



Measuring and improving comprehensive pediatric cardiac care: Learning from continuous quality improvement methods and tools



Paul Barach^{a,*}, Lawrence C. Kleinman^b

^a Children's Hospital, Wayne State University School of Medicine, MI, United States

^b Rainbow Babies & Children's Hospital, Case Western Reserve University School of Medicine, OH, United States

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ABSTRACT

Quality improvement (QI) is becoming a central part of the work of clinicians throughout healthcare. Continuous quality improvement (CQI), Lean Management Systems (LMS) and Lean Six Sigma (LSS) are management philosophies as well as management methods. They offer an approach, a set of tools, and a way of thinking about how to more effectively assess and study clinical flow, including addressing variation in clinical process and operations. We define CQI as the daily use of QI methods as a regular part of practice engaging all practice staff, constantly measuring structure, processes, outcomes against effective practices (benchmarking), moving from one QI project to the next, pursuing the goal of “The right care for every child every time”. It is based on clear scientific principles, a valid way of measuring change and has theories of reliability and human factors that underpin the interventions.

Significant variations in quality of care provided to pediatric patients leading to substandard care have been well documented. For example, in antibiotic prescribing for community acquired pneumonia; pediatric secondhand smoke reduction; screening for diabetes in cystic fibrosis program; and, in depression screening in Type 1 Diabetes. Despite this, not enough pediatric practices are performing continuous quality improvement (CQI) as part of their daily activities.

All health care professionals caring for children should consider incorporating quality measurement into their practice. However, we need to focus on what is the right approach to take and the right questions to ask and address the challenges of aggregating scientifically imperfect tests of change. Increasingly, colleagues, patients, payers and certifying agencies expect such measurement to achieve the Triple Aim of better health, better care and lower cost. In addition, new payment models increasingly pay providers for demonstrated value rather than volume, and they expect participation in continuous improvement. Quality Improvement (QI) is a critical component of the American Board of Pediatrics (ABP) Maintenance of Certification (MOC) Part 4. This requires pediatricians to participate in a meaningful manner in two data-driven QI projects every five years. Pediatricians can select quality measures to evaluate whether patient outcomes and experience improve, and if not, identify and overcome barriers. In this paper we discuss performance improvement using CQI and related methods, suggest approaches to help pediatric cardiologists to ask the right questions when seeking to drive improvement, and consider the implications of measurement theory and complexity science for QI and CQI.

1. Introduction

Pediatric health care neither delivers optimal processes of care nor achieves the best potential processes or outcomes [1a–d]. Improved child health care quality is an urgent imperative. In the past few years many successful CQI efforts have helped improve outcomes in pediatric cystic fibrosis, inflammatory bowel disease, and cardiac care. Successfully participating in quality improvement activities is so fundamental that it is now required for re-certification by the American Board of

Pediatrics. Quality health care is defined 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” (p. 1161) [2]. The Institute of Medicine (IOM) report, *To Err Is Human*, showed beyond doubt that the majority of medical errors result from faulty systems and processes, not individuals [3]. Consistent with leading thinkers in the field to the Institute of Medicine (IOM) report, *To Err Is Human*, the majority of medical errors result from faulty systems and processes, not individuals [3]. The seminal Institute

* Corresponding author.

E-mail address: pbarach@gmail.com (P. Barach).

of Medicine (IOM) report, *Crossing the Quality Chasm: A New Health System for the 21st Century* (IOM, 2001), was a call for all health care organizations to renew their focus on improving the quality and safety of patient care in all health care delivery settings [4,5]. Inefficient and variable processes, changing mix of patients, various health insurance plans, differences in clinical and continuing professional education and experience, and other factors contribute to the complexity of pediatric health care and harm in children [6–8].

With this in mind, the IOM also asserted that today's health care industry functions at a lower level than it can and should, and it put forth the following six aims of health care: effective, safe, patient-centered, timely, efficient, and equitable [5]. We consider these six aims to represent key attributes of high quality care. Deviation from desirable care can occur as overuse, or provision of inappropriate services; underuse, or failure to provide services that are likely to be of benefit, and misuse, which is a failure to deliver an intended service in the intended, effective and safe, manner [9–17].

Health care practices and organizations function as complex adaptive systems. That is, they are nonlinear, informed by relationships and interactions, and contextual in terms of both structures, work processes and cultures [18–22]. Since most errors are caused by system failures writ large or small, it is important to consider how various systematic approaches may identify inefficiencies, errors, and pending failures [23]. The integration of the sorts of thinking stimulated by complexity and implementation science with the techniques of quality improvement will offer key opportunities for both reliable learning and sustained improvement [24–28]. This paper will discuss strategies and tools for quality improvement that have been used to improve the quality and safety of health care including Lean, Six Sigma (see below) and Continuous Quality Improvement.

