Better monitoring of the acutely ill patient

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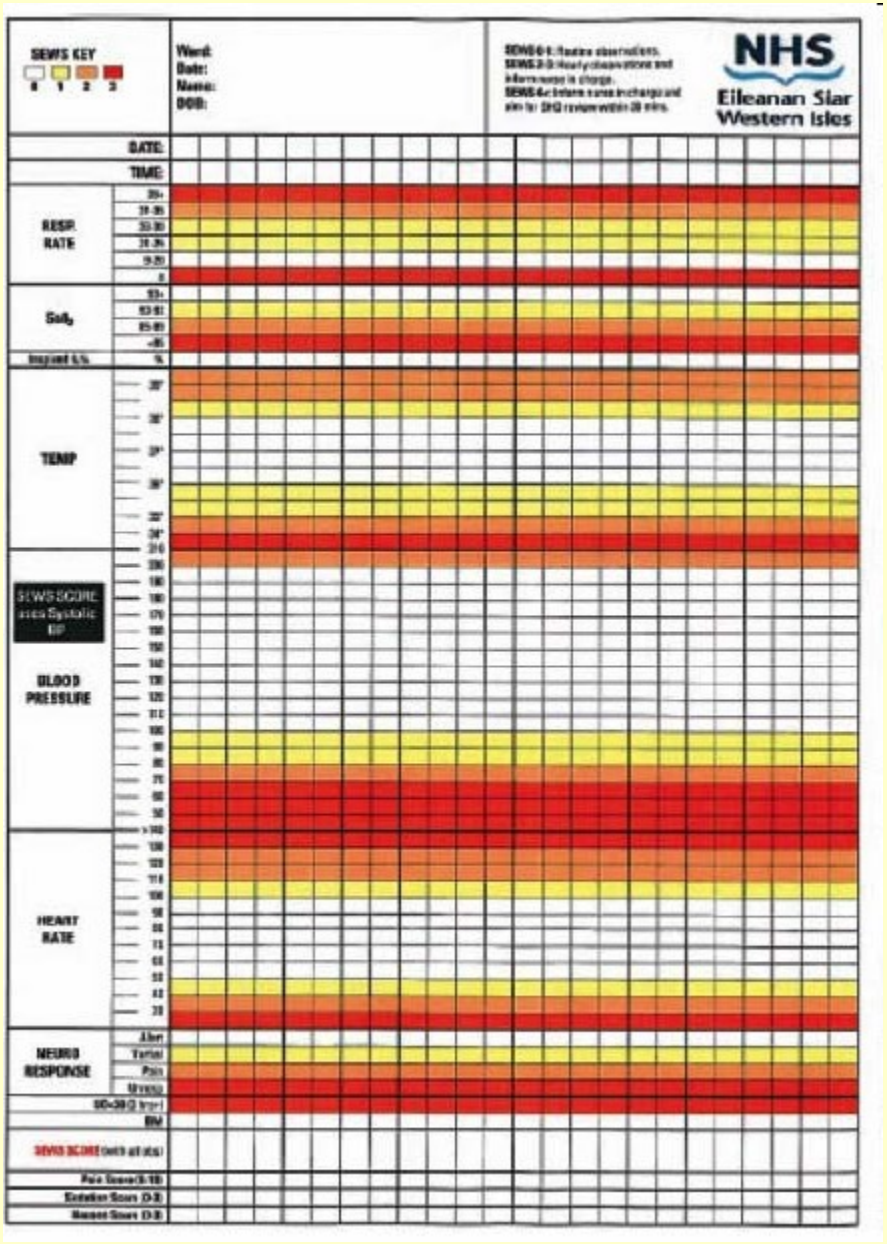
Better monitoring of the acutely ill patient

- There should be wider implementation of the Scottish Early Warning System (SEWS) documentation with a view to establishing a standardised clinical early warning system for Scotland.

NHS Quality Improvement Scotland


SEWS KEY
0 1 2 3
Ward:
Date:
Name:
DOB:
NHS
Eileanan Siar
Western Isles
DATE:
TIME:
RESP RATE
TEMP
BLOOD PRESSURE
HEART RATE
NEURO RESPONSE
Alert
Verbal
Pain
Unresp
BM
Pain Score (0-10)
Sedation Score (0-3)
Nausea Score (0-3)

Respiratory rate

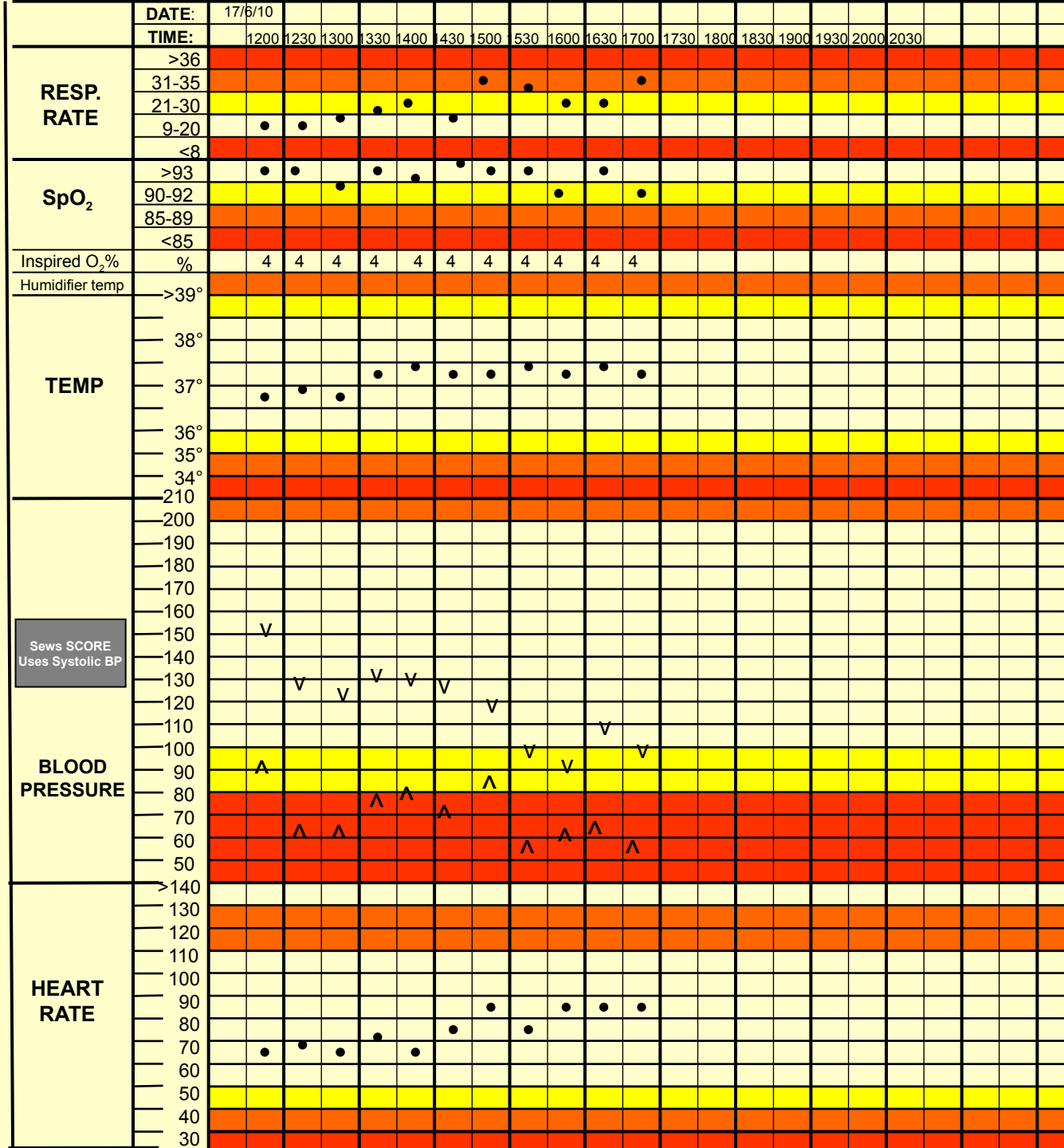
Oxygen Sats

Temperature

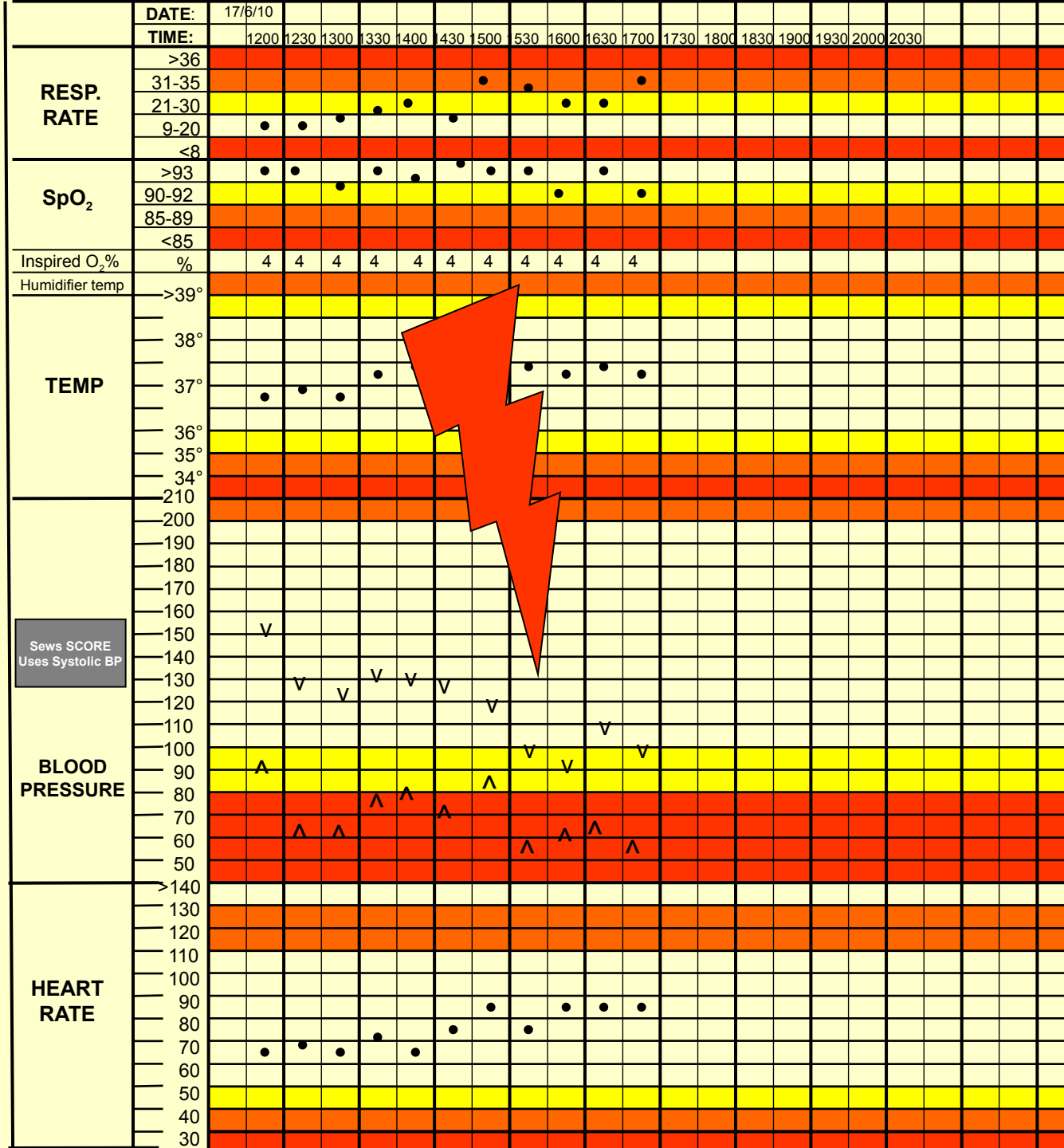
Blood Pressure

Heart rate

SCORE points for colours



Blood loss


DATE:
17/6/10
TIME:
1200 1230 1300 1330 1400 1430 1500 1530 1600 1630 1700 1730 1800 1830 1900 1930 2000 2030
RESP. RATE
>36
31-35
21-30
9-20
<8
SpO2
>93
90-92
85-89
<85
Inspired O2%
%
4 4 4 4 4 4 4 4 4 4
Humidifier temp
>39°
TEMP
38°
37°
36°
35°
34°
Sews SCORE
Uses Systolic BP
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
BLOOD PRESSURE
>140
130
120
110
100
90
80
70
60
50
40
30
HEART RATE

Automated - bad

Manual - good

What's wrong with SEWs?

