

# 10-Year Experience Integrating Strategic Performance Improvement Initiatives: Can the Balanced Scorecard, Six Sigma<sup>®</sup>, and Team Training All Thrive in a Single Hospital?

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## Abstract

**Objective:** This article demonstrates how Duke University Hospital has taken three widely diverse quality management initiatives and melded them into a comprehensive approach to achieve our strategic goals. **Methods:** The Balanced Scorecard (BSC) is a management system focused on developing a mission, strategic goals, and key metrics and linking these to specific operational initiatives. Six Sigma<sup>®</sup> provided a solid performance improvement framework utilizing the DMAIC approach: Define, Measure, Analyze, Improve, and Control. Team Training translated aviation's Crew Resource Management principles to a health care-specific methodology. **Results:** Utilization of the BSC has led to an increase in net margin by 236 percent. Six Sigma reduced the risk score in moderate sedation from 11.94 to 4.94 and event probability score from 3.31 to 1.34. Team Training increased awareness of safety processes by 26 percent, communication as a team by 29 percent, and independent observations of overall teamwork by 72 percent. **Conclusion:** The BSC consolidates strategic initiatives; Six Sigma facilitates focused improvement within operations; and Team Training improves communication across disciplines. Understanding these differences and building upon each approach's individual strengths is essential to success.

## Introduction

A number of quality management and performance improvement (PI) methodologies are readily available for use in the hospital setting.<sup>1, 2, 3, 4</sup> However, these models consist of differing frameworks and flow processes, which often compete for resources and may even have conflicting goals. Many of these methodologies have been used in business and then translated to health care.<sup>1, 2, 4</sup>

One concern with this translational approach is that the goal of business is primarily to improve shareholder value, whereas the primary goal in medicine is to improve patient care. As a result, the direct translation of these business principles to health care can result in confusion as to which strategy is best for what problem. In addition, as new methodologies are introduced, the questions become:

- What exactly does this new methodology replace?
- How do these methodologies interact with each other?
- What resources are being rechanneled or added to support this approach?

Such questions are routinely asked by physicians, who often verbalize frustration at being “kept in the dark” regarding strategic planning, quality management, and PI efforts.

To eliminate these questions and other impediments to success, one needs to systematically implement clinical improvement strategies in a way that utilizes the advantages of each approach, while focusing on long-term goals. The three approaches that will be outlined in this article include the Balanced Scorecard (BSC), Six Sigma, and Team Training. They represent a small component of the quality management arsenal, but they do illustrate how one can develop a thoughtful PI platform that readily supports the overall strategic plan.

## **The Balanced Scorecard**

Originally developed to support PI in industry, the BSC has been touted as a strategic planning framework that consolidates multiple improvement projects into a single integrated platform.<sup>1</sup> As such, the scorecard is an integration of multiple interventions and keeps “score” of the success or failure of the strategic goals. This approach is fundamental to success, promotes balance in the organization, and aligns all disciplines around a focused strategic agenda. The BSC at Duke Children’s Hospital has assisted in driving the success of the PI initiatives toward achieving the strategic goals.<sup>2, 5</sup> However, PI at the operational level requires additional tools and techniques that bridge the gap between strategy and tactics. Two specific tools that have been introduced in our hospital to perform this function include Six Sigma<sup>®</sup> and Team Training.

