# Pitfall in spirometry interpretation

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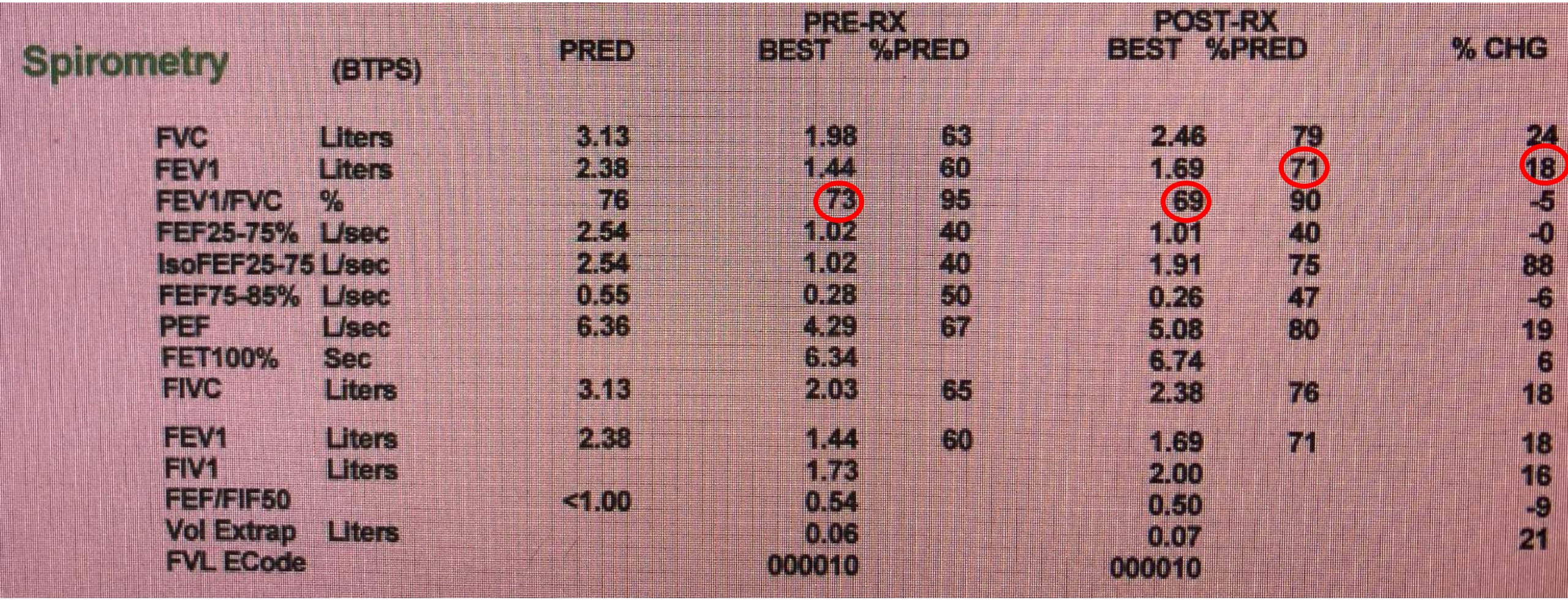
อายุรแพทย์โรคปอด รพ.อุดรธานี

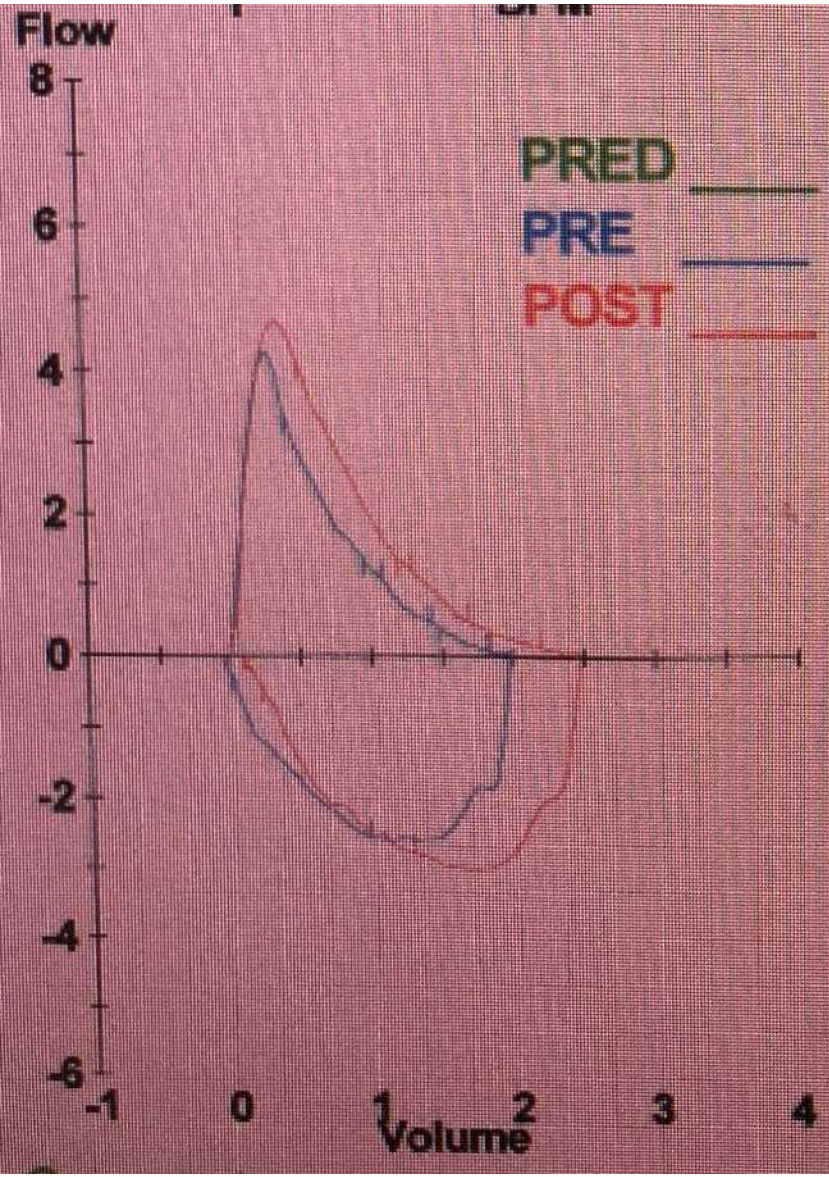
# Case1

- ผู้ป่วยชายไทย อายุ 63 ปี เลิกบุหรี่ 20 กว่าปี
- ได้รับการวินิจฉัยว่าเป็น COPD ตั้งแต่อายุ 50 ปี
- ได้รับยา LABA/ICS (medium dose)
- ส่งตัวจาก รพช.มารักษาที่ รพ.อุดรธานีเนื่องจากมี exacerbation บ่อย
- CXR: WNL
- นัดทำ spirometry

