

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

**Abstract**

**Background:** Collaborative Quality Improvement (QI) is an organized, multifaceted approach in healthcare where teams come together to share improvement methods, ideas, and data using standardized methodologies. Evidenced-based Practice for Improving Quality (EPIQ), a method adopted by the Canadian Neonatal Network, led to decreased mortality and morbidity in very preterm infants. The Alberta Quality Collaborative Quality Improvement (ABC-QI) trial aims to evaluate the impact of EPIQ collaborative QI strategies in moderate and late preterm infants (MLPIs) in Alberta, Canada.

**Methods:** A multi-centre, stepped-wedge cluster randomized trial involving 12 NICUs in Alberta will be conducted. All NICUs remain in the control arm (current practice) for the first year. Four NICUs move to the intervention arm (collaborative QI strategies) at the end of each year. Infants born at 32<sup>0/7</sup> to 36<sup>6/7</sup> weeks' gestation, without major congenital anomalies or chromosomal abnormalities, and with primary admission to participating NICUs or postpartum units will be included. NICU staff will complete a survey in the first year and be interviewed after implementation. The five components of EPIQ intervention include: QI Team building, QI education, evidence-based practice bundles for respiratory and nutritional management, QI mentoring, and networking and benchmarking. The primary outcome will be length of hospital stay and secondary outcomes include short-term clinical outcomes, healthcare costs, and staff perception of QI.

**Interpretation:** The ABC-QI study aims to provide detailed population-based data to fill existing gaps in MLPI research that can be used to implement better practices and support future research, benchmarking, and QI.

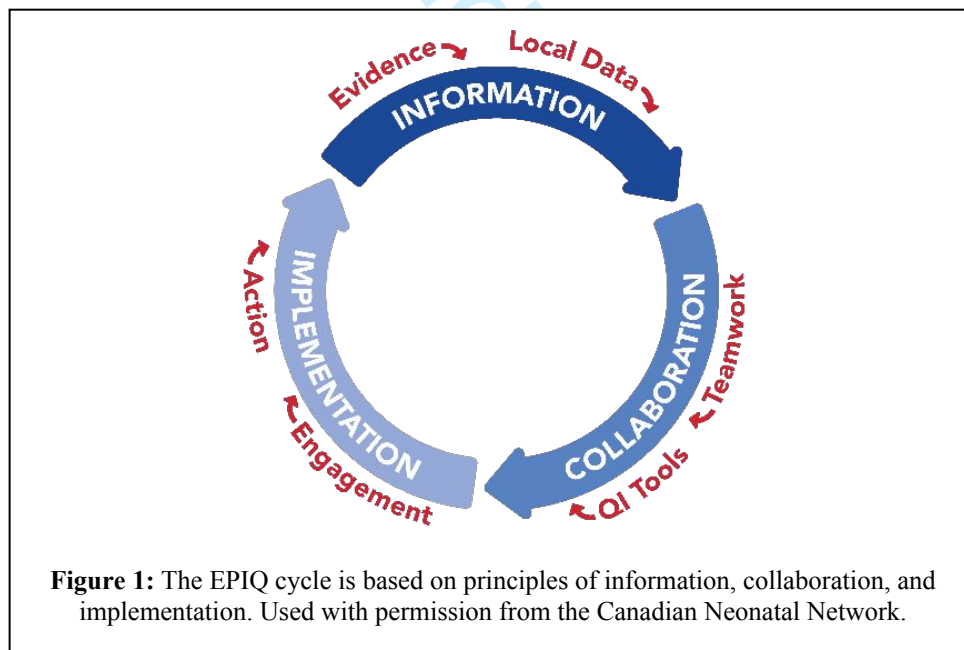
**Trial Registration:** NCT05231200

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

### Introduction:

Preterm birth represents 8% of live births in Canada. Of these, 85% are moderate and late preterm infants (MLPIs) born at 32-36 weeks' gestation (1). MLPIs are at an increased risk of significant morbidities and prolonged hospitalizations (2, 3), while the families of MLPIs often face significant financial and psychosocial burdens (4-7). Practice variation in care of MLPIs is associated with inconsistent outcomes and variable length of stay (LOS) between Neonatal Intensive Care Units (NICU) (8-10).

Collaborative Quality Improvement (QI) is an organized, multifaceted approach that includes teams from multiple healthcare sites coming together to learn, apply and share improvement methods, ideas, and data on service performance for a given healthcare topic. In a systematic review of 64 studies, applying collaborative QI practices led to significant improvements in clinical processes and patient outcomes (11). Studies in preterm infants < 32 weeks using Evidence-based Practice for Improving Quality (EPIQ) (12-14), a collaborative QI methodology adopted by the Canadian Neonatal Network (CNN) (15), decreased mortality and morbidity in infants less than 29 weeks' gestation (16). The EPIQ QI Cycle is driven by information, collaboration, and implementation (Figure 1) (17). This is based on the Promoting Action on Research Implementation in Health Services (PARiHS) framework for conceptualizing successful implementation of evidence-based practices (18). Although collaborative QI interventions can be associated with upfront costs including infrastructure and personnel, a systematic review showed the collaborative QI's potential for cost saving for both chronic and acute conditions (19). In high-risk neonates, collaborative QI was associated with cost savings that offset the institutional expenditure for its activities (20).



