Six Sigma management methods set quantitative error rate objectives because experience has shown that, lacking specific goals, improvement is too slow and unsatisfactory for the needs of the day.

Six Sigma addresses error prevention, variability reduction, problem detection, problem solving, and managed change.

Six Sigma uses a collection of management practices to achieve its specified goal. Some of these practices are based on statistics, but many are not.

WHY SIX SIGMA?

You are a healthcare executive, or you expect to be one in due course. Your organization provides error-free care to your patients, your patients are discharged on schedule every time, every patient leaves with a correct financial statement and the proper instructions for at-home care, and you surely have attained peace of mind with regard to the management of your organization. Your facility has happy and loyal clientele, your staff has professional satisfaction, and your managers and resources are applied to positive purposes. If this describes your situation, you can close the book now with our congratulations.

If you have not quite reached that level of perfection but errors at your organization are exceedingly rare, you, too, can close the book now with our congratulations.

If you are still reading, this book may be what you’ve been looking for. You are committed voluntarily to the standards of The Joint Commission. This includes their standards for sentinel events: events that are life threatening or worse and for which
a root-cause analysis and system-rectification plan are required. Six Sigma provides a systematic method for doing the analysis and rectifying the system.

You are committed to The Joint Commission standards for performance improvement. Six Sigma provides a systematic method for quantifying the existing system, defining trials, measuring progress, and characterizing long-term conformance.

You probably have a total quality management program, a continuous quality improvement program, and a quality assurance program, and you conform to the standard practices of each of your health professions. You undertook all of these as a means to an end: error-free provision of healthcare services.

You know instinctively the following:

- An organization that never makes errors has happy and loyal clientele.
- An organization that never makes errors is easy to manage.
- An organization that never makes errors has positive uses for resources.
- An organization that never makes errors attracts the best candidates for employment.
- An organization that never makes errors has peace of mind in the executive suite.

You also know that untoward events can happen, even in the best of organizations; therefore, you would wish to have at hand an organized management method for dealing with such events. Six Sigma provides such a method as it may be applied to products and services.

Efforts to improve production processes started in a systematic way before World War I with Taylor (1911), Gilbreth (1912), and others, who were known as efficiency experts. After World War I, a theory was developed that allowed the benefits to be applied systematically to all kinds of production. The best-known work was done by the telephone company at Bell Labs and in AT&T’s manufacturing arm, known in those days as Western Electric. Other major companies did similar work; the AT&T work is best known because, having no competitors, AT&T did not mind publishing its findings. This body of work came to be called scientific management.

Then came World War II. For three years, the American War Production Board ran the biggest command economy in the history of the world. Much of the production was done by giant companies that already knew scientific management, but much was also done by others who had been running small companies
and who suddenly found themselves employing thousands of workers. These small companies needed help. The War Production Board saw to it that they got that help by mandating scientific management across the board. The results impressed our enemies and our allies alike as war material flowed from factories deprived of the 15 million men then in uniform and staffed instead by women, youngsters, oldsters, and just about everyone else who was available, few of whom had ever seen the inside of a factory before.

After the war, things returned to normal in the United States, with pent-up consumer demand replacing military demand in most industries. Without the War Production Board to tell them how to manage their work, some companies continued to apply scientific management, and some did not. With demand so high, not much discipline came from the marketplace to force manufacturers to perform well.

Meanwhile, General Douglas MacArthur saw the need to revive Japanese industry to get Japan's postwar economy going. The American market for manufactured goods was, relatively speaking, open to imports. Exporting to the United States would earn Japan some hard currency. Adding technology in the form of scientific management would speed things up, so MacArthur engaged a group of production experts from the United States to advise Japanese industrialists on how to manage production. Among these were two Americans who figure prominently in the story: C. Edwards Deming (Walton 1990) and Joseph M. Juran (1995). Both enjoyed long professional lives and advised Japanese clients for decades while maintaining their American practices.

