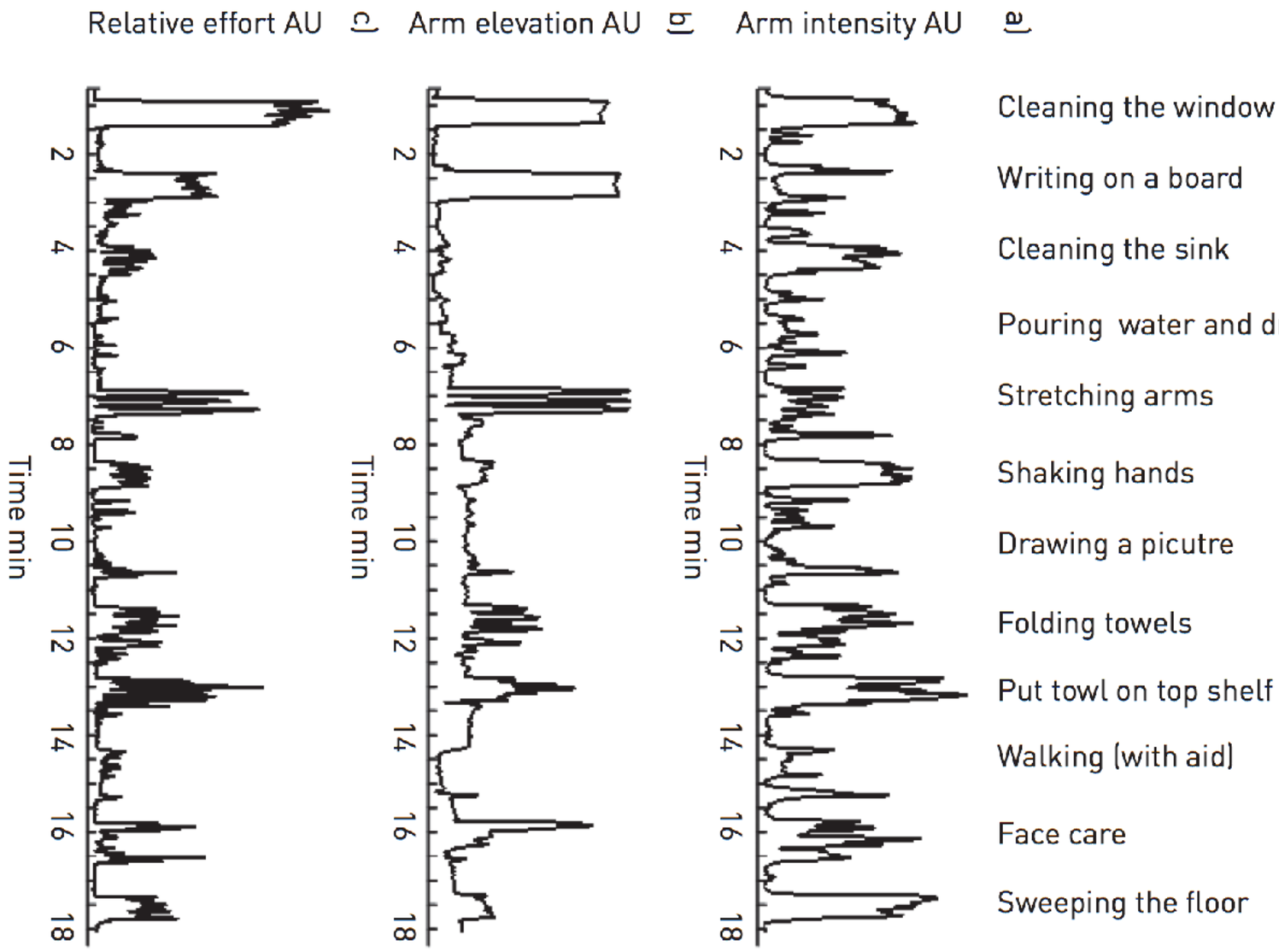
COPD patients perform daily arm activities less intensively than healthy subjects but require more muscle effort

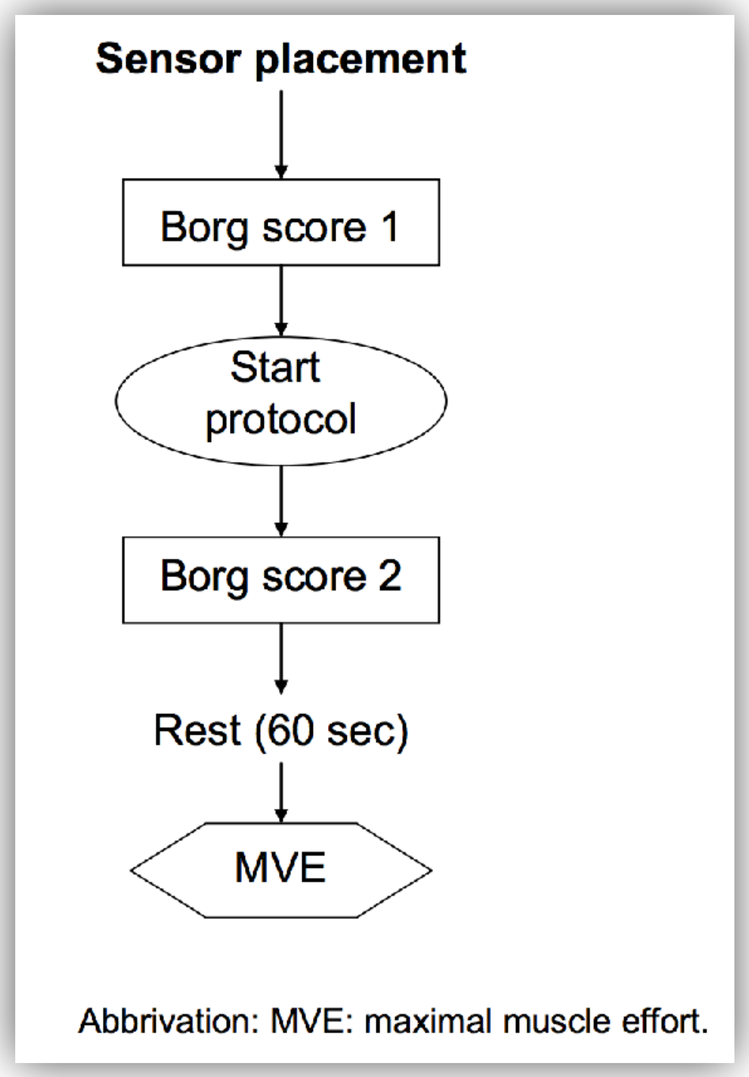




Eur Respir J. 2014 Jun;43(6):1631-41

COPD patients perform daily arm activities less intensively than healthy subjects but require more muscle effort

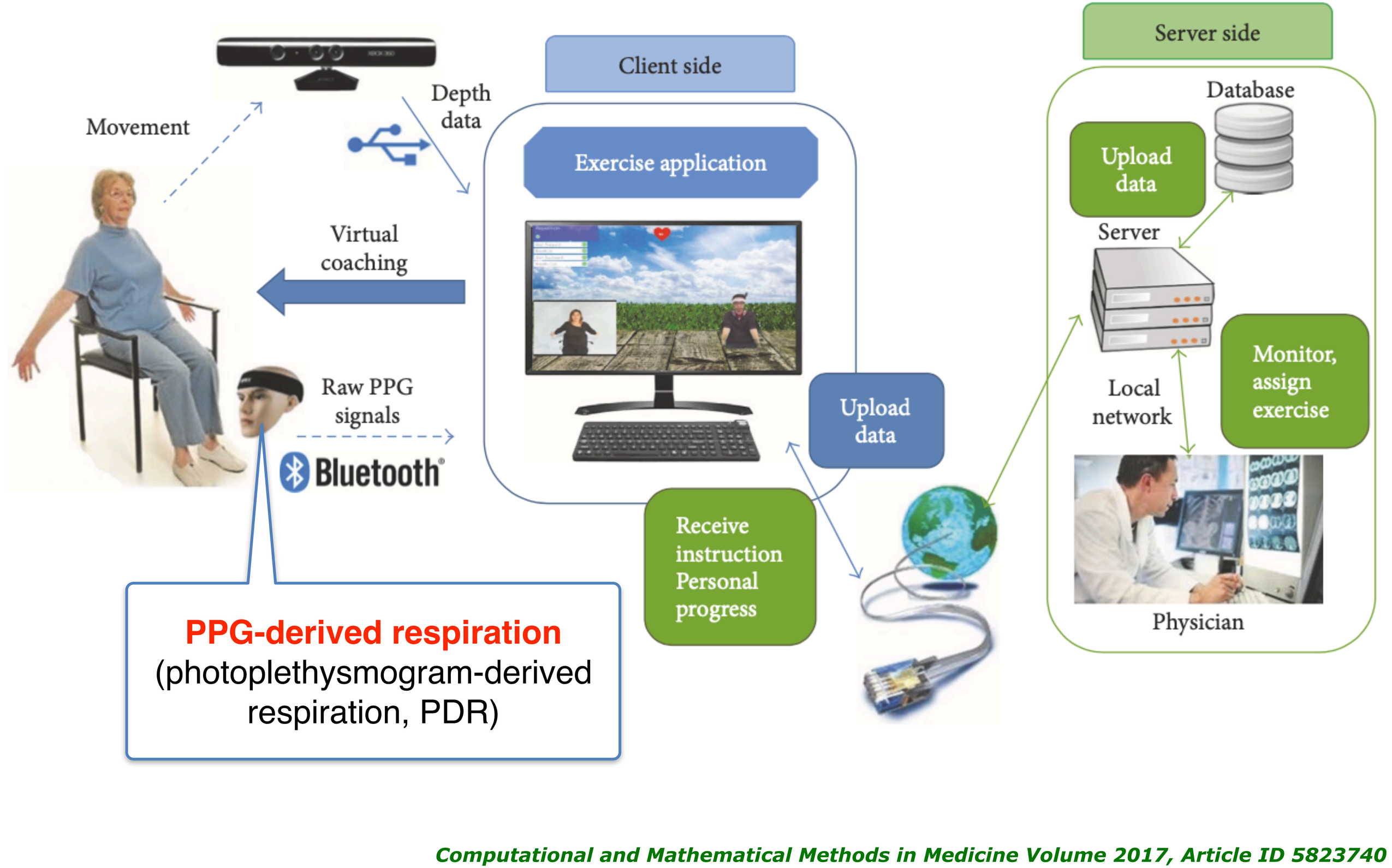




Relative effort = elevation + intensity

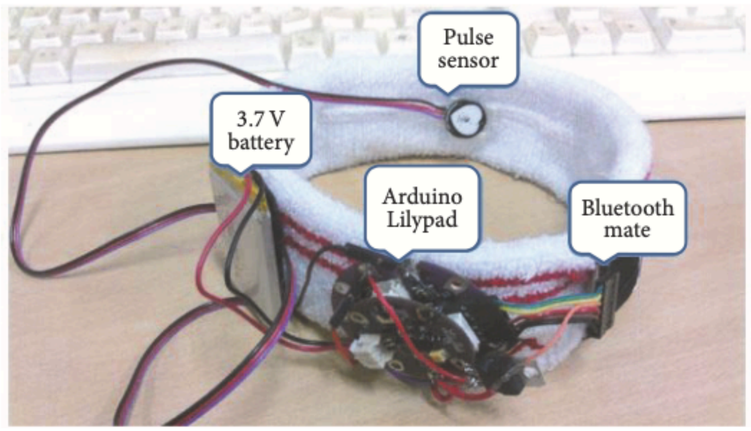
Eur Respir J. 2014 Jun;43(6):1631-41

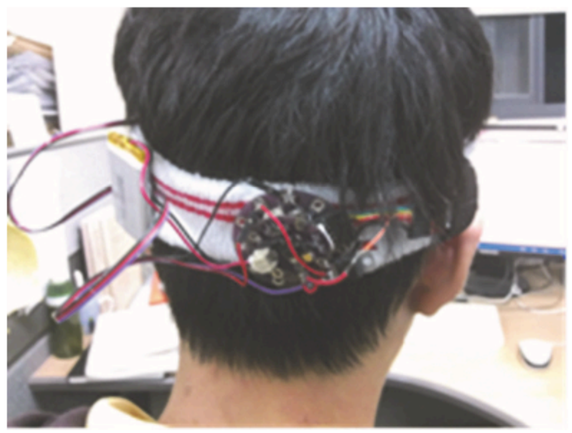
A Novel Remote Rehabilitation System with the Fusion of Noninvasive Wearable Device and Motion Sensing for Pulmonary Patients



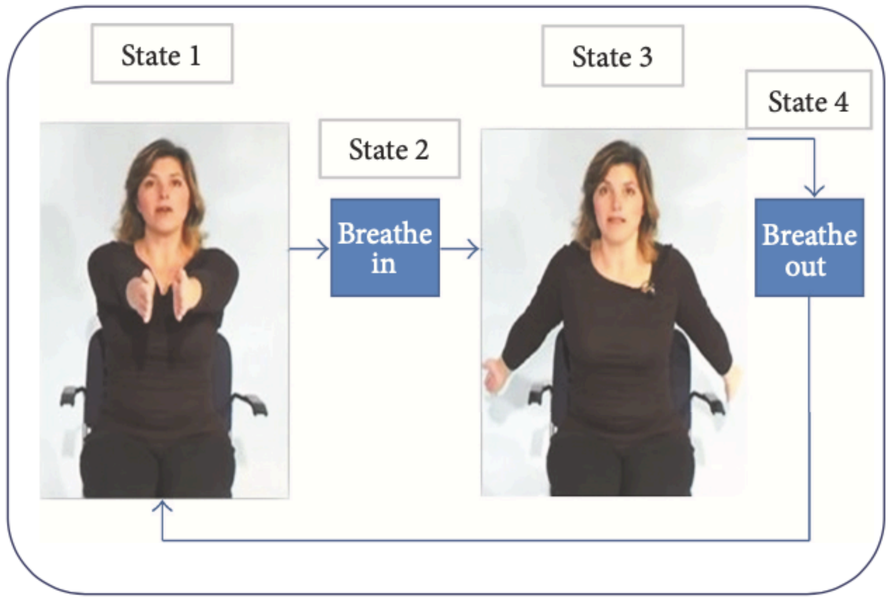
Computational and Mathematical Methods in Medicine Volume 2017, Article ID 5823740

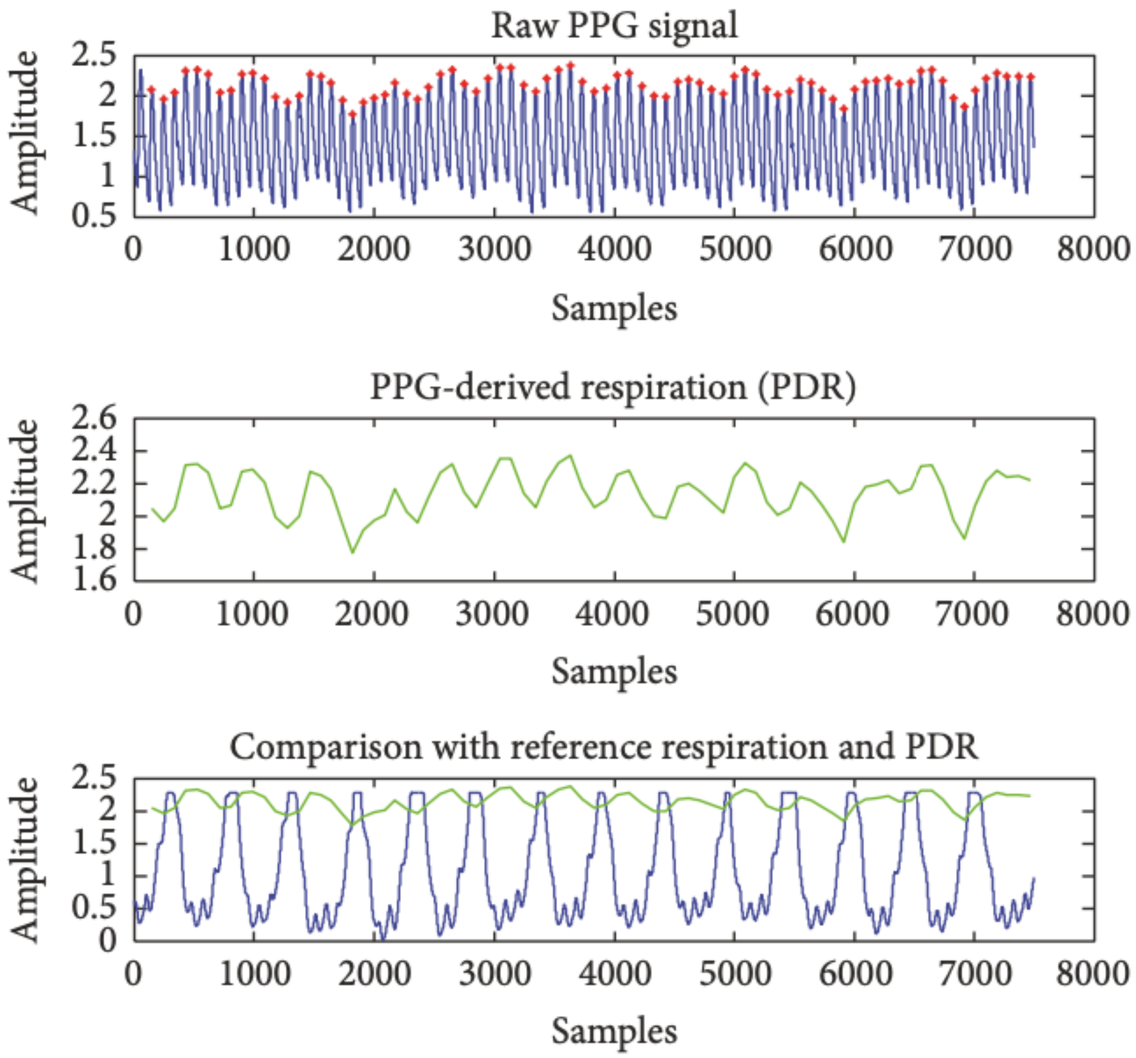
A Novel Remote Rehabilitation System with the Fusion of Noninvasive Wearable Device and Motion Sensing for Pulmonary Patients





