



# วิธีการตรวจ Spirometry

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ประธานเครือข่ายคลินิกโรคหืดและปอดอุดกั้นเรื้อรังแบบง่าย  
คณะแพทยศาสตร์ มหาวิทยาลัยขอนแก่น





# เนื้อหา



- ข้อบ่งชี้
- เครื่องมือ
- ขั้นตอนการทำ
- การแปลผล



## ข้อบ่งชี้ในการทำ spirometry



- เพื่อการวินิจฉัยโรค
- ติดตามการรักษา
- ประเมินสุขภาพ ทูพลภาพ
- สํารวจสุขภาพชุมชน

# Equipment

## I) Volume-displacement spirometer



water seal spirometer



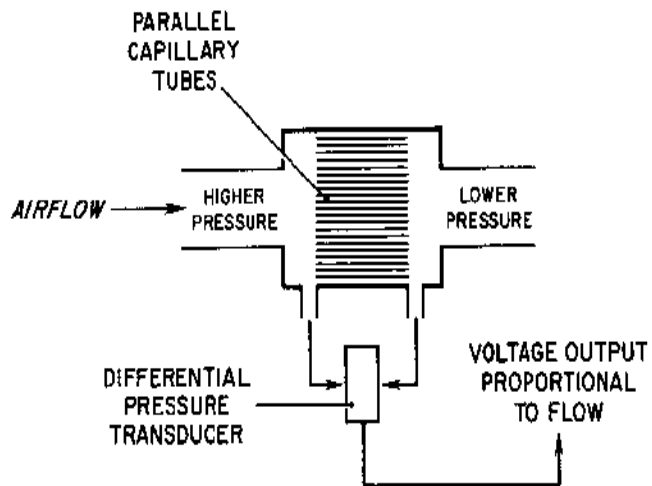
rolling seal spirometer



bellows or wedge spirometer

# Equipment

## II) Flow-sensing spirometer



# Measurement procedures

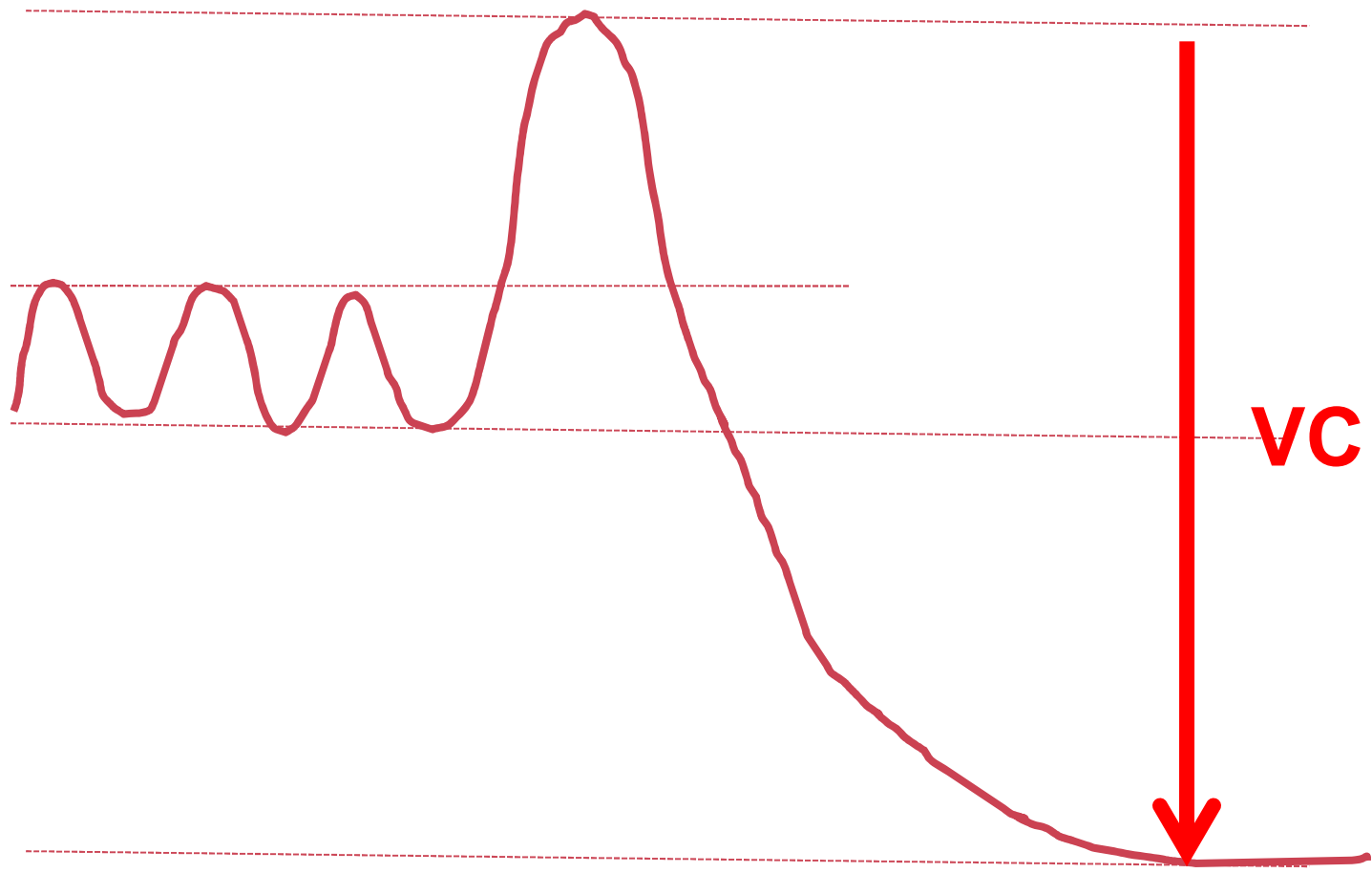
## ➤ Personnel qualifications



Maximal  
inspiratory  
level

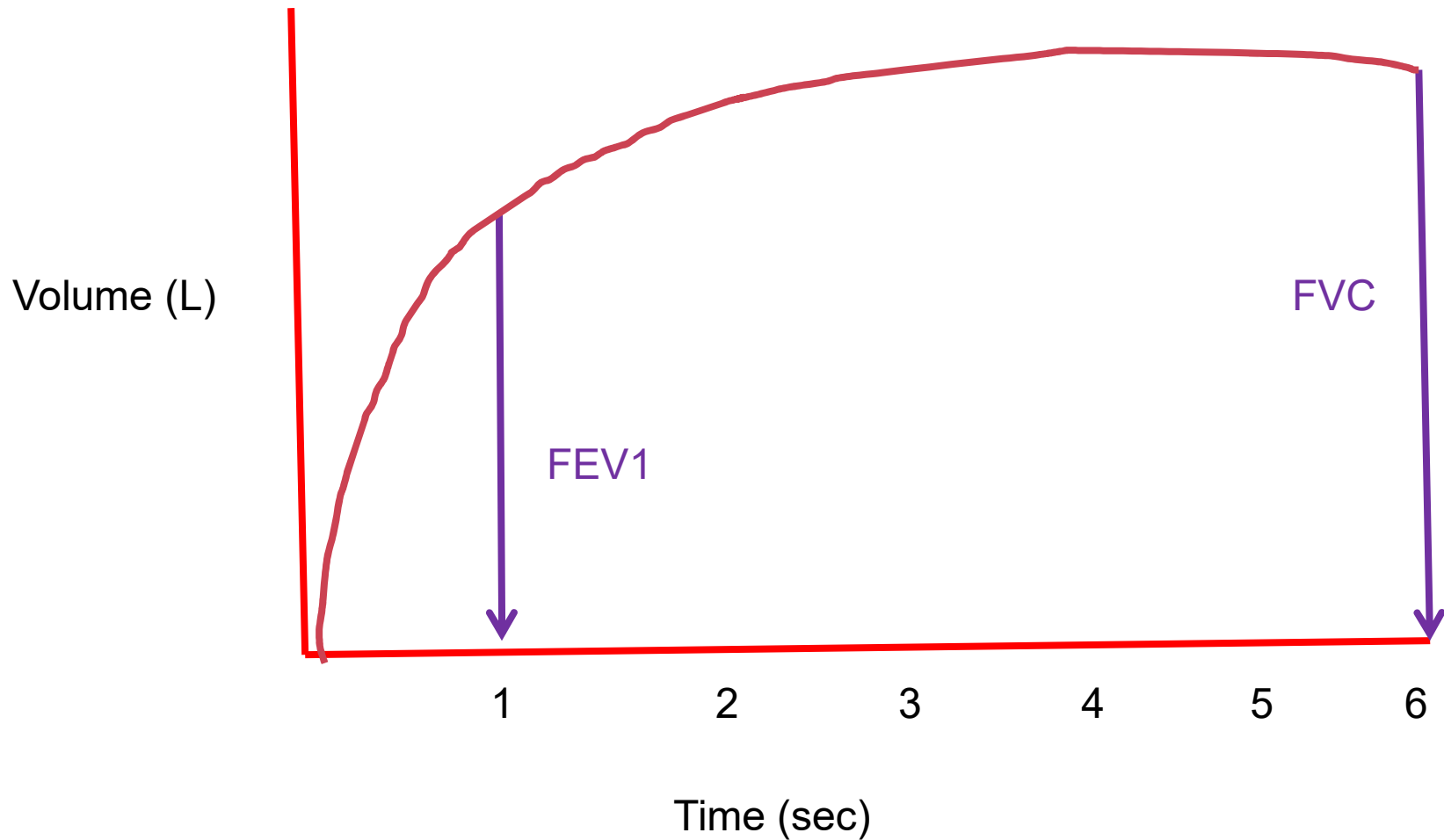
Resting  
expiratory  
level

Maximum  
expiratory  
level



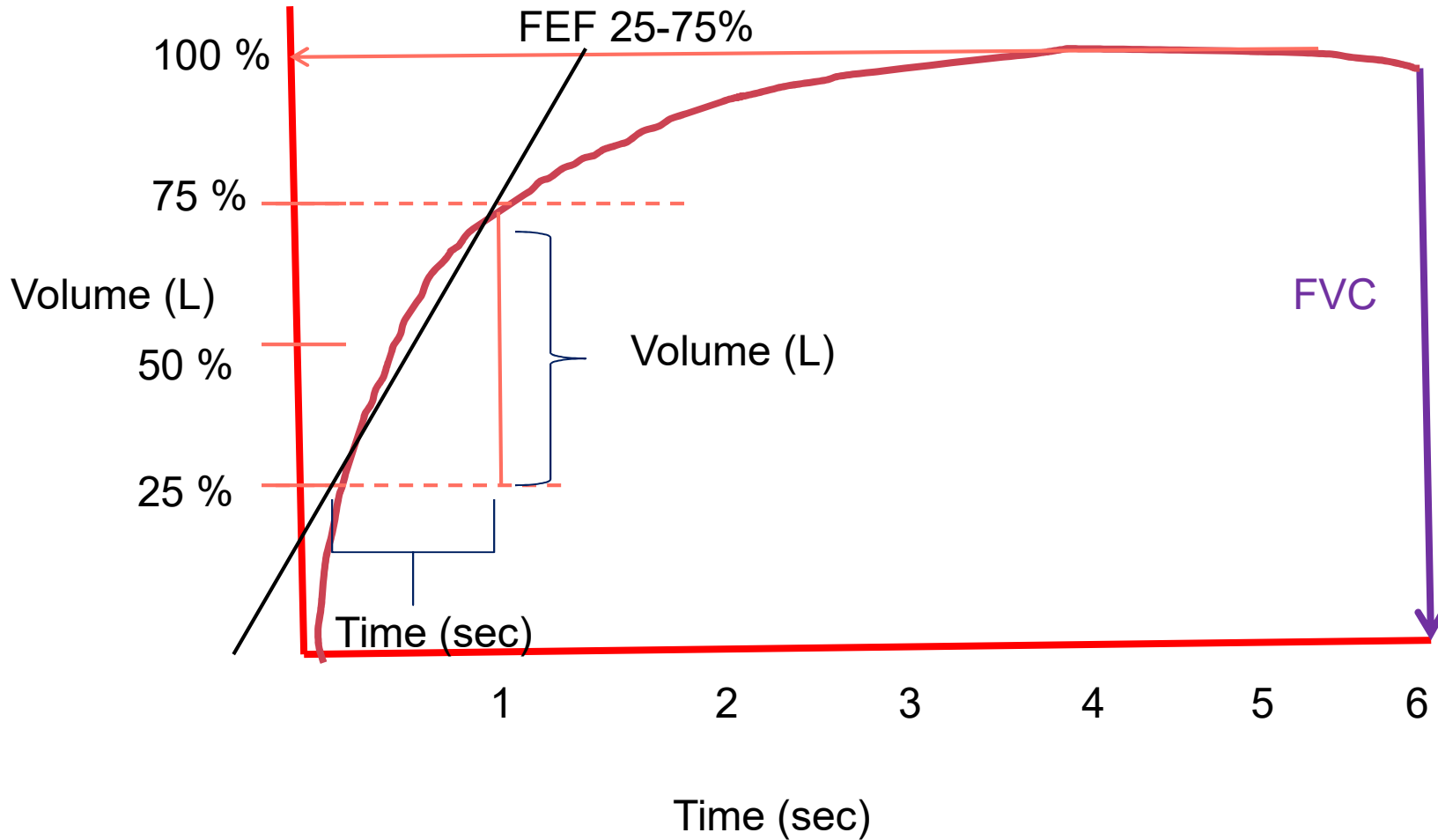
