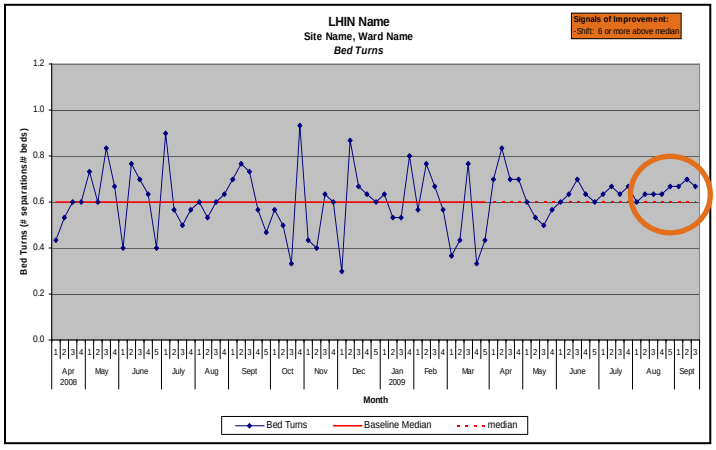
Interpreting Run Charts

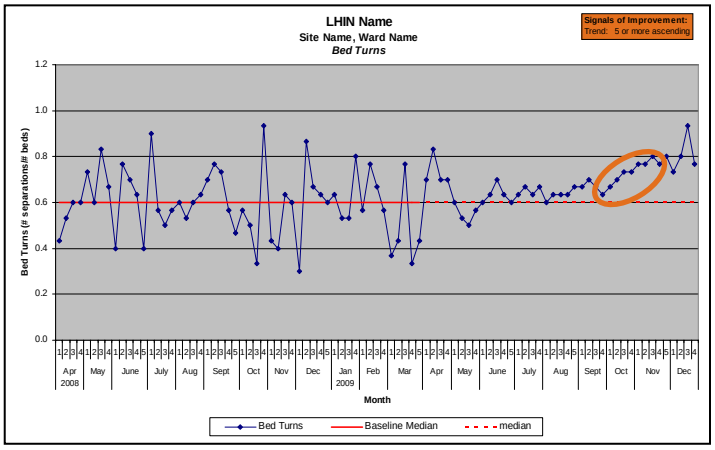
There are four rules for interpreting run charts. It is not necessary to find evidence of all four rules to determine that a change has occurred. The presence of any single rule is evidence of a non-random signal of change (there is less than 5% likelihood that the conditions of the rule will be met simply by chance).

Rule 1: Shift



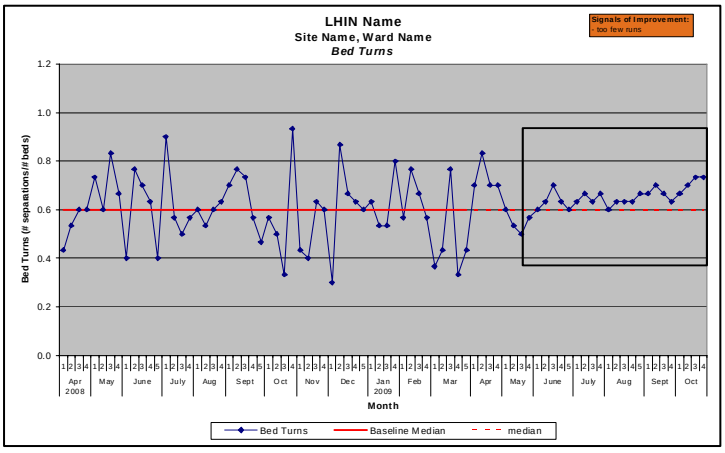
- A shift is six or more consecutive points, either all above or all below the median
- Values that fall on the median neither add to nor break a shift — skip them and continue counting

Rule 2: Trend



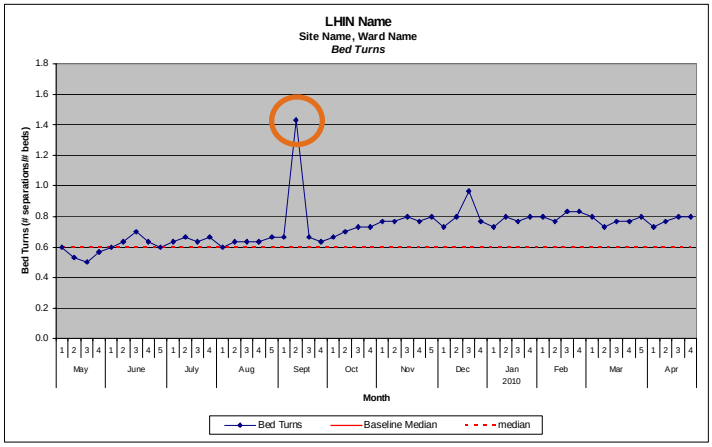
- A trend is five or more consecutive points all going up or all going down (Note: don't count the starting point)
- If the value of two or more consecutive points is the same, ignore one of the points and continue counting