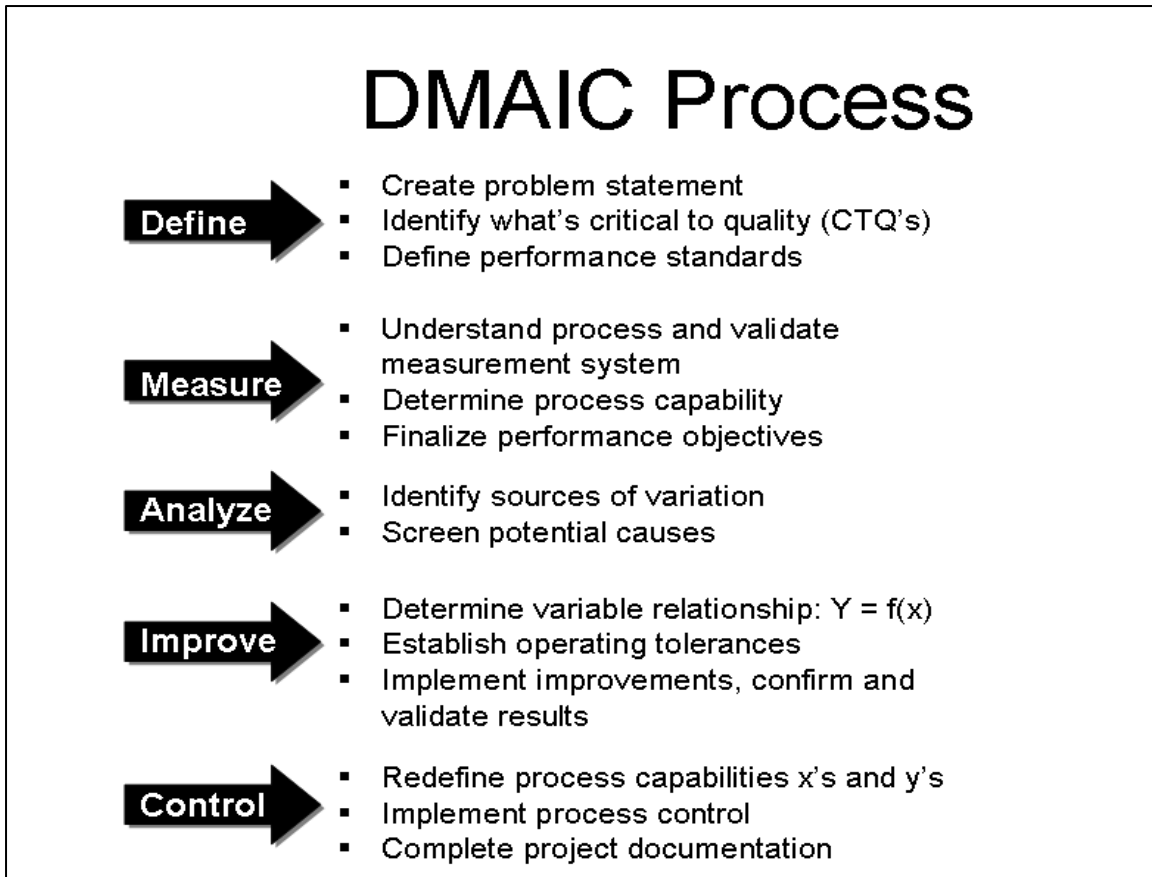
## **Six Sigma<sup>®</sup>**

Six Sigma is a data-driven approach that has been shown to excel at drilling into specific problems and reducing “defects.”<sup>3</sup> As such, Six Sigma represents a focused look at a specific practice. This methodology has been successful in manufacturing and other industries where work processes are associated with high levels of variability and where improvement efforts have the ability to measure specific data.<sup>3</sup> The methodology follows a very specific pattern outlined from experience in industry, consisting of 5 phases, which make up the DMAIC model: (1) Define, (2) Measure, (3) Analyze, (4) Improve, and (5) Control (Figure 1). Six Sigma projects are highly focused, “microscope-like” evaluations of specific practices. These projects require a team of individuals trained in Six Sigma methodology, data collection, and data analysis, as well as individuals who can initiate operational interventions to improve the targeted practice.

## **Team Training**

While PI methodologies provide an important framework for improvement, these changes are not sustainable unless the improvement model also addresses the human factors that affect the process. Providing health care requires fallible human beings to work in an incredibly complex environment with little room for error. In order to achieve sustained improvement, it is essential that we minimize the risk associated with human failures. Team Training, also called “Crew

Resource Management,” is a methodology that has been used in the aviation industry to improve human performance, communication, and team work.<sup>4</sup> Customizing this approach for health care provides a unique approach to PI that focuses on human behavior and helps identify ways to reduce or mitigate risk through enhanced communication and more effective teamwork.



**Figure 1.** Six Sigma<sup>®</sup> methodology. Six Sigma is a data-driven methodology using the DMAIC approach.

A multitude of clinical improvement approaches can be successful in a variety of settings. The goal of this article is to demonstrate how our institution has taken three of those approaches and melded them into a comprehensive model to achieve our strategic goals.

## Methods

### Balanced Scorecard

Balanced scorecard methodology starts with the development of the mission and strategic plan.<sup>1,2,5</sup> Senior management sets the strategic goals and provides support for the project. Once the senior management team has defined the strategic goals, the key metrics that measure performance are developed. Finally, initiatives are developed to improve performance and support achievement of the strategic goals. The scorecard functions as an important strategic

platform that drives the integration of key initiatives, methodologies, and processes across critical perspectives.

When translating the scorecard to health care, a significant modification of the “traditional” perspectives is required.<sup>2,5</sup> The major difference in a health care BSC, as opposed to an industry BSC, is that the major focus of the health care organization’s vision and mission is on patient safety and clinical quality rather than on financial performance. To reflect this difference in focus, the scorecard is modified in the following manner:

**Defining perspectives.** The traditional BSC has the following perspectives: Financial, Internal Business, Customer, and Learning and Growth. The Financial perspective is typically located on the top of the card showing its importance as the key concern for the organization. Health care modifications that have been used successfully include changing the perspectives to Quality and Patient Safety, Customer, Finance and Work Culture. The Quality and Patient Safety perspective is placed at the top indicating its priority importance in health care.

