# Patient Flow in Healthcare: A Key to Quality

18

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**Chapter Objectives**

- To introduce the concept of "flow" in healthcare as a quality measure
- To describe concrete methods to create operational improvement using Lean methodology
- To discuss the role of leadership in improving a system and setting a vision to jumpstart any project
- To use a case-based approach to illustrate the role of flow to either impede or improve patient care

## Introduction

In the current healthcare system, inherent delays and frustration have come to be expected. These same delays impact the quality of care throughout the system [1]. In the white paper "Achieving Hospital-Wide Patient Flow," Pat Rutherford from IHI discusses the impact of hospital flow on quality and patient care [2]. She describes the need for interdependent, interconnected systems to improve patient outcomes but also describes the challenges of such a system. With leadership and specific strategies, smooth patient flow is possible. Imagine the hospital of the future where diseases are identified at their earliest stages in the primary care office, and when evaluation or treatment is needed, it is carried out seamlessly in the hospital without time delays and interruptions between each step. A hospital where specialists are available at a moment's notice and all caregivers are focused on getting the patient well and home to family. This can be created – but will require a shift in how system-wide operational strategies are designed. In this chapter, principles will be illustrated with actual case studies about journeys to improve patient flow and discuss how system-wide spread of best practices can occur.

**Vignette 18.1**

In 2010, there was a case that spread across the news in Northern California. It describes the case of a little girl who required multiple amputations after waiting 4 hours to see a physician in the ED. Her father describes his despair as he waited to see a physician with his sick little girl. One cannot know if the outcome would have been different if she had been seen quickly, but this delay could not have helped. At another Northern California hospital in 2007, there was an impending crisis. A per-

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fect storm was developing that started in the ED and continued on the inpatient side. There were long delays for patients that often led to quality issues because of poor flow. At the same time, the hospital was seeking trauma center designation, volumes were increasing at double digit rates annually, and the county psychiatric unit closed their crisis stabilization unit and half of the inpatient beds. Boarding in the ED was a frequent problem. New leadership in the ED did not know what to do to improve care and patient flow. Leaders in the ED and hospital read about a course in "Lean Healthcare" and attended and began to spread the basic principles throughout the hospital. They methodically set about changing how healthcare was delivered and transformed healthcare delivery. They found that excellent flow dramatically improves quality for patients. These general principles apply across the health system both in the USA and around the world. The general flow principles learned can be replicated in any healthcare system but will require process changes and cultural transformation.

In 2011, another little girl came into the transformed emergency department with her father. She had a complaint of nausea and vomiting with normal vital signs. Previously, she easily could have waited 4 or 5 hours, but with improved flow, she is immediately seen by a doctor. He decides she is ill, does a spinal tap, and discovers she has meningococcal meningitis – a very time sensitive disease. She is immediately treated and admitted and makes a full recovery. For many years, the ED physician gets updates from her mother about how well she is doing, how she has started school on time, and most importantly she says: "without you my life would have been very different." This is the impact of flow in a hospital, consistent, reliable care that allows doctors to treat and save patients. This chapter will discuss general principles to improve operations and flow as well as change management and lean principles learned.

## Background

There is much data that supports the adverse health outcomes associated with poor patient flow [3]. Studies show that ED boarding increases both mortality and patient length of stay once they are admitted – further compounding the problem [4]. On the inpatient side, studies show that for every added patient with heart failure, pneumonia, or heart attack given to an overworked nurse, odds of readmission increase from 6% to 9%. For the ICU, every patient discharged early because of overcrowding has double the chances of being readmitted to the ICU. While this is a well-known phenomenon, very few hospital systems have been able to strategically address solutions to the problem. In the USA, the most common strategy is building additional space for care without looking at waste and poor flow as an etiology for problems [5].

Historically, the US healthcare system payment model has not rewarded patient flow. Hospitals depended on hospital admissions for reimbursement, and this translates to the more procedures the better for the hospitals' financial bottom line. Physicians in many areas have been compensated per patient, leading to multiple consultations per admission. The idea that hospital admission equals quality was widespread in the culture of patients. This system resulted in many unnecessary admissions to the hospital, with multiple consultations and procedures that could have been safely delayed but were often performed. The new current bundled payment model and payment for quality means hospitals now have a new focus on decreasing length of stay and avoiding readmissions. If designed well, this can improve patient care and encourage interdependence across the system from outpatient through the hospital. It also means that now a few smart, strategic, and unique hospitals are consid-

ering flow a top priority. There is hope that this will increase even more in the future.

## Leadership

Without top-level hospital leadership support, system-wide change is difficult [6]. The first step in any change management strategy is setting a clear vision. This vision must be simple and clear and able to be articulated by all employees. No change is easy, and without this leadership support and direction, new processes that are developed will quickly regress back to the status quo. Employees must know the "why" behind decisions that are made in order to stand behind them. Intermountain Healthcare is an example of one organization where visible leadership has helped to transform the organization. Leaders have set a clear vision that the goal is to "be a model health system by providing extraordinary care and superior service at an affordable cost." All employees understand this goal, and each department has goals that align with this vision. These goals are discussed at rounds where daily metrics are discussed. Frontline staff can escalate concerns to their manager. There are cascading reports up the chain to a daily report out at the highest leadership level, and each employee feels that their concerns are addressed in a timely manner. Successes on the department level are recognized by top leadership. This high-level leadership support is critical for system-wide flow improvement. Successful leaders are visible, break down barriers for the team, and create the inspiration necessary for success [7].