# Spirometry กันยายน 2561



| Spirometry | (BTPS) | PRED | PRE-RX BEST | %PRED | POST-RX BEST | %PRED | % CHG |
|---|---|---|---|---|---|---|---|
| FVC | Liters | 3.13 | 1.98 | 63 | 2.46 | 79 | 24 |
| FEV1 | Liters | 2.38 | 1.44 | 60 | 1.69 | 71 | 18 |
| FEV1/FVC | % | 76 | 73 | 95 | 69 | 90 | -5 |
| FEF25-75% | L/sec | 2.54 | 1.02 | 40 | 1.01 | 40 | -0 |
| IsoFEF25-75 | L/sec | 2.54 | 1.02 | 40 | 1.91 | 75 | 88 |
| FEF75-85% | L/sec | 0.55 | 0.28 | 50 | 0.26 | 47 | -6 |
| PEF | L/sec | 6.36 | 4.29 | 67 | 5.08 | 80 | 19 |
| FET100% | Sec | | 6.34 | | 6.74 | | 6 |
| FIVC | Liters | 3.13 | 2.03 | 65 | 2.38 | 76 | 18 |
| FEV1 | Liters | 2.38 | 1.44 | 60 | 1.69 | 71 | 18 |
| FIV1 | Liters | | 1.73 | | 2.00 | | 16 |
| FEF/FIF50 | | <1.00 | 0.54 | | 0.50 | | -9 |
| Vol Extrap | Liters | | 0.06 | | 0.07 | | 21 |
| FVL ECode | | | 000010 | | 000010 | | |


Flow
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Volume
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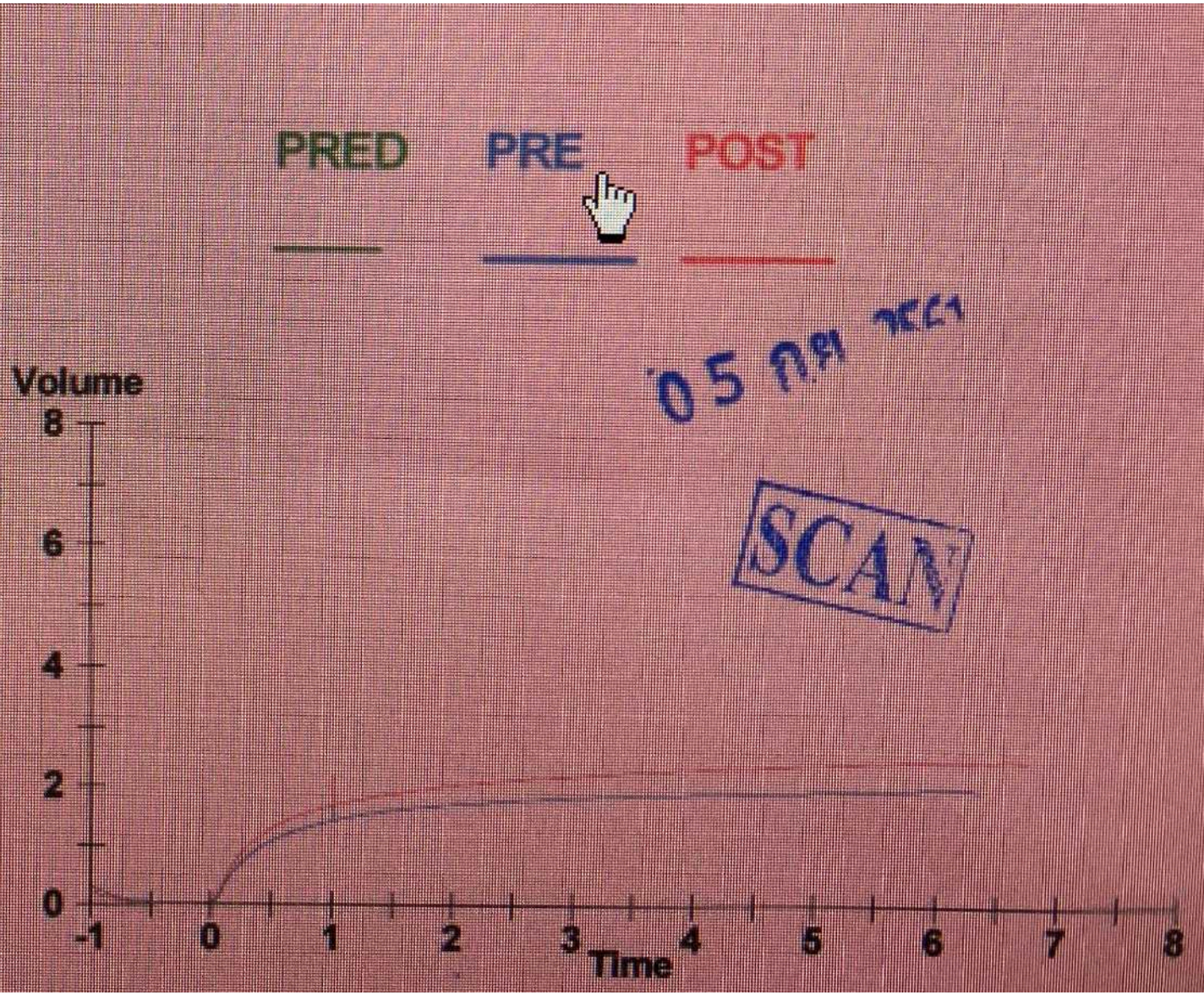
PRED
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Volume
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Time
'05 APR XCT
SCAN

# What is the diagnosis?

- Post bronchodilator FEV1/FVC < 70%
- Bronchodilator reversibility (FEV1 change 250 ml, 18%)
- Diagnosis?