**Defining goals linking performance metrics.** Once the strategic plan is defined, specific goals are determined by the team and linked to each strategic perspective. Limiting the goals to three or four per perspective is essential in order to maintain focus on initiatives that will drive the strategic plan. After the goals are determined, specific metrics are defined and linked to each goal. The metrics must be measurable and collected at least quarterly. Performance targets are then defined and linked to each metric. It is best to pick a modest improvement from baseline, such as 10 to 20 percent in the initial scorecard. Many of the operational metrics that populate the BSC are derived from a variety of databases that may include hospital operational and financial databases, patient safety data from internal safety reporting systems, patient satisfaction survey data, and work culture survey data.

**Driving the BSC to unit levels.** The performance on the scorecard rolls up to provide a single score for all goals and metrics. In this way, it provides balance to the organization because the overall score will be low if the organization performs well in one perspective (e.g., Finance) and does poorly in another (e.g., Quality). The next step is to have individual scorecards at the service unit level and, finally, at the individual operating unit level. This tiered approach encourages focused improvement efforts at the direct patient care level that are aligned with the strategic goals of the broader organization. Without this alignment, PI efforts are oftentimes reactionary and focused on local concerns that may have little impact on organizational outcomes. Aligning PI initiatives toward strategic goals provides a significant economy of scale and ensures that the entire organization benefits from collaborative efforts.

## **Six Sigma®**

Six Sigma was chosen as our hospital’s PI methodology in 2004, replacing the FADE methodology in use at that time. Six Sigma provides a rigorous PI platform, which utilizes the scientific method to focus on specific processes with high variability, measurability, and impact on performance (Figure 1). The methodology is well defined, and consists of the DMAIC approach (Define, Measure, Analyze, Improve, and Control).<sup>3</sup>

In the define phase, specific tools are utilized to define the project's purpose and scope, and identify factors that are critical to quality. In the measure phase, the goals are to develop a reliable measurement system to track the metrics that define high quality. In the analysis phase, data are collected and evaluated to identify the root causes of process variability. The improvement phase consists of developing and implementing initiatives to improve performance and evaluating the results of those initiatives. The final phase consists of controlling the process and achieving sustainable improvement.

Our hospital's Six Sigma structure consists primarily of "Black Belts" and "Green Belts," who have received advanced training in PI techniques and rigorous statistical analysis tools. These individuals are assigned projects based on organizational priorities and identified areas for improvement. Senior administrators are designated to serve as project champions and to assist in removing obstacles to improvement. Multidisciplinary work teams are formed and, under the guidance of the Black Belt or Green Belt, conduct a DMAIC process.

The ultimate goal of these teams is to identify solutions that lead to sustainable improvement. Given the scientific rigor and sophisticated statistical analysis inherent in Six Sigma, data may be analyzed and solutions generated using various techniques. We have undertaken projects that required nothing more complex than Pareto diagrams and others that necessitated complex multivariate analyses, yet all led to substantive process improvements.

## **Team Training**

Our initial Team Training work focused on modifying the aviation industry's Crew Resource Management process to better match health care teams' needs. In January 2006, the Pediatric Intensive Care Unit (PICU) was chosen as a pilot unit for the Health System's Team Training program, since it had a high census, strong local leadership, and a history of successful PI initiatives. Prior to the initiation of Team Training, a standardized Teamwork and Safety Climate Survey was administered to the PICU staff in order to evaluate teamwork and patient safety.<sup>6</sup>

A wide variety of staff and faculty members responded to the survey. Participants included physicians, nurses, administrators, respiratory therapists, pharmacists, unit clerks, and others. Survey analysis noted no differences in the background characteristics of survey respondents. In addition, evaluation of actual teamwork performance was accomplished through direct on-site observation of communication and teamwork behaviors by human factors experts. Once these baseline measurements were obtained, the health system's Chief Patient Safety Officer met with the unit's leadership team to define goals, metrics, concerns, and a training approach.

The actual Team Training consisted of a variety of didactic lectures, hands-on demonstrations, role playing, open discussions, and training internal coaches. The entire team—consisting of physicians, managers, nurses, respiratory therapists, pharmacists, social workers, ward clerks, and others—were invited to a 3-hour team training session. The improvement initiatives derived from this training were brought to the local safety and quality team meetings, revised as needed, and implemented. Reviews of the Team Training project were performed at the weekly safety meeting, monthly staff meetings, and monthly faculty meetings. A followup survey and repeat evaluation of teamwork were performed. Survey and observational data were compared using the Fisher exact test.

## Results

### Balanced Scorecard

In the “Quality and Patient Safety” perspective, several improvements have been noted. Compared to the previous fiscal year, there has been a reduction in morbidity, a decrease in re-admits from 7 percent to 4 percent, a decrease in infection rates from 3 percent to 1 percent, and a decrease in length of stay by 0.6 days. In addition, there has been an increase in average daily census by 9 percent over the previous fiscal year. In one focus area (PICU), throughput has increased by 10 percent, as measured by hospital discharges and PICU visits.

In the “Finance” perspective, the patient flow team achieved a 26 percent improvement in discharge times and 10 percent improvement in PICU encounters. Multiple finance-based initiatives have been implemented since the BSC was first put into place. The details of these initiatives are beyond the scope of this article, but they have resulted in an increase in the variable contribution margin by 240 percent and an improvement in net margin from losing \$4.7 million per year in FY04 to a total of \$7.4 million lost over the last 2 years.