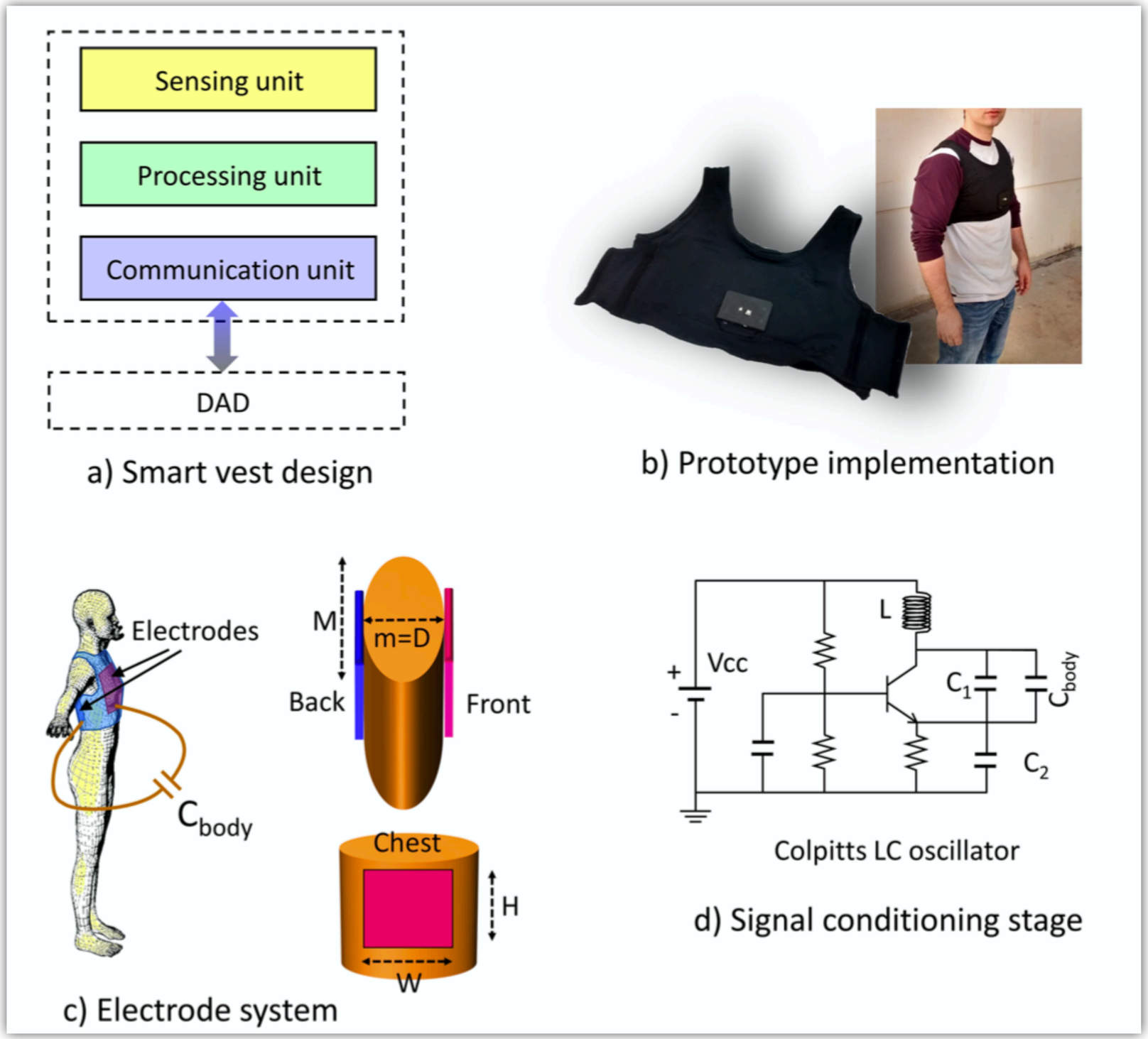
PPG-derived respiration





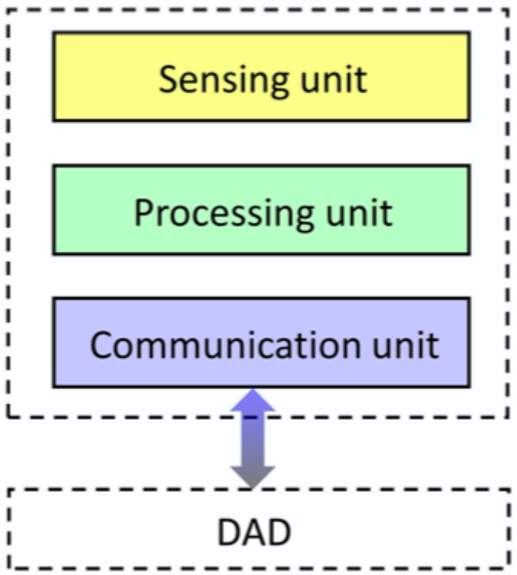
Computational and Mathematical Methods in Medicine Volume 2017, Article ID 5823740

Smart Vest for Respiratory Rate Monitoring of COPD Patients Based on Non-Contact Capacitive Sensing



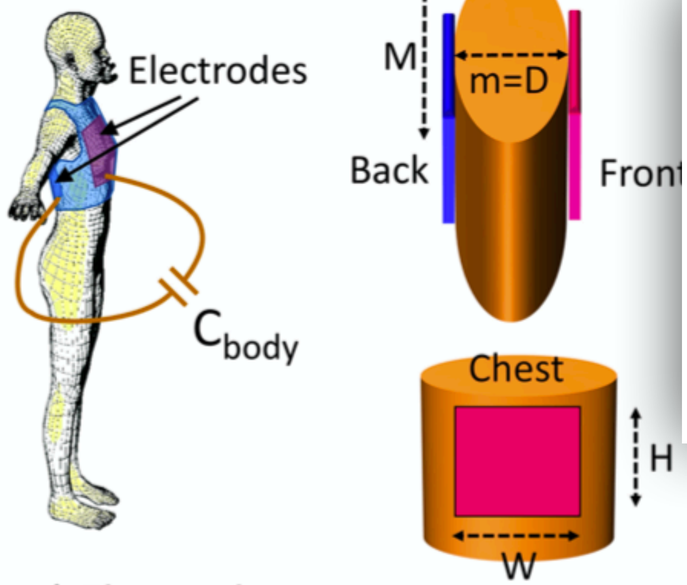
Sensors 2018, 18, 2144; doi:10.3390

Smart Vest for Respiratory Rate Monitoring of COPD Patients Based on Non-Contact Capacitive Sensing



a) Smart vest design

b) Prototype implementation



c) Electrode system

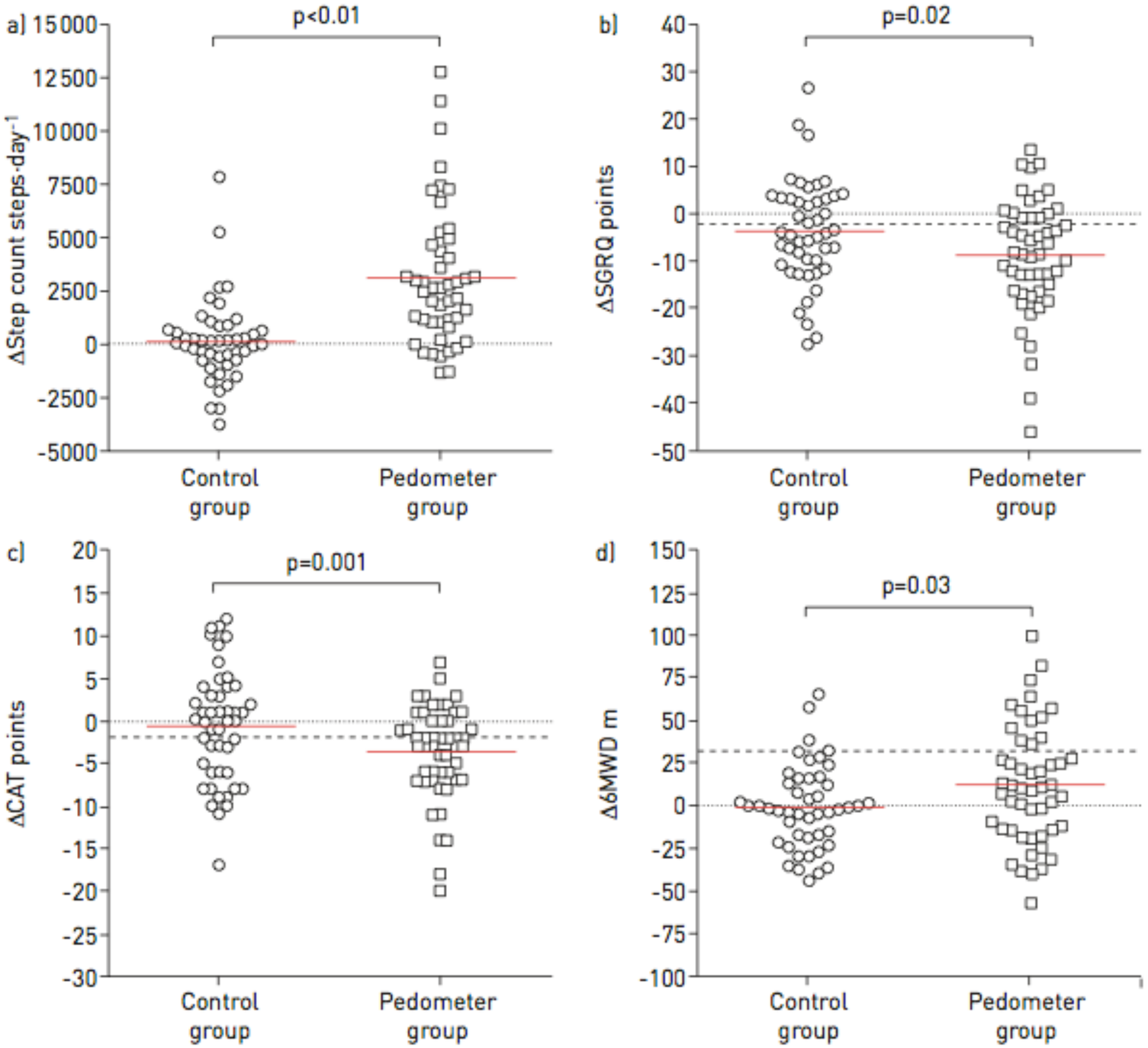
Ref.	Method	Average Error	CI	Protocol	Communication	Processing
This	Capacitive	−0.14	−0.68–0.4	rest (after exercising)	Bluetooth	Embedded
[19]	Accelerometer	−0.21	−2.32–1.89	rest (sitting)	Wired	PC (MATLAB)
[28]	Radar	−0.14	−1.1–0.86	rest (lying)	Wired	PC
[82]	Inductance	1.6	−0.03–3.17	rest	Bluetooth 4.0	Embedded
[26]	Impedance	0.13	−1.5–1.7	rest (lying)	-	Embedded
[25]	FBG	−0.01	−2.1–2.1	rest (lying)	Wired	PC
[32]	PPG	0.21	−1.1–1.5	rest (lying)	Wired	PC (MATLAB)
[29]	EMGdi	0.01	−2.39–2.41	rest (sitting)	Wired	PC (MATLAB)

d) Signal conditioning stage

Capacitive: 電容
Accelerometer: 加速規
Radar
Inductance: 感應線圈
Impedance: 電阻變化
FBG: 光纖
PPG: 胸前光線變化
EMGdi: 橫膈肌電圖

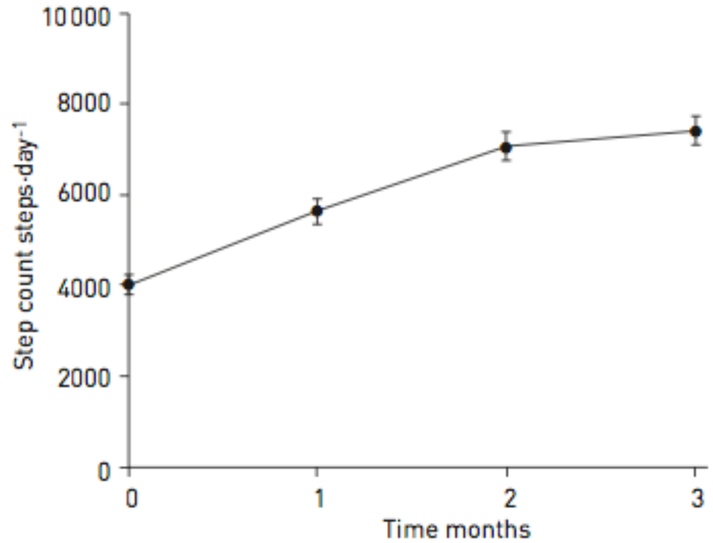
Sensors 2018, 18, 2144; doi:10.3390

Pedometers to enhance physical activity in COPD



Tanita PD724

3-month program

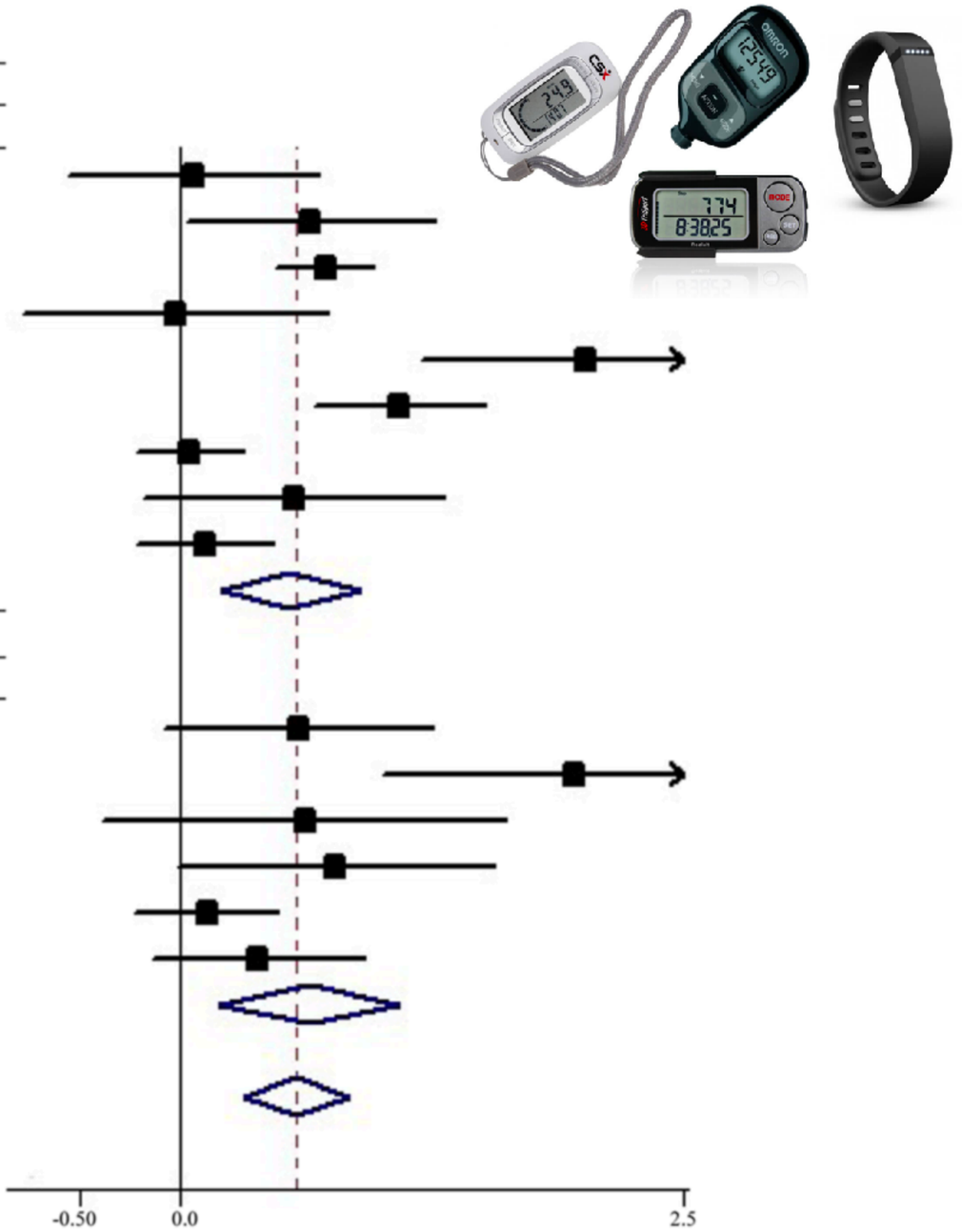


ERJ 2014 Sep 26. Epub

Using step counters to promote physical activity and exercise capacity in patients with chronic obstructive pulmonary disease: a meta-analysis

A. Step counter use vs UC	Step counter use			UC				
Source	N	Mean	SD	N	Mean	SD	SMD (95% CI)	Weight (%)
Altenburg *et al*. 2015[a]	22	537	1741	18	431	1221	0.07 (-0.55, 0.69)	6.46
Altenburg *et al*. 2015[b]	21	1002	2733	22	-814	2881	0.65 (0.03, 1.26)	6.52
Demeyer *et al*. 2017	140	870	2550	140	-678	1687	0.72 (0.47, 0.96)	9.37
Hornikx *et al*. 2015	12	984	1208	15	1013	1275	-0.02 (-0.78, 0.74)	5.49
Hospes *et al*. 2009	18	785	987	17	-1367	1149	2.01 (1.19, 2.84)	5.08
Mendoza *et al*. 2015	50	3080	3255	47	138	1950	1.09 (0.66, 1.52)	8.01
Moy *et al*. 2016	154	270	2254	84	163	2331	0.05 (-0.22, 0.31)	9.21
Tabak *et al*. 2014	13	-163	852	16	-639	848	0.56 (-0.19, 1.31)	5.57
Vorrink *et al*. 2016	68	-593	1956	64	-833	1965	0.12 (-0.22, 0.46)	8.68
Suboverall (I^2 = 81%)							**0.54 (0.20, 0.89)**	**64.38**
B. Step counter use + PR vs PR	Step counter use + PR			PR				
Source	N	Mean	SD	N	Mean	SD	SMD (95% CI)	Weight (%)
Altenburg *et al*. 2015[c]	22	547	841	15	-211	1759	0.59 (-0.08, 1.26)	6.10
Cruz *et al*. 2016	13	3279	2392	13	-187	740	1.96 (1.01, 2.90)	4.36
de Blok *et al*. 2006	8	1787	1113	8	1220	683	0.61 (-0.39, 1.62)	4.07
Kawagoshi *et al*. 2015[d]	15	3540	4395	12	849	1760	0.77 (-0.02, 1.56)	5.29
Nolan *et al*. 2017	63	272	833	59	155	967	0.13 (-0.23, 0.49)	8.57
Holland *et al*. 2017	25	520	1765	33	-160	1772	0.38 (-0.14, 0.91)	7.23
Suboverall (I^2 = 64%)							**0.64 (0.19, 1.08)**	**35.62**
Overall (I^2 = 75%)							**0.57 (0.31, 0.84)**	**100.0**

Effect size was calculated using a random-effects model.



