Applied Statistics and Data Analysis Tools

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Pre-conference Patient Safety Symposium

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Alleged Research: P.A.R.C. Analysis

- **P**ractical
- **A**ccumulated
- **R**ecords
- **C**ompilation

- **P**assive
- **A**nalysis
- **R**egressions
- **C**orrelations

- **P**rofound
- **A**nalysis
- **R**elying (on)
- **C**omputers

- **P**lanning
- **A**fter
- **R**esearch
- **C**ompleted

Everytown, USA

Established: 1892

Population: 15,330

Elevation: 1,583’

Why physicians get mad…

"The target is for 90% of the bottom quartile to perform at the 2004 average by the end of 2008."

??????????????????????????????

A tailor takes measurements…a doctor takes measurements…

- Is the purpose quantitative information…
- …or a causal explanation?

“Data Torturing”

- Data not designed & collected *specifically* for the current purpose can generally be “tortured” to confess to a “hidden agenda” [NEJM October 14, 1993]

Causal analysis on “suit” data

Vague data
collected in response to a…

Vague problem

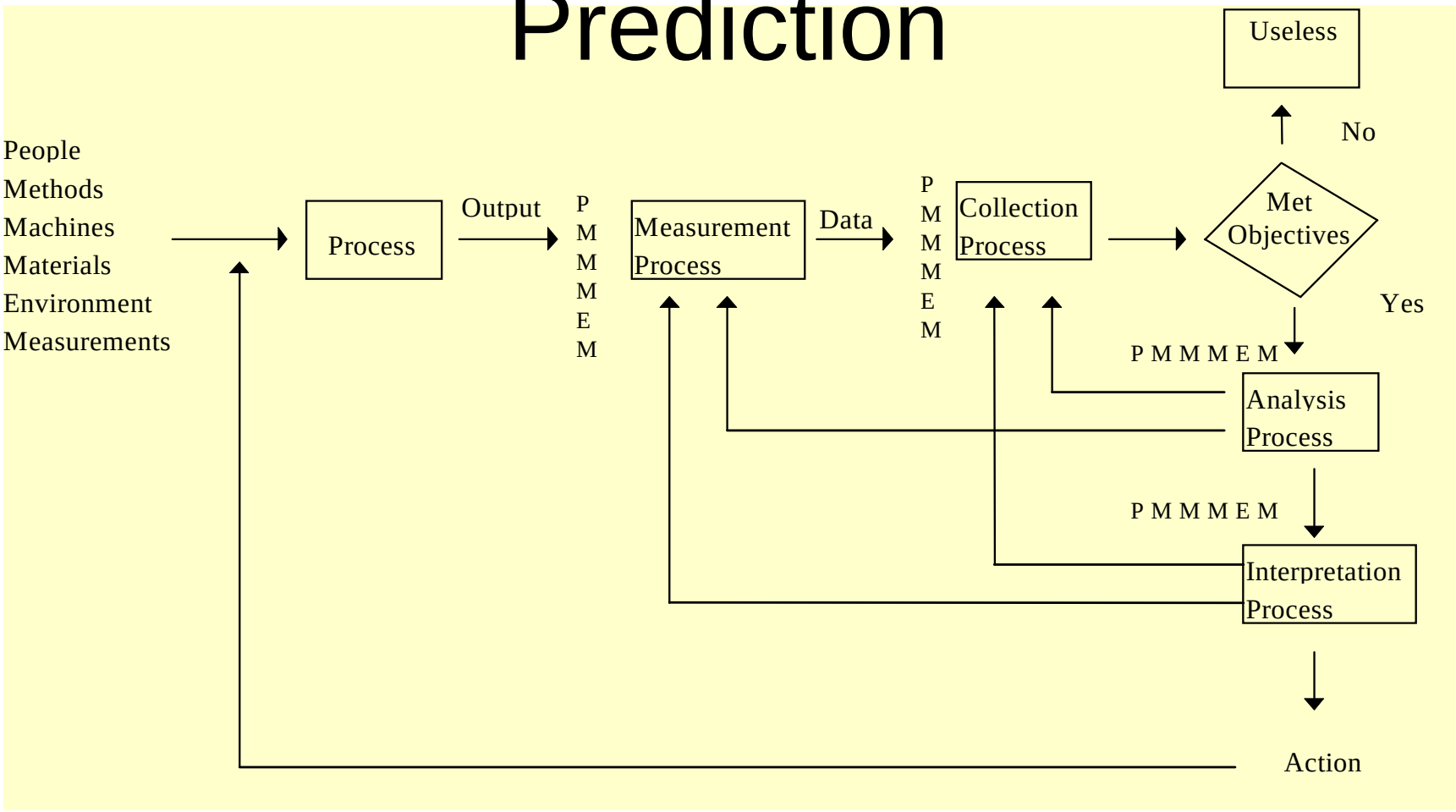
will yield a…

Vague solution,

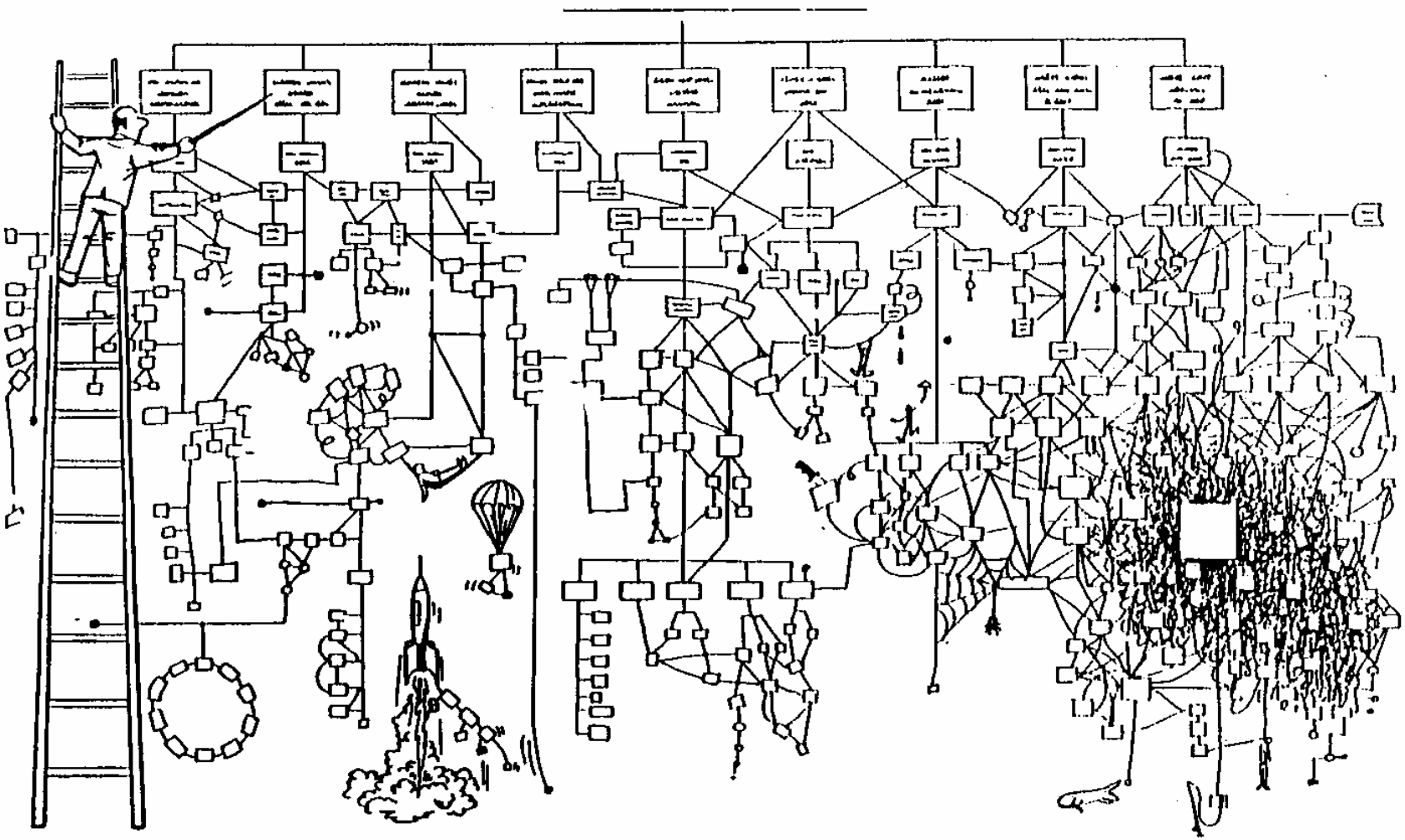
which, in turn, will yield a

Vague result.

“Process”: Estimation vs. Prediction

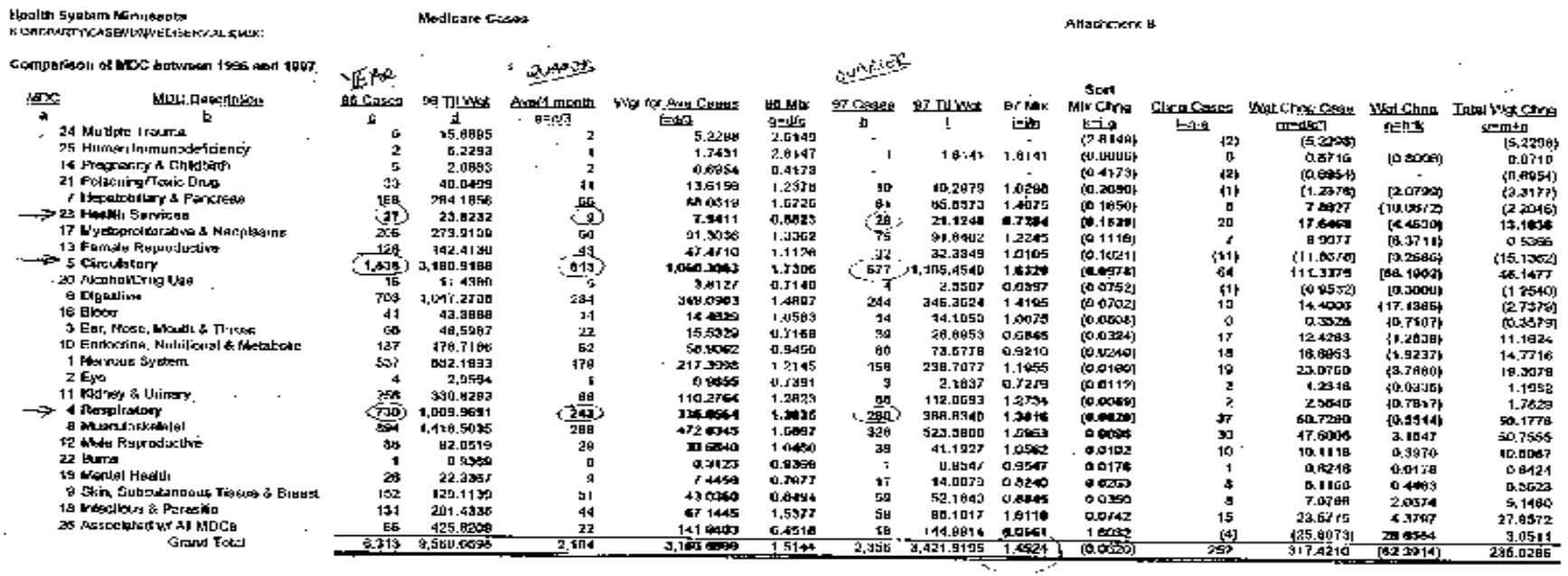


Clinical trial thinking: ***Control*** **of “variation” vs. …**



…Manifestation of variation

Déjà vu? How many meetings?