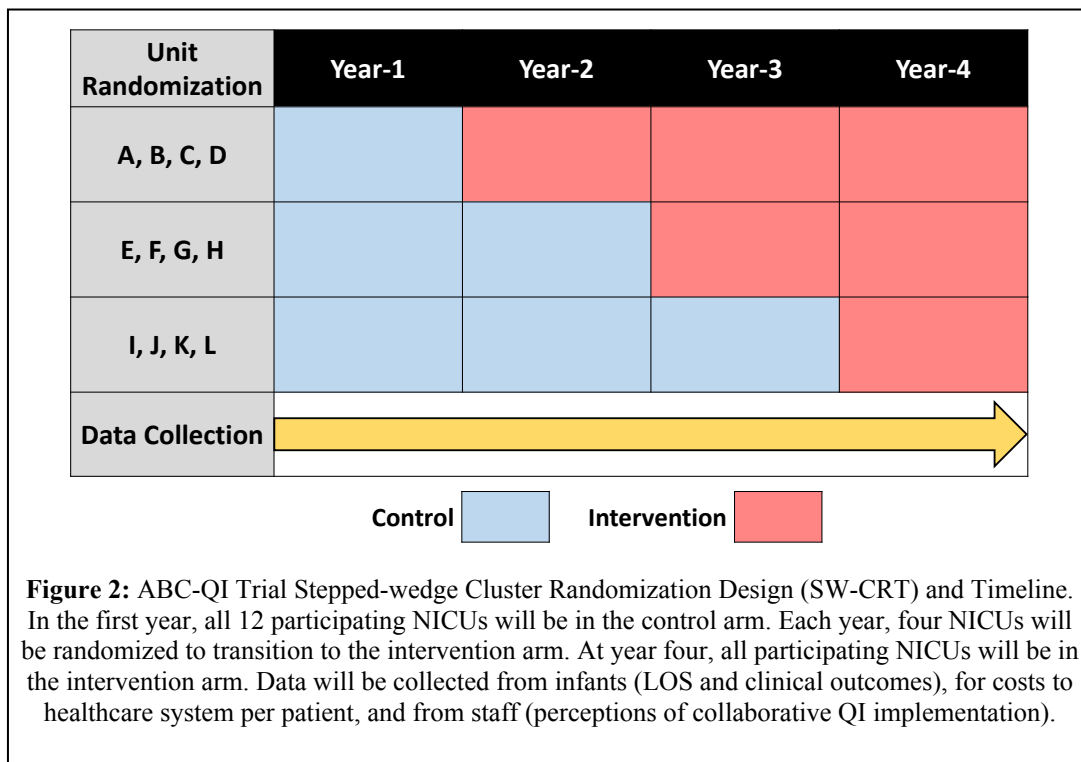
Despite the high proportion of MLPIs among NICU admissions, they are underrepresented in research and QI activities, resulting in a lack of detailed population-based data for research, benchmarking, and QI. The ABC-QI Trial aims to evaluate the impact of collaborative QI interventions in MLPIs on LOS, clinical outcomes, and cost to the healthcare system in 12 NICUs across Alberta, Canada.

### Methods:

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

### Study Design and Setting:

This study is a multi-center, stepped-wedge cluster randomized trial (SW-CRT) that involves 12 NICUs across the province of Alberta. There are 14 NICUs in Alberta; 10 Level II units where generally admission criteria include gestational age (GA)  $\geq$  32 weeks; 2 perinatal Level III units (Foothills Medical Centre in Calgary and Royal Alexandra Hospital in Edmonton), 1 Level III surgical NICU at Alberta Children's Hospital, and 1 Level IV NICU at Stollery Children's Hospital. The latter 2 NICUs will not participate in the study as most patients admitted require surgical interventions. See **Appendix 1** for details of Alberta NICUs. Each of the 12 participating NICUs is considered a cluster and will be randomized individually to transition from the control arm (current practice) to the intervention arm (collaborative QI strategies) at 3 time-points while stratifying by location, urban vs. regional, and level of care (**Figure 2**). Randomization will be conducted 9 months after initiation of data collection using opaque envelopes and all the units will know their transition time point.



### Evaluation of organizational culture and collaborative QI implementation:

1. QI Implementation Survey version 2 (QIIS-II): A cross-sectional survey (39 questions) will be conducted in the first year of the trial to develop understanding of the organizational culture and the status of QI implementation before NICUs transition to the intervention arm (**Appendix 2**) (21-23).
2. Collaborative QI implementation: semi-structured interviews will be conducted in a purposively selected sample from each NICU to develop an understanding of the barriers and facilitators in implementing EPIQ collaborative QI interventions. The interview questions (**Appendix 3**) are based on the Consolidated Framework for Implementation Research (CFIR) and spread over 5 domains: intervention characteristics, outer setting, inner setting, individual characteristics, and process (24).

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Study Population:**

Patient participants: Using a waiver of consent, all infants born at 32<sup>0/7</sup> to 36<sup>6/7</sup> weeks' gestation and admitted to participating NICUs or postpartum units between September 1, 2022 and August 31, 2026.

Exclusion criteria includes infants with major congenital anomalies or chromosomal abnormalities, primary admission to a surgical NICU, and infants born in or transferred to a NICU outside Alberta.

Staff participants: Management, nurses, physicians, and other healthcare providers will be invited by email to participate in the QIIS-II survey. Posters in staff areas and emails from managers will facilitate the recruitment of participants for the semi-structured interviews.

**Interventions:**

The study intervention consists of 5 collaborative QI strategies:

1. **QI Team Building:** Each NICU will create a multidisciplinary QI team, including a parent advisor when feasible, to lead the QI activities and education, and champion the culture and practice change.
2. **QI Education:** QI teams will receive standardized QI education using the 6-hour EPIQ Workshop (25) which involves a hands-on approach to enable successful implementation of QI projects.
3. **Implementation of two Standardized Practice Care Bundles:** A care bundle is a small, simple set (3-5 elements) of evidence-based practices that, when performed collectively and reliably, result in improved patient outcomes (26). For details on care bundle development and refinement see **Appendix 4. Respiratory Care:** stabilization and respiratory care in MLPs 1) establishing effective ventilation in the delivery room; 2) prevention of hypothermia; 3) early diagnosis and management of respiratory distress with Continuous Positive Airway Pressure (CPAP); 4) standardized approach for surfactant indications and administration; and 5) standardized approach for early extubation. **Nutritional Care:** nutritional support in MLPs 1) early initiation of enteral or parenteral nutrition; 2) standardized tables for feeding initiation and progression; 3) optimizing breastfeeding and use of breastmilk, and 4) standardized approach for the transition from enteral nutrition via tube feeds to oral feeds. Local QI teams will implement the care bundles using EPIQ methods through engagement and education of frontline staff to create change ideas that could be translated into the unit culture using Plan-Study-Do-Act (PDSA) cycles. The aim is to implement the two care bundles within 12 months of transition to the intervention arm.
4. **Mentoring:** Each NICU will have one or more mentors who are experienced in EPIQ methods to help local QI teams engage frontline staff in QI and navigate the unit-specific challenges during the intervention.
5. **Collaborative Networking:** NICUs in the intervention will participate in quarterly meetings to discuss progress and share their PDSA cycles and data to learn from each other. NICUs will have access to their data and receive quarterly reports using statistical process control (SPC) charts outlining their performance compared to the other units and the overall average.

**Control arm (current practices):** All participating NICUs will be in the control arm during the first year to collect baseline data of the current practices and between-unit variation, prepare repositories of existing guidelines, survey of existing QI activities. NICUs in the control arm can continue conducting QI activities relevant to their practice, but without receiving the interventions outlined above until they transition to the intervention arm. These activities will be captured and accounted for in the analysis.