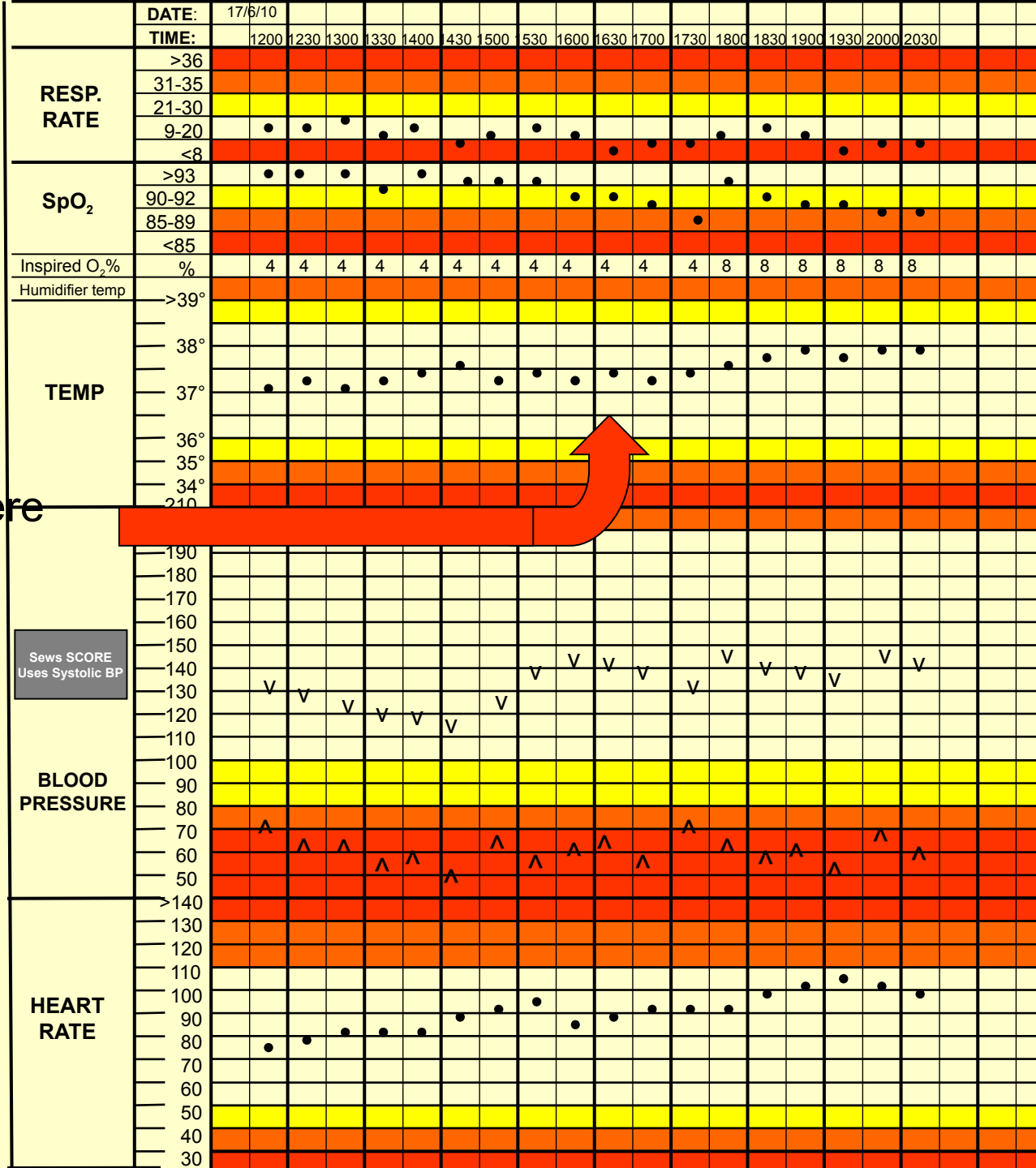
- Only as good as the measurements
  - Respiration is a good index
  - Respiration is badly measured
- There are better measurements
  - Heart rate and blood pressure often stable
- Clinical nous is a big help

Patient after surgery

Receiving oxygen

Unknown concentration

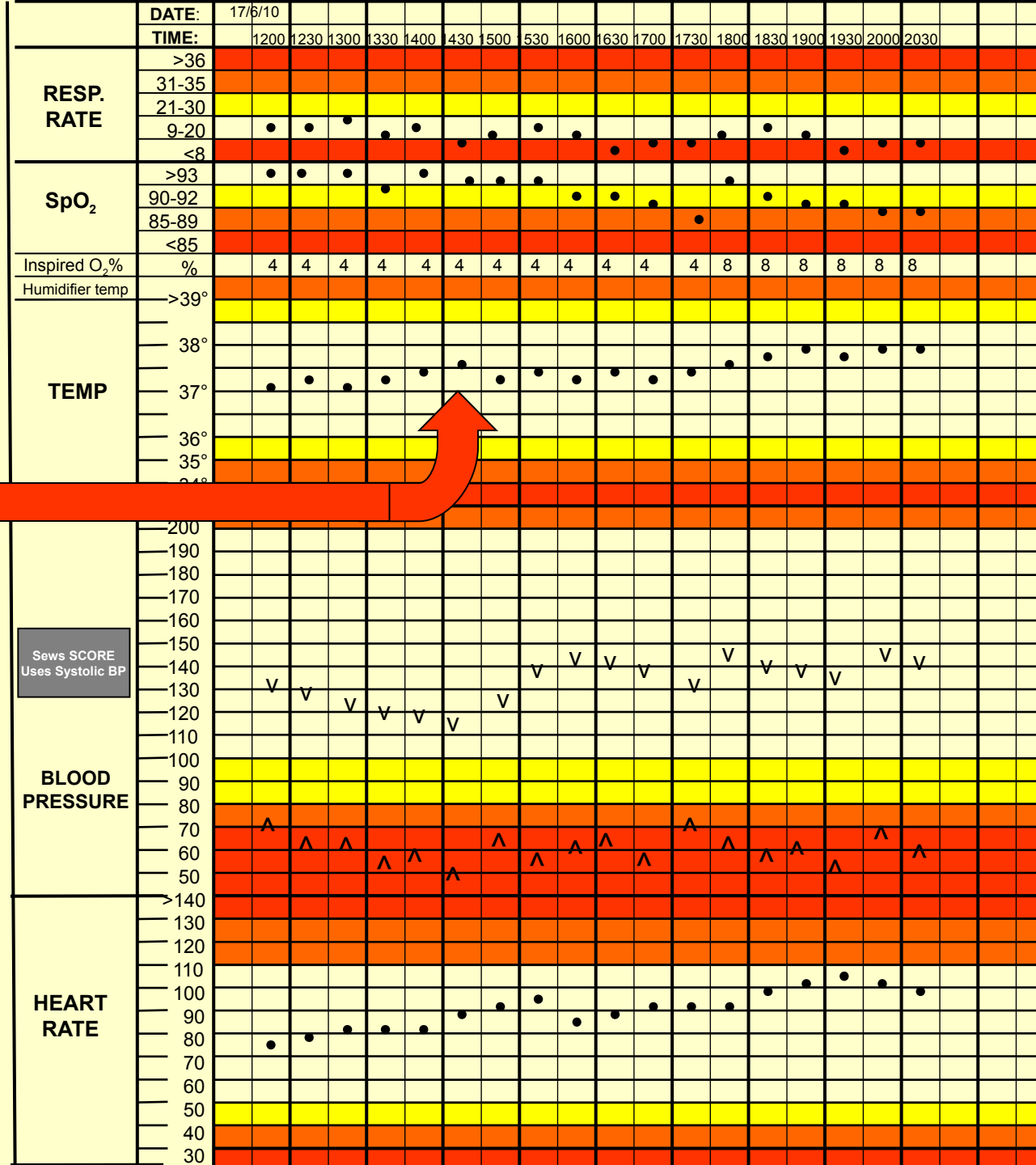
Triggers SEWS about here



Patient after surgery

Receiving oxygen: this conceals problems

Needed attention here



Example from ward chart

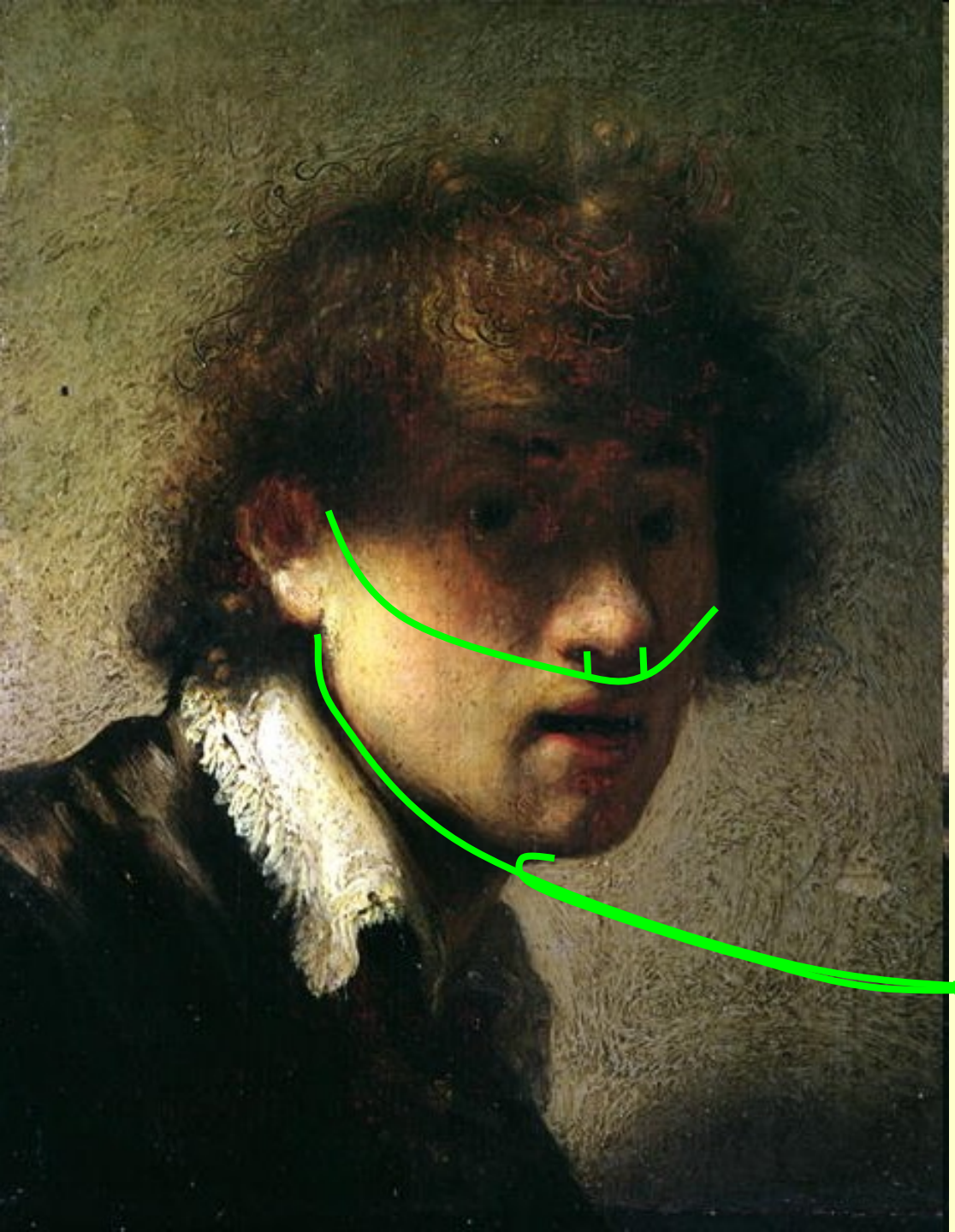
Time	PCA	SEWS
1800	12	12
2000		12
2030	12	
2100	16	16
2200	12	12
2300	16	
0000		16
0100	16	
0200	12	12
0230	12	
0400	16	
0500	14	
0600	12	12
0700	12	

Validation and evaluation of respiratory movements

- Patients after major surgery
- Frequent use of depressant analgesic agents e.g. morphine
- Useful monitor would reliably transduce rate.
- Complications are frequent and poorly detected: 10 to 15% of patients with opioid infusions.

