# Statistical Process Control for Ambulance Services

**Debbie Shaw & Niroshan Siriwardena**

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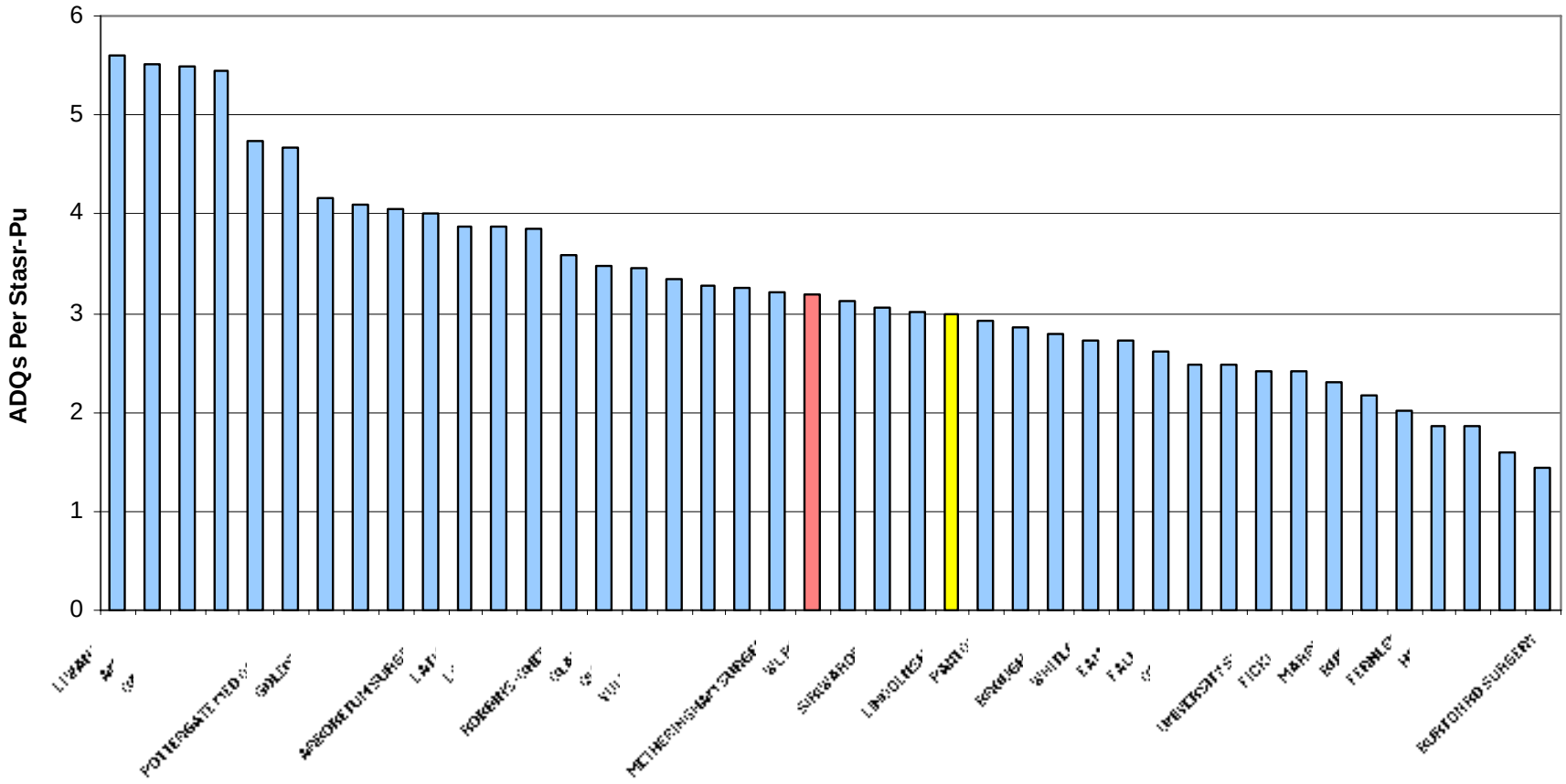
East Midlands Ambulance Service NHS
NHS Trust