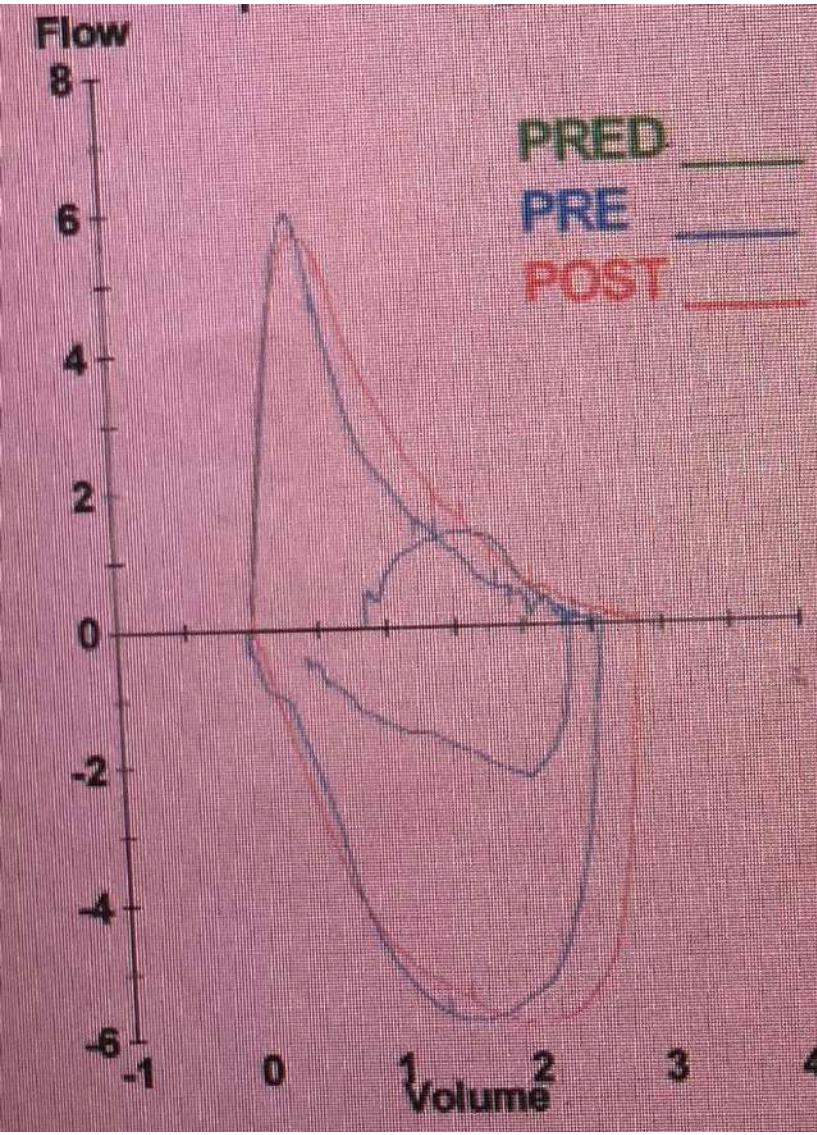
- Rx: step up to LABA/ICS to high dose

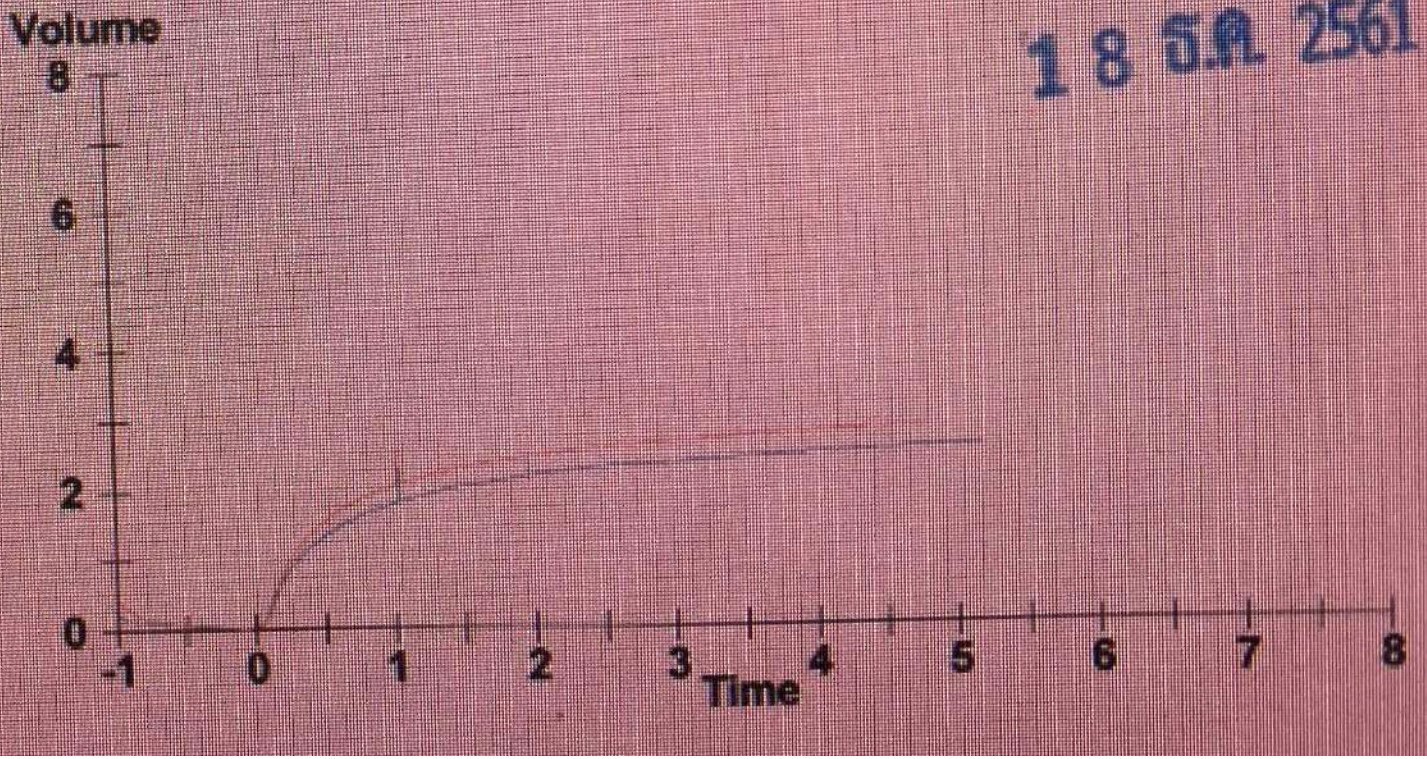
# Follow up 3 เดือน

- หลังได้รับการรักษา อาการดีขึ้น แต่ยังมีอาการ เหนื่อยสัปดาห์ละ 3-4 ครั้งต่อสัปดาห์
- Compliance ยังไม่ดี ลืมพ่นยา controller อยู่

# Spirometry ธ.ค. 2561

| Spirometry | (BTPS) | PRED | PRE-RX BEST | %PRED | POST-RX BEST | %PRED | % CHG |
|---|---|---|---|---|---|---|---|
| FVC | Liters | 3.13 | 2.56 | 82 | 2.85 | 91 | 11 |
| FEV1 | Liters | 2.38 | 1.83 | 77 | 2.07 | 87 | 13 |
| FEV1/FVC | % | 76 | 71 | 94 | 72 | 95 | 2 |
| FEF25-75% | L/sec | 2.54 | 1.22 | 48 | 1.48 | 58 | 21 |
| IsoFEF25-75 | L/sec | 2.54 | 1.22 | 48 | 2.07 | 81 | 69 |
| FEF75-85% | L/sec | 0.55 | 0.36 | 65 | 0.42 | 75 | 16 |
| PEF | L/sec | 6.36 | 6.01 | 95 | 5.68 | 89 | -6 |
| FET100% | Sec | | 5.14 | | 4.72 | | -8 |
| FIVC | Liters | 3.13 | 2.59 | 83 | 2.81 | 90 | 8 |
| FEV1 | Liters | 2.38 | 1.83 | 77 | 2.07 | 87 | 13 |
| FIV1 | Liters | | 2.35 | | 2.57 | | 10 |
| FEF/FIF50 | | <1.00 | 0.28 | | 0.36 | | 29 |
| Vol Extrap | Liters | | 0.07 | | 0.05 | | -25 |
| FVL ECode | | | 000011 | | 000011 | | |



