

REVIEWS

# The evolution of quality improvement in healthcare: Patient-centered care and health information technology applications

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## ABSTRACT

**Objective:** Quality improvement in the healthcare industry has evolved over the past few decades. In recent years, an increased focus on coordination of care efforts and the introduction of health information technology has been of high importance in improving the quality of patient care.

**Methods:** In this review, we present a history of quality improvement efforts, discuss quality improvement in the healthcare industry, and examine quality improvement strategies with a focus on patient-centered care and information technology applications via patient registries.

**Results:** Evidence shows that the key to quality improvement efforts in the healthcare industry is the coordination of patient care efforts through better data evaluation processes. By utilizing patient registries that can be linked to electronic health records (EHRs) and the Patient-Centered Medical Home (PCMH) framework, the quality of care provided to patients can be improved.

**Conclusions:** While many healthcare organizations have quality improvement departments or teams in place that may be able to handle these types of efforts, it is important for organizations to be familiar with processes and frameworks that employees at different levels of the organization can be involved in. In order to ensure successful outcomes from quality improvement initiatives, managers and clinicians should work together in identifying problems and developing solutions.

**Key Words:** Quality improvement, Coordinated care, Patient registries, Patient-centered care, Information technology

## 1. INTRODUCTION

Decision-making in the healthcare industry among clinicians and managers requires an awareness of the ever-changing landscape of healthcare in order to ensure quality care and services to patients. This is an important time for organizations to examine their quality improvement efforts. The industry is experiencing an increased focus on coordination of care efforts through incentives linked to the creation of Patient-Centered Medical Homes (PCMHs), a push to create Accountable Care Organizations (ACOs), and repercussions

of the Affordable Care Act (ACA). While many healthcare organizations have quality improvement departments or teams, it is important that all members of healthcare organizations participate in quality improvement efforts. In this paper, we provide an overview of the evolution of quality improvement efforts. Specifically, we define quality improvement as it exists today in healthcare organizations, provide an overview of quality improvement in the past century, and, most importantly, closely examine specific methods and frameworks that both clinicians and managers should be familiar with

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when making important decisions within their organizations. Finally, we provide current and future directions of quality improvement for the healthcare industry.

## 2. METHODS

In this review, we used several databases to extract information in regards to quality improvement in healthcare as it applies to coordinated care efforts. These databases included: MEDLINE<sup>®</sup>, Compendex databases, PubMed, Cumulative Index to Nursing and Allied Health Literature, PsycINFO, and Scopus, through October 30, 2015. The authors reviewed a number of studies in the field. Studies that were included in this review were related to the overall impact of quality improvement efforts on healthcare processes, including patient-centered care and PCMHs, as well as health information technology applications (*i.e.*, patient registries).

## 3. RESULTS

### 3.1 Definition of quality improvement

Tellis-Nayak and Synder<sup>[1]</sup> have defined quality improvement in general terms as a process that with the aid of an organization's leadership develops an environment where quality is ensured and focused upon customers. In the healthcare industry, Batalden and Davidoff<sup>[2]</sup> have defined quality improvement as a mixture of efforts by everyone involved, from clinicians to patients and systems of care to improve clinician knowledge and skills and to enhance patient health. The consensus among many in the healthcare industry is that quality improvement is an endeavor to provide cost-effective, efficient, better quality healthcare for patients, while improving processes within the healthcare industry. As quality improvement efforts in the healthcare industry have increased dramatically, questions have arisen as to: (1) how and what organizations do to improve the quality of health care for Americans; and (2) what the impact of quality improvement efforts has been on health care delivery thus far. In examining these two important questions, it is imperative to understand the history of quality improvement in the past century.

### 3.2 History of quality improvement

The idea of quality improvement did not originate within the healthcare industry. In fact, many of the techniques used in quality improvement efforts today in the healthcare industry were developed for the manufacturing industry. Efforts to seriously improve the quality of a final product began during the 1920's through the development of an increased demand for the use of manufactories.<sup>[3]</sup> By 1924, Walter A. Shewhart had developed the first known control chart, which later became known as the Shewhart Cycle. The Shewhart Cycle linked related quality improvement and statistical approaches

to manage effectively and continue the improvement processes within businesses, thereby better developing and controlling how final products were fabricated.<sup>[3,4]</sup> The Shewart Cycle consists of four main points: Plan, Do, Check/Study, and Act.<sup>[5-7]</sup> It is a cycle used continuously to improve processes leading to the final product of an industry. Each step is connected and based on the preceding step, and one cannot move on to the next step without completing the prior step.