Health System Minnesota

Medicare Cases

Attachment B

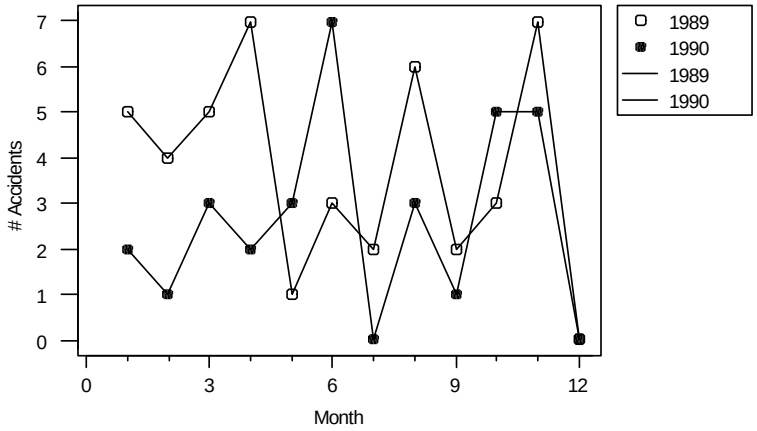
Comparison of MDC between 1996 and 1997

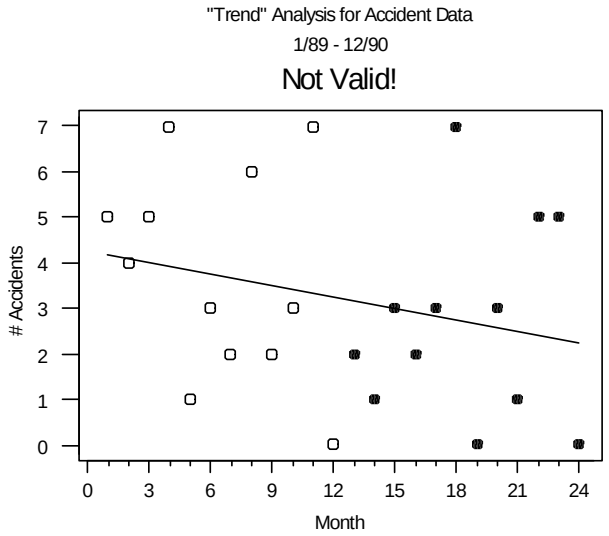
MDC	MDC Description	96 Cases	96 TI Wgt	Avg/1 month	Wgt for Ave Cases	96 Mix	97 Cases	97 TI Wgt	97 Mix	Mix Chng	Chng Cases	Wgt Chng Case	Wgt Chng	Total Wgt Chng
a	b	c	d	e=d/3	f=d/c	g=c/G	h	i	j=i/h	k=j-g	l=c-h	m=k*f	n=k*G	o=m+n
24	Multiple Trauma	6	35.6885	2	5.2298	2.0649	-	-	-	(2.0649)	(2)	(5.2298)		(5.2298)
25	Human Immunodeficiency	2	5.2293	1	1.7431	2.0647	1	1.8141	1.8141	(0.0006)	0	0.0716	(0.0008)	0.0710
14	Pregnancy & Childbirth	5	2.0883	2	0.6954	0.4173	-	-	-	(0.4173)	(2)	(0.6954)	-	(0.6954)
21	Poisoning/Toxic Drug	33	40.0499	11	13.6159	1.2378	30	40.2079	1.0268	(0.2080)	(1)	(1.2378)	(2.0792)	(3.3171)
7	Hepatobiliary & Pancreas	168	284.1856	56	68.0619	1.0220	81	85.8573	1.4075	(0.1650)	6	7.8927	(10.9572)	(2.2046)
23	Health Services	27	23.8232	9	7.9411	0.8823	28	21.1248	0.7384	(0.1439)	20	17.6468	(4.4530)	13.1938
17	Myeloproliferative & Neoplasms	206	279.9139	69	91.3036	1.0362	75	91.8402	1.2245	(0.1118)	7	8.9077	(8.3711)	0.5366
5	Circulatory	1,635	3,180.9188	545	1,060.3063	1.7306	577	1,105.4540	1.9159	(0.0974)	64	111.3379	(58.1992)	55.1477
20	Alcohol/Drug Use	16	51.4880	5	3.8127	0.7140	4	2.5507	0.6397	(0.0752)	(1)	(0.9552)	(0.3000)	(1.2540)
6	Digestive	703	1,041.2708	234	348.0903	1.4807	244	346.3624	1.4195	(0.0702)	13	14.4000	(17.4886)	(2.7378)
16	Blood	41	43.3888	14	14.4629	1.0583	14	14.1059	1.0075	(0.0508)	0	0.3526	(0.7107)	(0.3579)
3	Ear, Nose, Mouth & Throat	66	48.5987	22	15.5329	0.7168	39	28.6953	0.6865	(0.0324)	17	12.4283	(1.2638)	11.1624
10	Endocrine, Nutritional & Metabolic	127	176.7186	62	58.9062	0.9450	80	73.6778	0.9210	(0.0240)	19	16.8863	(1.9237)	14.7716
1	Nervous System	537	652.1833	179	217.3398	1.2145	158	238.7077	1.1455	(0.0690)	19	23.0760	(3.7680)	19.3078
2	Eye	4	2.0594	1	0.6865	0.7391	3	2.1837	0.7279	(0.0113)	2	1.2348	(0.0335)	1.1952
11	Kidney & Urinary	256	330.8283	88	110.2764	1.2823	86	112.0693	1.2734	(0.0089)	2	2.5640	(0.7847)	1.7629
4	Respiratory	730	1,009.9691	243	336.6564	1.3836	280	368.8340	1.3416	(0.0420)	37	50.7280	(0.5514)	50.1778
8	Musculoskeletal	894	1,418.5035	298	472.8345	1.0887	328	523.3800	1.0963	0.0076	30	47.6005	3.1047	50.7565
12	Male Reproductive	38	82.0519	20	30.6840	1.0460	38	41.1927	1.0562	0.0102	10	10.1118	0.3970	10.0087
22	Burns	1	0.9359	0	0.3123	0.9356	1	0.9547	0.9547	0.0176	1	0.6216	0.0138	0.6424
19	Mental Health	26	22.3357	9	7.4459	0.7077	17	14.0079	0.8240	0.0250	8	5.1160	0.4463	5.5623
9	Skin, Subcutaneous Tissue & Breast	152	129.1139	51	43.0380	0.8494	59	52.1840	0.8845	0.0350	8	7.0788	2.0574	9.1480
18	Infectious & Parasitic	131	201.4335	44	67.1445	1.5377	58	86.1017	1.6118	0.0742	15	23.6715	4.3797	27.8572
25	Associated w/ All MDCs	66	425.8208	22	141.9403	6.4518	18	144.8814	8.0501	1.6032	(4)	(25.8073)	28.8564	3.0511
	Grand Total	9,313	9,560.0695	2,104	3,186.6898	1.5144	2,356	3,421.9195	1.4524	(0.0620)	252	317.4210	(82.3914)	236.0286

Pages & pages…

Safety Data: Goal—reduce accidents by 25%

45 vs. 32





("Trend" of 4.173 to 2.243)

8 months are lower than previous year

Reduction is 46.2% !

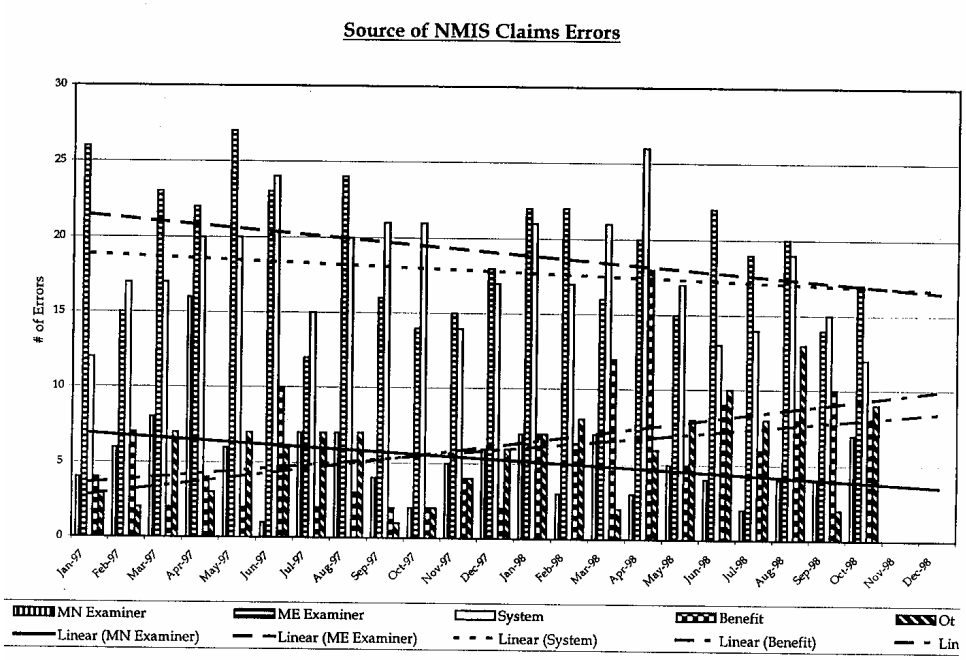
Every month—Safety review of each incident…

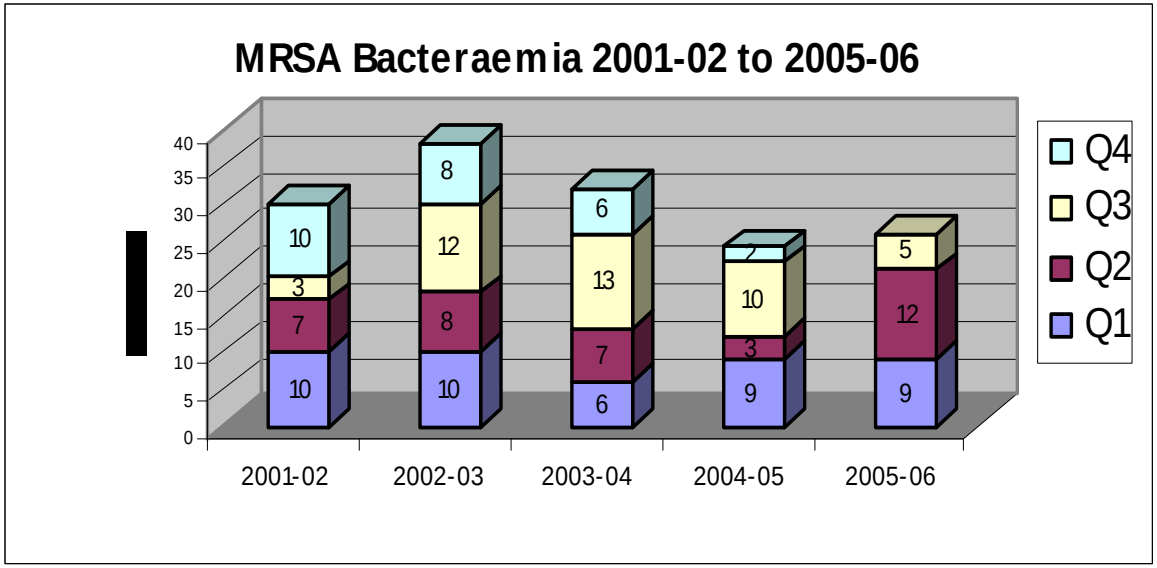
Goals a la Dilbert

- Boss:
  - Our goal this year is ZERO disabling injuries.
  - Last year our goal was 25 disabling injuries; however, in retrospect, that was a mistake…

“Process-oriented” definition of accident

- **“A hazardous situation that was unsuccessfully avoided.”**
- **“But, Davis, these things *shouldn’t* happen!”**
- **I know…but are you *perfectly designed* to have them happen?**