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

### Outcomes and Process Measures

The primary outcome is LOS until discharge home. Secondary outcomes include (1) cost to the healthcare system (2) short-term clinical outcomes including respiratory and nutritional care, weight, post-discharge information, mortality, and transfers from Level II to Level III NICU (**Appendix 5**). Staff perception of the QI initiative will be assessed via the QIIS-II survey, as well as semi-structured interviews of selected staff in each participating NICU, approximately 1-year post-intervention. Process Measures of Collaborative QI activities including the number of EPIQ workshops conducted and number of participants, finalization of care bundles, number of PDSA cycles completed in each unit, presentation in collaborative QI meetings, and benchmarking reports will be collected.

### Data sources

The study database is built using REDCap (Research Electronic Data Capture) tools hosted at the University of Alberta (27, 28). These include participant demographics, maternal characteristics, birth details, and short-term outcomes. Post-discharge data will be collected from multiple secondary data sources (**Appendix 6**) and the Canadian Institute for Health Information (CIHI) Patient Cost Estimator (29) will be used to calculate the daily cost. The data is abstracted from paper and electronic patient charts directly into the REDCap database. PDSA cycles will be entered by each QI team into the study database.

### Data Management

Participating sites will have individualized portal to the database and will be unable to access data from the other sites. Participants data will be collected, used, and disclosed in compliance with Alberta's Health Information Act (30). QIIS-II surveys, interview consent, and demographic data will be collected via University of Calgary Qualtrics, XM (Qualtrics, Provo, UT). Interview transcripts will be entered into REDCap. Access to patient identifiers will be limited to the research coordinator, the data analyst, and the Principal Investigator. After study completion, the de-identified, archived data will be transmitted to and stored at the Federated Research Data Repository (FRDR), for use by other qualified researchers.

### Sample Size

The anticipated sample size is 9,500 infants over 4 years. Power calculations account for the design effect that is determined by the number of sites and steps, the size of the clusters within each period, and the intra-cluster correlation coefficient (ICC) (31-34). Calculations account for the relative efficiency imposed by unequal cluster sizes (35). Using historic LOS data from 2018 and 2019, we obtained an observed ICC=0.034 from a negative binomial model with random intercepts for sites with a corresponding design effect of 3.41. At alpha level = 0.05, this provides power of > 99% to detect a 1-day reduction in LOS (historic mean LOS = 14 days). In the historic data, 81% of infants were singletons. Sample size calculations accounting for multiple births resulted in similar power. Our sample size will ensure we have adequate power for assessments of some of the secondary outcomes that are in common with the Alberta FICare trial. Anticipated rates of IV fluid use and respiratory support will be similar to infants with a gestational age of 34 weeks in the Alberta FICare data (both approximately 50%). Applying the same methods to power calculations for binary outcomes, we will have 80% power to detect a 10.2% relative reduction in event rates if the baseline rate is 50%, and 80% power to detect a relative reduction of 19.7% if the baseline event rate is 20%. Calculations are for a cross-sectional stepped wedge design and were programmed using R 4.0.2, and lme4 function for generalized linear mixed effect models (36).

### Statistical Analysis

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

Descriptive statistics will be used to summarize the participant's characteristics. Negative-binomial distribution will be used to model LOS (37). This analysis will use a generalized linear mixed model with a random intercept for the site, a fixed effect for the period, and a (0,1) indicator variable for control vs intervention periods(31, 36). We will also test for a period by intervention effect to determine if effectiveness varies over time and use random intercepts to account for multiple births. Linear mixed models will be used for continuous secondary outcomes and generalized linear mixed models for binary outcomes. As per the model for the primary outcome, these models will have random intercepts for sites and fixed effects for period and intervention. In addition, we will use QIIS-II scores of organizational culture as an effect modifier when modeling the effect of EPIQ on outcomes. Post-implementation interviews will be coded and analyzed using thematic analysis (39) to identify barriers and facilitators for EPIQ implementation. We will use the CIHI Patient Cost Estimator (29) to calculate the daily cost based on the Case Mix Groups for gestational age and birth weight and conduct an economic analysis using data collected in the trial and administrative data repositories in Alberta using a public healthcare payor perspective. Costs will include costs associated with health services as defined above over the study period. The outcome of the economic analysis is the incremental cost of the intervention compared to usual care. We will analyze the total cost variable as a dependent variable, using a linear mixed-effects regression model, to estimate the difference in expected health care cost between the two groups. The regression model will adjust for potential confounding variables such as gestational age, multiple births, delivery mode, and urban vs. regional sites.

The primary outcome will be analyzed at the end of the trial to preserve the alpha. Planned interim analyses of secondary outcomes that are considered QI outcomes related to the care bundles will be reported for each unit every quarter using Statistical Process Control (SPC) Charts. Contemporaneous change in process and outcome measures indicates effective QI implementation. Benchmarking between the participating NICUs will be provided annually using de-identifying codes for each NICU. Planned subgroup analyses include 1) NICU geographical location; 2) gestational age subgroups, 32-34 weeks, and 35-36 weeks as admission and discharge criteria and LOS varies between these groups; and 3) singleton and multiple births.

### Monitoring

The trial will have 3 committees: 1) Trial Steering Committee: oversee the trial progress and address any concern with the trial execution and management, 2) Trial Management Committee: daily management of the trial, implementing EPIQ collaborative QI interventions during each transition period and supporting each NICU local QI team, and 3) Data Management Committee: manage and maintain the trial database and data dictionary.

### Ethics Approval

The study has been approved by University of Calgary Conjoint Health Research Ethics board, University of Alberta Health Research Ethics Board, Alberta Health Services and Covenant Health.

### Interpretation

The ABC-QI study aims to provide real-world evidence of the benefit of collaborative QI strategies in MLPs. The study uses QI tools as an intervention which carries the potential for implementation of better practices and providing directions for future research in MLPs. Furthermore, knowledge sharing will assist in collaboration and build collective knowledge for future research. We will disseminate the results

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

to healthcare professionals, parent advisory groups, operational leaders, policymakers, government agencies, and other knowledge users through presentation in national and international conferences, media sources, and publication in relevant peer-reviewed journals using the Consolidated Standards of Reporting Trials (CONSORT) extension for SW-CRT (42).

### Limitations

EPIQ methodology aims for change in practice and culture. These changes follow the change cycle described by Prochaska and DiClemente, in which the last stage is relapse (43). We will mitigate this risk by ongoing engagement, quarterly benchmarking reports and the continuous capability of each unit to access their data. The study aims to implement 2 care bundles within 12 months of transition to intervention. Barriers due to operational changes or resourcing may limit the ability of the units to implement QI initiatives.