In the “Customer” perspective, patient satisfaction scores have exceeded the set targets over the last fiscal year (Press Ganey overall mean score of 84). In addition, the percentage of inpatients reporting Duke Children’s as “very good” has exceeded the target set for this fiscal year.

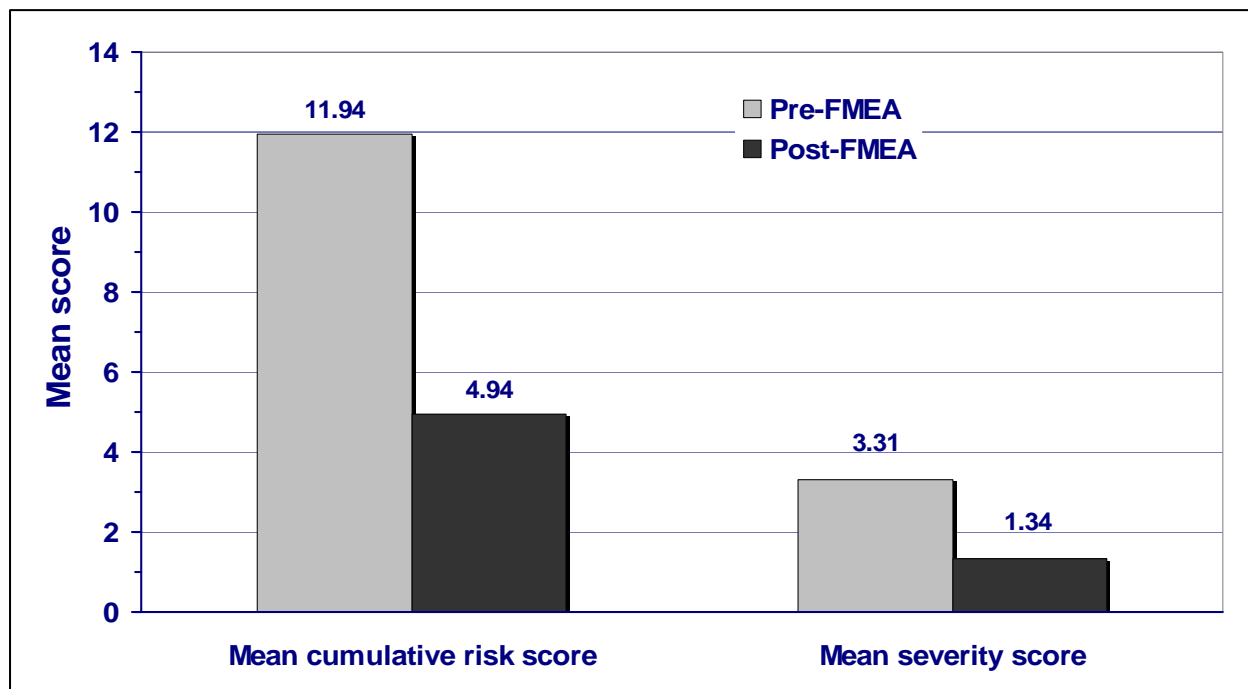
The majority of relevant data in the work culture perspective will be covered under team training.

### Six Sigma®

A number of formalized Six Sigma projects at both Black Belt and Green Belt levels have been implemented across Duke Children’s Hospital. Areas of focus include patient safety, patient flow, and patient satisfaction. Six Sigma initiatives in these areas have resulted in a 44 percent reduction in adverse drug events, a 38 percent increase in discharge efficiency, and significant percentile ranking improvements in patient satisfaction.

In addition to focused projects, the concept of “Safe System Design” has been integrated into the Duke Children’s PI structure and is used to build overall improvement within priority areas during the DMAIC Improve phase. This concept utilizes prospective risk assessment tools, such as failure modes and effects analysis (FMEA), and combines these with system-focused error-reduction and mistake-proofing principles. By using these tools, Duke Children’s has been able to significantly reduce patient risk in specific areas of focus.

For example, a Six Sigma initiative focused on pediatric moderate sedation decreased the mean risk score from 11.94 to 4.94 (16-point scale) and the event probability from 3.31 to 1.34 (4-point scale) (Figure 2). In order to sustain such improvement and minimize the risks associated with a return to previous patterns of behavior, PI efforts are focused on “hardwired” systems solutions and attempt to build in “forcing functions” whenever possible. The intent of this approach is to offset the inherent risks associated with fallible human beings functioning in a complex clinical environment. Six Sigma provides the infrastructure for developing and



**Figure 2.** Comparison of pre/post-FMEA score risk and severity analysis. Sigma Six-focused initiatives resulted in a 57 percent reduction in cumulative risk and a 60 percent reduction in severity score in pediatric sedation practices.