**Vignette 18.1 (Continued)**
Flow improvements at the California Hospital described earlier started in the emergency department. After coming back from Lean Training, a multidisciplinary "flow team" was established in the ED. This team had representatives from physician, nursing, tech, and clerical staff. They did an extensive redesign of the process for low-acuity patients. This project was picked because all care was under the control of the ED. Operational improvements for this cohort of patients immediately decreased "left without being seen" rates and markedly improved patient satisfaction. What was most important was that the hospital CEO was very supportive of the work and came to the ED and recognized each of the employees involved and the department. This began the cultural transformation and increased support for the next flow projects. Other employees were eager to participate and join further projects. Without this executive level support, sustained change would have been difficult.

## Flow Principles

It is well-known that having satisfied, engaged employees leads to optimal healthcare for patients. Job satisfaction in healthcare is related to many factors: optimized workflows, autonomy and the ability to participate in decisions that are made, and excellent communications and the ability to have a voice without risk of repercussion. Job burnout in healthcare is rampant, and healthcare workers mention that the hours of data entry required in the era of electronic medical records lead to stress and anxiety. While these factors are well-known, it is also very common in healthcare to have a reactive approach to problems instead of really considering the impact of decisions on workers. When a sentinel event occurs, it is common that new procedures are layered on a process and on workers who are already living at the high end of the utilization curve. (Fig. 18.1)

As illustrated by Dr. Chuck Noon in his book *The Definitive Guide to Emergency Department Operational Improvement*, the curve shows that when any system is utilized over 80%, wait times increase exponentially [8]. There is no doubt that procedures and standard work are necessary to

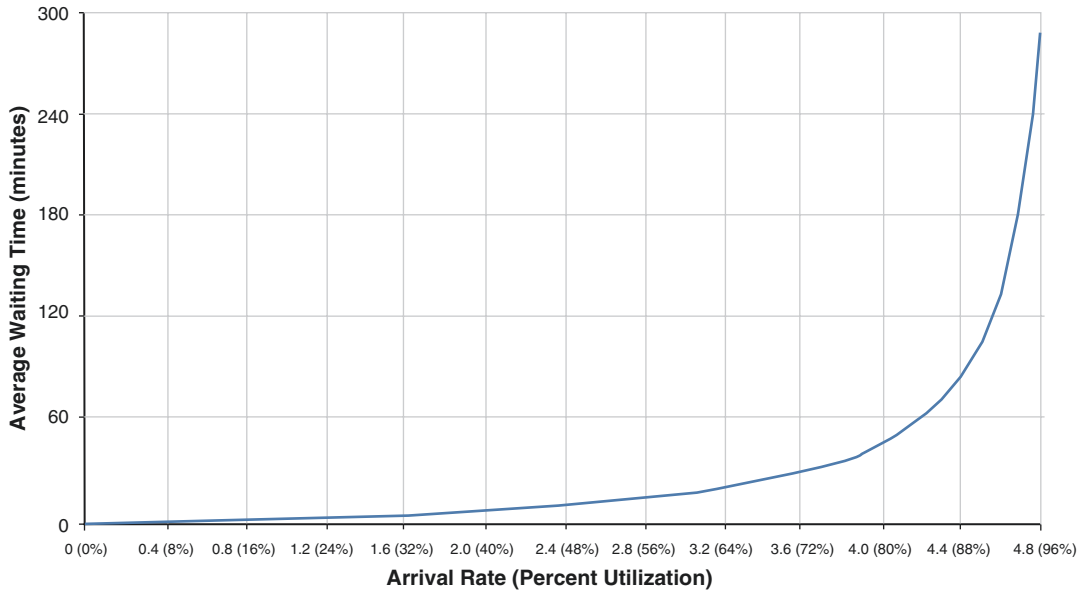


**Fig. 18.1** Utilization curve. (Image courtesy of Charles E. Noon)

avoid patient harm but should be done thoughtfully with consideration of what the new procedure does to workers and after a deep dive into the root cause of the problem. It is not uncommon for an unusual and non-preventable patient case to generate new procedures for every other patient in a system. This work may be non-value-added and take away from high-value procedures. When just a few minutes are added on to each patient in a busy system, wait times can increase exponentially. If a new policy or procedure must be incorporated by a busy server, it is critical to look at all steps in the process and either take away another task or redesign the system. Involving the frontline workers in decisions contributes to feelings of autonomy and improved patient satisfaction.

How does patient flow improve quality for patients and worker satisfaction? There are two critical principles of redesign: (1) do "this hour's work this hour" and (2) create systems that are better for patients but easier for people doing the work.

As stated in the IHI white paper on patient flow, the goal is to give patients "the right care, in the right place, at the right time" [2]. Healthcare is full of faulty systems that are done because of legacy designs. An optimal system allows the patient to seamlessly arrive, tell their story once to the healthcare team, get treatments and testing without delay, and go home or be admitted to the hospital. A system like this promotes quality healthcare and also allows healthcare workers to focus on doing what they like best: caring for patients. On the emergency medicine side, this means an even length of stay for patients across the 24 hours of arrivals. On the hospital side, thinking about a 24/7, 7-day a week hospital is ideal. Obviously, this cannot be attained overnight but should be the goal of anyone looking to improve flow in healthcare.