### Deming's 14 Steps

1. Create consistency of purpose.
2. Adopt the new philosophy.
3. Cease dependence on inspection.
4. End the practice of awarding business on the basis of price alone.
5. Improve constantly.
6. Institute training/retraining on the job.
7. Institute leadership for system improvement.
8. Drive out fear.
10. Eliminate arbitrary quotas and slogans without providing resources.
11. Eliminate work standards (quotas) for management.
12. Remove barriers to pride of workmanship.
13. Institute education and self-improvement for everyone.
14. Transform everyone's job to transform the organization.
At the time, Japan had two big hurdles to overcome to implement a successful export strategy: It had no money, and it was a long way from the American market. Because of the lack of money, each raw material item was precious, and nothing could be wasted. Because of the country’s distance from the American market, the Japanese manufacturers had to ship a product that would satisfy the American customer immediately on delivery because goods could not be shipped back to the factory to fix mistakes.

In short, the postwar Japanese companies had to build the product right, with no waste, or else their strategy would fail. Inspired by clear thinking on the matter and lacking any alternative, the Japanese exporters bore down and applied everything they could learn about low-error, low-loss manufacturing methods. They absorbed everything Deming and Juran had to offer, and they applied what they learned with zeal.

The Japanese started with transistor radios and motor scooters and moved over time to automobiles, sophisticated consumer products, computers, and capital goods, staying with the manufacturing discipline well after they had plenty of hard currency in the bank. The Japanese were discovering that their quality reputation earned them market share while minimizing costs.

This brings us up to the 1970s, which was a time of turmoil, stagflation, and malaise in the United States. American production was in such disarray that these popular-literature business theories emerged:

- Murphy’s Law (Murphy 1949)—Anything that can go wrong will go wrong
- Parkinson’s Law (Parkinson 1957)—Work expands to fill the time available
- The Peter Principle (Peter 1979)—Managers are promoted to their level of incompetence

American companies lost market share at home and abroad. The American government tried to help by imposing guidance in the form of quality assurance requirements on various civilian industries. These became institutionalized—that is, bureaucratized—over time, and they may or may not have been very helpful. American industrialists then trooped to Japan to learn from the quality masters.

In the 1980s, manufacturing started to turn around in the United States. Philip Crosby, head of quality assurance for the then-huge ITT corporation, published a bestseller called Quality is Free (1979). Crosby observed (and it was confirmed by a great number of industries) that American companies were spending 20 percent of their time, capital, and management resources fixing things. If a fraction of that effort were put into doing something right in the first place, the company would recoup a lot of time and money.
Business rediscovered Deming and Juran. The *In Search of Excellence* books (Peters and Waterman 1982) sold by the carload. Companies signed up for total quality management and later for continuous quality improvement programs.

The American government created the Malcolm Baldrige Award to recognize efforts in the improvement of quality. The government later added a separate Malcolm Baldrige award for healthcare (NIST 2001). The International Organization of Standardization recognized quality assurance by issuing the ISO 9000 family of standards.

By 1990, American manufacturing companies were generally competent at producing quality goods and were holding their own. That did not, however, prove to be the end of the story. Motorola was the first to say that not enough progress was being made and that something more had to be done. If not, the quality level would never get to the standard they felt they had to meet to compete in their markets against very serious international competition. Motorola instituted the first Six Sigma program. Other major companies, most notably General Electric, IBM, and Texas Instruments, followed. These were followed in turn, curiously enough, by the Japanese company Sony. Transaction-oriented service companies such as American Express also took up Six Sigma practices; many banks are now following American Express’s lead.

These companies had not been asleep between World War I and 1990; they had been leaders every step along the way. They had quality assurance programs, total quality management programs, and continuous quality improvement programs. They knew everything that could be known about scientific management. They were, as they had always been, leaders in production management.

So why did major companies decide they needed something new? Something more? These leaders came to believe that maintaining their good management practices would result in products with a few defects per thousand. They wanted not to get to zero defects, because that would be impossible, but to a few defects per million; that is a thousand times better than what they had been doing, and they felt they had to get to that level. On the basis of their experience, they realized their existing programs would take a very long time—too long—to get where they wanted to be, and they did not have much time. They needed to take action.

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**Crosby’s 14 Points**

1. Management commitment
2. Quality improvement team
3. Quality measurement
4. Cost-of-quality evaluation
5. Quality awareness
6. Corrective action
7. Ad-hoc committee for zero-defects planning
8. Supervisory training
9. Zero-defects day
10. Goal setting
11. Error-cause removal
12. Recognition
13. Quality councils
14. Do it over again
Thus, Six Sigma. Six Sigma goes beyond “continuous improvement” programs to specific, numeric goals. These goals have now been shown to be attainable in many industries.