- Overdyk FJ, Carter R, Maddox RR, Callura J, Herrin AE, Henriquez C. Continuous oximetry/capnometry monitoring reveals frequent desaturation and bradypnea during patient-controlled analgesia. Anesthesia and Analgesia 2007; 105: 412-8

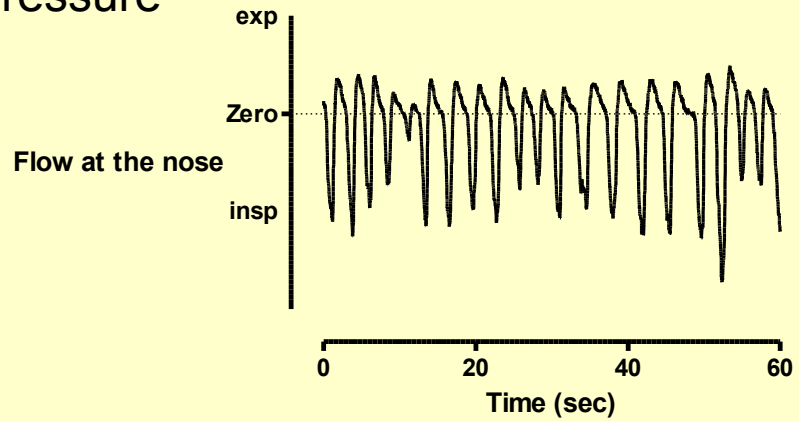
Measuring breathing



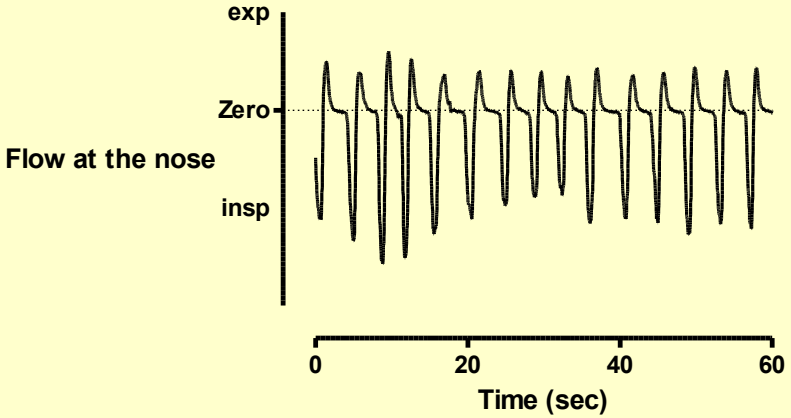
Pressure transducer

Breathing Patterns from nasal pressure

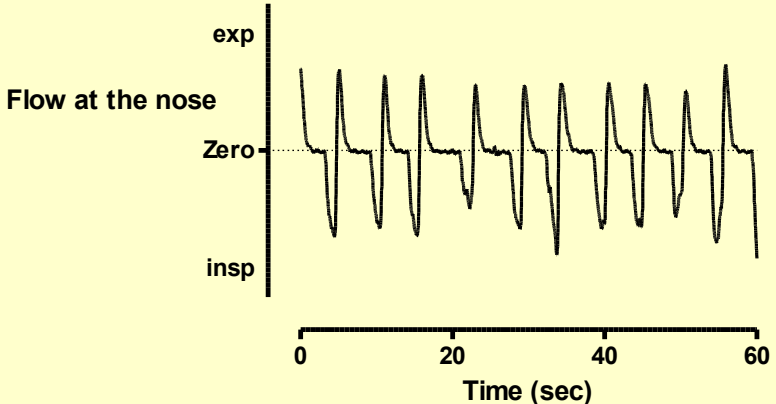
Normal volunteer

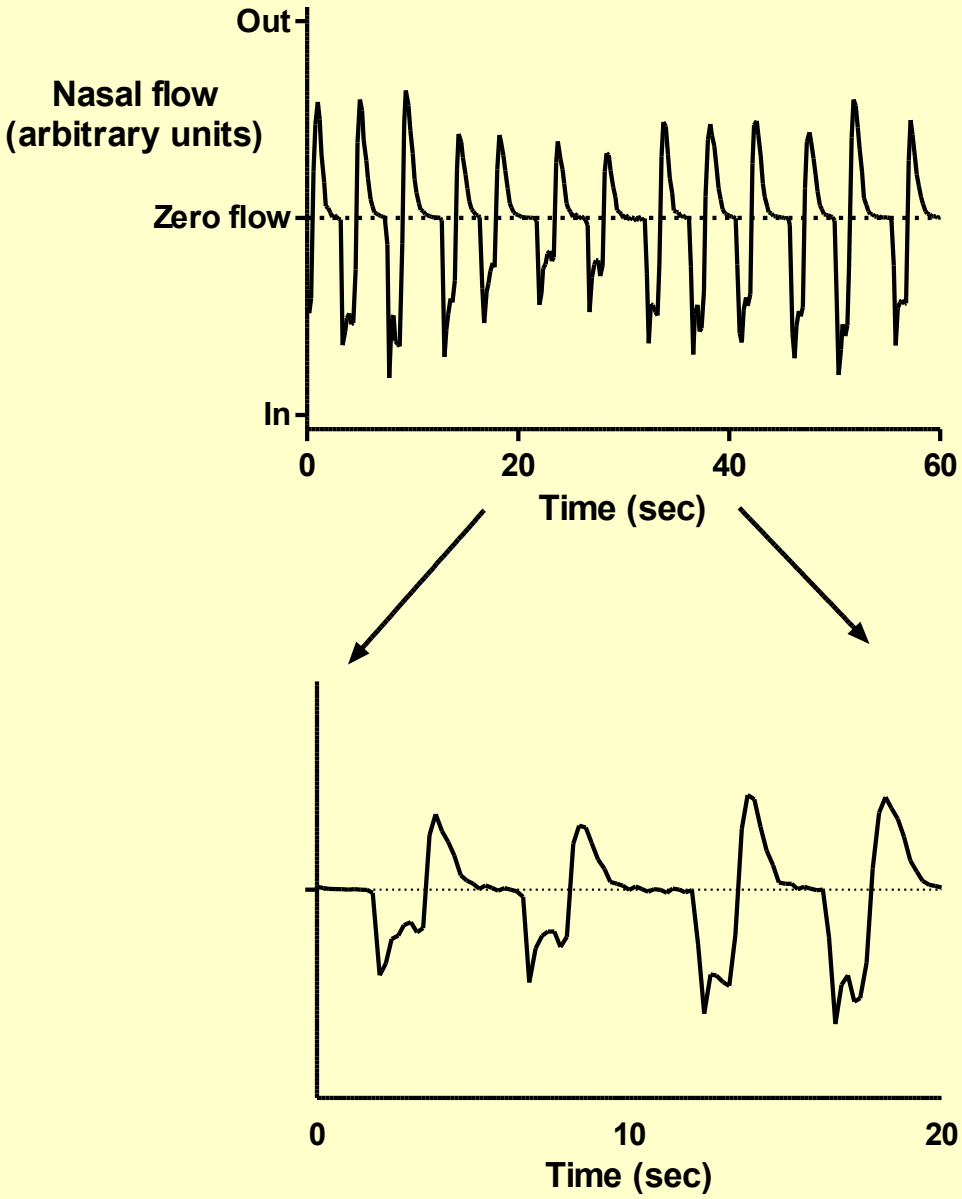


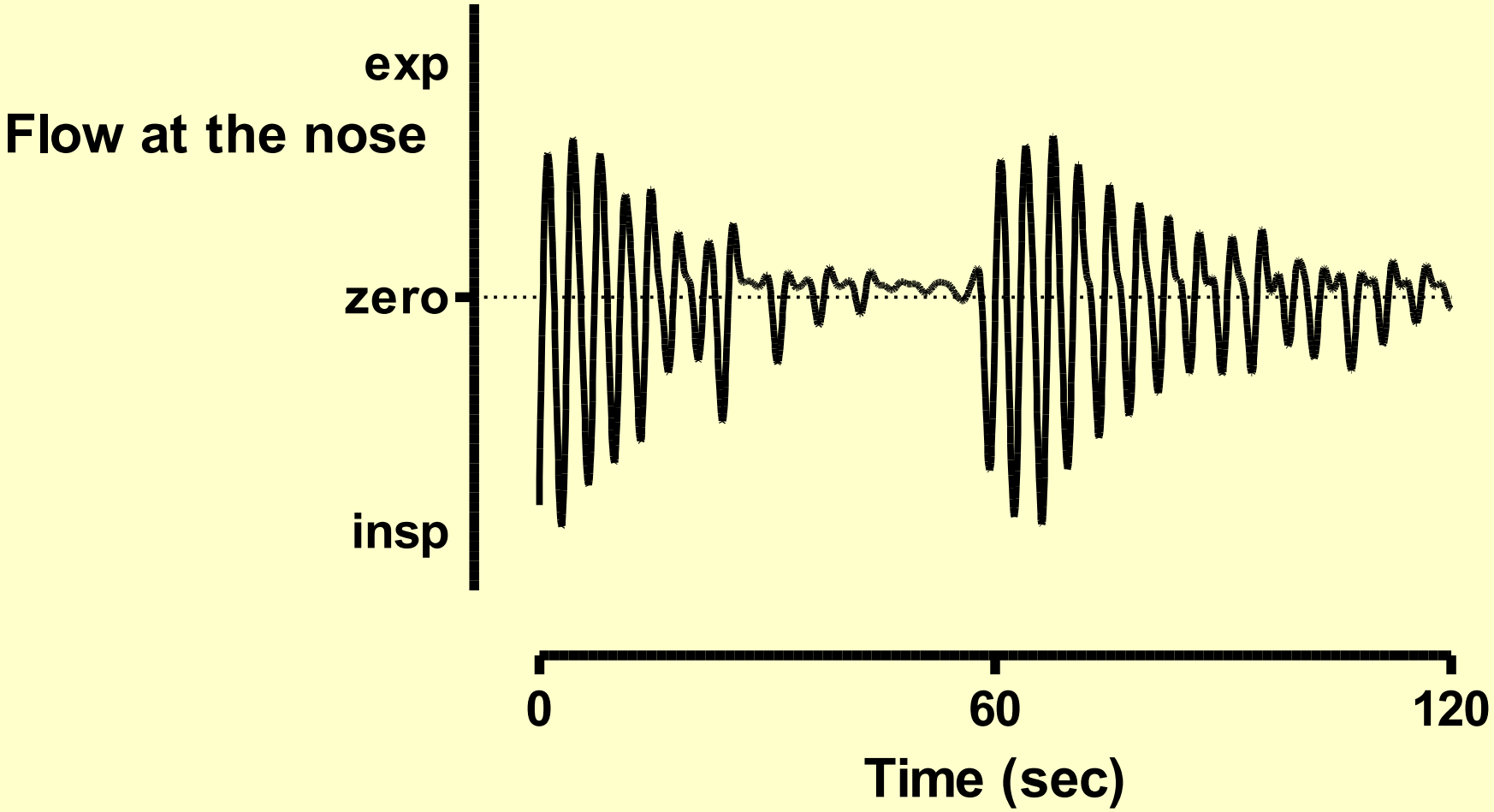
Patient after surgery



Patient after surgery

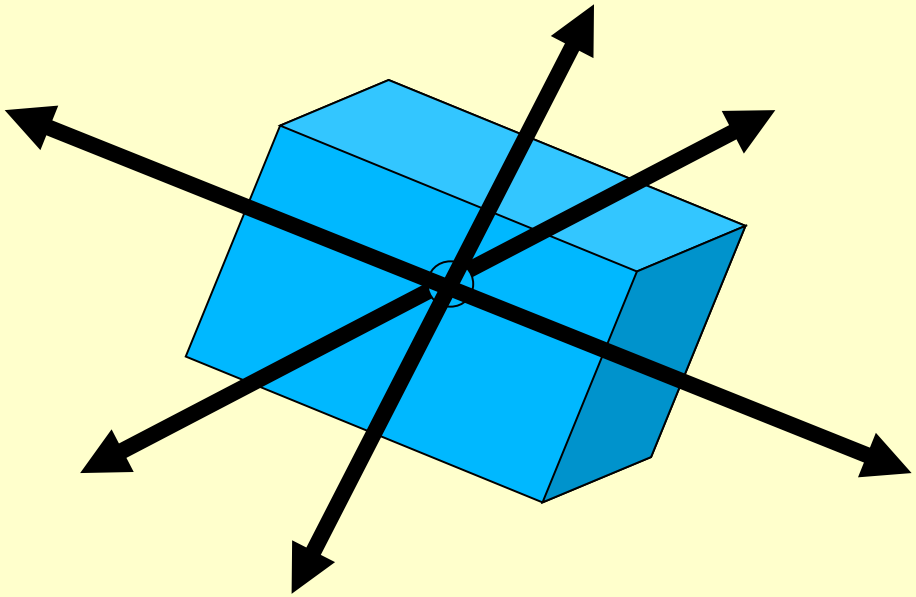



Out
Nasal flow
(arbitrary units)
Zero flow
In
0
20
40
60
Time (sec)
0
10
20
Time (sec)


exp
Flow at the nose
zero
insp
0
60
120
Time (sec)