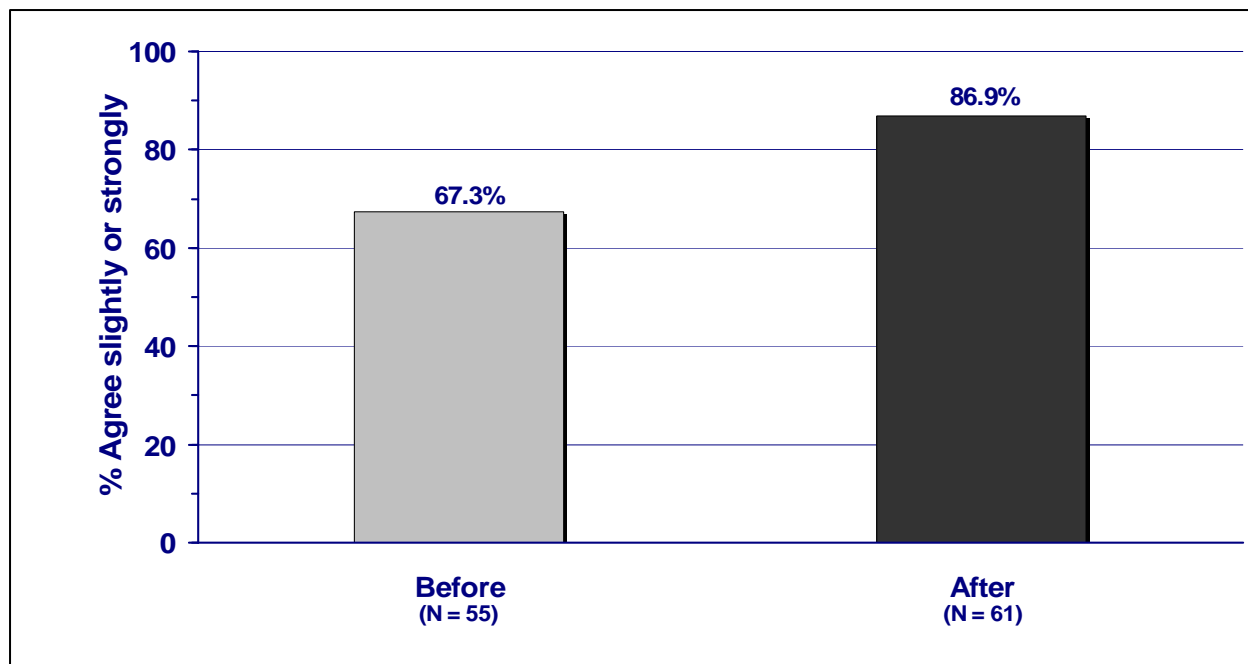
implementing these broad-based solutions; Team Training is then utilized to further mitigate potential risks associated with human behavior.

## Team Training

As a result of Team Training, a number of significant operational changes were implemented, including:

- The use of critical language to identify concerns (specifically the phrase, “I need clarity”).
- Pre- and post-round briefings and debriefings, or “huddles.”
- Situation-background-assessment-recommendation (SBAR) communication for nursing reports and telephone communications.
- Use of a “sterile cockpit” (a term borrowed from aviation’s crew resource management) limits interruptions during team rounds to criteria-driven, clinically necessary questions. This allows the team to focus on effective communication and critical issues during this vulnerable time period.
- Standardized communication process for patient handoffs.
- Utilization of an open agenda for weekly safety rounds.
- Improved distribution of safety minutes to all staff and faculty.

This focus on Team Training and the associated process improvements have resulted in significantly improved communication and an increased awareness of safety process. A repeat Teamwork and Safety Climate Survey administered 6 months after the initial training showed the



**Figure 3.** Results of staff surveys before and after Team Training. There was a 29 percent improvement in the staff’s perception of team work in response to the survey question: “The physicians and nurses here work together as a well-coordinated team.”  $P = 0.011$  (Fisher Exact test)

following: staff’s perception of teamwork increased from 67 percent to 87 percent ( $P = 0.011$ ) (Figure 3); use of briefings increased from 63 percent to 84 percent ( $P = 0.012$ ); and knowing the proper channels to direct questions regarding patient safety increased from 67 percent to 87 percent ( $P = 0.007$ ).