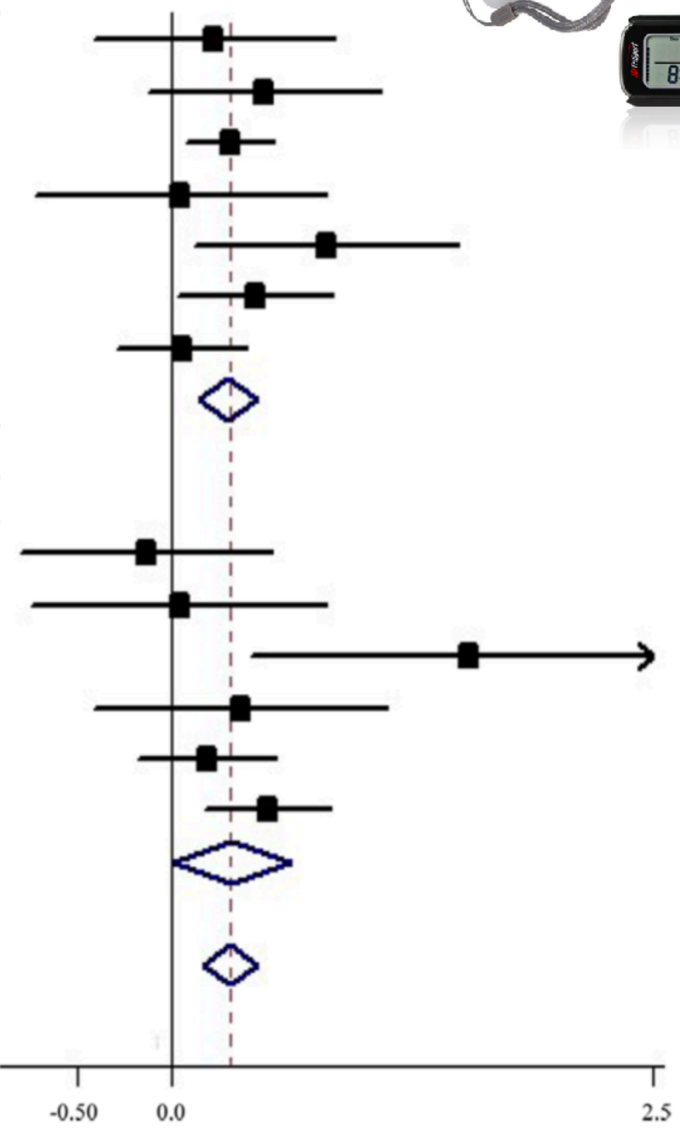
*Effect sizes of step counter use on **physical activity***

Ther Adv Respir Dis. 2018 Jan-Dec;12:1753466618787386.

Using step counters to promote physical activity and exercise capacity in patients with chronic obstructive pulmonary disease: a meta-analysis

A. Step counter use vs UC	Step counter use			UC				
Source	N	Mean	SD	N	Mean	SD	SMD (95% CI)	Weight (%)
Altenburg *et al.* 2015[a]	22	10	32.7	18	3.2	29.5	0.22 (-0.41, 0.84)	4.65
Altenburg *et al.* 2015[b]	21	23	37.7	22	3.5	43.7	0.48 (-0.13, 1.08)	4.91
Demeyer *et al.* 2017	150	12.7	45.9	149	-0.81	43	0.30 (0.08, 0.53)	22.35
Hornikx *et al.* 2015	12	67	84	15	64	59	0.04 (-0.72, 0.80)	3.24
Hospes *et al.* 2009	18	22.5	11.3	17	10	19.1	0.80 (0.11, 1.49)	3.87
Mendoza *et al.* 2015	50	12.4	34.6	47	-0.7	24.4	0.44 (0.03, 0.84)	9.97
Vorrink *et al.* 2016	68	4.8	36.6	64	3.3	25.5	0.05 (-0.29, 0.39)	12.95
Suboverall (I^2 = 1%)							**0.29 (0.14, 0.44)**	**61.95**
B. Step counter use + PR vs PR	Step counter use + PR			PR				
Source	N	Mean	SD	N	Mean	SD	SMD (95% CI)	Weight (%)
Altenburg *et al.* 2015[c]	22	17.2	50.9	15	24.5	56.1	-0.14 (-0.79, 0.52)	4.24
Cruz *et al.* 2016	13	54.1	20.2	13	53.5	13.9	0.03 (-0.73, 0.80)	3.17
de Blok *et al.* 2006[d]	8	46.6	25.8	8	13	16.8	1.54 (0.41, 2.68)	1.50
Kawagoshi *et al.* 2015[d]	15	76	36.7	12	63	36.7	0.35 (-0.41, 1.12)	3.19
Nolan *et al.* 2017[d]	63	90	77.8	59	75	88.9	0.18 (-0.18, 0.54)	12.16
Holland *et al.* 2017	72	29.4	67.6	76	-4.7	68.2	0.50 (0.17, 0.83)	13.79
Suboverall (I^2 = 42%)							**0.32 (0.01, 0.62)**	**38.05**
Overall (I^2 = 15%)							**0.30 (0.16, 0.45)**	**100.0**

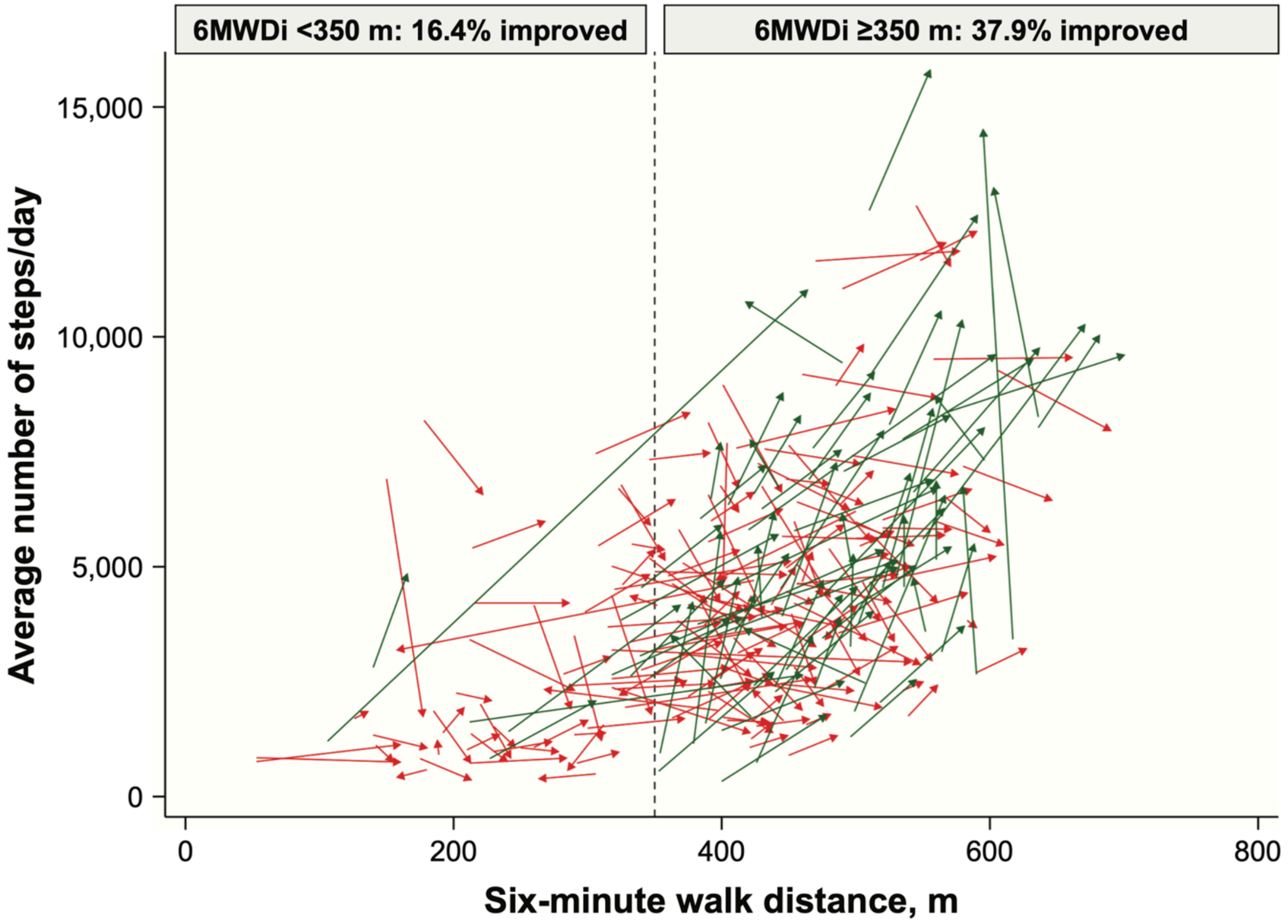
Effect size was calculated using a random-effects model.



Effect sizes of step counter use on ***Exercise Capacity***

Ther Adv Respir Dis. 2018 Jan-Dec;12:1753466618787386.

The likelihood of improving physical activity after pulmonary rehabilitation is increased in patients with COPD who have better exercise tolerance (6MWDi)



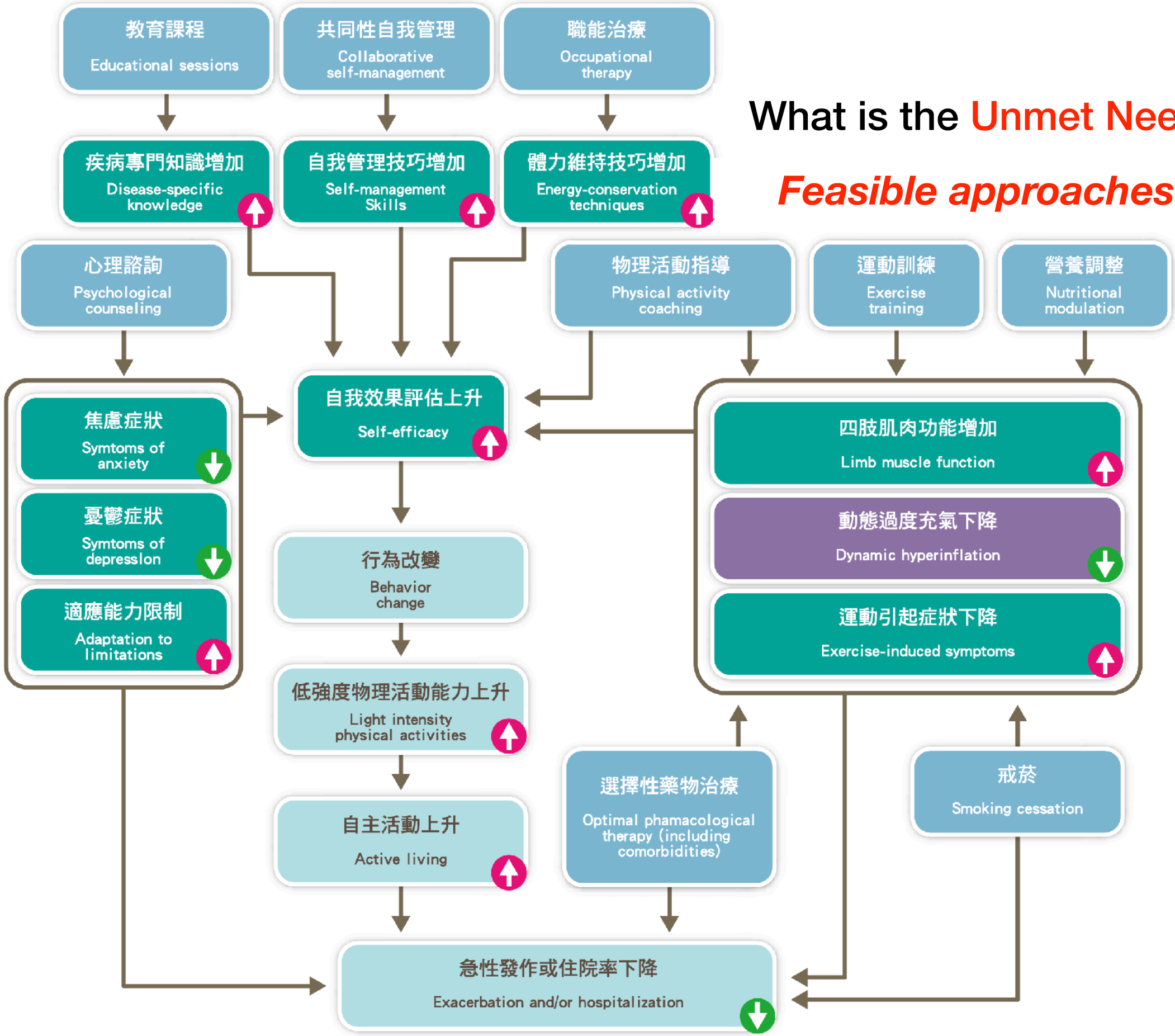
Improvement in PA ≥ 1,000 steps/day

Improvement in PA < 1,000 steps/day

Int J Chron Obstruct Pulmon Dis. 2018 Oct 24;13:3515-3527

What is the Unmet Need?

Feasible approaches?



What is the Unmet Need?

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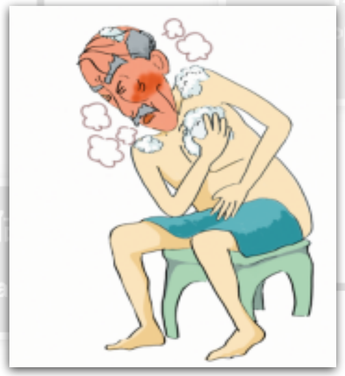
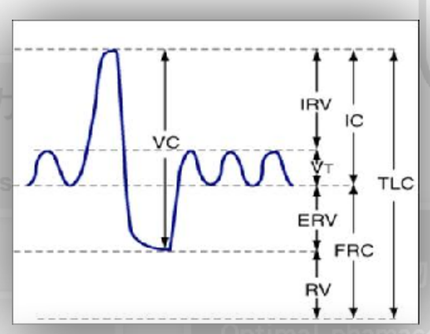


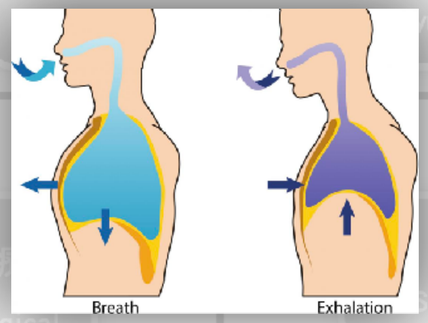
Environmental factors

Physical activity

Pulmonary function



Respiratory patterns



Others?

智慧型呼吸健康照護中心

系統訓練完成

個人化自動評估

慢性呼吸道疾病病患

穿戴式裝置:
G-sensor
Heart rate variability
Respiratory pattern

環境因素:
居家空氣品質監測
個人化空氣品質

居家自行評估:
問卷

醫療院所評估方法:
運動心肺功能
醫療人員評估

大數據分析
人工智慧演算法

初期系統訓練（數日至數週）

Environmental factors

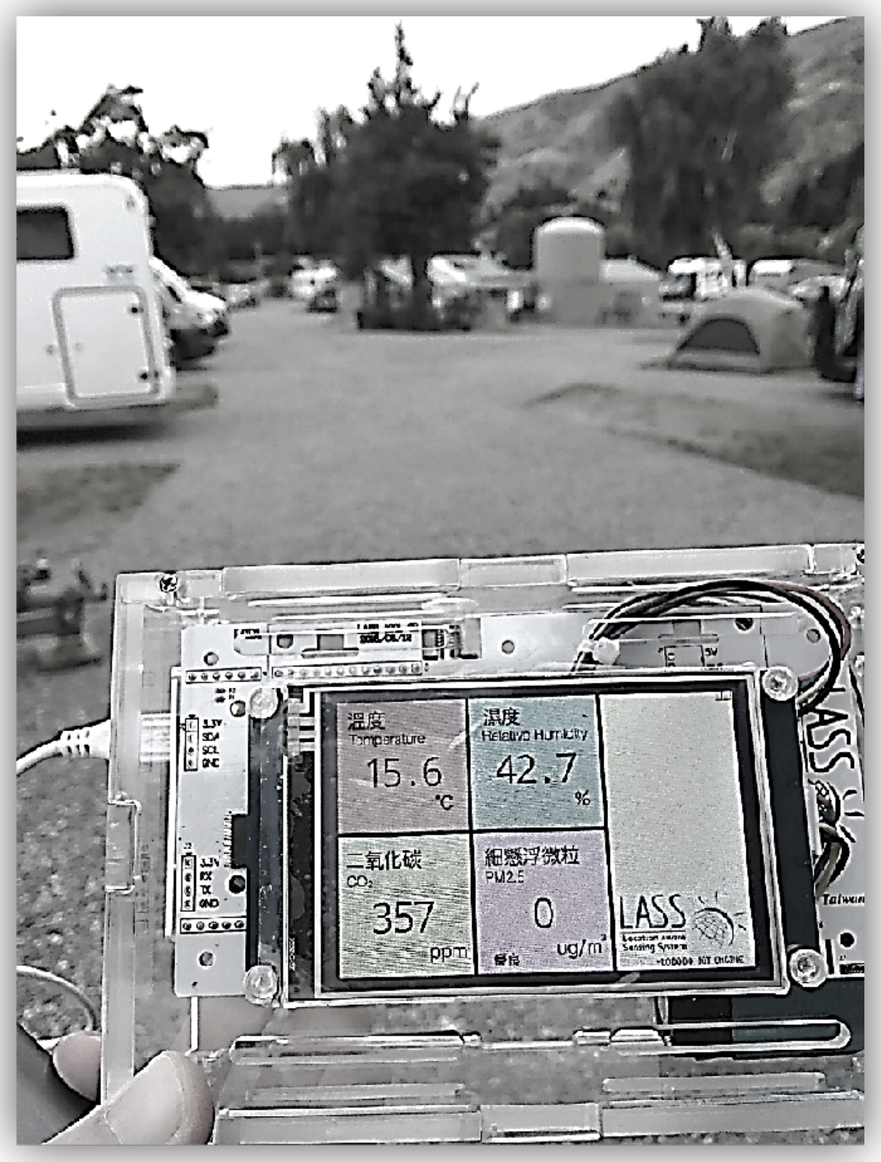
Physical activity

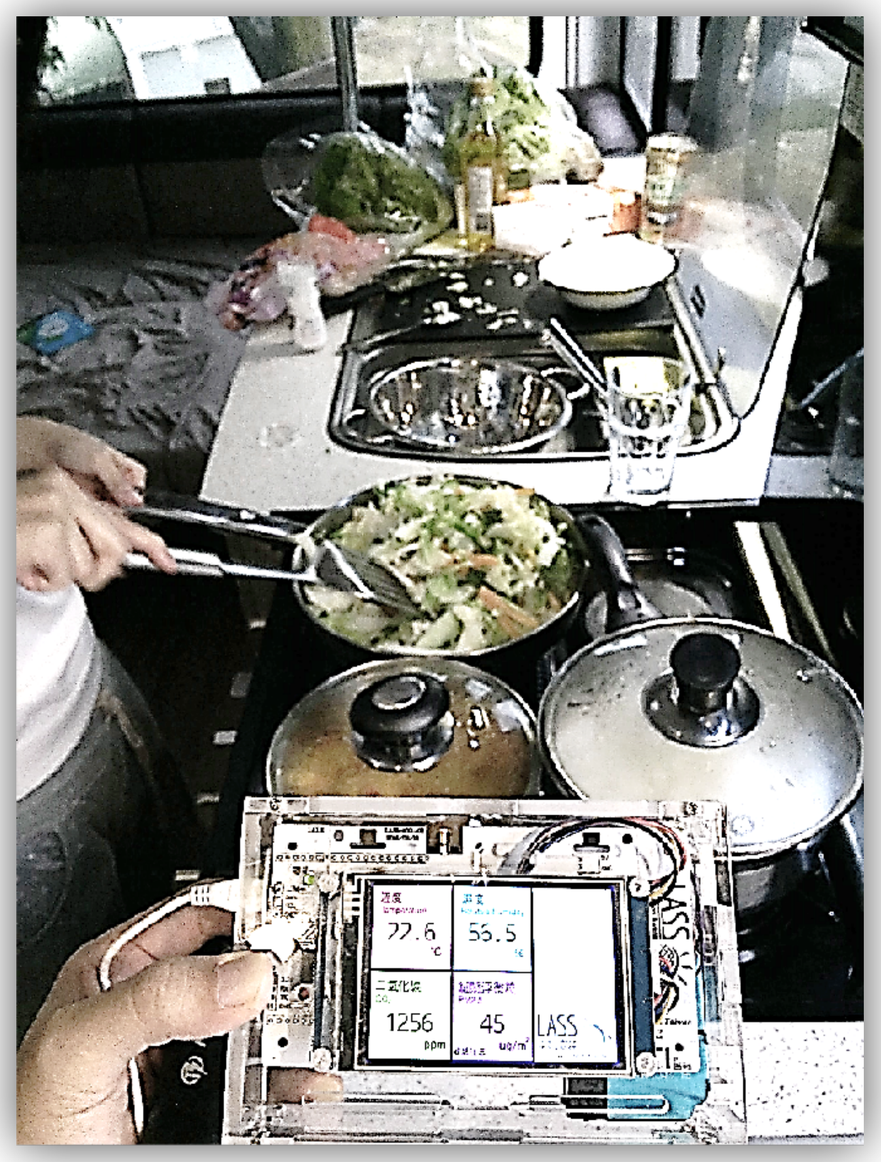
Pulmonary function

Respiratory patterns

Others?

