Improving Reliability in Healthcare

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Abstract: It is well known that health-care performance is highly variable and not reliable. To address this issue, a number of health-care leaders have been experimenting with operational methods derived from non-health-care industries. Leaders at Stanford Hospital and Clinics, Stanford Children's Hospital at Stanford, and ThedaCare have been studying and applying principles from consistently high-performing organizations such as Toyota (The Toyota Production System) and safety practices derived from aviation and other industries. They have been designing the new playbook for improving health-care reliability and performance. This article will explore 4 important constructs required to deliver high-reliability health care. These include purpose, process, people, and management system. We will also explore why improvement fails in health care, and finally, we will describe the rigorous training and constant attention to reviewing and updating standard work, which is required for success.¹

Purpose

Deploying True North metrics as well as key strategy objectives throughout an organization is critical if all staff members are going to understand what is most important to the organization. However, the difficult leadership challenge is to have frontline staff engaged in helping to decide. System change starts by clearly defining the purpose for which an organization exists. True North metrics establishes purpose; these are the few metrics that everyone in the organization can rally for. The True North metrics should be clear and impactful to patient care. There should only be a small number of True North metrics; for instance, preventable mortality is a True North metric at ThedaCare and is under the rubric of quality. Instead of telling staff this is an important metric, the question asked by leaders at ThedaCare is "what is the most important thing you can improve which will impact preventable mortality?" This question encourages staff engagement in identifying and solving problems at the level their work.

Frontline workers need to decide which things to measure on their own units that ultimately impact the True North goals. Management's role is to initiate the process of "catch ball" with the frontline staff. This process of alignment is necessary to assure the work at the front line will roll up to the system True North measures. For example, preventable mortality (measured using Hospital Standardized Mortality Ratio at ThedaCare) measures all deaths in a hospital. The frontline staff impacts certain care processes that drive preventable mortality. For example, falls on the medicine unit or ventilator-associated pneumonia both lead to preventable death. Each staff knows the ins and outs of how to prevent these problems. Staff members need to decide what they should work on that can directly affect the true north metric of preventable mortality. If leaders deploy "preventable mortality" metric to the ICU without engaging the frontline team, it's unlikely that team will get energized to impact the system metric. However, if the team is allowed to decide what's most important to their patients, the creativity and energy of each staff member is unleashed to solve the problem. This is a "bottom-up" approach.

Communicating the important system initiatives to everyone in a complex and large health-care organization is challenging. ThedaCare introduced a process developed by Toyota, which allows a dialogue to occur at all levels. This process is A3 thinking. Surprisingly, an A3 is simply named after the size of a piece of paper and contains relevant information concerning the background and current conditions of a problem (Fig. 1).

A3 thinking is fundamentally about a dialogue between upper echelons of an organization and the frontline staff. It's critical to get staff members involved because they usually understand the point at which the care process has broken down. They understand the work much better than the senior executives and usually have the best ideas regarding solving the problem.

Senior executives learn about what's going on at the front line by going to the gemba—the place where value is created for the patient such as the OR, ER, or clinic. Leaders should engage staff in a dialogue. This will inform the senior manager and allow them to develop the problem statement of the A3 with facts, not anecdotes, assumptions, or opinions. Writing the problem statement is the most critical part of A3 thinking because once the problem is defined, it becomes clearer which countermeasures or experiments the executives will try to solve the problem at the system level. Frontline staff is attempting to solve problems every day, but some problems are just too big for staff to solve on their

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FIGURE 1. The standard content sections of an A3 that help the problem solved understand the problem and the surrounding factors.

own. The system problems are what senior executives must focus on because they are the only people in the organization with the authority to make the decisions that will change processes at the system level.

Process

Making a serious commitment to changing the culture of an organization requires investment of resources in building improvement expertise. Stanford and ThedaCare did it by anointing several top employees to form a central lean improvement office. These staff became the backbone of the improvement system. However, these team members need the tools, training, and environment to learn the core competencies required to support front-line teams. This requires outside experts with experience in industry where lean methodology had been applied for many years. Our suggestion is those experts should come from world-class companies like Toyota and Danaher. Once the core team is trained, they can support the frontline improvement work and more importantly train others. At ThedaCare, this investment in facilitators and training paid a 3 to 1 financial return.

The goal of developing lean improvement facilitators is to support learning at the front line. Each worker in a health system should be able to identify problems and solve them using a plando-study-act (PDSA) method. PDSA is really nothing more than scientific method applied to daily problems, but it requires a rigorous attention to detail and method to develop every staff member to be proficient. The team members need to be coached in the real work—not the classroom. Once they have identified a problem, the improvement facilitator should work one-on-one with them to teach them the PDSA method to solve the problem.

