

Quality Improvement Collaborative for Preterm Infants in Healthcare Facilities

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Across all healthcare settings, it is important not only to provide safe and effective healthcare, but also to ensure that it is timely, patient-centered, efficient and equitable. There is a wide variability in neonatal and perinatal outcomes in India and other developing countries, with certain units demonstrating clinical outcomes that match the developed world, while others showing higher than expected mortality and morbidity. Collaborative quality improvement initiatives offer a pragmatic way to improve performance of healthcare delivery within and between neonatal units. Variations in application of evidence-based healthcare process and dependent health outcomes can be identified and targeted for improvement in quality improvement cycles. We herein describe the concept of Collaborative quality improvement, and the success stories of the best-known Collaborative quality improvement initiatives across the world. We also highlight the process and progress of creating Collaborative quality improvement in our country.

Keywords: Evidence-based medicine, Neonatal intensive care unit, Outcome, PDSA cycle.

Quality improvement (QI) in healthcare is “the combined and unceasing effort of everyone – healthcare professionals, patients and their families, researchers, payers, planners and educators – to make the changes that will lead to better patient outcomes (health), better system performance (care) and better professional development (learning)” [1]. At the core of this QI is orienting healthcare towards patient needs or meeting their unmet needs. In the neonatal intensive care unit (NICU), patient would include both the infant and his/her parents.

Evidence-based medicine (EBM) is all about promoting ‘practices that work, while eliminating those that are ineffective or harmful’ [2]. There is always this challenge of implementing what we know from research to what we do in clinical practice [3]. An important step in the practice of EBM is to evaluate one’s own performance. This is where quality improvement provides a framework to the clinicians to provide best possible care for their patients. Taking cues from other sectors like aviation and nuclear industry, high reliability and safety culture concepts are now being applied to the NICU environment also. But the outcomes measured should not be simply life or death but rather what the family and infant experience over long-term because of the time spent in the NICU. Considerations of the lifetime outcomes have shown to improve care for patients and are the most important measures to collect [4].

With rapid advancements in neonatal care and interventions like antenatal steroids, non-invasive respiratory support and surfactant, survival and morbidities of preterm infants have improved significantly [5-7]. In both developed and developing countries, it is important not only to provide safe and effective health care, but also care which is timely, patient-centered, efficient and equitable. Each of these six dimensions of quality defined by the Institute of Medicine in its landmark report can be measured and prioritized as outcomes to be improved using the QI framework [8]. There is often wide variability between healthcare facilities for all these outcomes. Some units achieve outcomes that can be benchmarked, while others may still be at the bottom of the ladder. Some of the variation can be attributed to the gap between the recommended and available infrastructure, monetary resources and personnel, which can be improved by forming a network of secondary- and tertiary-care neonatal units so that they can learn from each other on how to improve outcomes with more effective utilization of available resources [9].

Collaborative QI project involves a group of professionals from a single or multiple organization who get together to learn from one another, support and motivate each other in a structured approach with the intent of improving quality of health services. The underlying concept is that teams learn faster and are more

effective in implementing and spreading improvement ideas and assessing their own progress when collaborating and benchmarking with each other. Collaborative initiatives provide an unique opportunity to look into various clinical practices, outcomes and healthcare costs across different participating units, which are operating in similar demographic and economic conditions. Benchmarking these variations in clinical practices and outcomes is a powerful motivator for participating teams to improve many outcomes, as it represents what has been achieved locally by one's peers [10].

Collaborative QI methodology was started in North America in the late 1980s (New England Cardiovascular Disease Study Group, 1986 and Vermont Oxford Network, 1988) with the approach becoming more popular as the Breakthrough Series by the Institute for Healthcare Improvement (IHI) in 1995. Neonatal collaborative QI (**Web Table I**) [11-18] projects have ranged from collaborative working to improve the administration of antenatal steroids to eligible mothers to compliance with transfusion guidelines [19, 20].