# Performance measurement in the NHS

- League tables
- Balanced scorecards
- Traffic lights
- Targets

# League tables

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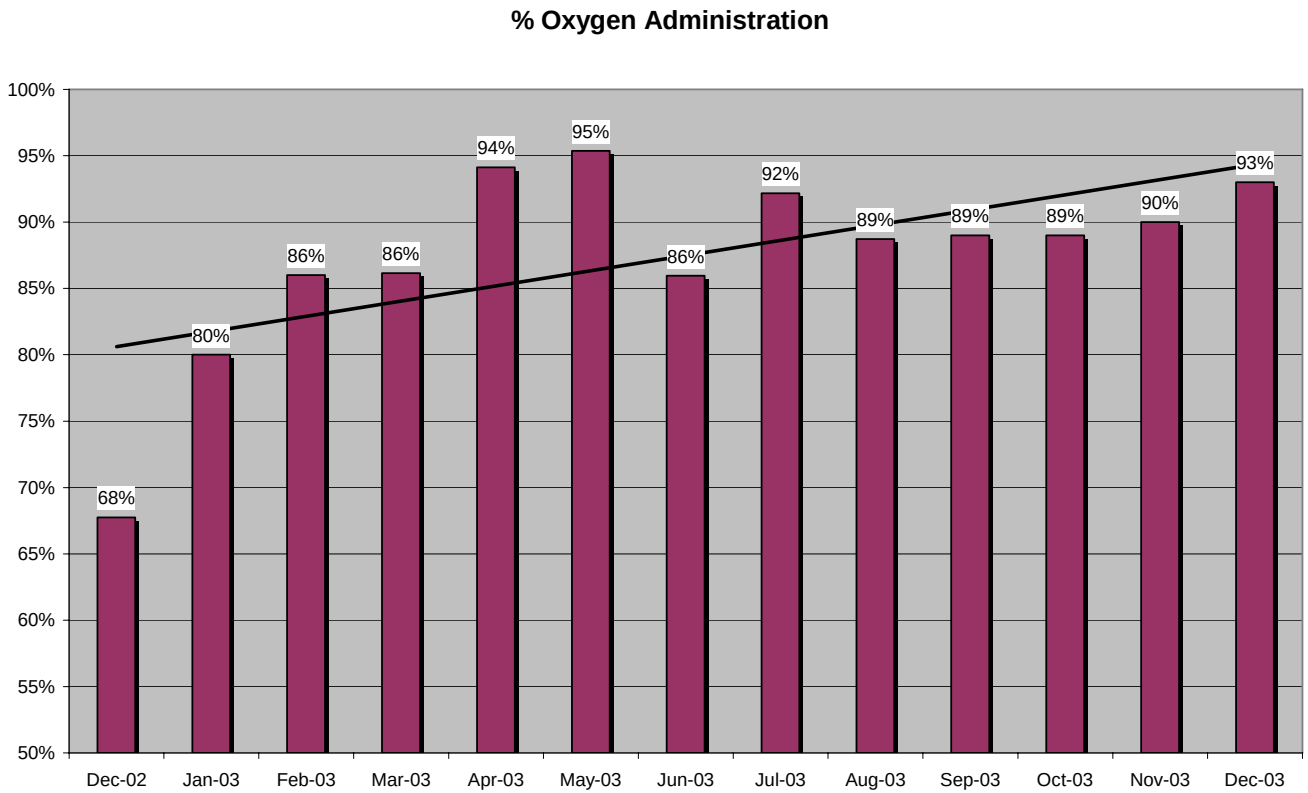
# Charts


% Oxygen Administration
100%
95%
90%
85%
80%
75%
70%
65%
60%
55%
50%
68%
80%
86%
86%
94%
95%
86%
92%
89%
89%
89%
90%
93%
Dec-02
Jan-03
Feb-03
Mar-03
Apr-03
May-03
Jun-03
Jul-03
Aug-03
Sep-03
Oct-03
Nov-03
Dec-03

'What do "targets" accomplish? Nothing. Wrong: their accomplishment is negative.‘

'Management by numerical goal is an attempt to manage without knowledge of what to do'.

*W Edwards Deming 1900-1993*

# History

- Walter Shewhart (Bell Telephone Laboratories 1924)
- W.E Deming
- Mohammed et al (Lancet, 357; 463-467)

# Types of variation

- “Common Cause” or “Routine” Variation
  - Inherent in a process

- “Special Cause” or “Exceptional” Variation
  - Something not part of a process

# Understanding variation

| "Routine" | "Exceptional" |
| --- | --- |
| "common cause" variation | "special cause" variation |
| due to "chance" causes | due to "assignable" causes |
| many factors | usually few, not many |
| often "unknowable" | can usually be identified |
| affects process most of the time | not part of the process |
| part of the process | intermittently apparent |
| variation is predictable | unpredictable variation |
| "noise in the system | |

# What to do about variation

"Routine"
("common cause variation")

- don't react to individual results
- look at the average and the range (limits)
- improve the whole process if these not acceptable
- or go for continuous quality improvement!

"Exceptional"
("special cause variation")

- investigate each point outside the limits
- look for the special cause and do something about it
- almost always something to find
- opportunities to learn