### Conclusion

The ABC-QI trial is the first Canadian study that aims to evaluate the impact of collaborative QI strategies in MLPIs on clinical outcomes, LOS, and cost to healthcare system on a wide scale. This study aims to address the existing gaps in MLPI research and provide detailed population-based data that can be used for future research, benchmarking, and QI in the MLPI population across Canada and worldwide.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

**Contributors:**

AAM, JT, KA, NS, PS, KB, BA, and DJ developed the concept and the design of the trial.

AAM, JT, KA, NS, PS, KB, BA, DJ, AS, PF, YA, GZ, CF, KF, DM, CJ, WI drafted sections of the grant application.

AAM, DP, KA drafted the manuscript.

All authors reviewed and approved the initial draft and final version of the manuscript.

**Funding:** The ABC-QI trial is supported by **GRANT #178288** from the Canadian Institutes of Health Research (CIHR). No competing interests declared by Authors.

**Data Sharing:**

After study completion, the de-identified, archived data will be transmitted to and stored at the Federated Research Data Repository (FRDR), for use by other qualified researchers.

**Acknowledgements:** The Authors thank the site medical and operational leads, Maternal, Newborn, Child, and Youth Strategic Clinical Network, and Alberta SPOR Support Unit for their support of the project. They also thank the Canadian Neonatal Network for providing and sharing their data dictionary and EPIQ materials as well as Dr. Stephen Shortell from the University of Berkeley for sharing the Quality Improvement Implementation Survey.



Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

**References:**

1. Statistics Canada. Table 13-10-0425-01 Live births, by weeks of gestation 2020 [cited 2021 March 15]. Available from: <https://www150.statcan.gc.ca/t1/tb11/en/cv.action?pid=1310042501#timeframe>.
2. Huff K, Rose RS, Engle WA. Late Preterm Infants: Morbidities, Mortality, and Management Recommendations. *Pediatr Clin North Am.* 2019;66(2):387-402.
3. Mitha A, Chen R, Altman M, Johansson S, Stephansson O, Bolk J. Neonatal morbidities in infants born late preterm at 35-36 weeks of gestation - a Swedish nationwide population-based study. *J Pediatr.* 2021.
4. Hodek JM, von der Schulenburg JM, Mittendorf T. Measuring economic consequences of preterm birth - Methodological recommendations for the evaluation of personal burden on children and their caregivers. *Health Econ Rev.* 2011;1(1):6.
5. Schecter R, Pham T, Hua A, Spinazzola R, Sonnenklar J, Li D, et al. Prevalence and Longevity of PTSD Symptoms Among Parents of NICU Infants Analyzed Across Gestational Age Categories. *Clin Pediatr (Phila).* 2020;59(2):163-9.
6. Lakshmanan A, Agni M, Lieu T, Fleegler E, Kipke M, Friedlich PS, et al. The impact of preterm birth <37 weeks on parents and families: a cross-sectional study in the 2 years after discharge from the neonatal intensive care unit. *Health Qual Life Outcomes.* 2017;15(1):38.
7. Ionio C, Colombo C, Brazzoduro V, Mascheroni E, Confalonieri E, Castoldi F, et al. Mothers and Fathers in NICU: The Impact of Preterm Birth on Parental Distress. *Eur J Psychol.* 2016;12(4):604-21.
8. Boyle EM, Johnson S, Manktelow B, Seaton SE, Draper ES, Smith LK, et al. Neonatal outcomes and delivery of care for infants born late preterm or moderately preterm: a prospective population-based study. *Arch Dis Child Fetal Neonatal Ed.* 2015;100(6):F479-85.
9. Aliaga S, Boggess K, Ivester TS, Price WA. Influence of neonatal practice variation on outcomes of late preterm birth. *Am J Perinatol.* 2014;31(8):659-66.
10. Benzie KM, Aziz K, Shah V, Faris P, Isaranuwatthai W, Scotland J, et al. Effectiveness of Alberta Family Integrated Care on infant length of stay in level II neonatal intensive care units: a cluster randomized controlled trial. *BMC Pediatr.* 2020;20(1):535.
11. 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(3):226-40.
12. Lee SK, Aziz K, Singhal N, Cronin CM. The Evidence-based Practice for Improving Quality method has greater impact on improvement of outcomes than dissemination of practice change guidelines and quality improvement training in neonatal intensive care units. *Paediatrics & child health.* 2015;20(1):e1-9.
13. Cronin CM, Baker GR, Lee SK, Ohlsson A, McMillan DD, Seshia MM, et al. Reflections on knowledge translation in Canadian NICUs using the EPIQ method. *Healthc Q.* 2011;14 Spec No 3:8-16.
14. Lee SK, Singhal N, Aziz K, Cronin CM. The EPIQ evidence reviews - practical tools for an integrated approach to knowledge translation. *Paediatrics & child health.* 2011;16(10):629-30.
15. The Canadian Neonatal Network Annual Report 2019. The Canadian Neonatal Network™; 2020.
16. Lee SK, Shah PS, Singhal N, Aziz K, Synnes A, McMillan D, et al. Association of a quality improvement program with neonatal outcomes in extremely preterm infants: a prospective cohort study. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne.* 2014;186(13):E485-94.