Expanding on Shewhart's work, Edward Deming brought quality improvement efforts to the forefront of the business world. At the time, during the 1940's, the Japanese economy had deteriorated and they were recovering from World War II. Deming was asked to help and teach Japanese businesses about quality improvement.<sup>[3]</sup> Deming demonstrated through his "14 Points of Management" that the environment in which one works must uphold the idea of continued improvement not only individually but as an organization as a whole.<sup>[7,8]</sup> Deming's teachings demonstrated that employees from different faucets of an organization (*e.g.*, those who are knee deep in what is occurring) need to be engrossed in quality improvement efforts and not just the organizations leadership.<sup>[8]</sup> With Deming's techniques, Japanese companies eventually took the lead and became leaders in several industries that were able to produce higher quality products at a much lower cost during the 20<sup>th</sup> century.<sup>[3,8]</sup> The rest of the business world took notice and began to examine their quality improvement efforts and processes. It was not until the early 1980's that the healthcare industry in the United States began to formalize a quality improvement movement, which had begun years before in the manufacturing industry.<sup>[3,7]</sup>

### 3.3 Quality improvement in the healthcare industry

Even though the idea of quality improvement was not heavily emphasized within the healthcare industry until the 1980's, efforts to improve and develop quality care for patients had in fact already been in existence. Even before Shewhart, Deming, and Juran, individuals in the healthcare industry had begun to examine and analyze ways of ensuring that patients were treated correctly and that treatments were leading to improved healthcare for patients.<sup>[9]</sup> In 1910, Ernest Codman led the idea of improving hospital care by following up on patients to ensure treatments were effective.<sup>[9]</sup> Codman's ideas laid the groundwork for the American College of Surgeons to develop a "minimum standard" of care, which generally focused on improving care provided in the hospital.<sup>[9]</sup> Following these efforts, and nearly forty years later, the Joint Commission on Accreditation of Healthcare Organizations, now known as The Joint Commission (TJC), was developed. TJC is responsible for implementing and advocating for qual-

ity programs not only at the organizational level but also for the entire healthcare system.<sup>[9]</sup>

### 3.3.1 *The stakeholders*

Quality in the healthcare industry today is not what it was twenty or even ten years ago. Patients are more involved with their care and take an interest in healthcare processes. Reports on quality improvement projects taking place in hospitals and other clinical settings across the country have increased. Both quality of care and improved health system processes are the focus of these reports and projects.<sup>[10]</sup> An increased number of private and public healthcare organizations are working together to improve quality in healthcare. Organizations such as the Institute for Health Care Improvement, the National Committee for Quality Assurance (NCQA), TJC, and the National Quality Measures Clearing House among others aid in the improvement of quality of care and healthcare industry services. Medical associations or medical academies of medical specialties within healthcare shape quality improvement by providing treatment recommendations and setting standards for clinicians and health organizations to use when treating patients. They also provide a means for benchmarking, and organizations can review data to measure quality improvement efforts. Such organizations provide learning materials to aid clinicians and health organizations in better serving patients and improving processes. Alongside health policy makers, these organizations help to mold current healthcare industry quality improvement efforts.

### 3.3.2 *Methods in use*

As stated previously, the methods used in healthcare were originally created for the manufacturing industry. Lean methods, Six Sigma, Plan-Do-Study-Act methods, flow charts, and fishbone diagrams all are all important tools for executing improvement efforts. For example, Six Sigma was developed during the 1980's by Motorola with the goal of eliminating deficits in processes to create a low cost, high quality product.<sup>[11]</sup> The objective of Six Sigma is first to define the problem, then to measure and obtain process performance measurements, and finally to analyze the process and determine the cause of the issue. These steps assist in determining whether the process in place should be redesigned or if it can be further improved.<sup>[5,11]</sup> The concept of Six Sigma has moved from manufacturing and into the healthcare industry, where it is used to improve processes already in place and to create new ones, while delivering care to patients.

Lean, like Six Sigma, was developed in the manufacturing industry. The objective of Lean is to deal with the waste that occurs in processes of various industries.<sup>[12]</sup> In health-

care, the concept of Lean applies to the improvement of customer satisfaction, and the empowerment of those involved in healthcare processes. At the same time, Lean helps to eliminate wasteful steps and/or recourses that really have no importance to the successful delivery of high quality medical care.<sup>[5,12]</sup> Using the Lean method allows administrators to work closely with their staff, encouraging both individual and organizational improvement.<sup>[12]</sup> Many organizations have started to link methodologies together as a means to improve their organization's outcomes. An example of this effort is the creation of Lean Six Sigma.