室外空氣品質良好；室內空氣品質不佳





Environmental factors

Physical activity

Pulmonary function

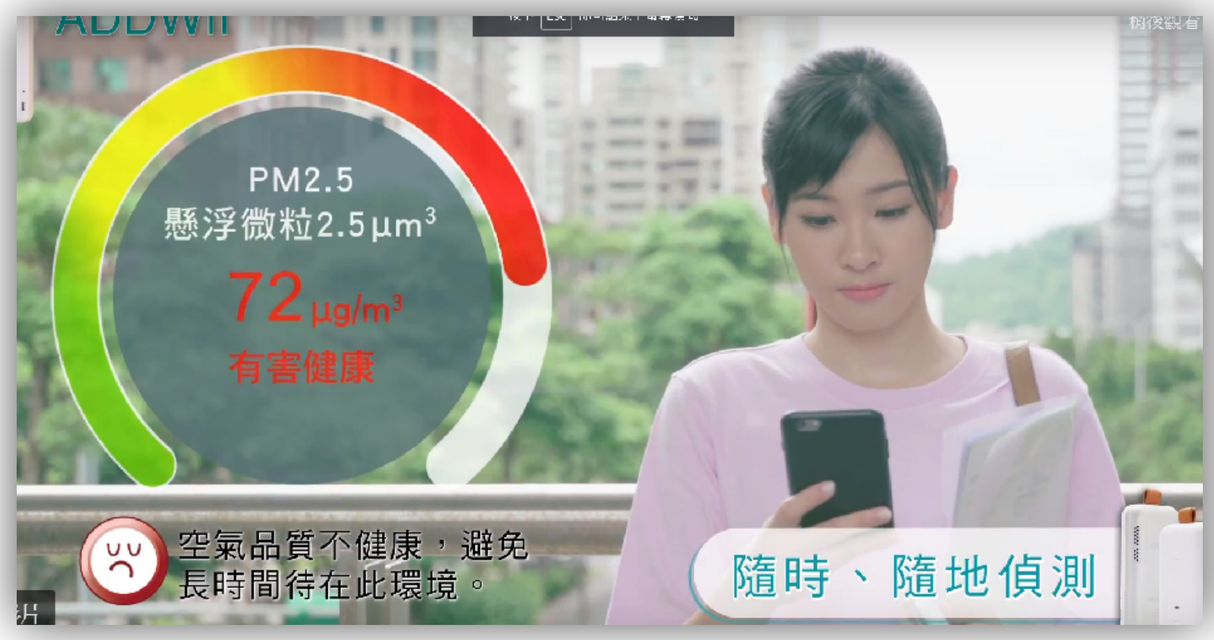
Respiratory patterns

Others?

Mobile nose : PM2.5, TVOC, CO2, Temp, Humidity

https://www.addwii.com/shop/

Microjet Technology Co., Ltd.



ADDWII 隨身空污鼻：個人空污健康記錄器

ADDWII

Mobile Nose 隨身空污鼻

隨 身 · 隨 時 · 隨 地

您 身 邊 的 空 污 監 測 器

個人

個人隨身、隨時、隨地的空氣品質，強調指標個人化，室內戶外兼顧

移動

將空污偵測裝置由定點帶入全移動世代，體積輕巧，在攜帶和移動上展現高度靈活與彈性。

主動偵測

多項專利的微型泵浦核心技術，提供 TVOC、PM2.5、eCO2 及溫、溼度的精準數據

全記錄

終身記錄，將使用者每分每秒所吸入的空氣品質資料，終身儲存於雲端

雲端數據

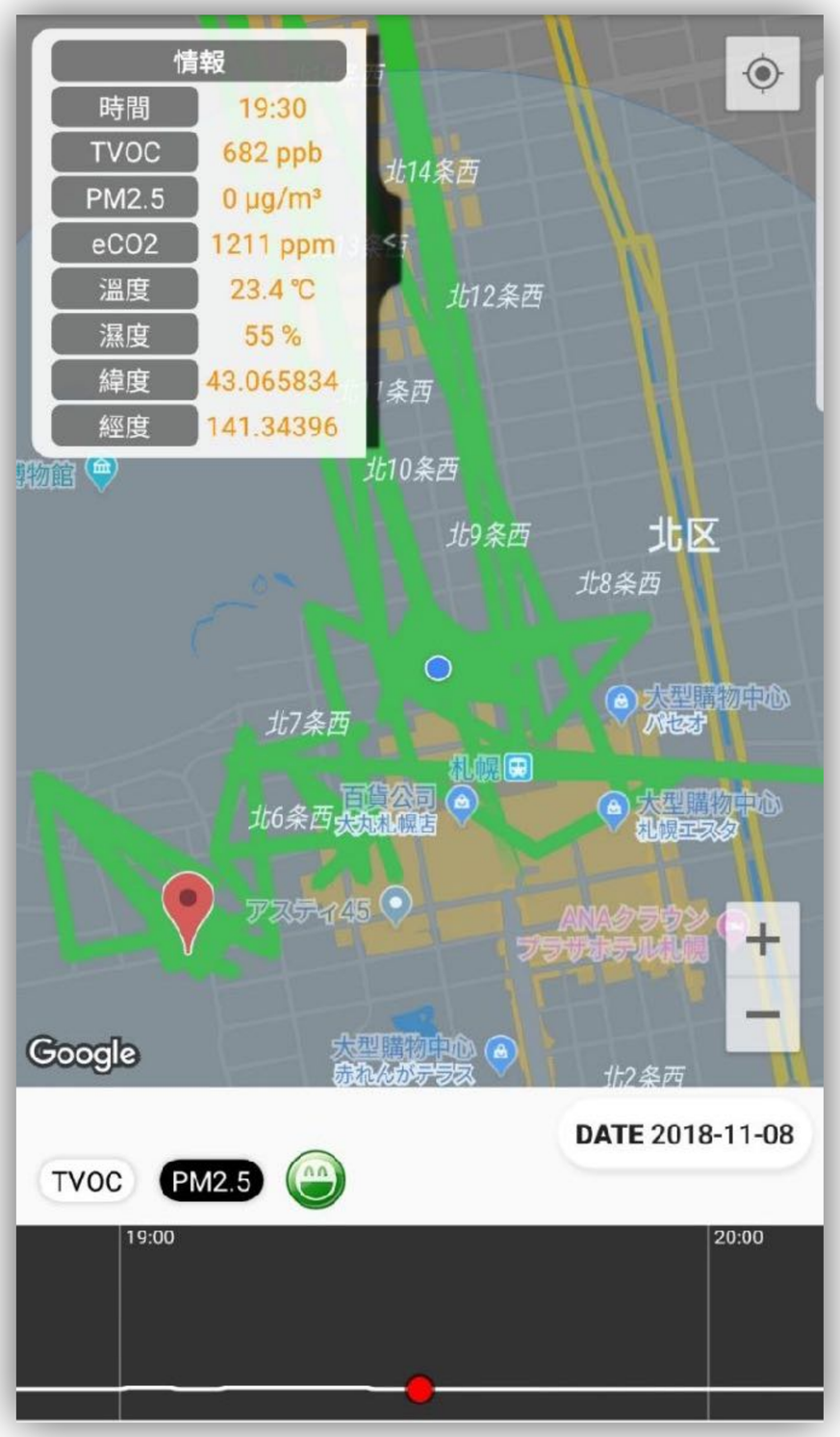
大數據資料，除了個人隱私不公開，可做為相關研究和醫療機構參考

用戶中心

透過使用裝置所蒐集的數值與使用經驗，能在社群媒體平台上交流

個人

個人隨身、隨時、隨地的空氣品質，強調指標個人化，室內戶外兼顧



移動

個人移動式空污偵測裝置，在攜帶和移動上展現高度靈活與彈性。

智慧型呼吸健康照護中心

系統訓練完成

個人化自動評估

慢性呼吸道疾病病患

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大數據分析
人工智慧演算法

初期系統訓練（數日至數週）

Environmental factors

Physical activity

Pulmonary function

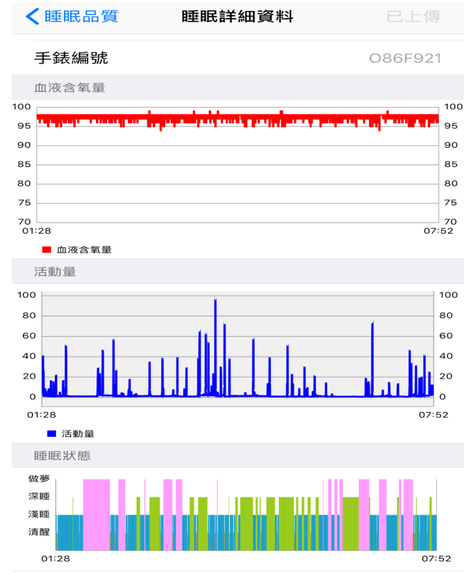
Respiratory patterns

Others?

北科大李仁貴教授開發：動心醫電 血氧手錶

主畫面　　流速血壓量測　　流速血壓記錄

心率偵測　　心率分析圖　　壓力量測



Environmental factors　　**Physical activity**　　Pulmonary function　　Respiratory patterns　　Others?

北科大李仁貴教授開發：動心醫電 血氧手錶

土城世代控制組資料(control=10)

運動前後肺功能 - 運動前後HRV

運動中 心跳血氧趨勢

過去COPD cohort手錶研究 (case=20)

Environmental factors

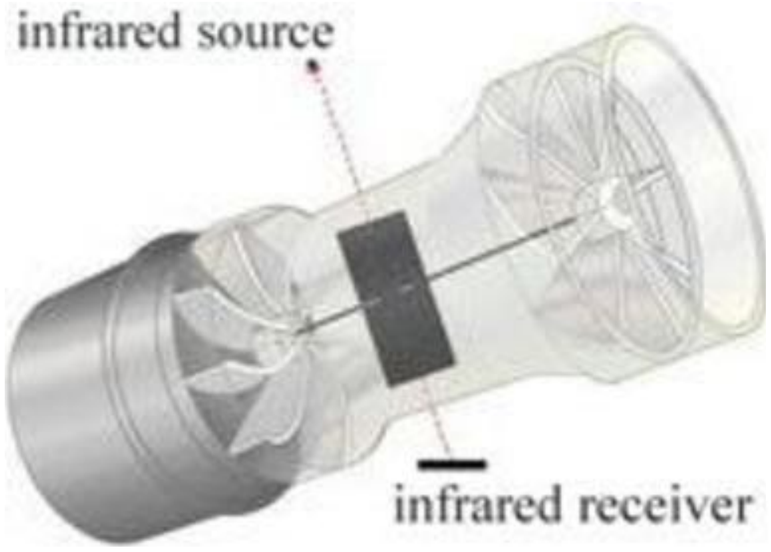
Physical activity

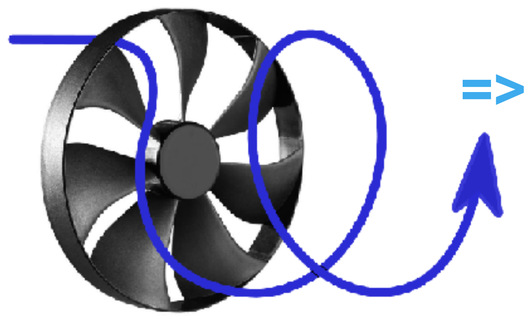
Pulmonary function

Respiratory patterns

Others?

傳統肺功能檢測儀器





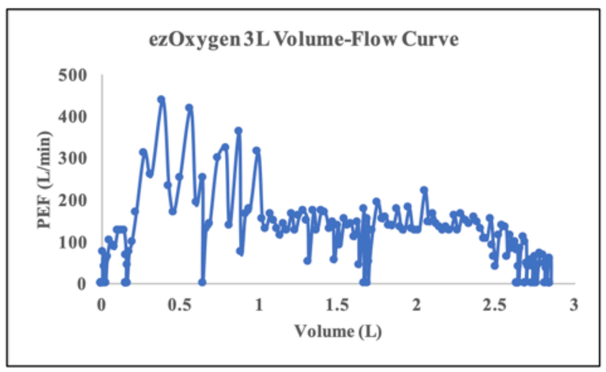
Air flow, Rotating fan

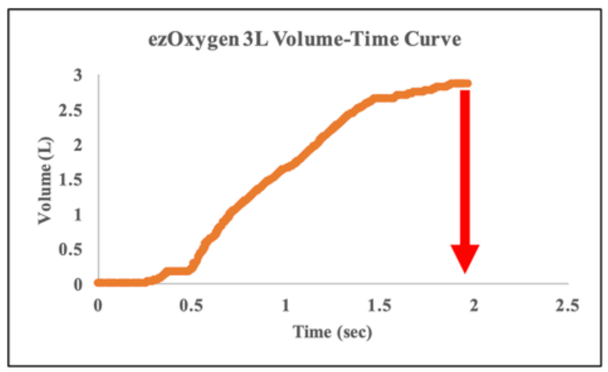
Law of inertia

Smooth curve

=> Diagnosed airway disease at late stage

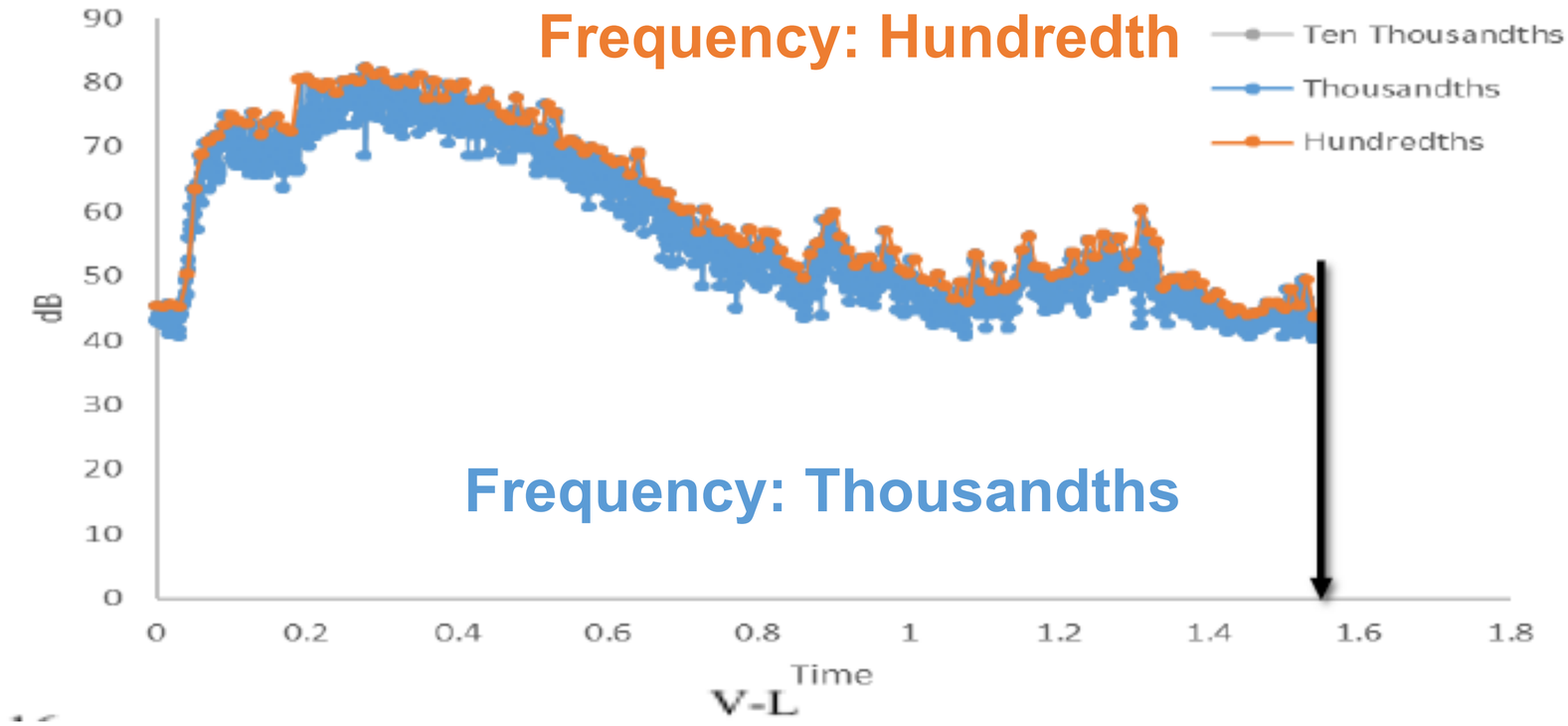
Using ultrasonic signals to restore the original physical signals, and collect the big data.