I *HATE* bar graphs & trend lines…

SHA name	30-Mar-03	6-Apr-03	13-Apr-03	20-Apr-03	27-Apr-03	4-May-03	11-May-03	18-May-03	25-May-03	1-Jun-03
Avon, Gloucestershire & Wiltshire	89.7%	85.1%	83.9%	85.1%	85.2%	84.9%	85.7%	85.5%	85.3%	85.2%
Bedfordshire and Hertfordshire	93.1%	89.1%	88.0%	84.9%	84.3%	85.4%	85.7%	86.8%	87.8%	85.3%
Birmingham and the Black Country	91.8%	85.4%	84.9%	85.8%	85.6%	84.8%	88.7%	88.3%	86.7%	87.5%
Cheshire & Merseyside	95.2%	90.1%	88.5%	87.3%	87.0%	85.7%	88.1%	88.0%	87.9%	87.6%
County Durham & Tees Valley	94.8%	96.4%	94.7%	94.6%	92.2%	93.9%	95.5%	94.3%	92.0%	94.2%
Cumbria & Lancashire	91.7%	91.6%	92.1%	93.0%	92.0%	92.7%	93.6%	93.5%	92.6%	91.9%
Dorset & Somerset	93.8%	91.2%	89.7%	92.3%	91.5%	91.5%	89.7%	93.2%	90.9%	92.8%
Essex	93.8%	90.8%	91.2%	91.1%	91.5%	90.3%	92.3%	89.9%	91.1%	90.5%
Greater Manchester	94.7%	91.0%	90.7%	88.8%	89.5%	90.0%	90.8%	92.6%	91.1%	89.8%
Hampshire and Isle of Wight	90.6%	83.5%	84.3%	81.4%	84.0%	82.3%	81.7%	82.8%	80.8%	79.7%
Kent and Medway	88.1%	90.1%	89.5%	89.6%	87.6%	86.0%	91.0%	92.2%	89.3%	87.4%
Leicestershire, Northamptonshire & Rutland	86.1%	73.3%	72.2%	74.7%	74.0%	72.8%	77.4%	75.9%	78.4%	73.0%
Norfolk, Suffolk and Cambridgeshire	93.6%	88.4%	86.6%	86.0%	85.8%	87.9%	87.6%	87.3%	85.9%	86.0%
North and East Yorkshire and Northern Lincolnshire	94.2%	92.7%	93.3%	92.4%	91.7%	90.0%	91.5%	91.7%	90.7%	92.0%
North Central London	93.7%	83.7%	86.6%	84.4%	86.1%	84.9%	84.9%	85.4%	85.1%	83.9%
North East London	93.7%	84.4%	80.8%	79.7%	78.8%	78.8%	81.9%	81.6%	79.6%	80.1%
North West London	94.6%	86.7%	86.2%	86.4%	83.7%	83.1%	81.9%	82.2%	81.4%	82.6%
Northumberland, Tyne and Wear	94.1%	92.5%	91.5%	92.0%	90.0%	90.1%	92.4%	92.7%	92.6%	92.1%
Shropshire and Staffordshire	95.4%	88.0%	89.0%	84.0%	85.6%	83.9%	84.2%	85.8%	87.4%	83.0%
South East London	96.1%	89.7%	90.9%	91.5%	89.0%	88.7%	89.2%	90.0%	88.9%	89.2%
South West London	95.5%	80.5%	83.4%	81.4%	80.6%	81.9%	82.0%	81.0%	80.1%	80.3%
South West Peninsula	95.7%	90.9%	90.1%	89.5%	89.4%	89.1%	92.5%	92.8%	88.6%	90.1%
South Yorkshire	95.1%	86.6%	85.4%	86.0%	84.8%	86.0%	87.9%	91.0%	89.9%	87.7%
Surrey and Sussex	88.4%	84.4%	85.0%	85.7%	84.3%	83.7%	83.4%	85.0%	83.7%	83.5%
Thames Valley	83.2%	80.3%	80.0%	79.2%	81.4%	78.4%	80.4%	83.7%	81.7%	79.6%
Trent	93.1%	87.7%	88.6%	88.1%	88.1%	87.4%	89.2%	90.0%	87.4%	86.2%
West Midlands South	93.7%	89.1%	92.0%	91.6%	88.5%	87.9%	89.3%	89.5%	91.8%	94.3%
West Yorkshire	93.6%	90.8%	90.2%	90.1%	91.8%	90.7%	90.1%	91.7%	89.7%	89.8%
England total	92.9%	87.8%	87.6%	87.1%	86.7%	86.3%	87.5%	88.1%	87.1%	86.7%

…and the traffic light plague…AND…

Indicator	Trust Status	A&E	Cancer	Crit Care	Medicine	O&G	Paeds	SR&T	Surgery	T&O
IP Activity										
OP Activity										
A&E 4 hr Wait										
IP >6 months										
Op > 13 weeks										

Status Key

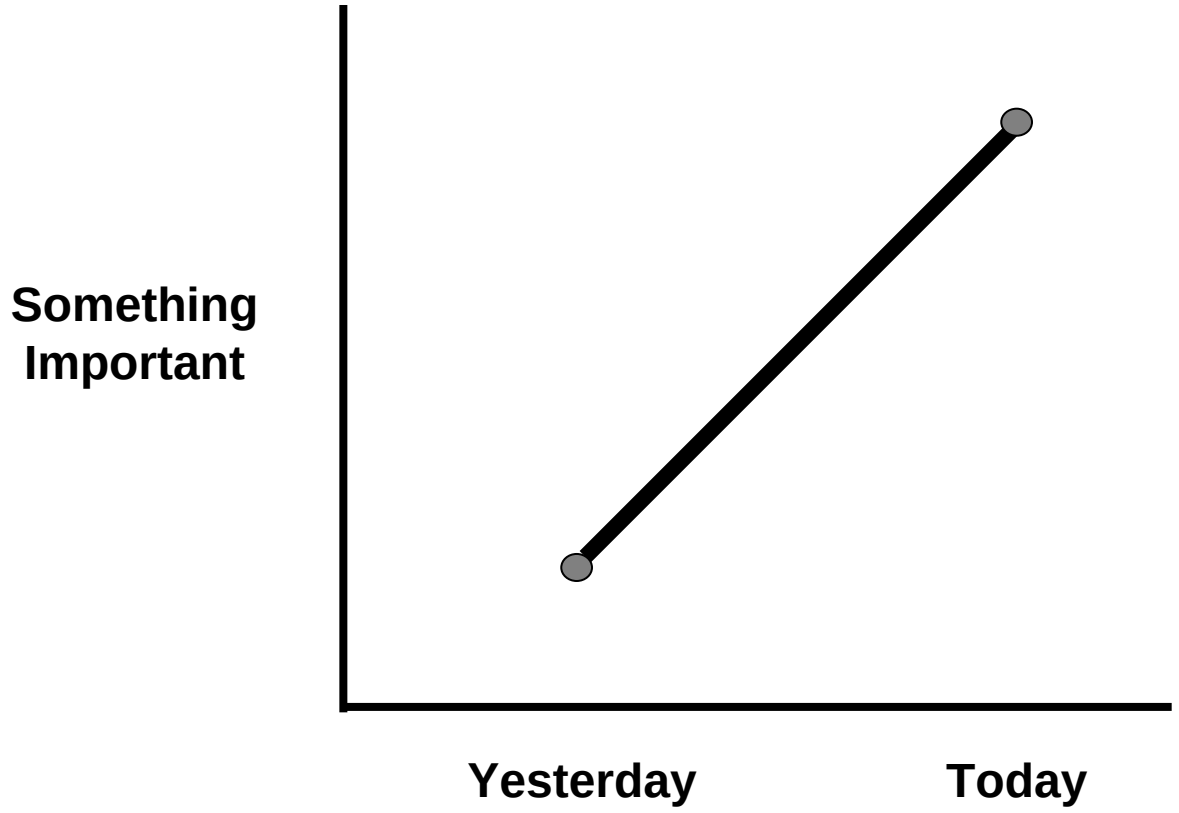
On Target or Achieved

Below or Worse than Target

Significantly Below or worse than Target

What the…?!

Given two numbers…

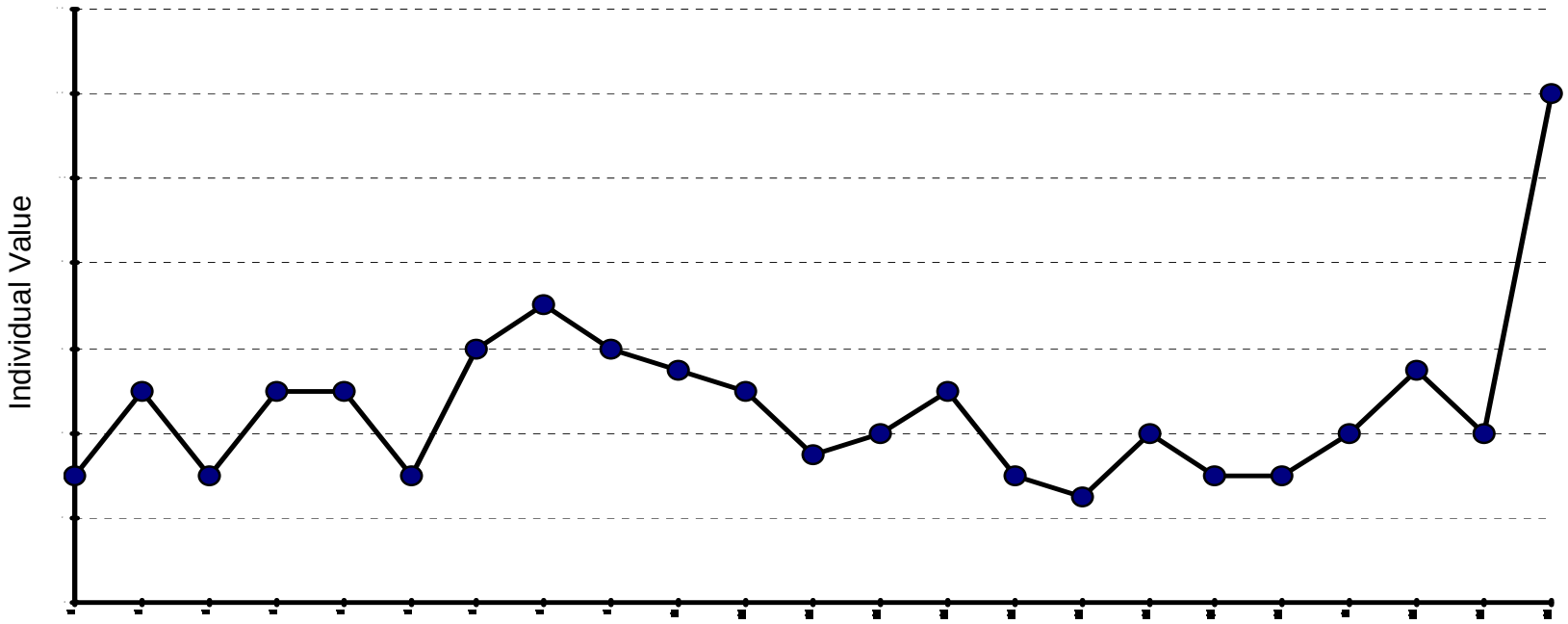


…one will be bigger!

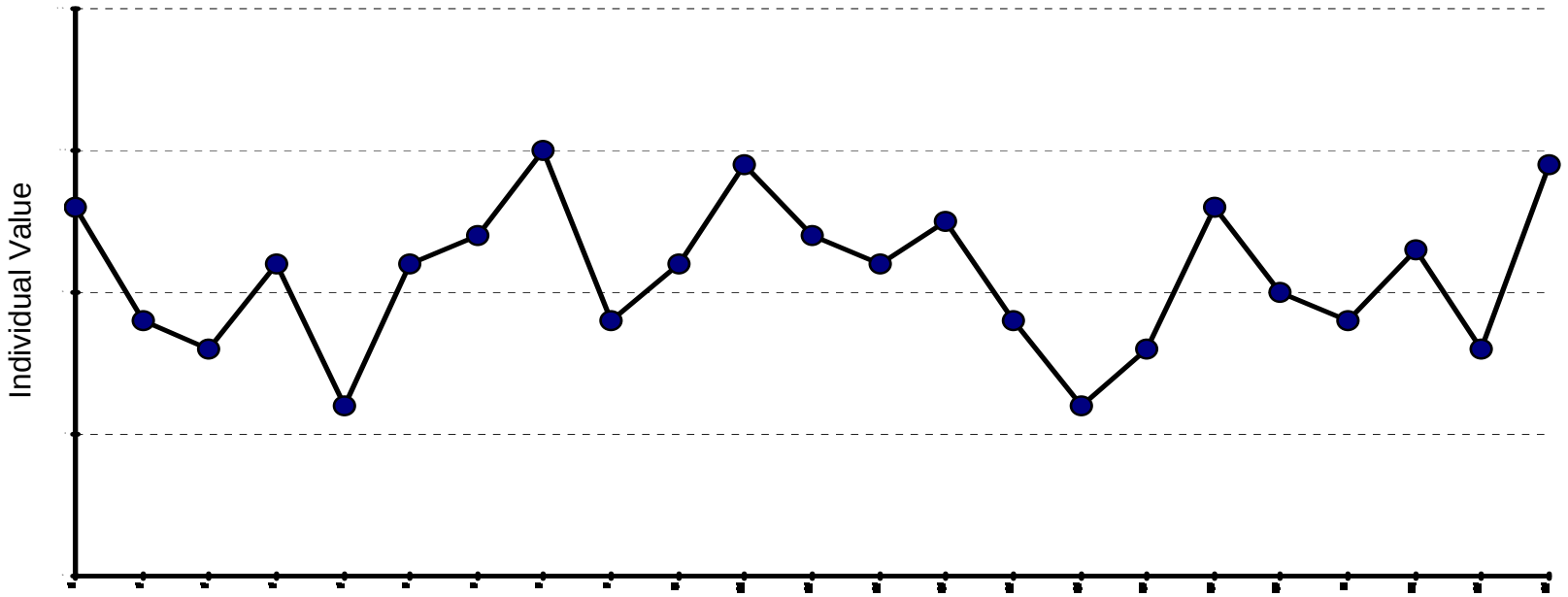
⇨**Processes “speak” to us through data**

--Is the process that produced the current number the same as the process that produced the previous number?

Does it look like this…?



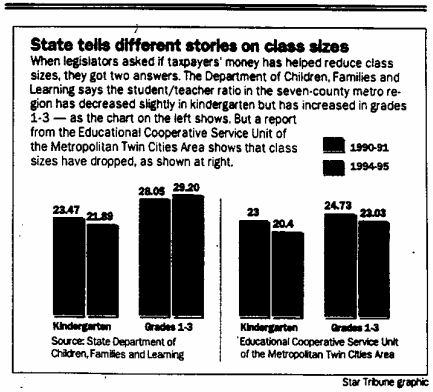
...or this?



