

**The Use of Formal Quality Improvement Methods to Improve Programs in Local
Health Departments:
A Systematic Review of Published Literature**

By

Michael J. Steiner

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[Signature]

Advisor

[Printed name]

Date

[Signature]

Second Reader

[Printed name]

Date

Abstract

Background: Formal quality improvement (QI) methods were originally introduced in business management and have recently been adopted in healthcare delivery. Local health departments (LHD) have begun to use QI methods to make care in clinical services more efficient or to improve access; however, LHD use of QI methods for traditional population or other public health improvements is less well described.

Objective: To systematically review the published literature on the use of formal QI methods to improve population-based health intervention or other public health programs used in LHDs.

Methods: A structured search of PubMed was created to identify articles describing direct experience using formal QI methods to improve a population-based public health intervention, public health administrative structures or processes in LHDs. Solely clinic-based interventions were excluded because of extensive literature for clinic-based interventions in similar fields. Titles and abstracts were reviewed and articles that met inclusion criteria were then selected for full text review. In order to expand the pool of literature, published story boards from the National Network of Public Health Institutes clearinghouse site were also extracted. Articles that met inclusion after full text review had recommended QI implementation strategies and measured outcomes extracted. Quantitative reporting of outcomes was planned in addition to qualitative reporting of 'best practices' for effective use of QI in LHDs.

Results: Full text review was completed for 37 out of 395 titles initially identified, and eight final articles were included. Published studies included descriptions of individual health departments (HD) programs, QI collaboratives among HDs, and state division of health supported QI processes. There were no randomized or controlled trials of QI interventions. All published studies were case reports listing areas of success and lessons learned. The lessons through the publications were that LHDs should clarify processes early in the improvement process, involve staff in process and change, and measure outcomes. Additionally, QI was found to spread quickly within organizations, and related, having QI expertise either locally or from the outside helped move programs forward. Individual QI Storyboards were identified from the website of the National Network of Public Health Institutes and 138 met inclusion criteria. Abstracts described programs that generally used the PDSA method but reported on a wide variety of public health programs.

Discussion: The use of QI methods in population-based health interventions and other nonclinical public health programs by local health departments is limited. QI approaches such as elimination of waste, reduction of defects, and small trials of change could successfully improve public health interventions, and should be more broadly implemented both under real-world and experimental conditions.

Introduction

Quality improvement (QI) is a continuous process that uses a deliberate and systematic method to improve a system and outcome (Batalden, 1991; Riley et al., 2010). Over the past 30 years, the use of formal QI methods has become common place in healthcare settings (Association., 1991) and more recently in public health systems (Beitsch, Leep, Shah, Brooks, & Pestronk, 2010). With the adaption of Total Quality Management in the 1970s, American businesses began a commitment to systematic improvements over time. Total Quality Management shifted to Continuous Quality Improvement and then to just Quality Improvement (QI) as the use of business methods spread to other fields including healthcare (American Society for Quality, 2012a; Kaluzny, 2004).

It should be noted that these forms of QI are inherently different than Quality Assurance (QA), which focuses more on processes or standards by which organizations can assess their performance. Often this focuses on implementation of a set of external standards into an organization (Randolph & Lea, 2012). For example, clinical laboratory testing is federally regulated through the Clinical Laboratory Improvement Amendments (CLIA) at Centers for Medicare and Medicaid Services. As stated on their website, “The objective of the CLIA program is to ensure quality laboratory tests” and obtaining certification in part involves assuring certain laboratory personnel requirements and proficiency-testing to compare one laboratory’s test results against an external source (Centers for Medicaid and Medicare Services, 2012). In contrast, a quality improvement approach to testing in that laboratory might involve improving the turn-around test for laboratory results, improving the patient experience during phlebotomy, or relating the laboratory results to clinical implementation. There is a role for both QA and QI

in organizations, but the continuous internally-driven process of QI usually extends beyond external standards and seeks internal and customer-related improvement needs.

The newest systems of improvement in healthcare and public health continue to draw on other fields of science and business including human systems factors, statistics, organizational management and change theory (American Society for Quality, 2012a). The most commonly used improvement frameworks in healthcare currently include the Model for Improvement (MFI) (Langley, 2009), Six Sigma, and Lean. The Model for Improvement is endorsed and promoted as a change method of the Institute for Healthcare Improvement and is the most widely used in healthcare settings (Institute for Healthcare Improvement, 2012). The MFI works from a multi-step process that includes identifying the aim or aims of the improvement, identifying a team to implement and test change, identifying measures, and considering potential changes. The MFI then moves to its core feature which is the use of frequently repeated brief, small improvement attempts using Plan, Do, Study, and Act cycles (PDSA). Lean is an improvement method popularized by Toyota manufacturing that seeks to eliminate waste, particularly waste that consumers would not want to pay for, as a way to drive improvement in systems (American Society for Quality, 2012b). The focus on efficiency, customer/patient experience and perception of value resonates within healthcare and has facilitated its adoption. Six Sigma seeks to eliminate errors and is particularly popular in healthcare settings because of the recognition that in this setting errors endanger patient's safety, are common and have severe consequences (Kohn LT, 1999). In addition to these three methods used in healthcare, the Public Health Foundation advocates the use of the Plan Do Check Act (PDCA) Problem Solving Method (Foundation, 2010). This process is different from the complete MFI method using PDCA or PDSA as an overall framework instead of a tool to rapidly test change ideas.

