

Quality improvement initiatives for areas of practice with high medical-legal risk in obstetrical care:

A systematic review

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ABSTRACT

BACKGROUND: Diverse needs for quality improvement are recognized in obstetrical care and prioritizing these needs can be challenging. One solution is to align quality improvement efforts with areas posing high medical-legal risk to physicians, which coincide with factors contributing to patient harm.

OBJECTIVE: To review published evaluations of obstetrical quality improvement initiatives and identify those that addressed areas of high medical-legal risk for physicians (according to Canadian medical-legal data).

METHODS: We searched CINAHL Plus, MEDLINE, Cochrane databases, Database of Abstracts of Reviews of Effects, the Health Technology Assessment Database, and grey literature for articles published between January 1, 2005 and September 22, 2016. We included studies evaluating a quality improvement initiative that involved physicians in Canadian or American hospital labour and delivery units. Eligible studies had clear study outcome measures and were randomized or prospective controlled trials, cohort or time series studies, or pre-post studies. We appraised study quality using the Quality Improvement Minimum Quality Criteria Set.

RESULTS: We screened 6,257 titles/abstracts and 202 full-text articles and included 73 articles. Fifty-five articles (75%) addressed ≥ 1 area of high medical-legal risk. The most common of these areas was collaborative care (31 articles) followed by induction and augmentation of labour (30 articles), management of shoulder dystocia (19 articles), assisted vaginal delivery (8 articles), and timing of decisions to perform an urgent caesarean section (2 articles). While nearly all articles reported favourable outcomes, the quality of reporting was variable.

CONCLUSIONS: While many initiatives show alignment with areas of high medical-legal risk, evaluation studies are still required to address the timing of urgent caesarean sections and processes in assisted vaginal delivery.

Prospero registration number: CRD42016052118

INTRODUCTION

Patient safety incidents that include deaths or high-severity injuries occur each year in labour and delivery units in Canada.¹ According to the U.S. Centers for Disease Control and Prevention, for every 10,000 delivery hospitalizations in 2014, there were 144 indicators of severe maternal morbidity, reflecting a 200% increase since 1993.²

In the two decades since the Institute of Medicine published *To Err is Human: Building a Safer Health System*,³ patient safety and quality improvement have been urgent priorities in healthcare and particularly in obstetrical care.⁴ A challenge with improving care in this area is the additional complexity of multiple providers managing the care of two interdependent patients simultaneously. As quality improvement science has advanced, the number of initiatives undertaken in obstetrical care has also increased. It is unclear, however, whether these initiatives addressed areas of high medical-legal risk for physicians. Aligning quality improvement efforts with areas of medical-legal risk not only focuses resources for quality improvement, but may also increase physician engagement by achieving two correlated goals: increased patient safety and decreased medical-legal risk.⁵ This is even more likely in obstetrical care, where physicians generally face higher medical-legal risks than other specialty areas.⁶

We conducted a systematic review of published observational or experimental studies (with or without a comparison group) that evaluated hospital-based labour and delivery quality improvement initiatives in Canada or the U.S. The primary objective was to describe the types of quality improvement initiatives evaluated, and to identify those addressing areas of practice posing high medical-legal risk to Canadian physicians in obstetrical care. According to Canadian medical-legal data^{1,7} these areas include induction and augmentation of labour, management of shoulder dystocia, assisted vaginal delivery, timing of decisions to perform an urgent caesarean section (i.e., from decision to section), and collaborative care. Our secondary objective was to appraise the impact of the identified quality improvement initiatives and quality of the evaluation studies.

METHODS

We registered our protocol with the PROSPERO database (registration number CRD42016052118) and used the PRISMA guidelines⁸ to guide our systematic review.

Sources and search strategy

A research librarian (EW) developed our search strategy, with input from the research team, and conducted a search for eligible articles using multiple databases: CINAHL Plus (Ebsco); MEDLINE Ahead of Print, In-Process & Other Non-Indexed citations and MEDLINE (Ovid); Cochrane Central Register of Controlled Studies (Ovid); Cochrane Database of Systematic Reviews; Database of Abstracts of Reviews of Effects (Ovid); and Health Technology Assessment (Ovid). We included a combination of MeSH terms and keywords in our MEDLINE strategy, and then translated this strategy for other databases using appropriate indexing terms and syntax. To ensure we captured current medical practices, we limited our electronic search to articles published between January 1, 2005 and September 22, 2016 and applied filters to limit our search to studies involving humans and only eligible study designs (described below). We set no limits on publication language. **The appendix*** provides our MEDLINE search terms. We identified additional publications by screening reference lists from included articles and consulting experts in the field.