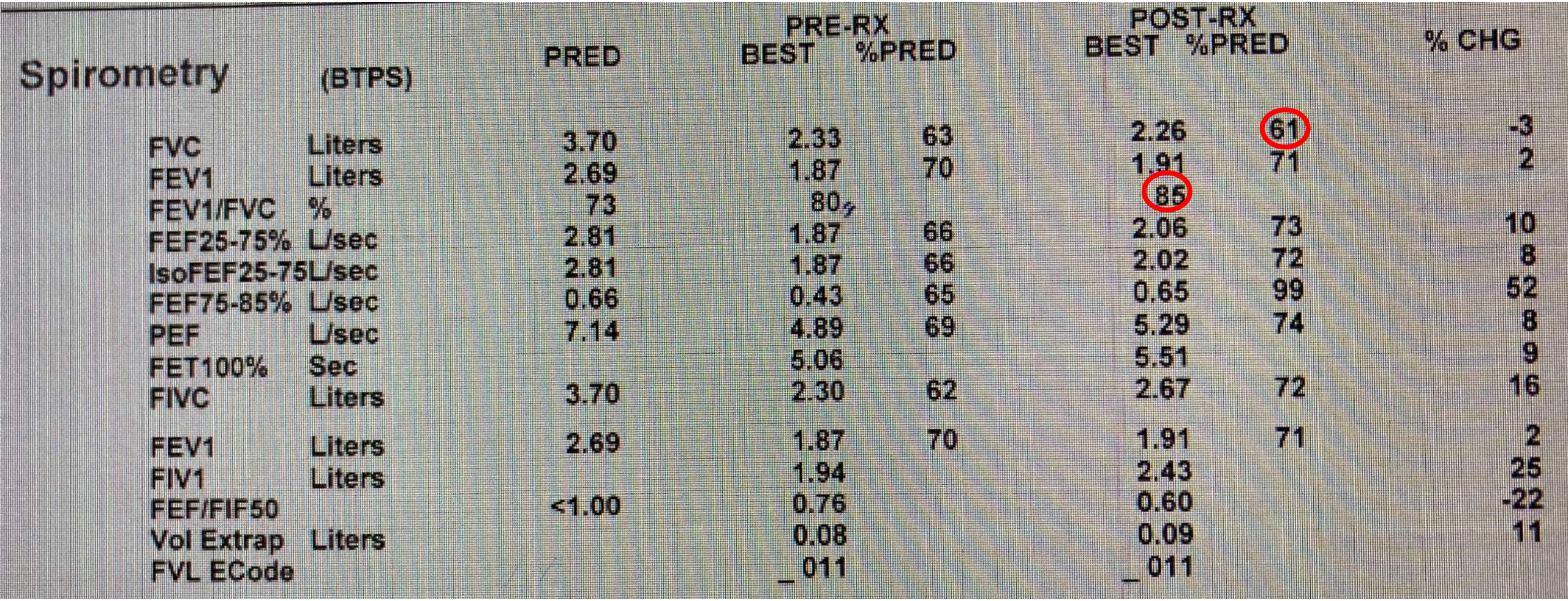

PRED PRE POST

# Impression

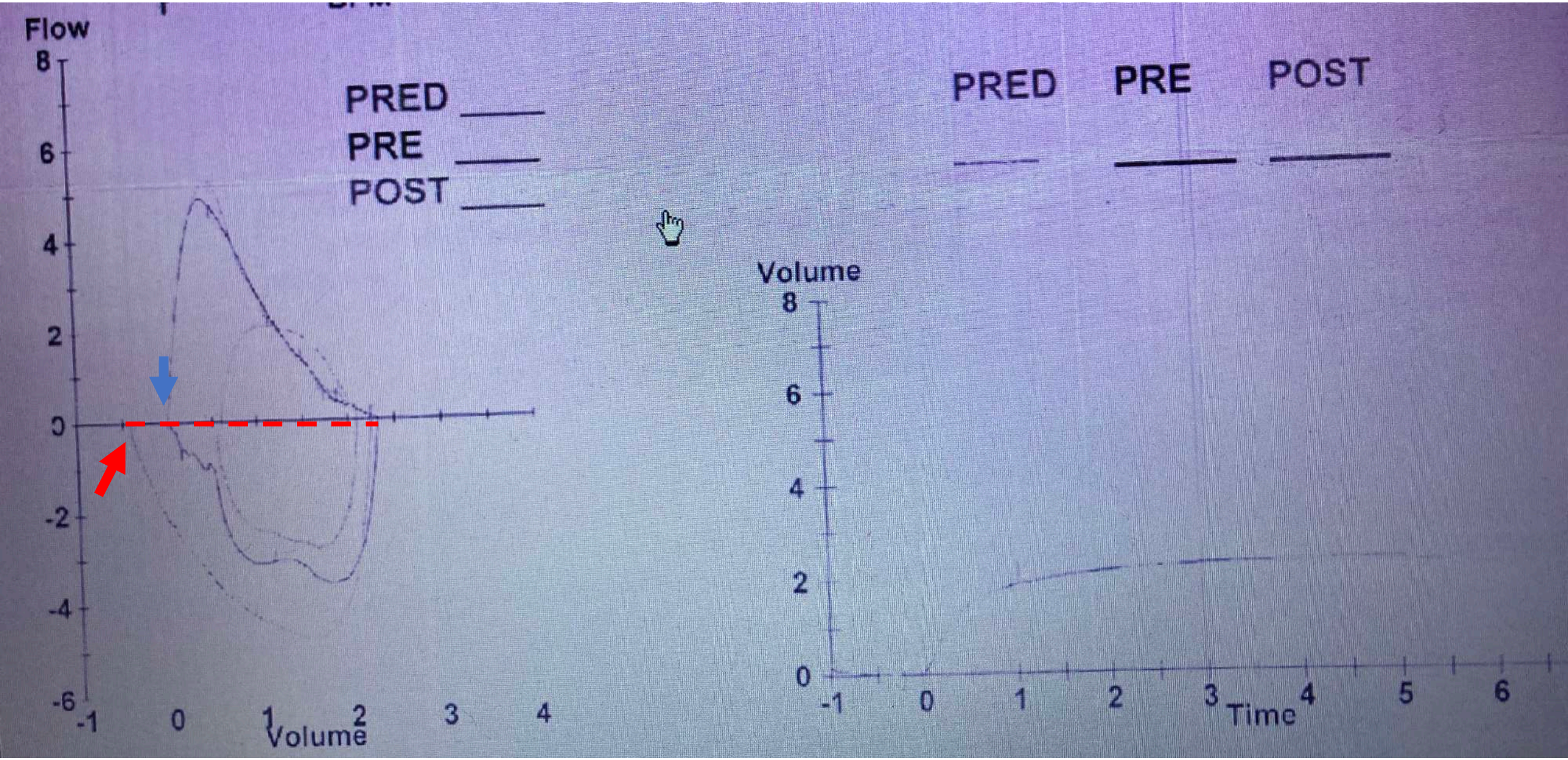
- Asthma
- +/- COPD overlap

- เตือนเรื่อง adherance ต่อการใช้ยา
- ได้รับการ add LAMA
- Plan ติดตาม spirometry หลัง compliance ดี เพื่อดูว่ามี fixed obstruction ไหม

# Spirometry 2558 หลังรักษา exacerbation ด้วย systemic steroid



| Spirometry | (BTPS) | PRED | PRE-RX BEST | PRE-RX %PRED | POST-RX BEST | POST-RX %PRED | % CHG |
|---|---|---|---|---|---|---|---|
| FVC | Liters | 3.70 | 2.33 | 63 | 2.26 | 61 | -3 |
| FEV1 | Liters | 2.69 | 1.87 | 70 | 1.91 | 71 | 2 |
| FEV1/FVC | % | 73 | 80 | | 85 | | |
| FEF25-75% | L/sec | 2.81 | 1.87 | 66 | 2.06 | 73 | 10 |
| IsoFEF25-75 | L/sec | 2.81 | 1.87 | 66 | 2.02 | 72 | 8 |
| FEF75-85% | L/sec | 0.66 | 0.43 | 65 | 0.65 | 99 | 52 |
| PEF | L/sec | 7.14 | 4.89 | 69 | 5.29 | 74 | 8 |
| FET100% | Sec | | 5.06 | | 5.51 | | 9 |
| FIVC | Liters | 3.70 | 2.30 | 62 | 2.67 | 72 | 16 |
| FEV1 | Liters | 2.69 | 1.87 | 70 | 1.91 | 71 | 2 |
| FIV1 | Liters | | 1.94 | | 2.43 | | 25 |
| FEF/FIF50 | | <1.00 | 0.76 | | 0.60 | | -22 |
| Vol Extrap | Liters | | 0.08 | | 0.09 | | 11 |
| FVL ECode | | | _011 | | _011 | | |