One driver of QI adoption in public health is that individual health and healthcare systems have adopted more and more formal improvement systems since the publication of the Institute of Medicine's Report, *Crossing the Quality Chasm* (Committee on Quality of Healthcare in America, 2001). This book shocked the country into realizing that the delivery of healthcare was not producing the outcomes it should be achieving for a wide variety of reasons including process variability, errors, and lack of an improvement culture. It also promoted a transformed healthcare system and proposed a way to improve healthcare in the country (Committee on Quality of Healthcare in America, 2001). Another pressure specific to QI adoption in public health and LHDs is the new voluntary national accreditation system. While this system of recognition and accreditation is currently voluntary, accreditation may become necessary in the future in order to find funding for programs (Riley, Bender, & Lownik, 2012). The accreditation system is a set of standards based on 12 core domains based on the ten essential services of public health. One of these 12 domains is the maintenance of a system to continuously improve the programs in the LHD (Riley et al., 2012). Additionally, QI can be the tool used to transform health department performance across all of the other accreditation domains.

Currently over 50% of health departments report using a QI process (Beitsch et al., 2010), however very little information about their QI efforts have been published. The goal of this paper is to systematically review the published literature on formal QI processes that have been implemented in LHD. Many LHDs provide a wide range of services including clinical services, environmental services, and population-based interventions. However, this paper focuses on the use of formal QI methods to improve population-based and all other non-clinical interventions. A description of each individual intervention that has been published in peer-reviewed literature is presented along with a summary of the data across studies to identify similarities of successful

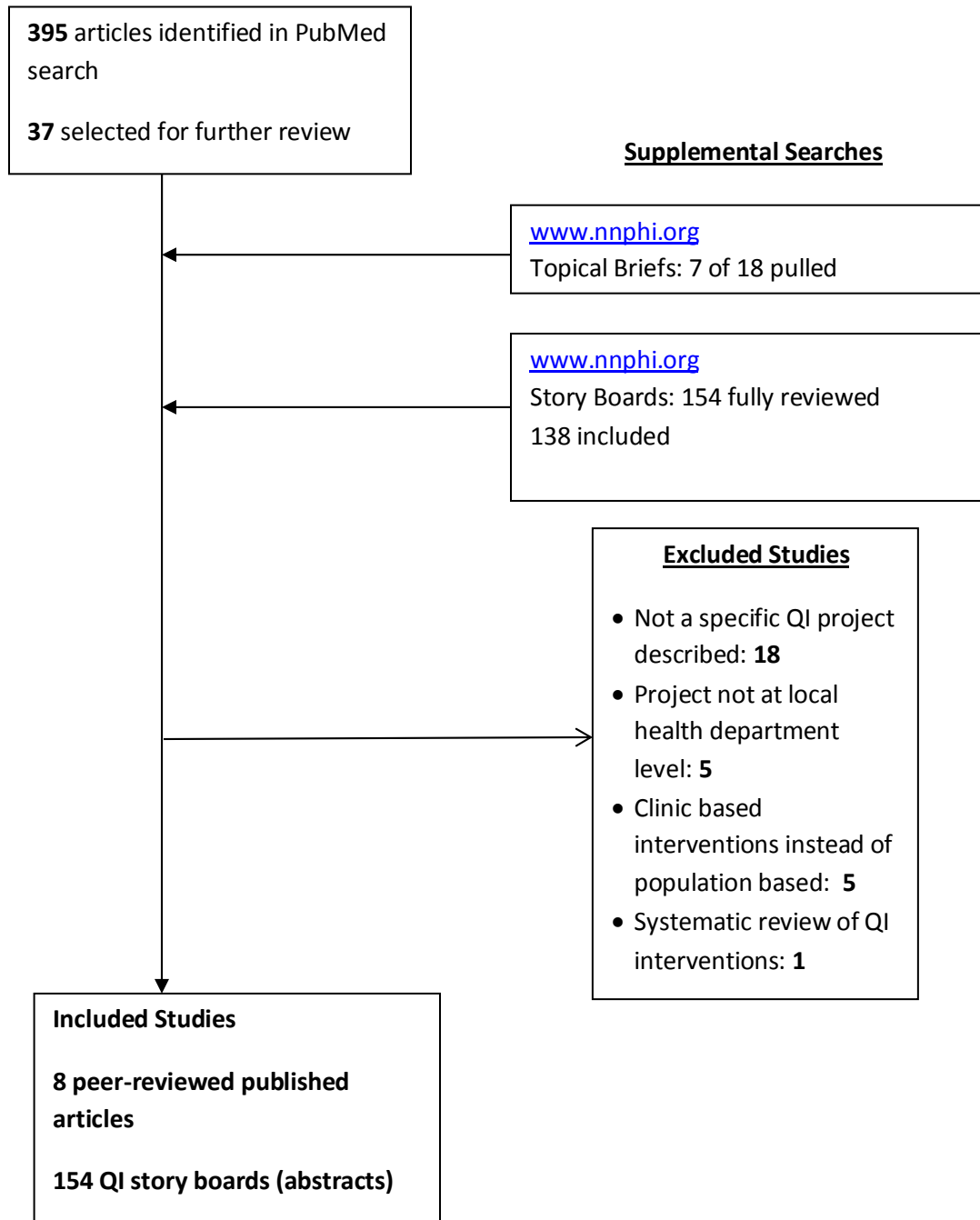
QI projects and barriers to implementation. Additionally, QI storyboards published online from the National Network of Public Health Institutes were also summarized briefly to expand the available data. This concise summary of the available literature of population-level interventions in LHDs can provide a stimulus for further peer-reviewed publications and facilitate the use of tested QI methods across LHDs.