We limited our grey literature search to evaluated quality improvement initiatives that met our search criteria in trial repositories, such as ClinicalTrials.gov. We also searched websites or repositories of relevant organizations or associations using a modified search appropriate for the interface.

Eligibility screening

We applied the PICOS principle (Participants, Interventions, Comparators, Outcomes, and Setting or Study design) to develop inclusion and exclusion criteria. To be eligible for review, studies must have included physicians delivering care inside labour and delivery units in Canada or the U.S.

Eligible initiatives were those intended for quality improvement, which we conceptualized as any effort in the healthcare system to make changes leading to better patient outcomes, better system performance, and better professional development.⁹ Eligible outcomes were process of care or clinical outcomes specific to the labour and delivery process, patient or provider satisfaction, or medical-legal outcomes. We excluded initiatives that only involved antepartum or postpartum care. We also excluded articles that did not report any study outcome, or those only involving neonatal resuscitation or neonatal warming because we were interested in initiatives designed to improve maternal-fetal care. We did not exclude articles based on the comparator group. Eligible study designs were systematic reviews (reference lists only), randomized controlled trials, prospective controlled trials, cohort or time series studies, and pre-post studies.

Two reviewers (CLB and RD) independently screened titles, abstracts, and full-text articles for eligibility and resolved disagreements by consensus. If there was no consensus then they consulted a third reviewer (LAC). When results from the initiative were unpublished (e.g., conference abstracts) or an article was not publicly available then we contacted the authors via email with a maximum of two contact attempts.

Identifying areas of high medical-legal risk

We identified five medical-legal high-risk areas *a priori* based on relevance in retrospective analyses of medical-legal matters in Canada performed by the [name blinded]. Medical-legal matters were complaints against physicians in Canada, in the form of civil legal actions or complaints to regulatory authorities or hospitals, brought forward to the [name blinded] by physicians seeking medical-legal advice. Four areas of practice—induction and augmentation of labour, management of shoulder dystocia, assisted vaginal delivery, and the timing of decisions to perform an urgent caesarean section (i.e., from decision to section)—are frequently identified by the [name blinded] as areas of high medical-legal risk in published^{1,7} and unpublished reports. Our fifth area of interest was collaborative care¹⁰ since issues related to collaborative care are common in Canadian obstetrical medical-legal cases.

For example, previous medical-legal reports highlighted deficiencies in situational awareness, ineffective communication, and failures to follow protocols among obstetrical teams.^{1,7}

Electronic fetal heart rate monitoring is another essential component of obstetrical patient safety that features in medical-legal cases^{1,7} and in national quality improvement initiatives in Canada; however, we did not explicitly focus on this area for the current review.

Data extraction

Two reviewers (CLB and RD) independently, manually extracted the following variables from each article: country, type of hospital, annual number of births, sample size, single or multi-site setting, study design, comparison groups (including early care for pre-post study designs), years of data collection, years of follow-up, medical-legal high-risk area, type of intervention, and the main result from the quality improvement study. Reviewers identified the “main result” in accordance with the language and emphasized results in each article. Each reviewer entered variables into a customized Microsoft Access database using shared decision criteria (available upon request from the authors), and then resolved any differences by consensus.

Quality appraisal

Most published risk of bias frameworks are not designed to appraise pre-post studies which we anticipated in our review. We therefore chose the Quality Improvement Minimum Quality Criteria Set (QI-MQCS)¹¹ to appraise the quality of the studies. The QI-MQCS comprises 16 domains; for each one, reviewers decided whether a criterion was “met” or “not met”. We also applied two additional domains: 1) whether or not the authors stated their study objectives, and 2) whether or not the authors reported results that tied directly to their stated objectives.

