Four Essential Ways Control Charts Guide Healthcare Improvement

– Lloyd Provost

Control Charts Essential to Better Healthcare

Healthcare improvement is complex work, from identifying opportunities for improvement to measuring the impact of interventions and understanding real causes of variation.

Health systems can add structure and clarity to improvement work by using control charts to monitor projects, gain critical insight into opportunities, understand the efficacy of initiatives, and sustain improved processes over time.

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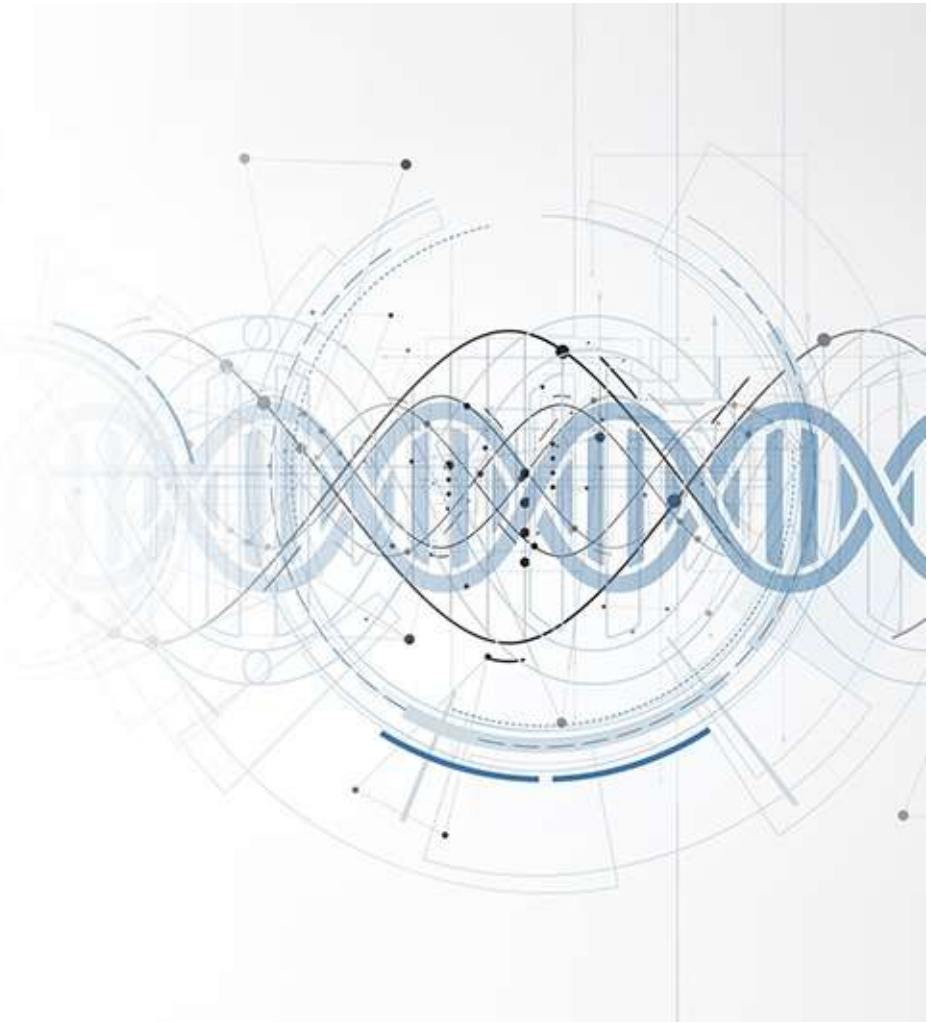
In improvement initiatives, health systems can use control charts to support the Model for Improvement *(Figure 1)* a method for accelerating improvement, by addressing three fundamental questions:

1. What is the goal of the improvement project?

2. How will the organization know that a change is an improvement?

3. What change can the organization make that will result in improvement?



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After its three questions, the Model for Improvement applies the Plan-Do-Study-Act (PDSA) cycle (Figure 1), a framework for evaluating changes in a real work setting to determine if those changes result in improvement.