# Two kinds of mistake

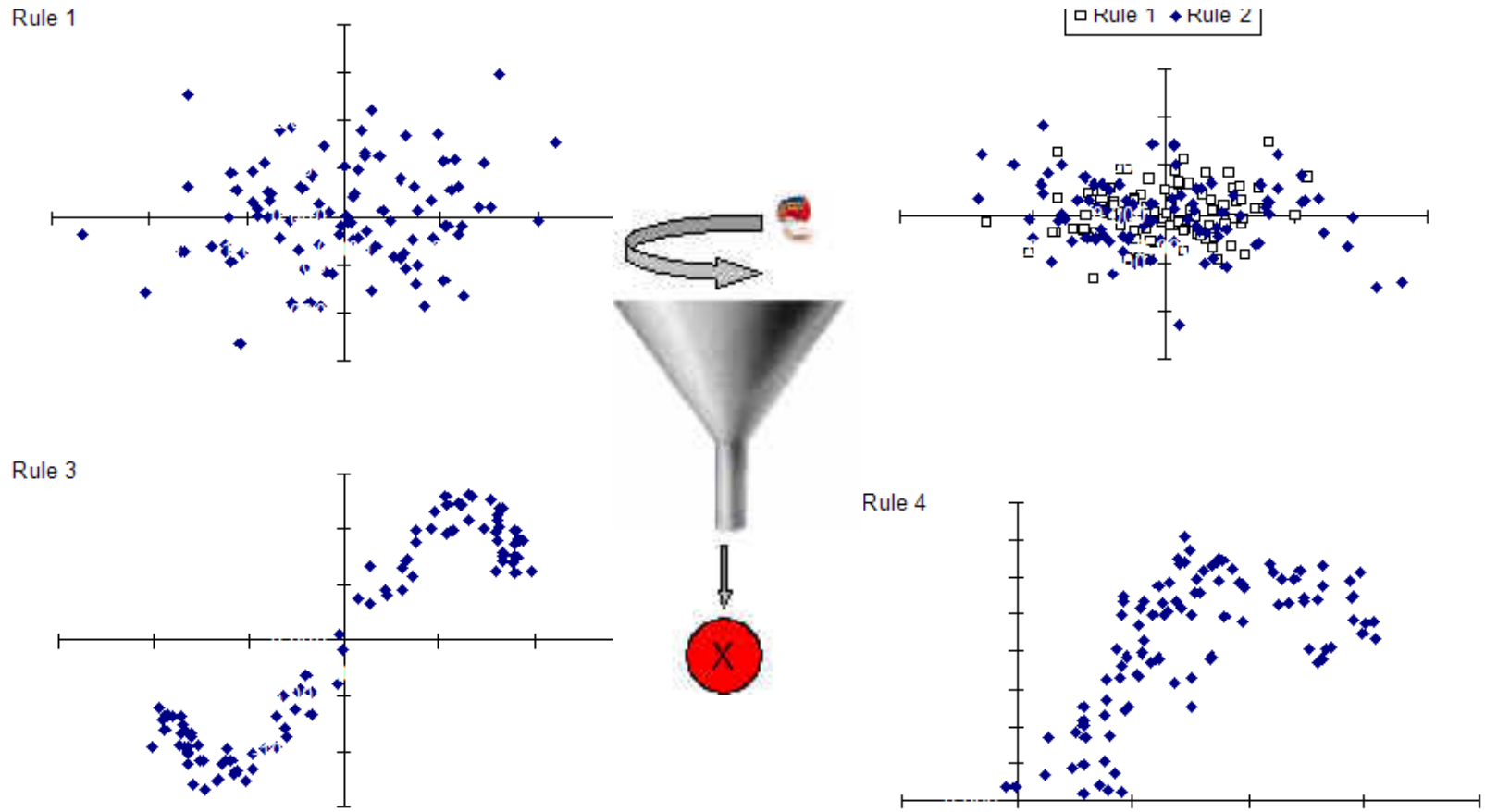
Mistake 1

- Respond as if there is exceptional variation when there is only routine variation happening
- Will make things worse
- Wasted effort

Mistake 2

- Fail to spot exceptional variation – assume there is just random variation at work
- Miss an opportunity to
  - reduce variation
  - improve quality
  - learn something