**VC**

## Volume-time curve



FEV1= Force Expiratory Volume in 1 second  
FVC= Force Vital Capacity

# Volume-time curve



FEV1= Force Expiratory Volume in 1 second  
FVC= Force Vital Capacity

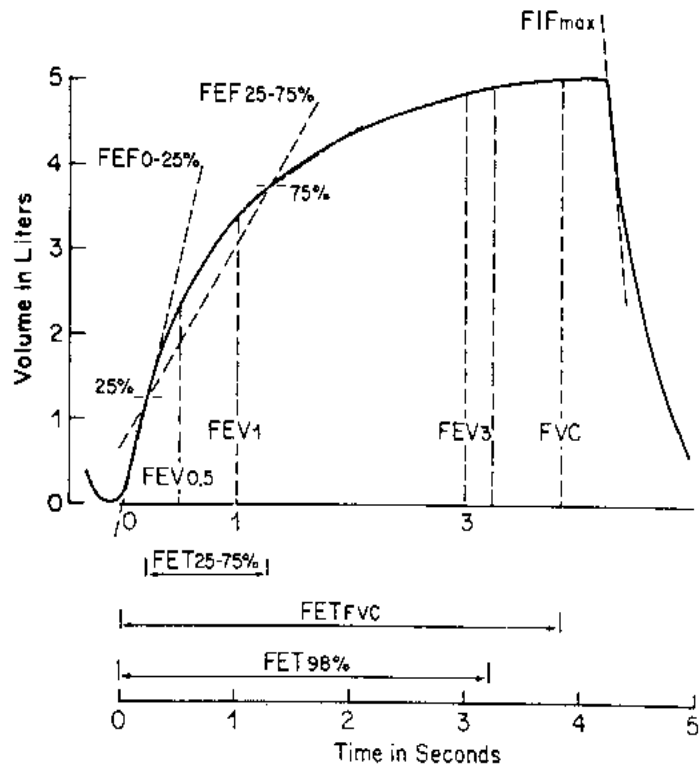
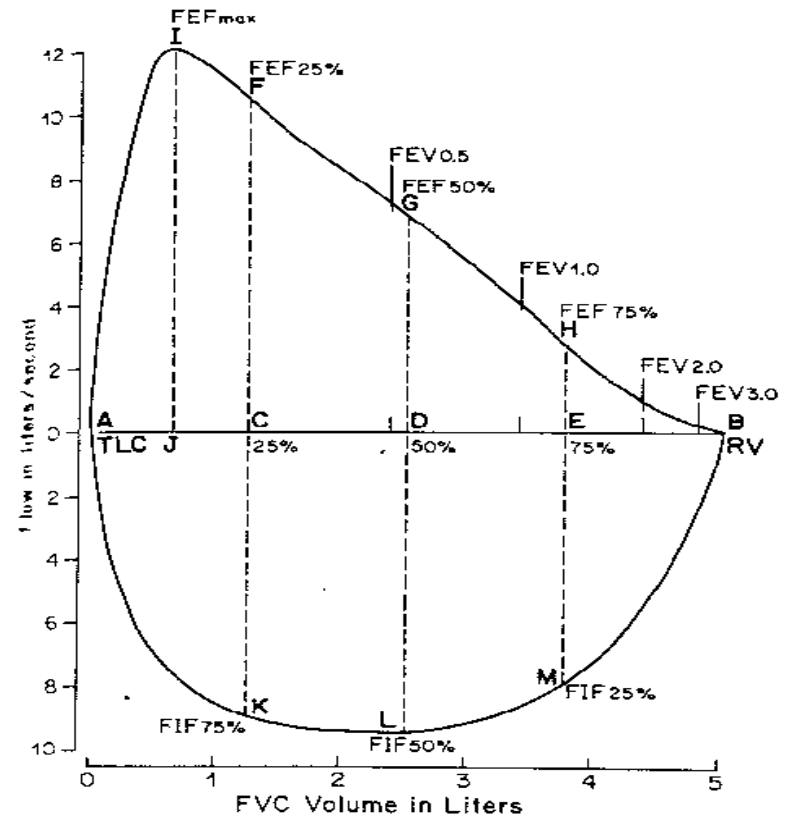


FIG. 7-1. Measurements from the volume-time curve.



# Flow-chart diagram of FVC spirometry testing

Perform FVC maneuver



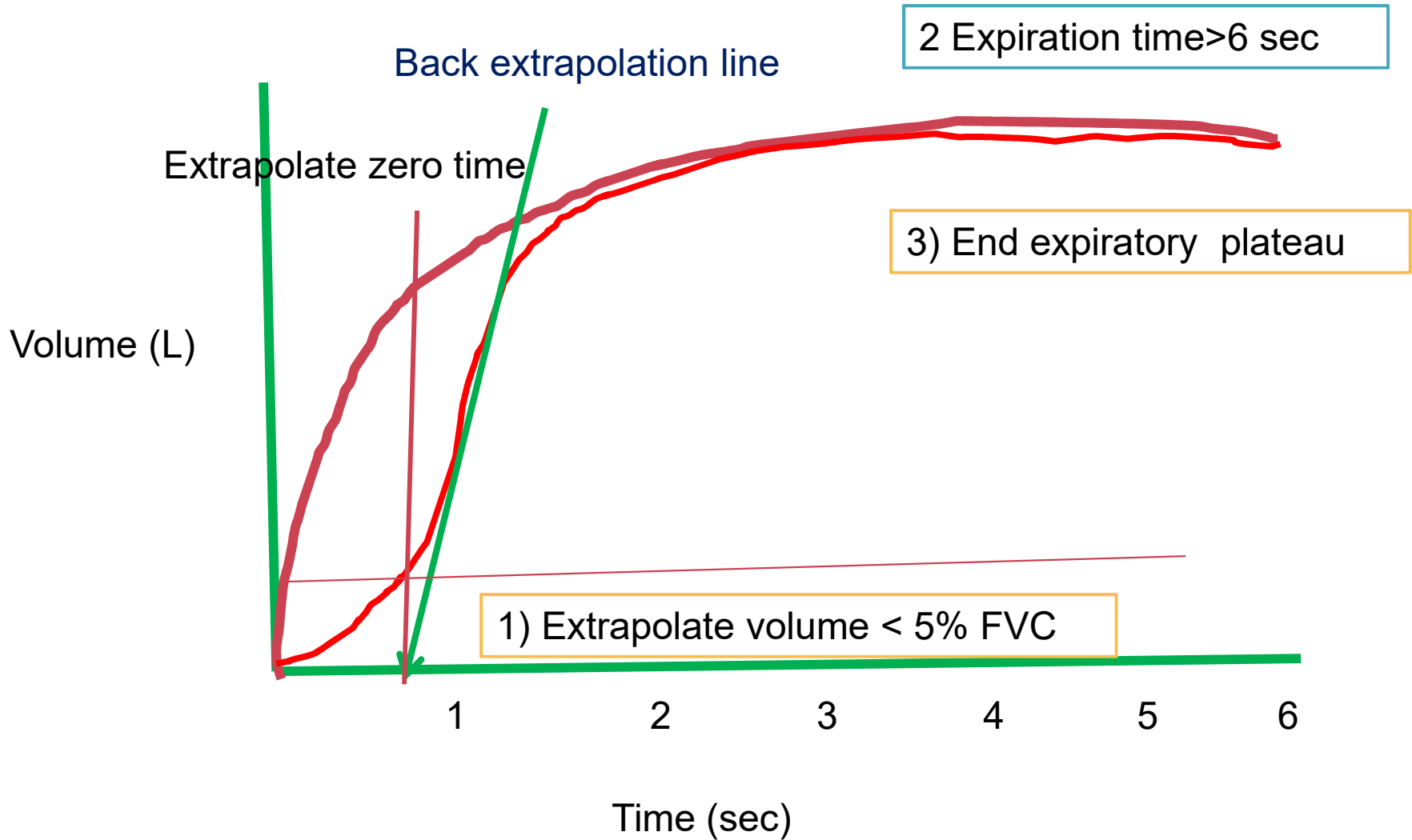
Meet acceptability criteria?