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

17. CNN. EPIQ and CNF [video]. Canadian Neonatal Foundation; 2022 [Available from: <https://www.youtube.com/watch?v=lxFl1bckcOE>].
18. Kitson AL, Rycroft-Malone J, Harvey G, McCormack B, Seers K, Titchen A. Evaluating the successful implementation of evidence into practice using the PARIHS framework: theoretical and practical challenges. *Implementation Science*. 2008;3(1):1.
19. de la Perrelle L, Radisic G, Cations M, Kaambwa B, Barbery G, Laver K. Costs and economic evaluations of Quality Improvement Collaboratives in healthcare: a systematic review. *BMC Health Serv Res*. 2020;20(1):155.
20. Rogowski JA, Horbar JD, Plsek PE, Baker LS, Deterding J, Edwards WH, et al. Economic implications of neonatal intensive care unit collaborative quality improvement. *Pediatrics*. 2001;107(1):23-9.
21. Shortell SM, Zimmerman JE, Gillies RR, Duffy J, Devers KJ, Rousseau DM, et al. Continuously improving patient care: practical lessons and an assessment tool from the National ICU Study. *QRB Qual Rev Bull*. 1992;18(5):150-5.
22. Shortell SM, Jones RH, Rademaker AW, Gillies RR, Dranove DS, Hughes EF, et al. Assessing the impact of total quality management and organizational culture on multiple outcomes of care for coronary artery bypass graft surgery patients. *Med Care*. 2000;38(2):207-17.
23. Shortell SM, O'Brien JL, Carman JM, Foster RW, Hughes EF, Boerstler H, et al. Assessing the impact of continuous quality improvement/total quality management: concept versus implementation. *Health Serv Res*. 1995;30(2):377-401.
24. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. *Implement Sci*. 2009;4:50.
25. Gould JB. The role of regional collaboratives: the California Perinatal Quality Care Collaborative model. *Clinics in perinatology*. 2010;37(1):71-86.
26. Institute for Healthcare Improvement. What is a Bundle? : Institute for Healthcare Improvement; 2021 [Available from: <http://www.ihl.org/resources/Pages/ImprovementStories/WhatIsaBundle.aspx>].
27. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, et al. The REDCap consortium: Building an international community of software platform partners. *J Biomed Inform*. 2019;95:103208.
28. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-81.
29. Canadian Institute for Health Information. Patient Cost Estimator 2021 [cited 2021 March 17]. Available from: <https://www.cihi.ca/en/patient-cost-estimator>.
30. Health Information Act. In: Health, editor. Edmonton: Alberta Queen's Printer; 2021.
31. Hussey MA, Hughes JP. Design and analysis of stepped wedge cluster randomized trials. *Contemp Clin Trials*. 2007;28(2):182-91.
32. Hemming K, Taljaard M. Sample size calculations for stepped wedge and cluster randomised trials: a unified approach. *J Clin Epidemiol*. 2016;69:137-46.
33. Nakagawa S, Johnson PCD, Schielzeth H. The coefficient of determination R(2) and intra-class correlation coefficient from generalized linear mixed-effects models revisited and expanded. *J R Soc Interface*. 2017;14(134).
34. Hsieh FY, Lavori PW, Cohen HJ, Feussner JR. An overview of variance inflation factors for sample-size calculation. *Eval Health Prof*. 2003;26(3):239-57.

Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32  
– 36 Weeks' Gestation: A Protocol for a Multi-Centre, Stepped-Wedge Cluster Randomized Trial (The  
ABC-QI Trial)

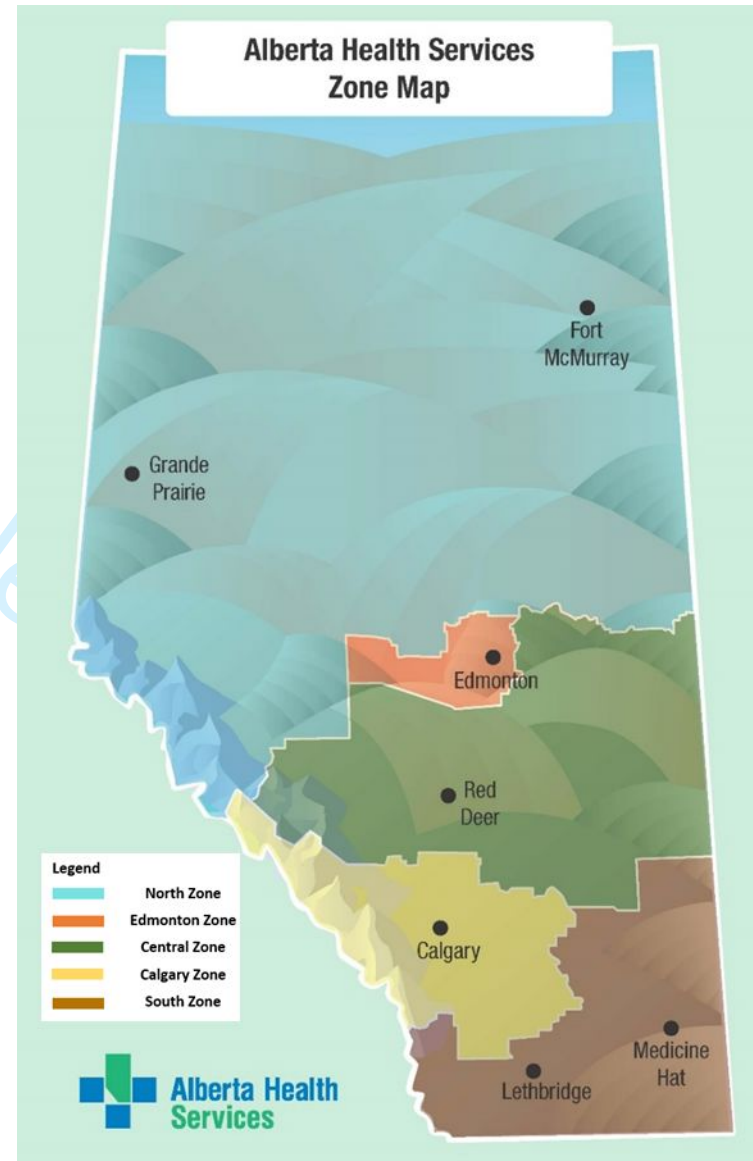
35. Girling AJ. Relative efficiency of unequal cluster sizes in stepped wedge and other trial designs under longitudinal or cross-sectional sampling. *Stat Med.* 2018;37(30):4652-64.
36. Bates D, Machler M, Bolker B, Walker S. Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software.* 2014;67:1-48.
37. Austin PC, Rothwell DM, Tu JV. A comparison of statistical modeling strategies for analyzing length of stay after CABG surgery. *Health Services and Outcomes Research Methodology.* 2002;3(2):107-33.
38. Leeper TJ. margins: Marginal Effects for Model Objects. R package version 0.3.23 ed2018.
39. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology.* 2006;3(2):77-101.
40. Briggs A, Nixon R, Dixon S, Thompson S. Parametric modelling of cost data: some simulation evidence. *Health Econ.* 2005;14(4):421-8.
41. Barber J, Thompson S. Multiple regression of cost data: use of generalised linear models. *J Health Serv Res Policy.* 2004;9(4):197-204.
42. Hemming K, Taljaard M, McKenzie JE, Hooper R, Copas A, Thompson JA, et al. Reporting of stepped wedge cluster randomised trials: extension of the CONSORT 2010 statement with explanation and elaboration. *BMJ.* 2018;363:k1614.
43. Prochaska JO, DiClemente CC. Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol.* 1983;51(3):390-5.