### 3.3.3 *The impact of quality improvement on healthcare*

Although there is some debate over which quality improvement tools should be used in certain situations, there is growing evidence that quality improvement efforts have made a positive impact on the healthcare industry as a whole.<sup>[13]</sup> For example, Canel *et al.*<sup>[14]</sup> conducted a study on quality improvement methodologies and tools used to improve medical records assembly processes for several hospitals. The authors concluded that the application of quality improvement tools and methodologies contributed to the improvement of the medical records assembly process, which in turn led to a reduction in the amount of time it took to file a patient's record. Another example includes a study conducted by Hosford.<sup>[15]</sup> Hosford examined whether quality improvement efforts in hospitals led to a reduction in medical errors. The findings of this study show that quality improvement efforts performed at different hospital facilities indeed led to a reduction in medical errors.<sup>[15]</sup>

Further, a study conducted in 2008 demonstrated that ventilator patients in a community hospital in Santa Cruz, California, experienced improved outcomes after managers implemented the Plan-Do-Study-Act-Model to assess critical care processes in the intensive care unit.<sup>[16]</sup> Another study conducted in 2009 showed that series of quality improvement projects that were implemented over a three year period in a pediatric residency program led to the improved management of children with obesity, better compliance with national patient safety goals, and improved patient flow.<sup>[17]</sup> Another recent study involving statistical process control analysis in an Australian intensive care unit, showed that the redesign of the discharge process led to a reduction in the average patient discharge delay time.<sup>[18]</sup> The researchers concluded that using quality improvement tools, such as statistical process control and the implementation of teams, led to a timelier and effective discharge process.

Overall, in a recent review, Brandao de Souza<sup>[12]</sup> concluded that Lean methodologies have been successful within the United States private healthcare industry, and that Lean

methodologies are expanding internationally to other countries to improve the quality of their healthcare systems.<sup>[12]</sup> In recent years, the application of information technology and patient-centered care approach have been proven useful to healthcare managers and administrators who are looking to improve process within their organization. The next sections of this paper will outline in more detail the efficacy of the PCMH model and the use health information technology via patient registries.

### 3.3.4 *Quality improvement in patient-centered care and health information technology applications via patient registries*

Health information technology, particularly patient registries, is considered by many to be staples of the PCMH model.<sup>[19]</sup> While not new, the PCMH model has gained in popularity since 2007.<sup>[19]</sup> The “Joint Principles of the PCMH” were articulated by four medical professional organizations (*e.g.*, Academy of Family Physicians, American Academy of Pediatrics, American College of Physicians, American Osteopathic Association) that represented primary care specialties in 2007.<sup>[20]</sup> These principles include: (1) the assignment of a personal physician, (2) a whole-person orientation, (3) coordination and integration of care, (4) the use of information technology and patient input to maintain and enhance quality and safety, (5) enhanced access to care, and (6) a payment schedule that appropriately recognizes the added value provided to patients who are members of a PCMH.<sup>[20]</sup>

PCMHs are also intended to support the communication and coordination of care between primary care physicians and specialists.<sup>[21]</sup> Recently, the National NCQA operationalized these principles by identifying six “must-pass elements” for achieving NCQA recognition at any level.<sup>[22]</sup> These include, “access during office hours, use of data for population management, care management, support of self-care processes, tracking of referrals and follow-up, and implementation of continuous quality improvement.”<sup>[22]</sup>

Recent evidence suggests that the patient-centered model has an effect on quality of care and patient outcomes. In 2010, Jaen *et al.*<sup>[23]</sup> showed that the patient-centered model adopted by PCMHs can have an impact on quality. The results of their twenty six month long study showed that implementation of PCMH components was associated with small improvements in condition specific quality of care. A 2012 systematic review of 61 studies predominantly showed that PCMHs are associated with a wide range of positive outcomes.<sup>[24]</sup>