COLLABORATIVE LEARNING

The core concepts of a quality improvement collaborative include (**Web Fig. 1**) [21, 22]:

- An improvement collaborative is a shared learning activity that brings a large number of teams from different sites to work together to gain rapid achievements in processes, quality and efficiency in a specific area of care (*e.g.*, improve breastfeeding rates, reduce Hospital Acquired Infections) during a defined time period.
- Essential components of any collaborative QI are [23]: Identifying specific topic or agenda; Stakeholders or participants include multi-disciplinary teams from different centers; Clinical and QI experts to support participant teams; Model for improvement: Plan and test changes; and Series of structured learning activities over a pre-defined time period.
- At the outset of starting a collaborative QI is the identification of a common agenda, where good evidence exists on best practices and has a potential to improve patient-and system-outcomes. Well defined agenda ensure participating groups understand their own processes, outcomes and try to ensure closure of gap between existing and best practices.
- Organizational structure of Collaborative QI usually has two wings namely data and quality improvement. Administration is run by an executive committee that develops and prioritizes strategic plan. Subcommittee on collaborative quality improvement analyze data and address priority areas of quality improvement. Person in charge of administrative, data and quality improvement oversee day-to-day operations [24].
- Developing implementation packages in QI for individual units includes creating toolkits, webcasts, workshops and academic presentations on identified areas of quality improvement and disseminating the knowledge amongst the individual unit stake holders after identifying a local champion.
- Clinical practices that are evidence based, practices in places that are good or best and adaptations that lead to improved care are shared among the participating centers. These practices and processes form the implementation packages of a collaborative QI.
- Participation is voluntary and include multidisciplinary team of doctors, nursing staff and non-clinical members from different organization. Usually each team has 2-8 members.
- The participating sites work out and test ways to put in practice the concepts included in the implementation package and work to overcome barriers to make them work in their local settings.
- Participating teams collect a set of core indicators that define the common outcome indicators and shared process indicators. The process indicators guide the quality of the care processes the teams are trying to improve and the achievement of desired health outcomes.
- Participant teams are guided and supported by clinical and QI experts who also act as facilitators and provide technical ideas on clinical and quality improvement strategies.
- Teams test changes by applying an improvement or change model. In any improvement model an intervention is introduced, and one or more indicators are monitored and measured to see the effect of the intervention on the desired outcome. Many improvement models have been implemented using the Model for Improvement advocated by the Institute for Healthcare Improvement (IHI) (**Fig. 1**). Most commonly, practice changes in NICUs are tested using the Rapid Cycle Model, which involves a series of Plan-Do-Study-Act (PDSA) cycles [25]. In each cycle, a small change is planned and tested, the outcomes of the process are monitored and evaluated, and then further changes are made.
- An intervention that is successful in improving the

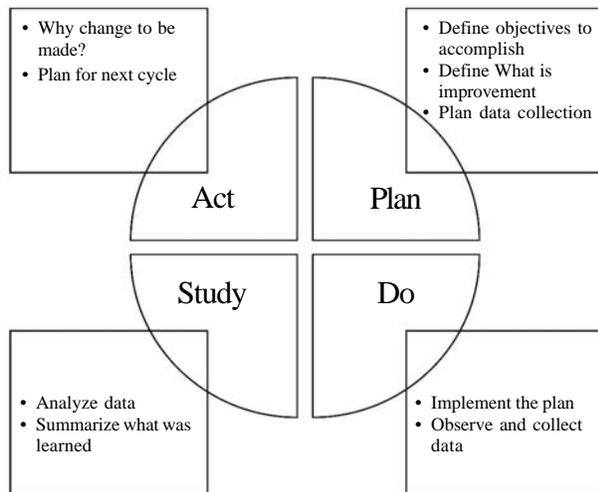


FIG. 1 PDSA model (Adopted from IHI white paper) [22].

process is adopted and if the intervention leads to failure it is either adapted or abandoned. The change ideas are shared among the participating centers on a regular basis leading to a faster QI process, decreasing wastage in systems and saving cost.

- Shared learning is the most distinct differentiating feature of improvement collaborative from a traditional QI method. Multiple teams try improvements in same topic area. The teams test and implement process redesigns and changes and share their experiences in doing so. This facilitates shared learning of test changes that are both successful and unsuccessful. Frequent monitoring of process and outcome indicators and sharing of test changes help to spur the pace of improvement and creates a friendly competition among the participating teams. The network of shared learning results in rapid development and testing of innovations to solve problems, rapid dissemination of effective changes, and rapid development of effective models of care, enhancing the original implementation package of evidence-based standards with operational learning. Shared learning may also involve communication of results by coaches who visit multiple teams, use of a Web site where data and experiences are posted, telephone calls, smaller meetings of representatives from all QI teams together [21].
- Typically, collaborative QI projects run for 9-18 months; launched with an initial shared learning session of 2 days, where all participants teach and learn. This session includes sharing the aim, defining changes, measures and outcomes. Also, the participants develop action plans. In addition,

monthly conference or video call is done to review data reports on strategies, changes and learning. Feedback and coaching from reports is done once or twice per month for all. Two to three learning sessions are done separated over duration of few months, wherein participating units freely exchange ideas, share strategies employed to overcome obstacles and create an environment of tactic competition. Three to six months after the conclusion of collaborative QI project, a shared learning session is conducted to sustain the improvements gained [24].