Flow
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Volume
PRED
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PRED
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Volume
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Time

# PFT to document variable expiratory airflow limitation

In a patient with typical respiratory symptoms, obtaining evidence of excessive variability in expiratory lung function is an essential component of the diagnosis of asthma. Some specific examples are:

- An increase in lung function after administration of a bronchodilator, or after a trial of controller treatment
- A decrease in lung function after exercise or during a bronchial provocation test
- Variation in lung function beyond the normal range when it is repeated over time, either on separate visits, or on home monitoring over at least 1–2 weeks

| 2. Confirmed variable expiratory airflow limitation | |
|---|---|
| Documented excessive variability in lung function* (one or more of the tests below) | The greater the variations, or the more occasions excess variation is seen, the more confident the diagnosis |
| **AND** documented expiratory airflow limitation* | At a time when $FEV_1$ is reduced, confirm that $FEV_1$/FVC is reduced (it is usually >0.75–0.80 in adults, >0.90 in children[10]) |
| Positive bronchodilator (BD) reversibility test* (more likely to be positive if BD medication is withheld before test: SABA ≥4 hours, LABA ≥15 hours) | *Adults*: increase in $FEV_1$ of >12% and >200 mL from baseline, 10–15 minutes after 200–400 mcg salbutamol (albuterol) or equivalent (greater confidence if increase is >15% and >400 mL).<br>*Children*: increase in $FEV_1$ of >12% predicted |
| Excessive variability in twice-daily PEF over 2 weeks* | *Adults*: average daily diurnal PEF variability >10%**<br>*Children*: average daily diurnal PEF variability >13%** |
| Significant increase in lung function after 4 weeks of anti-inflammatory treatment | *Adults*: increase in $FEV_1$ by >12% and >200 mL (or PEF† by >20%) from baseline after 4 weeks of treatment, outside respiratory infections |
| Positive exercise challenge test* | *Adults*: fall in $FEV_1$ of >10% and >200 mL from baseline<br>*Children*: fall in $FEV_1$ of >12% predicted, or PEF >15% |
| Positive bronchial challenge test (usually only performed in adults) | Fall in $FEV_1$ from baseline of ≥20% with standard doses of methacholine or histamine, or ≥15% with standardized hyperventilation, hypertonic saline or mannitol challenge |
| Excessive variation in lung function between visits* (good specificity but poor sensitivity) | *Adults*: variation in $FEV_1$ of >12% and >200 mL between visits, outside of respiratory infections<br>*Children*: variation in $FEV_1$ of >12% in $FEV_1$ or >15% in PEF† between visits (may include respiratory infections) |

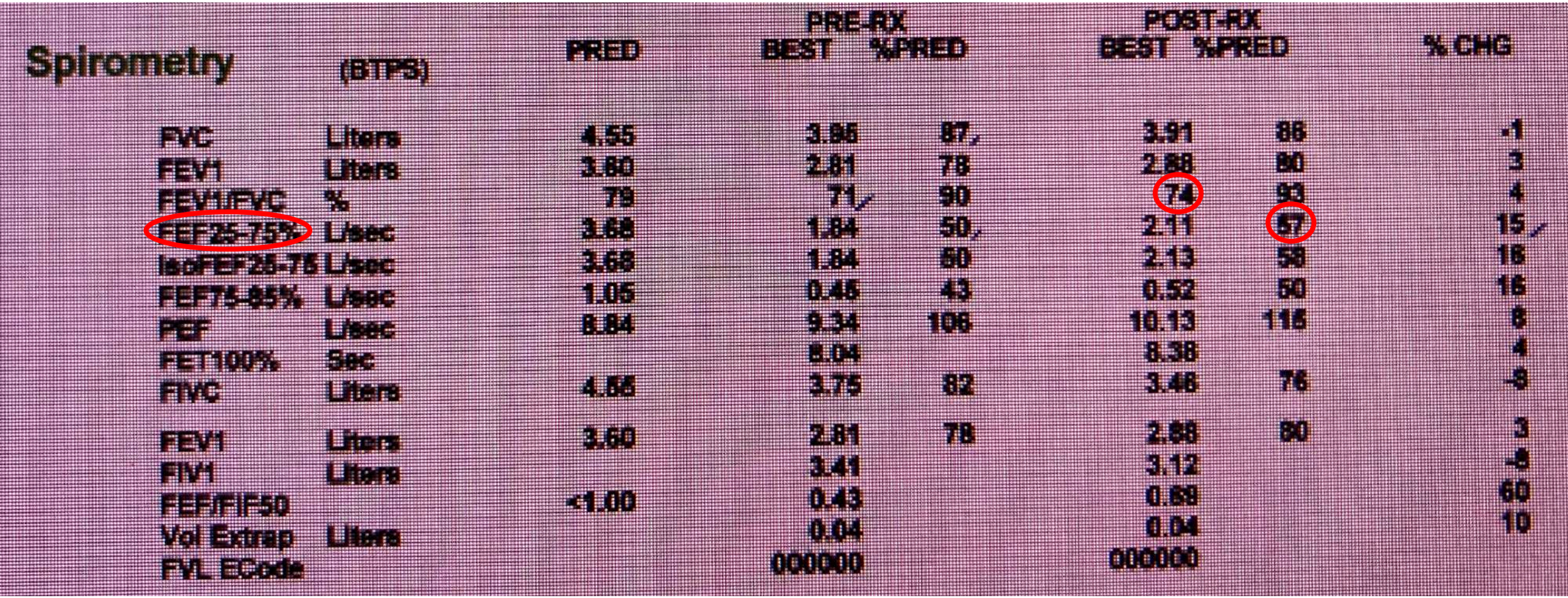
# Summary

- Uncontrolled asthma มี post BD FEV1/FVC < 70% ได้ (บางคนไม่มี post BD reversibility ได้)
- หาหลักฐานของ variable expiratory airflow limitation
  - จาก post bronchodilator
  - จากหลังการรักษาด้วย controller
  - จากการเปลี่ยนแปลงระหว่างวัน หรือ ระหว่างนัด