1) Satisfactory start-of-test

2) FVC > 6 sec

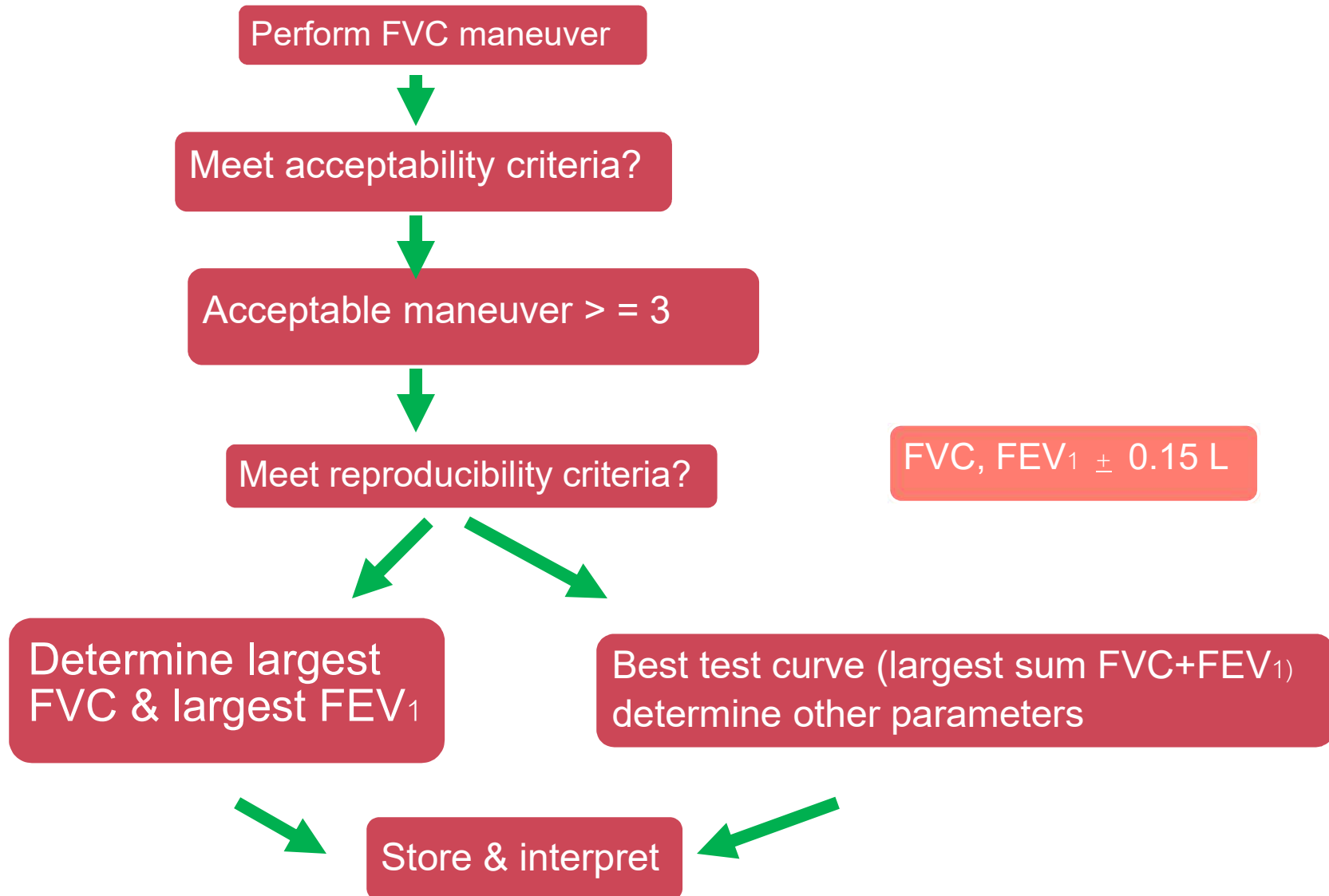
3) end-of-test criteria

# Volume-time curve



FEV1= Force Expiratory Volume in 1 second  
FVC= Force Vital Capacity

# Flow-chart diagram of FVC spirometry testing



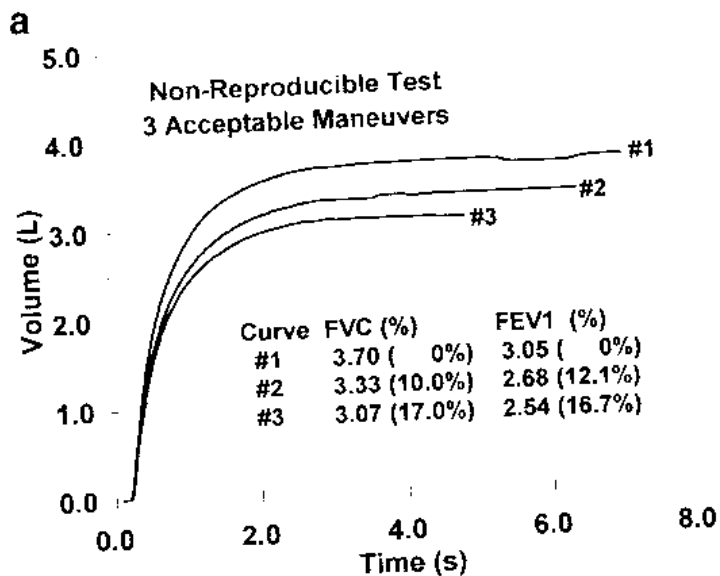


Figure A7a. Nonreproducible test with three acceptable volume-time curves. Percents are difference from largest value.

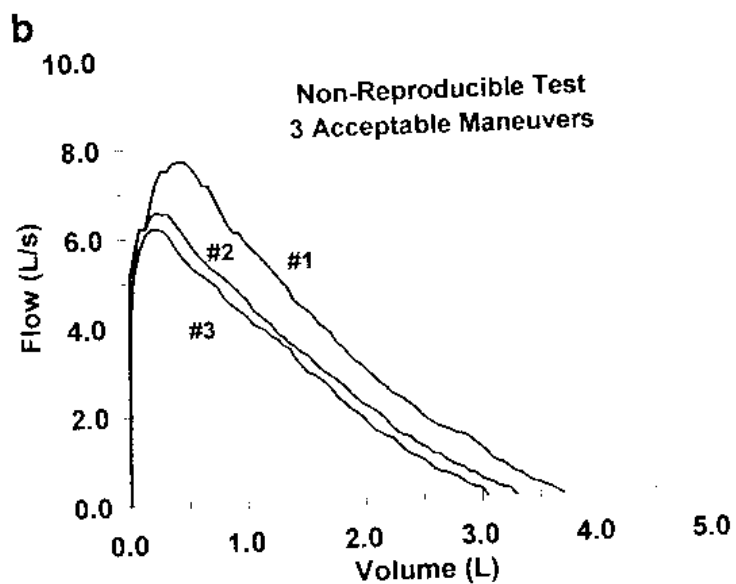


Figure A7b. Nonreproducible test with three acceptable flow-volume curves.