Another distinct feature of a collaborative is to spread the improvement beyond the initial teams to larger organizations and regions and countries. A collaborative usually concludes with a final package of interventions that have been field-tested and proven to yield results in a particular setting complemented by a set of organizational learning that facilitates achieving those results. Dissemination of information gathered from Collaborative QI activities through online tools such as CNN-EPIQ's Virtual Research Community, the VON's NICQ pedia or Pediatrix's Quality Steps system, Pediatrix-University Web site and so on widen the scale of implementation packages across clinical settings [13,26]. Collaborative QI offers a pragmatic way to improve performance of healthcare delivery both at hospital and community level. The power of collaborative research lies in multiple centers performing the same project locally and submitting their results to a coordinating team. The sample size is therefore bigger, and the results are more generalizable [27].

CHALLENGES IN IMPLEMENTATION OF A QI COLLABORATIVE [22,28]

Current review of evidence suggests that success of running a quality improvement collaborative depends on following factors.

- Participating teams which consist of multi-professionals, like nursing staff are more likely to implement process changes.
- Administrative and leadership support at participating units in fostering a culture of quality improvement.
- Geographical span of participating units might influence success of collaboratives, even though evidence on comparative efficacy of regional *versus* national collaboratives is lacking.
- Nature of participating centers influences success of collaborative, if all are of similar nature like (tertiary or primary care), then there is more probability of completing collaborative.

- Availability of continuous and reliable quality data on measurement of practices and change is another bottleneck in the implementation of collaborative QI, maintaining data quality. Legal and ethical framework regarding data sharing and public display of collaborative QI data needs to be addressed clearly.
- Not enough evidence to suggest if one particular method of contact (physical *versus* online or email) between the participating centers has influence on collaborative successes.
- Challenges to health care organization include convincing people involved in owning up problem solving, aligning regional quality improvement priorities with those of individual centers and getting data collection and monitoring systems right. Organizational barriers can be technical, structural, psychosocial, managerial, and related to goals and values [29].
- Sustaining the results of Collaborative Quality Improvement efforts can be particularly challenging and requires systematic, thoughtful planning and action to ensure that the changes result in permanent work culture improvement [14].

An Example of Collaborative Quality Improvement in India

In 2012, a Neonatal collaborative consisting of six of the best public and private neonatal intensive care units in the country came together to decrease Healthcare-associated infections. ACCESS Health International facilitated this with technical assistance from the Institute for Healthcare Improvement. The collaborative objective was to decrease healthcare associated infections (HAIs) by transparently comparing outcomes, sharing best practices, testing changes for resolving barriers identified by application of problem analysis tools and acceleration of improvement by learning from each other. Several changes were done to decrease incidence of HAIs by increasing the reliability of processes like hand hygiene, aseptic insertion and maintenance of peripheral and central venous line, aseptic preparation of parenteral nutrition and intravenous fluids. The participating hospitals met once every 6 months over a period of 18 months for learning sessions. The first meeting provided an opportunity for all the clinical leaders to agree upon operational definitions of the outcome, process measures and capability was built on quality improvement methods and tools. This helped create a standardized surveillance mechanism for recording healthcare associated infections. Across all six hospitals, data was collected along with testing of changes over a period of 12 months. Four out of six hospitals continued the surveillance

mechanism and improvement activity even after the collaborative ended, demonstrating the sustainability of the intervention. The hospital with the highest incidence of healthcare associated infections showed the maximum improvement with more than 50% reduction from baseline in both microbiological and clinical blood stream infections per 1000 patient days. The collaborative approach with adoption of shared practices, strong engagement of clinical leaders, and utilization of data were thought to be key reasons for this improvement. The results of this collaborative led to the scale up of QI work across two Indian states as the Safe Care Saving Lives project [30].

SCOPE FOR INDIAN COLLABORATIVE

Below mentioned are examples of Indian collaboratives where data was collected and variation in outcome and clinical practices were measured in NICUs across the country. They can form the basis of future collaborative QI by shared learning.

