Review Article

Quality and Efficiency Improvement Tools for Every Radiologist

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Abbreviations and Acronyms

RCA
root cause analysis

PDSA
Plan-Do-Study-Act

In an era of value-based medicine, data-driven quality improvement is more important than ever to ensure safe and efficient imaging services. Familiarity with high-value tools enables all radiologists to successfully engage in quality and efficiency improvement. In this article, we review the model for improvement, strategies for measurement, and common practical tools with real-life examples that include Run chart, Control chart (Shewhart chart), Fishbone (Cause-and-Effect or Ishikawa) diagram, Pareto chart, 5 Whys, and Root Cause Analysis.

Key Words: Quality improvement tools.

INTRODUCTION

In Radiology, quality improvement is the constant effort to improve performance, safety, and patient outcomes based on imaging services (1–3). Diagnostic imaging and image-guided procedures require a complex system of information, equipment, personnel, and decision-making that must be well integrated to provide patient care effectively and safely. Appropriate intervention at points of inefficiency or potential hazard can reduce costs and benefit patient care. Involving departmental and hospital leadership is essential to establish an organizational commitment to support these activities (2,3). Understanding the model for improvement, strategies for measurement, and practical quality improvement tools enables every radiologist to successfully engage in quality and efficiency improvement.

THE MODEL FOR IMPROVEMENT

Quality improvement is most effective when it is systematic, data-driven, continuous, and incorporated as a *core responsibility* of health-care professionals. It should employ a formal methodology and focus on system change. In contrast, informal improvement efforts are frequently sporadic, anecdotal, rarely data-driven, and implemented without an assigned responsible supervisor. Such patchwork improvements are challenging to integrate into a cohesive system and may lead to future inefficiencies, not initially anticipated.

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The "Model for Improvement," as outlined by the Institute of Healthcare Improvement, emphasizes project aims, designing measurements around the aims, and then testing small changes before enterprise-wide implementation. The process is then continued in a cycle of Plan-Do-Study-Act (PDSA) (Table 1) (4,5).

Implementing solutions locally on a trial basis is very helpful. If the change is successful, it can then be applied widely, thereby avoiding spending limited resources on efforts that are inefficient or of limited value. Sharing the practical benefits of an implemented solution especially by showcasing objective outcome measures can aid in achieving staff buy-in, which is essential for achieving and maintaining success.

When staff members from various department sections and with diverse perspectives champion small changes within this framework, significant improvements can be identified and, moreover, a culture of improvement is fostered throughout the entire department.

LEAN MANAGEMENT AND SIX SIGMA

Parallel frameworks to approach quality improvement exist including Lean Management and Six Sigma, which integrate slightly different tools and philosophies. These models are adapted from industry for minimizing waste and decreasing error rates. Description of these alternative models is available elsewhere (6,7), although beyond the scope of our article, which focuses on specific tools that stem from the model of improvement.

One of these tools that is frequently used in the clinical practice is A3 framework. The A3 sheet (so named because that is the paper size used to document this process) is the Toyota standard for documenting problem identification, analysis, proposed solutions, and status review. An A3 sheet is a great tool for communication between team members and the whole department. As such, it aids in effective and efficient

TABLE 1. The Model for Improvement Specifies Aims, followed by Measurements Needed to Track Progress Toward the Specified Aims, and then Specific Ideas That Will Enable Us to Accomplish Our Aims

Aims	What are we trying to accomplish? • State clear objectives—know exactly what you are trying to do
Measurements	How will we know that a change is an improvement? • Measure processes and outcomes
Change ideas	What change can we make that will result in improvement? • What have others done? • What hunches do we have? • What can we learn as we go?

TABLE 2. Types of Measures, Relation to Aims, and Our Health Example

Aims	Clear objectives • Improve my health and energy by losing 10 pounds in the next two months • Walk with my friend around the lake three mornings each week, eliminating ice cream, and doing yoga on Thursday evenings
Outcome measures	Assess progress toward the ultimate aim • Weight, energy level
Progress measures	Learning during PDSA cycles • Daily ingested calories, yoga sessions attended, walks completed
Balance measures	Assess system improvement • Clothing size, endurance

dialogue, while communicating project progress to rest of the staff.

AIM

Before any intervention, it is essential to know exactly what you are trying to accomplish. Articulating an "aims statement" clearly defines the scope and limitations of the project, outlines specific measurable goals, delineates a timeframe, and identifies perceived challenges. For example, from a personal perspective, my aims statement might be: I am going to improve my health and energy level by losing 10 pounds in the next 2 months. I will achieve this by walking with my friend around the lake three mornings each week, eliminating ice cream, and doing yoga on Thursday evenings. This statement is very different from just saying "I am going to lose weight."

MEASUREMENT

Understanding how to harness data to guide and validate an intervention is critical for implementing a successful change. By establishing a baseline, the impact of an intervention can be monitored, sustainability ensured, and ineffective solutions avoided. Measurement separates what you think is happening from what is actually happening. Only data collection and analysis can confirm whether a change is actually an improvement.

Ideally, measurements should be used to speed things up, not slow things down (5). Good measures are designed around aims; they must be relevant, quantifiable, and accurate to validate improvement. Also, they should be easy to collect during daily routine and minimize administrative burdens, for example, by requiring less than a week of data for each data point.

Questions to consider when choosing measures include:

- Does the indicator relate to a condition that occurs frequently or greatly impacts your patients?
- Is the indicator based on accepted guidelines or developed through formal group decision-making methods?
- Can the indicator be *measured* realistically and efficiently given the finite resources at your facility?
- Can the performance rate associated with the indicator realistically be *improved* given the inherent limitations of specific clinical services and the patient population?

There are three types of measures: outcome, process, and balance measures (5). *Outcome measures* assess progress toward the ultimate goal, such as complication and survival rates. *Process measures* can be either quantitative or qualitative and are used for learning during PDSA cycles to evaluate progress during the process. Examples of process measures include report turnaround time and non-diagnostic biopsy rate. *Balance measures* assess whether the system as a whole is being improved to make sure that improvement in one area does not cause detriment in another. Examples of balance measures include physician burnout rate, costs, and patient satisfaction. These different measures tell the improvement story to capture the complete picture (Table 2).

Important practical factors to consider before embarking on quality improvement projects are *how the data will be obtained, by whom, and how frequently*. Who will make the graphs and who will review the results? Harnessing existing data collection mechanisms is essential for your success. If you wait for your IT department to build a special dashboard, then your project most likely will never come to fruition. Ask your administrators and technicians about metrics that are already being collected and use those for your project. If you need a specific metric that is not being currently collected, then look for something simple that requires little time investment.

More data is not always better. In fact, small sample sizes are typically sufficient, less time-consuming, and less expensive (Fig 1). In most cases, small random weekly or daily samples are more than sufficient.

Measurement for quality improvement is different from measurement for research (Table 3). Several key distinctions include accepting bias rather than trying to eliminate it, aiming for