The second principle is creating systems that are better for patients but easier for people doing the work. There are only three ways to create capacity in a healthcare system: decrease length of stay, decrease arrivals to a system, or build more beds. Building beds is not an optimal plan in today's financial climate, so the ideal place to start is thinking about how to decrease length of stay. Decreasing length of stay does not mean decreasing patient care time. Each patient should receive compassionate, customized care with ample time with the healthcare team. This is considered "value-added" work in Lean Healthcare

[9]. Where length of stay can be decreased is in all of the non-value-added activities that occur in medicine. Examples are waiting for care, excess movement and transportation, equipment not available, poor communication and defects, and rework. Improving flow in the ED is a "war won in minutes," and on the hospital side, it is a "war won in hours." When looking at ED flow projects, the goal should be to decrease length of stay by minutes at a time. On the hospital side, the goal should be to decrease total length of stay by several hours at a time. Surprisingly, these small incremental improvements can drive bed utilization down and eliminate waits for patients. This defined means to look at every step in a process critically and redesign patient-centered flow systems that decrease length of stay. (Key Points Box 18.1)

**Key Points Box 18.1**

*Lean Healthcare* uses some of the same operational principles originally developed by the Toyota Production Company. Lean Healthcare is a set of operating philosophies and methods designed to create maximum value for patients. It uses basic tools and methods to systematically reduce waste and therefore waits for patients. It emphasizes what is value-added from the patient perspective, employee involvement, and continuous improvement. Waste in the system is considered and removed whenever possible. Waste in Lean Healthcare includes excess transportation, inventory, motion, waiting, overproduction, overprocessing, and defects. Examples include waits for transport, blood hemolysis, cardiac monitoring when not required, and hospital readmission.

**Vignette 18.2**

Imagine a patient arriving in an emergency department with a wrist injury after snowboarding. The patient signs in at registration and her verbatim chief complaint is entered. She is immediately brought into a treatment room chair and assessed by a physician assistant and a nurse together. The history is taken just once, and all necessary information is gathered. Vital signs are obtained, and pain is treated on the way to radiology. After the x-ray is taken, the physician assistant immediately shows the x-ray to the patient who is reassured there is no fracture. A splint is applied, and discharge instructions are discussed by the team, and all questions are answered. Within 30 minutes the patient is heading back home to their family. The patient cannot stop talking about the excellent care, and the healthcare team has the ability to spend even more time with patients because much of the waste is removed from the system.

There is an old saying "there is only one way to eat an elephant: a bite at a time." The above described care pathway was not developed overnight. It occurred after a systematic redesign of each aspect of patient care. First, triage was eliminated when possible or markedly shortened for all patients. Then, care teams were developed for low-acuity flow. Initially there was a separate office for providers and nurses, but the team recognized this created waste for the patient since the history was repeated. Every step in the process was carefully considered and redesigned after multiple trials with input from all workers and patients. Every step was measured, equipment was standardized and optimized, and care teams were developed. No detail was too small. An example was treating patients in chairs instead of lying on a gurney. A gurney was available if needed, but if not, a chair could be cleaned in 30 seconds, while a gurney took 3 minutes to turnover. This small step multiplied over hundreds and thousands of patients makes a huge difference. The new seamless

process created high-quality care, the highest patient satisfaction, and job satisfaction that was unmatched. Because the team had more time and care was standardized, patient complaints were essentially eliminated. With the new system, the teams were much more productive but still had time to talk with their paired colleague and "make a new friend" as a department leader often stated. These changes were both better for patients in both quality and experience and easier for people doing the work with higher job satisfaction.

## Segmentation for Quality

We can infer in medicine that waiting and boarding lead to adverse outcomes for patients simply due to the lack of immediate attention and care. Mathematically, it would seem that pooling of resources to care for patients would optimize care and flow through a hospital system. Considering and optimizing workflows with the main idea of preserving high-acuity beds in both the ED and the hospital can jumpstart flow through the entire system. This segmentation allows care providers to standardize care based on evidence-based best practices. Starting in the ED, the most common type of segmentation is a fast-track area for low-acuity patients. One excellent model locates the fast track near the front door. The goal of design is to minimize movement of the patient and the care team and be sure all equipment needed for the team is at their fingertips. This optimized model has the physician or advanced care provider and the nurse sitting together. The patient tells their story one time to the care team, and all necessary information and data (vital signs, exam) are collected in the one room. If no testing is necessary, discharge instructions and prescriptions are printed in the room and given to the patient. If studies are necessary, a clearly defined area in view of the care team is established as a visual signal that the x-ray is completed. With this model, only two rooms are necessary for care: the assessment room and a procedure room. This system maximizes team work and eliminates most of the motion waste and poor communication of other systems. Improving flow is a war won in minutes, and this method eliminates much of the unnecessary flow. The team can see three to four patients per hour but usually only have one to two active patients because it is a flow-based model. When care is done, the patient is discharged home quickly and efficiently. All members of the care team have more time to spend with patients and less on wasted motion.