National Neonatal Perinatal Database Network (NNPD): Over a time period of 1995-2003, data collected for about 200,000 neonates across various NICUs in India showed improved neonatal outcomes over three different time periods, probably attributed to improved care practices. Across NICUs from a similar geographical area and having similar disease burden, mortality and morbidity outcomes varied. This is ideal platform for planning QI collaborative across different health care practices and outcomes.

VLBW Infant Survival in Hospitals of India (VISHI): In a more recent collaborative work across India, 11 different level 3 NICU units collaborated for over a period of one year. In this collaborative effort, outcomes of VLBW infants admitted across different NICUs were studied. Standardized neonatal mortality rates varied across different neonatal centers, thus emphasizing the need to start QI collaborative practice to reduce variability in clinical practice responsible for varied outcomes [31].

Indian Neonatal Collaborative (INNC): A group of hospitals led by PGIMER, Chandigarh have created a database platform for collecting data on neonatal quality indicators and processes. Nearly 12 centers are contributing data to this online database. Centers with at least 100 VLBW admissions per annum are eligible for this collaborative. The live reporting of quality indicators on a dashboard from this database would form a platform for network centers to initiate unit based and collaborative improvement projects [32].

All collaborative or networking initiatives in our country have so far collected invaluable data on neonatal

Box I THE FUTURE DIRECTIONS FOR QUALITY IMPROVEMENT IN HEALTHCARE OF PRETERM*

- Including parents of infants in the implementation of QI collaborative projects, this will achieve true multidisciplinary nature of teams.
- QI should be a part of medical curriculum, thus inculcating the culture of collaborative QI very early in to the day to day life of future lead clinicians and administrators.
- Research should focus on determining effectiveness of different approaches of collaborative like 'breakthrough' versus 'communities of practice'.
- Collaboratives are very intense in terms of manpower and cost, hence there is a need to determine their cost effectiveness in long term.

*From reference 22.

survival, morbidities across the country. Going beyond passive data collection, a road map needs to be put in place to establish collaboratives across the length and breadth of the country to address pertaining problems of VLBW outcomes, antibiotic resistance, birth asphyxia and many more. Initially providers need to be identified who are passionate and knowledgeable about QI. For any quality initiative to succeed the clinical team must be enthusiastic about improving, transparent and honest in sharing data, and willing to learn and make practice changes to support improvement. Ultimately collaborative QI needs to be integrated in day-to-day work culture (**Box 1**).

In our country, identifying and creating QI teams at service delivery or unit level will form the first step in starting collaborative QI projects. QI team members will work together to understand their local priorities at unit level, analyze their processes, test and implement changes to improve performance, and monitor results. Such QI teams can then be connected to create a platform to share results, innovations, and challenges and to learn from one another. Sharing outcome variations and clinical challenges in different NICU units, will avoid duplication of efforts in solving problems and provide an opportunity to improve service delivery. Hand holding or 'coaching' will ensure that QI teams function optimally, possessing knowledge and skills in both technical content related to the improvement objectives and quality improvement tools.

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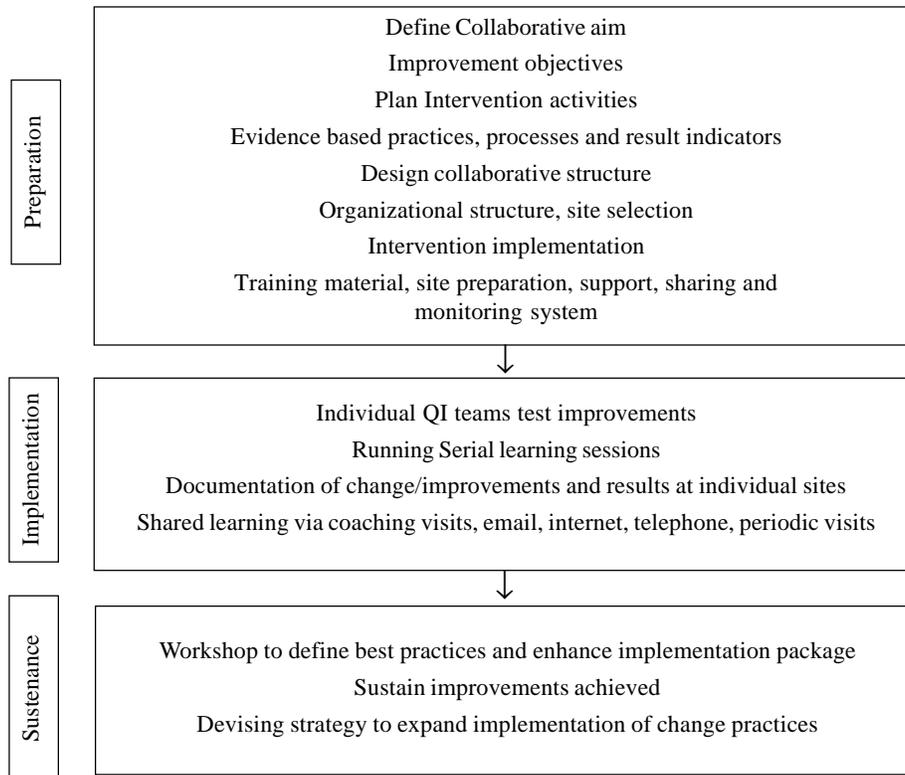
REFERENCES