# Funnel experiment

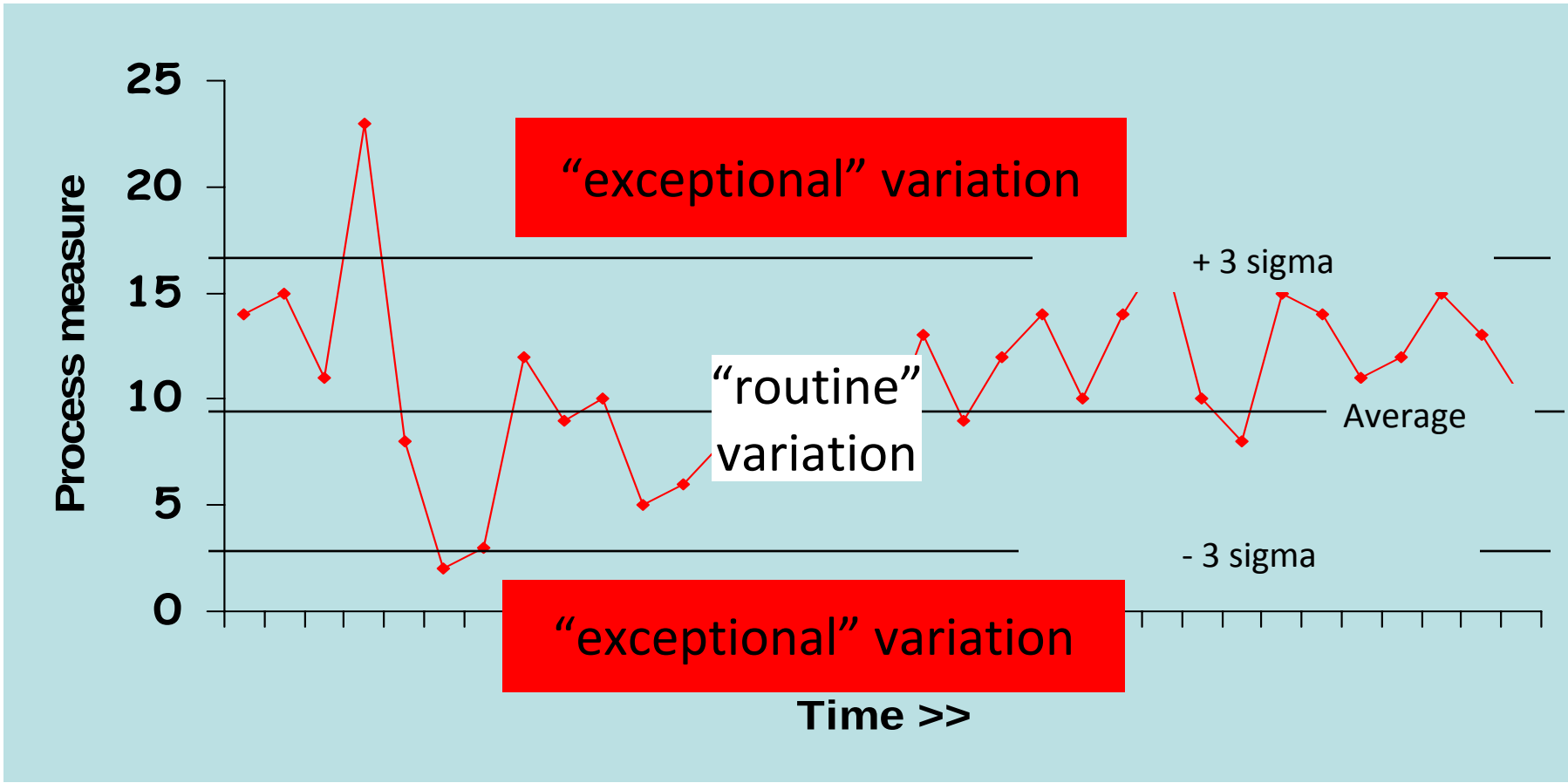



*Out of the Crisis by W. Edward Deming, 1968*

# Control charts

- Graphical method developed by Shewhart to help distinguish two kinds of variation
  - predictable vs. unpredictable
  - common vs. special cause
  - routine vs. exceptional

# An example control chart

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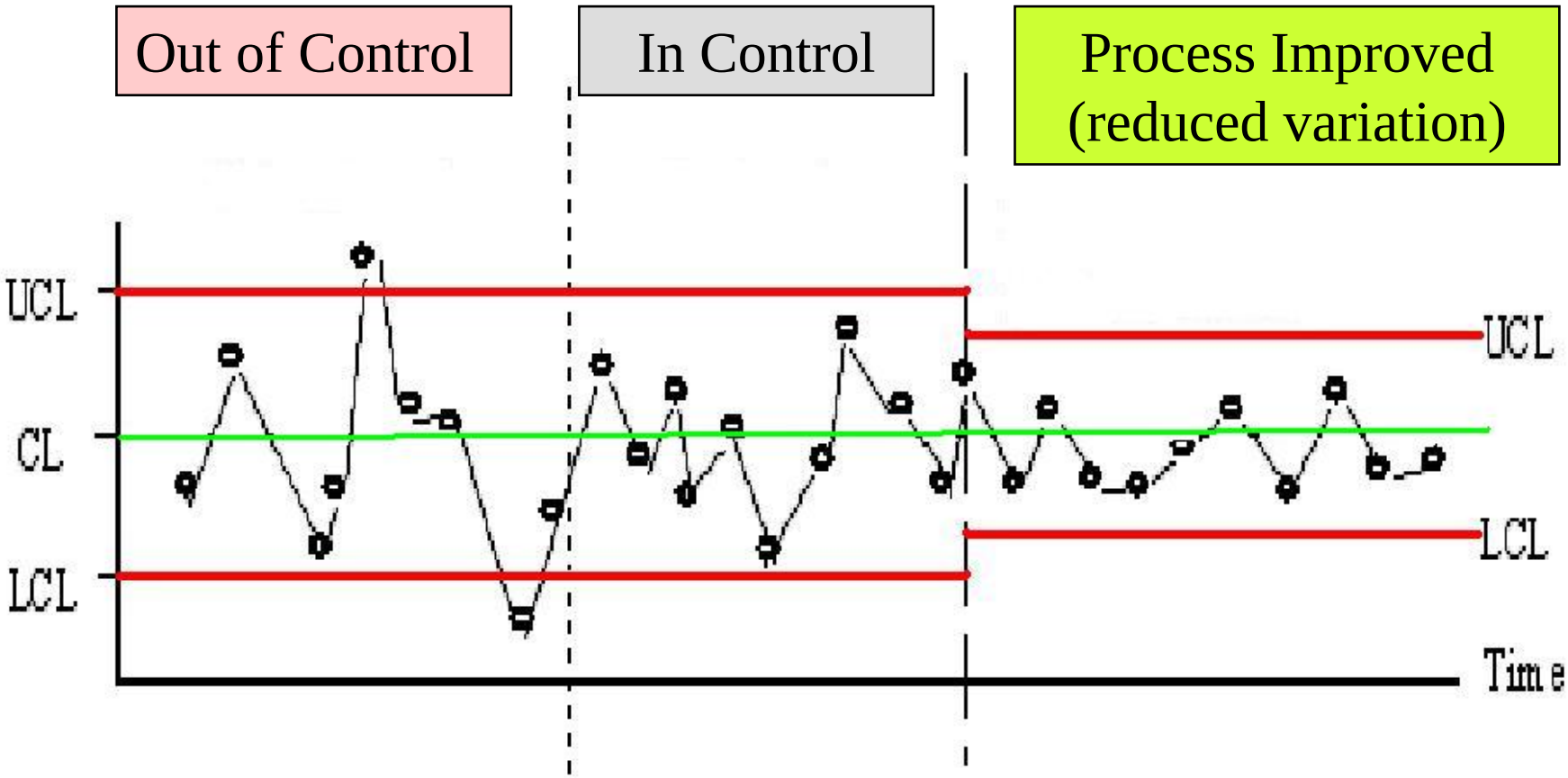
# Process “control”