Star Tribune

State reports say class sizes are down – and up

Spins on stats befuddle legislators

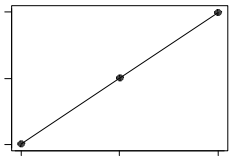


Weekend's 13 traffic deaths surpassed last year's total of 9

Officials seek reasons for rise in overall road deaths

(600 vs. 576)

More Bad Habits: The Myth of Trends

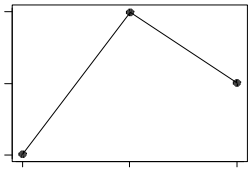


“Upward Trend” (?)

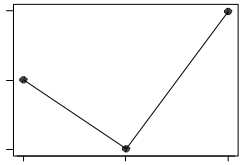
This month…

vs. last month…

vs. 12 months ago

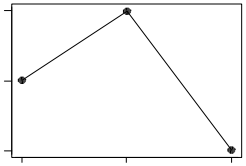


“Downturn” (?)



“Rebound” (?)

3 Months of Quarterly results…

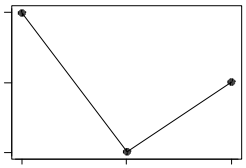


“Setback” (?)

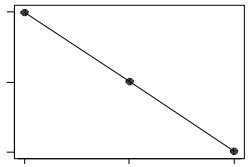
This quarter…

vs. last quarter…

vs. same quarter last year



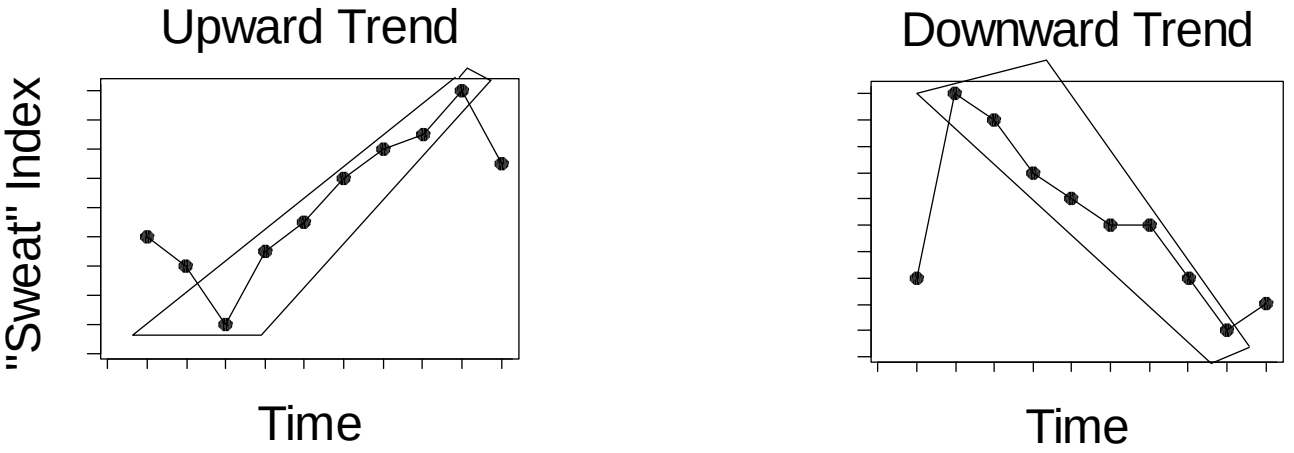
“Turnaround” (?)



“Downward Trend” (?)

Whether or not you understand statistics, you are already using statistics!

“Statistical” definition of “trend”



Special Cause – A sequence of SEVEN or more points continuously increasing or continuously decreasing.

Note: If the total number of observations is 20 or less, SIX continuously increasing or decreasing points can be used to declare a trend.

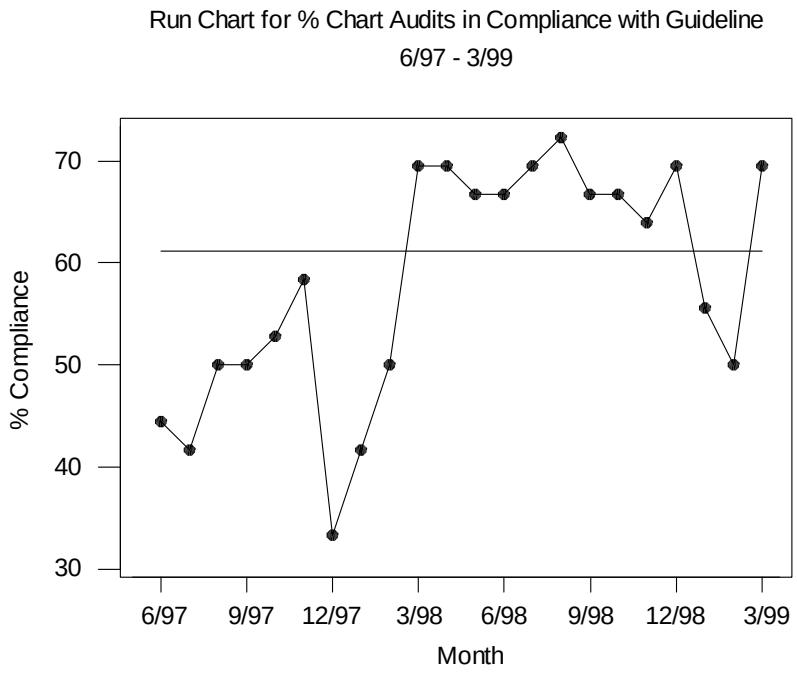
This rule is to be used only when people are making conclusions from a tabulated set of data *without any context of variation* for interpretation.

Statistics = Understanding Variation

- There are TWO kinds of variation
  - Special cause (Unique occurrence, “One off”)
  - Common cause (Inherent, “Systemic”)
- Treating one as the other MAKES THINGS WORSE
  - The human tendency is to treat ALL variation as “one off”
  - Even if things “shouldn’t” happen, you might be “perfectly designed” to have them happen
  - If something doesn’t “go right” or “isn’t supposed to happen,” it is a process breakdown

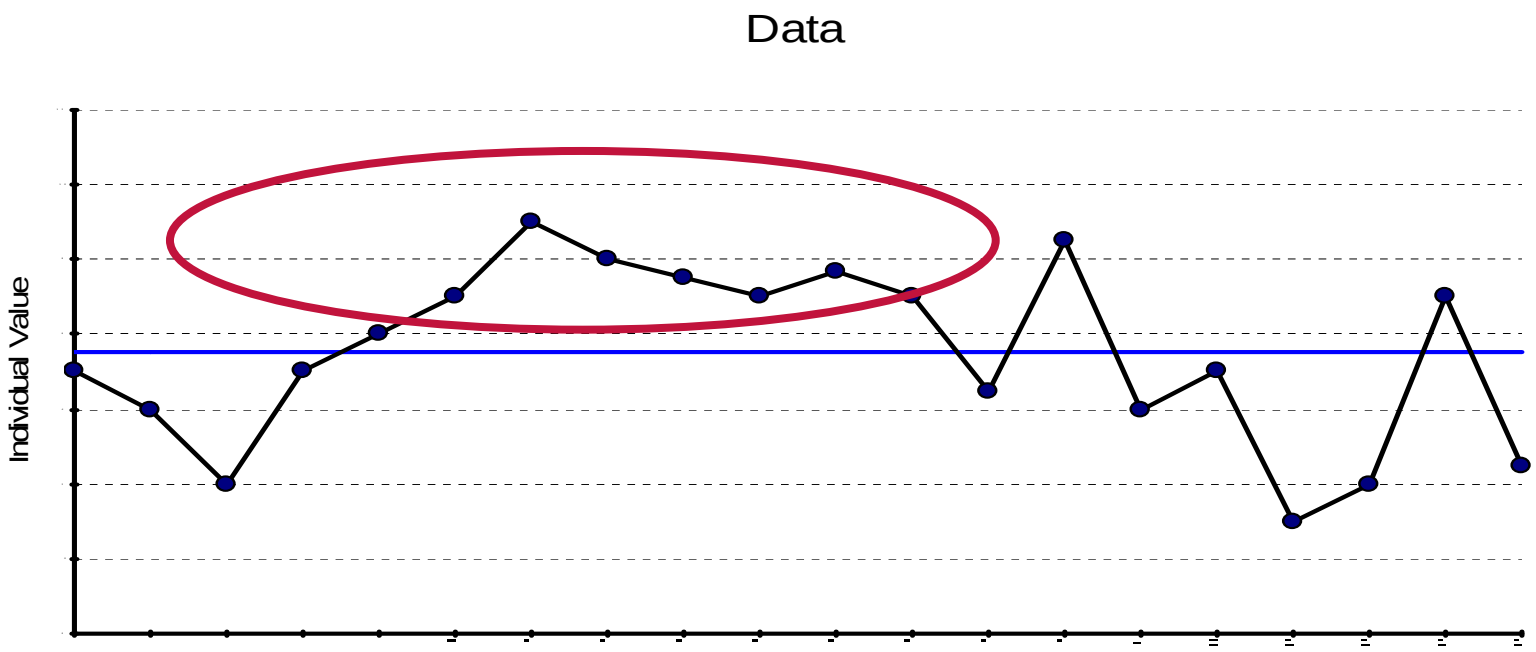
How are they doing with guideline implementation? GOAL: 75%

% Compliance		
6/97	44.44	%
	41.67	
	50.00	
9/97	50.00	
	52.78	
	58.33	
12/97	33.33	
	41.67	
	50.00	
3/98	69.44	
	69.44	
	66.67	
6/98	66.67	
	69.44	
	72.22	
9/98	66.67	
	66.67	
	63.89	
12/98	69.44	
	55.56	
	50.00	
3/99	69.44	

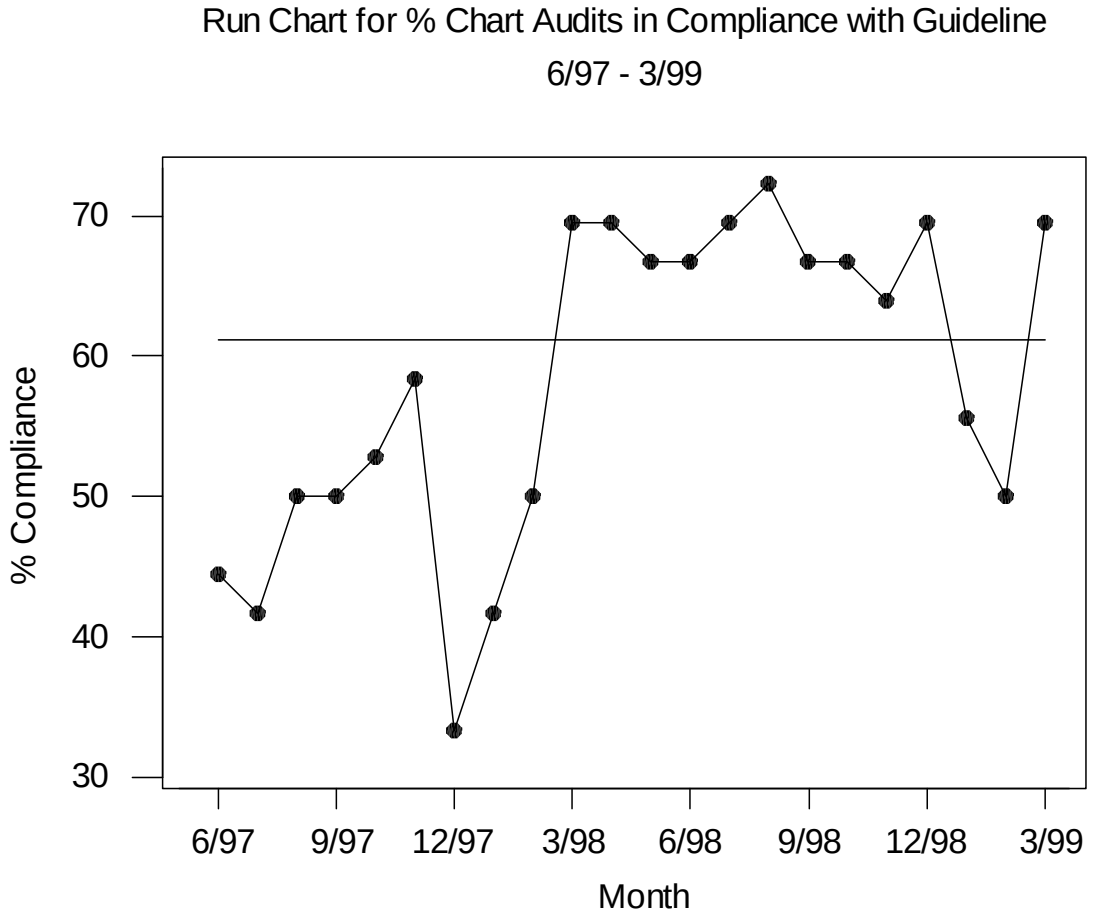


No "trend"

Special Cause: A consecutive sequence of 8 or more points on one side of the median



Note: Omit entirely any data points literally on the median—They neither add to nor break the current run.