1. Batalden PB, Davidoff F. What is "quality improvement" and how can it transform healthcare? *Qual Saf Health Care.* 2007;16:2-3.
2. Soll RF. Evaluating the medical evidence for quality improvement. *Clin Perinatol.* 2010;37:11-28.
3. Glasziou P, Ogrinc G, Goodman S. Can evidence-based medicine and clinical quality improvement learn from each other? *BMJ Qual Saf.* 2011;20:i13-17.
4. Porter ME. What is value in health care? *N Engl J Med.* 2010;363:2477-81.
5. National Neonatology Forum: Report 1995: National Neonatal Perinatal Database network. New Delhi: 1996.
6. National Neonatology Forum: National Neonatal Perinatal Database. Report of the year 2000. New Delhi, 2001.
7. National Neonatology Forum: National neonatal perinatal report of the year 2002. New Delhi, 2005.
8. Institute of Medicine (US) Committee on Quality of Health Care in America. *Crossing the Quality Chasm: A New Health System for the 21st Century.* Washington (DC): National Academies Press (US); 2001. Available from: www.ncbi.nlm.nih.gov/books/NBK222274/. Accessed April 18, 2018.
9. Lasswell SM, Barfield WD, Rochat RW, Blackmon L. Perinatal regionalization for very low-birth-weight and very preterm infants: A meta-analysis. *JAMA.* 2010;304:992-1000.
10. Schouten LMT, Hulscher MEJL, van Everdingen JJE, Huijsman R, Grol RPTM. Evidence for the impact of quality improvement collaboratives: Systematic review. *BMJ.* 2008;336:1491-4.
11. Horbar JD, Rogowski J, Plsek PE, Delmore P, Edwards WH, Hocker J, *et al.* Collaborative quality improvement for neonatal intensive care. NIC/Q Project Investigators of the Vermont Oxford Network. *Pediatrics.* 2001;107:14-22.
12. Payne NR, Finkelstein MJ, Liu M, Kaempf JW, Sharek PJ, Olsen S. NICU practices and outcomes associated with 9 years of quality improvement collaboratives. *Pediatrics.* 2010;125:437-46.
13. Walsh M, Lupton A, Kazzi SN, Engle WA, Yao Q, Rasmussen M, *et al.* A cluster-randomized trial of benchmarking and multimodal quality improvement to improve rates of survival free of bronchopulmonary dysplasia for infants with birth weights of less than 1250 grams. *Pediatrics.* 2007;119:876-90.
14. Lee SK, Aziz K, Singhal N, Cronin CM, James A, Lee DSC, *et al.* Improving the quality of care for infants: A cluster randomized controlled trial. *CMAJ Can Med Assoc J J Assoc Medicale Can.* 2009;181:469-76.
15. Lee HC, Kurtin PS, Wight NE, Chance K, Cucinotta-Fobes