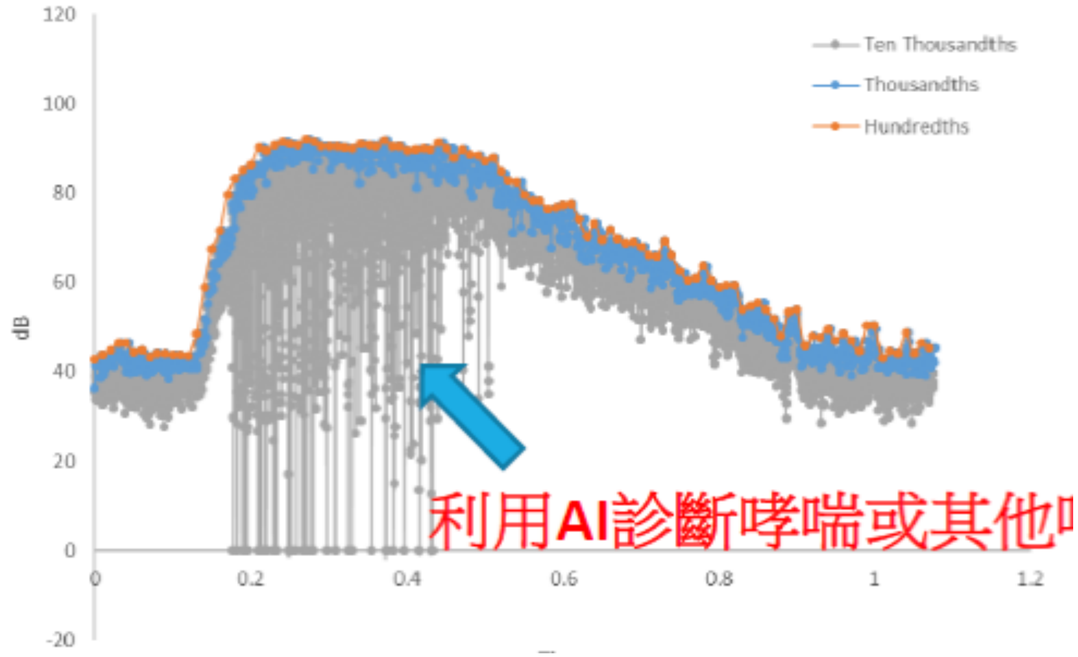




Data analysis				
No.	**PEF (L/min)**	**FEV1 (L)**	**FVC (L)**	**Exhale time (sec)**
ezOxygen 3L	437	1.64	2.85	1.97
MIR 3L	446	4.00	4.12	4.20*

Environmental factors | **Physical activity** | **Pulmonary function** | **Respiratory patterns** | **Others?**





Frequency: Ten thousands

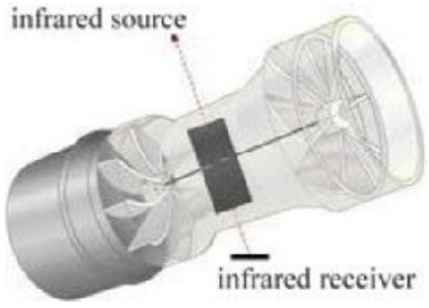
Revealed the detailed airflow changes

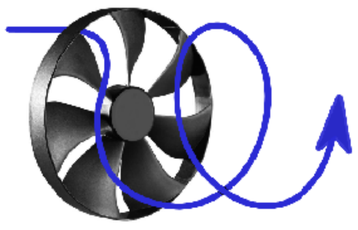
Early detection the airway disease

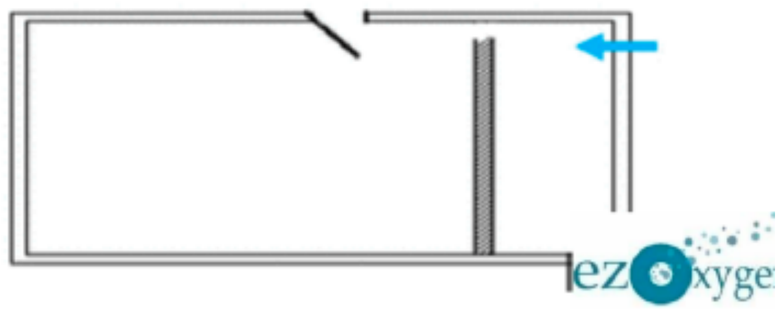
Frequency: Ten Thousandths

Environmental factors | Physical activity | **Pulmonary function** | Respiratory patterns | Others?

傳統肺功能檢測儀器

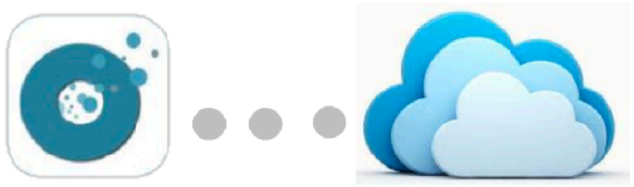






ezoxygen

Peak Flow 、FEV1 and FVC



Download on the App Store

GET IT ON Google Play

Environmental factors

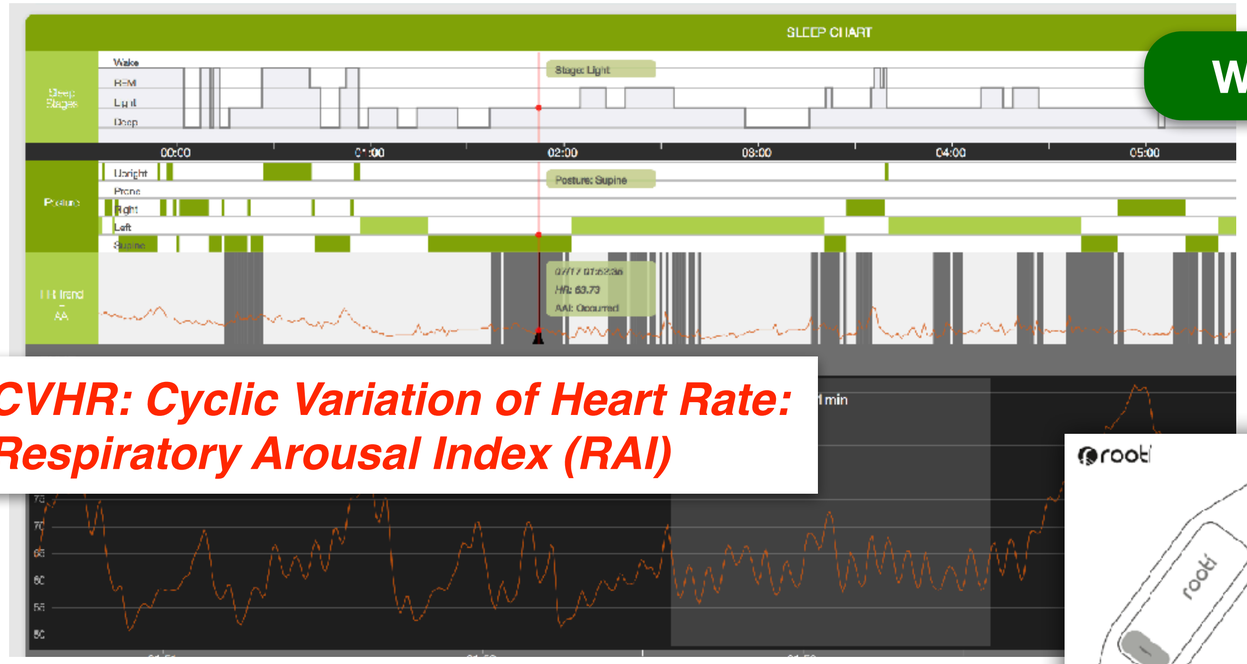
Physical activity

Pulmonary function

Respiratory patterns

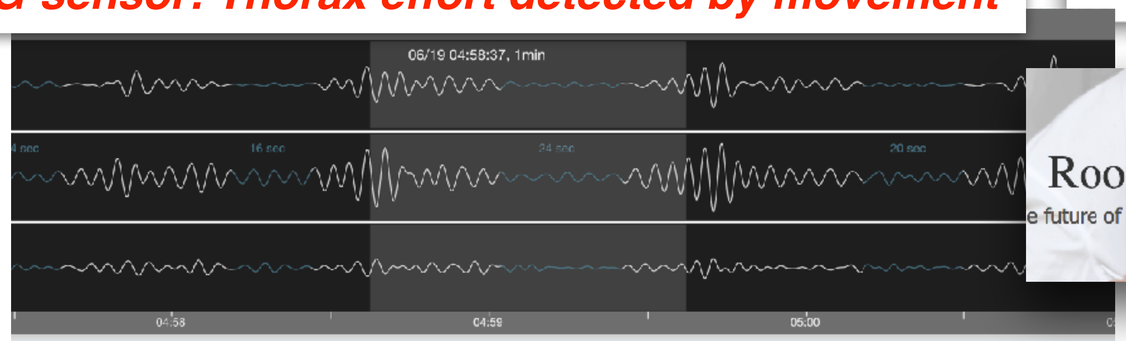
Others?

Wearable device



CVHR: Cyclic Variation of Heart Rate: Respiratory Arousal Index (RAI)

G-sensor: Thorax effort detected by movement

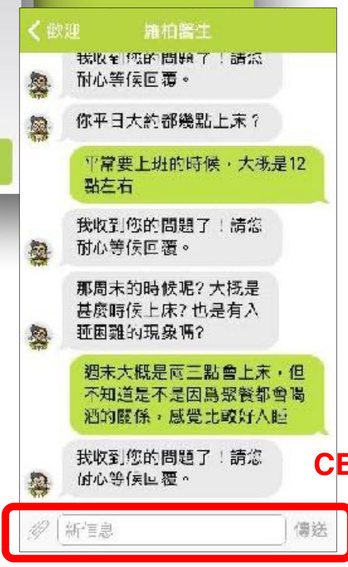


Sleep quality

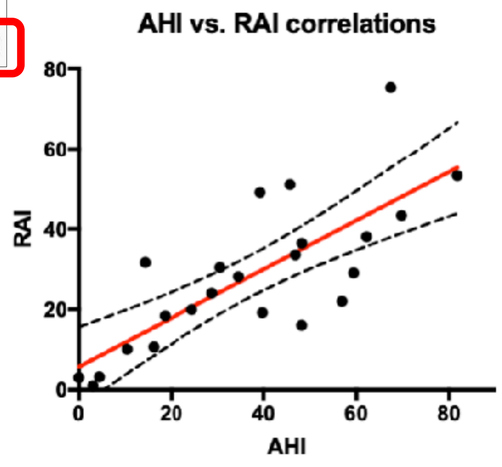
Sleep Diary

Data Monitoring

online Q&A

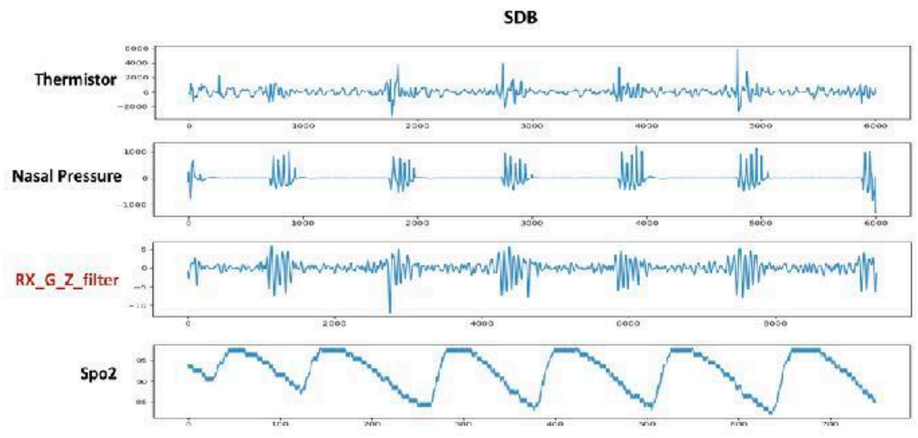


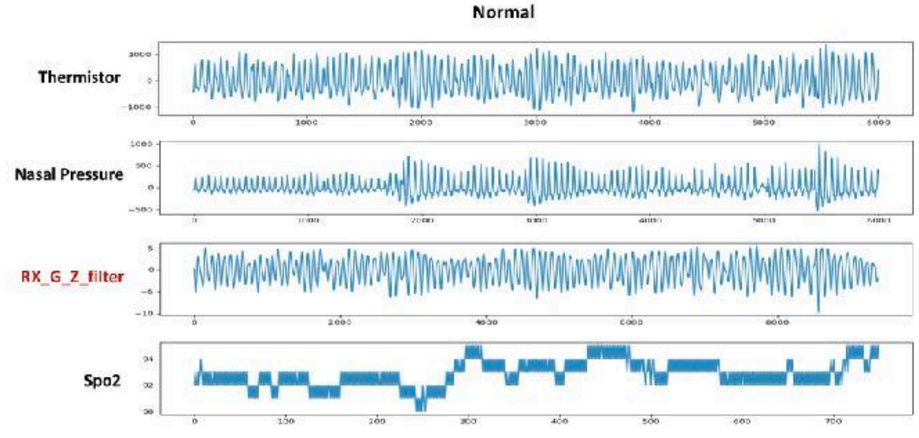
CBTi-like Chatbot



Pearson correlation
95% CI: 0.5237 to 0.8973

r = 0.7698, r squared = 0.5925
P < 0.0001





Environmental factors

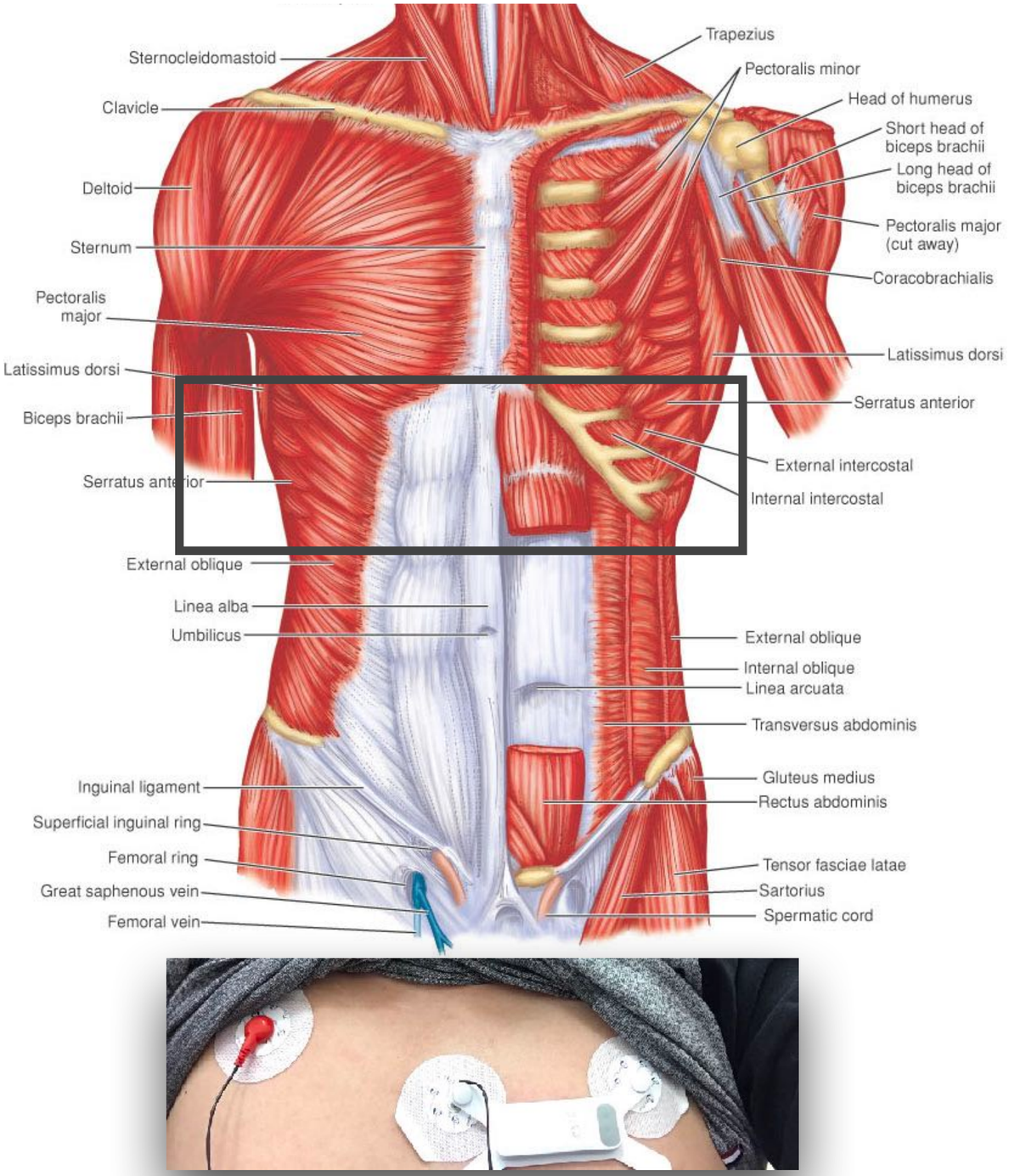
Physical activity

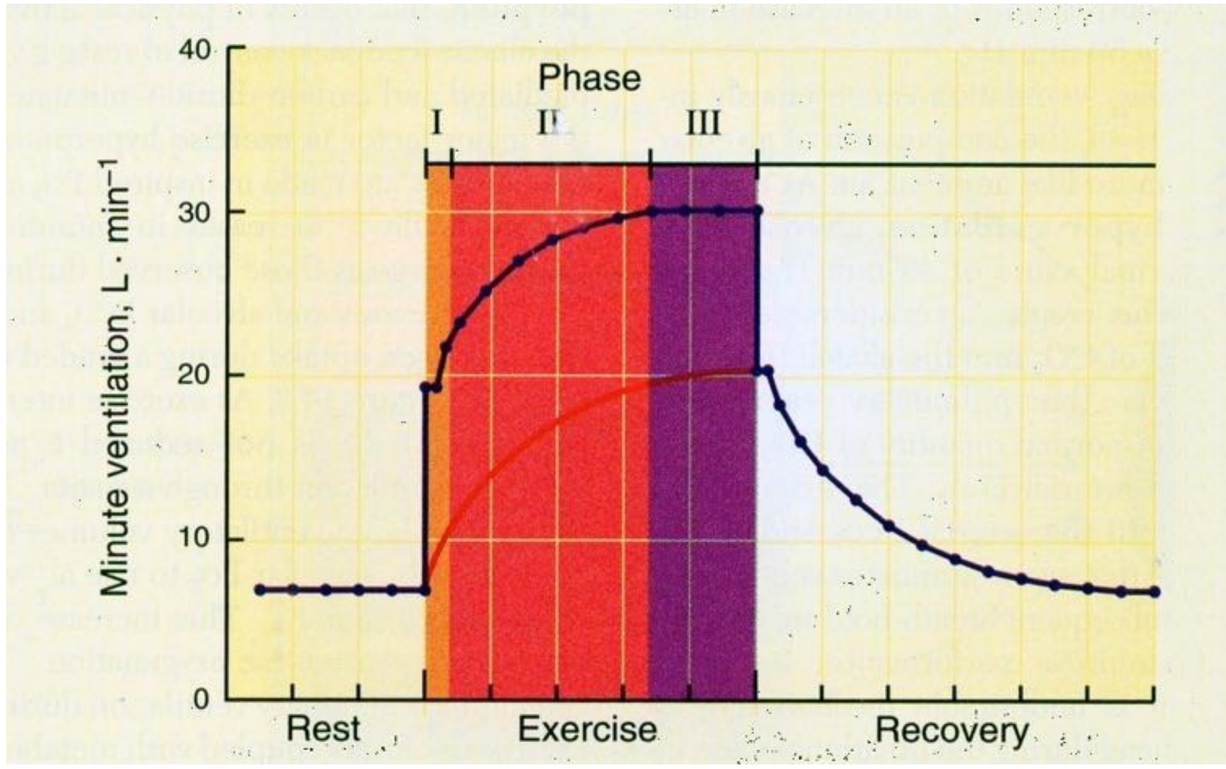
Pulmonary function

Respiratory patterns

Others?