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for the Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Appendix 1: Alberta NICUs Information. Reference: Alberta Health Services Internal Website (InSite)**

<https://insite.albertahealthservices.ca/about/Page1371.aspx>; [Bed Survey 2021 \(albertahealthservices.ca\)](#)

Hospital	NICU Beds	Level of Care	Participation
<b>North Zone</b>			
Grande Prairie Regional Hospital	10	II	Yes
<b>Edmonton Zone</b>			
Stollery Children's Hospital: PCE NICU (Royal Alexandra Hospital site)	69	III	Yes
Stollery Children's Hospital: DS NICU (University Site)	18	IV	No
Grey Nuns Community Hospital	25	II	Yes
Misericordia Community Hospital	18	II	Yes
Sturgeon Community Hospital	6	II	Yes
<b>Central Zone</b>			
Red Deer Regional Hospital	17	II	Yes
<b>Calgary Zone</b>			
Foothills Medical Centre	39	III	Yes
Alberta Children's Hospital	14	III	No
Peter Lougheed Centre	27	II	Yes
Rockyview General Hospital	30	II	Yes
South Health Campus	16	II	Yes
<b>South Zone</b>			
Medicine Hat Regional Hospital	7	II	Yes
Chinook Regional Hospital, Lethbridge	16	II	Yes



**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for the Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Appendix 2: Quality Improvement Implementation Survey II**  
(Used with permission from Berkeley Public Health)

**PART 1: PARTICIPANT'S INFORMATION:**

**1. What is your profession? Select one:**

- a. Neonatologist
- b. Pediatrician
- c. Pediatrics / Neonatology resident or trainee
- d. Clinical Assistant
- e. Nurse practitioner
- f. Unit manager
- g. Bedside nurse
- h. Nurse Clinician
- i. Nurse Educator
- j. Nurse, Other
- k. Respiratory therapist
- l. Respiratory supervisor/manager
- m. Dietitian
- n. Pharmacist
- o. Social worker
- p. Other, please specify

**2. Where do you work? Select all that apply:**

- a. Queen Elizabeth II Hospital
- b. Sturgeon Community Hospital, Edmonton
- c. Misericordia Community Hospital, Edmonton
- d. Grey Nuns Community Hospital, Edmonton
- e. Royal Alexandra Hospital, Edmonton
- f. Red Deer Regional Hospital, Red Deer
- g. Peter Lougheed Centre, Calgary
- h. Foothills Medical Centre, Calgary
- i. Rockyview General Hospital, Calgary
- j. South Health Campus, Calgary
- k. Chinook Regional Hospital, Lethbridge
- l. Medicine Hat Regional Hospital, Medicine Hat

**3. Years of experience:**

- a. Less than five years
- b. Five to ten years
- c. Eleven to twenty years

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for the Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

- d. More than 20 years

**PART 2: UNIT CULTURE**

**Instructions:** These questions relate to the type of unit that your institution is most like.

Each of these items contains four descriptions of Units. Please distribute 100 points among the four descriptions depending on how similar the description is to your unit. None of the descriptions is any better than the others; they are just different. For each question, please use all 100 points.

For example: In question 1, if Unit A seems very similar to mine, B seems somewhat similar, and C and D do not seem similar at all, I might give 70 points to A and the remaining 30 points to B.

**4. Unit Character (Please distribute 100 points)**

\_\_\_\_\_ Unit A is a very personal place. It is a lot like an extended family. People seem to share a lot of themselves.

\_\_\_\_\_ Unit B is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks.

\_\_\_\_\_ Unit C is a very formalized and structured place. Bureaucratic procedures generally govern what people do.

\_\_\_\_\_ Unit D is very production oriented. A major concern is with getting the job done. People aren't very personally involved.

**5. Unit's Managers (Please distribute 100 points)**

\_\_\_\_\_ Managers in unit A are warm and caring. They seek to develop employees' full potential and act as their mentors or guides.

\_\_\_\_\_ Managers in unit B are risk-takers. They encourage employees to take risks and be innovative.

\_\_\_\_\_ Managers in unit C are rule-enforcers. They expect employees to follow established rules, policies, and procedures.

\_\_\_\_\_ Managers in unit D are coordinators and coaches. They help employees meet the unit's goals and objectives.

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for the Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**6. Unit Cohesion (Please distribute 100 points)**

\_\_\_\_\_ The glue that holds unit A together is loyalty and tradition. Commitment to this unit runs high.

\_\_\_\_\_ The glue that holds unit B together is a commitment to innovation and development. There is an emphasis on being first.

\_\_\_\_\_ The glue that holds unit C together is formal rules and policies. Maintaining a smooth-running operation is important here.

\_\_\_\_\_ The glue that holds unit D together is the emphasis on tasks and goal accomplishment. A production orientation is commonly shared.

**7. Unit Emphases (Please distribute 100 points)**

\_\_\_\_\_ Unit A emphasizes human resources. High cohesion and morale in the organization are important.

\_\_\_\_\_ Unit B emphasizes growth and acquiring new resources. Readiness to meet new challenges is important.

\_\_\_\_\_ Unit C emphasizes permanence and stability. Efficient, smooth operations are important.

\_\_\_\_\_ Unit D emphasizes competitive actions and achievement. Measurable goals are important.

**8. Unit Rewards (Please distribute 100 points)**

\_\_\_\_\_ Unit A distributes its rewards fairly equally among its members. It's important that everyone from top to bottom be treated as equally as possible.

\_\_\_\_\_ Unit B distributes its rewards based on individual initiative. Those with innovative ideas and actions are most rewarded.

\_\_\_\_\_ Unit C distributes rewards based on rank. The higher you are, the more you get.

\_\_\_\_\_ Unit D distributes rewards based on the achievement of objectives. Individuals who provide leadership and contribute to attaining the unit's goals are rewarded.

**PART 3: QUALITY OF CARE AND SERVICES**

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for the Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Instructions:** In this section, you are asked to assess your unit's efforts to improve the quality of care and services it provides. Please read each statement carefully. Indicate the extent to which you agree or disagree that the statement characterizes your unit by selecting the appropriate response (1 = Strongly Disagree, 5 = Strongly Agree). In answering the questions, you should think about what the unit is **actually like now**, not how you think it might be in the future or how you might wish it to be.

### GLOSSARY/SPECIAL INSTRUCTIONS

<b>Unit</b>	In responding to questions that ask you to make a global judgment about the "unit" please respond based upon your knowledge and experience of the department or area in which you are currently employed, the other departments or areas you come in contact within the course of doing your job, and the information you have on the Unit as a whole.
<b>Quality of Care and Services</b>	Throughout the survey, you are asked to make judgments about the "quality of care and services provided." In these questions, "quality of care and services" refers to how well the Unit performs the many activities and functions involved in patient care.  The term "quality of care and services" is not limited to the technical quality of care provided to patients; "quality of care and services" is a broader, more general category that includes not only the technical quality of care but also includes how well patient service needs are met.
<b>Senior Executives</b>	In general, the senior executives have the overall responsibility for unit operation and administration. President (CEO, administrator), senior or other vice presidents, chair or vice-chair of nursing, executive director, and medical director are some of the titles held by people who occupy senior executive positions. In some Units, these employees have the title of associate administrator.
<b>Middle Managers</b>	Middle managers include site leads, unit medical directors, unit managers, and first line supervisors that are not part of the senior executive staff.