This presentation describes four ways control charts in healthcare can support successful improvement.

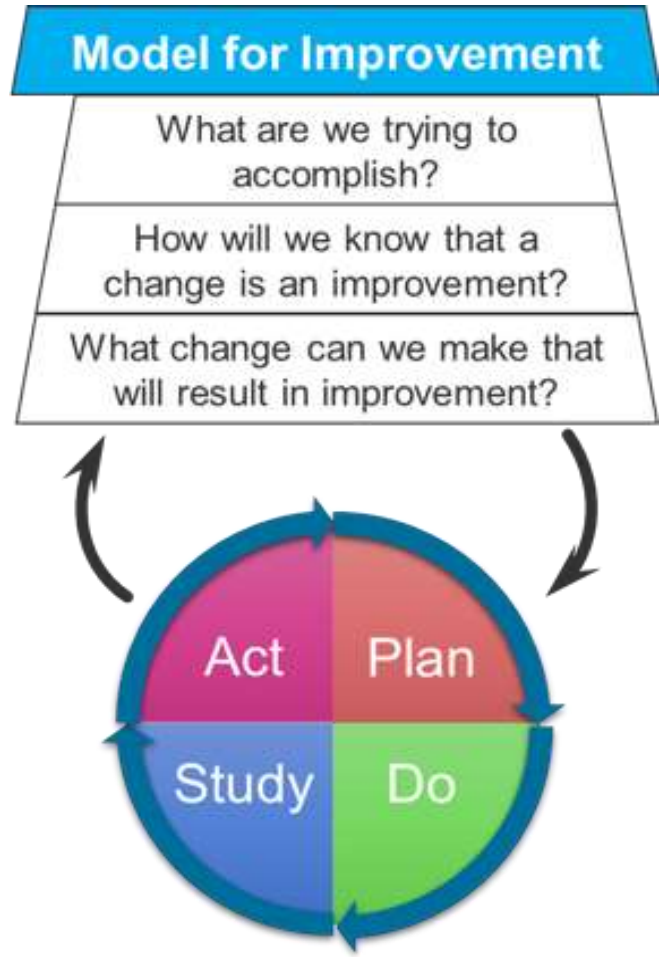

Figure 1: The API Model for Improvement and the PDSA cycle

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4 Ways Control Charts Improve Healthcare

#1. Control Charts Help Health Systems Visualize Existing Process Variation

Control charts, also known as Shewhart charts (Figure 2) or statistical process control charts, help organizations study how a process changes over time.

The charts plot historical data and include a central line for the average of the data, an upper line for the upper control limit, and a lower line for the lower control limit.

Users compare current data to the lines to determine if the variation in a process is stable (only common cause variation) or unpredictable (some special cause variation).

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4 Ways Control Charts Improve Healthcare