Another idea utilizing operational redesign is a vertical treatment area in the emergency department. Traditionally, most patients are treated on a gurney in the ED. These beds become the scarcest resource, and lack of beds creates long waits and delays in care. Almost every ED has over 50% of patients who are categorized as "mid-acuity" and are not differentiated more than that. Many of these patients are well-appearing patients who need more testing to determine the diagnosis. These are the patients that can rapidly occupy all the high-acuity beds and create long delays for patients. There are many workflows done in emergency medicine that continue just because historically they have always been done a specific way. Starting IVs on all patients getting a blood draw is one such procedure. When interviewed, most patients would prefer to just know what is wrong and not have an IV unless medications are needed. There is also much evidence that many medications are safer and as effective when given orally. If a patient presents with a complaint such as abdominal pain and looks well, a vertical treatment space may be ideal. In this system, the patient would again be seen by the care team of a provider and nurse together. An assessment is done including history and physical exam and tests are ordered. A nurse or phlebotomist draws blood, all radiology studies are ordered, and oral medications are given. Instead of lying on an uncomfortable gurney, the patient waits in a "results waiting room." When all tests are completed, the provider brings the patient back into the assessment room to discuss the results and a plan for care. If results reveal something that requires admission, then at that time, the patient can be transferred to the main ED for further treatment. This is a very small percentage of patients. This requires system redesign and

thinking in a different way and considering every step in a process. Each time an unnecessary IV is established, it adds to the nursing workload. Every IV that is inserted must be removed as well. IVs are generally safe but are not completely without risk as well. Peripheral IV infiltrates and extravasations, site hematomas, phlebitis, and air embolism are all known rare complications. Care is improved when the care team is trained to think differently – if a patient is dehydrated and needs fluids, an IV is established, but if it is not needed avoiding this procedure can decrease workload, preserve high-acuity beds, and improve patient quality and satisfaction.

On the hospital side, these same principles hold true. Creation of a low and mid-acuity observation unit will preserve high-acuity beds and prevent boarding for patients. Many hospitals cohort observation patients based on CMS rules that were developed and state that any patient who does not stay "two midnights" should be put into observation status. This has broadened the number of patients on observation status. Cohorting of these patients is faulty and will not improve hospital flow. Observation should be created around standard diagnosis-based care plans with the idea for 24-hour and 48-hour care plans. There is much evidence available about optimal care and quality for various diagnoses. A perfect example is transient ischemic attack (TIA) or stroke without deficits. Often these patients are in the hospital for several days. With careful planning all evidence-based care can be completed within 24 hours. Often, patients are observed on a cardiac monitor for long periods of time even when they do not require it. Patients can have all imaging done, see a consultant, and get an evidence-based treatment plan in under 24 hours. Again, a system that is better for patients, delivers higher quality care, and is better for the healthcare system. There are many diagnoses that are amenable to this kind of care, and a system can be created to optimize both quality of care and flow. Chest pain, syncope, asthma, head injury, and TIA as noted above are all diagnoses that are amenable to a 24-hour observation unit, but any diagnosis that can have a protocol established with clear pathways can be placed in observation. An example of a new process to improve flow is a procedure room co-located within the observation unit. This can allow GI and pulmonary specialists to do procedures easily and allows many more patients to be placed in the unit. Most 24-hour observation units are staffed by emergency physicians or supervised advanced practitioners and nursing staff with hospitalist consultation as needed.

Several other segmented units are possible in the hospital to improve flow. For example, a rapid surgical unit with agreed-upon protocols can provide high-quality, patient-centered care. Patients can understand what needs to happen postop to progress to discharging home before the surgery even happens. Technology can be used to record walking, PO intake, and pain control. These rapid surgical units can decrease length of stay by 24 hours or more – especially if patients are given the discharge information pre-op. Another segmented unit is a medical "48-hour" unit staffed by hospitalists. This is ideal for diagnoses like congestive heart failure and pneumonia that require therapies but are well-defined and have outcome measures for discharge.

There are two primary goals of segmentation: provide protocol driven, patient-centered high-quality care *and* preserve high-acuity beds in the ED and hospital for admitted patients. There is risk with segmentation, however. Queueing theory can help to illustrate this problem. Queuing theory is the mathematical study of waiting lines or queues. It is considered a branch of operations research and originated with research by Agner Erlang when he created models to describe the Copenhagen telephone exchange [10].

Using this mathematical model, in general systems should pool resources, which means sharing patient load among all physicians and nurses to prevent one server sitting idle while the other is overwhelmed. In the ED, an example would be when physicians pick up patients when they feel they are ready in any area and work with all nurses. Despite this general principle, segmented care improves quality and flow when there is an assigned team and clear workflows [11]. The power of each of these segmented care pathways is in the teamwork and how the well-defined workflows are designed to decrease the length of stay. These areas must be designed to

not become the safety net when things are going wrong and prior to initiating volumes must be assessed so each area is highly productive. Using data to design workflows will determine the hours of operation for each segment and help to decide if segmented areas should be combined (combination low and mid-acuity patients in one area) and also the number of observation unit beds in the hospital. Well-defined segmentation can jumpstart flow of the entire hospital system.

**Vignette 18.3**
A 75-year-old woman comes in with a lower GI bleed at 10 pm. She is rapidly seen by an ED physician. An IV is established, baseline labs are drawn, and her vital signs and hemoglobin are stable. The observation unit is contacted and care is transferred. A standardized bowel prep is started, serial hemoglobin levels are drawn, and a message is left for the GI physician. At 7 am, the GI physician checks the phone and prioritizes patients in the observation unit. The procedure is done in the unit, and bleeding has stopped. Results are discussed with the patient, and she is very happy to go home 14 hours after admission to the ED. The GI doctor states "he can do twice as many procedures easily because he is not waiting for patients to be transported." The patient raves to her neighbors about the timely high-quality care she received.

## Teamwork and Communication

In the book *Team of Teams*, General Stanley McChrystal [12] describes two case scenarios: the first in which a plane crew with an hour of fuel, no incapacitating technical issues and clear protocols in place to deal with small technical issues crashed in 1978, and the second and very famous scenario where Captain Sullenberger landed a plane in the Hudson River in 2009 after complete engine failure 2000 feet above the ground. General McChrystal describes how a primary difference in the two scenarios was how the airline crews were structured. In 1978, airline crews were structured as a command. All team members looked to the captain for instructions, orders, and guidance. By 2009, airline crews were structured as teams, and each crew member knew their role and had the autonomy to make decisions under pressure.