Process changed "too fast"

Note effect of feedback

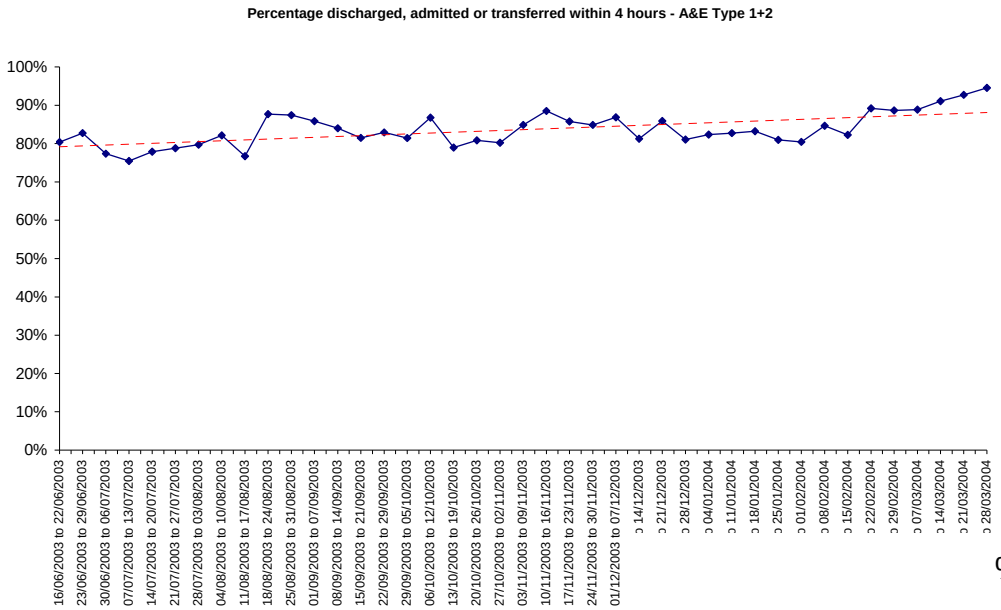
Wisdom from Jim Clemmer

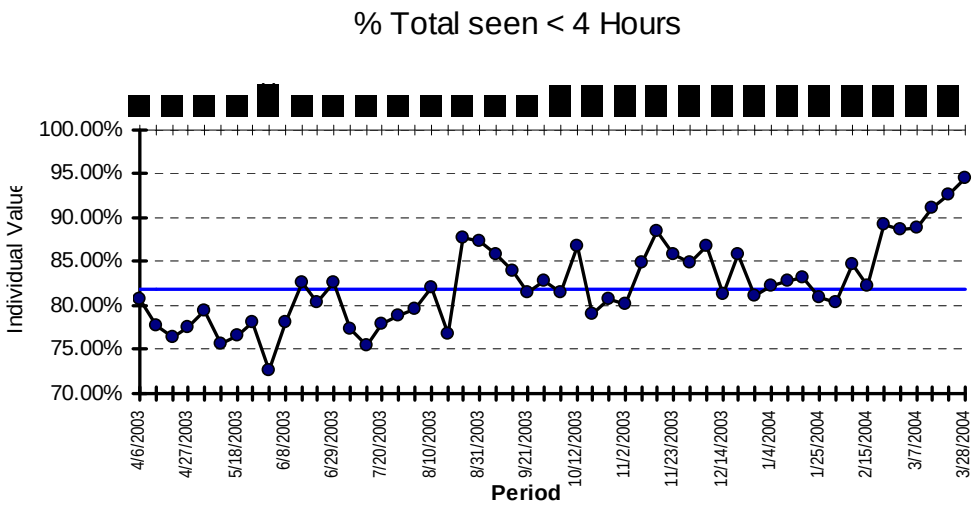
"Weighing myself ten times a day won't reduce my weight. No matter how sophisticated our measurements are, they're only indicators. What the indicators say are much less important than what's being done with the information. Measurements that don't lead to meaningful action aren't just useless; they are wasteful."

"Crude measures of the right things are better than precise measures of the wrong things."

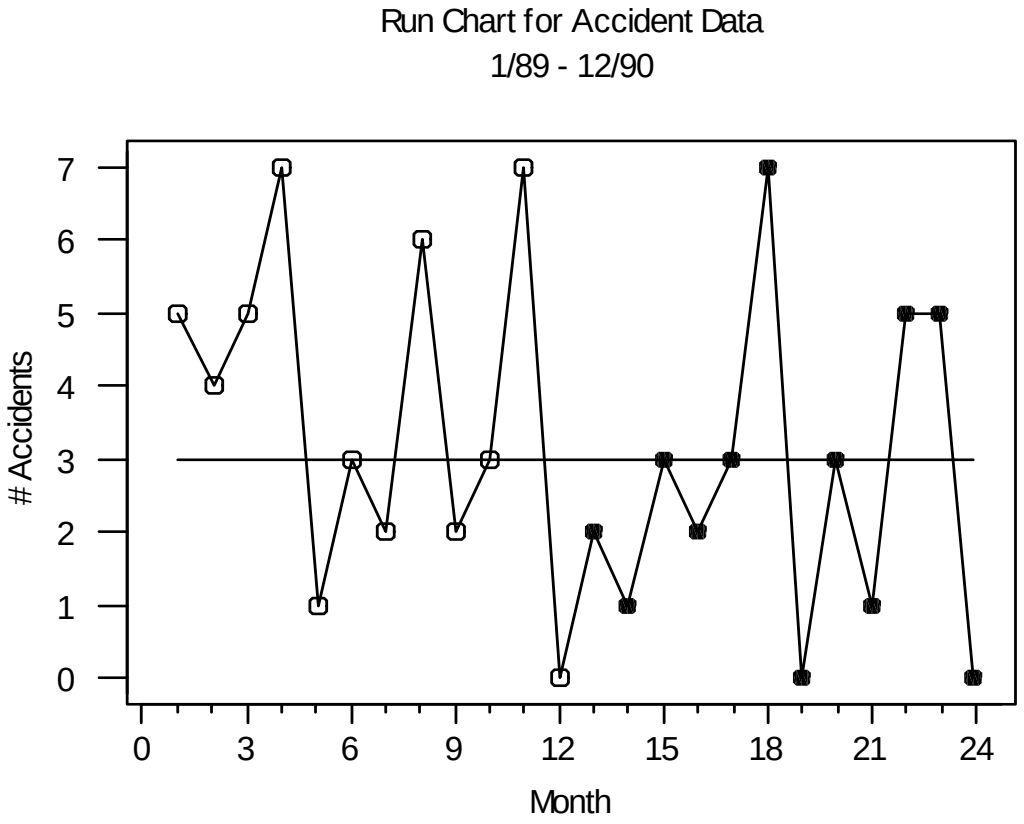
Improvement strategy: *More frequent samples* (over time) of "good enough" measures

TREND?! I think NOT!!!





Safety Data Run Chart



(Median = 3)

1. **Has it truly improved?**
2. **What about the monthly meeting going over every incident?**

Need “common cause” strategy

- Statistics on the number of accidents does not improve the number of accidents
- You cannot treat data points individually
- You cannot “dissect” an accident individually
  - “Root cause” analysis
  - “Near miss” analysis
- You cannot compare two points
  - % change, “too big” a change…

“Common cause” strategy

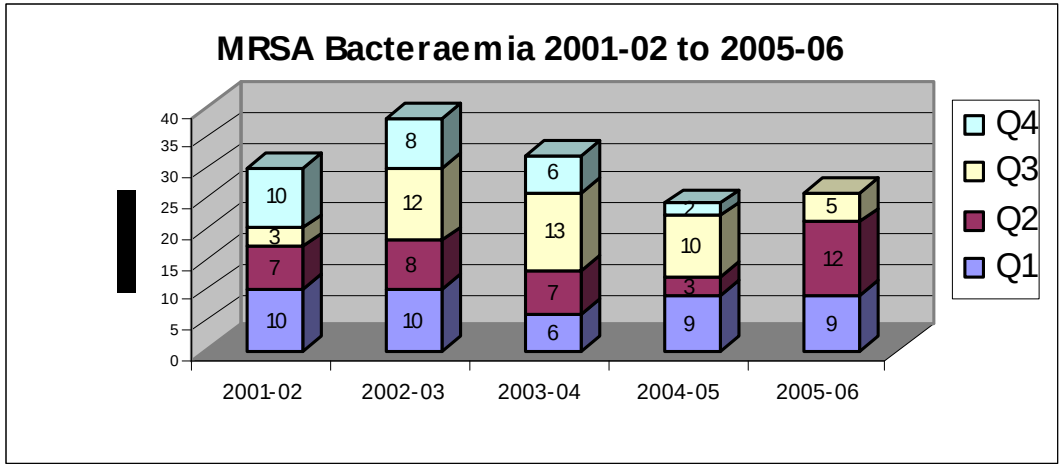
- **So…how do we go about improving the Accident and guideline compliance “processes”?**
- ***We need a common cause strategy.***
- **There is a misconception that if something is common cause, you need to “accept” the current level of performance.**
- ***NOTHING COULD BE FURTHER FROM THE TRUTH!***

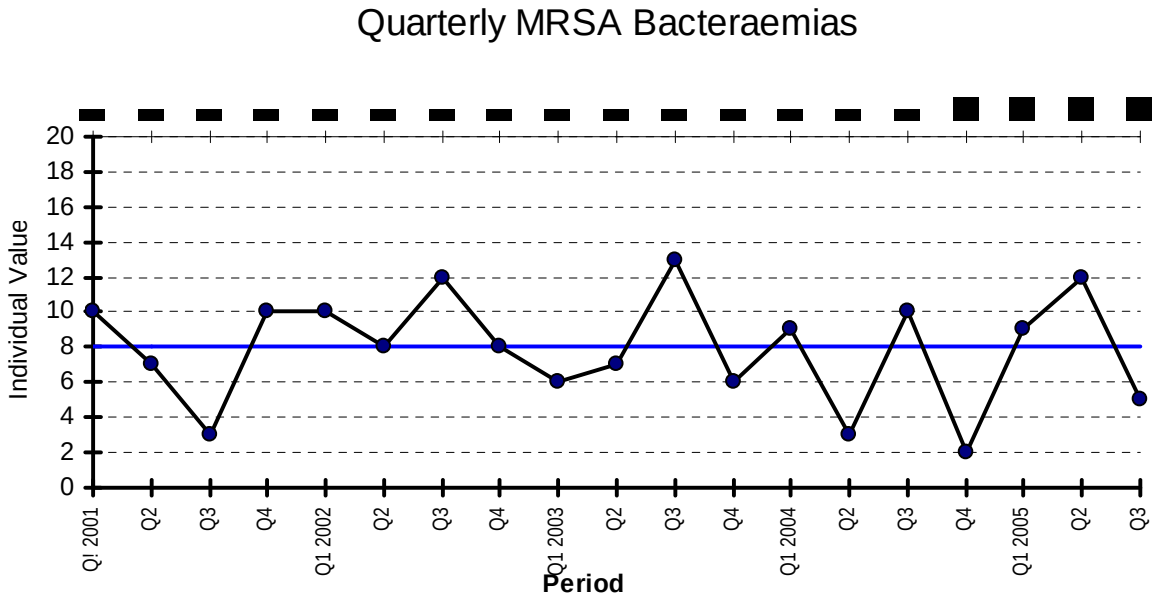
Myth of Common Cause Helplessness

Matrix of Adverse Events

Event Type	Unit						Total
	A	B	C	D	E	F	
1	0	0	1	0	2	1	4
2	1	0	0	0	1	0	2
3	0	**16**	1	0	2	0	**19**
4	0	0	0	0	1	0	1
5	2	1	3	1	4	2	**13**
6	0	0	0	0	3	0	3
27							
28					(less than 6 each)		
29							
Totals	6	**19**	7	3	**35**	7	77

Remember this?