# Case2

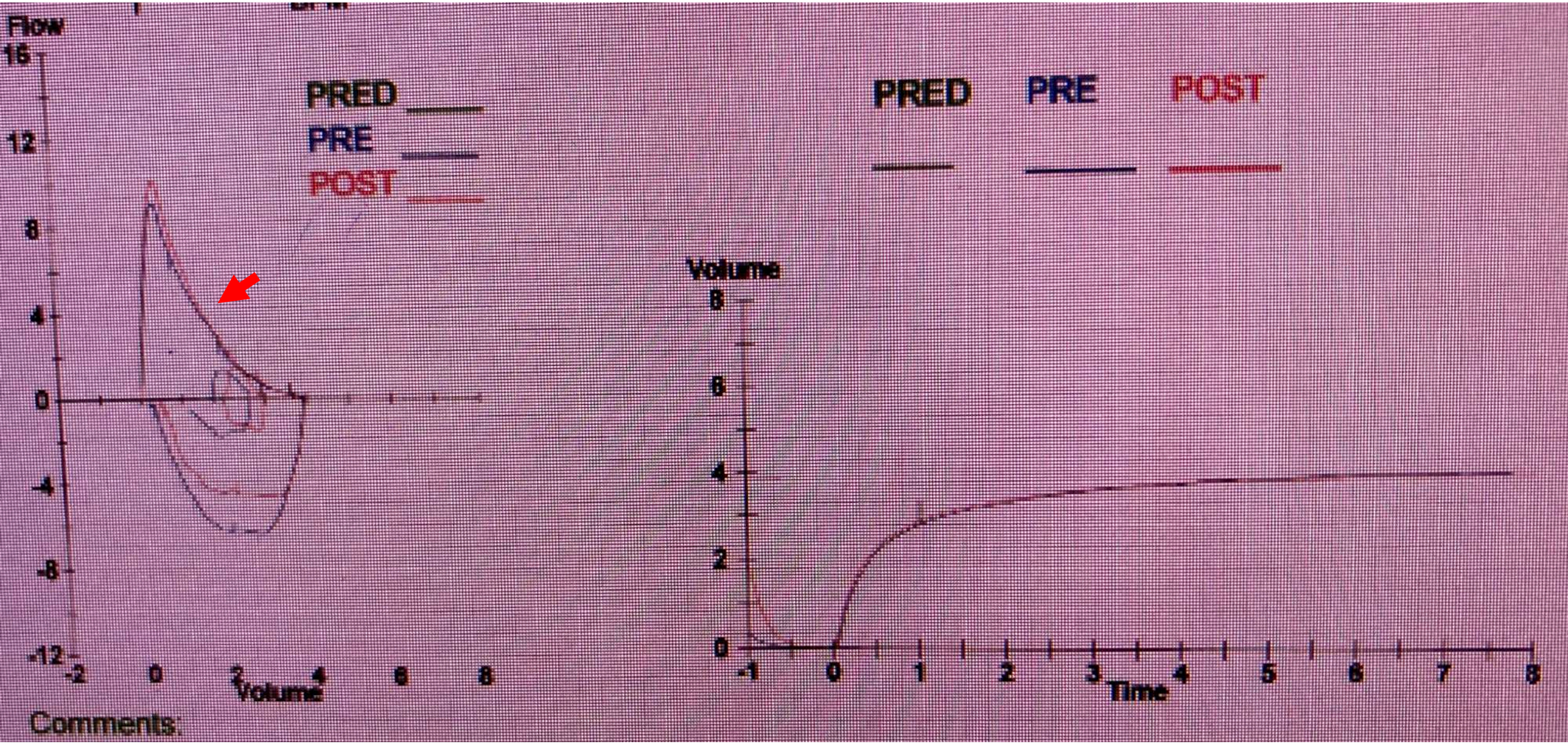
- ผู้ป่วยชายไทยอายุ 46 ปี
- สูบบุหรี่อยู่
- มีอาการเหนื่อย ไอมีเสมหะ ชอบเหนื่อยเวลาอากาศเย็น หายใจเสียงวี๊ดตอนกลางคืน
- CXR: WNL

# Spirometry ม.ค. 2561



Spirometry (BTPS)

| | | PRED | PRE-RX BEST | PRE-RX %PRED | POST-RX BEST | POST-RX %PRED | %CHG |
|---|---|---|---|---|---|---|---|
| FVC | Liters | 4.55 | 3.86 | 87 | 3.91 | 86 | -1 |
| FEV1 | Liters | 3.60 | 2.81 | 78 | 2.88 | 80 | 3 |
| FEV1/FVC | % | 79 | 71 | 90 | 74 | 93 | 4 |
| FEF25-75% | L/sec | 3.68 | 1.84 | 50 | 2.11 | 57 | 15 |
| IsoFEF25-75 | L/sec | 3.68 | 1.84 | 50 | 2.13 | 58 | 16 |
| FEF75-85% | L/sec | 1.05 | 0.46 | 43 | 0.52 | 50 | 16 |
| PEF | L/sec | 8.84 | 9.34 | 106 | 10.13 | 115 | 8 |
| FET100% | Sec | | 8.04 | | 8.38 | | 4 |
| FIVC | Liters | 4.66 | 3.75 | 82 | 3.46 | 76 | -8 |
| FEV1 | Liters | 3.60 | 2.81 | 78 | 2.88 | 80 | 3 |
| FIV1 | Liters | | 3.41 | | 3.12 | | -8 |
| FEF/FIF50 | | <1.00 | 0.43 | | 0.68 | | 60 |
| Vol Extrap | Liters | | 0.04 | | 0.04 | | 10 |
| FVL ECode | | | 000000 | | 000000 | | |


Flow
16
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-12
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Volume
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Volume
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7
8
Time
Comments:

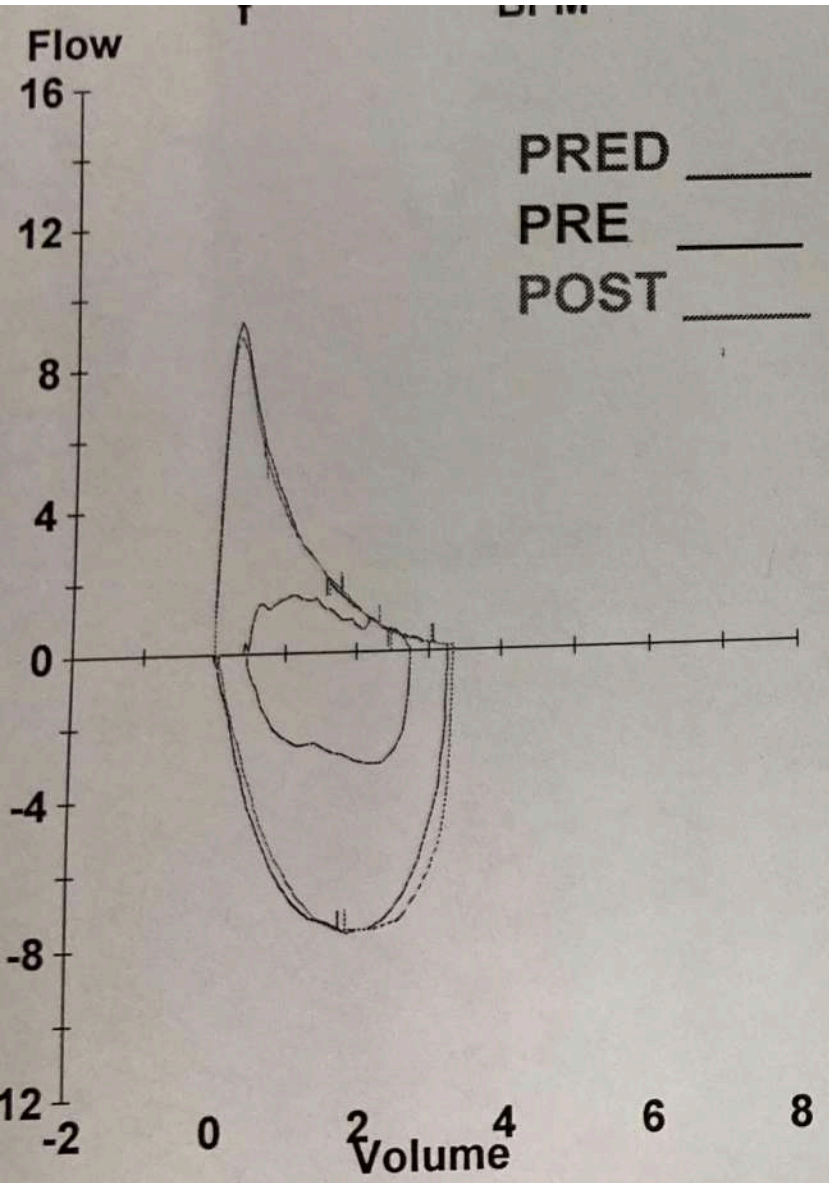
# Spirometry interpretation

- Spirometry: small airway obstruction, no BD reversibility
- ได้รับการรักษาด้วย LABA/ICS