Methods

A systematic review of the published literature was conducted to identify primary data that described implementation of a formal QI process in one or more LHDs. Specifically, articles had to describe results from the application of formal QI methods to programs or interventions that were not clinic-based. For example, population-based programs could include smoking cessation advertising, environmental health and sanitation could include restaurant inspections, and administrative processes within LHDs could include structure for accepting reports or programs to educate employees. A comprehensive search of the literature was carried out with consultation from a health sciences librarian experienced in systematic reviews. The PubMed database was queried with varying combinations of MESH terms and other search terms and the optimized final was ("quality improvement" OR "total quality management" OR "six sigma" OR "lean") AND ("public health practice" OR "health department" OR "public health administration" OR "community health services") with no other search limitations. The search was conducted on September 5th, 2012 and produced 395 titles and abstracts for preliminary review (Figure 1). Titles and abstracts were reviewed and included for full text review if: 1) they described implementation of a formal QI process in a non-clinic based program, and 2) they were set in an LHD in the United States. Articles were included if they involved a collaborative of LHDs that made improvements applied to individual LHDs. However, interventions to

improve state health departments or non-LHD programs and clinic-based programs, even within an LHD, were excluded. Thirty-seven full text articles were reviewed from the published literature and nine were included for final analysis.

Figure 1. Selection process for studies included in this review (Moher, Liberati, Tetzlaff, & Altman, 2009)



Due to the limited number of published articles meeting the inclusion criteria, expert opinion was also sought from academic and community experts in the use of quality improvement in public health to identify other sources. Based on the recommendation of these experts, this paper also reviewed the National Network of Public Health Institutes repository of QI projects and conference proceedings (<http://www.nnphi.org/program-areas/accreditation-and-performance-improvement>, accessed most recently 10-5-2012, Figure 1). In 2005 the Robert Wood Johnson Foundation funded a Multi-State Learning Collaborative which was a multi-year, multisite learning collaborative of QI methods in LHDs. Sixteen states (Indiana, Iowa, Florida, Michigan, Minnesota, Missouri, Montana, New Jersey, Oklahoma, South Carolina, Washington and Wisconsin) participated in the final stage of the collaborative, and then ‘mini-collaboratives’ or sub-collaboratives of individual LHDs within the states were organized. The goal of the collaborative was to bring state health departments and LHDs together with stakeholders to improve public health by implementing QI. Though data and published studies from this collaborative did not meet inclusion criteria for this review, the collaborative has revealed information that will definitely inform future use of QI in LHDs. The National Network of Public Health Institutes (NNHPI) managed the collaborative and published the results of local projects in a variety of formats including ‘Stories and Topical Briefs’ and QI Storyboards. (National Network of Public Health Institutes, 2012a). “Stories and Topical Briefs” was reviewed and 7 of 18 potential postings were relevant to the current review (National Network of Public Health Institutes, 2012b). QI Storyboards contained 154 documents that described local QI projects and were presented in abstract format and all of these sites were fully reviewed (National Network of Public Health Institutes, 2012a). Storyboard information was included based on the same criteria as the published, peer-reviewed literature. Examples of the aims for

the improvement projects detailed in individual story boards were to increase public use of restaurant inspection reports, to increase collaboration among community partners and to increase prenatal mothers use of Women, Infants and Children (WIC) services (National Network of Public Health Institutes, 2012a). Meeting and webinar materials present on the websites were excluded as there was not an assurance of peer-review, and the author of this paper was not present during the original calls or conference presentations. These sites often did not contain all of the original materials available from the presentation and original data was not always evident.

Based on criteria in the previous paragraph, data, including formal QI methodology used, intervention(s) undertaken, and outcome measures employed, was extracted from all included sources and summarized. The planned quantitative summary was not possible given the heterogeneity of variables, techniques, and outcomes. As a result, information across published studies was summarized individually. Included published QI story board content was summarized across descriptions, recognizing that individual storyboards had not been subjected to peer-review prior to publication. The intent of this storyboard analysis was to provide a more complete description of the population health QI activities occurring in LHDs that may not be adequately described in manuscripts. Commonalities were identified where possible in an attempt to identify practices that might have broad applicability. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines are intended for authors of systematic reviews to improve methodology and reporting. These guidelines were used throughout this project and manuscripts as applicable (Moher et al., 2009).

Results

Eight published descriptions of QI implementation in LHDs met inclusion criteria (Table 1). In order to supplement the peer-reviewed published data, we identified 138 QI Storyboards from the NNHPI website that also met the two inclusion criteria for the peer-reviewed articles (National Network of Public Health Institutes, 2012a).