#1. Control Charts Help Health Systems Visualize Existing Process Variation

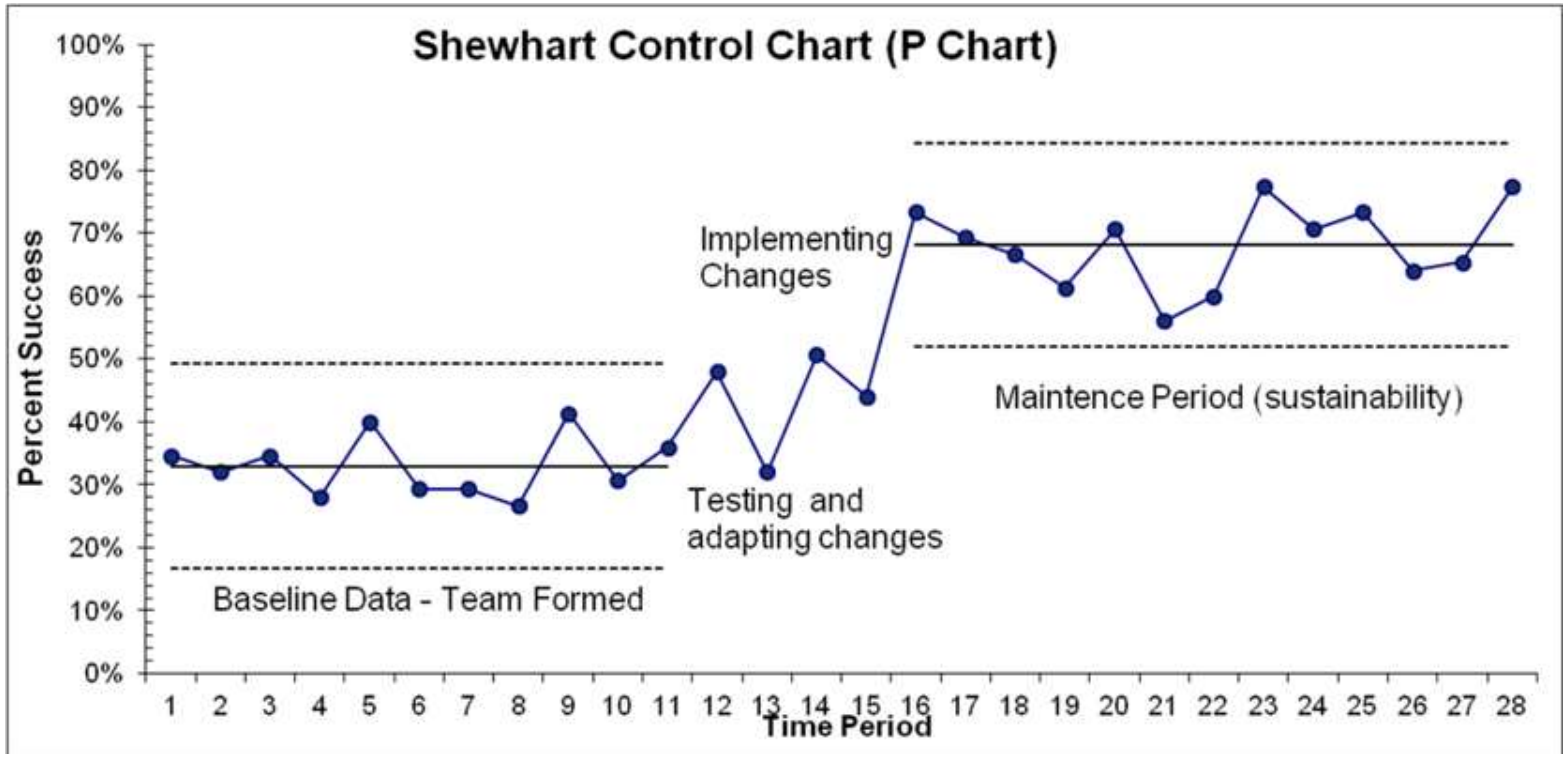

Figure 2: The Shewhart control chart

4 Ways Control Charts Improve Healthcare

#1. Control Charts Help Health Systems Visualize Existing Process Variation

Common Cause Variation Versus Special Cause Variation

According to the Shewhart concept of common cause and special cause variation, common causes are an inherent part of a system or process that impact all stakeholders and outcomes at all times.

Special causes arise from specific circumstances that impact only a subset of people or outcomes.

During improvement initiatives, health systems can use the distinction between common and special cause variation to identify changes that will result in improvement and assess how effectively these changes improve a process.

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4 Ways Control Charts Improve Healthcare

#2. Control Charts Guide Improvement Strategy

Control charts help health systems measure healthcare processes and determine the strategy and scope for an improvement initiative.