Atul Gawande describes this same concept in *The Checklist Manifesto* [13]. He describes the importance of standard work in the form of checklists while still having communication and teamwork to allow each team member to feel comfortable identifying and solving identified problems. In order to improve operations, each team member must understand their individual role in the patient care system. In our current healthcare system, this lack of standard work and role clarity can lead to delays and quality issues throughout the system.

A clear recommendation to improve flow and quality in healthcare is the establishment of care teams. In the ED, the pairing of low and mid-acuity providers with a nurse while minimizing movement improves flow, communication, and quality. For high-acuity ED patients, establishing care teams in the main ED will improve all metrics. When the high-acuity teams are sitting in close proximity and processes are implemented where all team members greet patients on arrival, there are clear communication and expectations set with the care team. Patients are also aware immediately about the treatment team and can be involved in decisions at the outset. This close proximity allows the team to round on patients together multiple times in a shift. This improves communication and balances the workload for nursing as well. Close communication prevents missed orders and clarifies the care plan for the team. On the hospital side, a similar situation is the geographic assignment of hospitalists on the floor. When this is possible, communication is markedly improved and nurses can prioritize work after rounding with the physician. Whether implemented or not, daily multidisciplinary rounding as standard work involving the patient and family has been shown to improve communication, assure all care activities are completed

(checklist), and involve patients and families in decision-making.

**Vignette 18.4**

In a high-volume ED with a footprint as large as a football field, prior to any operational changes, physicians cared for patients in any area of the department. It was very common for physicians to have patients on each end of the department. It was difficult for nurses to know which physicians were treating patients, and no communication system was in place. One day, the treating physician was sitting at one end of the department, while a patient located on the opposite side had a systolic blood pressure of 70. The nurse did not want to leave the critical patient but was unsure how to find the physician.

The ED leadership team recognized that the system that was in place impeded communication and created uneven workflows. They created care teams of one MD and several nurses who sat together and cared for patients in a pod. A patient came in with a fever and low blood pressure. The team recognized that the patient likely had sepsis, and timely antibiotics and fluids were important to decrease mortality. The team had standard work where the entire team met the patient on arrival. While the physician spoke to the patient and family and got history and placed orders, one nurse completed all tasks and started IV fluids and obtained labs. The other nurse documented the care and obtained timely antibiotics. With timely care, the patient's blood pressure stabilized, and the patient received antibiotics within 1 hour of arrival. The patient was quickly admitted to the hospital.

## Performance Improvement in Healthcare

(Key Points Box 18.2)

**Key Points Box 18.2**

*Servant leadership* is a leadership philosophy in which the leader embraces care of employees. This varies from traditional leadership where the leader's focus is organizationally driven. A servant leader shares power, puts the needs of the employees first, and helps people develop and perform as highly as possible. The focus is on employee personal growth. The benefit is in increased employee engagement and commitment to the organization [14].

Creating a healthcare system with optimal flow and quality starts with a passion for excellence initiated by a determined leader. This leader creates the vision for either the organization or department and shares it on a daily basis with the healthcare team. Servant leadership means that the professional development of the team is a high priority. The vision of the leader is considered the "true north" and guides project development. The basic principles of Lean Healthcare mean that leaders "go to the Gemba" to see the work, and workflows are not top-down driven but involve frontline workers and a "Kaizen" mindset of continuous improvement. "Kaizen" is a Japanese term that means continuous improvement. This leadership vision combined with a Kaizen mindset leads to a culture of respect that runs through the entire organization.

This leadership and vision can jumpstart a process improvement project. It lets frontline staff know that leadership considers consistent improvement a priority. Leadership commitment to the monetary costs of training staff on basic principles of process improvement and the tools needed for a disciplined approach emphasizes this organizational prioritization. This training allows staff to look at processes with an engineering mindset and a critical thinking approach. The goal of any process improvement project is to create systems that are better for patients but easier for people doing the work. This essential principle guides the selection of frontline staff involved in each project. Process improvement is

a long-term strategy. The goal is continuous improvement with clearly measurable metrics determined at the outset that are visible to all employees. A several day Kaizen event has been shown to change faulty processes that have been in place for years, and the rewards will be in improved quality care, engaged staff with higher satisfaction, and improved organizational financial performance. The staff becomes a "community of scientists."

One option to start the journey is at the department level. After the vision is set by senior leadership, focused Lean training can begin on the unit level. A multidisciplinary team is identified to work on a predetermined problem that creates a bottleneck in the department. Pre-work is done to determine the scope of the project and to develop metrics that will show improvement. During the event, the current process is mapped out with each step written down from the patient perspective. This opens the eyes of the team to problems. Each step is determined to be "value-added" or "non-value-added" from the patient perspective. This creates a framework for the development of a new improved process that is then trialed and a system is put in place to trial along with a plan for complete implementation. At the end of the event, the team presents to upper leadership who relate the project to the overall organizational vision. This validation by leadership begins to create a flow-based culture focused on patient-centered continuous improvement. This step-by-step approach is repeated over and over and when combined with daily operational boards with escalation to senior leadership results in a recipe for high-quality, cost-effective patient care without delays. There are several healthcare organizations in the USA that are well-known for their implementation of Lean Healthcare systems.