Table 1. Published studies of quality improvement interventions for public health programs using formal QI methods in local health departments

Study	Title	Location (s)	Individual Organization vs. Collaborative	Objective	QI Method Used	Outcomes	Lesson Learned
Gunzenhauser et al (Gunzenhauser et al., 2010)	The quality improvement experience in a high-performing local health department: Los Angeles County	Los Angeles, CA	Individual	Improve professional practice, performance improvement and public health science. In total 53 Population goals set, broadly applicable.	Results Accountability Framework	253 Measures established such as reducing tobacco-related death in Los Angeles County.	Align QI activities with strategic plan, develop ongoing process for identifying areas for focus
Harrison et al (Harrison et al., 2012)	Applying the model for improvement in a local health department: quality improvement as an effective approach in navigating the changing landscape of public health practice in Buncombe County, North Carolina.	Buncombe Co, NC	Individual, as part of a trial group implementing QI infrastructure	Improve public health preparedness for H1N1 Influenza	Model for Improvement	Residents who had viewed a preparedness commercial and adjusted their preparedness kit	QI activities can quickly spread to other areas of the health department, build on strengths, use available resources
Kotch et al (Kotch et al.,	Performance-based management in local	Six counties	Collaborative	Achieve improved	Performance-based	The program was deemed	Link clinic activities to

1993)	health departments: measuring the success of implementation.	in southwestern NC		awareness by staff of low birth weight problems, programs, and concern for low birth weight	Management System	successful in half of counties. Increased awareness of problems and programs around low birth weight.	performance standards are acceptable, and can be used successfully to improve outcomes.
Lotstein et al (Lotstein et al., 2008)	Using quality improvement methods to improve public health emergency preparedness: PREPARE for Pandemic Influenza	5 States and LHDs	Collaborative	Improve preparedness for H1N1 influenza	Model for Improvement	Implementing strategies, successful adoption of QI strategies,	Processes necessary include clarify health processes and develop measures, create right incentives, create base expertise in QI, demonstrate large-scale efforts
Morrow et al (Morrow, Nguyen, Shultz, Murphy, & Mignano, 2012)	A local health department's journey to the summit: a case study of a decade of quality improvement.	Onondaga County HD (upstate NY)	Individual	Review a decade of active QI activity in an LHD.	Modified PDSA	10 important improvements across the LHD listed including: 1. Decrease in calls to Animal Control 2. Increase in referrals of mothers with high risk pregnancies,	Difference between small qi (multiple small changes) and Big QI (cultural shift in organization). Annual QI summit can be used to spread QI through the organization. Barriers are inadequate

							resources, inconsistent buy-in, and low participation in the annual QI summit.
Ramaswamy et al (Ramaswamy et al., 2012)	Standardizing environmental health processes at the Iowa Department of Public Health.	3 LHDs in Iowa	Collaborative	Standardize processes for environmental health	Process Mapping inspired by Lean methodology	Streamline process maps for a variety of activities to improve performance. Examples include response time to disease outbreaks and performing food inspections	Documenting processes: reduces assumptions about work activities, identifies areas of risk, brings non-standard processes to light, and facilitates metric development, and allows identification of knowledge sharing.
Randolph et al (Randolph et al., 2012)	Lessons learned from building a culture and infrastructure for continuous quality improvement at Cabarrus Health Alliance.	Single public hospital authority similar to an LHD	Individual and collaborative	Describe improvement process at a local healthcare entity	Model for Improvement, Lean, business process analysis	Improve clinic efficiency, improve dental clinic efficiency, improve oral health screening, improve early intervention services and early childcare	Learn about QI first, listen to employees, look for outside leaders and resources, set stretch goals, ensure that leaders are sponsors of

						services in Head Start program, multiple other outcomes	projects
Wright et al (Wright et al., 2012)	Using quality improvement to promote breast-feeding in a local health department.	Single LHD in NC	Part of a collaborative	Improve breast feeding rates in an LHD	Model for improvement	Improved area in LHD clinic for breastfeeding, actively contacting new mothers to breast feed and support, incentivize adoption not educational messages that promote breastfeeding, promoting new WIC packages	Staff buy-in critical to implement successfully, involve staff who will be affected by changes, early success is important

Descriptions of Single Health Department QI Programs

Two of the eight articles described QI processes that were not part of collaboratives among LHDs, but instead were implemented by individual LHDs. The first is by Gunzenhauser et al. (2010) reporting on the Los Angeles County Health Department. This large LHD employs 3700 people and has a 750 million dollar budget. The paper describes attempts to formalize the use of QI in what the authors call *performance improvement* within a *Results Accountability Framework*. Gunzenhauser et al. (2010) defines this structure as “a model that links shared accountability for population health outcomes with ‘direct’ accountability for services provided at the program level” (p. 41). However, this paper also describes applying QI methods to novel areas of LHD function, including professional practice and public health science. Though those issues weren’t explicitly included in this review, they are a unique application of QI science. For example, within professional practice, they systematically identified best practices for management of different professions within the LHD and attempted to adjust organizational management to become align with those practices through the use of QI techniques. Similarly, they identified best practices for identifying public health science and improving the process of translation from publication or dissemination of knowledge to implementation into their processes within the LHD.

The performance improvement portion of the QI program included 53 population goals (e.g., reducing tobacco related death and disability within Los Angeles County), 224 population indicators, and 736 performance measures (e.g., number of jurisdictions that adopt smoking bans in outdoor areas) across 21 programs. Results for the multiple goals and improvement processes were not all reported in the paper; however, some data are reported to reinforce areas of emphasis in the paper. For example, within the organizational goals they set out to have all

employees complete a “Core Functions in Public Health” class and were able to increase the percentage attended from 14% to 43%.