- ติดตามการรักษา 1 ปี ยังมีอาการเหนื่อยง่ายอยู่
- PEF 550 L/min (91%)
- repeat spirometry

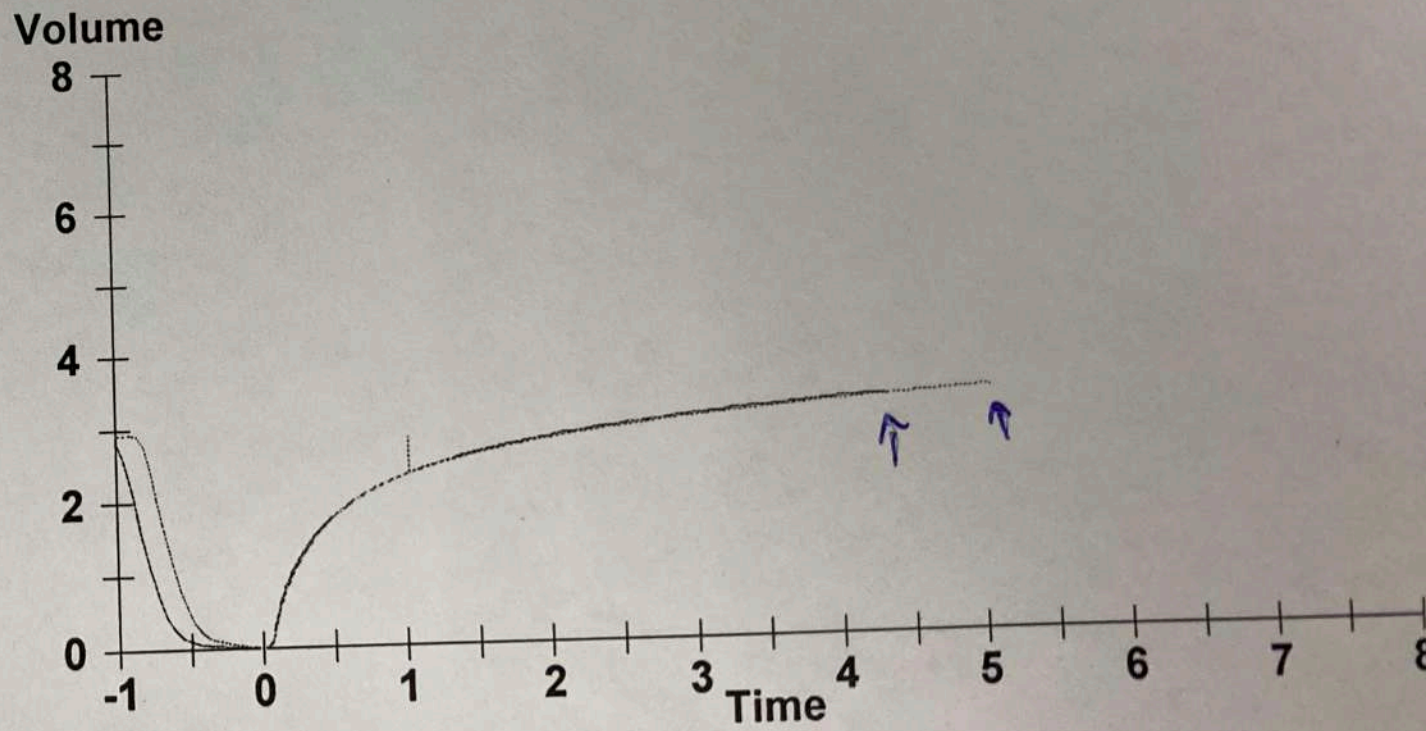
# Spirometry ก.ค. 2563

| Spirometry | (BTPS) | PRED | PRE-RX BEST | %PRED | POST-RX BEST | %PRED | % CHG |
|---|---|---|---|---|---|---|---|
| FVC | Liters | 4.49 | 3.27 | 73 | 3.35 | 75 | 2 |
| FEV1 | Liters | 3.51 | 2.35 | 67 | 2.34 | 67 | -0 |
| FEV1/FVC | % | 78 | 72 | 91 | 70 | 89 | -2 |
| FEF25-75% | L/sec | 3.55 | 1.56 | 44 | 1.45 | 41 | -7 |
| IsoFEF25-75 | L/sec | 3.55 | 1.56 | 44 | 1.68 | 47 | 8 |
| FEF75-85% | L/sec | 0.98 | 0.46 | 47 | 0.39 | 40 | -14 |
| PEF | L/sec | 8.74 | 9.27 | 106 | 8.83 | 101 | -5 |
| FET100% | Sec | | 4.32 | | 5.06 | | 17 |
| FIVC | Liters | 4.49 | 3.28 | 73 | 3.31 | 74 | 1 |
| FEV1 | Liters | 3.51 | 2.35 | 67 | 2.34 | 67 | -0 |
| FIV1 | Liters | | | | 3.08 | | |
| FEF/FIF50 | | <1.00 | 0.27 | | 0.27 | | -1 |
| Vol Extrap | Liters | | 0.02 | | 0.02 | | -17 |
| FVL ECode | | | 000011 | | 000011 | | |