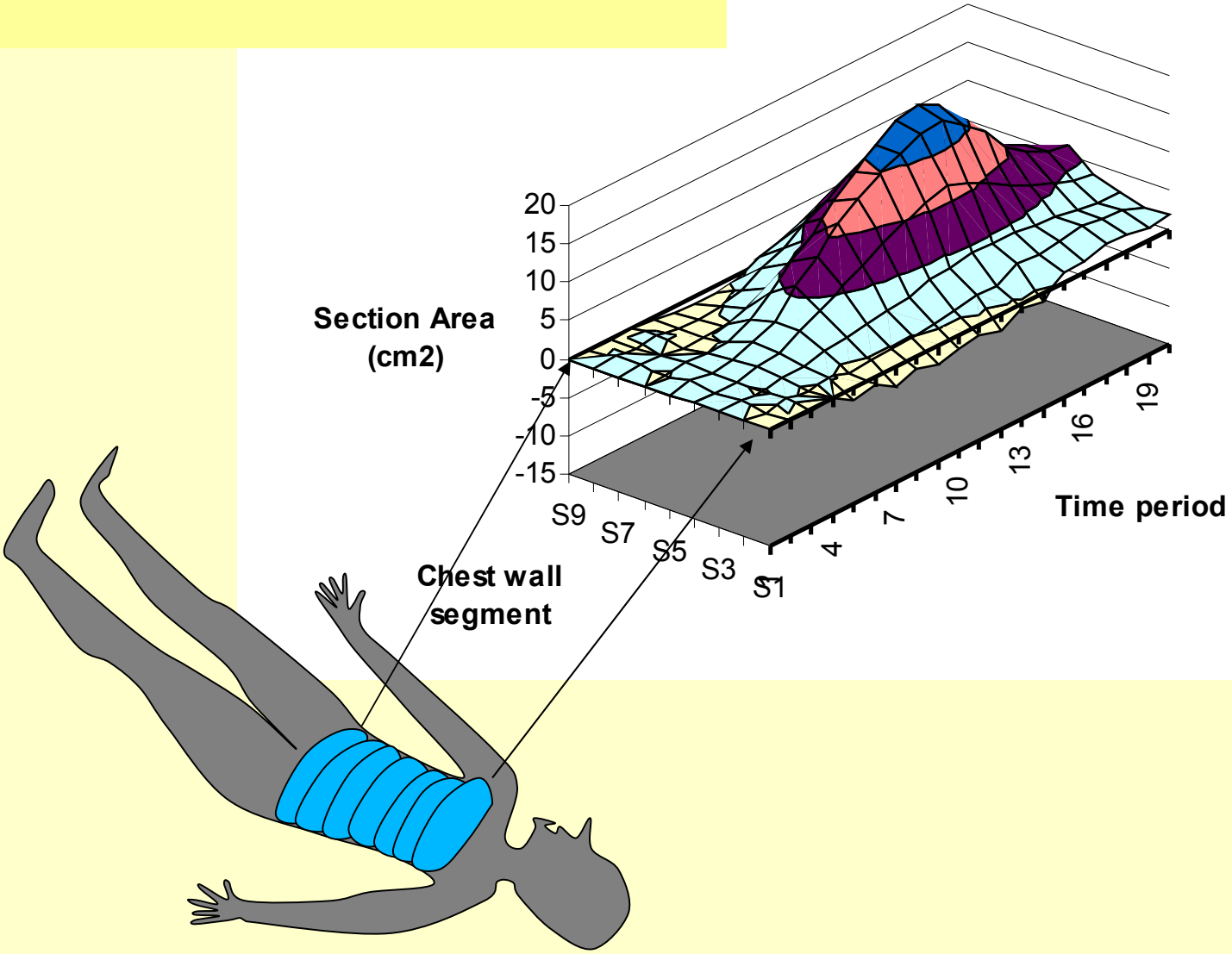
The RespTemp Speck

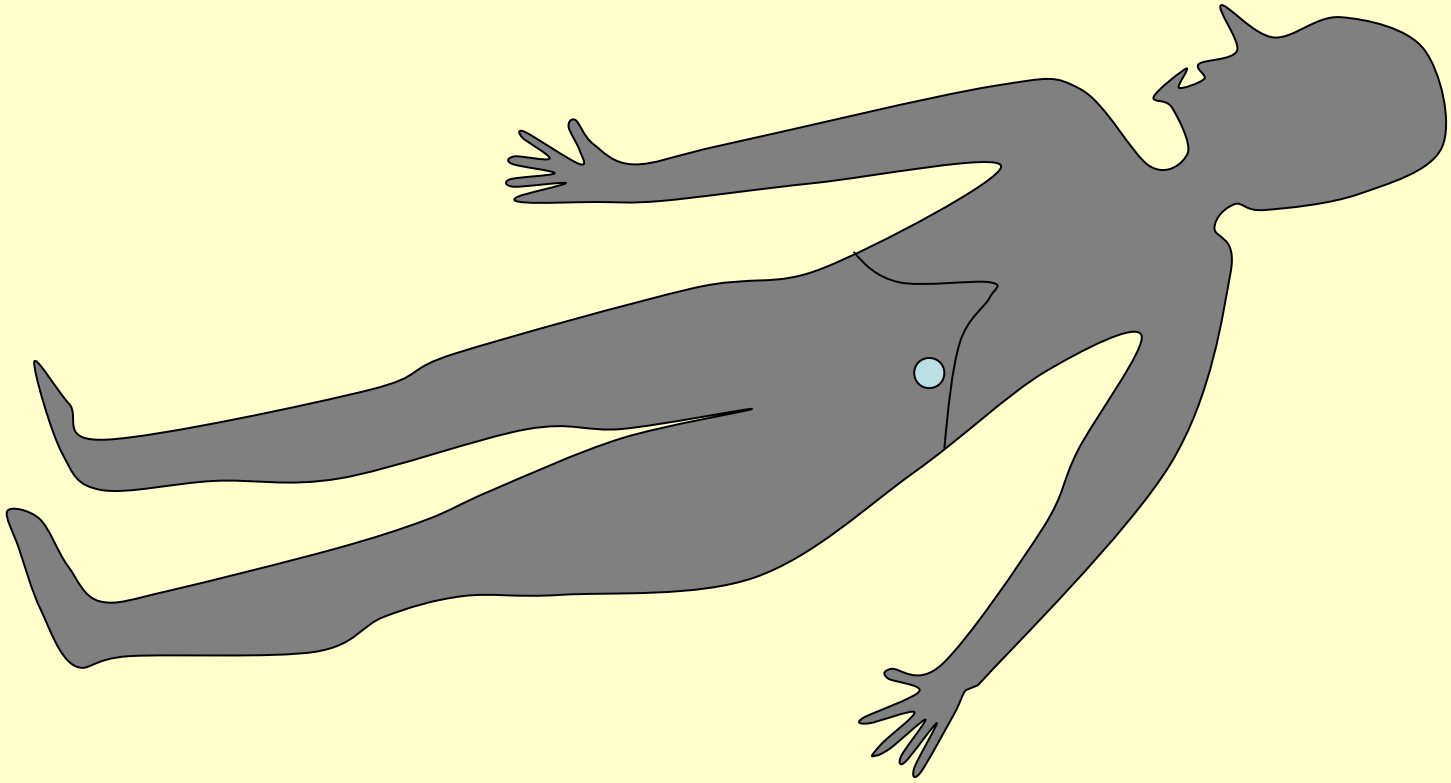
- A small capsule with sensors
  - Orientation (gravity)
  - Acceleration (orthogonal axes)

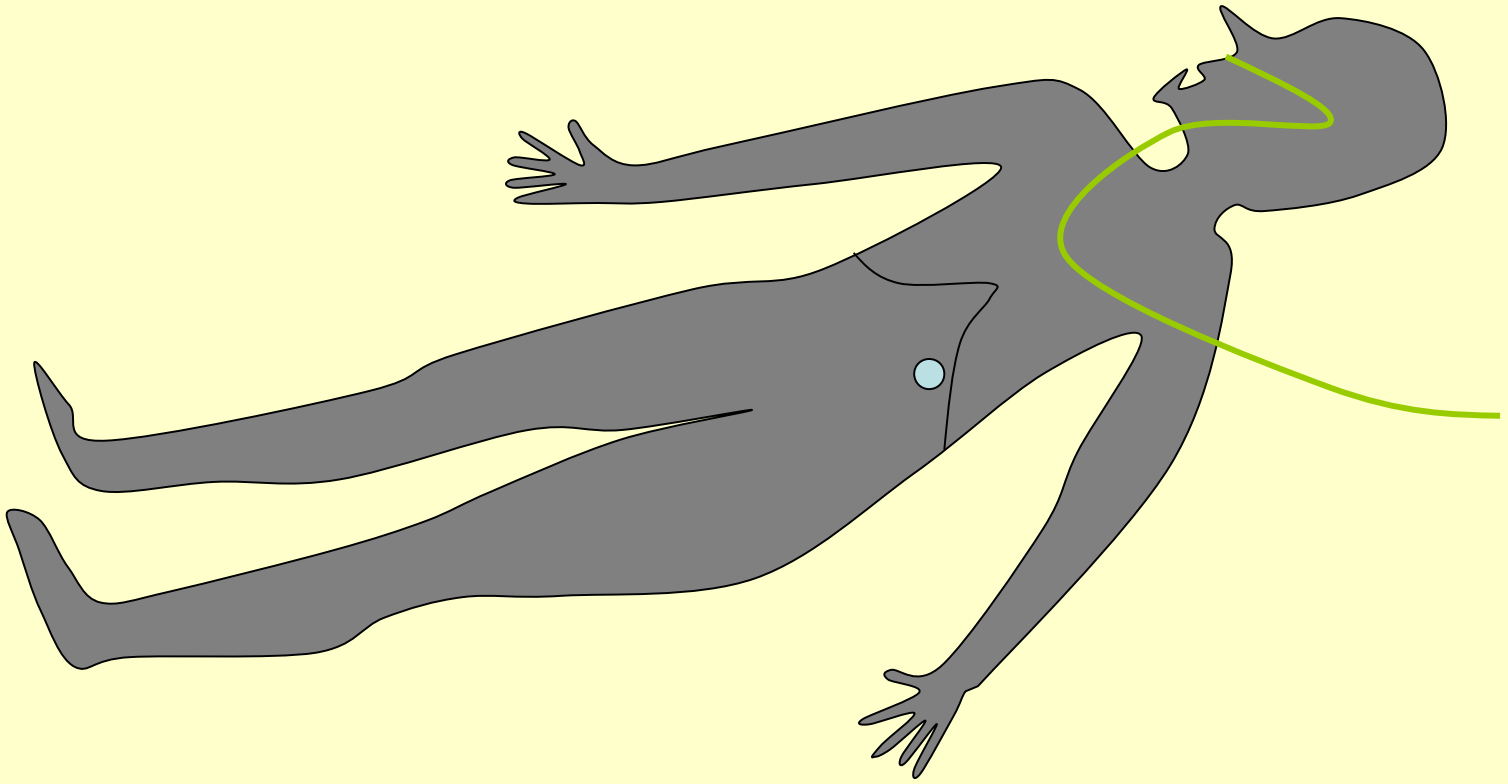


- 433MHz transmitter
- Receiver, netbook

Most breathing movements are abdominal





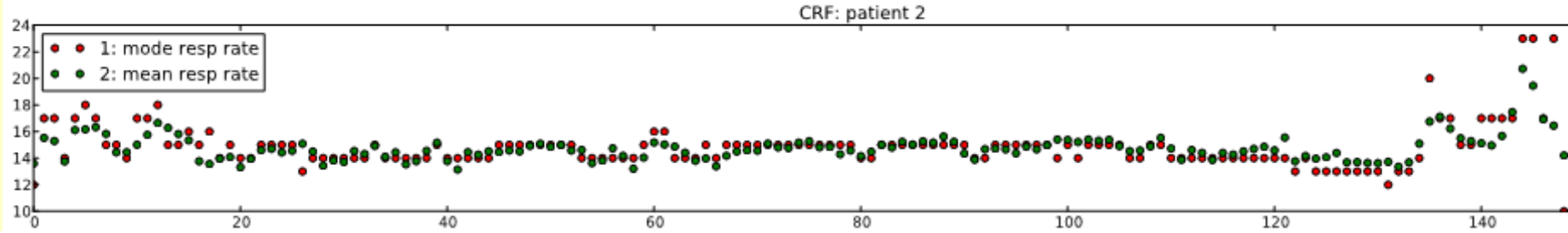


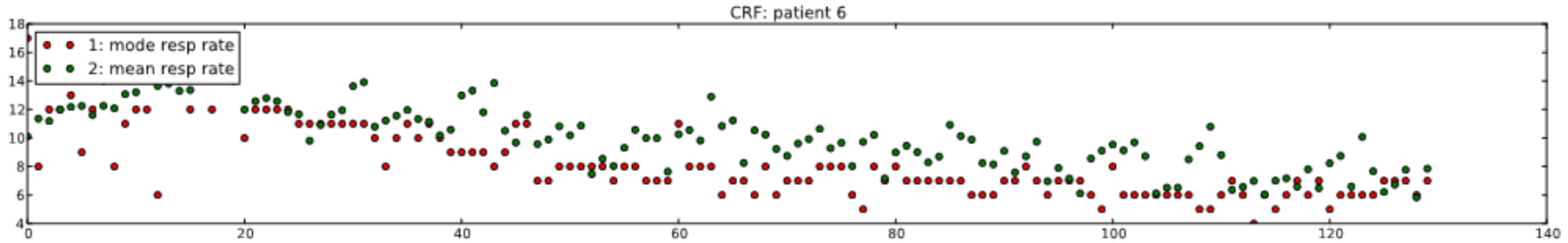
Compare signals

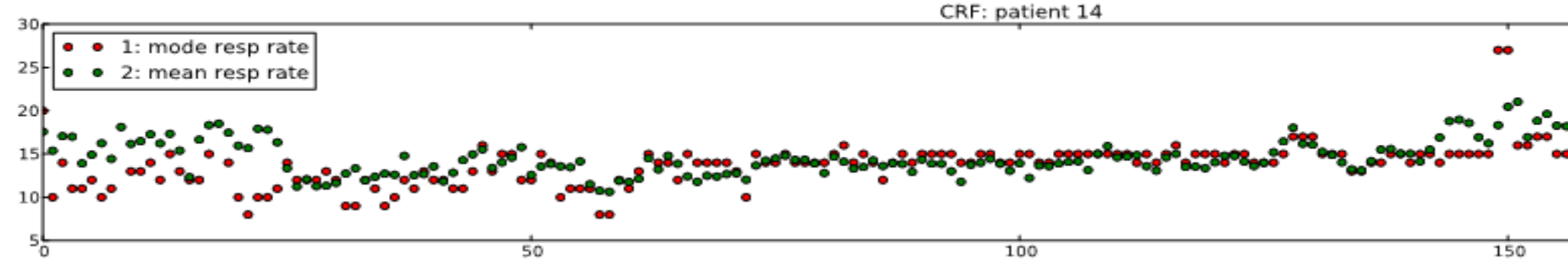
Clinical research facility

- Pilot study of 20 patients after major surgery
- Problems mainly with nasal cannula
- 70% acceptability
- Reliable values for respiratory rate in each 5 minute period overnight.