The Japanese experience is helpful because, in one human generation, postwar Japanese industry went through four complete technology generations—from handwork to hand-fed machines to self-feeding machines to self-controlling and self-monitoring machines. Most Japanese manufacturing was done in small batches, so special attention was paid to reducing setup time and understanding the flow of work.

Where is healthcare today? We are still doing a lot of handwork. Some mechanization and some computerization of instrumentation have arrived, and some robots are used—for example, in hip surgery. More mechanization is probably coming, but right now healthcare is largely handwork.

The contributions made back in the handwork stage of industrialization reduced back-breaking physical effort, organized the work and the tool crib, designed new tools, broke down tasks so they could be improved step by step, and taught workers to inspect their own work.

Many of these improvements were made specifically to reduce the frequency of worker error. With some thought, those lessons learned can today be applied to healthcare.

**WHAT IS SIX SIGMA?**

Six Sigma is a systematic method for improving the output of the organization by improving the quality of the system. This is done by reducing variability, preventing error, solving problems, managing change, and monitoring long-term performance in quantitative terms so that any incipient problems are detected before they become bothersome. Six Sigma is a quantitative method that deals with measures commonly called *quality measures*. Before discussing the application of a quality measure, having a definition of *quality* will be helpful.

The Institute of Medicine (IOM 2001, 1) defines quality as “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.” This goes in a good direction and would be hard to contradict but does not apply to something that can be quantified.

Crosby (1979, 15) provides an operable definition of quality by saying, “Quality is conformance to requirements.” Nothing more, nothing less. This is a functional measure, and it works with something that can be quantified. Does the work meet the requirements or not? Does it pass or fail? What is the percentage of passes and
the percentage of failures? No credit is given for being close or for good intentions; there is no extra credit for doing more than the specification required.

If the Crosby meaning of quality applies, what, then, is an error? To be consistent with Crosby, an error must be that which reduces conformance to requirements. An error need not, by itself, cause conformance to fail; an error need only detract.

In industry, a defective part is reworked or tossed in the reject pile. In healthcare, there is no reject pile, so any error causes rework, and rework takes time and resources.

Errors in healthcare service include the following:

- Administrative error in admission
- Incorrect or untimely diagnosis
- Error in medication
- Error in therapy or other treatment
- Administrative error in the patient record
- Untimely treatment
- Departure from nursing standard
- Departure from any other professional standard
- Error in prerelease patient indoctrination
- Administrative error in discharge
- Error in any financial statement
- Error in take-home instructions or medication
- Delayed discharge or too-soon readmission
- Other such action or inaction that has an effect on the timely treatment and discharge of the patient

Errors include direct injuries to the patient and all of the other things that detract from timely and effective treatment: a patient falls in the bathroom; an immobile patient is not turned in bed and risks pressure ulcers; X-rays are misfiled; supplies run out; schedules are botched; a department runs out of nurses and has to oblige some nurses to work a double shift; one department smooths out its workload by bunching the work up in the next department; billing errors are made. All these possibilities and many more detract from the organization’s service to the patient and community.

Plenty of other management issues are not directly involved in service: unauthorized people parking in the doctors’ parking spots; the capital budget campaign;

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The Four Facets of Six Sigma

1. Preventing error
2. Detecting problems
3. Solving problems
4. Managing change

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noisy helicopters annoying the neighbors; succession planning; recruiting. Six Sigma has nothing to offer for these topics.

**SIX SIGMA AND QUALITY MANAGEMENT PROGRAMS**

**Baldrige Award for Health Care**

The Baldrige award is an annual recognition of performance quality, sponsored by the federal government’s National Institute of Standards and Technology, the erstwhile Bureau of Standards. The Baldrige competition has been run for more than 25 years, and winning is a big feather in a cap. While the criteria vary slightly from year to year and are published annually, the main goal remains to boost awareness of and involvement in performance initiatives. Those pursuing the award may bemoan all the tracking charts. But because the Baldrige competition rewards improvement more than actual achievement, an organization that had been doing poorly and moves up to pretty good will score well and probably better than an organization that has been at the pinnacle of performance for years. There is merit in this approach, as the aim is to get lots of organizations to do better, while the top few continue to take care of themselves (NIST 2016).

Baldrige awards are given by sector. One of the sectors is healthcare.