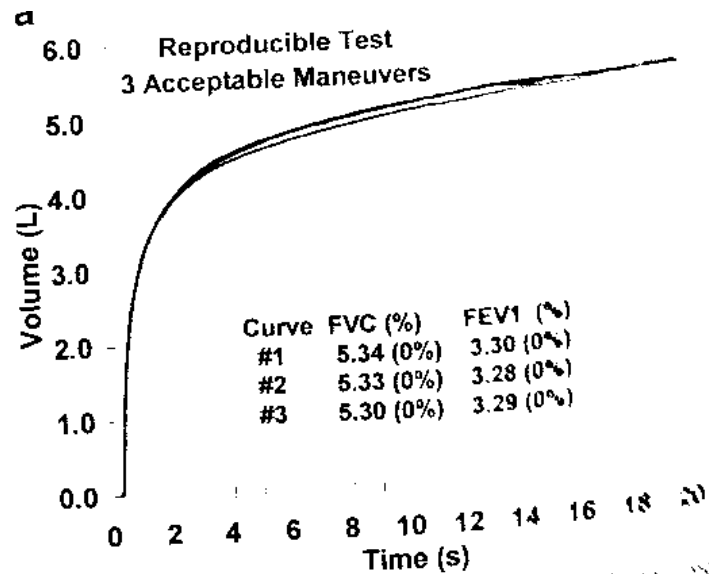


Figure A8a. Reproducible test with three acceptable volume-time curves. Percents are difference from largest value.

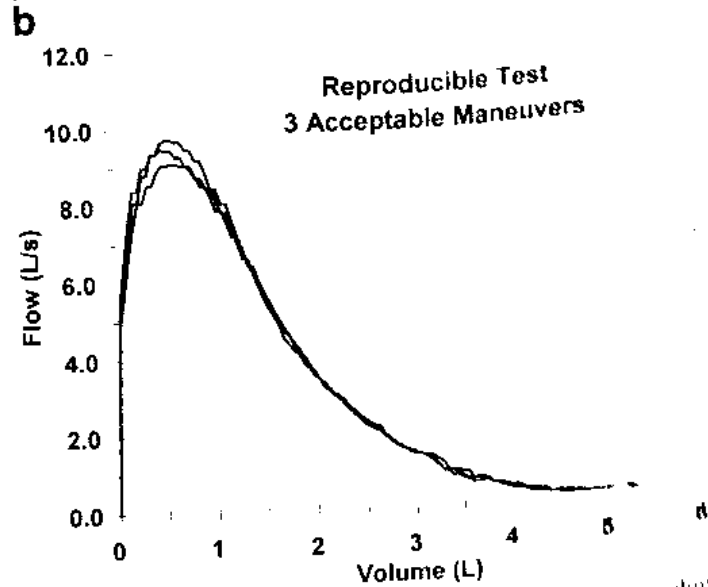


Figure A8b. Reproducible test with three acceptable flow-volume curves.

Pre

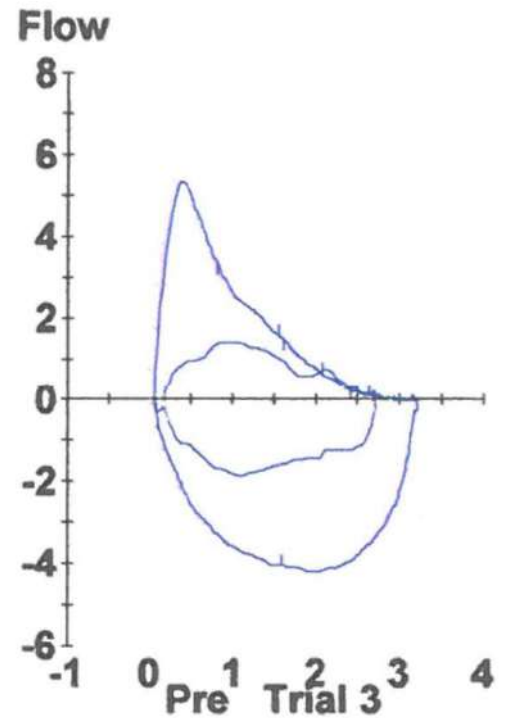
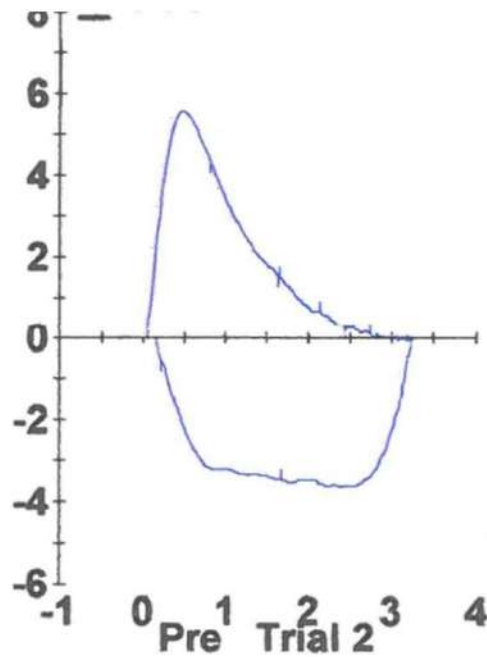
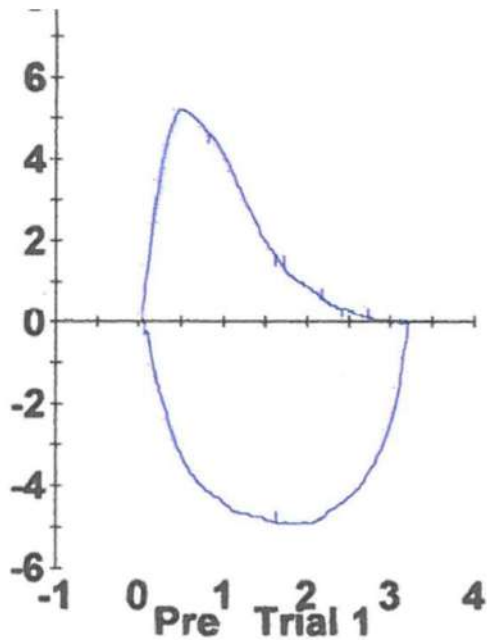
Trial 1