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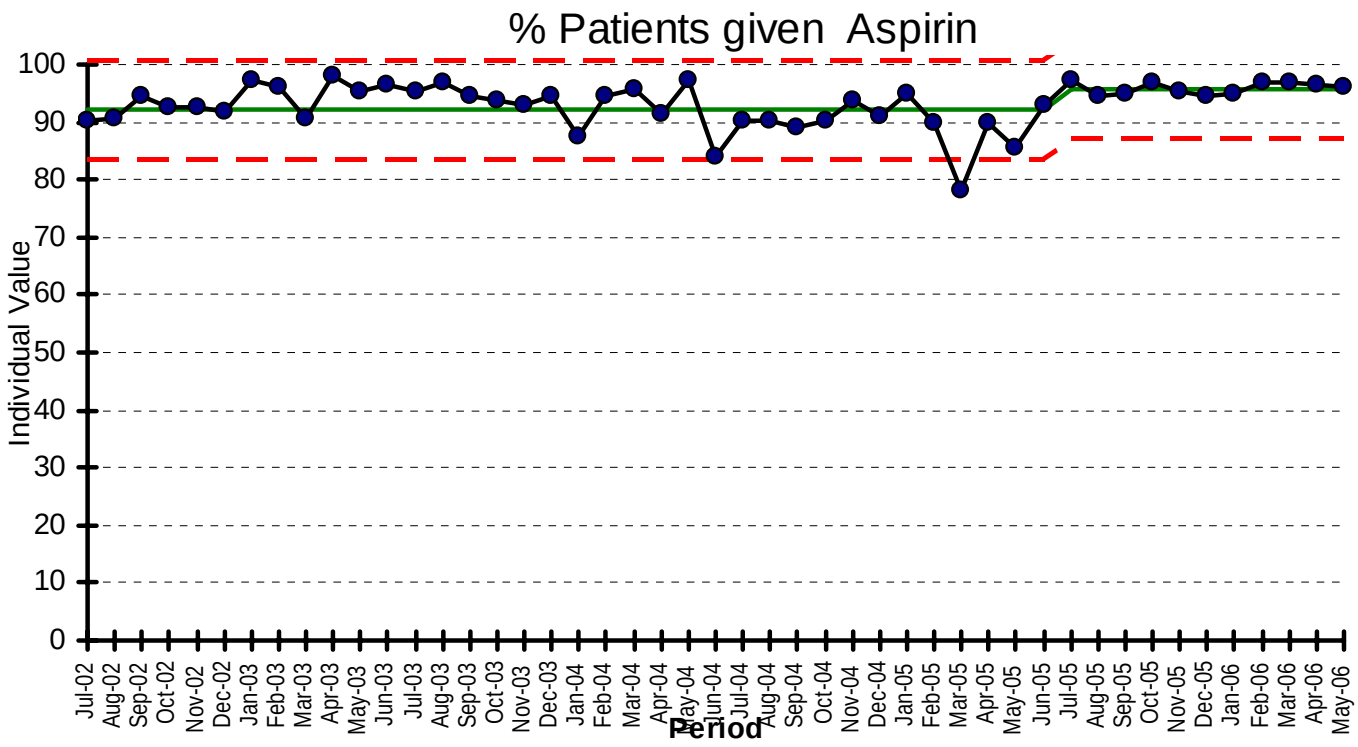
# Uses of control charts

- Monitoring
  - maintaining the status quo
- Analysis of variation
  - “how is this process working?”
- Improvement
  - action to reduce variation

- Measurement for judgement
- Measurement for diagnosis
- Measurement for improvement

# Aspirin

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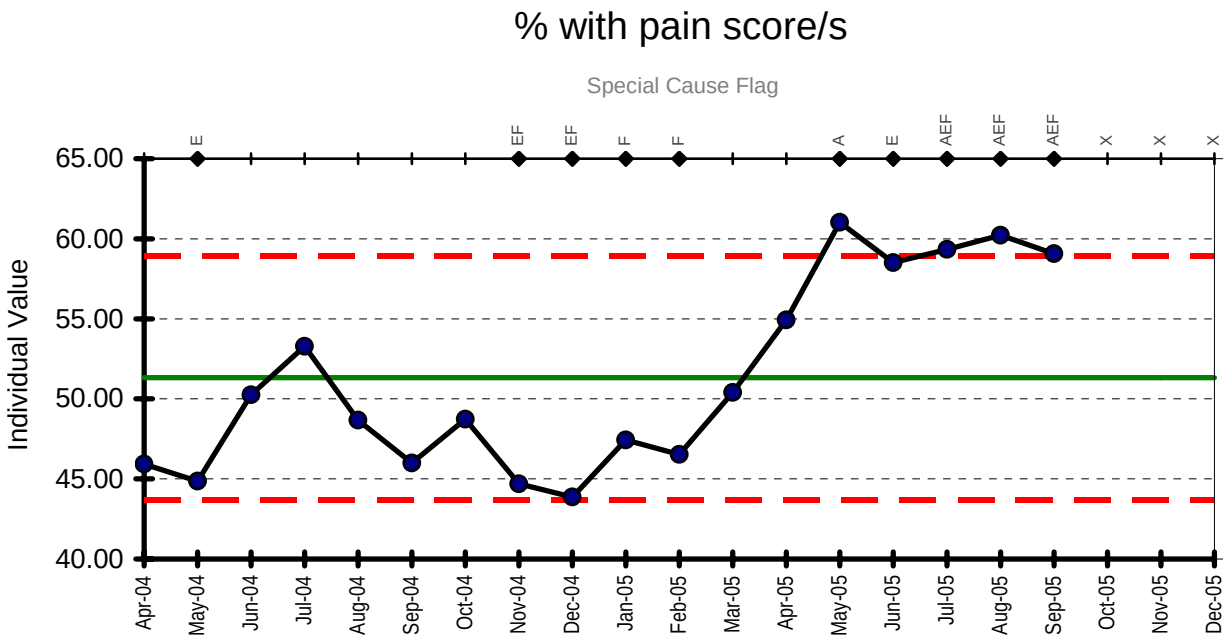
# Pain scores