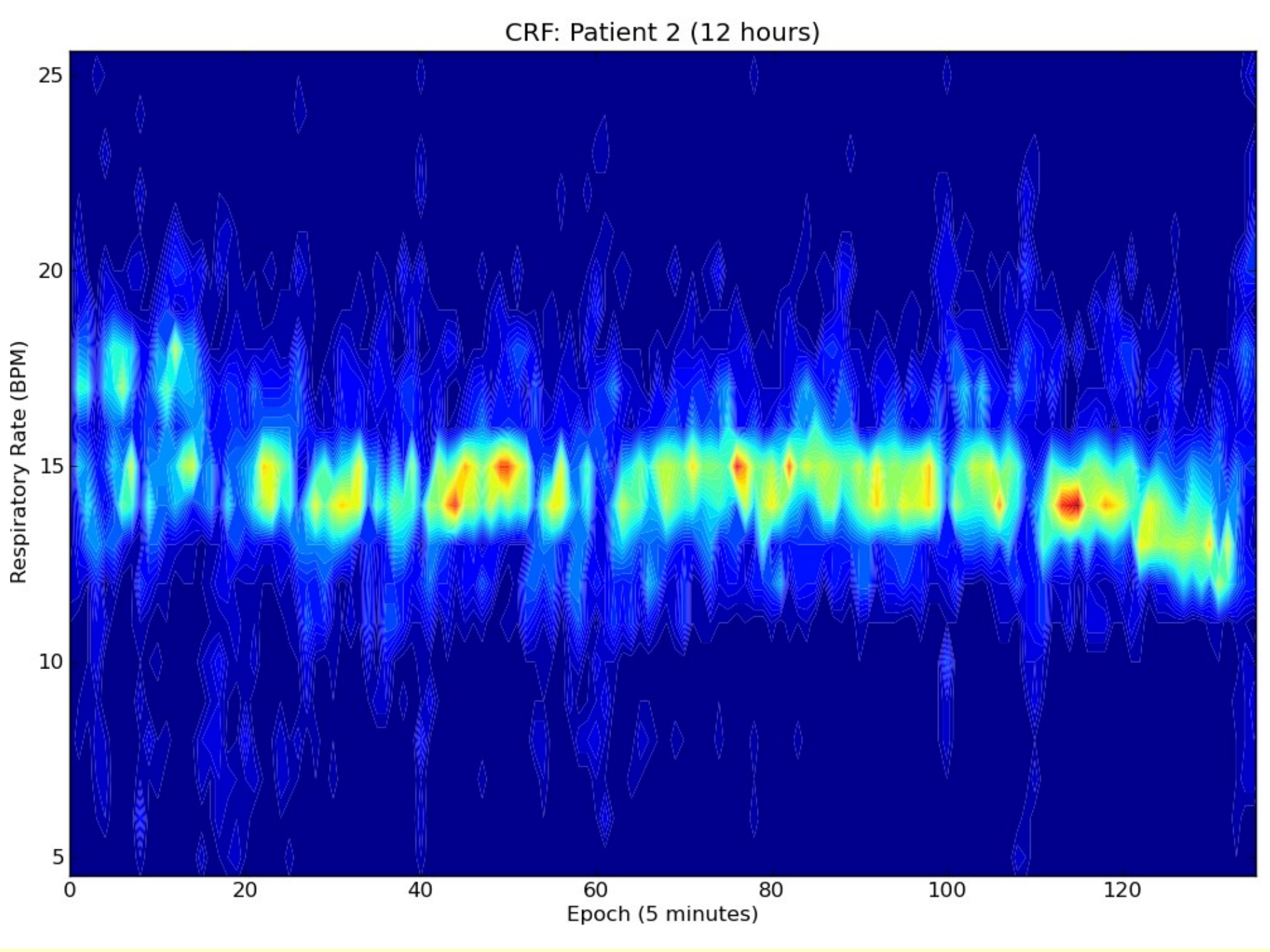
Examples

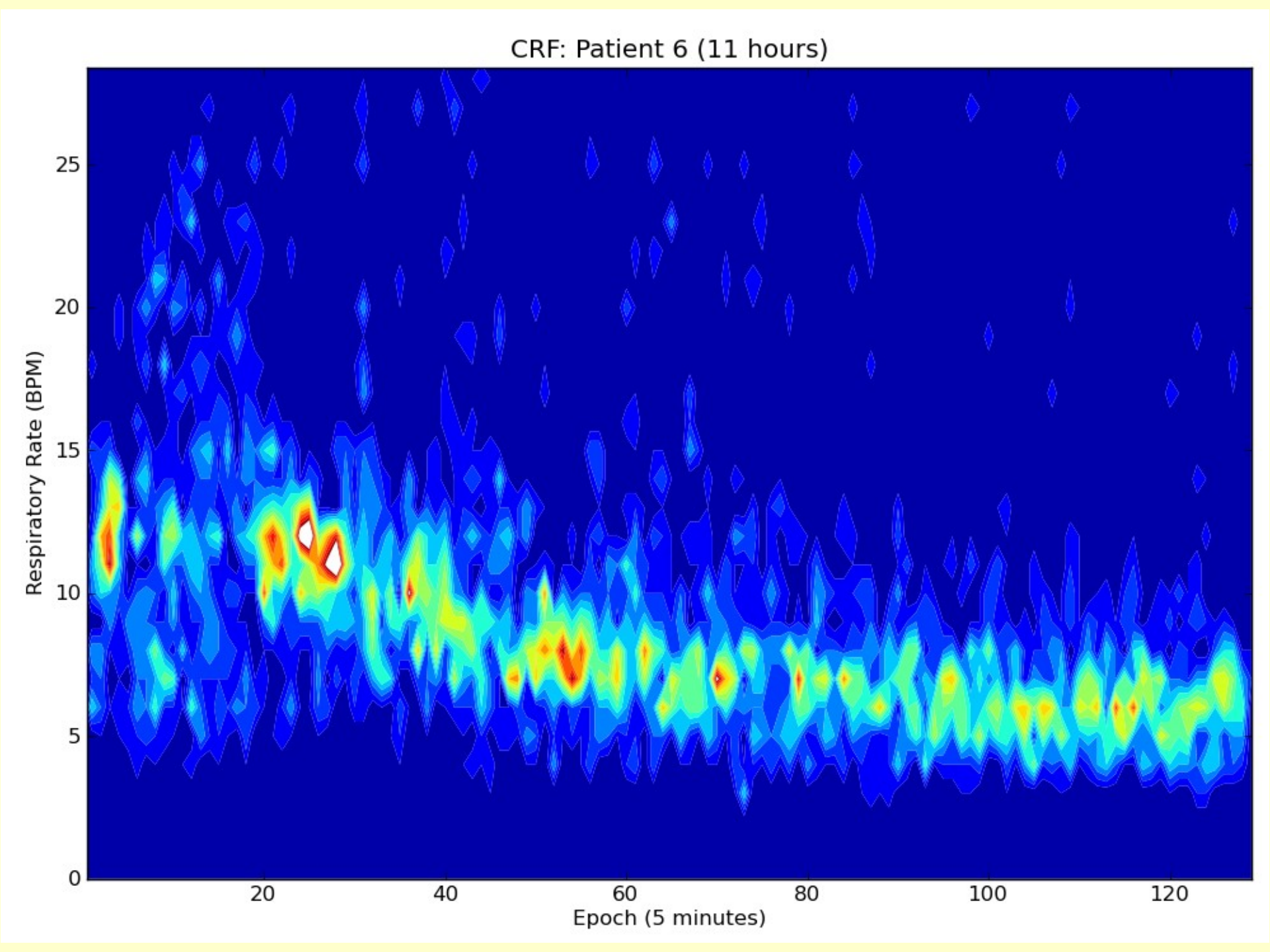


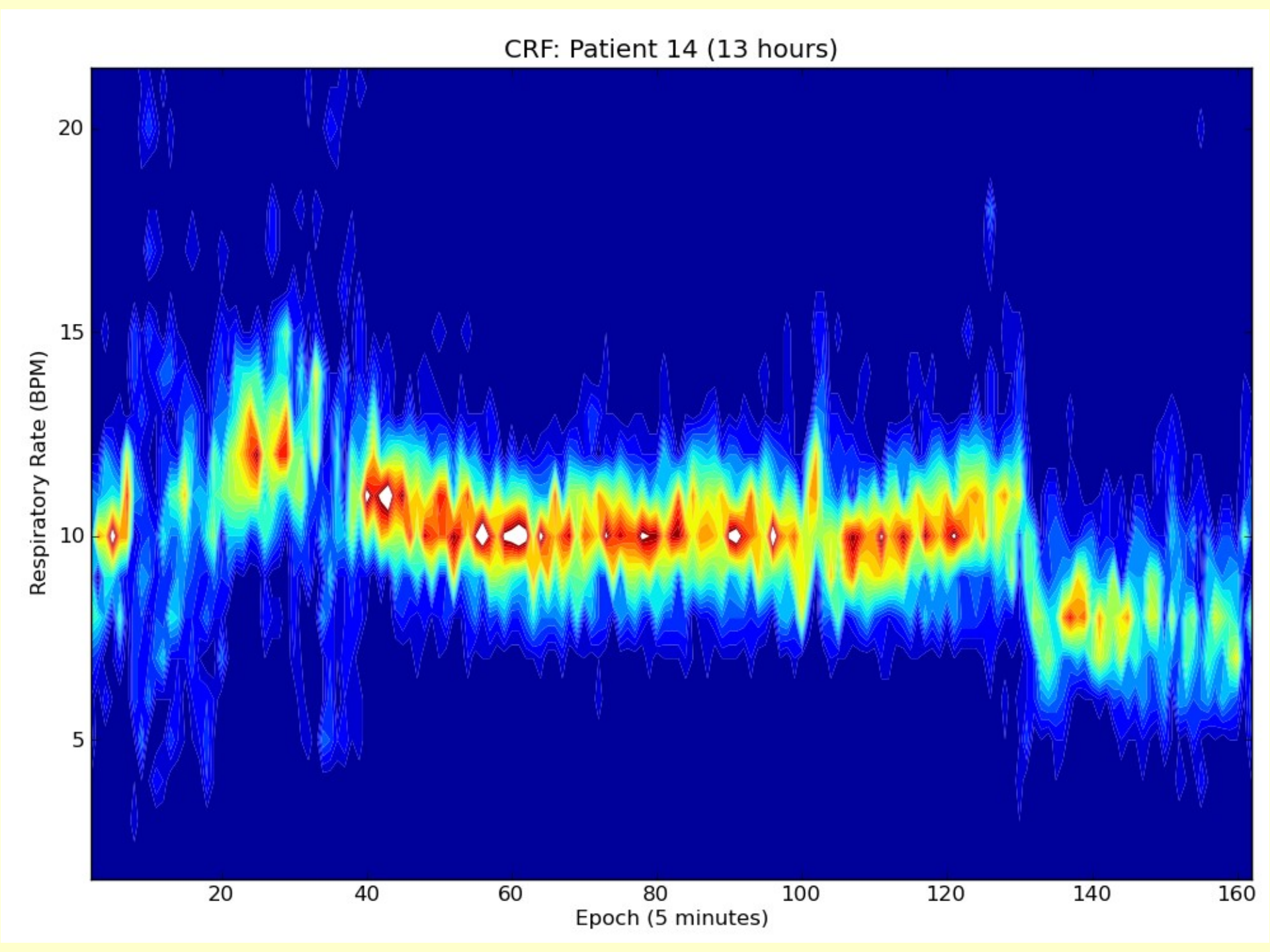




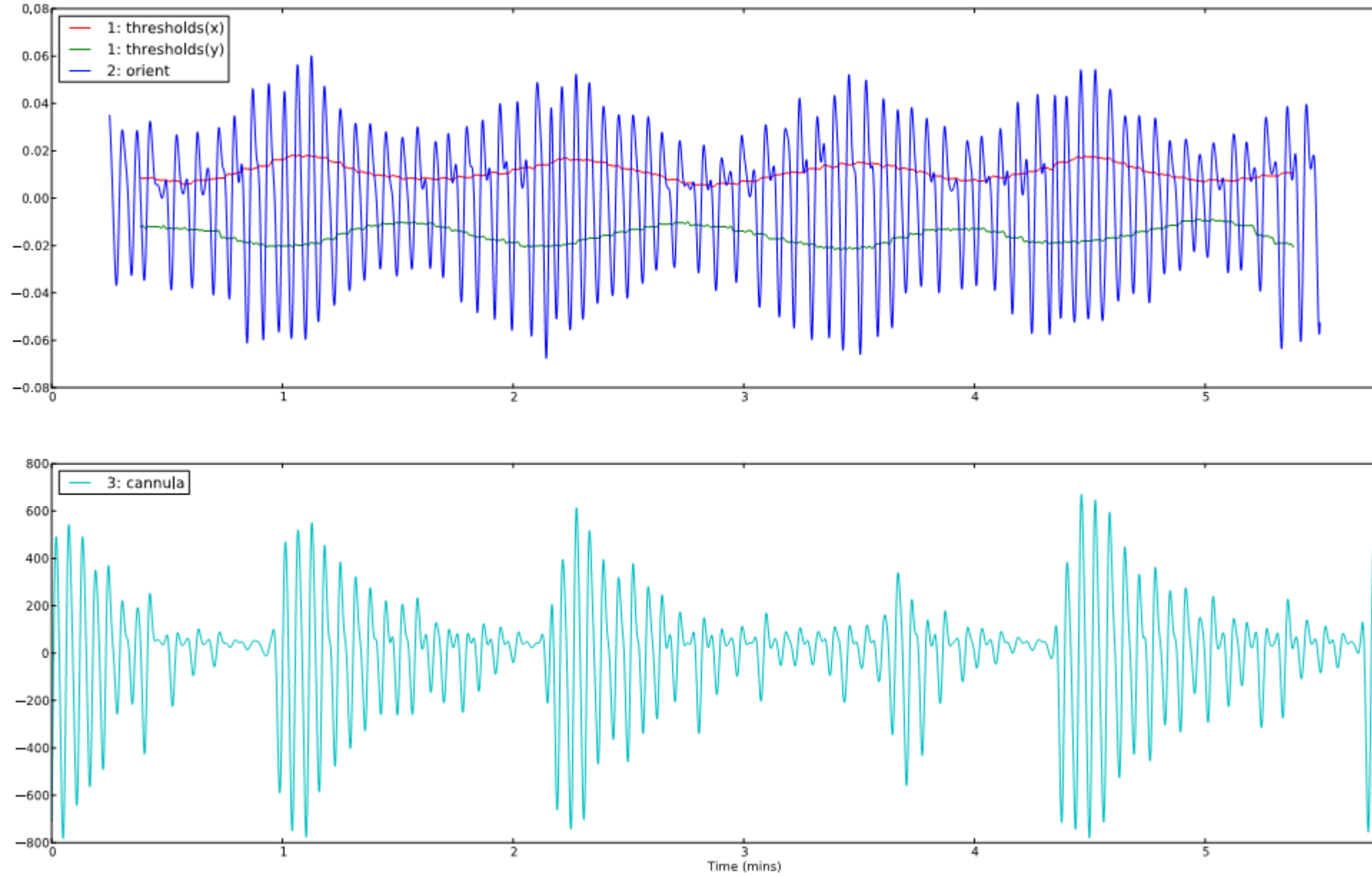
Two measures: mean and median rates


CRF: Patient 2 (12 hours)
Respiratory Rate (BPM)
25
20
15
10
5
0
20
40
60
80
100
120
Epoch (5 minutes)


CRF: Patient 6 (11 hours)
Respiratory Rate (BPM)
0
5
10
15