Further, a systematic review conducted by Chaudhry *et al.*<sup>[25]</sup> on information technology and its effect on quality, efficiency, and healthcare costs found three major benefits. These bene-

fits included increased adherence to guideline based care, enhanced surveillance and monitoring, and decreased medication errors.<sup>[25]</sup> Another systematic literature review prepared for the Agency for Healthcare Research and Quality showed an overall positive effect of health information technology intervention on process outcomes. The researchers examined 97 articles that evaluated the effect of health information technology applications that facilitate patient-centered care are on health care process outcomes. The researchers conclude their study by indicating that “substantial evidence exists confirming that health information technology applications with patient-centered care -related components have a positive effect on health care outcomes.”<sup>[26]</sup>

It is clear from these extensive reviews that the future of quality improvement in the healthcare industry lies in the industry’s ability to use information technology as a tool in improvement efforts. David W. Bates<sup>[27]</sup> stated it best when he wrote, “teams will have not only the information they now have but also detailed time data, information about how often processes fail or are delayed and information about the outcomes of processes.” Bates’s ideas are not deemed uncommon among those in the healthcare industry. The use of information technology will aid clinicians, executives, and staff members in making better-informed decisions about process changes and/or maintaining efficient and effective processes within the care industry.

Technology has allowed quality improvement to evolve and focus on a more clinical-decision support approach to patient care. Patient registries are tools that capture and track important patient information and assist a group of providers in proactively overseeing a patient’s health status. Patient registries can play a key quality improvement role in patient care. The registry tools include patient lists, automated notifications, and decision support tools, all which cater towards care delivery and coordination. Registries also tend to have a built in reminder system. The reminder system alerts healthcare providers when a patient is due for an appointment.<sup>[28]</sup> These reminders are key for patients that require more attention and they also list unique or additional steps that differ from the average patient encounter.<sup>[28]</sup> Other registry tools include population level standardized reports, benchmarking reports, and population dashboards, which are attributed to the accomplishment of different population measurements.<sup>[29]</sup> In short, the tools used in patient registries have the potential to help caregivers provide improved care to patients.

Patient registries are a key step towards improving a patient’s future efficient care. Such registries are a practical means of quality improvement through a more clinical approach as opposed to simple Electronic Medical Records (EMRs).

EMR systems, which are widely used, provide health-related patient information that adheres to nationally recognized standards and allow healthcare providers to manage the patient across different means of care.<sup>[29]</sup> Simple EMRs have a more general, multi-purposed functionality.<sup>[29]</sup> The protocols of EMRs are based on the diagnosis of the provider.<sup>[29]</sup> With a registry, however, the focus of care is based on data and outcomes and can also be focused on group care.<sup>[30]</sup> This aspect makes registries more proactive in patient care, and thus registries provide better treatment to patients when they need it most. Many patient registries can be built within an EMR or the more comprehensive Electronic Health Record (EHR) system. However, healthcare providers may not choose to adopt this function into their current system. Also, different EMR and EHR vendors offer types of patient registries. Not all patient registries can be classified as being equally efficient.

The focus of patient registries is to determine a patient's outcomes based on the patient's current health practices or the intervention process that the provider is considering.<sup>[30]</sup> Specifically, registries are focused on assembling data needed for reporting, monitoring the status relative to the program, and providing insight on the gaps and trends of care. This process allows different parties to make decisions based on evidence.

Patient registries are important for regulatory purposes as well. Patient registries help fulfill FDA requirements on risk minimization plans.<sup>[31]</sup> They help with increased demand from payers to provide data of long-term effectiveness.<sup>[31]</sup> Such demands are key in providing and improving evidence-based management care of patients.<sup>[31]</sup> Registry regulatory purposes can be seen in the development of the Immunization Decision support information systems.

Recently the growth of Clinical Decision Support for Immunization (CDSI) registry has shown prevalence in healthcare. Current EHR systems are not built to adapt the immunization decision support systems to the existing infrastructure. However, more recently, there has been an innovative idea to incorporate immunization decision support through a web based service, which can allow for providers to keep track of new vaccination regulations, as well as, vaccinations received by patients.

Immunizations are an effective way of preventing disease, disabilities, and death.<sup>[32]</sup> With the changing guidelines for immunizations, it is imperative that immunization registries are considered a requirement for healthcare organizations. Currently, regional Immunization Information Systems (IDS) and CDSI are used as decision-making tools for providers.<sup>[33]</sup> The adaptation of these tools is necessary because many

patients receive vaccinations, which are then recorded on paper based immunization records, and vaccination guidelines change frequently.<sup>[32]</sup> Through the implementation of IDS, there can be a uniform and more efficient approach to maintaining immunization records for patients.<sup>[32]</sup>

The Centers for Disease Control and Prevention (CDC) is creating health information system tools in order to develop new vaccination decision support methods for a child's immunization schedule.<sup>[33]</sup> The CDC hopes that through the implementation of the new system, it will be easier to develop and maintain immunization evaluation and the forecasting of products; to ensure a patient's immunization status is current, accurate and consistent; to increase the accuracy and consistency of immunization evaluation and forecasting for population health; and also to improve the timeliness of accommodating new and changed ACIP regulations.<sup>[34]</sup> It is imperative that providers stay up to date with changing vaccine regulations so that the best quality of care is provided to patients.