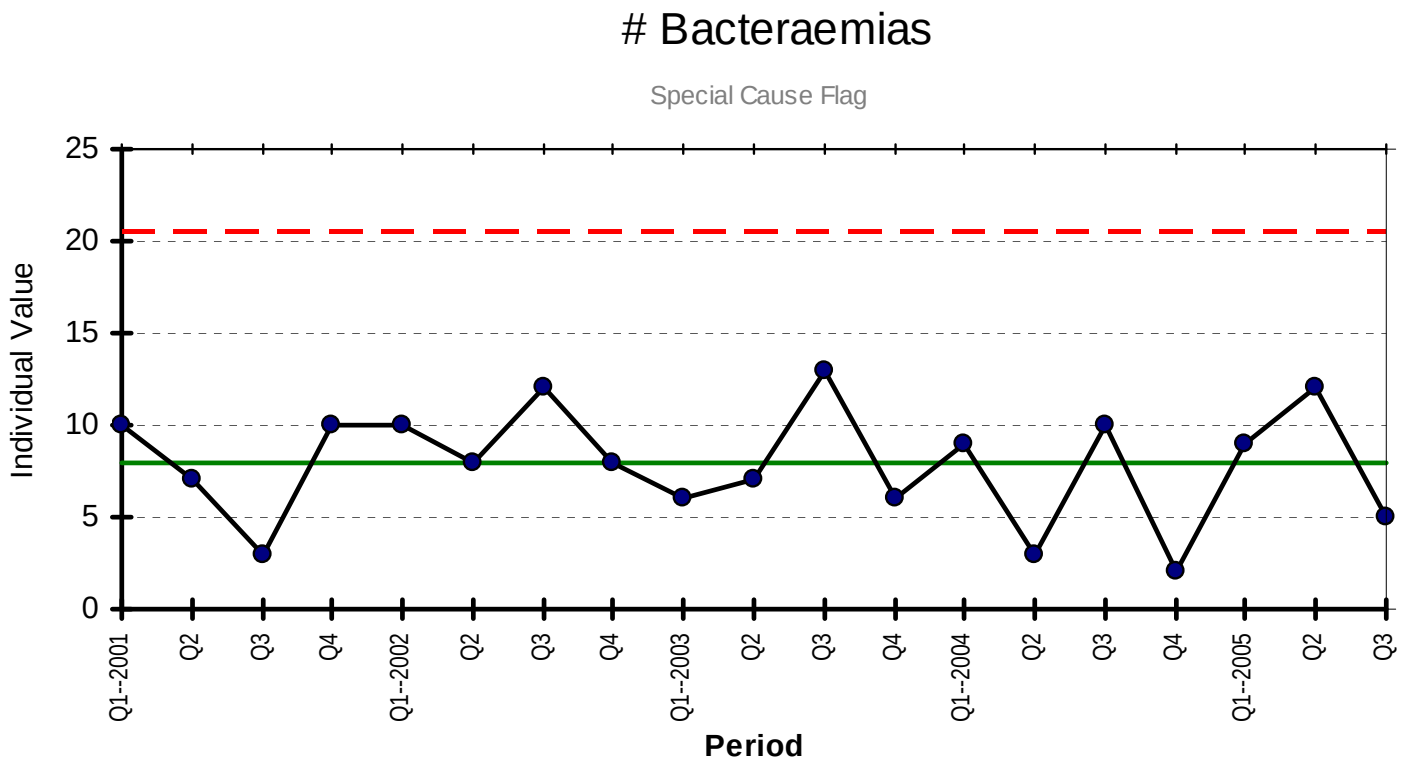




Period	# Bacteraemias	Moving Range	Sorted Moving Ranges
Q1--2001	10	*	0
Q2	7	3	1
Q3	3	4	2
Q4	10	7	2
Q1--2002	10	0	3
Q2	8	2	3
Q3	12	4	3
Q4	8	4	4
Q1--2003	6	2	4
Q2	7	1	4
Q3	13	6	6
Q4	6	7	6
Q1--2004	9	3	7
Q2	3	6	7
Q3	10	7	7
Q4	2	8	7
Q1--2005	9	7	7
Q2	12	3	8
Q3	5	7	

Median moving range = 4: KEY number

FYI: (And the math is so simple, it would astound you)



Quarter-to-quarter difference: ≤ 15

What's changed in 5 years?

How about a "matrix analysis" of the 150 bacteraemias?

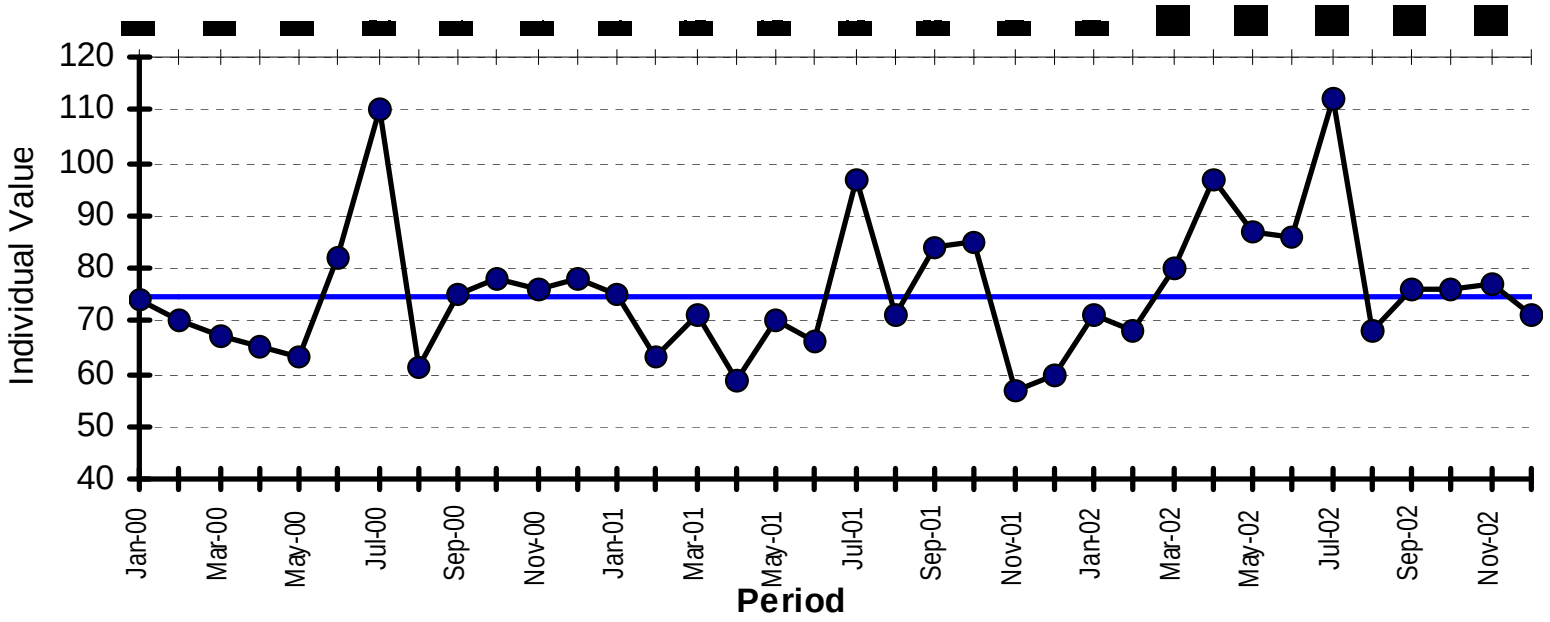
Medication Error Meeting—Constructed from 24 reports of “This month…last month…12 months ago…”

2000		2001		2002	
	Errors		**Errors**		**Errors**
Jan 00	74	Jan 01	75	Jan 02	71
	70		63		68
	67		71		80
	65		59		97
	63		70		87
	82		66		86
Jul 00	110	Jul 01	97	Jul 02	112
	61		71		68
	75		84		76
	78		85		76
	76		57		77
	78		60		71

Descriptive Statistics

N	Mean	Median	TrMean	StDev	SE Mean	Minimum	Maximum	Q1	Q3
36	75.72	74.50	74.63	12.91	2.15	57.00	112.00	67.25	81.50

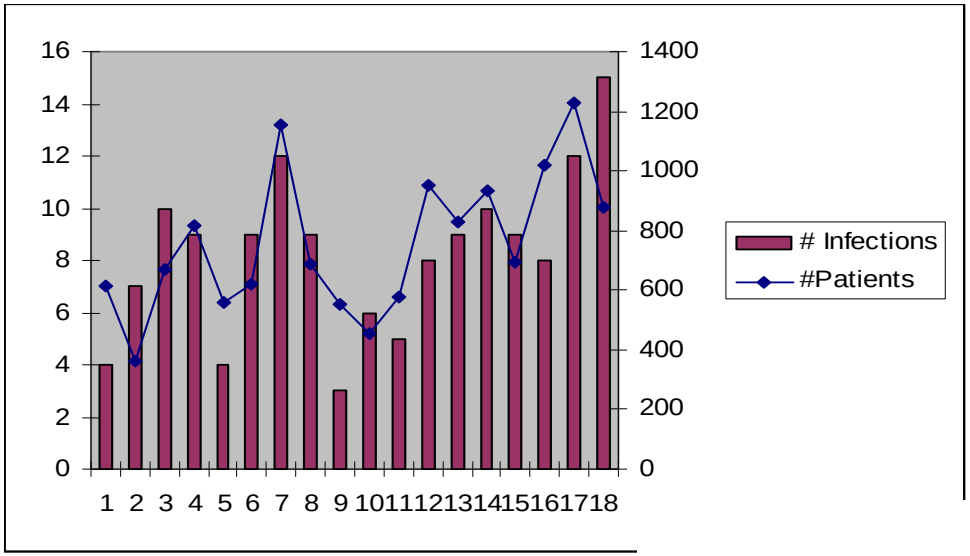
VERY common misconception



"Matrix" analysis of *July* errors vs.

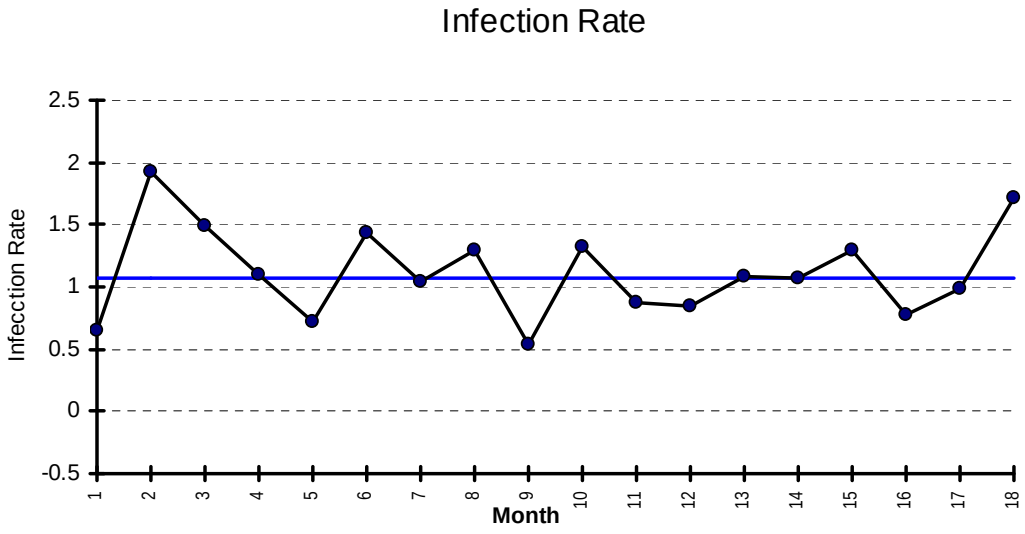
"Matrix" analysis of *other 11 months*

“We made a difference!”—Reduced NICU Infections



Really?

Matrix the sum of the numerators



Exhaust in-house data

- Get a BASELINE of the extent of the problem
- Does everyone agree on definitions of key terms and how to assess a situation?
  - Get a “number”
  - Decide that something “did” or “did not” occur
- MAYBE do some high level stratification
  - Try to LOCALIZE the “20%” of the process causing “80%” of the problem
  - Proceed to “Study Current Process”
- Stop collecting useless data

Operational Definition a la Dilbert

- Dilbert (to date): I'm so lucky to be dating you, Liz. You're at least an "8."
- Liz: You're a "10."
- Dilbert: (Pause)…Are we using the same scale?
- Liz: Ten is the number of seconds it would take to replace you.

“Confucian” Operational Definition

- “Person with one clock knows what time it is…”
- “…person with two clocks not so sure!”

Study Current Process

- **Better traceability to process inputs with current data collection methods**
  - **Sometimes called “Stratification”**
- **Capture and record potentially available data that is virtually there for the taking**
- **Data definitions that are agreed-upon and better-suited to objectives**

****Reduce data contamination due to “human” variation**

****Establish extent of problem(s)**

****Pareto analysis to localize**

****Establish baseline for measuring improvement efforts**

- **(Tolerable “jerkaround”)**

“Cut New Windows”—Process Dissection

(Also called “Disaggregation”)

- **Collecting data not needed for routine process operation**
- **Process is split into sub-processes, which are individually studied**
- **Data collection process may be awkward and disruptive to routine operation**

****Intense focus on a major isolated source of localized variation (Isolated “20%”)**

- **(Uncomfortable “jerkaround”)**

Designed Experimentation

- **Test of a process redesign suggested by first three levels of data collection**

****Use of run / control chart to assess success**

- (MAJOR “jerkaround”…and vulnerable to HUMAN variation!)