20
25
20
40
60
80
100
120
Epoch (5 minutes)

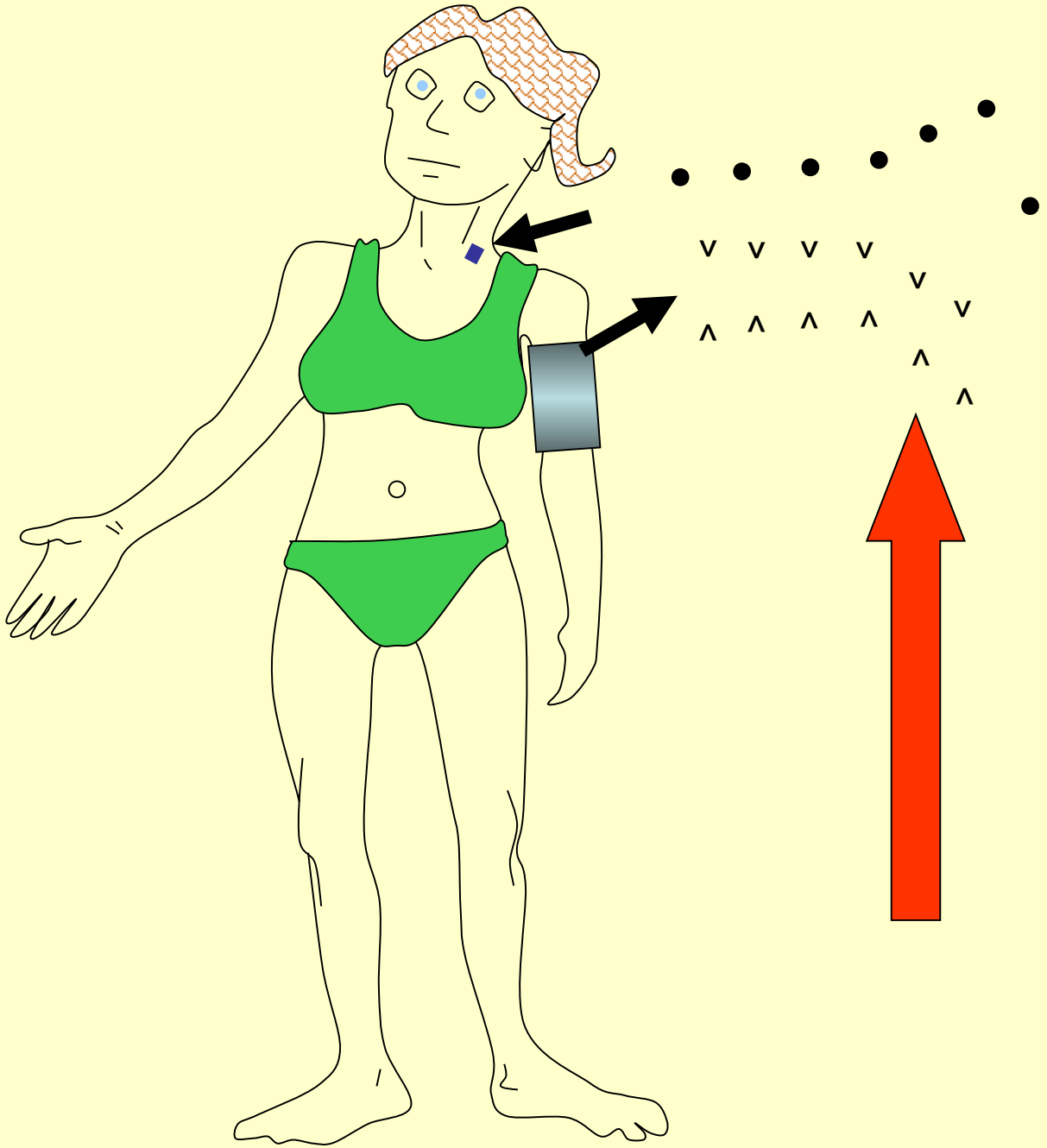

CRF: Patient 14 (13 hours)
Respiratory Rate (BPM)
20
15
10
5
20
40
60
80
100
120
140
160
Epoch (5 minutes)

What about obstructions?

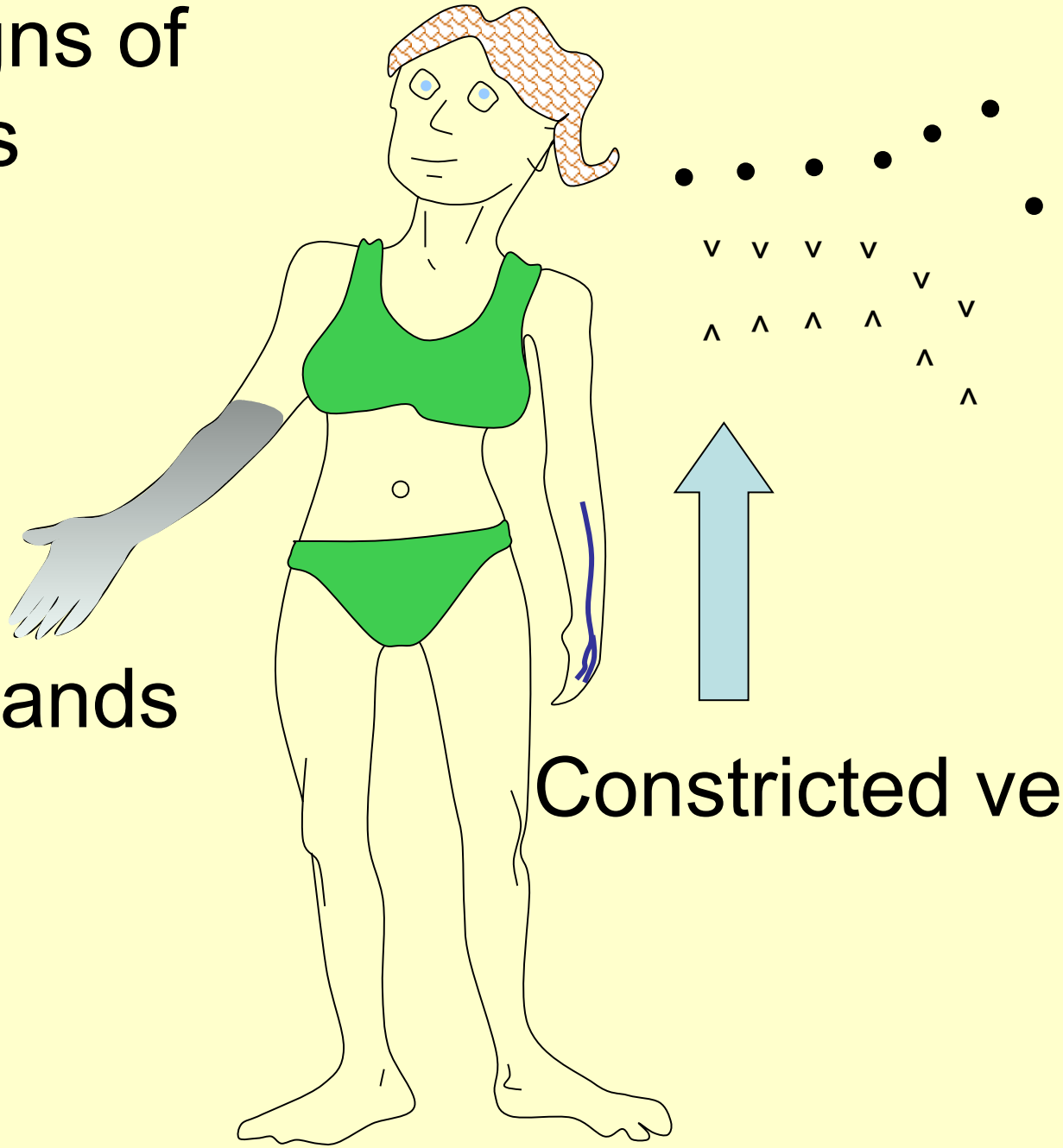


Measures of the circulation

- Unrecognised blood loss
  - “homeostasis”
- Sustain blood pressure
  - Running on empty