2. What is Continuous Quality Improvement?

Continuous Quality Improvement (CQI) has been used in the manufacturing world more extensively than in the healthcare field. However, the underlying foundation of medicine is in fact quite closely tied to the principles of CQI. The foundation for CQI was laid by Dr. Walter Shewart working in the Bell Telephone Laboratories in the 1920s conducting research on methods to improve quality and lower costs [29]. Shewart developed the concept of control with regard to addressing and reducing variation, and came up with statistical process control charts which provide a straightforward way to determine if outcomes of the process are in control or not [30].

Statistical process control (SPC) integrates statistical theory with a conceptual framework for considering improvement: control means that a process produces stable results; variability is a measure of the tightness of control; and a changed process will generate different outcomes [31]. Hence it provides the groundwork for the “tests of change” that underlie the CQI process [32]. The prototypical feature of CQI is the iterative implementation of PDSA (Plan Do Study Act) Cycles [33]. If the results are beneficial and stable, continue with the change and refine and improve in an ongoing manner to develop a stable process with reduced variation. If the results are adverse, discard the data and try something else. Continue to observe the results until a pattern of foreseeable results emerges from performing certain actions.

CQI is comfortable for healthcare professionals to learn since it is based on a basic scientific model of discovery. However, CQI may shift from the expected rules of science as small tests of change that feel like pilot studies may be leveraged to drive meaningful process change. As healthcare professionals learn the concepts and strategies behind CQI, they will infuse their scientific background and experiences into the program. Innovative measures and positive results will follow quickly. These results include a higher quality of pediatric services delivered, happier patients and customers, and sometimes lower costs. CQI begins with a clear vision of the transformed environment, identification of necessary changes to achieve that vision, and input from engaged team

members who understand the needs for the practice. In short, the journey to the desired future state involves a transformation of people, process, and technology [34]. CQI is a philosophy that encourages all health care team members to frequently ask: “How are we doing?” and “Can we do it better?” which may include, can we do it more efficiently?? Can we do it faster? Can we do it in a more timely way? [35] Continuous improvement incorporates a cultural appreciation that the only acceptable benchmark is the best that the pediatric practice can accomplish. This is in contrast to many healthcare organizations that seek to achieve external benchmarks framed misleadingly as “best practices”.

One of the realities of health care systems is that they are hugely complicated and function in a non-linear and unpredictable manner. So achieving optimal success from CQI requires thoughtful implementation that avoids settling into a mechanistic process defined only by statistical wisdom or blind metrics. The critical thinking that defines how to ask questions and select tests of change should incorporate a mindful appreciation of context, the thoughtful application of the potential for feedback loops to create nonlinear interactions, and a sensitivity to identify emergent clinical properties that make sense to the clinicians (sensemaking), and are not captured by the SPC approach [36,37]. In the language of evaluation scientists, thoughtful approaches to improvement should build in discovery capacity to complement SPC charts [38a]. Further, the rich understanding of personnel on the front lines, clinical staff, support staff, and patients, should be incorporated when identifying opportunities for improvement. SPC charts are especially helpful for assessing stability and reducing variation, but sometimes the need for change is more fundamental than reducing variability. A colloquial definition of quality is *doing the right thing, well, at the right time*. Variation speaks to doing the thing well and in a timely manner, but less so to doing the right thing.

Besides creating this inquisitive CQI culture in an organization, the key to any improvement initiative is mindfully applying a structured approach to evaluate the current processes and to design interventions to improve systems and processes to achieve the desired outcome and move towards the desired future state. Applying CQI to a pediatric cardiac care practice's implementation means that the health care team must understand the current state of evidence regarding both clinical effectiveness and organizational/system functioning. For example, a structured CQI approach was applied when applying the evidence in delaying surgical repair of hypoplastic left heart congenital defects. The learning collaborative demonstrated improvement in interstage survival and the salutatory role of home visits by a nutrition expert [38 b]. Local knowledge regarding the opportunities for improvement in the current state are integrated with an appreciation for how the CQI can change care delivery in this organization versus simply generic improvement independent of the organization's culture and context of care. The choice of measures and the identification of outcomes are critical for success and supportive staff. The QI plan provides a roadmap for change and for assessing change. The team if engaged may also intervene, when needed, to adjust this plan based on continuous monitoring of progress.

3. Lean Management and Six Sigma

We briefly review Lean and Six Sigma as complementary approaches to CQI methods for improving quality of care. Six Sigma, as its name implies (sigma being the Greek symbol used in statistics to identify the standard deviation) utilizes statistical methods to identify and reduce variation in processes [39]. Six Sigma is widely used in traditional business and in health care organizations, with increasing numbers of managers and leaders being trained and recognized for their proficiency using a system of colored belts (e.g. green belts) [40]. Six Sigma has been applied in several areas of health care, and starts with process mapping to identify critical-to-quality elements and then focuses on changes to these elements through the DMAIC (define,

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