One of the important functions lean facilitators provide is to bring teams together to study care processes. The first step in the study process is value stream mapping (Fig. 2).

A value stream is a set of processes that deliver value to a customer. This involves a step-by-step evaluation of the patient experience in the case of health care. Every step is carefully measured as to how long it takes to perform it, who performs it, how many defects there are in performing it, and so on.² Understanding this initial performance is critical to establishing measures for improvement. Removing the non-value added tasks (waste) improves the quality and cost of the care delivery, which is the ultimate goal. The next step once the value stream is mapped is remove non-value added steps in the process. Stanford University hospital uses Rapid Process Improvement Workshops (RPIWs) to do this. These are rapid improvement events, which involve 10–12 frontline staff and usually a patient. The purpose of RPIWs is to identify and remove non-value added steps. Waste is manifested in a number of ways. A waste seen in healthcare frequently is waiting.

Process Improvement at Stanford Hospital and Clinics

The Emergency Department (ED) at Stanford Hospital and Clinics has continued to grow between 6% and 10% each year, hitting record high volumes, which contributed to ED and hospital overcrowding. This period of overcrowding correlated with steady declines in patient satisfaction. In September 2011, ED physician and nursing leadership and a multidisciplinary team partnered using a lean management approach facilitated by Stanford's lean facilitators. The work included value stream mapping and implementation of rapid improvement events. It required the application of a management system (discussed later) for sustainment.

As a result of these efforts, the ED achieved the highest patient satisfaction metrics and lowest length of stay in the previous 2 years. Press Ganey patient satisfaction scores for 2 questions realized significant improvements. "Likelihood To Recommend" improved from 51st all PG database percentile to the 78th percentile,



FIGURE 2. Value stream map displays a patient's experience from start to finish in an ambulatory care center at ThedaCare.

and "Informed About Delays" improved from 18th percentile to 55th percentile. The median length of stay decreased by 11% percent and door-to-doctor time decreased by 43% in their ED. For admitted patients, the time between decision of patient disposition and departing the department and discharged patients reduced by 23% and 22%, respectively. The number of patients who left without being seen dropped from the industry standard of 2% to 0.65%. These gains were held through the use of visual systems and leader standard work applied throughout the ED.

The ED work highlighted the need to examine the broader value stream for General Medicine patients including analyzing the ED arrival through inpatient discharge continuum. The team is now designing a future state centered on a patient's multidisciplinary plan of care. This will be integrated through all patient care transitions, starting at the end of the value stream to improve coordination with postacute settings, remove bottlenecks related to discharge, insert multidisciplinary communication, and across critical clinical pathways to maximize the overall value stream and support flow.

Process Improvement at ThedaCare

A fundamental principle of high reliability organizations is to build safety and quality into processes. This means a care process is designed to be 100% reliable. ThedaCare leaders embarked on the development of an inpatient care redesign with safety and quality in mind. It was named "Collaborative Care."³ This process designed quality into the care by creating a series of tollgates, which patients pass through during the hospital stay (Fig. 3). The tollgates are stop points for the care team to ask critical questions about the quality and flow of the care. For example, one of the tollgates for a pneumonia patient is the oxygen saturation level of the blood. If it is not to the evidence-based level of 90%, the patient cannot move to the next level of care. This way that critical quality indicator is built into the system automatically. All quality goals are built into the tollgate system, which has led to nearly 100% compliance with the core measures for the common conditions such as pneumonia, heart failure, and so on (Fig. 4).³

Using this redesigned process, ThedaCare has eliminated all medication reconciliation errors when done by an inpatient pharmacist. As of June of 2014, 30-day readmission rates have dropped to less than 6% with the national average close to 19%, and the Bellin ThedaCare Pioneer ACO was reported by Medicare to have the lowest cost per beneficiary in the Pioneer ACO program.⁴

Standard Work

The success of the two above examples is predicated on another fundamental principle of high reliability: standard work. Much of what we do in health care is actually not based in scientific evidence because not every condition has been subjected to scientific rigor. This fact is used by clinicians to argue that they therefore can and should do what they think is right for the patients. This has led to each clinician developing personalized standards. Most processes in health care are in chaos; therefore, the role of clinicians should be to work together to create standard work for their institution. Clinicians should be focused on stabilizing, standardizing, and improving clinical processes. Where clinical evidence doesn't exist, clinicians need to build a common standard and study outcomes to discover best practice. If the



FIGURE 3. A visual of Tollgates of care used at ThedaCare to manage clinical care processes. At each tollgate, the RN leader assesses whether all necessary quality targets and clinical quidelines have been met before the patient moves to the next tollgate of care.

standard is not producing the outcome, we expect we need to improve (change) the standard. Virginia Mason's spine center is a case in point. Standardizing spine care by redesigning care using a multidisciplinary approach clinicians have doubled productivity, reduced days to return to work from 9 to 4.3, and reduced MRI use by more than 20% (9).