Trial 2

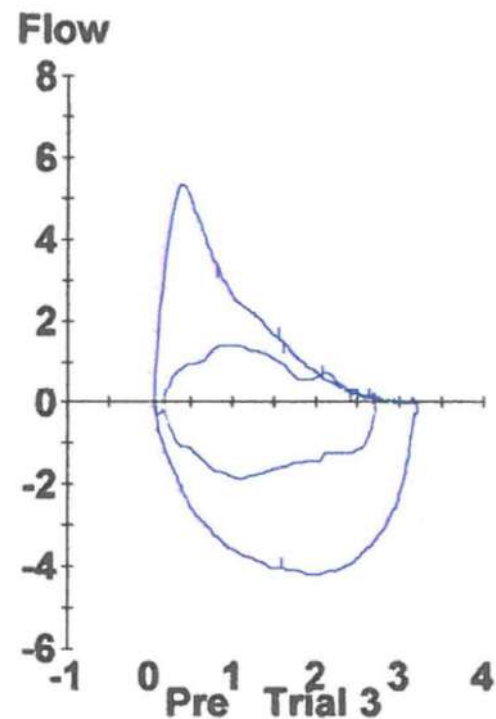
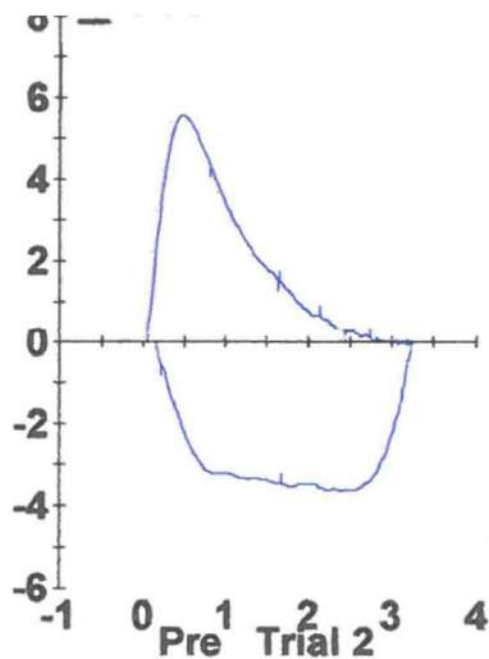
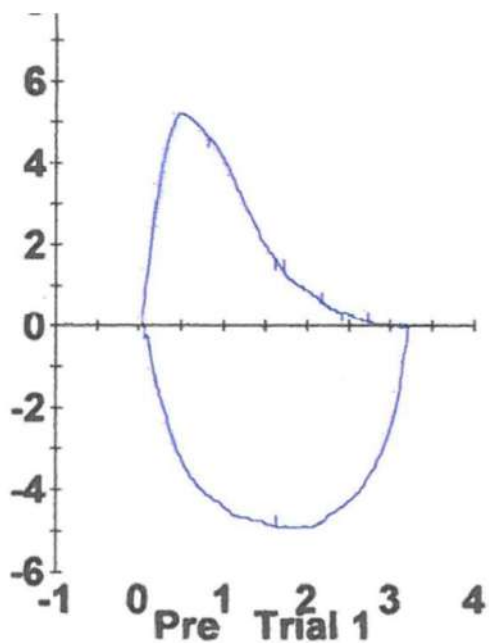
Trial 3

**Spirometry**

FVC            Liters  
FEV1           Liters  
FEV1/FVC      %  
FEV3           Liters  
FEF25-75%    L/min  
PEF            L/min



		Pre	Trial 1	Trial 2	Trial 3
<b>Spirometry</b>					
FVC	Liters		3.17	3.20	3.19
FEV1	Liters		2.14	2.09	2.03
FEV1/FVC	%		68	65	64
FEV3	Liters		2.69	2.69	2.61
FEF25-75%	L/min		71	64	59
PEF	L/min		314	336	322



## การแปลผล

- เลือกค่ามาตรฐาน
- ประเมินคุณภาพการทดสอบ

### คนปกติคือ

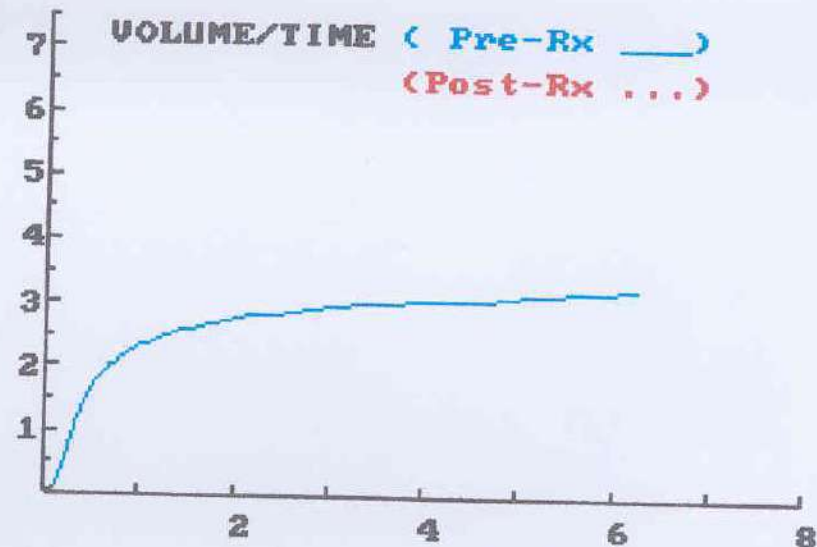
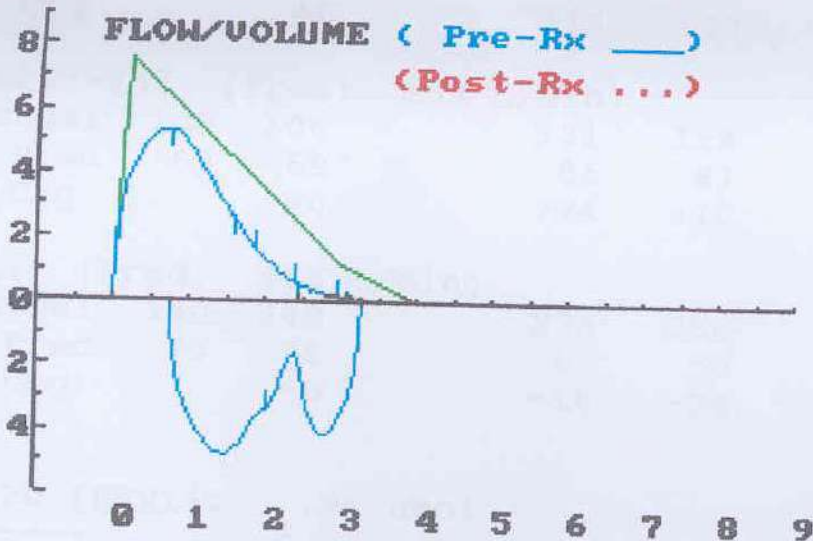
1. FEV1/VC อยู่ในเกณฑ์ปกติ
  2. FVC มากกว่า 80% predicted
-

Age: 69 Years  
 Sex/Race: Male / Oriental  
 Height: 67 in 169 cm  
 Weight: 143 lbs 65 kg

Room: Out/P Date: 14-JUL-05  
 Temp/Pres: 27 C / 736 mmHg  
 Physician: watchara  
 Tested by: uraiwan

	SPIROMETRY (BTPS)	Liters	PRED	PRE-RX		POST-RX		%CHG
				BEST	%PRED	BEST	%PRED	
FVC			3.95	3.26	83			
FEV1		Liters	2.70	2.39	89			
FEV1/FVC		%	70	73				
FEF25-75%		L/Min	153	106	69			
FEF25%		L/Min		316				
FEF50%		L/Min	214	152	71			
FEF75%		L/Min	72	33	46*			
PEF		L/Min	455	340	75			
E Code				10011				

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 \* = OUTSIDE NORMAL RANGE  
 IPS-0L10-06 IPS-0H10-05 N-1804-4



Age: 69 Years  
Sex/Race: Male / Oriental  
Height: 67 in 169 cm  
Weight: 143 lbs 65 kg

Room: Out/P Date: 14-JUL-05  
Temp/Pres: 27 C / 736 mmHg  
Physician: watchara  
Tested by: uraiwan

SPIROMETRY (BTPS)		PRED	PRE-RX BEST	%PRED	POST-RX BEST	%PRED	%CHG
FVC	Liters	3.95	3.26	83			
FEV1	Liters	2.70	2.39	89			
FEV1/FVC	%	70	73				
FEF25-75%	L/Min	153	106	69			
FEF25%	L/Min		316				
FEF50%	L/Min	214	152	71			
FEF75%	L/Min	72	33	46*			
PEF	L/Min	455	340	75			
E Code			10011				