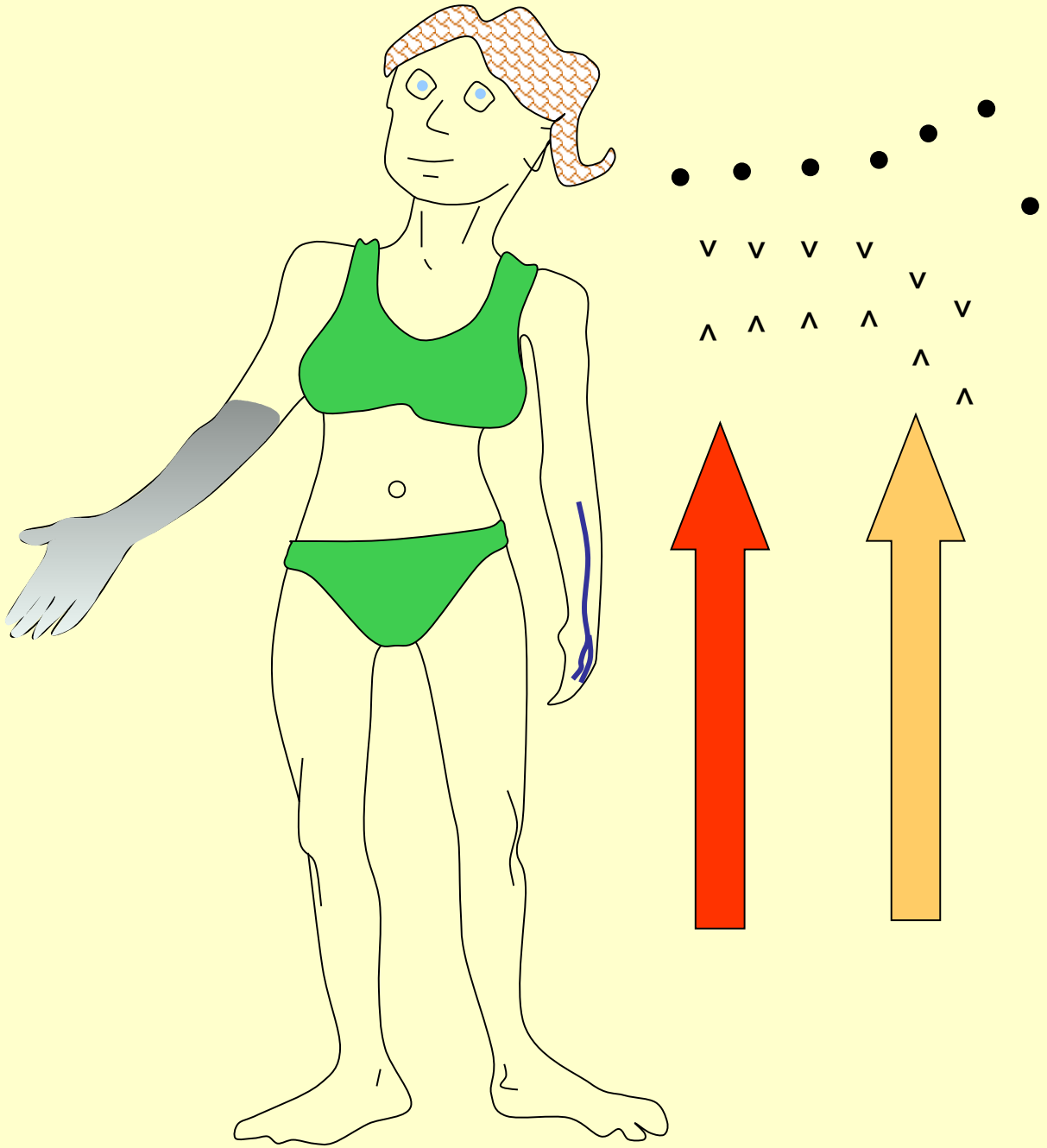


Earlier signs of Blood loss

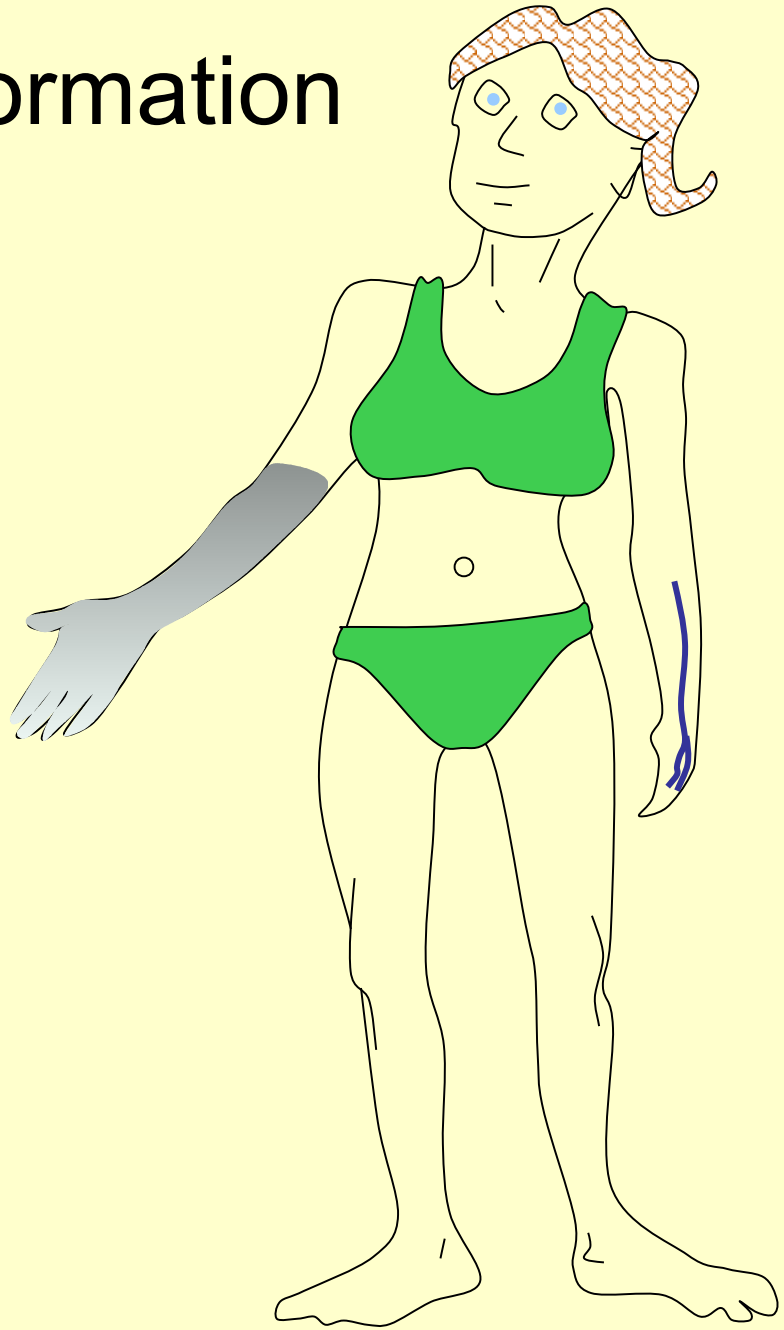


Cold hands

Constricted veins



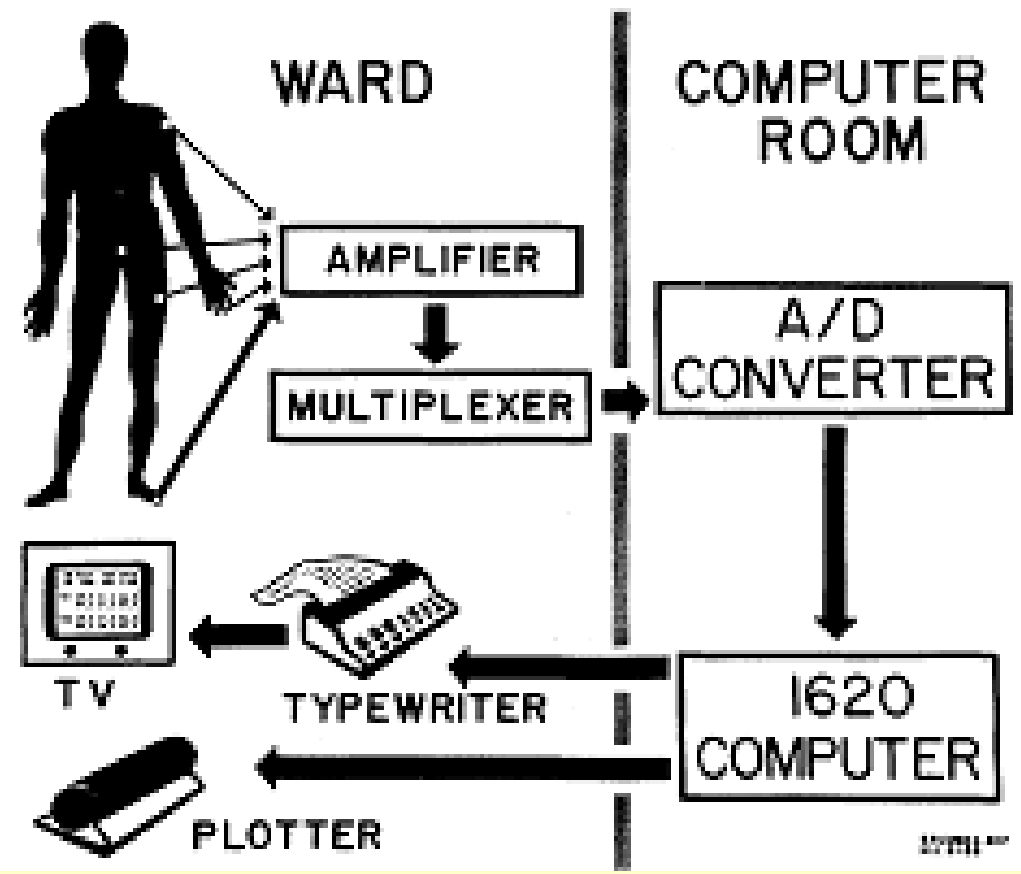
Clinical information is vital



Skin temperature isn't "new" technology….

Joly and Weil

- "Temperature gradient served as a more predictable indicator of survival or fatality than either arterial pressure or cardiac index"
- "…provides a valuable, inexpensive and noninvasive monitor in critically ill patients"

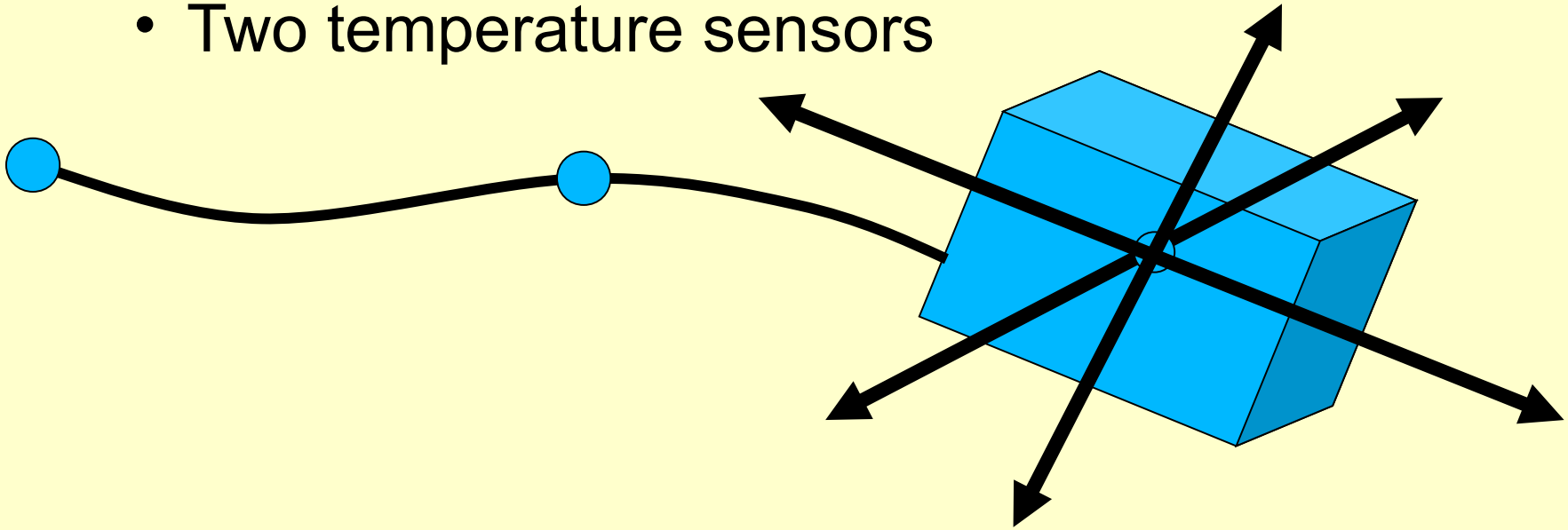


“The information was transmitted to an analog–to–digital converter and an IBM 1620 digital computer”

Joly and Weil, Temperature of the great toe as an indicator of the severity of shock Circulation (1969) **39** 131-8