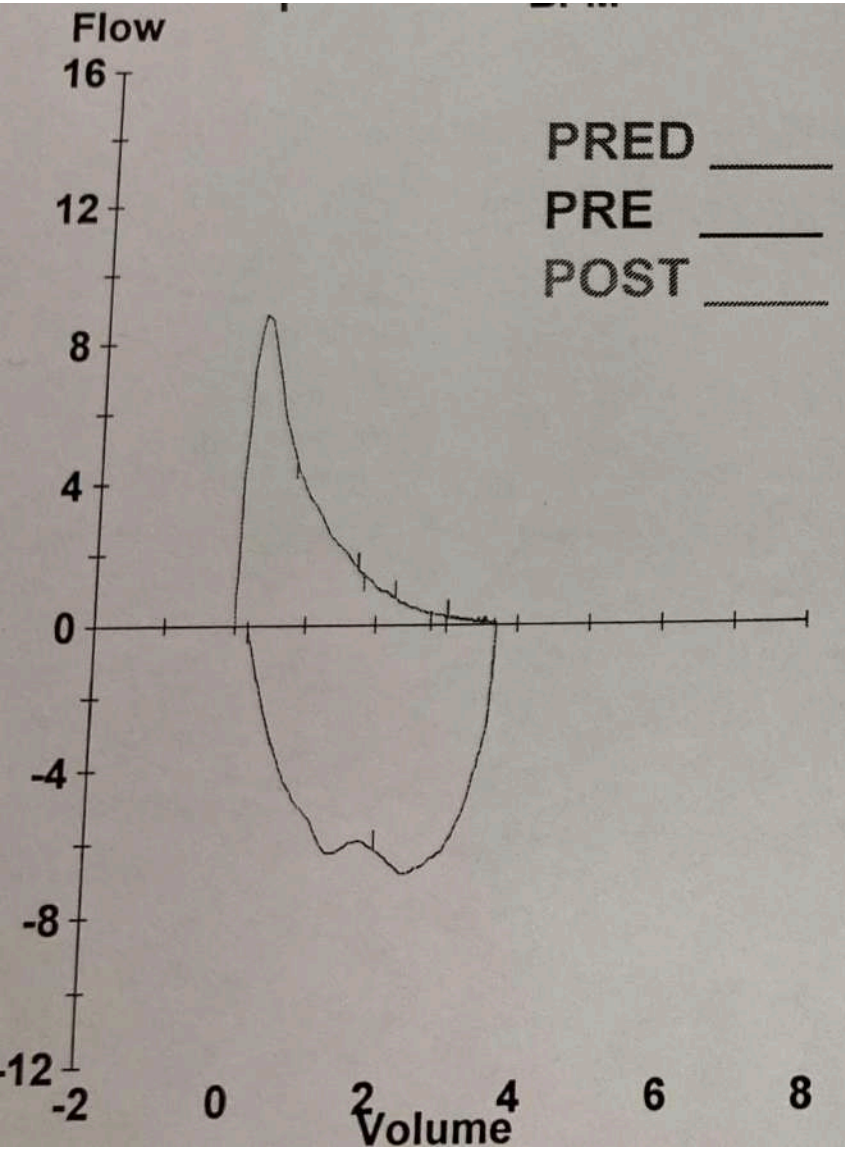

PRED _____
PRE _____
POST _____

PRED PRE POST
____ _____ _____



# Repeat post BD spirometry

| Spirometry | (BTPS) | PRED | BEST | %PRED |
|---|---|---|---|---|
| FVC | Liters | 4.49 | 3.71 | 83 |
| FEV1 | Liters | 3.51 | 2.30 | 65 |
| FEV1/FVC | % | 78 | 62 | 79 |
| FEF25-75% | L/sec | 3.55 | 0.98 | 28 |
| IsoFEF25-75 | L/sec | 3.55 | 0.98 | 28 |
| FEF75-85% | L/sec | 0.98 | 0.23 | 23 |
| PEF | L/sec | 8.74 | 8.83 | 101 |
| FET100% | Sec | | 10.12 | |
| FIVC | Liters | 4.49 | 3.53 | 79 |
| FEV1 | Liters | 3.51 | 2.30 | 65 |
| FIV1 | Liters | | 3.29 | |
| FEF/FIF50 | | <1.00 | 0.23 | |
| Vol Extrap | Liters | | 0.01 | |
| FVL ECode | | | 111010 | |


Flow
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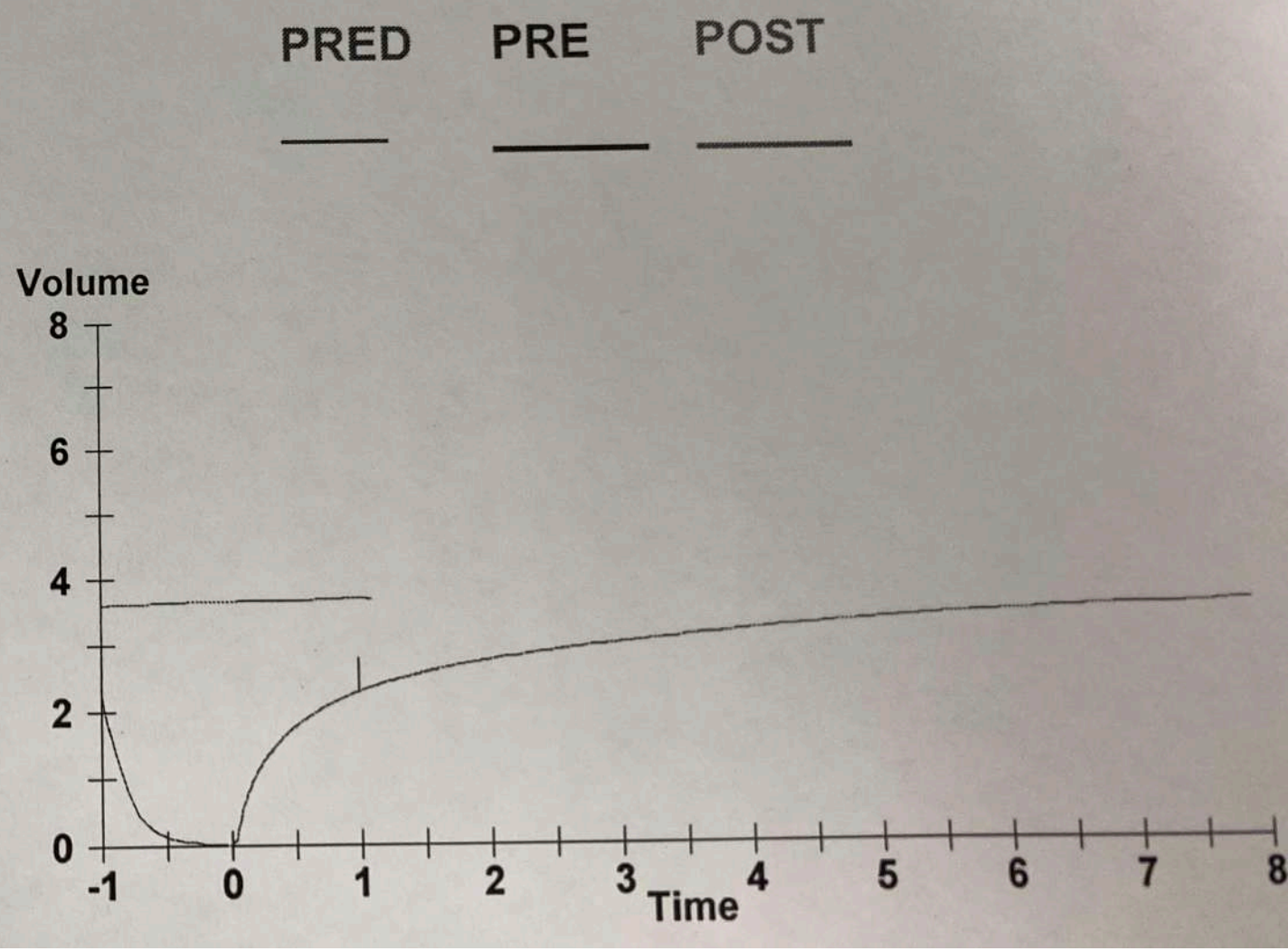
8
Volume
PRED
PRE
POST


PRED
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Volume
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-1
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1
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3
4
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8
Time

# Spirometry interpretation

- Confirm FEV1/FVC < 0.7
- Dx: COPD with dyspnea symptom

- Treatment
  - Add LAMA
  - Advice for smoking cessation

# considerations in performing spirometry

## PERFORMANCE

- Spirometry should be performed using techniques that meet published standards.[b]
- The expiratory volume/time traces should be smooth and free from irregularities. The pause between inspiration and expiration should be < 1 second.
- The recording should go on long enough for a volume plateau to be reached, which may take more than 15 seconds in severe disease.
- Both FVC and $FEV_1$ should be the largest value obtained from any of three technically satisfactory curves and the FVC and $FEV_1$ values in these three curves should vary by no more than 5% or 150 ml, whichever is greater.
- The $FEV_1$/FVC ratio should be taken from the technically acceptable curve with the largest sum of FVC and $FEV_1$.

# If post BD FEV1/FVC is between 0.6-0.8

Assessment of the presence or absence of airflow obstruction based on a single measurement of the post-bronchodilator $FEV_1$/FVC ratio should be confirmed by repeat spirometry on a separate occasion if the value is between 0.6 and 0.8, as in some cases the ratio may change as a result of biological variation when measured at a later interval.[28,29] If the initial post-bronchodilator $FEV_1$/FVC ratio is less than 0.6 it is very unlikely to rise above 0.7 spontaneously.[28]

# Thank you