A second paper by Morrow describes a 10 year improvement process in the Onondaga County Health Department in Syracuse, NY (Morrow et al., 2012). This article also describes the spread of QI interventions across an HD over a prolonged period. The onset of quality related work in this LHD occurred in the late 1980s through Quality Assurance, but over the subsequent 10 years transformed into a series of quality improvement activities. All improvements through the LHD were expected to use a formalized 4-step improvement process involving baseline data; implementation of a small, specific intervention; post-intervention data collection and assessment of next change to be made. This culture of small, incremental, frequent improvements is analogous to that advocated through PDSA planning found in other LHDs. These changes were then highlighted at an annual QI summit. Projects for improvement again spanned population health segments, but also included clinic-based and administrative programs. For example, the LHD sought to improve perinatal health outcomes. They sought to impact this by increasing referrals of high-risk clients to maternal and child health services at the LHD and they accomplished this by partnering with The Department of Social Services and changing processes. The article did not measure the population-level impact, but was able to dramatically increase referral rate. This type of improvement would allow redeployment of those funds for other health initiatives. After years of QI work the authors argue that they have transformed from doing a series of discrete frontline QI projects to having a system wide culture change at an organizational level.

Both of the LHDs who published their individual outcomes with QI emphasized lessons learned and predictors of success for other similar programs. Gunzenhauser et al. (2010)

emphasized the importance of aligning QI activities with the strategic plan for the organization and the development of ongoing processes to continue focusing the QI efforts as improvements are made and teams move from one improvement project to another improvement project . Morrow discussed similar facilitators, but also identified barriers to implementation including inadequate resources, inconsistent buy-in from staff, and low participation in formal QI activities by those in the organization. The authors state that they are still addressing barriers while they make progress to achieving “Big QI” status or organizational change supporting a culture of continuous improvement and accountability Many steps in the transition along this include explicit leadership issues such as changing culture, ‘buy-in’ from senior staff, and empowering front-line workers to take the lead identifying opportunities for improvement and generating and implementing solutions (Morrow et al., 2012).

Descriptions of Individual Local Health Departments Collaborating At a Local Level

Lotstein et al. (2008) published an article on the use of an Institute for Healthcare Improvement Breakthrough collaborative structure, which relies on the Model for Improvement among other tools. They segmented emergency preparedness into three realms: command and control (organizational structures for mobilization and response), disease control and treatment (triage and treatment of illness), and risk communication (dissemination of information to population). Pandemic preparedness is an important function of public health, and directly effects population-health by improving health outcomes in communities during widespread infections or other pandemics. Five LHDs participated in the collaborative and the paper reports on lessons learned and HD staff preparedness for emergencies after the collaborative improvement process. The QI teams focused improvement in three main areas of emergency preparedness including command and control, disease control and treatment, and risk

communication. The QI teams found that measurement of baseline performance in process measures from all three of these areas helped prompt action, and that PDSA cycles were low risk, inexpensive ways to test new changes. Additionally, they emphasized the importance of partnerships with other agencies as a final key indicator of improvement through the process. Their findings mirror those proposed by other authors who have examined the issue of public health emergency preparedness (Seid et al., 2007). Lotstein et al. (2008) note that despite the perception and impressions that the efforts were very successful, they present very little specific data about improved outcomes.

Kotch et al. (1993) describe an LHD collaborative in southwest North Carolina that was supported by the Centers for Disease Control, the State Health Department, and the University of North Carolina School of Public Health (Kotch et al., 1993). The targeted intervention was to reduce prematurity and low birth weight across the participating counties. The group used a management approach to improve these public health outcomes called Performance Based Management System (PBMS). This improvement model is a management strategy to optimize performance by specifying objectives, setting standards to meet those objectives, guiding staff on activities, and then assessing performance by change over time and comparing to regional data. (Kotch et al., 1993). The implementation of this was consistent with other QI processes, using local consumers and recommended practices to develop the intervention, expert opinion and data to inform decision making, continuous feedback, and outcomes focus. Specifically, Kotch et al. (1993) sought to improve staff knowledge about low birth weight. Awareness of low birth weight health problems, awareness of programs, and concern about the health problems and lack of programs all were associated with actual low birth weight rates in these counties. Based on this relationship, the authors sought to improve staff understanding as a mechanism to improve

program utilization which would then impact low birth weight rates. Due to that proposed causal pathway, the results of the paper primarily reported staff-related outcomes, but state that those changes improved rates of prenatal care. They acknowledge a limitation of not measuring and reporting directly on rates of prematurity and low birth weights.

Descriptions of Individual Reports of Local Health Departments Participating in State-wide Collaboratives

Four included studies are written at least in part by authors from a single group, the Center for Public Health Quality. This organization initially was formed as part of the North Carolina Division of Public Health, but has since taken on a more national role across health departments and programs in other states. Two of the articles, describe improvements in LHDs that used formal QI methods while participating in the state-wide improvement system (Harrison et al., 2012; Wright et al., 2012). Both of these projects used the Model for Improvement as an improvement framework, with some infusion of Lean principles, including elimination of waste and Kaizen improvement events. Kaizen events are a focused, often week-long, improvement event. These events include staff and management from the organization and also include outside consultants who all work together to rapidly redesign a process. Harrison et al. (2012) describes the use of QI at a LHD to improve public health preparedness for H1N1 influenza in a county of western North Carolina. Sequential PDSA cycles were used to raise the understanding of the need to create preparedness kits in the community (Harrison et al., 2012). Wright et al. (2012) describe the use of the Model for Improvement to improve breast feeding rates and breast feeding friendly atmosphere within an LHD. The authors describe four new approaches to breast-

feeding promotion: 1) create a nurturing environment at the LHD for breast-feeding, 2) actively telephoning new mothers to support breast feeding, 3) provide gifts and incentives for mothers who attend educational sessions on breast feeding, and 4) finally promote new WIC food packages to mothers. Planned improvements were identified through review of published literature, interviews with mothers who had used the previous program, and discussion with experts in the field. Through a series of PDSA cycles implemented over a period of two years, all of these improvements were realized. The other lessons learned by the authors were that QI programs should build on current areas of strength within the LHD, and to be ready for QI to spread to other areas in the LHD as people become excited about the process and outcomes.