## Virginia Mason

Virginia Mason, a healthcare system based in Seattle, is known throughout the world as a leader in patient safety and quality by using the principles described above. The journey started in 2002. In 2000, Dr. Gary Kaplan took over as CEO. The company had suffered financial losses that threated long-term survival. He was a visionary leader who told his team: "we change or we die." The entire executive team flew to Japan to observe Lean management techniques and the Toyota Production System and then developed a new strategic plan that was patient-centered and focused on four pillars: people, quality, service, and innovation. They created a program of continuous improvement that also involved patient input. This vision has not varied, and now the medical group has integrated the philosophy throughout the entire system. They now teach process improvement and training to healthcare leaders and are known throughout the world as a patient-centered quality leader because of their search for a perfect patient experience that eliminates errors and defects [15].

## Intermountain Healthcare

Another well-known health system that has applied process improvement principles to healthcare is Intermountain Healthcare. They are based in Salt Lake City, Utah, and have visitors from around the world who come to learn how they have developed and sustained improvement. Intermountain started their improvement journey with their frontline team members. They recognized that there was no standard work for frontline managers and employees. They redeveloped charge nurse positions with coaching and clear expectations. Charge nurses were required to round on frontline staff to see if standard tasks were completed. Starting here allowed the organization to spread the culture of improvement both up and down the chain of command. Daily rounds were initiated on each unit with an escalation up the leadership chain including to the CEO, allowing upper leadership to understand problems at the frontline daily [16].

Each of these health systems has made the commitment to strive for perfection using process improvement methodology.

## Open Data to Drive Performance

Physicians are often skeptical about data, particularly unblinded data. This is related to a number of concerns. Physicians question the accuracy and relevance of data. Most importantly physicians are skeptical about the intent behind the release of unblinded data. There is general concern that data will be used punitively or that data will be released to the public. Usually, the goal of data release is to influence physician behavior or increase physician productivity.

**Vignette 18.5**
A study was done looking at two individual EDs. One ED shared blinded data with the group. The second ED shared unblinded data in a different way. The data was combined with identification of high performers and discussion of best practices that were validated with the group. The study found that the first ED had no significant improvement in physician metrics, while the second ED that combined sharing data with education around best practices had a 10.9% improvement in physician productivity with significant reduction in variation across providers. This improvement was not associated with any declines in quality or service scores. The data that was shared was done in a nonpunitive way and was combined with a discussion around the vision for improved patient care and eliminating waits.

When implementing multiple changes to improve flow, it is critical to have well-defined metrics to show that the system is improving. Having a discussion with the staff involved in the process about which metrics will be tracked and addressing concerns about data validity at the onset will improve buy-in and avoid controversies later. When the data is used in context with the vision for high-quality and improved patient care, physicians are less likely to feel individually attacked.

Many organizations make the mistake of sharing multiple metrics without context with workers. Most workers will not look closely at the metrics, and even more importantly many times, this will create a defensive culture and not lead to any organizational improvement. Instead of this, a few well-targeted metrics shared in the context of the vision for improved patient care and flow can engage the entire team. When these metrics are shared with advice on best practices from peers, data can be used to drive performance. Physicians and other healthcare professionals are much more likely to respond to active sharing and a collaborative approach in contrast to passive sharing [17].

**Vignette 18.6**
At a monthly staff meeting, unblinded data was shared by the radiology champion on CT scan utilization for all providers. Prior to sharing, there was a discussion about possible concerns of the physician group and because of this the data excluded trauma patients where ordering was not under the ED control. When the data was shared, lower utilizers gave their own tips and strategies to the group in a fun and entertaining way. The newest research was also shared including the PECARN (Pediatric Emergency Care Applied Research Network) study with best practices for children with head injuries. One physician reported to the group "I had no idea I was the highest utilizer of head CT's in the department!" She reported later that the positive attitude of the group and the education she received allowed her to comfortably change her practice. The next month, her CT utilization was at the 50th percentile with no quality issues. This improvement was sustained the following year.

## Technology to Improve Flow

In the book *Punish the Machine* [18], Dr. Uli Chettipally states that 50% of what physicians do in American healthcare is unnecessary, ineffective, or dangerous. This waste can be categorized as excess movement, waiting, unnecessary steps, unnecessary procedures, and errors. To improve medical care and reduce cost, Lean operations' management with a critical eye and embracing technology are necessary. Currently the electronic medical record is not being used to its fullest potential. At the present time, the computerized medical record is a crude instrument used for documentation, reimbursement, and regulatory compliance. There are two areas in particular that technology could improve flow and quality: operational flow and clinical care.

For operational flow, there is a wealth of opportunity. In Silicon Valley, there are a group of engineers engaged in improving healthcare operations. This markedly different approach uses predictive analytics and machine learning to predict when crowding and surge are about to occur and offers possible solutions. In real time, the analytics can help with flow by deciding which patients should get testing first when a test is the only barrier to discharge. It can schedule the hospital stay so patients know what to expect, and it can notify the physician when all testing is completed and even predicts the probability the patient will be admitted and request a bed much earlier in the process. On the retrospective side, software allows a manager to perform root cause analysis of problems quickly and efficiently. An example is when it is noted that the length of stay was longer during a particular part of the day. The manager can simply click on that period and find out the cause. Perhaps the lab was slower than normal, or radiology turnaround time was not optimal, or there was an influx of patients that overwhelmed the treatment team. This allows targeted improvement to occur. These examples are only the tip of the iceberg for what artificial intelligence can do for operations. Imagine if the second patient walks into the ED, it is predicted that the patient is at risk of a serious outcome. The patient is pulled in front of other less serious patients and immediately seen by a treatment team and care is initiated.