The control chart can help determine the focus of the next PDSA cycle in one of four areas:

1. Identifying variation.
2. Understanding variation.
3. Removing common causes of variation (fundamental redesign of the system).
4. Understanding and acting on special causes of variation (fixing the current system).

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#2. Control Charts Guide Improvement Strategy

For example, to improve the health of children with diabetes, a health system can use control chart principles to identify variation and opportunities for improvement in pediatric diabetes care.

Their initial work might focus on the cost and care of patients admitted to the hospital with diabetic ketoacidosis (DKA).

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4 Ways Control Charts Improve Healthcare

#2. Control Charts Guide Improvement Strategy

With control charts of the length of stay (LOS) for the last 30 DKA patients admitted, the improvement team can learn from the variation in the current process and optimize their improvement strategy.

Insight from the control charts can help the team make a critical differentiation:

- *Do they need to focus on problems related to specific patients (special cause)?*
- *Do they need to think about fundamental changes to the care pathway (common causes)?*

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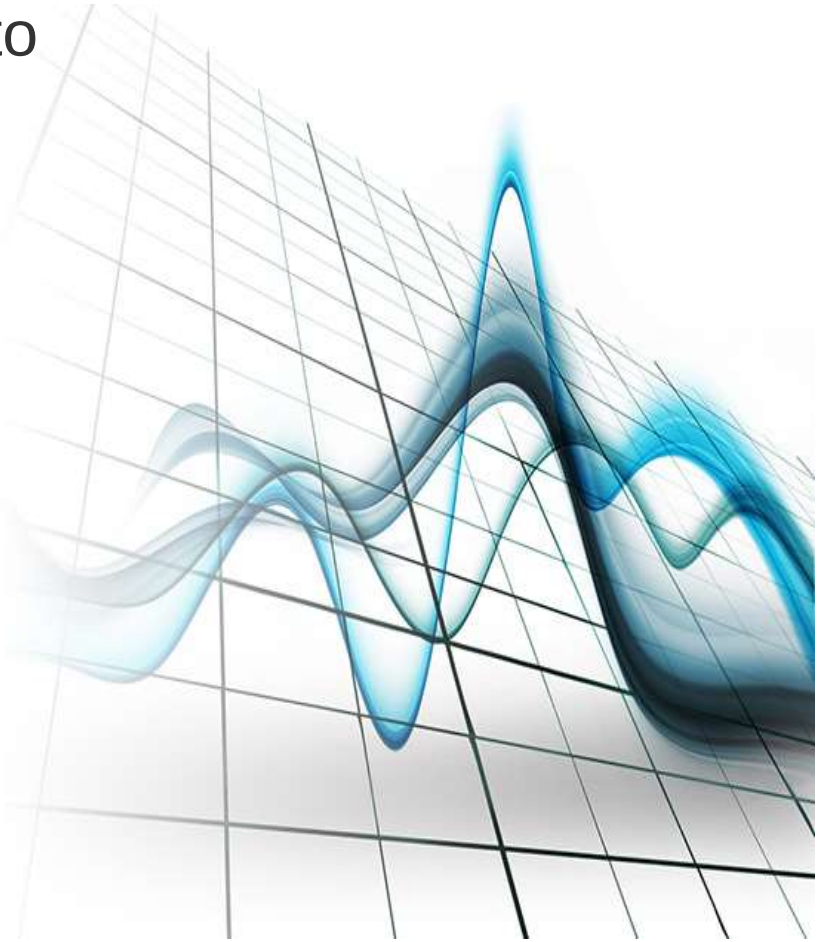
4 Ways Control Charts Improve Healthcare

#3. Control Charts Confirm when a Change Is an Improvement

The control chart method provides a formal way to decide whether observed variation in a measure of quality is due to implemented changes or to other causes of variation in the system.

Health systems can study this question at both the project level and in a PDSA test of change.



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4 Ways Control Charts Improve Healthcare

#3. Control Charts Confirm when a Change Is an Improvement

Project Level

By monitoring the outcome and process measures throughout the life of the improvement project, improvement teams can understand the cumulative impact of the changes implemented.