Two articles were written with the assistance of the authors from the Center for Public Health Quality, but describe improvement processes that were not connected to the work at the center. A paper authored by Randolph et al. (2012) met inclusion criteria and elucidated lessons learned from a culture and infrastructure change at a single LHD health department. The primary goals for this project were directed at clinical efficiency and access to individual health services, however the article met inclusion criteria because they also describe public health measures that arose as the QI culture grew throughout the entire organization. According to the authors, within a year of starting formal QI methods and implementation within the clinic, the culture of QI spread to WIC (Women, Infants, and Children nutrition program) and oral health screening programs. Additionally, the LHD became a leader in the local community and helped spread a QI approach to aligned community partners such as child care and Head Start programs. The specific lessons cited by the authors included:

- learning about the importance of setting stretch goals, or goals that require the organization to extend beyond current capabilities to be achieved,

- engaging leaders through the organization,
- empowering frontline people to make changes,
- starting with small projects, and sustaining momentum by creating infrastructure and support for continuous QI. An example is the development of a QI Council that reviews individual project proposals, assists with implementation and reviews organizational performance measures.

The final article by Ramaswamy et al. (2012) describes interventions in 3 LHDs to pilot a potential statewide change in the implementation of environmental health processes. The authors developed process maps for responding to community concerns or cases that are brought forward and community outreach in various areas of environmental health such as mold complaints, disease outbreaks, and tanning facility inspection. After process mapping occurred, the authors attempted to identify redundancy and waste. Process mapping is a step in formal QI methodologies such as Lean, and the intent was for this effort to eventually standardize processes through the state. Outcomes of the interventions related to environmental health were not measured for this study (Ramaswamy et al., 2012).

QI Story Boards and Public Health Improvement

The Multi-State Learning Collaborative encouraged LHDs to submit QI Storyboards to document and advertise the improvements that occurred as a result of their participation. These story boards were published by the NNPHI and were reviewed as part of this paper. One hundred and fifty-four QI storyboards were reviewed and 138 were included for analysis. The 16 excluded storyboards either described state health department programs (n=6) or described clinic-based QI interventions such as reducing cycle times or improving access to clinic visits

(n=10). Among the other studies, 117 of the storyboards clearly described using PDSA cycles to improve population health targets. Twenty-one of the storyboards stated that they used a formal QI process, but did not clearly describe their improvement method. However, the Multi-state Learning Collaborative used the PDSA Method as their main methodology, and in line with that, none of the included storyboards described use of a Lean (waste elimination) or Six Sigma (defect reduction) approach to improvement. There was one excluded storyboard that included Lean as part of the improvement methodology in addition to PDSA.

The health programs that were targeted for improvement in the storyboards are depicted in Table 2. The most common area for intervention was internal HD activities or activities that would affect overall HD performance. Examples of this included improved communication with the community and setting goals within the HD. Though it can be difficult to see the direct connection between administrative processes and public health interventions, this type of change and improvement has the potential to improve all LHD operations, including the effectiveness of population-health initiatives. The second most common initiative with health program impact was nutrition/obesity/activity levels, followed by pre- and perinatal interventions.

Table 2. Health department population health areas impacted by described QI Story

Boards

Health Program Area	Number	Example of Aims
LHD Functions	47	Increase community awareness of services, increase retention of public health nurses, improve reporting of public health indicators
Nutrition/Obesity/Activity	43	Increase fitness programs in elementary schools, increase childhood exercise in schools, decrease calorie consumption in schools, weight loss
Pre and Perinatal Health	16	Reduce barriers to prenatal care for high risk populations, increase program utilization among multiparous women
Tobacco Cessation	14	Increase number of smoke-free workplaces, reduce population rates of tobacco use
Immunizations	10	Standardize processes for identifying children who are missing immunizations, partner with childcare facilities
Breastfeeding	3	Increase rate of receiving breastfeeding education, increase ‘Baby Friendly’ hospital designation
Food safety assessment	2	Standardize food safety assessments in the community, improve food safety knowledge
Sexually transmitted infections	1	Reduce cases of syphilis

*6 Story boards included both tobacco and physical activity improvements.