People

Paul O'Neill, former Alcoa CEO, created a new value system when he took over Alcoa in 1987. He asked "can you say "yes" every day to this question: Do my staff have the tools, training, and environment to do work that gives their life meaning?" O'Neill used this fundamental value to improve the abysmal employee safety record at Alcoa. Respect meant no one should be

Eight Wastes

- Waiting
- Transportation
- Defects
- Unused human talent
- Extra Processing
- Motion
- Inventory
- Overproduction

FIGURE 4. The wastes that can exist in any process of delivering value to patient.

injured at work. He used this value to make Alcoa the safest company in the world. The values leaders espouse support the culture they intend to build. If health-care leaders asked O'Neill's simple question, they would lead differently.

We are the product of our environment. Most of today's clinical and administrative training programs teach autocracy and control, but improvement requires a different set of behaviors. Typical medical training is still using the guild concept of education developed in 15th century. The great master, the clinical professor, is observed and copied. What modern medicine and high reliability requires is leader standard work. This means a set of core competencies that are taught to management and physicians with the purpose delivering reliable, high-quality results. The competencies include mentoring, facilitating, and coaching others.

Building New Behaviors at Lucile Stanford Children's Hospital

The learning systems for teaching new competencies are changing significantly. At Stanford Children's in Palo Alto, Dr. Lou Halamek has developed a simulation center. Simulation has been a core-training tool for clinical medicine for years, but at Stanford, they are training the teamwork and management aspects of the work in a respectful environment where inexperienced leaders can make mistakes and receive coaching in safe place. Simulation-based learning, a long and integral component of the safety programs in industries characterized by high-risk to human life, is gaining momentum in health care.

The Center for Advanced Pediatric and Perinatal Education (CAPE) is the epicenter of simulation-based training and research at Stanford Children's Hospital on the campus of Stanford University in Palo Alto, California. In addition to facilitating the acquisition and maintenance of the cognitive, technical, and behavioral skills necessary to deliver competent and compassionate care to children and pregnant women, CAPE uses simulation

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to identify and remediate human and system weaknesses before they become manifest during the care of actual patients. The mission of CAPE is closely aligned with that of the hospital, and its programs focus on improving the safety, effectiveness, and efficiency of patient care. This is best exemplified by the CAPE Circle of Safety, the process whereby human and system weaknesses identified through the activities of professionals in the fields of patient safety, quality assurance, and risk management serve as the basis for the simulation-based programs conducted at CAPE and within the hospital itself.

An example of the value of this strategy is the Obstetrics Simulation (OB Sim) program. OB Sim is a multidisciplinary team-training program that bases its scenarios on outcome data generated by risk management. By recreating problematic situations and drilling staff in the appropriate responses to these reallife events, the OB Sim program has played a role in effectively reducing litigation associated with childbirth and has a calculated return on investment in excess of 300%. Similar programs are being launched in neonatal resuscitation, management of reactions to radiographic contrast agents, and other high-risk activities.

Underlying CAPE's work is a commitment to examining successful learning strategies used in other high-risk industries and adapting them to meet the needs of the health-care professionals at Stanford. Through ongoing collaboration with colleagues at the Center for Aviation Safety Research in the Department of Aviation in the Parks College of Engineering, Aviation and Technology at St. Louis University and NASA's Johnson Space Center in Houston, Texas, the team at CAPE continues to develop novel approaches to the challenges inherent in health care. Center for Advanced Pediatric and Perinatal Education and the leadership of Stanford Medicine (the Stanford School of Medicine, Stanford University Hospital and Stanford Children's Hospital) are currently exploring the development of a comprehensive hospital operations center linked with sophisticated simulation capabilities. By taking a systems engineering approach to health care, they hope to find new ways to provide safer, more effective, and more efficient care, not only in their hospitals but also in local community clinics and patient homes, where more and more care will be delivered in the future.