In the diabetes improvement scenario, a control chart for weekly measures of average LOS and readmissions would be appropriate.

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#3. Control Charts Confirm when a Change Is an Improvement

PDSA Level

A special cause signal on a control chart in a PDSA test cycle can provide evidence that the change the improvement team is testing impacts a process or outcome measure.

For example, the improvement team in the pediatric diabetes project might test the use of evidence-based changes to improve insulin timeliness.

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#3. Control Charts Confirm when a Change Is an Improvement

PDSA Level

If the baseline control chart for time to administer insulin were stable, the improvement team would know they needed a process change to become timelier.

They could study the current process and discuss ways to reduce the time for patients to receive insulin.

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#3. Control Charts Confirm when a Change Is an Improvement

PDSA Level

By plotting timeliness for each patient, within a week of beginning to test these changes, the control chart would show signals of special cause, confirming the predicted improvement.

The team could then implement the changes and continue to monitor the chart to hold the gain.

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#4. Control Charts Identify Potential Changes that Will Result in Improvement

Control charts that use rational subgrouping and stratification can also help users study causes of variation to develop ideas for change.

For example, if an improvement team theorizes that there are particular times of day when problems occur, they can subgroup the data on the applicable control chart time of day to evaluate this theory.

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#4. Control Charts Identify Potential Changes that Will Result in Improvement

For example, if the pediatric diabetes improvement team were seeking ways to improve use of flu shots among patients with diabetes, they could use a control chart to study flu shot use for different age groups.

A team member could use the control chart to show the percentage of patients who received flu shots and use this rational subgroup analysis to develop different strategies to reach pre-school and school-aged children.

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Control Charts in Healthcare Plot a Route to Key Improvement Understanding, Increased ROI

Health systems can use control charts to understand the causes of variation in key measures and unlock understanding of effective improvement strategies, potential changes that result in improvement, and how effectively these changes improve a process.

Organizations that routinely deploy control charts to monitor key process measures can charter effective improvement initiatives and expect to see an increase in the return on their investment in improvement.

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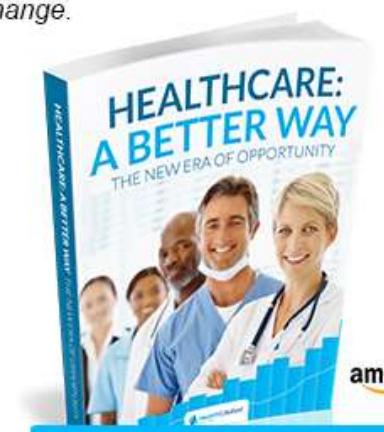

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Lloyd Provost

With an education in statistics, Lloyd works as an advisor to organizations, helping them make improvements in their products and services and increase their capacity to continually learn and improve. His experience includes consulting in planning, management systems, measurement, planned experimentation, and other methods for improvement of quality and productivity. Lloyd has advised clients worldwide in a variety of industries including computers, health care, chemical, manufacturing, engineering, construction, automotive, electronics, food, transportation, professional services, retail, education, and government. Through API's partnership with the Institute of Healthcare Improvement (IHI), Lloyd is a senior fellow and serves as an improvement advisor supporting IHI's innovation and improvement programs. He serves as faculty for IHI's Improvement Advisor Professional Development Program and supports IHI's programs in developing countries. Lloyd has a Bachelor of Science in Statistics from the University of Tennessee and a Master of Science in Statistics from the University of Florida. He is the author of several papers relating to quality and measurement and co-author of books on planned experimentation and the science of improvement Quality Improvement Through Planned Experimentation (2nd edition, McGraw-Hill, 1998) and The Improvement Guide: A Practical Approach to Enhancing Organizational Performance (Jossey-Bass, 2009). He was the year 2003 recipient of the Deming Medal awarded by the American Society for Quality.

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