## ผลการตรวจ

1. Normal

2. Obstruct

3. Restrict

STEP1 ดู FEV1/FVC

ถ้า < 70 (อายุ >40) หรือ 75 (อายุ <40) = obstruction

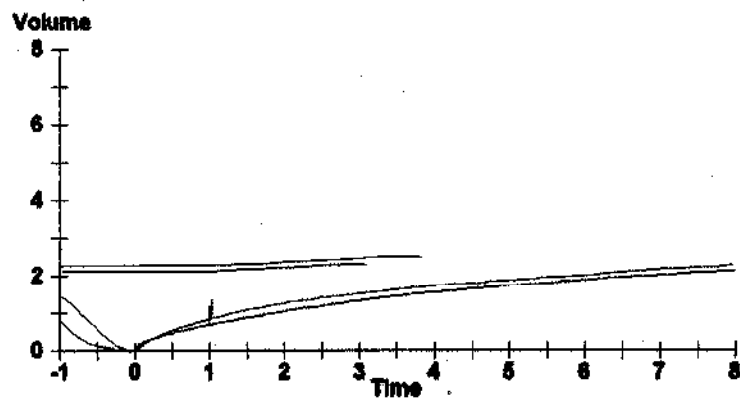
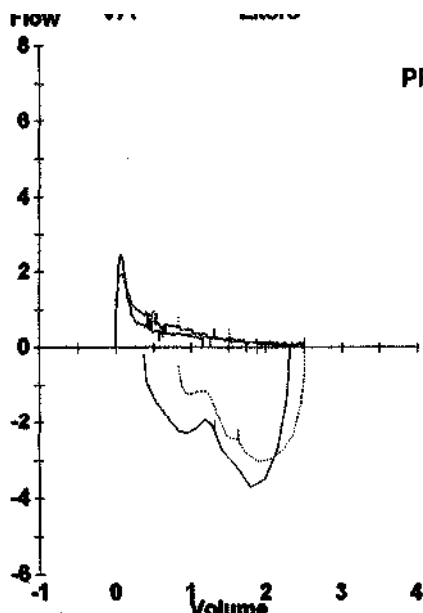
STEP2 ดู FVC ถ้า < 80% = Restriction

STEP3 ดู FEF25-75% ถ้า < 65 % = small airways

Gender: Male      Age: 63  
 Race: Asian      Any Info: copd  
 Height(cm): 162      Weight(kg): 56.0

Date: 29/11/02  
 Temp: 28      PBar: 740  
 Phvsician: Watchara

Spirometry	(BTPS)	PRED	PRE-RX		POST-RX		% Chg
			BEST	%PRED	BEST	%PRED	
FVC	Liters	3.66	2.32	63	2.52	69	9
FEV1	Liters	2.61	0.75	29	0.85	32	13
FEV1/FVC	%	72	32		33		
FEF25-75%	L/min	161	16	10	17	10	6
FEF50%	L/min	194	16	8	18	9	15
PEF	L/min	425	167	39	122	29	-27
MVV	L/min	116					



# Revesibility

metry		(BTPS)	PRED	PRE-RX BEST	%PRED	POST-RX BEST	%PRED	% CHG
FVL Time				21:48		22:44		
FVC	Liters		3.98	2.81	71	2.97	75	6
FEV1	Liters		3.04	1.50	49	1.95	64	31
FEV1/FVC	%		75	53		66		
FEF25-75%	L/min		198	47	24	76	38	63
FEF25%	L/min			114		167		46
FEF50%	L/min		225	56	25	95	42	71
FEF75%	L/min		85	22	26	38	45	73
PEF	L/min		451	192	43	297	66	55
FIVC	Liters		3.98	0.15	4	0.18	4	21
IC	Liters		2.65	1.49	56	1.73	65	16
FEV1	Liters		3.04	1.50	49	1.95	64	31
Vol Extrap	Liters			0.04		0.09		115
FVL ECode				000000		000000		
MVV	L/min		133					
f	BPM							

**FEV1 หรือ FVC เพิ่มขึ้นมากกว่า 12% และมากกว่า 200 cc**

# Obstructive abnormality

- FEV1/VC ต่ำกว่าค่ามาตรฐาน แปลว่ามี obstruction

ความรุนแรงของการอุดกั้นดูที่ FEV1 ว่าเป็นกี่เปอร์เซ็นต์ของค่ามาตรฐาน

mild	% predict FEV1 $\geq 70$
moderate	% predict FEV1 $< 70$ and $\geq 60$
moderately severe	% predict FEV1 $< 60$ and $\geq 50$
severe	% predict FEV1 $< 50$ and $\geq 34$
very severe	% predict FEV1 $< 34$

Spirometry		PRED	PRE-RX BEST	%PRED
	(BTPS)		10:41	
FVL Time				
FVC	Liters	2.84	1.76	62
FEV1	Liters	2.12	1.48	70
FEV1/FVC	%	75	84	
FEF25-75%	L/min	154	108	70
FEF25%	L/min		276	
FEF50%	L/min	195	160	82
FEF75%	L/min	68	37	54
PEF	L/min	329	278	85
FIVC	Liters	2.84	1.69	59
FEV1	Liters	2.12	1.48	70
IC	Liters	1.90		
FEF/FIF50		<1.00	1.37	
Vol Extrap	Liters		0.09	
FVL ECode			001000	
MVV	L/min	96		
f	BPM			

# Restrictive abnormality

FEV1/VC อยู่ในเกณฑ์ปกติ และ FVC ต่ำกว่าค่ามาตรฐาน  
ความรุนแรงของ Restrictive ดูที่ FVC ว่าเป็นกี่% ของค่ามาตรฐาน

mild	% pred VC < LLN but $\geq$ 70
moderate	% pred VC < 70 but $\geq$ 60
moderately severe	% pred VC < 60 but $\geq$ 50
severe	% pred VC < 50 but $\geq$ 34
very severe	% pred VC < 34

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Name: buakhai phooboonthong  
 Age: 59 Years  
 Sex/Race: Female / Oriental  
 Height: 58 in 147 cm  
 Weight: 112 lbs 51 kg

ID#: ET0356  
 Room: ward5e Date: 17-SEP-99  
 Temp/Pres: 31 C / 731 mmHg  
 Physician: dr.watchara  
 Tested by: kaew