Respiratory patterns by muscle impedance changes





Morphological change

↓

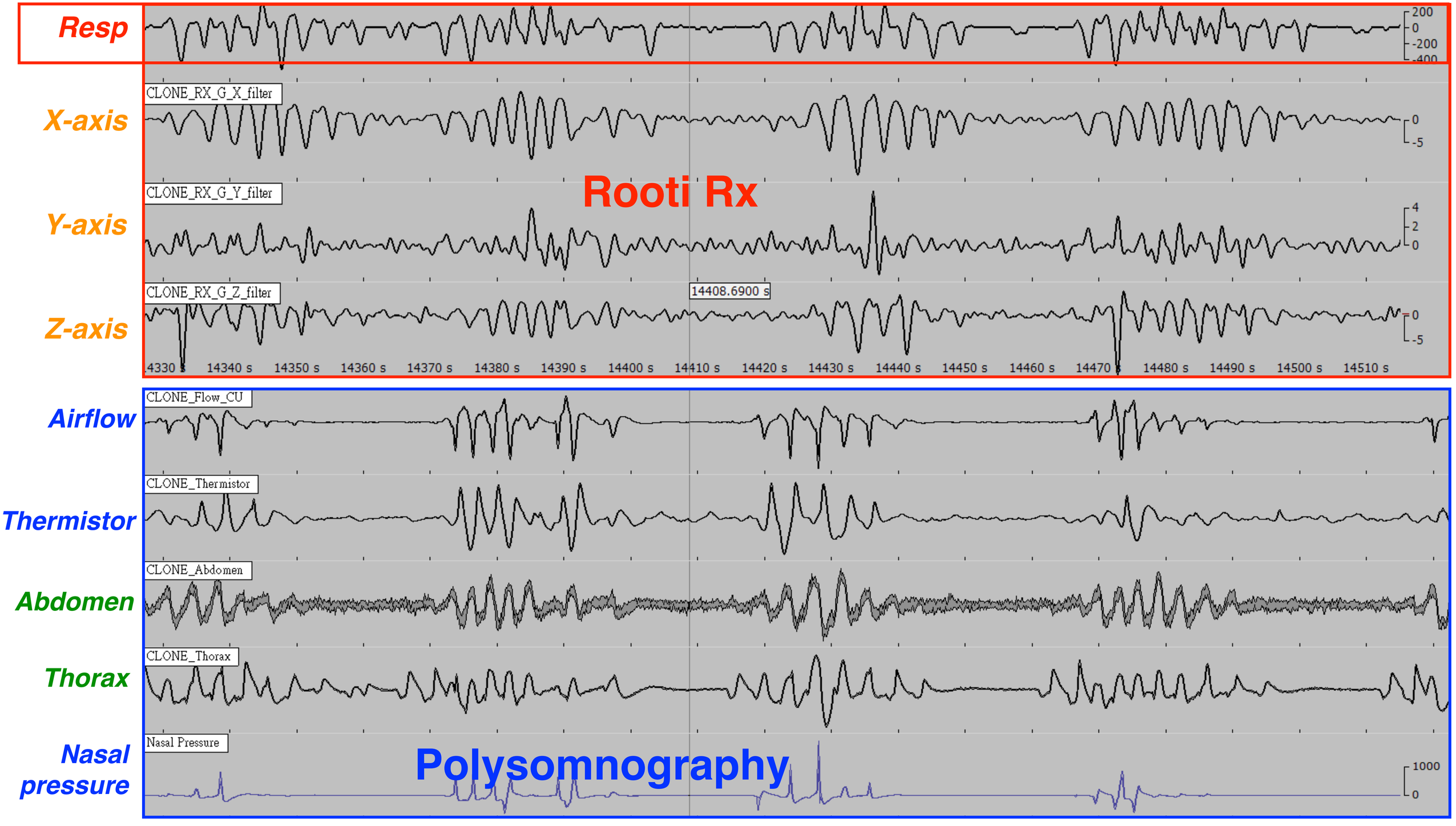
Impedance change

↓

Voltage change

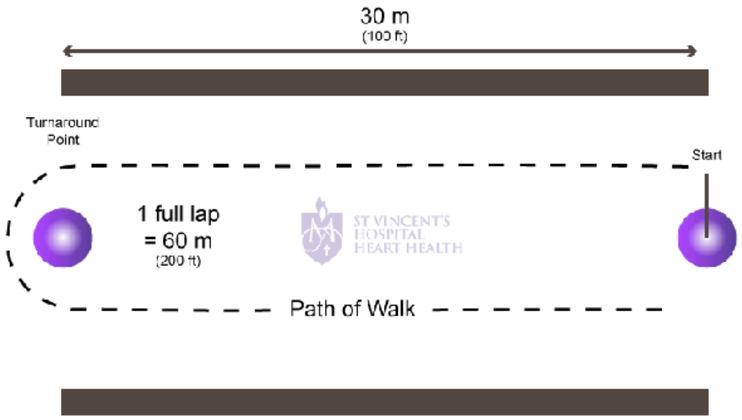
Environmental factors | Physical activity | Pulmonary function | **Respiratory patterns** | Others?

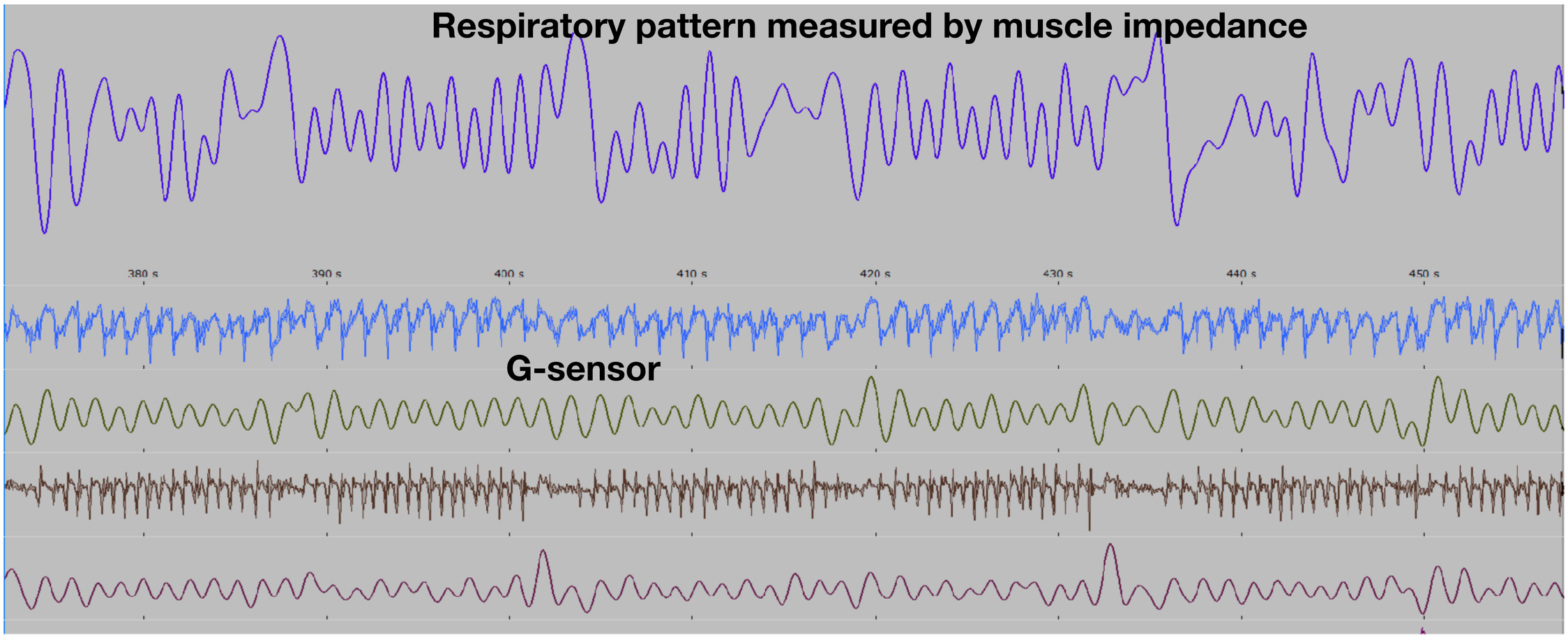
Respiratory patterns by muscle impedance changes



Environmental factors | Physical activity | Pulmonary function | **Respiratory patterns** | Others?

Respiratory Patterns during 6 Minute Walk Test





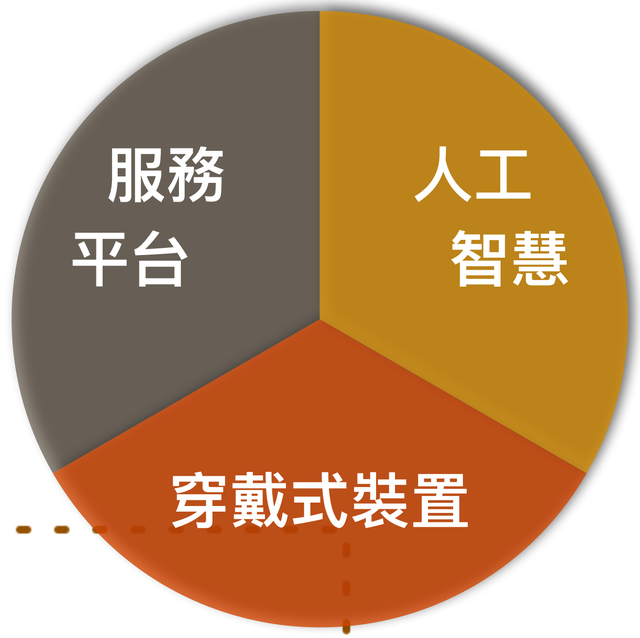
Environmental factors | Physical activity | Pulmonary function | **Respiratory patterns** | Others?

民國104年底成立 智慧型呼吸健康照護中心

產業界
（穿戴式裝置）
（手持裝置）
（醫療器材）

臺北醫學大學
（醫學院胸腔學科）
（管理學院）
（醫科院、醫工院）

學術界
（資訊、工程
管理、服務
商業）



智慧型呼吸健
康照護中心

財務機構
（健康保險）
（健康檢查）
（理財方案）

區域、醫學中心
（雙和醫院、
北醫附設醫院、
萬芳醫院、
etc.）

基層醫療
（台北、新
北之診所
等）

慢性呼吸道
疾病病患

雲端資料與大數據平台

空間資訊污染物擴散模式

(現有) 即時PM 2.5現況

(計畫) LUR; 推估個人時、空PM2.5暴露值(模式)

上班時間*(X_1Y_1)+在家時間*(X_2Y_2)

增加佈點
提供室內暴露資料

Personal Temporal and Spatial info.

Model validation with health outcome

Personal Vital signs (HRR) [GPS]

提供預警系統訊息
建議用藥提示

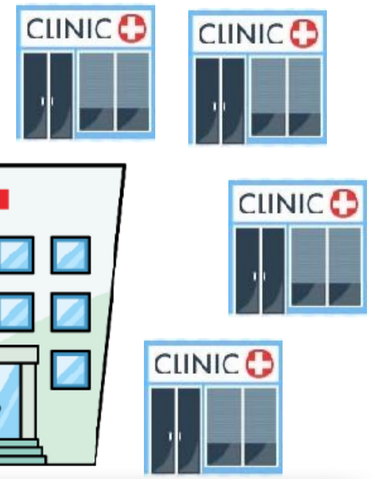
大數據中心

計算空汙與生命徵象模式
建立大數據預告警示系統
[北中南]

病患職業暴露(問卷)
醫院、診所AE紀錄

建立轉診網絡資料庫
提供預警系統訊息

綠色轉診通道
特別門診



基層診所

COPD收案200+人，老人健檢空汙問卷；醫院診所群紀錄AE資料、職業等刺激物暴露 - 流病資料、精準預測

個人穿戴裝置

(現有) 生命徵象偵測 – SatO2, HR, BP, GPS 定位

Environmental factors

Physical activity

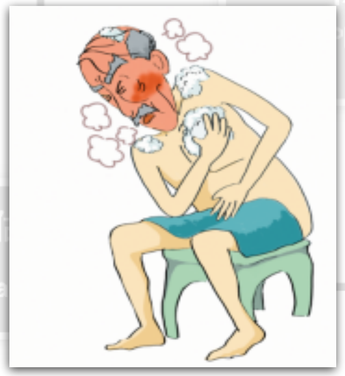
Pulmonary function

Respiratory patterns

Others?

What is the Unmet Need?

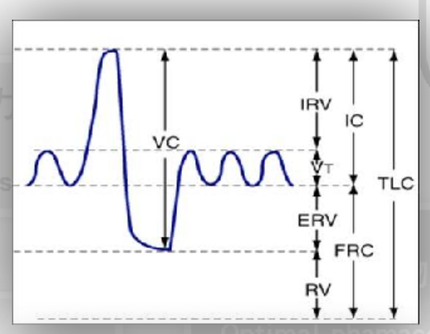
Feasible approaches?



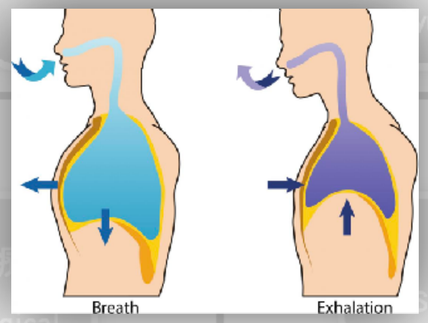
Environmental factors

Physical activity

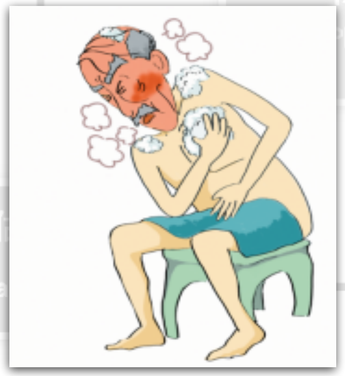
Pulmonary function



Respiratory patterns



Others?



What is the Unmet Need?

Feasible approaches?

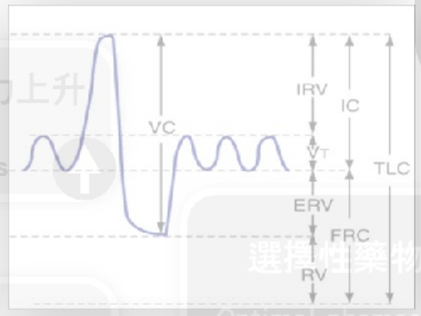
Environmental factors

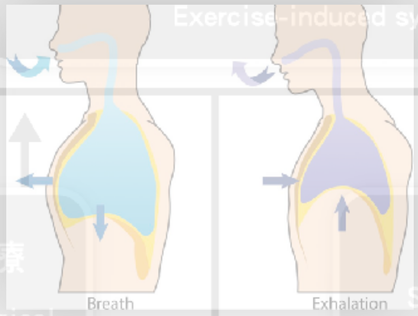
Physical activity

Pulmonary function

Respiratory patterns

Others?





What is the Unmet Need?

Feasible approaches?