% with pain score/s
Special Cause Flag
E
EF
EF
F
F
A
E
AEF
AEF
AEF
X
X
X
65.00
60.00
55.00
50.00
45.00
40.00
Individual Value
Apr-04
May-04
Jun-04
Jul-04
Aug-04
Sep-04
Oct-04
Nov-04
Dec-04
Jan-05
Feb-05
Mar-05
Apr-05
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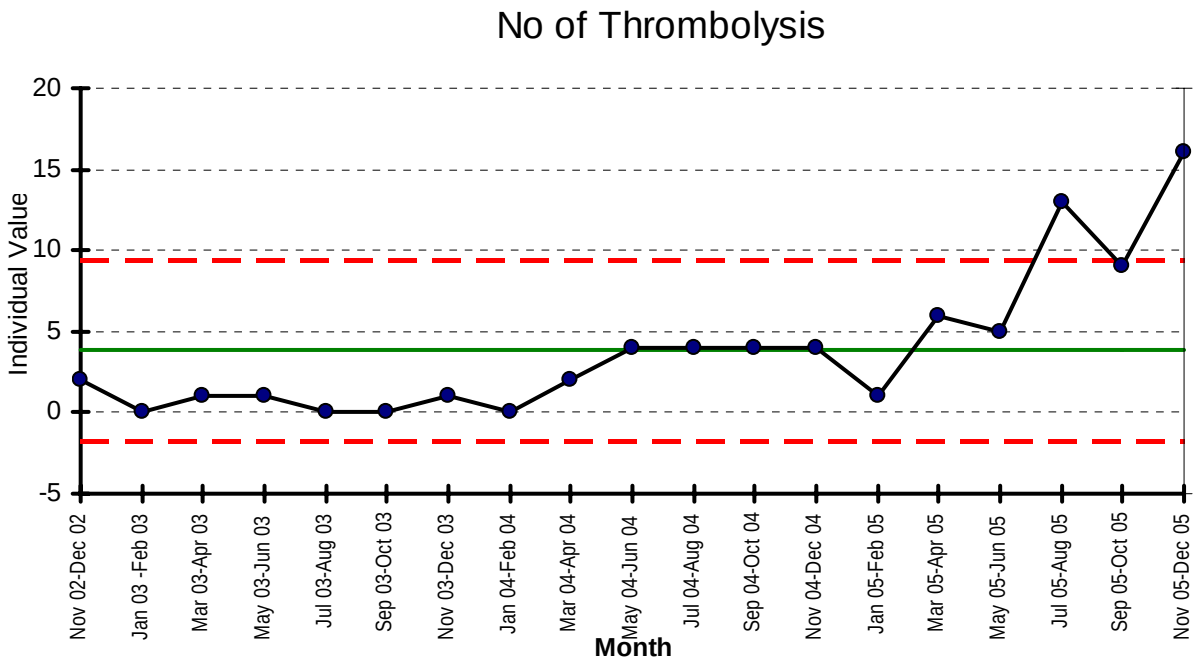
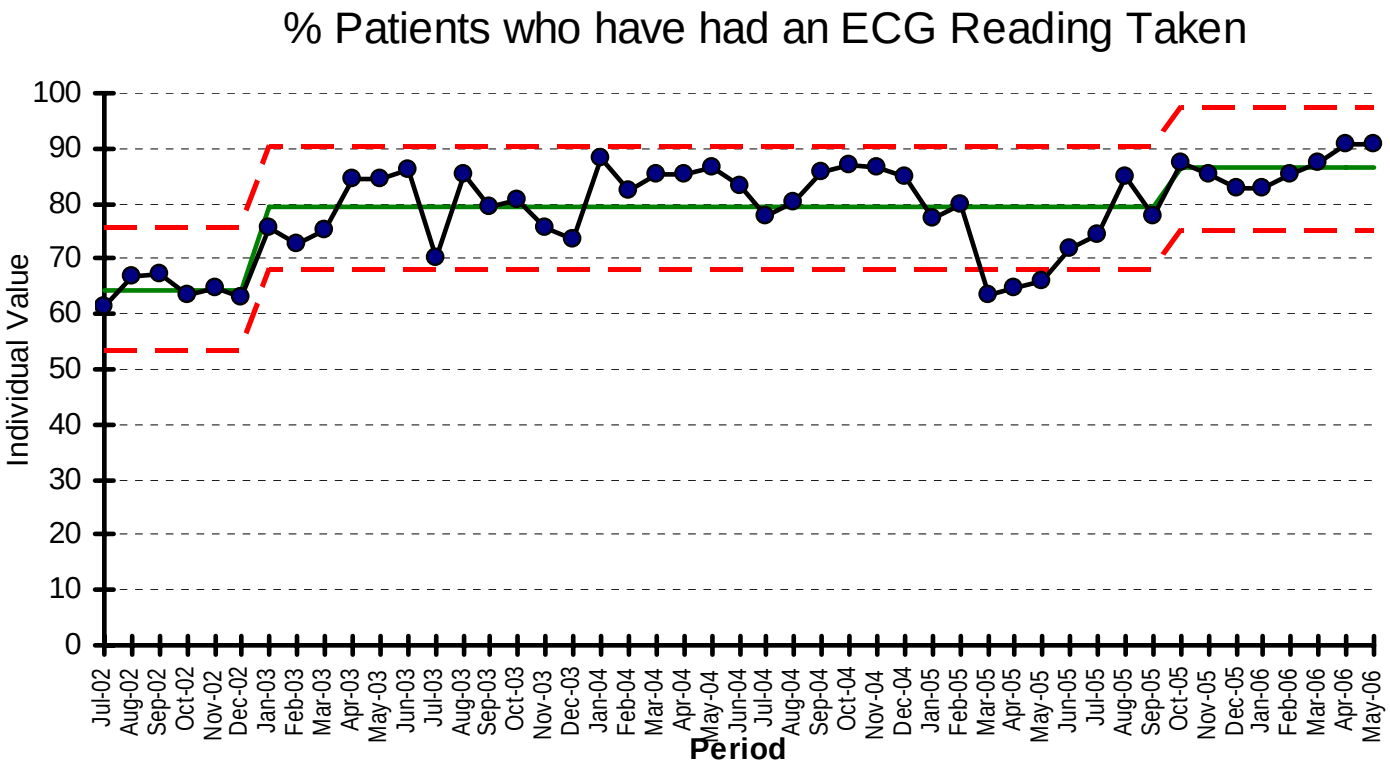
Nov-05
Dec-05