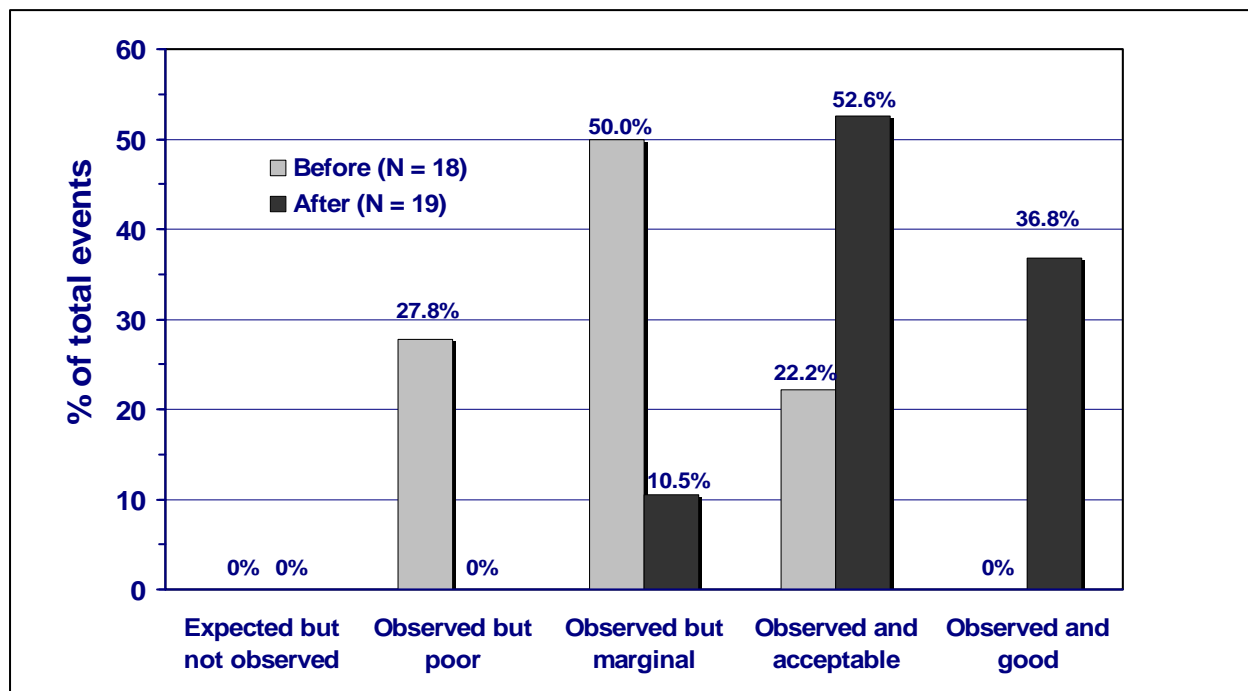
The independent observations of teamwork were also improved: overall teamwork increased by 72 percent ( $P < 0.001$ ) (Figure 4), and overall perception of teamwork increased by 75 percent ( $P < 0.001$ ). Surveys also demonstrated that 95 percent of participants believed that Team Training would improve the way they did business, and 100 percent of participants would recommend Team Training to coworkers.

## Discussion

Because of the wide variety of options available and the hospital staff’s lack of experience, many health care providers find implementing clinical improvement programs in health care to be challenging.<sup>1-4</sup> To be successful, these programs must be supported by senior management, physicians, and caregivers. Physicians, as a group, often are difficult to engage. PI initiatives may require physicians to change their practice, yet they frequently do not include input from the physicians, resulting in a lack of physician support for improvement initiatives and placing physicians at odds with administrators.

Clinical improvement initiatives that involve a change in physician practice must engage physicians in the process. Engaging physicians is challenging, as they typically lack a background in PI and perceive that they will have difficulty contributing to the mission. This





**Figure 4.** Results of an independent evaluation of teamwork before and after Team Training. In an independent evaluation of teamwork, overall teamwork in the PICU improved by 72 percent (Acceptable + Good scores Before vs. After).  $P < 0.001$  (Fisher’s Exact test).

reluctance can be overcome by developing a specific training program for physicians, identifying clear goals and areas of focus, and linking the physicians with current operational and clinical PI teams. In this way the physicians can become an integral part of the process, and the organization can leverage their considerable influence to achieve success.

Another concern is that institutions may have several different PI approaches ongoing simultaneously. This can be very unsettling to the team and result in confusion and a lack of clear direction. To address these concerns, a systematic approach should be used that identifies a specific goal and links projects to a specific initiative that is based on the strengths and limitations of the framework being utilized.

The BSC is an excellent strategic platform that consolidates all strategic initiatives and identifies areas of opportunity.<sup>1, 2, 5</sup> Once areas of opportunity have been identified, more focused approaches can be used to drill into the data. One way to describe this to the organization is to consider the BSC as the “telescope” of the organization. As such, the BSC looks widely over the landscape for any peaks or valleys and looks into the future to determine the strategic direction. If the BSC identifies a specific peak, in this analogy a mountain, then Six Sigma methodology is used to examine a specific hill on that mountain. Six Sigma is utilized as the “microscope” that looks deeply into an area that has been identified as having high variability and the need for focused process improvement.

Team training is an excellent framework for examining the effects of human factors on performance. It is ideally suited in situations where you are focusing on improving communication and education across disciplines. It reflects how interactions between individuals

affect outcomes. In the analogy above, team training would be similar to examining how the grass, plants, and trees all coexist on that mountain.