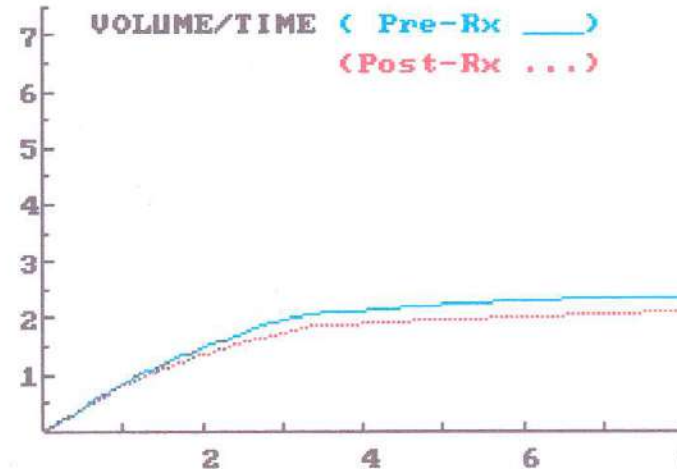
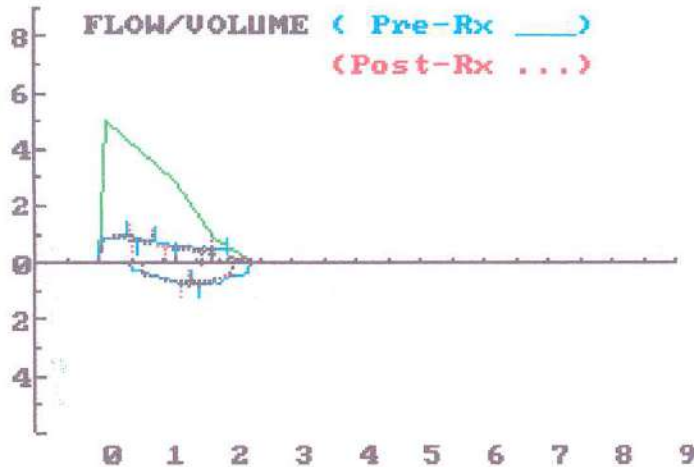
Diagnosis: chca, trachial stenosis  
 Dyspnea: Yes How Long: 1mon  
 Cough: Yes How Long: 2mon  
 Smoker: No

Prev Study: post tubing 5day  
 Medication: s/p cholecys  
 Resting: Yes Exer: Yes  
 Productive: Yes Vol: 6

SPIROMETRY (BTPS)		PRED	PRE-RX BEST	%PRED	POST-RX BEST	%PRED	%CHG
FVC	Liters	2.40	2.37	99	2.11	88	-11
FEV1	Liters	1.76	0.87 #	50*	0.84 #	48*	-3
FEV1/FVC	%	74	37		40		
FEF25-75%	L/Sec	2.26	0.62 #	27*	0.56 #	25*	-10
FEF25%	L/Sec		0.84		0.85		1
FEF50%	L/Sec	2.88	0.62 #	22*	0.55 #	19*	-11
FEF75%	L/Sec	0.88	0.52	59*	0.39	44*	-25
PEF	L/Sec	5.01	0.93 #	19*	1.00 #	20*	8
E Code			10000		10000		

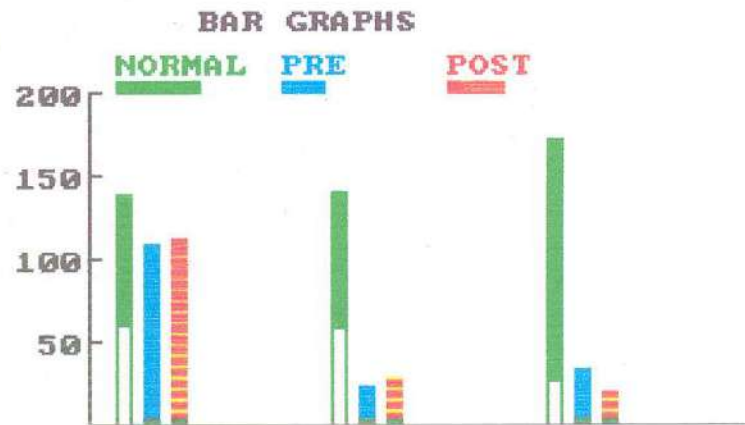
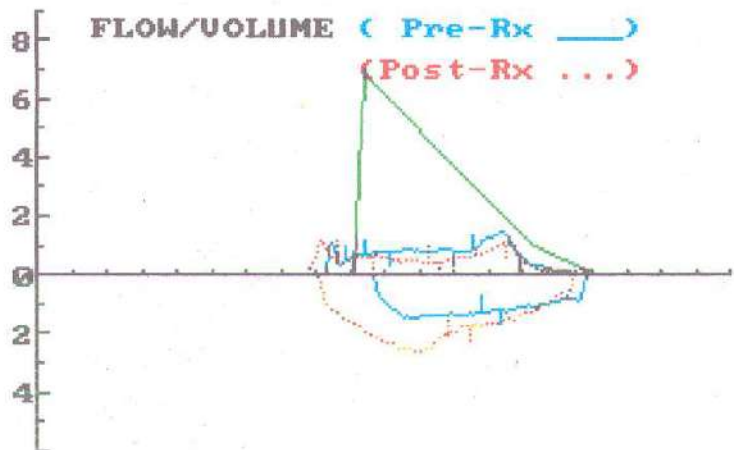
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# = OUTSIDE 95% CONFIDENCE INTERVAL \* = OUTSIDE NORMAL RANGE  
 IPS-OL10-08 IPS-OH10-07 N-1804-4



			PRE-RX			POST-RX			%CHG
			PRED	BEST	%PRED	BEST	%PRED		
<b>SPIROMETRY (BTPS)</b>									
FVC	Liters		3.46	3.75	108	3.86	112	3	
FEV1	Liters		2.46	0.57 #	23*	0.71 #	29*	25	
FEV1/FVC	%		72	15		18			
FEF25-75%	L/Sec		2.55	0.88	35*	0.54 #	21*	-39	
FEF25%	L/Sec			0.79		0.61		-23	
FEF50%	L/Sec		3.03	0.79	26*	0.42	14*	-47	
FEF75%	L/Sec		0.98	0.64	65	1.02	104	59	
PEF	L/Sec		6.77	1.41 #	21*	1.17 #	17*	-17	
E Code				11000		00000			
MVV	L/Min		110	31 #	28*	35 #	32*	13	
			PRE-RX			POST-RX			%CHG
			PRED	AVG	%PRED	AVG	%PRED		
<b>LUNG VOLUMES (BTPS)</b>									
VC	Liters		3.46	3.97	115	4.08	118	3	
TLC	Liters		4.91	6.07 #	124*	6.34 #	129*	4	
RV	Liters		1.98	2.10	106	2.26	114	8	
RV/TLC	%		39	35		36			
FRC PL	Liters		2.96	2.76	93	2.96	100	7	
<b>DIFFUSION</b>									
DLCO	ml/Min/mmHg		16.5	21.3	129*				

IPS-0L10-08 IPS-0H10-07 N-1804-4



Gender: Male

Age: 61 Race: Asian

Height(cm): 161 Weight(kg): 63.0

Info: RHINITIS

Pneumometry		PRED	PRE-RX BEST	%PRED
FVL Time	(BTPS)		20:11	
FVC	Liters	3.62	3.34	92
FEV1	Liters	2.62	1.84	70
FEV1/FVC	%	73	55	
FEF25-75%	L/min	165	36	22
FEF25%	L/min		160	
FEF50%	L/min	194	43	22
FEF75%	L/min	66	15	22
PEF	L/min	420	354	84

ometry		PRED	PRE-RX	
	(BTPS)		BEST	%PRED
FVL Time			19:03	
FVC	Liters	3.98	3.26	82
FEV1	Liters	3.03	2.54	84
FEV1/FVC	%	75	78	
FEF25-75%	L/min	196	135	69
FEF25%	L/min		278	
FEF50%	L/min	223	171	77
FEF75%	L/min	83	52	63
PEF	L/min	452	377	83