Data registries are a growing phenomenon in the healthcare field. This growth allows providers to provide more effective and accurate care to patients.<sup>[29]</sup> Registries provide uniform and clinical data that is used to better assess outcomes for populations affected by a particular disease, condition, or exposure.<sup>[29]</sup> The registry is more population focused than EMR or EHR systems alone and is used for patient tracking and outcome measurements, surveillance, public health program planning, quality improvement initiatives, and for research purposes.<sup>[29]</sup>

For instance, studies have shown that heart failure trials have predominantly focused their sample population on white males with an average age of 60 years. Patient registries, on the other hand, provide evidence that heart failure tends to occur in patients older than 60 years of age, affect more diverse populations, and carry a higher mortality rate.<sup>[30]</sup> Studies such as this one prove that registries can be the next step to a more comprehensive understanding of real data, which can lead to better quality patient care.

#### **4. FUTURE DIRECTIONS OF QUALITY IMPROVEMENT IN THE HEALTHCARE INDUSTRY**

The key to quality improvement efforts in the healthcare industry is the coordination of patient care efforts through better data processes. Quality improvement efforts in the future more than ever before will merge different quality practices together to improve healthcare industry processes. By utilizing patient registries that can be linked to EHRs and the PCMH framework, quality of care can be improved.

Improvements in care in this era of change will require innovative but proven ways to improve quality of care, patient satisfaction, and organizational processes. Leadership will play an important role, alongside clinicians and staff, in improving the quality of care, as well as the quality of the organization as a whole. Healthcare managers are increasingly required to coordinate quality improvement efforts. They will have to rely on tested strategies and frameworks for providing coordinated and quality care. Furthermore, clinicians will need to work with their patients more and include them in the decision making process more so than they are now.

Quality improvement efforts in the healthcare industry are of great importance on all levels: financial, strategic, and patient care. Clinicians, healthcare administrators, medical associations, and other stakeholders across the United States are actively working to improve quality of care. Similar to other industries, healthcare is already making use of tried and true quality improvement efforts. It is important to emphasize that, during this incredible time of change in the healthcare arena, it is essential for healthcare leaders to make evidence-based decisions when using care coordination efforts within their organizations. Solutions to many problems can be found in the PCMH framework and patient registry methodology. Careful selection of available methodologies and strategies should involve employees at multiple levels of an organization so that an appropriate solution is found that meets the needs of the organization. Finally, leadership has the potential to become a conduit for the solutions generated by those who are most involved and affected by the work that they perform. The importance of leadership and using evidence in providing quality care should not be overlooked in this era of great change.

This review was not intended to be an all encompassing review that outlines each and every quality improvement method. Rather, this review is a targeted one that suggests certain quality improvement tools for certain scenarios. While this limitation results in a truncated review, we encourage healthcare managers to review other evidence by searching the databases that mentioned the methods section of this paper. In fact, we would encourage these managers to continually review the existing literature to learn from the ongoing successes of other healthcare organizations.

## 5. CONCLUSIONS

Quality improvement efforts, whether they are patient centered, process centered, or employee centered, have contributed significantly to the improvement of health care delivery over the past 100 years. In order to ensure successful outcomes from quality improvement initiatives, managers and clinicians need to work together in identifying problems, such as poor quality of patient care, and then implement possible solutions. According to Becher and Chassin,<sup>[33]</sup> “patients suffer harm because of three different types of quality problems. The first occurs when patients do not get beneficial health services. The second happens when patients undergo treatments or procedures from which they will not benefit. The third occurs when patients receive appropriate medical services, but those services are provided badly.” A health care environment that promotes the collaboration of administrators and physicians in ensuring quality of patient care is critical. Together, and with evidence, those problems related to patient harm can be reduced.<sup>[35]</sup>

## CONFLICTS OF INTEREST DISCLOSURE

The authors declare that they have no competing interests.

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