Since it is designed to increase shareholder value, the traditional BSC has limitations in health care.<sup>1</sup> Duke Hospital has found that by altering the scorecard to place the emphasis on quality and safety, the scorecard has been adopted by both practitioners and administration. The BSC has now become the methodology for how each operating unit reports performance to the senior management team. Unit-specific scorecards are also displayed in full view of all the staff and faculty on the individual units. The individual unit scorecards are updated on a monthly or quarterly basis, and these scorecards roll up to the service line scorecard, which then rolls up into the hospital scorecard.

The BSC requires thoughtful, considered adjustments in goals and metrics to meet the changing strategic plan. For example, if an ICU expansion is planned, the BSC might be updated with new goals and metrics tied to this project and reflected in the ICU scorecards. In this way, the BSC functions as a living record of how performance is tracking against the strategic plan.

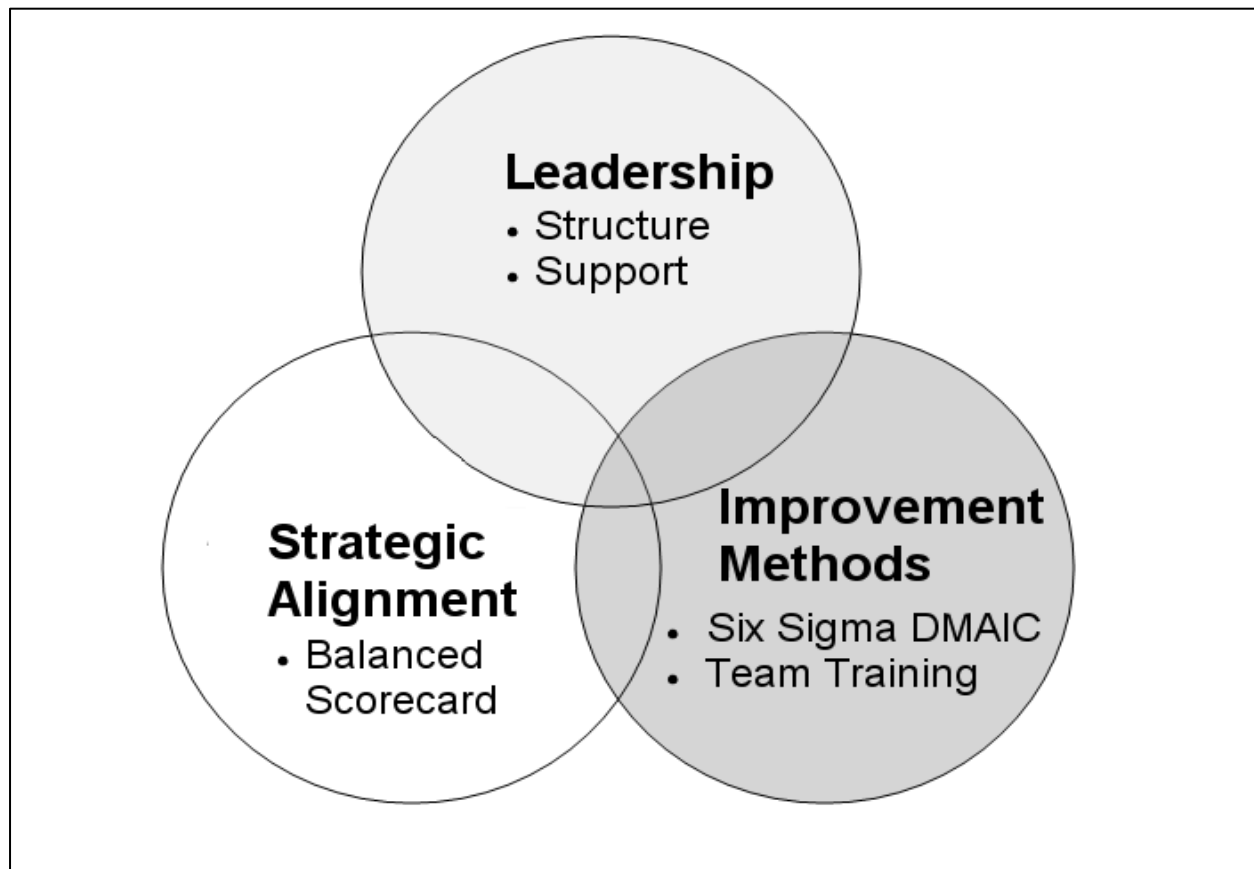
One of the most important aspects of our program is the incorporation of Six Sigma as a key element of the overall patient safety and clinical quality structure. Six Sigma is a PI methodology that applies a rigorous, analytic approach to improving performance, and it has proven to be extremely useful in addressing safety and quality issues across Children's Services.<sup>3</sup> The scientific rigor inherent in Six Sigma allows for highly detailed analyses of clinical concerns, and the improvement tools present in the Six Sigma "toolkit" provide numerous options for correcting and controlling problem areas.

Implementing Six Sigma in health care has many hurdles, though. First, one must train individuals in the Six Sigma methodology, which requires a significant time and capital expenditure. Once these individuals are trained, they can begin the process of defining what is critical to quality.