Management System

Management is critical to building and sustaining a culture of continuous improvement. Yet most managers spend their day firefighting. There are so many problems to deal with they can't think about changing the organization to provide more reliable results. Recently, management systems have come to light as critical components of improving care outcomes.^{5,6} What we know from examining work in more than 158 organizations around the world⁷ is a management system that is focused on teaching frontline workers to identify and solve problems real time every day works to improve and sustain clinical results. The essence of this system is a set of competencies that each manager must learn to successfully change their department or clinic. These competencies have been well documented.8 This is a system created for all levels of management. The system is an interwoven set of puzzle pieces that has to do with a series of behaviors, processes and principles that lead to an environment where all workers are engaged and involved in improving care delivery. Management's role is to support these frontline workers ultimately resulting in higher reliability clinical outcomes. This is what Deming described as a management by process system.⁹ In contrast a management by objectives approach allows each manager to behave and act any way they would like as long as the objectives are met.

The improvement management system is delivered in 8 segments at ThedaCare. The first is creating a "no meeting zone" each day where the managers and executives are at the "gemba" meaning where the value is created for the patient. This means that time is built into their schedules for them to work at the clinic, operating room, or emergency room not their offices or meetings. These managers and executives use a "status sheet" to start each day. The status sheet is a set of questions that begin a dialogue between the manager and the nurse leader on the floor. This dialogue concerns the possible problems of the day designed to proactively identify potential problems thereby eliminating them before they can occur.

Subsequently, the manager will facilitate a defect huddle each day during which frontline workers surface any problems or issues that have occurred that day. In the old world, the manager would solve all the problems. In the new world, staff members are encouraged to both identify and solve these problems. This leads to engagement of staff in problem solving and improvement.

The manager is responsible for maintaining a visual tracking center, which is updated daily with data on unit experience from the last 24 hours. Staff members populate the tracking center with critical information on patient falls, medication errors, and other drivers of clinical performance. As new staff ideas are implemented, this creates new standard work for the unit. The standard is created and improved by frontline staff that agrees to the standard work.

Observation of the process of standard work is another one of management's responsibilities. It's impossible to know if the standard work is in place without observation of the work. This observation is not done to shame and blame staff and or physicians who are not following standard work but to understand why the standard isn't being followed. As discussed earlier, improvement can only occur when a standard is established. Once established, new learning can lead to changing the existing standard to deliver better results. In fact, during observations of frontline people performing the work, better ways are regularly identified and then codified as the new best way and trained to all staff. This process repeated over and over allows for changing the standard work for the better regularly.

Once a month, managers meet to discuss how their teams are performing. This occurs with the established team, which includes the manager, the quality department person, the educator, the finance person, and anyone else the manager feels is important to help achieve results. The team reviews what is working and what isn't using the A3 tool. The team reviews the plan that has been in place, what has happened with the plan, and what should be adjusted or studied to improve the process of the original plan. Success measures are clear and performance obvious.

Managers create a scorecard with the metrics and targets established for their unit. This is a way of knowing whether the unit is winning or losing each month. This guides the manager to decide where the most important priorities are. The measures on this scorecard roll up to directors, vice presidents, and so for forth until the measures eventually roll to True North.

All of the above is leader standard work. It is patterned after Deming's management by process thinking. The manager must execute each day the processes of observing the standard work, being in the gemba between 8:00 and 10:00 a.m., using a status sheet to understand how the day should progress, facilitating the defect huddle, updating the visual tracking center, meeting with her leadership team at certain intervals, watching the scorecard, and teaching each staff member to identify and solve problems every day.

These same concepts have been applied to create SHC's management system and leader standard work that has been embedded in the work noted previously in the emergency department. SHC has found this is the way to sustain outcomes. Managers

don't magically acquire these skills they need to be intensively trained.

The Importance of Training at Every Level

One of our takeaways from implementing this methodology is that every individual needs training and coaching. The changes required are not intuitive. The only way to learn the required competencies is to do it in the work. For example, the management competencies described previously are learned in a 4-month training program that is completed 95% in the work. A coach is assigned to each new manager or executive, and the teaching occurs through direct observation of the manager or executive working with his or her teams. Real-time feedback is delivered each day until the manager or executive is comfortable with the competency expectations.

Internal and external coaches are required. In some cases, coaches are current managers or executives with proven competency in the manager and leader standard work. External coaches are important when starting from ground zero. At ThedaCare, we used external coaches every week to train management and improvement facilitators. To this day, ThedaCare still uses external coaching resources to teach staff. This training needs to occur in the work with real problems, and it needs to be delivered by full-time improvement professionals. Too many times, we see a performance improvement "expert" who has 2 or 3 other jobs. Manufacturing industry experts suggest as many as 3% of company's workers should be dedicated to full-time improvement.¹⁰ This resource is then focused on teaching frontline workers the process of identifying and solving problems. Over time, as these tools become embedded in the management culture, the need for full-time experts diminishes. The trainers need to be trained as well, which leads to the need for outside experts. We believe using outside experts from high performing manufacturing companies like Toyota and other lean companies is critical to learning these skills.