**The Balanced Score Card**

The Balanced Score Card model for strategic management helps senior managers teach middle and junior managers to overcome the tendency to get caught up in the urgent matter of the day and pay some attention to important strategic interests. Applied to healthcare, the idea is to require all levels of management to report on four strategic topics, such as patient safety, nurse staffing, market share, and cost. One important contribution of the Balanced Score Card is to make all middle managers aware that they have a contribution to make to each of the key topics (Kaplan 2010; Research Gate 2016).

**Total Quality Management**

Total Quality Management, often called *TQM* (ASQ Quality Press 2013), attempts to adapt and apply to healthcare the concept of continuous improvement used in
other industries. TQM may be seen as a forerunner of the current High-Reliability Organization initiatives, because effective TQM requires involvement of all levels of management, buy in by professionals and other employees, and measures of performance.

The challenge with TQM is that continuous change in operations might be fine at the local level but self-defeating at higher levels of aggregation, by rewarding local optimization rather than global optimization. The Six Sigma approach is to standardize and then make a few discrete, larger changes that can be tested and measured globally.

**HOW IS SIX SIGMA APPLIED?**

Mature Six Sigma organizations simply include Six Sigma methods in everything they do, so no special attention is required. Before reaching that level of maturity, organizations select projects for Six Sigma attention, execute those projects, measure the results, and then take up more projects.

A Six Sigma project addresses work to be redesigned, a problem to be solved, a change to be instituted, or a key process or set of processes to be monitored so that any problem can be detected and resolved. Usually these three are connected; once a problem is solved, some change will be instituted to provide the solution, and the new process will be monitored over the long term to detect any new problems. Six Sigma error-prevention techniques will be implemented in the design of the solution to the problem.

Six Sigma projects are designed by black belts, who also oversee the projects. The projects are normally carried out by green belts. For early projects and major projects, the organization will assign a senior manager to act as a sponsor.

Some organizations have Six Sigma champions who promote Six Sigma; whether that is a good idea depends on the organization’s culture. If the organization relies on the line organization to manage new methods, no particular need exists to also have champions. If the organization likes matrix management methods, champions may well fit in and accelerate the inculcation of Six Sigma into the organization as a whole.

To start, an organization needs two or three black belts and a few green belts. Theoretically, one black belt would be enough, but one is a fragile number. Black belts

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**Six Sigma Belts**

- Green belts can carry out projects.
- Black belts can design and direct projects.
- Master black belts can train others and direct multiple projects.
belts are members of the organization who have an interest and are willing to accept training in something new; they do not have to have an advanced math background. Training can be done on-site or at a training facility, preferably by a Six Sigma training firm that specializes in healthcare.

In the long run, the organization may want to have about 1 percent of the professional staff trained at the black belt level and about 4 or 5 percent trained as green belts.

A typical on-site training program runs for one week, with the trainees taken away from their regular duties for essentially all of that week. By the end of that time, each person will have been assigned a training project to complete during the balance of the month. The trainer will be on call during that month to coach the trainees as necessary. The group meets again for one or two days to review the projects, straighten out any difficulties, and award green belts to successful participants.

Trainees pursuing the black belt will repeat the process, with another week of additional classroom training followed by a more substantial project that typically runs for another month. At the end of that second month, successful participants will be awarded the black belt.

Black belts who take a keen interest in Six Sigma may wish to pursue the master black belt at a training facility or through an online training company. Master black belts need more of a mathematical background or experience in statistical analysis as well as an interest in teaching others.

Many companies provide Six Sigma training, although few have specialized in healthcare issues. Most do industrial training, with an emphasis on factory performance. Many Six Sigma consulting companies will perform Six Sigma projects on a fee basis; some do both training and consulting. Relatively few have consulting experience in healthcare, although the number is growing.

This book includes a large number of healthcare cases, in part because healthcare training material is not available to any extent elsewhere. The 20-plus cases in this book provide sufficient case-study material for training green belts and black belts.

Most Six Sigma training companies and consulting companies have websites; any standard web search engine will identify them. Interested organizations may also contact the authors for training and consultation with specialization in healthcare.

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### General Electric’s Six Sigma Program

GE has embraced Six Sigma throughout its giant corporation, requiring all management candidates to be at least green belts. The company has an informative website at www.ge.com/sixsigma.