Extended Literature Review

There were a few key articles that did not meet inclusion criteria, but did provide important information to inform the knowledge of QI in LHDs seeking to improve population health interventions. One of these articles is by Dilley, Bekemeier, and Harris (2012), who completed a systematic review focused on QI interventions in public health. A few critical differences emerged between their review and the current review. First of all, they included studies with QI programs implemented at any level within the U.S. public health system, so

state-wide or regional interventions were included. The authors of the article identified a series of common steps for QI work in public health including:

- ‘process mapping’ early in the QI cycle
- engagement of top level leadership
- inclusion of participants from outside of the organization
- forming a clear QI question to be answered
- use of data that is collected from a wide variety of sources to assess the success of an intervention

These themes overlap with the lessons learned and discussed in many of the studies included in this current paper (Lotstein et al., 2008; Randolph et al., 2012; Wright et al., 2012) Dilley et al. (2012) also evaluated the length of time included in the published QI literature in public health interventions. The published literature included follow-up times from 5 months to 10 years after initiation of the QI intervention. Another difference between the systematic review by Dilley et al. (2012) and this paper is that Dilley did not include information published online or in alternate formats. Inclusion of the QI storyboards and improvement stories published as part of a large collaborative or after meetings could broaden the perspectives on QI in LHDs by including authors and LHDs that would not seek out peer-reviewed publication.

Joly, Booth, Shaler, and Conway (2012) from Southern Maine School of Public Service reported facilitators of collaborative QI networks in public health. This paper was based on the Multi-State Learning Collaborative that was funded by the Robert Wood Johnson Foundation and the source of the previously discussed QI storyboards. Based on interviews carried out

toward the end of the collaborative, 11 factors were identified to as relevant to the success of QI public health collaboratives. These factors were:

- advanced planning efforts
- selection of qualified faculty
- timely and skill-based training and assistance
- engagement and commitment of senior leaders
- application of evidence to achieve desired change
- adoption of a credible improvement model
- evaluation of efforts and outcomes
- articulation of clear roles and goals
- availability of resources to implement small scale change
- selection of target areas
- previous QI experience.

Quality improvement work is often effectively completed in learning or improvement collaboratives. These results will be informative to future collaboratives, who should attempt to assure that as many of these factors are in place prior to initiation. This learning collaborative went on to study transformation of QI implementation and staff self-efficacy in these states and LHDs in a sister study(Joly, Booth, Shaler, & Mittal, 2012). Surveys were conducted by participating sites and control sites at various points during the study to measure progress in the number of LHDs that implemented QI strategies. Participating sites were much more likely to participate in QI, have culture change within the organization to improve the atmosphere for QI work, and increased QI competence (Joly, Booth, Shaler, & Mittal, 2012). They dubbed the tool to measure these variables the ‘QI maturity tool’. These paired studies, though not included in

the systematic review criteria, reinforce that certain factors likely predict the success of QI collaboratives and demonstrate that when funding is adequate and other facilitators are in place, collaborative relationships among LHDs can increase QI use, competence and QI maturity within LHDs.

Synthesis of Published Studies

Table 1 summarizes the published studies on QI in public health and also helps with synthesis of information from the studies. A disproportionate number of the studies either were related to a North Carolina program called the Center for Public Health Quality or by a limited set of authors (Harrison et al., 2012; Morrow et al., 2012; Ramaswamy et al., 2012; Randolph et al., 2012; Wright et al., 2012). All of the authors report that the programs were successful, which makes it likely that a publication bias exists towards positive results in public health QI reporting, similar to such biases in other fields (Dickersin, 1990). Despite this claim by authors, many of the articles report only intermediate outcomes such as staff satisfaction instead of patient/client-centered outcomes that directly measure the health of the public. For example, the published studies by Harrison et al. (2012) and Lotstein et al. (2008) could potentially measure actual influenza infection rates in the community. Most articles addressed lessons learned.

Upon review the following lessons were consistently identified:

1. Clarify processes early in the improvement cycle
2. Measure outcomes
3. Support the quick spread of QI to other areas of the organization
4. Involve staff in the process and changes

5. Obtain QI expertise as it is helpful and necessary for success. Organizations either paired external experts with those in the LHD or used a training model where LHD staff were taught and then implemented after the experts had finished.

These factors from the published literature included in the review are similar to those included in lessons learned from the Multi-State Learning Collaborative and also similar to those synthesized in the work by Dilley et al. (2012). All three areas emphasized using data or measuring outcomes. Additionally, lessons learned in all three reinforced the importance of using structured QI methods, potentially including the use of outside QI consultants to come build local skills in QI methods. Interestingly, the synthesis of the published studies in this study emphasized involving staff and those working in the LHDs in the process from the beginning of the cycle. However, the study by Joly, Booth, Shaler, and Mittal (2012) which summarized the Multi-State Learning Collaborative and the study by Dilley et al. (2012) emphasized engaging high-level leaders in the QI efforts. This difference likely emphasizes the importance of communication broadly across the LHD and assuring that there is alignment at all levels of the organization.

Discussion

The use of formal QI methodology is becoming common in LHDs (Randolph & Lea, 2012). However, there are very few peer-reviewed published data describing these methods and how effectively they are being employed, including their outcomes. The available evidence largely focuses on a single QI implementation program in North Carolina that has been used to spread QI knowledge and processes to local HDs throughout the state. However, not all articles were from NC, in fact publications described QI successes from Los Angeles to New York to the

rural South. This paper identified factors for success and lessons-learned including the need to clarify processes and identify outcomes with measures, that QI can spread quickly to other areas of the HD when there are early successes and organizational alignment, and that despite the need to formally involve members of the HD in the process, specific QI expertise was also necessary and helpful.