心理諮詢
Psychological counseling

物理活動指導
Physical activity coaching

運動訓練
Exercise training

營養調整
Nutritional modulation

焦慮症狀
Symtoms of anxiety

憂鬱症狀
Symtoms of depresslon

適應能力限制
Adaptation to limitations

自我效果評估上升
Self-efficacy

四肢肌肉功能增加
Limb muscle function

動態過度充氣下降
Dynamic hyperinflation

運動引起症狀下降
Exercise-induced symptoms

行為改變
Behavior change

低強度物理活動能力上升
Light intensity

自主活動上升
Active living

Optimal phamacological therapy (including comorbidities)

Smoking cessation

急性發作或住院率下降
Exacerbation and/or hospitalization

Environmental factors

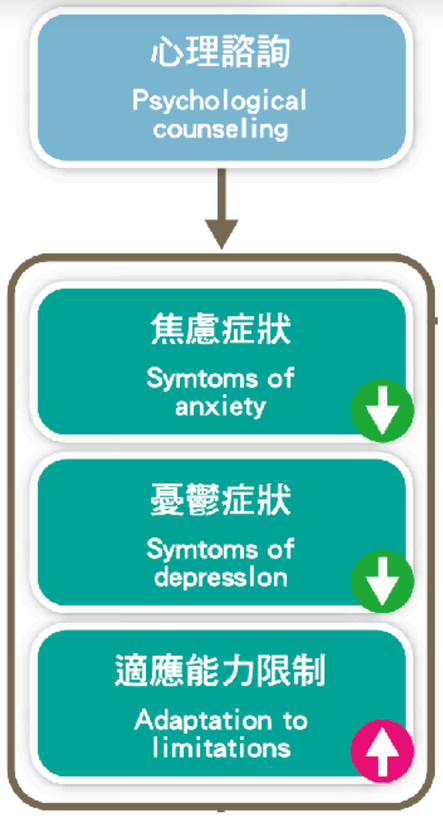
Physical activity

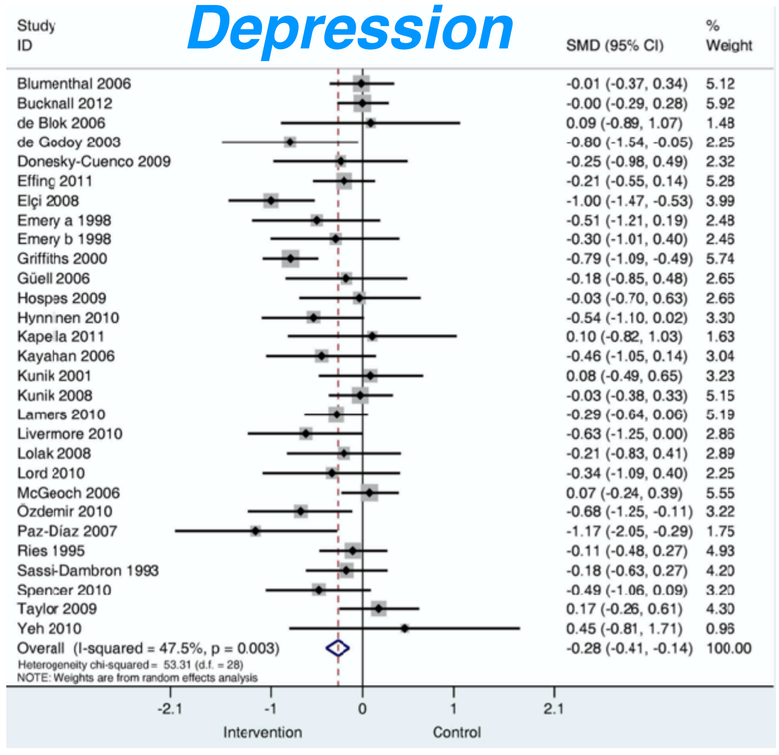
Pulmonary function

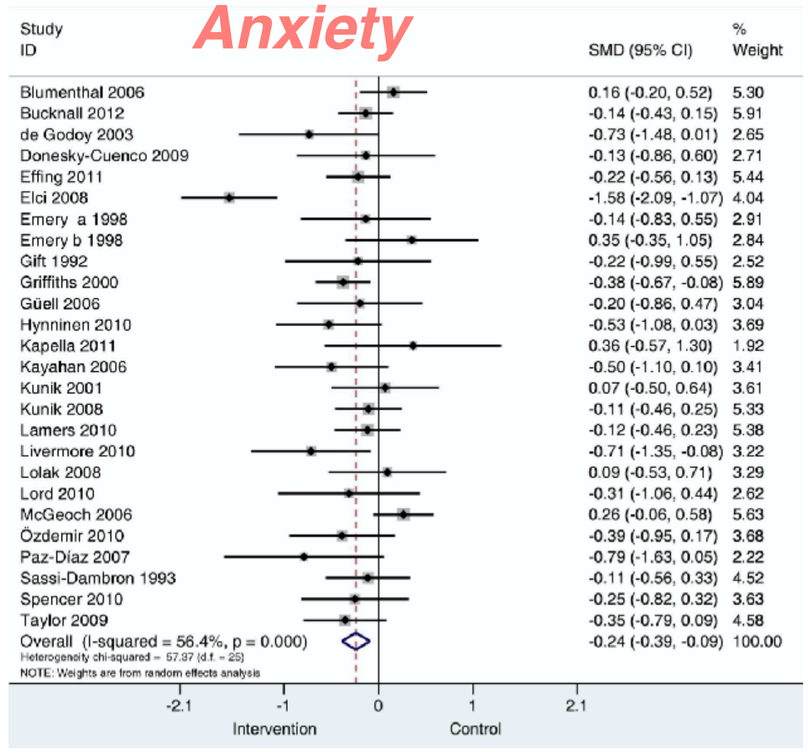
Respiratory patterns

Anxiety Depression

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







Environmental factors

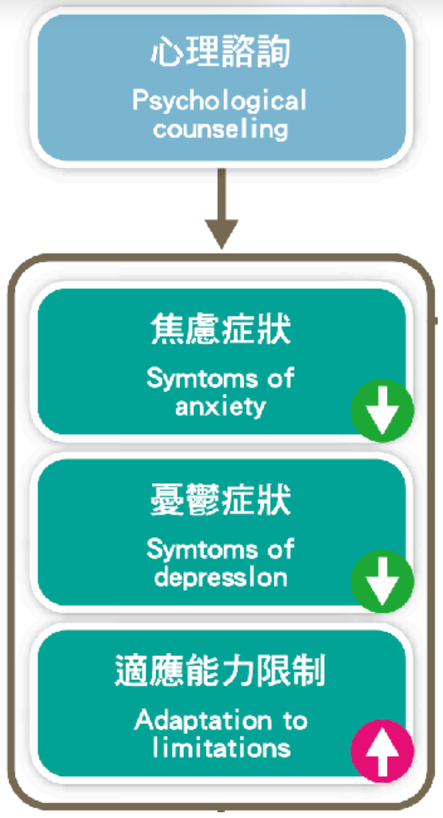
Physical activity

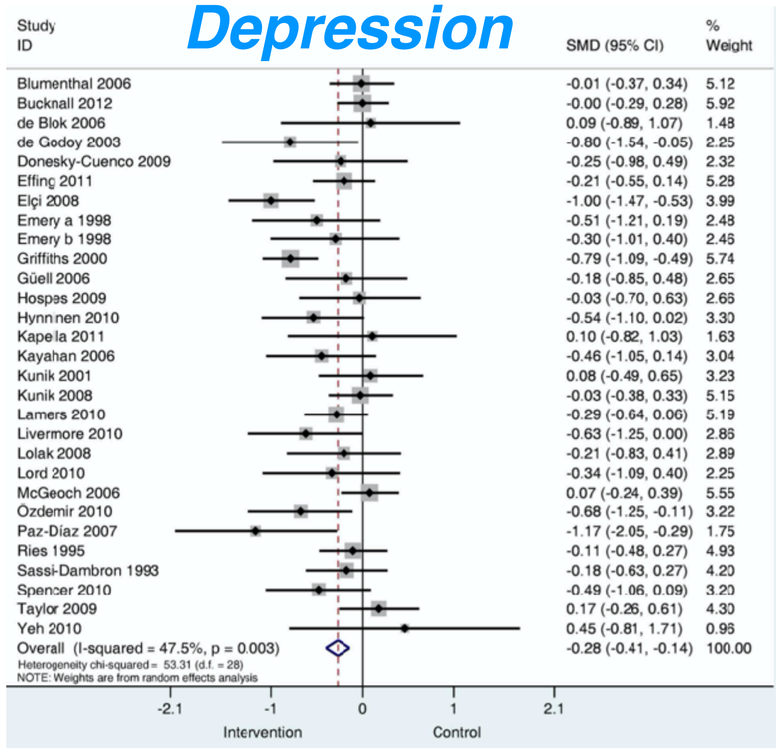
Pulmonary function

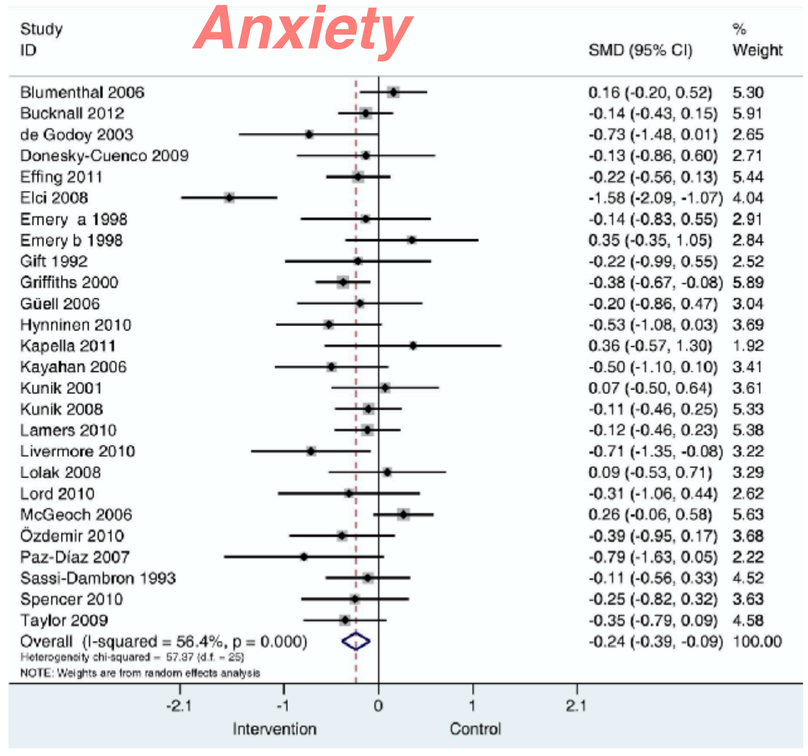
Respiratory patterns

Anxiety Depression

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







Environmental factors

Physical activity

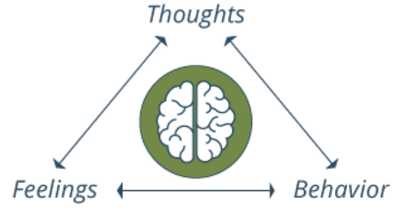
Pulmonary function

Respiratory patterns

Anxiety Depression

Multi-component Exercise Training

Cognitive behavior therapy

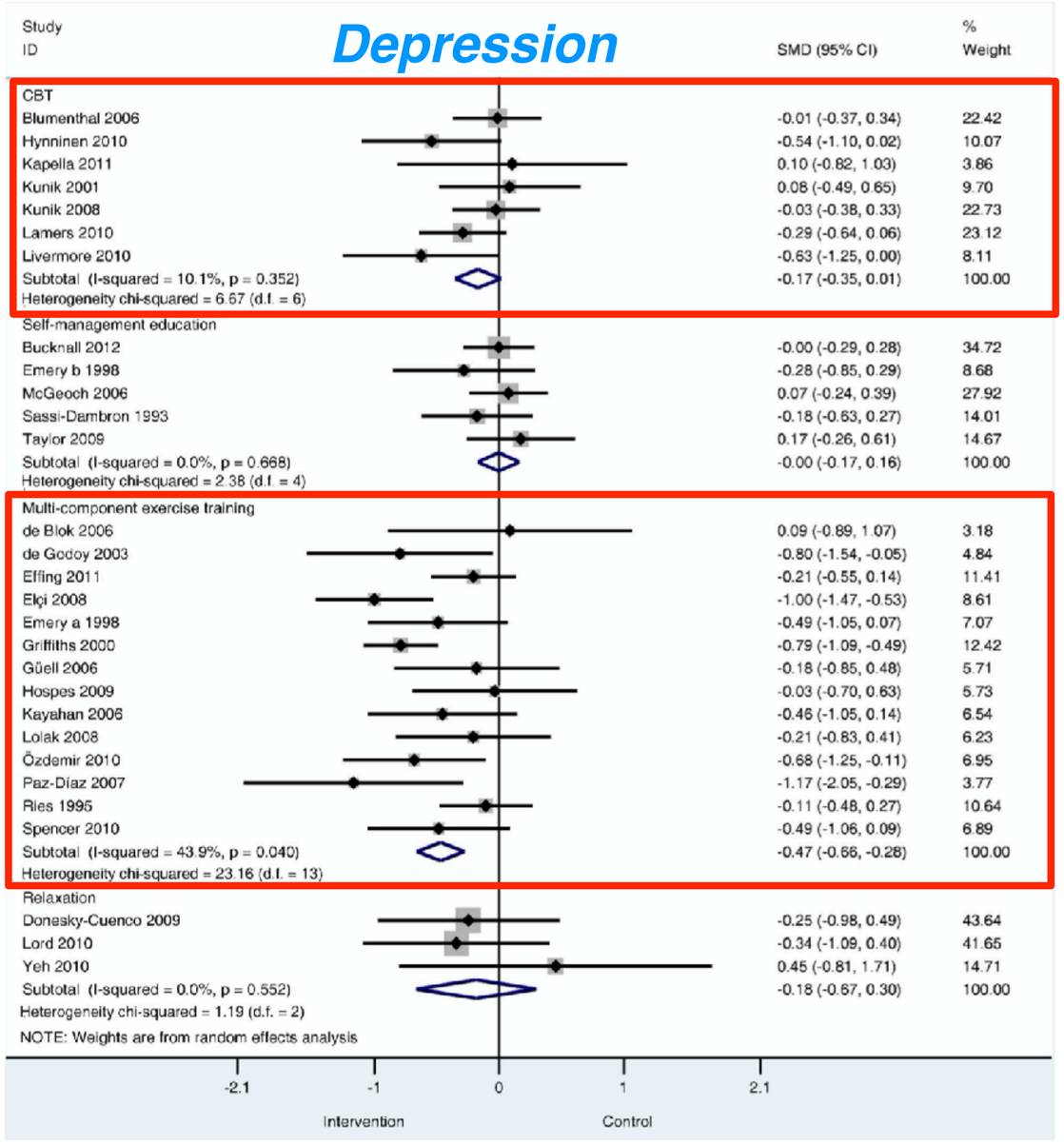


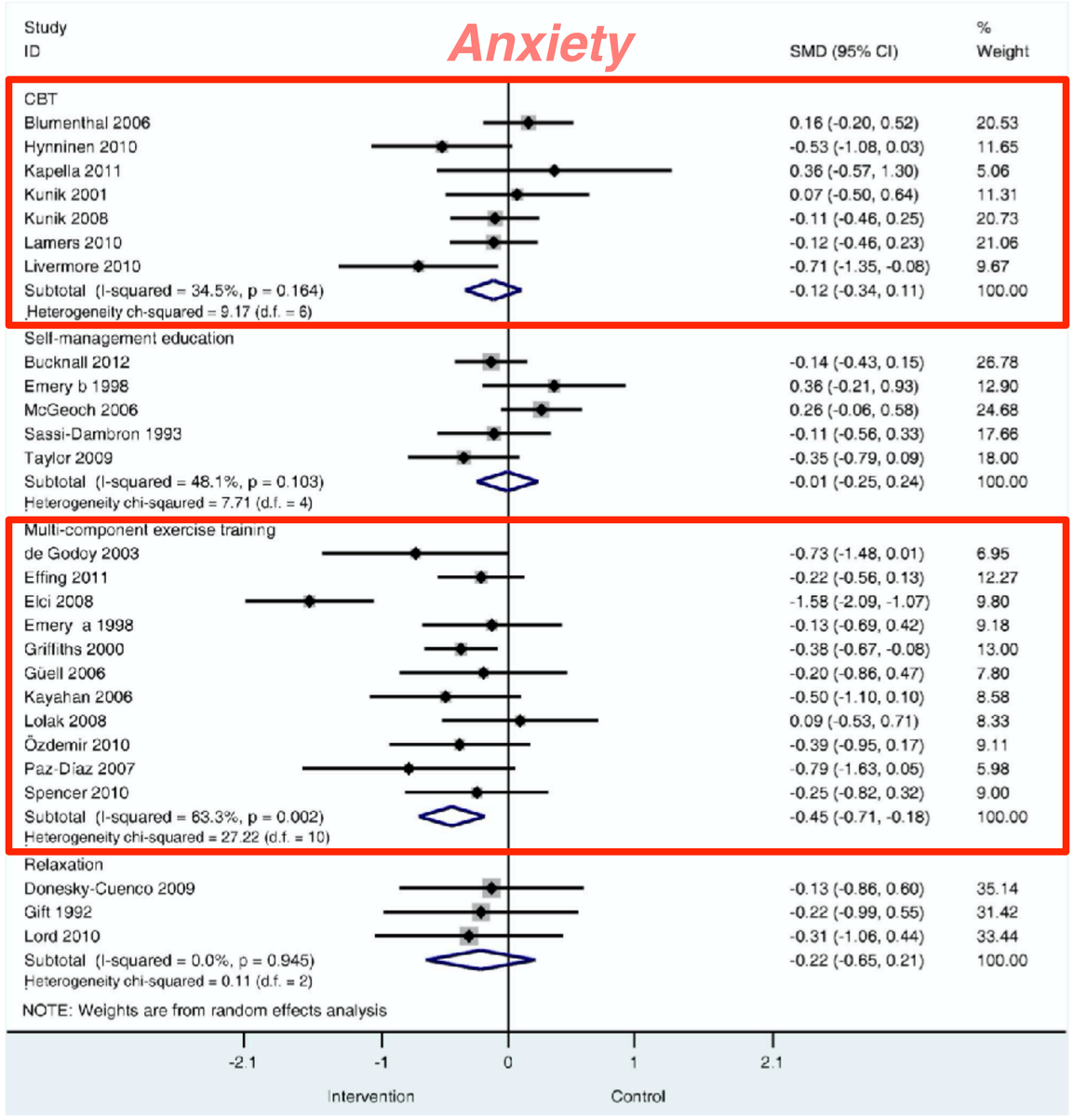
Self-management education

Relaxation

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

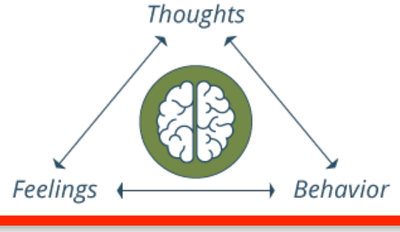
PLoS ONE 8(4), 2013: e60532. doi:10.1371





Multi-component Exercise Training

Cognitive behavior therapy

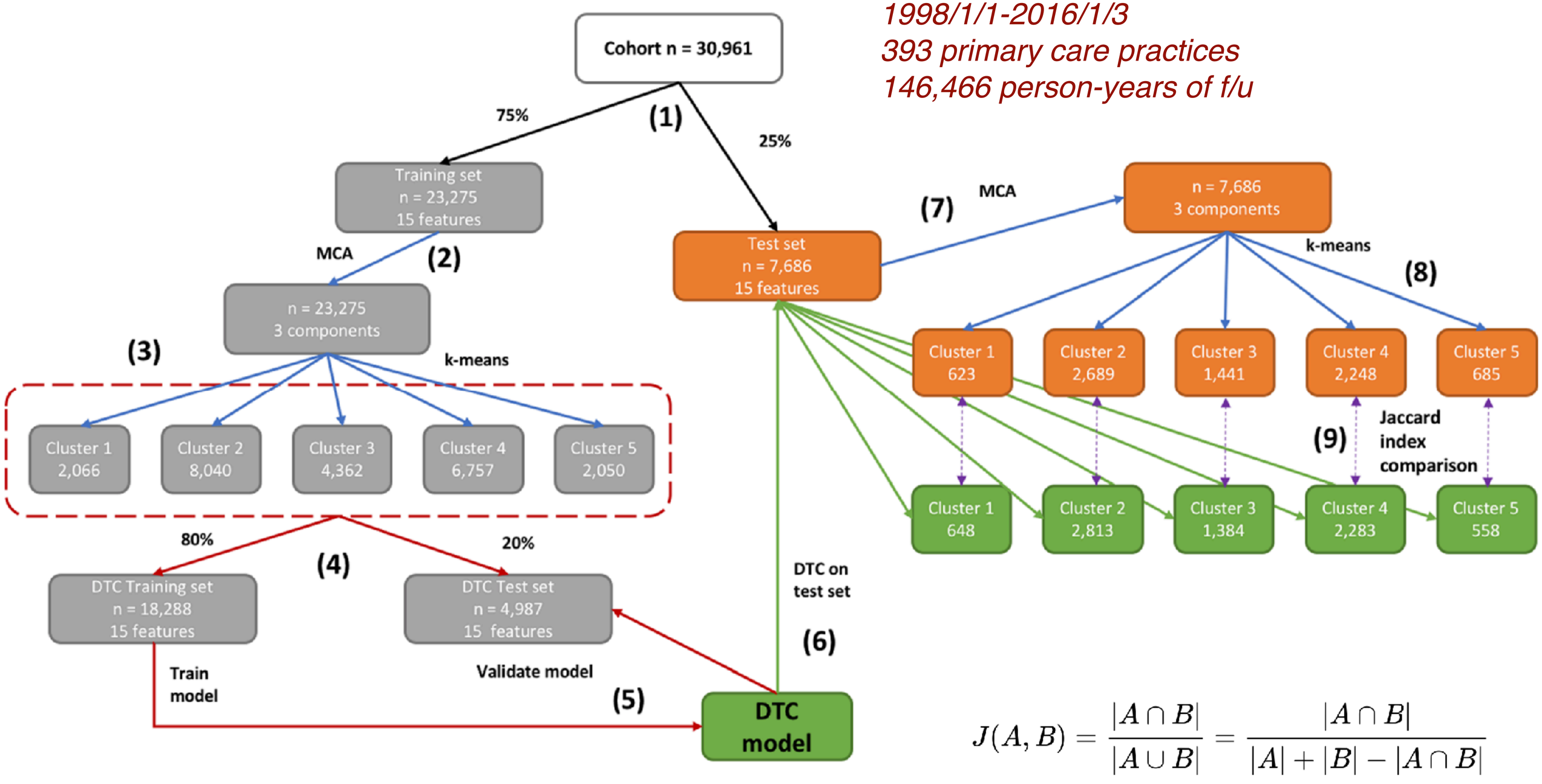


Self-management education

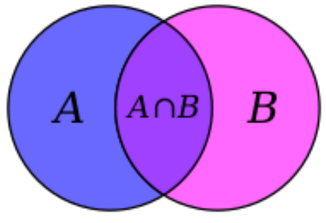
Relaxation

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

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



$$J(A,B) = \frac{|A \cap B|}{|A \cup B|} = \frac{|A \cap B|}{|A| + |B| - |A \cap B|}$$



Jaccard index: 92%

BMC Med Inform Decis Mak. 2019 Apr 18;19(1):86.