On the clinical side, artificial intelligence is even more promising. New medical research is released daily, and it is impossible for the individual physician to keep abreast of all new trends. There is a widely quoted article that it takes 17 years for a new best practice to be implemented broadly [19]. Programs are being developed to put best practice healthcare recommendations in front of the physician while treating the patient. This allows patients and their families to be involved in the clinical decision-making. While this has much promise and is markedly better than what is available now, the future holds even more promise. Imagine if after seeing a patient, the physician is able to see what the outcome was for the last thousand patients with the same diagnosis and if treatments could be targeted to patient's specific characteristics.

The future is bright for the use of technology to improve both patient clinical care and flow through the hospital system. It will require a new mindset and a partnership between clinicians and engineers to put this in practice. The emphasis must be on helping the clinician deliver high-quality clinical care while eliminating waste and unnecessary cost in the system. The case study below illustrates how data can be used with patients for shared decision-making utilizing best practices.

**Vignette 18.7**

A 7-year-old girl is brought into the ED after a head injury while playing soccer. She hit her head on another player and fell to the ground. There was no loss of consciousness, but she has a mild headache and nausea. The mother is very concerned and wants a cat scan. As the physician opens the chart, the PECARN rules open, and the physician explains the significance of the study and goes through each of the questions together. At the end, the computer states the risk for serious head injury is under 1/2000, and the physician and

mother have an informed discussion about the risks and benefits of CT. They decide to forgo the CT for now, and head injury instructions are given. They are discharged within 30 minutes of arrival, costs are minimal, and the child has an excellent outcome without the radiation risk associated with an unnecessary CT scan usage. Both physician and mother are very happy with the clinical interaction. (Fig. 18.2)

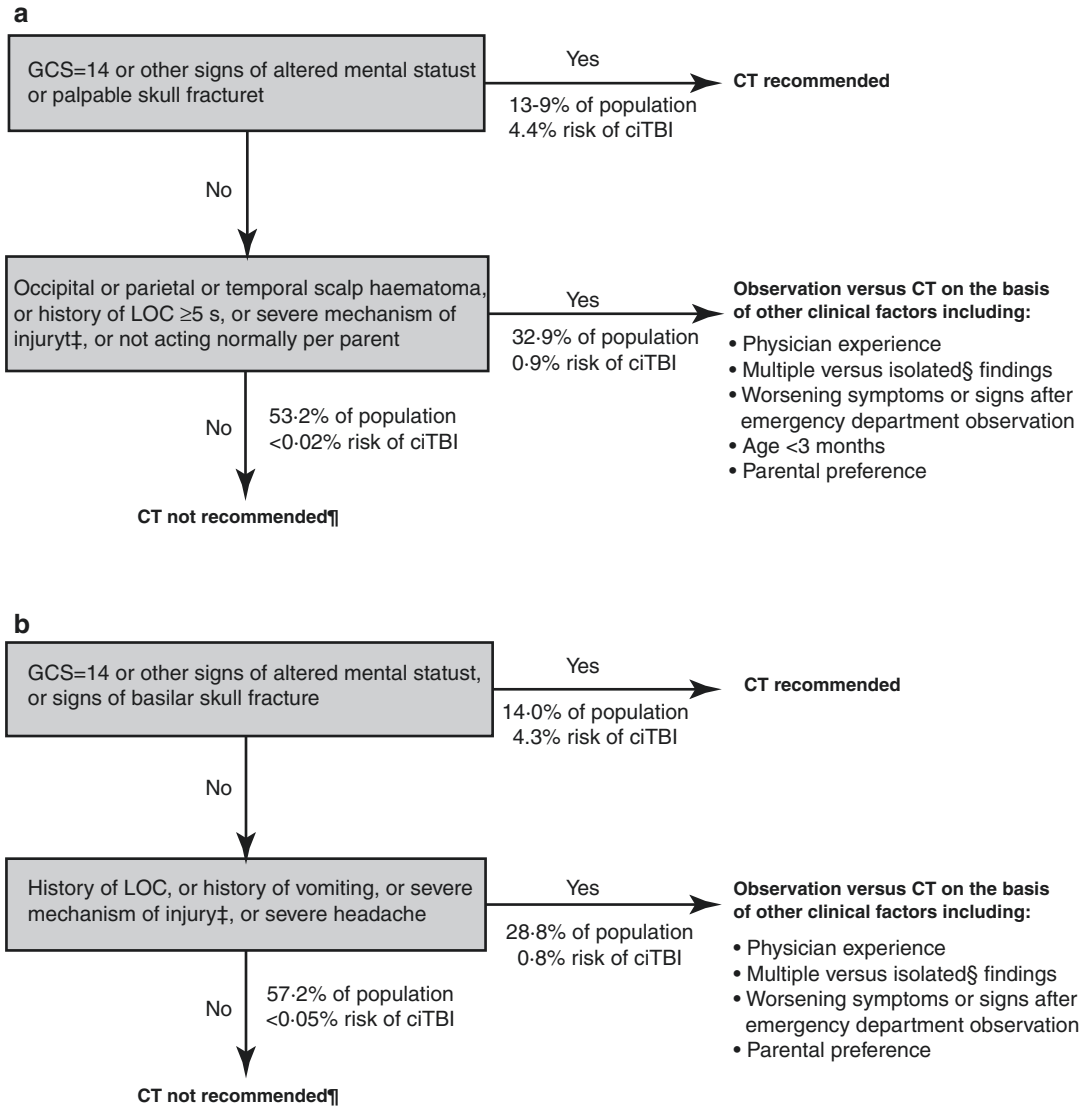


**Fig. 18.2** **a** children <2 years of age and **b** is for children ≥2 years of age [20]. Reprinted from The Lancet, Vol. 374/Edition Number 9696, Kuppermann N, Holmes JF, Dayan PS, et al., Pediatric Emergency Care Applied Research Network (PECARN). Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study, p. 1160–11770, Copyright (2009), with permission from Elsevier)