Rule 3: Runs



- A non-random pattern is signaled by too few or too many runs (crossings of the median line)
- Too many runs suggests that there may be two separate distributions of the data, while too few runs signals that the data are clustered on one side of the median (may lead to a shift if there are enough data points).
- To determine the number of runs:
  - Step 1: Count the number of times the line connecting the data point crosses the median and add one
  - Step 2: Count the number of data points that do not fall on the median
  - Step 3: Refer to the table (on reverse) for comparison values.

Rule 4: Astronomical Point



- An astronomical data point is one that is an obviously different value; anyone studying the chart would agree that it is unusual
- Every data set will have a highest point and a lowest point, but this does not necessarily make it "astronomical"
- Caution: if there are large differences (>25%) in the denominator, then a Shewhart control chart may be required to differentiate between a point where the data truly is different and a point that appears different because of the difference in denominator.

Rule 3: Runs

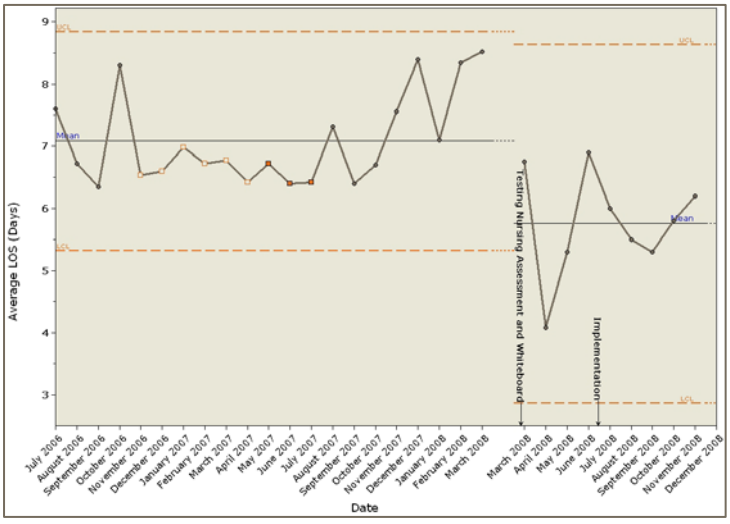
Table for checking for too many or too few runs

Based on about a 5% risk of failing the run test for random patterns of data. Adapted from Swed, Feda S. and Eisenhart, C. (1943). "Tables for Testing Randomness of Grouping in a Sequence of Alternatives. Annals of Mathematical Statistics. Vol. XIV, pp.66 and 87, Tables II and III. (Data Guide 3-18)

# data points (not on median)	Lower limit for # runs (fewer is too few)	Upper limit for # runs (more is too many)
10	3	9
11	3	10
12	3	11
13	4	11
14	4	12
15	5	12
16	5	13
17	5	13
18	6	14
19	6	15
20	6	16
21	7	16
22	7	17
23	7	17
24	8	18
25	8	18
26	9	19
27	10	19
28	10	20
29	10	20
30	11	21

# data points (not on median)	Lower limit for # runs (fewer is too few)	Upper limit for # runs (more is too many)
31	11	22
32	11	23
33	12	23
34	12	24
35	12	24
36	13	25
37	13	25
38	14	26
39	14	26
40	15	27
41	15	27
42	16	28
43	16	28
44	17	29
45	17	30
46	17	31
47	18	31
48	18	32
49	19	32
50	19	33
51	20	33

Shewhart (Control) Charts



Common Cause:

- Refers to random variation inherent in the process over time; affects everyone working in the process and affects all outcomes
- The process is stable if only common cause variation is noted

Special Cause:

- Arises because of specific circumstances — something was different in that particular case
- The process is unstable if there is special cause variation

Rules for Determining Special Cause:

- A single point outside the control limits
- 8 or more points in a row on one side of the mean
- 6 consecutive points increasing or decreasing
- 2 of 3 points in the outside third of a control limit
- 15 consecutive points in the inner third (nearest the mean)