- T, Hanson-Timpson TA, *et al.* A quality improvement project to increase breast milk use in very low birth weight infants. *Pediatrics*. 2012;130:e1679-87.
16. Ozawa M, Yokoo K, Funaba Y, Fukushima S, Fukuhara R, Uchida M, *et al.* A quality improvement collaborative program for neonatal pain management in Japan. *Adv Neonatal Care*. 2017;17:184-91.
 17. Spence K, Henderson-Smart D. Closing the evidence-practice gap for newborn pain using clinical networks. *J Paediatr Child Health*. 2011;47:92-8.
 18. Johnston AM, Bullock CE, Graham JE, Reilly MC, Rocha C, Hoopes RD, *et al.* Implementation and case-study results of potentially better practices for family-centered care: The family-centered care map. *Pediatrics*. 2006;118:S108-14.
 19. Baer VL, Henry E, Lambert DK, Stoddard RA, Wiedmeier SE, Eggert LD, *et al.* Implementing a program to improve compliance with neonatal intensive care unit transfusion guidelines was accompanied by a reduction in transfusion rate: A pre-post analysis within a multihospital health care system. *Transfusion (Paris)*. 2011;51:264-9.
 20. Lee HC, Lyndon A, Blumenfeld YJ, Dudley RA, Gould JB. Antenatal steroid administration for premature neonates in California. *Obstet Gynecol*. 2011;117:603-9.
 21. The_improvement_collaborative. Available from: https://www.usaidassist.org/sites/assist/files/the_improvement_collaborative.june08.pdf. Accessed May 29, 2018.
 22. IHI Breakthrough Series whitepaper 2003. Available from: http://www.ncpc.org.uk/sites/default/files/Anita_IHI_BreakthroughSerieswhitepaper2003.pdf. Accessed April 18, 2018.
 23. Improvement Collaboratives in Healthcare. Available from: https://www.health.org.uk/sites/health/files/Improvement_CollaborativesInHealthcare.pdf. Accessed June 15, 2018.
 24. Gould JB. The role of regional collaboratives: the California Perinatal Quality Care Collaborative model. *Clin Perinatol*. 2010;37:71-86.
 25. Langley GL, Moen R, Nolan KM, Nolan TW, Norman CL, Provost LP. *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance*. 2nd ed. San Francisco, California, USA: Jossey-Bass Publishers; 2009.
 26. Lee SK, McMillan DD, Ohlsson A, Pendray M, Synnes A, Whyte R, *et al.* Variations in practice and outcomes in the Canadian NICU network: 1996-1997. *Pediatrics*. 2000;106:1070-9.
 27. Kilo CM. Improving care through collaboration. *Pediatrics*. 1999;103:384-93.
 28. Wells S, Tamir O, Gray J, Naidoo D, Bekhit M, Goldmann D. Are quality improvement collaboratives effective? A systematic review. *BMJ Qual Saf*. 2018;27:226-40.
 29. Ziegenfuss JT. Organizational barriers to quality improvement in medical and health care organizations. *Qual Assur Util Rev*. 1991;6:115-22.
 30. Safe Care, Saving Lives. ACCESS Health Int. Available from: <http://accessh.org/project/safe-care-saving-lives/>. Accessed April 18, 2018.
 31. Investigators VIS in H of I (VISHI) S, Murki S, Kumar N, Chawla D, Bansal A, Mehta A, *et al.* Variability in Survival of Very Low Birth Weight Neonates in Hospitals of India. *Indian J Pediatr*. 2015;82:565-7.
 32. Indian Neonatal Collaborative. Available from: <https://inncc.org/>. Accessed April 18, 2018.
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WEB TABLE I QUALITY IMPROVEMENT COLLABORATIVE PROJECTS WORLDWIDE

<i>Study Topic</i>	<i>Network</i>	<i>Year and author</i>	<i>Type of study</i>	<i>Outcome</i>	<i>Comments</i>
Nosocomial Infection	VON	2001, Horbar [11]	Pre and post; Infection care bundles	Decreased CONS Sepsis	Decreased oxygen administration
BPD- 9 years analysis of QI	VON	2010, Payne [12]	Pre and post	Similar BPD rates. Decreased delivery room intubation, conventional ventilation and postnatal steroids and increased use of CPAP	Improvement sustained
BPD	NICHD-NRN	2007, Walsh [13]	Cluster RCT	No changes in BPD	Decreased Mechanical ventilation
BPD and nosocomial infection	CNN-EPIQ	2009, Lee [14]	Cluster RCT	Decreased BPD and infection	
Breast milk usage	CPQCC	2012, Lee [15]	Pre and post	Increased Breast milk usage and Decreased NEC rates	Sustained improvement for six months
Pain	NRNJ	2017, Mio ozawa [16]	Pre and Post	Better pain management across seven centers	Objective electronic capture of pain record
Pain	AZNN	2011, Henderson Smart [17]	Pre and post	Improved pain care practice	Use of breast milk or sucrose for pain relief
Family centered care	VON	2006, Jhonston [18]	Pre and post	Shorter hospital stay and better growth in babies at discharge	Improved family satisfaction



WEB FIG. 1 *Improvement Collaborative Model (Adopted from IHI Breakthrough Series White Paper 2003).*