## Conclusion

In the USA, about 17% of GDP is currently spent on healthcare. On average, other wealthy countries spend about half as much per person on healthcare. Even more importantly, the quality of care delivered is poor in many instances. A 2014 report from the Commonwealth Fund stated that the USA "ranked last overall among 11 industrialized countries on measures of health system quality, efficiency, access to care, equity and healthy lives" [21]. While the USA has the highest costs, it also has the lowest performance.

Changing this alarming pattern will require a paradigm shift in how medical care is delivered across the system. Excellent patient flow across a system utilizing technology and best practices will deliver the highest quality care. There are bright spots across the country. These must be embraced and used as a stepping stone to even further improvement.

To make this fundamental shift, leadership will be key. These leaders will set the vision for delivering high-quality, cost-effective care while recognizing how important timely care is for both patient and caregivers. This respect for time and elimination of waste will improve patient and family satisfaction and prevent physician burnout. Thinking about how every decision impacts flow is fundamental. Real change will come when the frontline staff doing the work understands the vision and are engaged to solve problems. High-quality care and operations will always be intertwined. While this is not a small undertaking, this vision combined with a mindset of continuous improvement will assure improved high-quality patient care [22].

**Editors' Comments**

The most important facet impacting the business of healthcare is probably patient flow; having patients move throughout the system in a safe, expeditious manner is crucial for optimizing operations while simultaneously enhancing the finances of the organization. As such, this chapter presents excellent strategies on how to ensure the patient flow in your healthcare system drives quality.

The concept of patient flow is relatively new and may not be fully understood by all of our readers. The author begins the chapter with striking case studies that demonstrate through the vignettes the impact of patient flow on quality, safety, and outcomes; indeed, those of us in healthcare settings have seen this replayed – sometimes on a daily basis. Once the reader understands how patient flow contributes to overall quality and safety not only for that one patient, but for patients within the entire system, then we have reached common ground.

The author builds on the burning platform of patient flow by delving into the science of flow. For the sophisticated reader, the chapter explores how improvement science can lead and support patient flow efforts and how to best consider patient flow from a scientific approach. Through the vignettes, the author highlights specific scenarios such as "low-acuity flow" and "segmentation for quality." Both are explained thoroughly by the author that it is not unreasonable for the reader to pilot some of the strategies that may apply in their healthcare system.

As seen throughout the prior chapters in this textbook, success in managing and optimizing patient flow comes down to teamwork and communication. Teamwork and communication are the keystones for any successfully change endeavor that is of the magnitude and significance as patient flow. The teamwork and communication can be microunit based or can be organizational; depending on the scope of the patient flow initiative, the improvement scientist will have to build the right team and utilize the proper communication channels.

Ultimately, success in managing patient flow will come down to data and technology, the two final areas discussed in the chapter. This chapter serves as an excellent primer to introduce readers to patient flow and to simultaneously guide the advanced improvement scientists on the best strategies to incorporate improvement methodologies to patient flow.

## Chapter Review Questions

1. What is the definition of Lean Healthcare?

   *Answer:* Lean Healthcare is a set of operating philosophies and methods based on the Toyota Production System principles designed to create maximum value for patients. It uses basic tools and methods to systematically reduce waste and therefore wait times for patients. It emphasizes what is value-added from the patient perspective, employee involvement, and continuous improvement.
2. What are the two known impacts on patient care and hospital operations found with boarding patients in the emergency department?

   *Answer:* Increased mortality and longer length of stay after admission.
3. Describe two examples of segmentation in the emergency department and one example for the inpatient units.

   *Answer:* (a) In the ED, a streamlined low-acuity treatment area and a vertical treatment area for mid-acuity, well-appearing patient, and (b) on the inpatient unit, an observation unit with defined patient pathways.
4. True or False: The role of a leader is to direct frontline staff on their daily work.

   *Answer:* False. The role of the leader is to create a vision for the staff and support the process improvement work in process.
5. Does transparent data improve physician performance?

   *Answer:* It depends. If transparent data is paired with sharing of best practices, physician performance can improve. Sharing of transparent data is not a panacea, but there is broad subjective sentiment that transparency drives improvement.
6. What is the definition of Kaizen?

   *Answer:* Continuous improvement. A Kaizen event brings a group of people together in a structured way to solve a well-defined problem.
7. Describe two ways that analytics will help improve flow and patient care in the future.

   *Answer:* Analytics can help with retrospective review of issues, real-time "pushes" to staff to assist with workflow, and prospective predictions of high volume with recommendations to plan for it. On the clinical side, analytics can bring best practices up to the clinician and allow shared decision-making with patients and family.
8. Describe a basic framework for process improvement in healthcare

   *Answer:* Process improvement is best when leadership sets the vision. Lean education of frontline staff ensures everyone uses the same methodology for projects. This combined with multidisciplinary teams for process improvement, Kaizen events, and clear metrics using technology create a robust framework for improvement.

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