Rare events

Another data set

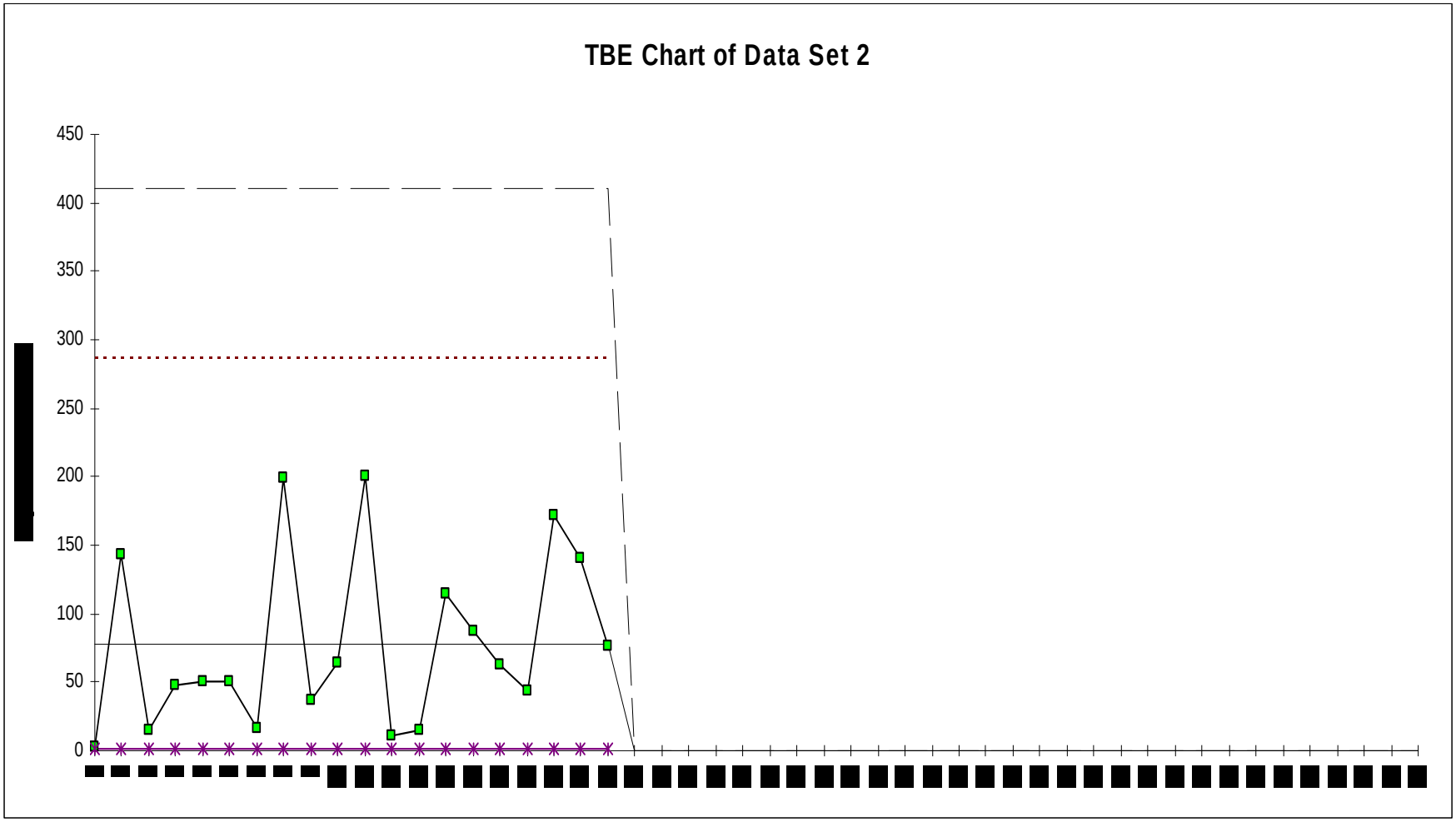
Date of death	Day of year	**Days Between Deaths for Large Babies (over 1500g)**	Deaths per day	**Mortality Rate for Large Babies (over 1501g)**
2/25/1998	56			
2/28/1998	59	3	0.3333	121.67
7/21/1998	202	143	0.0070	2.55
8/5/1998	217	15	0.0667	24.33
9/22/1998	265	48	0.0208	7.60
11/12/1998	316	51	0.0196	7.16
1/1/1999	1	50	0.0200	7.30
1/17/1999	17	16	0.0625	22.81
8/4/1999	216	199	0.0050	1.83
9/10/1999	253	37	0.0270	9.86
11/3/1999	317	64	0.0156	5.70
5/21/2000	142	200	0.0050	1.83
6/1/2000	153	11	0.0909	33.18
6/16/2000	168	15	0.0667	24.33
10/9/2000	283	115	0.0087	3.17
1/4/2001	4	87	0.0115	4.20
3/8/2001	67	63	0.0159	5.79
5/10/2001	130	44	0.0227	8.30
10/29/2001	302	172	0.0058	2.12
3/18/2002	77	140	0.0071	2.61
6/3/2002	154	77	0.0130	4.74

Average time between deaths: 77.5 days

“Time between events” theory

- Exponential distribution
- Data in table above: Average = 77.5
- 99% limits
  - Lower limit: 0.005 x Average (0.4)
  - Upper limit: 5.30 x Average (411)
- Special cause signals ($p < 0.01$):
  - 5-in-a-row above the average (Improvement)
  - 10-in-a-row below the average (Worsening)
  - 2-out-of-3 consecutive events between 95% and 99% limits (Improvement)
    - 95% point = 3.69 x Average (286)

First data point of “3” has a p = 0.04



An alternate, simpler method?

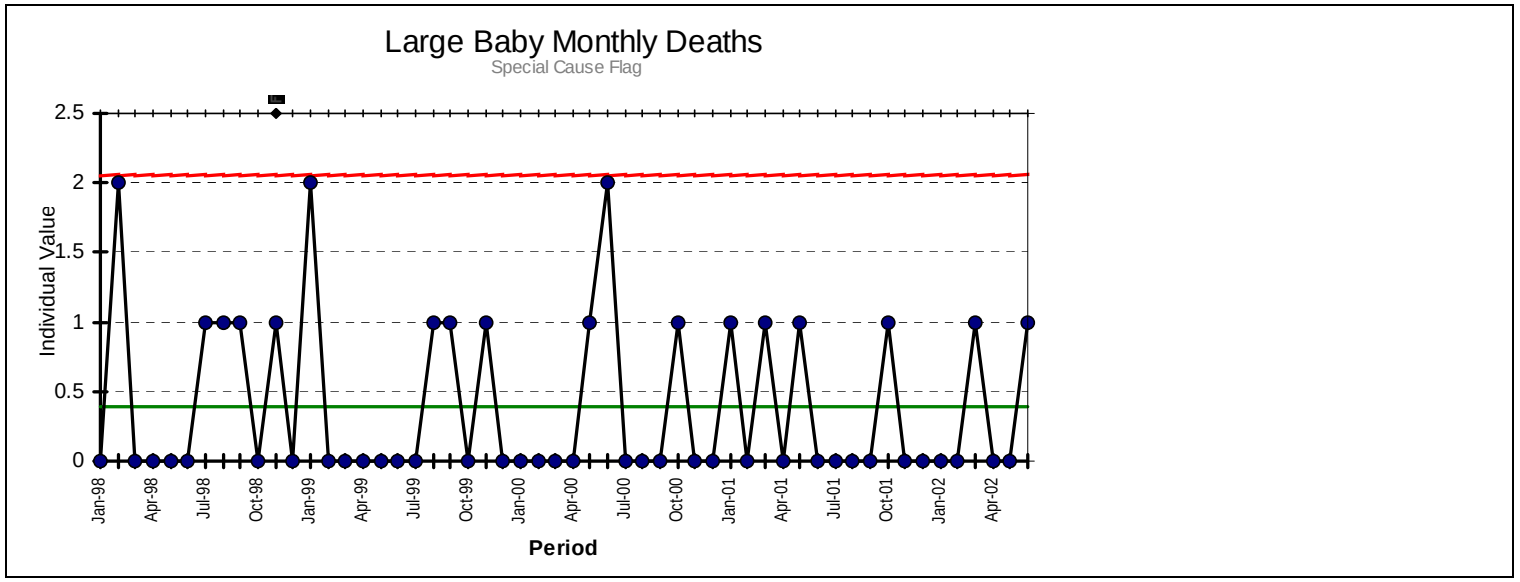
Find a period where the average occurrence is “1”

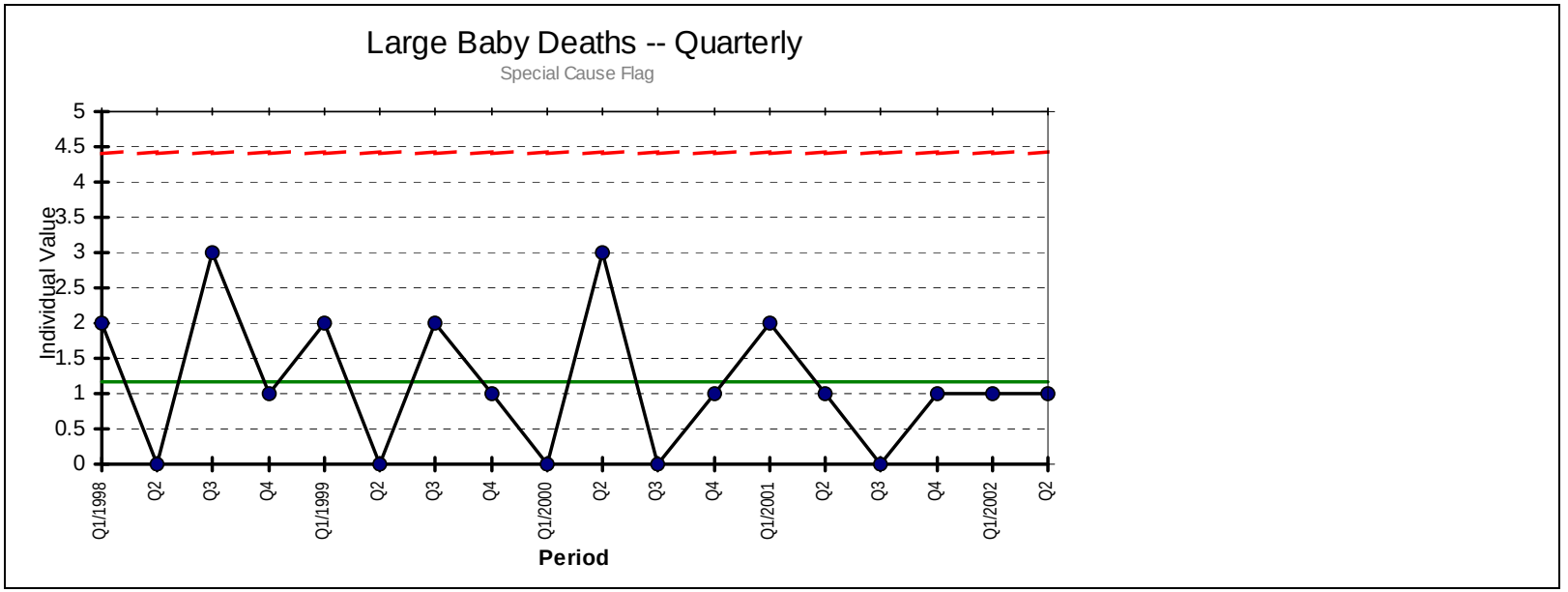
Special cause: 7 zeroes in-a-row

Poisson counts: Average count = 1,

7 “zeroes” in-a-row: $p = (0.368)^7 = 0.0009$

$[(0.368)^6 = 0.0025]$.