The RespTemp Speck

- Added sensors
  - Orientation (gravity)
  - Acceleration (orthogonal axes)
  - Two temperature sensors



Current project

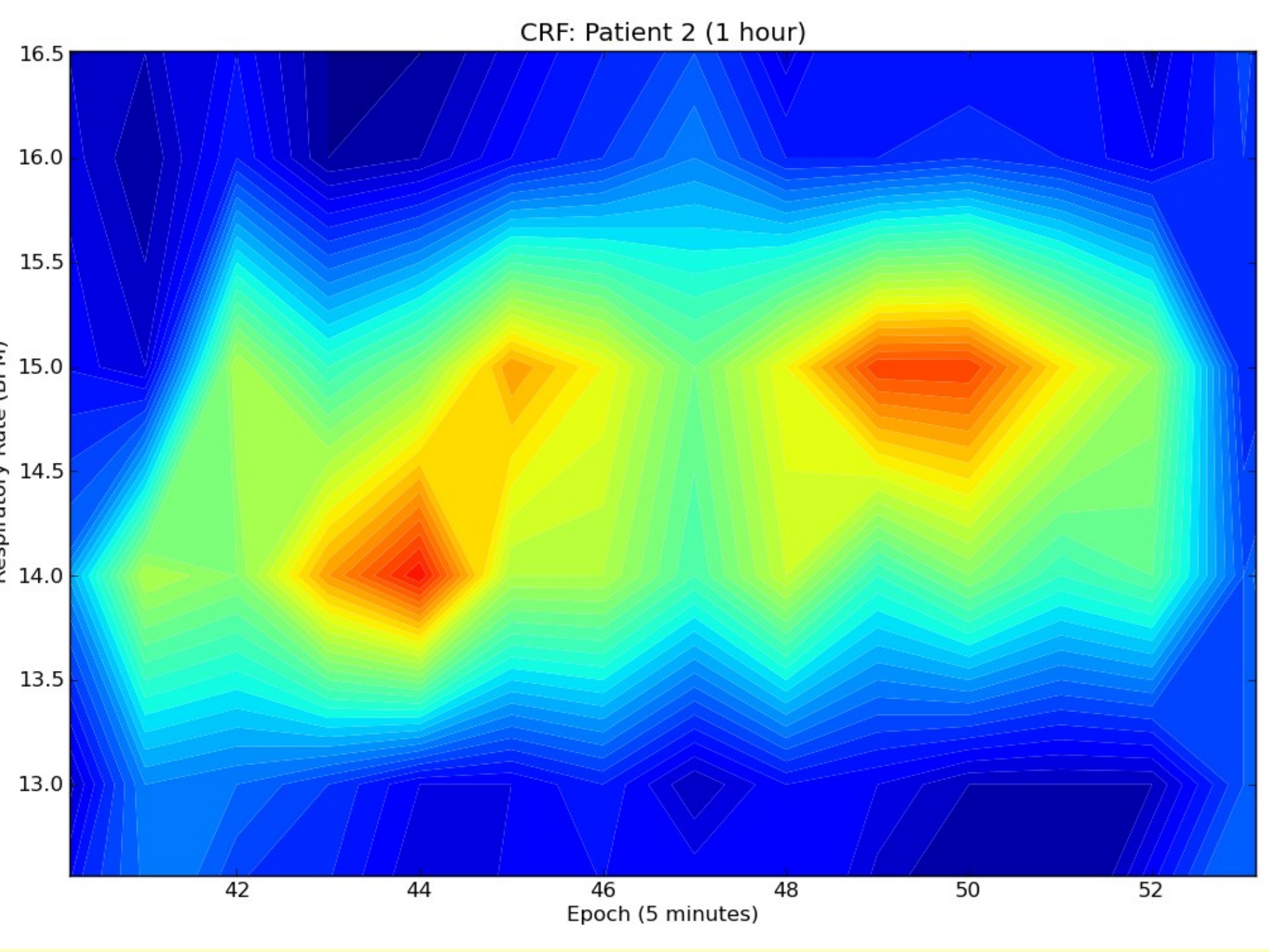
- Introduce monitoring to a surgical ward
  - Acquire signals
  - Display valuable information reliably
  - Learn to interpret the information
  - Learn to apply the information
- What could come of this?
  - Simple interventions can work
  - Complication rates decrease from 27 to 17%
  - Death rates after surgery 1.5% down to 0.8%
    - De Vries et al NEJM **363** 1928 (Nov 11 2010)

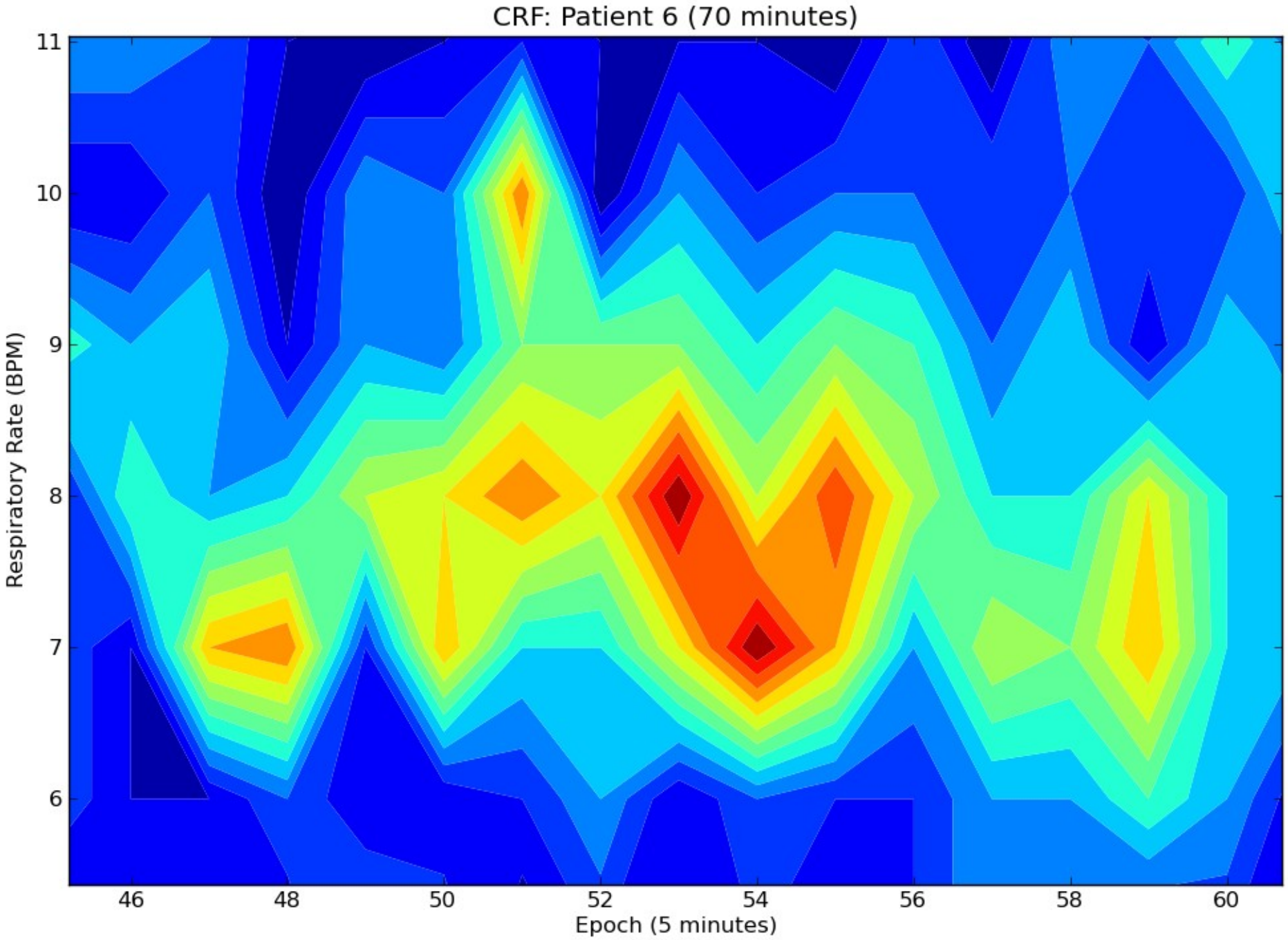
Our plans

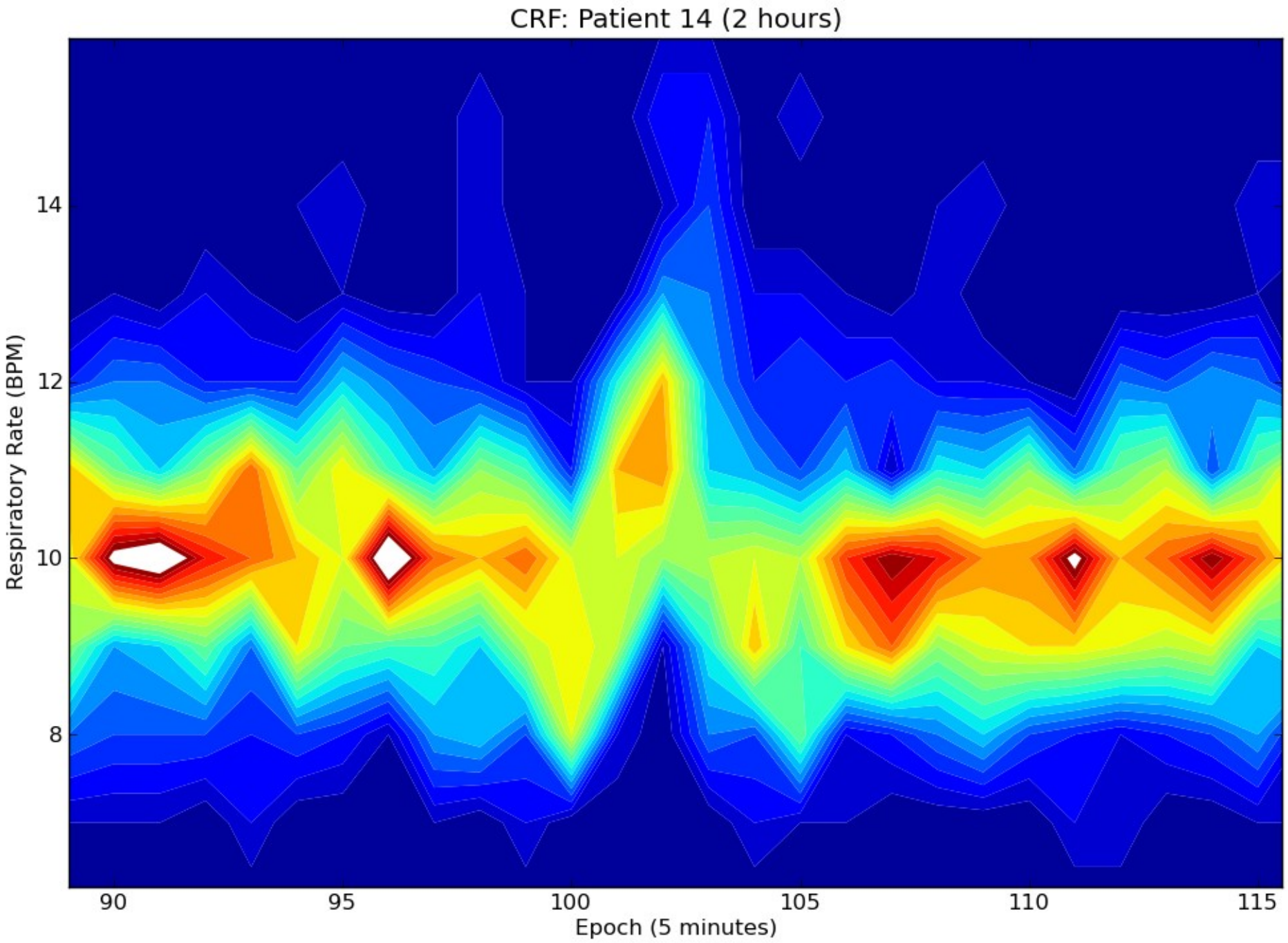
- MRC Efficacy and Mechanism Evaluation application
  - Informatics
  - Anaesthetics
  - Edinburgh Clinical Trials Unit
  - Nursing studies
  - Asst Med Director, Patient Safety
  - Probably more!

Thanks to:

- Andrew Bates, Janek Mann, DK Arvind
- Alasdair Waite and Antony Bateman
- Wellcome clinical research facility


CRF: Patient 2 (1 hour)
16.5
16.0
15.5
15.0
14.5
14.0
13.5
13.0
Respiratory Rate (BPM)
42
44
46
48
50
52
Epoch (5 minutes)


CRF: Patient 6 (70 minutes)
Respiratory Rate (BPM)
11
10
9
8
7
6
46
48
50
52
54
56
58
60
Epoch (5 minutes)


CRF: Patient 14 (2 hours)
Respiratory Rate (BPM)
14
12
10
8
90
95
100
105
110
115
Epoch (5 minutes)