The competencies required are different for each level of the organization. The CEO standard work has a different focus than the frontline manager, for example. The CEO is at the gemba looking for barriers to improvement that only the CEO can remove. Whereas the frontline manager gemba is focused on developing staff to problem solve and see waste. Either way, there is still standard work developed at each level. When these standards are established for everyone, no matter what job, that will create high reliability of care outcomes.

Barriers to Health-Care Improvement

Measurement

What gets measured gets done. But is the health-care industry measuring the meaningful activities that impact the outcome of patient care? To be paid by Medicare, health systems must report a series of measures. For example, clinical process measures such as aspirin on arrival in the ER during heart attack must be reported. Meaningful use measures are supposed to reflect the application of technology to clinical care,¹¹ but from the patient's perspective, these process measures have little impact on care. In fact, recent studies have shown process quality measures have little impact on hospital mortality rates.²

The dilemma the health-care industry faces is that the government considers all measures equal in importance. The multitude of government reporting requirements do not clarify which measures are important to patients, important for care outcomes, or important financially, and only confuse health-care teams. Teams are expected to improve every reportable measure regardless of the impact on patient care, but that expectation is simply not possible because these same care teams also have the work of caring for patients each day. This measurement burden requires a lot of frontline worker time and organizational resources. The time devoted to improving measures with little to no impact on patient care could be spent studying the underlying performance of existing care processes and improving those processes.

Waste in the System

The care team's time is precious. Unfortunately, much time is wasted chasing unimportant reporting requirements. Caregiver's activities can be assessed through understanding the 8 wastes (Fig. 4). Originally described in industry, these wastes are also applicable to understanding health-care underperformance and errors.¹² Waiting is one form of waste every caregiver is familiar with.

Staff members are accustomed to waiting for medications to arrive from the pharmacy, for specialty consultants to arrive, or for the radiology department to complete tests.

Excessive motion is another important waste. Staff members are constantly moving in search of items they need to care for patients such as IV pumps or supplies. This causes care staff to spend time away from the bedside, which interrupts care. This leads to defects such as medication reconciliation errors, falls, and iatrogenic infections. These wastes bog workers down, and they end up spending more time firefighting and creating "work-arounds" instead of focusing on the best patient care.

The reason defects, waiting, and other forms of waste exist is that there is no standard work, or the staff member is not adhering to standard work. Every worker invents their own way of doing the work, which creates chaotic care processes. The result of unstandardized processes is significant variation in patient care. A fundamental principle of improvement is that standard work must be established for improvement to be possible.¹³ This is a fundamental principle because the processes and outcomes cannot be assessed and compared if there is no standard of care to compare with. However, most health-care processes do not have standard work, thus making improvement impossible.

Standardized Problem Solving

The lack of a consistent problem-solving method also impacts improvement. Without the tools, training, and environment to make meaningful change, staff members are only left one choice—work around the existing problems.

The lack of standard work and the lack of an improvement system are not the only barriers to improvement. One of us (JST) was Chief Medical Officer before becoming the CEO. It was frustrating to shine the light(resources) on a certain problem and radically improve the result only to see the improvement revert to baseline once the light was diverted somewhere else. The reason improvements were not sustained was that the quality department managed the initial improvement. Once the improvement was made and the quality department left, no one was there to track, monitor, and maintain the improvement efforts. When the improvement is part of the daily work of the care team, it cannot be delegated to the quality department or elsewhere. The ultimate responsibility for instigating and maintaining quality needs to rest with day-to-day workers delivering care to the patient.

CONCLUSIONS

Creating a culture of continuous improvement is the key to creating higher reliability in health care. The roadmap to get there is becoming clearer. Health-care leaders at Stanford University Hospital, Stanford Children's, and ThedaCare have been experimenting with this roadmap. It includes a different way of leading

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and managing. It applies tools and principles that were developed in manufacturing to health-care processes. It relies on developing frontline staff to be capable of solving problems every day, and it connects the frontline worker with the organizational purpose. With the cost and quality problems, American health care is plagued with its important that the principles designed to deliver highly reliable outcomes become part of the playbook for every hospital and clinic. The end result will be safer more cost effective care for every person.

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