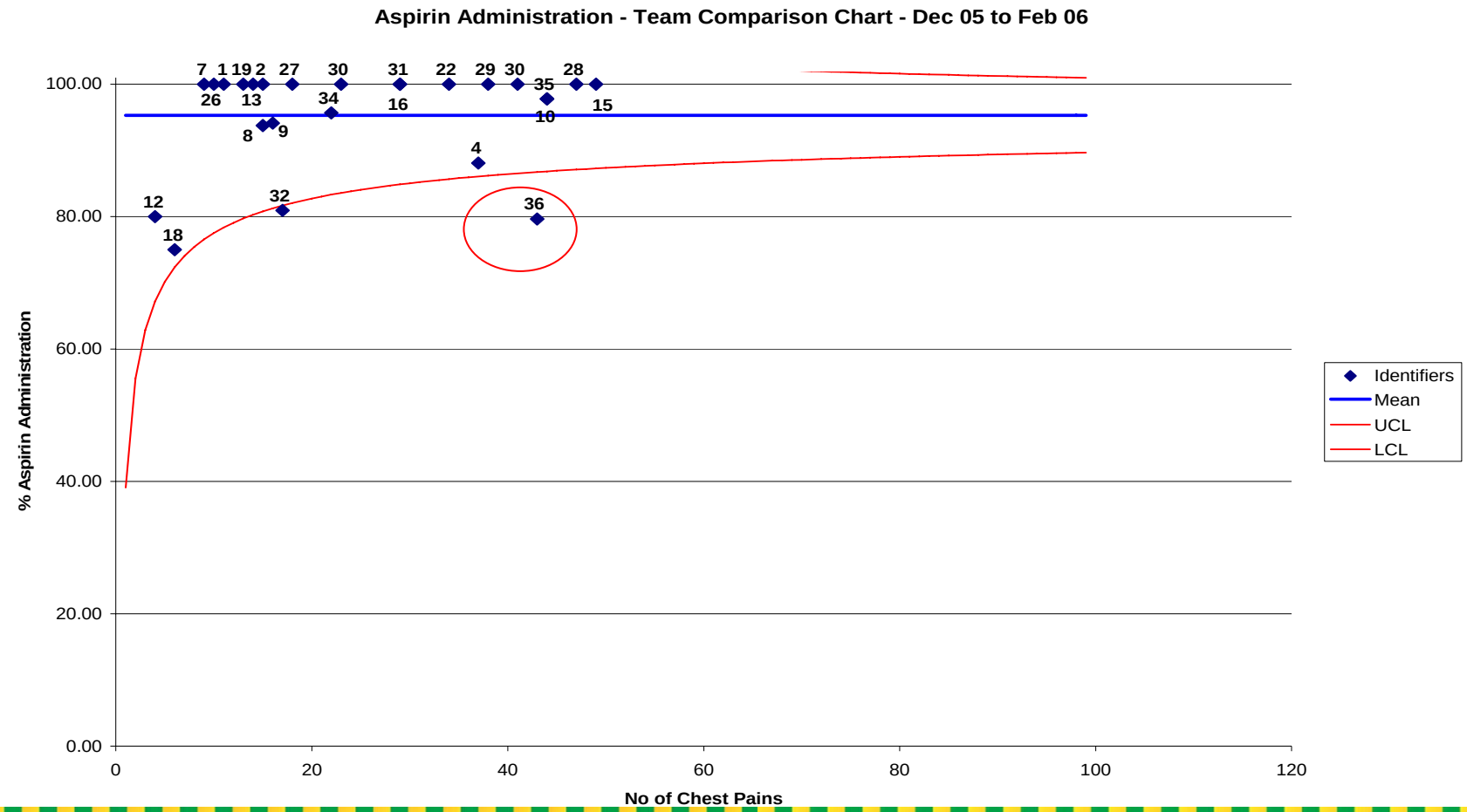
# Prehospital thrombolysis



# ECG acquisition



# Aspirin

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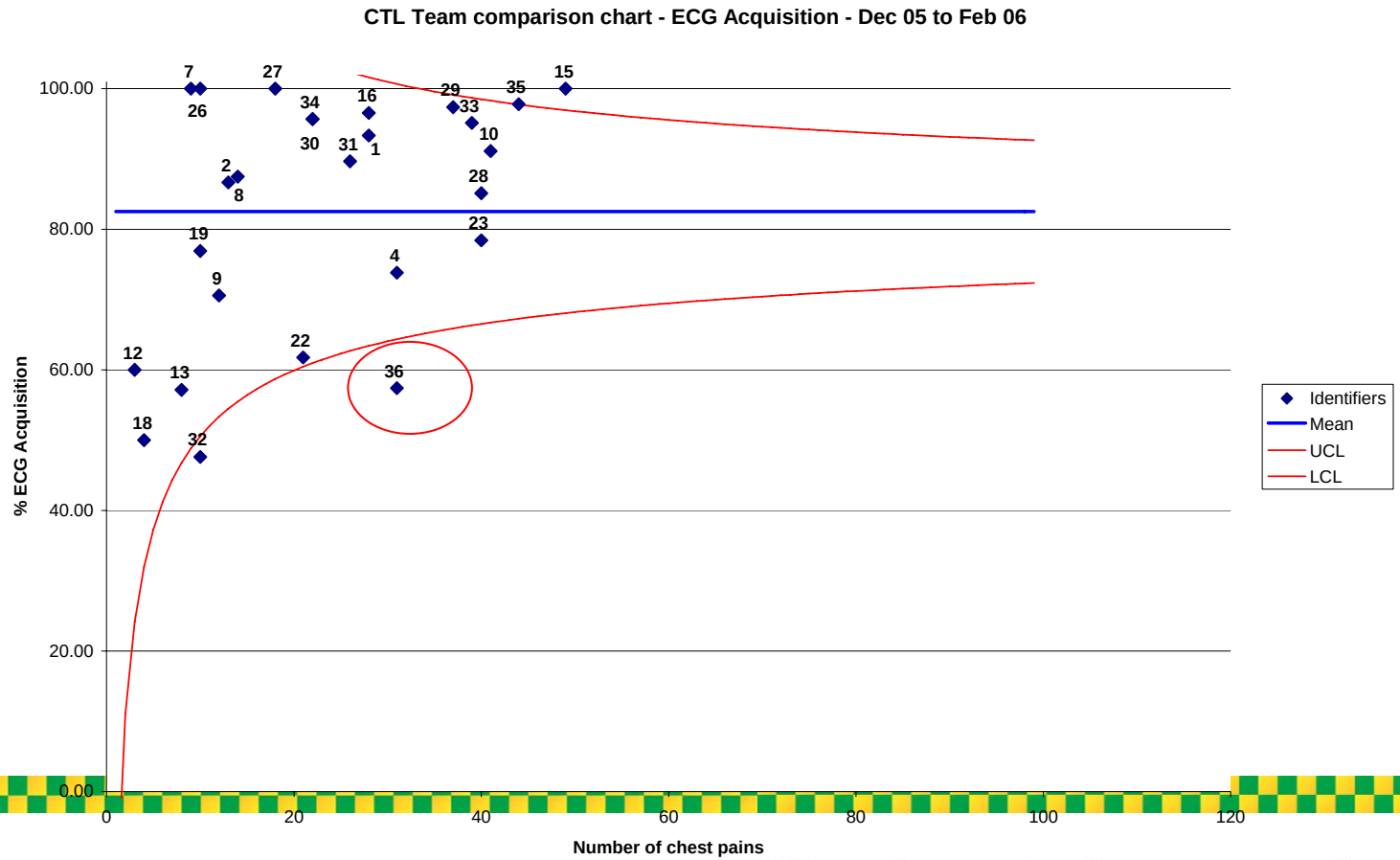
# 12-Lead ECGs

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# Recommended reading

- Statistical Process Control Methods in Public Health Intelligence, APHO Technical Briefing number 2, Dec 2007
- Improving Healthcare with Control Charts: Basic and Advanced SPC Methods and Case Studies, by Raymond G. Carey, 2003, ASQ Quality Press, Milwaukee, WI
- Measuring Quality Improvement in Healthcare: A Guide to Statistical Process Control Applications by R. G. Carey & R. C. Lloyd, 1995, ASQ Quality Press, Milwaukee, WI
- Making Sense of Data: SPC for the Service Sector, by Donald J. Wheeler, 2003, SPC Press, Knoxville

# Questions & Comments

http://www.youtube.com/watch?v=4wp3m1vg06Q

# Thank you!