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

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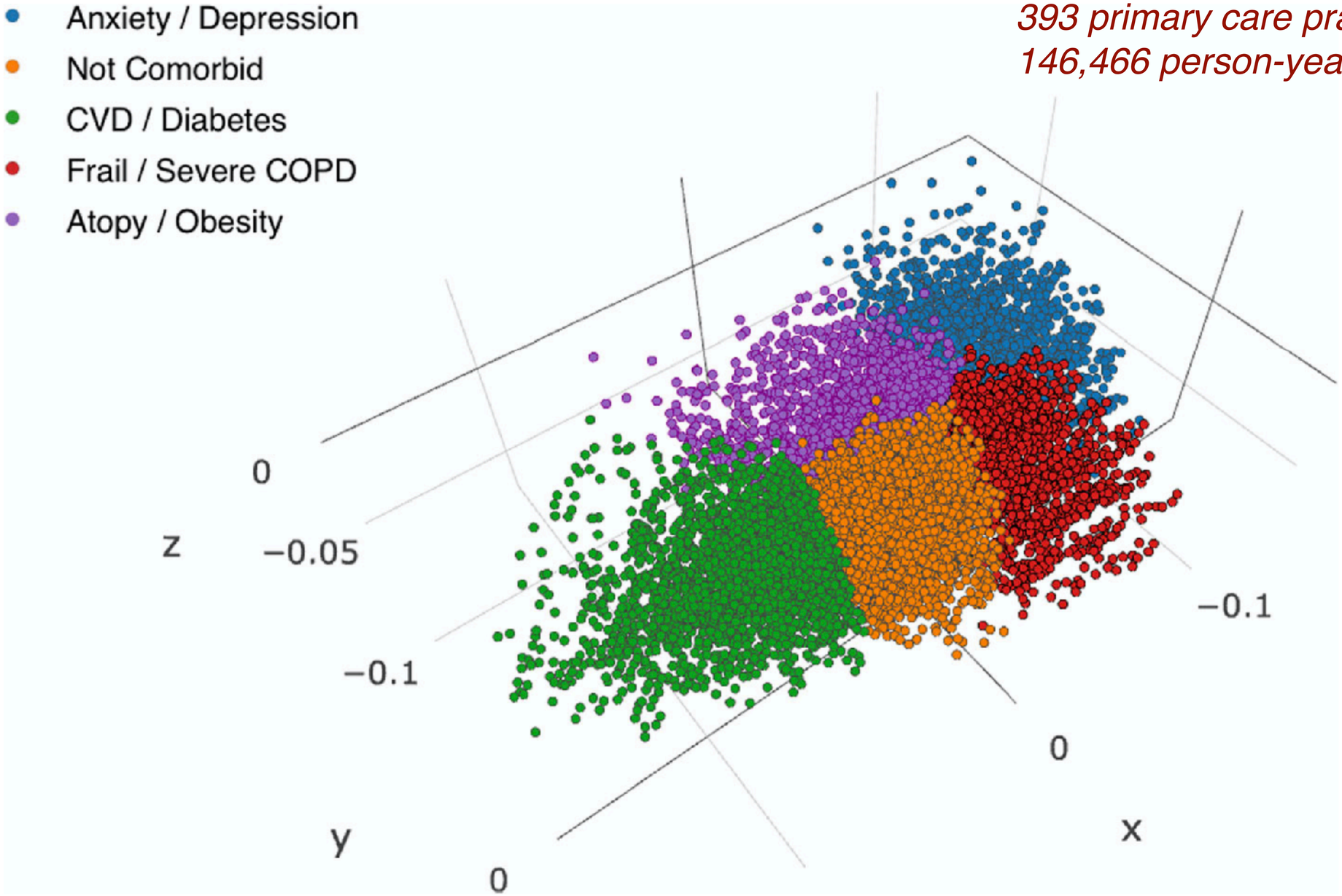
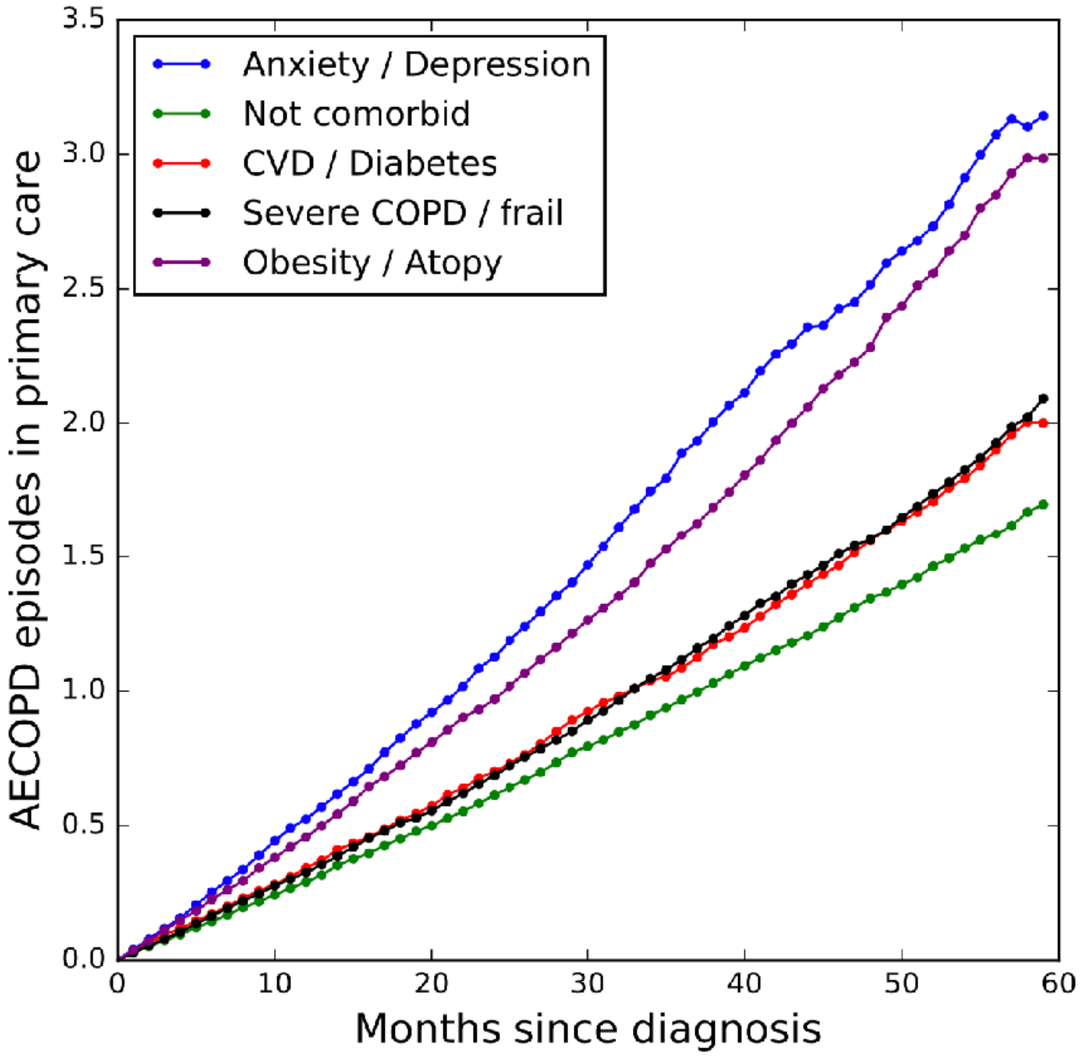


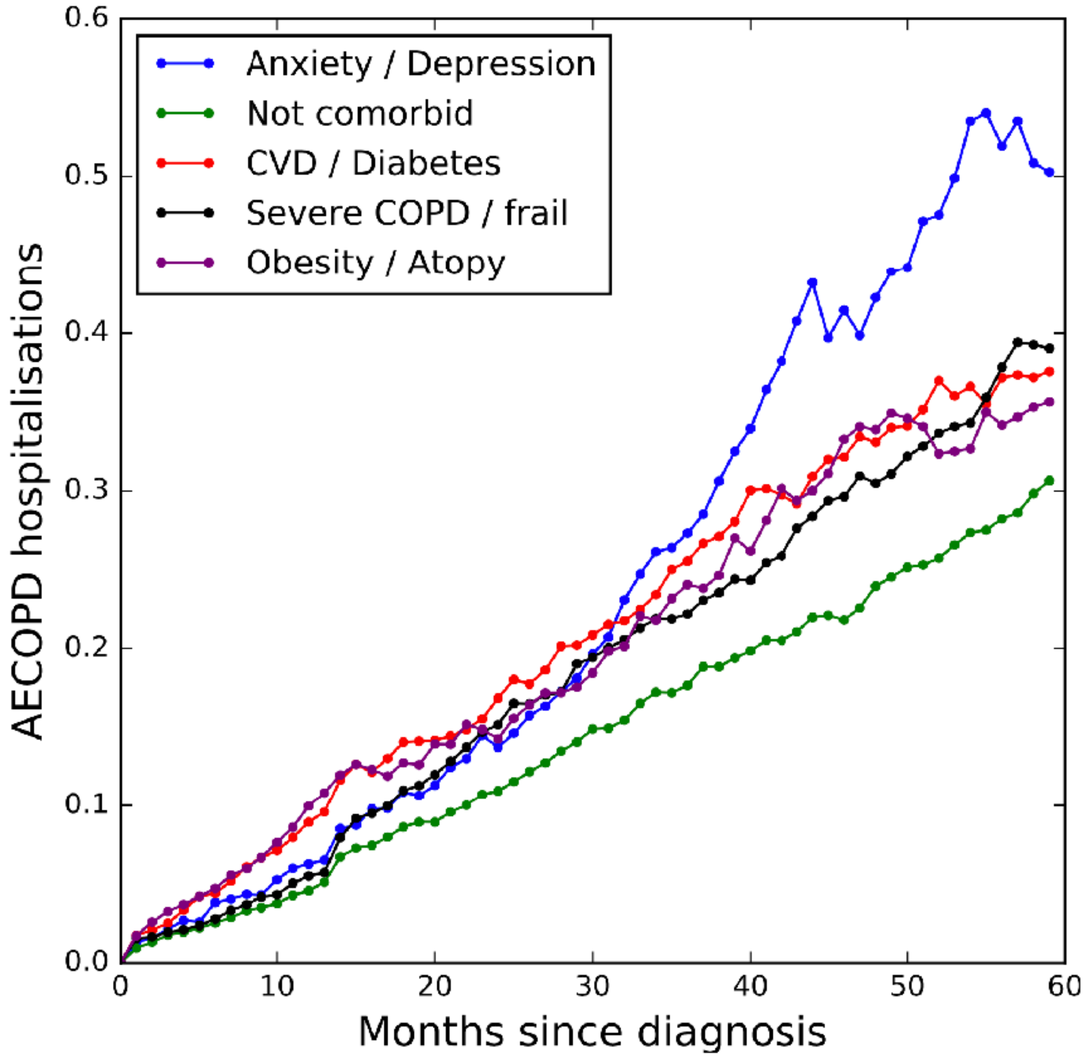
15 clinical features:

- *BMI*
- *Chronic Rhinosinusitis*
- *Anxiety*
- *Atopy*
- *Depression*
- *Diabetes*
- *Eosinophils >2%*
- *GERD*
- *GOLD*
- *Heart Failure*
- *Hypertension*
- *Ischemic Heart Dx*
- *Smoking*
- *Therapy Type*

BMC Med Inform Decis Mak. 2019 Apr 18;19(1):86.

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

BMC Med Inform Decis Mak. 2019 Apr 18;19(1):86.

What is the Unmet Need?

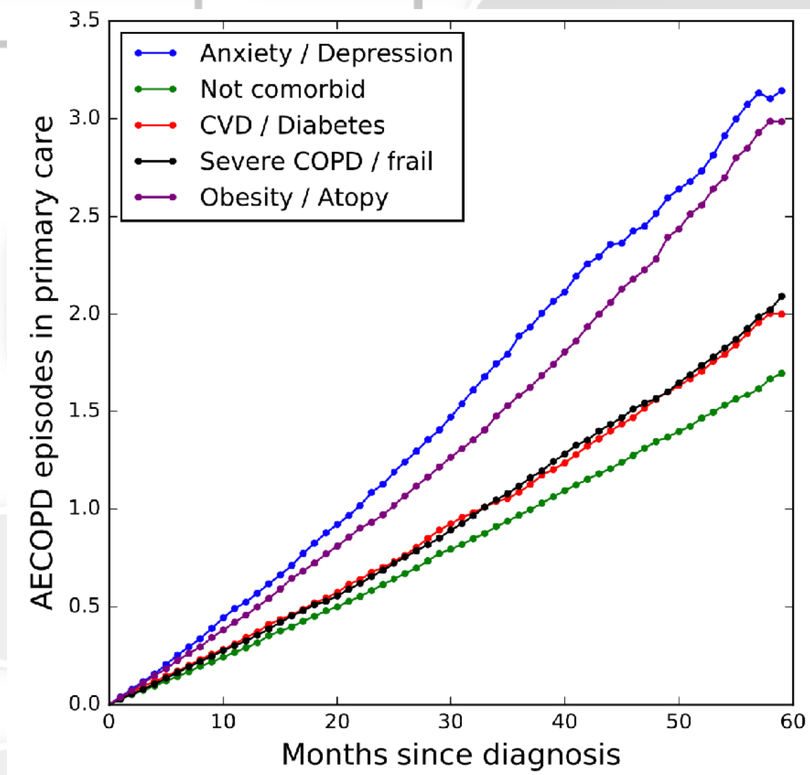
Feasible approaches?

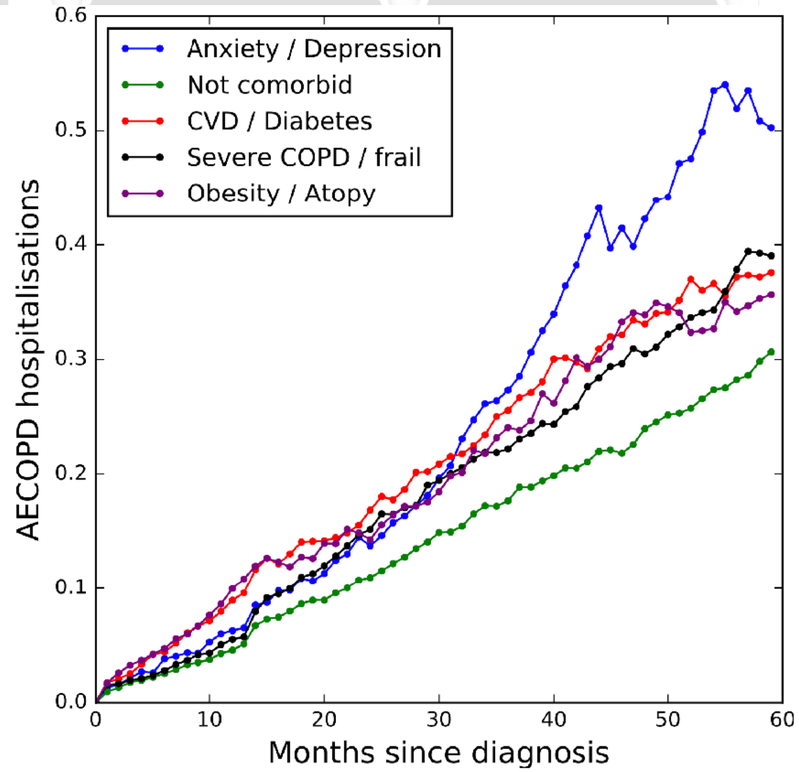
心理諮詢
Psychological counseling

焦慮症狀
Symtoms of anxiety

憂鬱症狀
Symtoms of depression

適應能力限制
Adaptation to limitations





Environmental factors

Physical activity

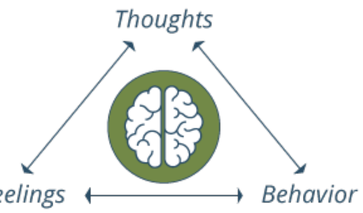
Pulmonary function

Respiratory patterns

Anxiety Depression

Multi-component Exercise Training

Cognitive behavior therapy



聊天機器人：語言特徵擷取

- 正面vs負面
- 字數多寡
- 反應快慢
- 語調變化

2018/11/29-12/2 醫療科技展

空氣品質監測站
偵測大環境空污數據

空氣品質監測資料

大數據中心
人工智慧演算空污及個人生理數值資料庫，建立呼吸道疾病預測模型

蒐集居家空氣品質

個人生理數值

預警訊息

●建立轉診資料庫
●提供預警訊息
(診斷及轉診建議)

PM2.5
穿戴裝置
居家空氣品質

穿戴裝置
個人生理數值

聊天機器人
提供預警訊息 (生活習慣調整、用藥提示及就醫建議)

智慧型呼吸健康照護中心

綠色轉診網絡

CLINIC

CLINIC

CLINIC

CLINIC

合作醫療院所
記錄個案看診資訊

就醫

醫療服務

照護對象
(企業團體/個人會員)

Thanks for your attention