### RESPONSE CATEGORIES

In indicating a response, please keep in mind the following general guidelines regarding the choices of response categories:

- You should indicate **Strongly Agree** when, for example, the statement represents a completely accurate description of your Unit.
- You should indicate **Strongly Disagree** when the description is completely inaccurate.
- The response **Neither Agree Nor Disagree** should be indicated when, based upon your experience, you believe the statement is neither a particularly accurate nor a particularly inaccurate description of your Unit. This situation may arise because there is wide variation in the activities the statement describes. For example, you might circle neither agree nor disagree when the statement is true of some departments but not of others.
- If you do not have enough information to answer a question, please choose "**Don't Know.**"



**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

	<u>STRONGLY DISAGREE</u>	<u>DISAGREE</u>	<u>NEITHER DISAGREES NOR AGREE</u>	<u>AGREE</u>	<u>STRONGLY AGREE</u>	<u>DON'T KNOW</u>
<b>Leadership:</b>						
9.						
	1	2	3	4	5	0
10.						
	1	2	3	4	5	0
11.						
	1	2	3	4	5	0
12.						
	1	2	3	4	5	0
13.						
	1	2	3	4	5	0
<b>Human Resource Utilization</b>						
14.						
	1	2	3	4	5	0
15.						
	1	2	3	4	5	0
16.						
	1	2	3	4	5	0
17.						
	1	2	3	4	5	0
<b>Employee Quality Planning Involvement:</b>						
18.						
	1	2	3	4	5	0

**Appendix Materials: Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)**

- |     |   |   |   |   |   |   |   |
|-----|---|---|---|---|---|---|---|
| 19. | Middle managers (e.g., site leads, program directors, and first line supervisors) are playing a key role in setting priorities for quality improvement. | 1 | 2 | 3 | 4 | 5 | 0 |
| 20. | Unit employees have the authority to correct problems in their area when quality standards are not being met.   | 1 | 2 | 3 | 4 | 5 | 0 |
| 21. | Unit employees are supported when they take necessary risks to improve quality.   | 1 | 2 | 3 | 4 | 5 | 0 |
| 22. | The unit has an effective system for employees to make suggestions to management on how to improve quality.   | 1 | 2 | 3 | 4 | 5 | 0 |

**Patient Satisfaction:**

- |     |   |   |   |   |   |   |   |
|-----|---|---|---|---|---|---|---|
| 23. | The unit does a good job of assessing current patient needs and expectations.                       | 1 | 2 | 3 | 4 | 5 | 0 |
| 24. | Unit employees promptly resolve patient complaints.   | 1 | 2 | 3 | 4 | 5 | 0 |
| 25. | Patients' complaints are studied to identify patterns and prevent the same problems from recurring. | 1 | 2 | 3 | 4 | 5 | 0 |
| 26. | The unit uses data from patients to improve services.   | 1 | 2 | 3 | 4 | 5 | 0 |
| 27. | The unit uses data on customer expectations and/or satisfaction when designing new services.        | 1 | 2 | 3 | 4 | 5 | 0 |

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Appendix 3: Semi-structured Interview Questions**

**Intervention characteristics**

1. In thinking about the ABC initiative, what did you like about it and what were some challenges you faced? What things would have to change and what would you keep the same? [probes]
  - a. Its development, validity, and relative advantage over old approaches.
  - b. The ability of the intervention to be adapted or refined to meet the site's individual needs.
  - c. The duration, scope, or disruptiveness.
  - d. Quality of the QI education and benchmarking.
  - e. Format of the care bundles.
  - f. Quality of the centralized collaboration meetings.
  - g. Costs associated with implementation (investment, supply, opportunity costs).

**Outer setting [external to AHS]:**

2. How does/has the Alberta Collaborative Quality Improvement (QI) initiative affect/affected patient care and outcomes? Are there any other organizations or factors outside AHS that might be influencing this initiative? [probes]
  - a. Patients' needs, parent perception.
  - b. What do you know about other organizations that have implemented similar QI initiatives?
  - c. Do you think EPIQ provides an advantage to your NICU compared to other NICUs?

**Inner setting**

3. All units are unique, what are some of the characteristics in your unit that influence the initiatives?
  - a. What facilitated the implementation Alberta Collaborative Quality Improvement (QI) initiative at your site (or zone)? [probes]
    - i. Relationships (colleagues, supervisors, teams), communication (formal and informal), climate/culture, engagement, relative priority, and readiness.
  - b. What were some barriers to the implementation Alberta Collaborative Quality Improvement (QI) initiative at your site (or zone)? [probes]
    - i. Relationships (colleagues, supervisors, teams), communication (formal and informal), climate/culture, engagement, relative priority, and readiness.
4. In AHS, to what extent is the need for QI recognized and prioritized? What would AHS need to do if they were going to implement this approach for other care bundles?

**Individual characteristics**

5. In thinking about the intervention, in general, how receptive are staff in implementing new things, and how receptive were staff in implementing ABC-QI? [probes]
  - a. Confidence, change readiness, knowledge/beliefs, and commitment to change.

**Process**

6. Tell me a bit about the implementations? What processes did you use to implement ABC-QI? What were the challenges? What worked? [probes]
  - a. Planning and quality of methods.
  - b. Engagement and education.

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks’ Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

- c. Execution of interventions.
- d. Receiving feedback and evaluating progress.

Confidential

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks’ Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Appendix 4: Development of Standardized Practice Bundles for Respiratory and Nutritional Care**

The following steps will guide the development of the care bundles:

1. An environmental scan will be conducted to see the practices used across the province of Alberta. The research team will reach out to the 12 NICUs in Alberta to attain practice guidelines (or any form of guidelines) for nutrition and respiratory care in Moderate and Late Preterm infants 32-36 weeks gestation.
2. Systematic literature searches will be conducted to assess 1) nutrition and 2) respiratory practices and their associated health outcomes in preterm infants 320/7 to 366/7 weeks gestational age. Searches will favor high quality systematic reviews and randomized clinical trials over observations studies.
3. Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Methodology (<https://gdt.gradepro.org/app/handbook/handbook.html>) will be used to evaluate and further refine the evidence for practice recommendations and inclusion into the care bundles. All reporting will be done following PRISMA guidelines.
4. A modified Delphi methodology will be used to establish clinical consensus for the finalized practice care bundles.

