- When there is not a lower or upper limit on one side of the center line (for example, on a standard deviation chart with fewer than six measures in a subgroup or on a P chart with 100% as a possible result for the process), Rules 1 and 4 do not apply to the side missing the limit.

The five rules are designed to rapidly detect special cause occurring in the system that generated the measure. While they work as a system, each rule is useful to identify different types of special causes. Rule 1 quickly identifies sudden changes in the measure. Rule 2 identifies small, sustained changes (like a small improvement to a process). Rule 3 detects a small, consistent drift in a process (trend). Rule 4 adds additional sensitivity to detect changes that have not yet triggered Rule 1 or Rule 2. Rule 5 is especially useful in detecting a reduction of variation with an I chart, or for detecting improper subgrouping with an $\overline{X}$ chart.

Special circumstances may warrant use of some additional tests given by Nelson.[15] Deming emphasizes that the most important issue is the necessity to state in advance what rules to apply to a given situation.[16]

For improvement activities, these five rules can be used to provide evidence of an improvement to a process or system. These rules also provide evidence of "losing" gains previously made in a system. Figure 4.6 illustrates this important application of the special cause rules.

In this example, a hospital improvement team did some great work to improve patient satisfaction scores during 2004 and early 2005. Shewhart limits for the improved process were calculated using data from the 20 months after full implementation (May 2004 through December 2005). These limits were extended into 2006. In July 2006, as special cause (Rule # 1) was detected. Investigations of this special cause revealed there had been some slippage back into old procedures used prior to the improvement team's work.

As stated earlier, the Shewhart chart provides a basis for taking action to improve a process.

FIGURE 4.6   Detecting "Losing the Gains" for an Improved Process
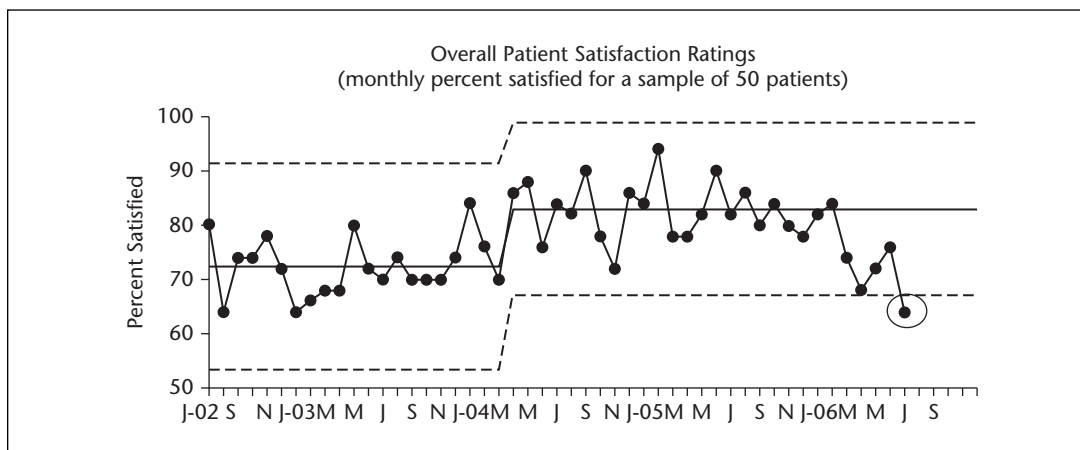
[15]Nelson, L., "The Shewhart Chart—Test for Special Causes," *Journal of Quality Technology*, 1984, *16*(4), 237–239.

[16]Deming, W. E., *Out of the Crisis,* Chapter 11.