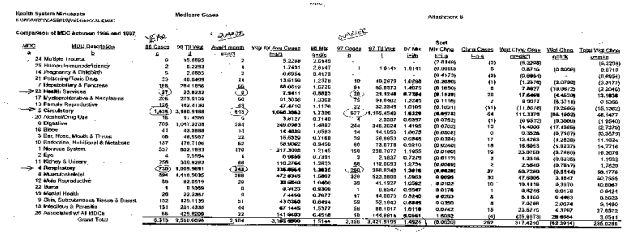

Large Baby Monthly Deaths
Special Cause Flag
Individual Value
2.5
2
1.5
1
0.5
0
Jan-98
Apr-98
Jul-98
Oct-98
Jan-99
Apr-99
Jul-99
Oct-99
Jan-00
Apr-00
Jul-00
Oct-00
Jan-01
Apr-01
Jul-01
Oct-01
Jan-02
Apr-02
Period

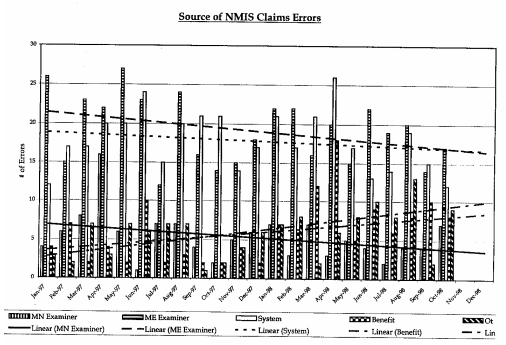

Large Baby Deaths -- Quarterly
Special Cause Flag
Individual Value
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Q1/1998
Q2
Q3
Q4
Q1/1999
Q2
Q3
Q4
Q1/2000
Q2
Q3
Q4
Q1/2001
Q2
Q3
Q4
Q1/2002
Q2
Period

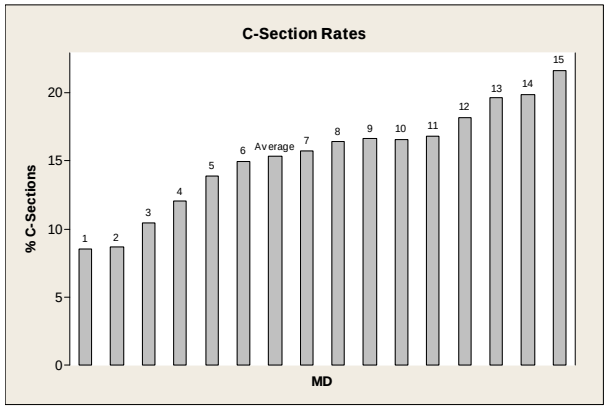
Transition to More “Advanced” Skills

- From:
  - Colors & Faces & Drawing circles
- To:
  - Counting up to “8”
  - Subtracting two numbers
  - Sorting a list of numbers
  - *Asking better questions!*
  - *Reacting appropriately to variation*
    - Common cause vs. special cause strategy
    - Reducing inappropriate & unintended variation
    - Better prediction

This...?

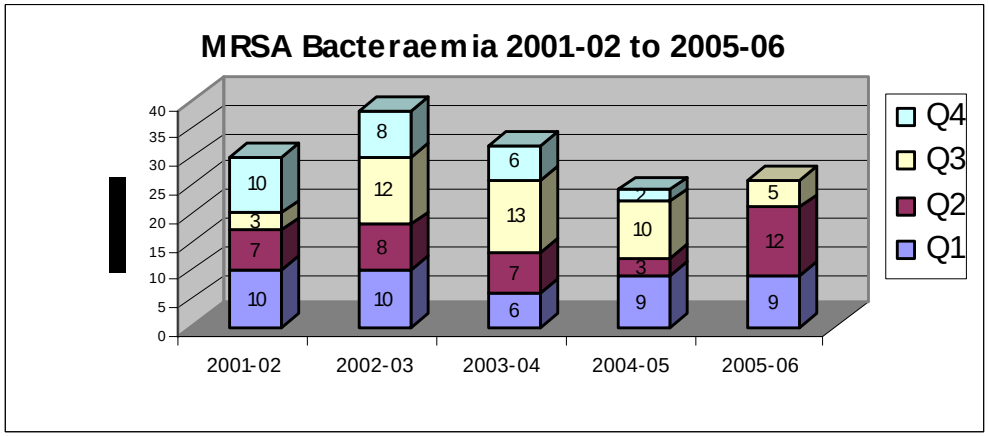




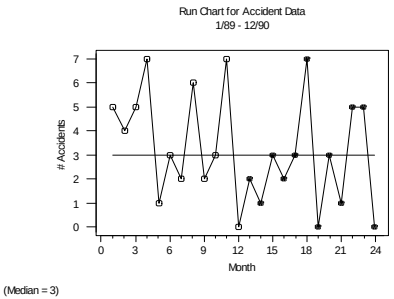


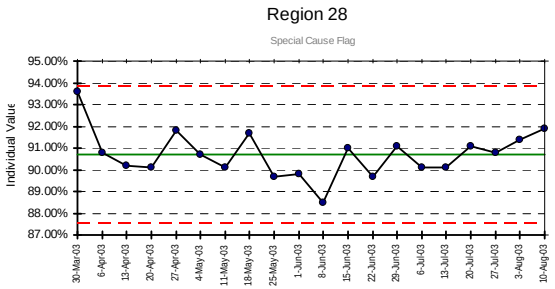
Indicator	Trust Status	A&E	Cancer	Crit Care	Medicine	O&G	Paeds	SR&T	Surgery	T&O
IP Activity	☺	☺	☺	☺	☺	😐	☺	😐	☺	☺
OP Activity	☺	☹	😐	😐	😐	😐	☺	☺	☺	☺
A&E 4 hr Wait	☹	☹								
IP >6 months	☹	☺	☺	☺	☺	☺	☺	☺	😐	☹
Op > 13 weeks	☹	☺	☺	😐	☺	☺	☺	😐	😐	☹

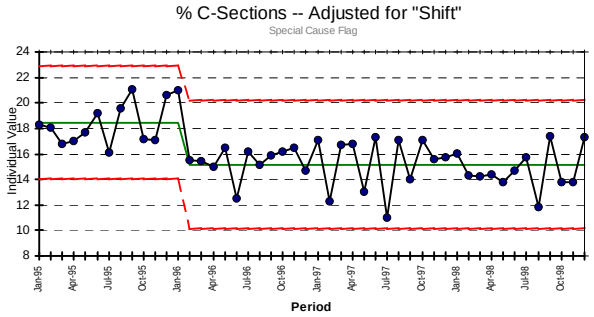
Kent and Medway	K&M	98.4%	96.7%	98.4%	97.3%	96.9%	96.4%
County Durham & Tees Valley	CDTV	96.7%	95.6%	96.5%	96.3%	94.7%	96.4%
Trent	Trent	96.7%	95.3%	96.7%	95.5%	94.0%	96.6%
Shropshire & Staffordshire	SASHA	97.9%	97.1%	98.1%	97.3%	97.5%	96.6%
Hampshire & the Isle of Wight	H&IOW	96.6%	95.9%	96.0%	96.7%	95.1%	96.7%
West Midlands South	WMS	97.0%	96.4%	97.6%	97.4%	96.1%	96.7%
Bedfordshire & Hertfordshire	Beds&Herts	96.6%	96.0%	96.7%	96.4%	95.2%	96.8%
Leicestershire. Northamptonshire & Rutlan	LNR	96.3%	96.2%	97.3%	96.9%	95.6%	96.8%
Birmingham & the Black Country	BBC	96.8%	95.8%	96.4%	96.6%	94.7%	96.9%
Surrey & Sussex	Sy&Sx	96.7%	96.7%	96.7%	97.0%	95.9%	97.5%
Greater Manchester	GM	96.7%	96.7%	96.5%	96.6%	95.9%	97.6%
Cumbria & Lancashire	C&L	98.0%	97.7%	98.1%	97.9%	97.7%	97.8%
South West Peninsula	SWP	97.2%	97.8%	97.2%	98.0%	97.8%	97.8%
Avon. Gloucestershire & Wiltshire	AG&W	96.8%	97.0%	96.4%	97.2%	96.2%	97.8%
Norfolk. Suffolk & Cambridgeshire	NSC	97.2%	97.7%	97.6%	98.0%	97.4%	98.1%

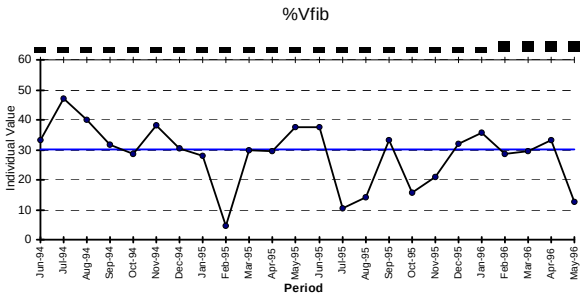


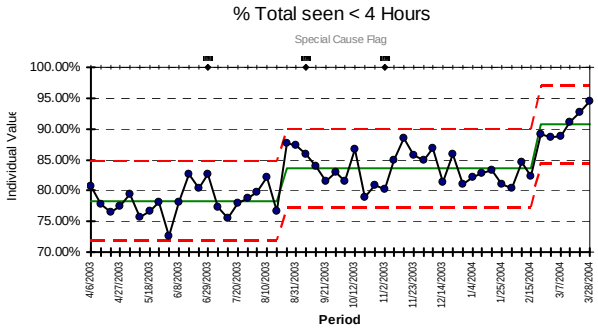
…or this?

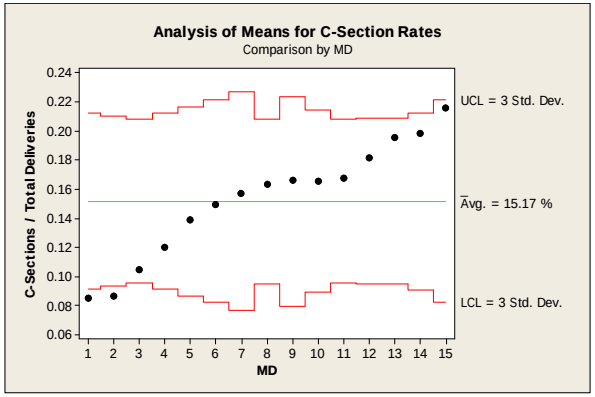

Run Chart for Accident Data
1/89 - 12/90
Accidents
Month
(Median = 3)


Region 28
Special Cause Flag
Individual Value


% C-Sections -- Adjusted for "Shift"
Special Cause Flag
Individual Value
Period

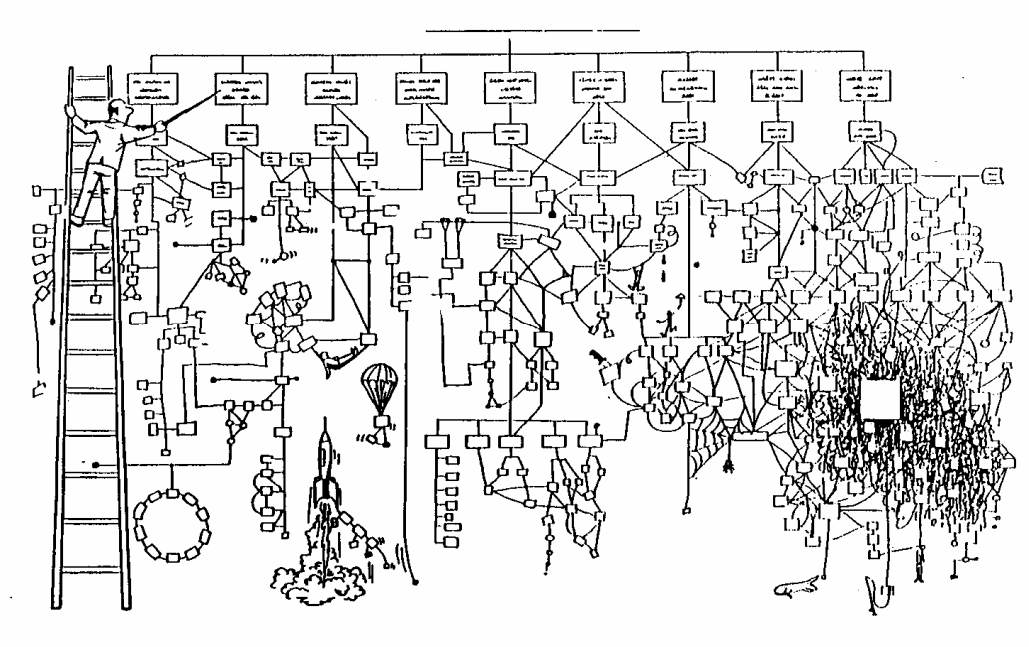

%Vfib
Individual Value
Period


% Total seen < 4 Hours
Special Cause Flag
Individual Value
Period


Analysis of Means for C-Section Rates
Comparison by MD
C-Sections / Total Deliveries
UCL = 3 Std. Dev.
Avg. = 15.17 %
LCL = 3 Std. Dev.
MD

It’s not the problems that march into your office…

- …It’s the problems no one is aware of that you are ***perfectly designed*** to get
- Reducing *inappropriate & unintended* variation for purposes of *better prediction*



Six Statistical Traps

1. Treating **all** observed variation in a time series data sequence as special cause.
2. Fitting inappropriate “trend” lines to a time series data sequence.
3. Unnecessary obsession with and incorrect application of the Normal distribution.
4. Incorrect calculation of standard deviation and “sigma” limits. [Note: NO “spreadsheet calculations of Std. Dev.]
5. Choosing **arbitrary** cutoffs for “above” average and “below” average.
6. Improving processes through the use of arbitrary numerical goals and standards.

“For every problem, there is a solution: simple…obvious…and wrong!”

--W. Edwards Deming

“If we’re actually trying to do the wrong thing, the only reason we may be saved from disaster is because we are doing it badly.”

--David Kerridge