Confidential

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Appendix 5: Details and Definitions of the Primary and Secondary Outcomes for the ABC-QI Trial.**

<b>Outcome</b>	<b>Definition</b>
Length of hospital stay (LOS)	From birth until discharge home or death, whichever came first, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
Cost to the healthcare system	Per participant from birth until discharge home or death, whichever came first, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date). The Canadian Institute for Health Information Patient Cost Estimator will be used to calculate the daily cost based on the Case Mix Groups for gestational age and birth weight.
Hypothermia	The number of patients with hypothermia within 1 hour of birth, defined as axillary temperature <36.5°C.
Hypoglycemia	The number of patients with hypoglycemia in the first 24 hours of age, defined as blood glucose <2.6 mmol/L.
Surfactant Administration	Date, type, and method of administration in the first 168 hours of age.
Duration of respiratory support	Defined as the total number of days administered. From birth until discharge home or death, whichever came first, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
Age at achieving enteral feeding of 120 ml/kg/day.	From birth until discharge home or death, whichever came first, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
Postmenstrual age at achieving oral demand feeding for 3 consecutive days without tube feeding.	From birth until discharge home or death, whichever came first, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
Time to regain birth weight.	Defined as the difference in days between birth date and date when the infant regains or exceeds birth weight after initial weight loss. From birth until discharge home or death, whichever came first, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
Weight in grams	At discharge home in survivors, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
Length in centimeters	At discharge home in survivors, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
Head circumference in centimeters	At discharge home in survivors, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date).
z-score on Fenton 2013 Preterm Growth Charts	At discharge home in survivors, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date). Gestational age (weeks), weight (g), length (cm), and head circumference (cm) will be combined to calculate z-score.
Breastmilk use	Proportion of breastmilk use at discharge home in survivors, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date). Defined as the number of feeds where the infant received breastfeeding or maternal expressed breastmilk.

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

Rehospitalizations	The number of unplanned rehospitalizations per participant within 30 days after discharge. Defined as unplanned readmission to any hospital in Alberta following discharge.
Emergency room visits	The number of emergency room visits per participant within 30 days after discharge. Defined as any emergency room visits to any hospital in Alberta following discharge.
Hospital mortality	Until first discharge home, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date). Defined as the proportion of infants who die before first discharge home.
Infant mortality before 1 year of corrected age.	Corrected age = chronological age – days required for an infant to complete postmenstrual age of 40 weeks.
Transfer from Level II to Level III NICU	Until first discharge home, assessed until the participant reaches a corrected age of 6 months (6 months after their birth due date). Defined as the proportion of infants who require escalation of care and transfer to Level III NICU.

**Appendix Materials:** Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks' Gestation: A Protocol for a Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)

**Appendix 6: Secondary Data Sources, Description, and Usage for the ABC-QI Trial.**

Source	Description and Usage
Alberta Health Services Enterprise Data Warehouse Services (EDWS)	The EDWS department is responsible for integrating data from multiple source systems to support measurement and reporting services. Used to capture information about the utilization of healthcare resources within 30 days after discharge home.
Discharge Abstract Database (DAD)	The DAD contains administrative, clinical, and demographic information on hospital discharges (including deaths, sign-outs, and transfers). Used to capture rehospitalization within 30 days of discharge.
National Ambulatory Care Reporting System (NACRS)	The NACRS contains data for all hospital-based and community-based ambulatory care. Used to capture emergency room visits within 30 days of discharge.
Alberta Vital Statistics	Alberta Vital Statistics contains birth and death records. Used to capture infant mortality up to 1 year of age.
Canadian Institute for Health Information Patient Cost Estimator (PCE)	PCE is an interactive tool to estimate the average cost of healthcare services provided in hospitals. Used to calculate the daily cost based on the Case Mix Groups for gestational age and birth weight.



**Alberta (AB) Collaborative Quality Improvement Strategies to Improve Outcomes of Preterm Infants 32 – 36 Weeks’ Gestation: A Protocol for the Multi-centre, Stepped-Wedge Cluster Randomized Trial (The ABC-QI Trial)**

Ayman Abou Mehrem<sup>1,2</sup> MD MSc, Jennifer Toye<sup>3</sup> MD MSc, Khalid Aziz<sup>4</sup> MD MSc, Karen Benzies<sup>2,5</sup> PhD, Belal Alshaikh<sup>1,2</sup> MD MSc, David Johnson<sup>1,2</sup> MD, Peter Faris PhD<sup>6,7</sup>, Amuchou Soraisham<sup>1,2</sup> MD DM, Deborah McNeil PhD<sup>2,7</sup>, Yazid N Al Hamarneh PhD<sup>9,10</sup>, Karen Foss PhD<sup>6,8</sup>, Charlotte Foulston MD<sup>1,6</sup>, Christine Johns PhD<sup>6</sup>, Gabrielle L Zimmermann<sup>7,9</sup> PhD, Hussein Zein<sup>1</sup> MD MSc, Leonora Hendson<sup>1,2</sup> MD MSc, Wanrudee Isaranuwatchai PhD<sup>11,12</sup>, Kumar Kumaran<sup>3</sup> MBBS, Dana Price PhD<sup>1</sup>, Nalini Singhal<sup>1,2</sup> MBBS, Prakesh S Shah<sup>13,14</sup>, MBBS, MSc for the ABC-QI Trial Investigators.

**Affiliations:**

1. Department of Pediatrics, Cumming School of Medicine, University of Calgary, Calgary, AB, Canada
2. Alberta Children’s Hospital Research Institute (ACHRI), University of Calgary, Calgary, AB, Canada
3. Department of Pediatrics, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada
4. Office of Lifelong Learning, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada
5. Faculty of Nursing, University of Calgary, Calgary, AB, Canada
6. Alberta Health Services (AHS), AB, Canada
7. Community Health Sciences, Cumming School of Medicine, University of Calgary, Canada, AB, Canada
8. Covenant Health, AB, Canada
9. Alberta SPOR SUPPORT Unit, AB, Canada
10. Department of Pharmacology, Faculty of Medicine and Dentistry, University of Alberta
11. Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, ON, Canada
12. St. Michael’s Hospital, Toronto, ON, Canada
13. Department of Pediatrics, Mount Sinai Hospital, Toronto, ON, Canada
14. Department of Pediatrics, University of Toronto, Toronto, ON, Canada

**Corresponding Author:**

Dr. Ayman Abou Mehrem, Clinical Associate Professor and Staff Neonatologist  
 Section of Neonatology, Rm 780D, Foothills Medical Centre  
 1403 29 Street NW, Calgary, AB, Canada T2N 2T9  
 Tel: 403-944-4638  
 Email: [a.aboumehrem@ucalgary.ca](mailto:a.aboumehrem@ucalgary.ca)