Second, data collection efforts—i.e., accurate measurement and analysis—in health care typically lag behind similar efforts in industry. This is a function of multiple issues including, but not limited to, lack of contemporary IT (e.g., bar coding), lack of IT investment, and conflicting priorities.

Third, after the measurement and analysis have been completed, the recommended PI initiatives frequently require clinicians and operational individuals who are not trained in Six Sigma to make changes in practice. Unlike a production line with machines, health care frequently requires changes in human behavior. This can be problematic if the individuals who must change have no knowledge of what is driving the change.

Finally, control of the process can be difficult as priorities in the organization shift. Despite these challenges, if one utilizes Six Sigma as a focused approach to achieve key specific goals of the BSC, success can be achieved. Figure 5 illustrates the Performance Improvement model used at Duke Hospital and Duke Children's. The ongoing success of our Six Sigma initiatives has led us to increase the number of Six Sigma-trained staff and faculty within Children's Services. Duke



**Figure 5.** Performance improvement at Duke Hospital. Visual diagram of how the Balanced Scorecard (BSC), Six Sigma, and Team Training are integrated for PI at Duke. The BSC provides strategic alignment; Six Sigma provides the tools and structure to support detailed analysis; and Team Training is a tool used to improve human performance. All are supported by leadership, which provides the structure to support improvement and organizational learning.

Children’s first began intensive training in January 2004 and now has a total of four fully trained Six Sigma experts (including two physician faculty members) and five others who have received intermediate level training who are actively involved in Children’s performance initiatives.

Team Training has been utilized in other industries and is only now being translated into health care.<sup>4,7</sup> Since health care can be considered one of the highest risk service-based industries, and since human factors play a significant role in performance, one might have expected Team Training to have occurred earlier. The reason for this delay is multifactorial but may include: lack of formalized health care team training approaches; the perception that team training is “soft” and will not result in significant improvement; the lack of trained members of the team to lead the training; and the reluctance of leaders to facilitate an open discussion with a diverse staff.

Team training has the potential for dramatic effects on human performance.<sup>7</sup> Staff members who have undergone team training perceived a significant increase in the amount of teamwork and

found the improved perception of leadership rewarding. These types of results have led Duke to institute Team Training in several areas throughout the institution.

While all improvement initiatives need strong champions if they are to be successful, Team Training requires it more than most, because it involves many more people from multiple disciplines and requires these leaders to stand up in front of the entire team and facilitate an open discussion. The champions must include physicians, managers, senior operational staff, and bedside staff, who are passionate, open, and willing to change.

The best area to start team training is one that has opportunity, leaders who are respected, and experience in complex PI initiatives. It is helpful for those leading the Team Training to have undergone formal training themselves, to have done a trial run, and to have a specific agenda that is both interactive and action-oriented.

The output from Team Training must be made actionable immediately. A mechanism to review the initiatives and modify the approach also must be developed. It is helpful to develop “coaches” in each area who can train new hires and reinforce what has been implemented. A standard communication methodology should also be in place so that all receive key information. It is also necessary to routinely repeat Team Training exercises to reemphasize certain aspects and to train any new personnel.

Despite all these impediments, Team Training can result in significant improvements in health care, specifically improving education and communication. Techniques used in the aviation industry are translatable to medicine but require “personalization” to each institution’s specific culture and challenges. Using the structured approach outlined here, Team Training can result in positive outcomes, not only for staff, but also for patients and their families as well. Within Duke Children’s, Team Training has become an essential part of caring for the patient and the entire team, and Duke Medicine is now beginning Team Training at the medical school level.

## **Limitations**

Many PI initiatives are directed at unique institutional desires driven by the strategic plan. This frequently makes translating the PI approach different from institution to institution. While this is a concern, the core principles of BSC, Six Sigma, and Team Training are the same and have been translated across both the adult and children’s areas of Duke. All three approaches have been used successfully in other industries, and the uniqueness of the approach described is how to integrate these different platforms and processes in a single institution.

Another limitation is the basic concern of PI research in health care. Outcomes in health care sometimes are difficult to interpret because many confounding factors contribute to the result. It is difficult to remove all confounders, so this remains a limitation. It should be noted however, that Duke has several internal controls, such as other areas where PI initiatives were not undertaken. For example, improvement in patient flow was only demonstrated in the groups that underwent a Six Sigma project. While it is impossible to account for all potential confounders, our results are generally translatable to other institutions, and our approaches should be used as a model to drive clinical improvement.

## Conclusion

Strategic management tools and PI frameworks can be integrated and used to achieve a significant improvement in performance. To achieve these results, one must employ a systematic approach that links the strengths of a specific framework with a specific problem. The BSC is an overarching management system that consolidates strategic initiatives and identifies areas of opportunity. Six Sigma is used when focused areas of improvement are needed. Team Training is an excellent framework for improving communication and education across disciplines. Understanding these differences is essential to achieve clinical success.

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