There are definite limitations of the published literature about QI in LHDs that were included. The inclusion criteria were that the intervention used a formalized QI methodology and that the QI intervention addressed a process that was not in clinic or solely a clinical program. Particularly, the published studies addressed population-based health programs and also administrative processes within LHDs. First of all, only positive studies have been published to date. This makes it highly likely that when programs fail to work people tend not to write about them or submit the work for publication. So, for example, the successful and published case reports may represent situations where dynamic leaders drove change and the results may not be readily duplicated in other settings. The external validity of this may not be high since it was dependent on the ability of certain leaders. It is highly likely that the LHDs that publicly report results, such as those included in this paper, are more likely to have positive studies and may have a systematic bias either toward or against becoming a more successful LHD overall. This potential bias has not been studied in a systematic way; however, the possibility of bias is present though the direction of the bias may be unclear. Although the published series represents multiple regions, sizes and settings for LHDs, the number of studies is so small that it is difficult to have high confidence in the external validity. Despite the geographic and size diversity, none of the studies included an experimental or quasi-experimental design with randomization or control groups. Additionally, the included studies

represented a broad range of publication dates which may not all be applicable to the current atmosphere of public health. The included time periods involved a wide variety of issues in public health and crossed a variety of improvement theories from PBMS to Lean. Hence, summarizing positive outcomes across times and methods may ‘collapse’ across a variety of conditions which could limit the internal validity of the data synthesis.

Overall, the literature on QI for public health population-based and other non-clinical interventions is inadequate to inform the increasing spread of QI across health departments. As accreditation of LHDs becomes a standard, QI methods will become more widely used and expected. However, this transmission and implementation should be based on a solid evidence base to assure that limited resources are used effectively. The use of QI for clinic-based interventions can borrow an evidence base of experiences from similar industries such as hospital and private clinics. However, the use of QI for population-based interventions or other non-clinical interventions specific to LHDs may be more unique within public health. For this reason, the burden is on public health practitioners, academia, and QI experts to partner and establish a fundamental knowledge base of best practice or evidence-based processes for methodology, implementation and outcomes. The MFI has demonstrated efficacy in multiple setting in healthcare, public health, and other industries. Additionally, t another body of literature exists based on use of the PDCA or PDSA method advocated by the Public Health Foundation. This methodology shares the use of rapid cycle improvement and PDSA cycles with MFI. Since these methods have been consistently demonstrated to work, further research to ‘prove’ these methods are likely not a high research priority. However, randomized or other controlled trials comparing one method to another in real settings would greatly add both to the knowledge about optimal strategies in improving public health, as well as a better understanding of when one

method should be used instead of another. Higher priority questions for the next stage of research in this area are whether Six Sigma and Lean can be applied to population-based interventions or other non-clinical LHD interventions, how to engage communities in QI efforts in LHDs, and the use of direct measures of population health as outcomes.

The review of story boards published online was presented in order to provide a broader overview of QI methods being used in LHDs and to supplement the limitations in the peer-reviewed and published literature. The story boards do provide a snap-shot of topics that are actively being addressed by engaged LHDs across the country. However, individually they are subject to high degrees of bias in reporting and lack of external validity or the ability to apply the results on that sample to the larger population. (Lang, 2006) As a group, the published storyboards do explicitly demonstrate that the most commonly used improvement methodology in LHDs currently is PDSA technique and secondarily the MFI. Additionally, they provide evidence that these efforts are spread through a variety of population based initiatives which can potentially improve overall health quality at a population level.

Conclusions and Recommendations

In summary, a number of LHDs are using PDSA as a formal QI method to improve programs that address population health. The interventions that are published generally describe local experience and lessons learned during implementation of a QI process in single or across multiple HDs. An overall assessment of the available literature and reports is that QI, when implemented, is well-liked in LHDs and effective at improving knowledge and processes, though most do not report on actual achievement of public health outcomes based on public health services. Future research will likely employ control groups and random assignment of

interventions, in addition to measuring public health outcomes instead of staff perceptions or other process and intermediate outcome measures. Presently, the overall peer-reviewed literature of QI use in LHDs is inadequate and future research of QI in LHDs should seek to broaden the range of tools that can be used and increase the confidence in using QI methods to address nonclinical issues. With QI established as an effective methodology in numerous fields, including healthcare, the future research should not need to focus greatly on testing the effectiveness of QI methodology, but study how, which methods, under what conditions, and other specific QI implementation questions. The limited published experience summarized in this paper combined with the inclusion of QI in accreditation standards for HDs will lead to increasing use of QI methods, which could facilitate the generation of better evidence and implementation guidance.

Recommendations for next steps include structuring methodologically rigorous QI research in LHDs examining outcomes in population health. These projects should be informed by the increasing understanding of how to conduct research in QI (Davidoff, Batalden, Stevens, Ogrinc, & Mooney, 2008), but also not distract from the core intent which is to improve systems, processes and outcomes. Accordingly, important outcomes should be directly measured to assure that invested resources are producing the intended changes in the health of the population.

For practitioners making changes using QI in LHDs, implementation of QI cannot wait for formal research methods and published results. Implementation of improvement should be informed by this paper and the synthesis of the current literature. Successful non-clinical population health QI efforts have been effectively used to clarify processes early in the improvement cycle using tools such as process mapping, an important step to identifying gaps in performance and linking processes to outcomes. Outcomes should be directly measured and

reportedly frequently. Involvement of everyone in the LHD, or at least representatives from all parts of the organization, is important, and can help facilitate spread of QI to other areas of the LHD. Finally, working in collaborations and groups may both facilitate change and also allow the use of consultants or local experts with specific QI expertise.

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