Results synthesis

Due to the heterogeneity of quality improvement initiatives in our review, we did not undertake a meta-analysis. We therefore summarized our findings using descriptive tables and frequencies. We categorized study outcomes *post hoc*, based on their prevalence, as process of care, clinical, staff/patient perceptions, medical-legal, or balancing measures (the new problems created when changes are made¹²).

RESULTS

Our initial search results identified 6,257 unique citations after removing duplicates. Following title and abstract screening, we considered 202 full-text articles for eligibility. Ultimately, 73 full-text articles were eligible and available for inclusion (see **Figure 1**).¹³⁻⁸⁷ Most initiatives targeted more than one area of high medical-legal risk using multiple types of interventions concurrently, with multiple outcomes. Hence, the interventions intended for individual high-risk areas were difficult to identify and appraise. For ease of interpretation, **Table 1** provides an abbreviated summary of articles addressing only one area of high medical-legal risk. **The appendix*** is a complete summary of all 73 articles, which was the basis for our systematic review.

TABLE 1: Summary of 17 quality improvement initiatives in labour and delivery units in Canada or the United States that targeted only one area of high medical-legal risk (published 2005-2016)

First author, publication year	Medical-legal high risk area of practice	Study design / Years of data collection	Type of hospital / Annual number of births	Type of intervention	Type of outcome	Main results of the intervention
Altimier 2011 ¹³	Induction and augmentation	Pre-post, Retrospective cohort / 2005-2007	Community / 1,850	Guideline, Standardized forms, Training not stated, Other ^a	Process of care, Perceptions, Balancing	Elective inductions <39 weeks gestational age declined from 12.1% to 2.0% (sig.) and overall induction rate declined from 26.5% to 22.1% (not sig.)
Clark 2007 ⁸⁸	Induction and augmentation	Pre-post, Retrospective cohort / 2005	Tertiary care / 3,700	Checklist, Guideline, Policy, Standardized protocol, Training not stated	Process of care, Clinical, Balancing	Maximum oxytocin infusion rate declined from 13.8 to 11.4 mU/min (sig.); C-section delivery rates declined from 15% to 13% (not sig.); neonatal adverse outcomes declined from 31% to 18% (sig.)
Clark 2010 ²⁵	Induction and augmentation	Retrospective cohort / May - July 2007 and 2009	Not stated / 220,000	Chain-of-command policy, Guideline, Policy, Training - didactic, Other ^a	Process of care, Clinical	"Hard stop" policies to reduce elective early term delivery showed the greatest decline in rates (8.2% to 1.7%, sig.)
Doyle 2012 ²⁹	Induction and augmentation	Pre-post, Retrospective cohort / 2008-2011	Other / 3,000	Audit and feedback, Champions, Standardized forms, Standardized protocol, Technology changes, Training - simulation, Training - other ^b	Process of care	Elective induction of labour at <39 weeks gestational age eliminated in 25 of 28 months post-implementation
Durham 2008 ³¹	Induction and augmentation	Pre-post / Not stated	Community / 6,500	Guideline, Training not stated, Other ^a	Perceptions, Process of care	Increased nurse satisfaction; decreased pre-delivery length of stay (12.7 to 10.7 hours) by disallowing elective inductions in women with unfavourable cervix; better able to predict patient volume (qualitative assessment)
Fisch 2009 ³⁴	Induction and augmentation	Retrospective cohort / 2004-2007	Academic, Other, Tertiary care / 9,300	Champions, Guideline, Standardized forms, Standardized protocol, Technology changes, Training not stated, Other ^a	Process of care, Balancing	Overall induction rate dropped from 24.9% to 16.6% (sig.); elective inductions dropped from 9.1% to 6.4% (sig.); elective inductions <39 weeks gestational age dropped from 11.8% to 4.3% (sig.)
Kenny 2013 ⁴⁸	Induction and augmentation	Cohort, Pre-post / 2005-2010	Not stated / Not stated	Policy, Standardized forms, Technology changes, Training not stated, Other ^a	Clinical, Balancing	C-section rate decreased (21% vs. 12%, sig.); no change in NICU admissions (5.5% to 5.6%, not sig.)
Krening 2012 ⁵⁰	Induction and augmentation	Pre-post / 2007-2011	Community, Non-profit, Rural / 25 to <200	Champions, Checklist, Guideline, Policy, Standardized forms, Standardized protocol, Technology changes, Training not stated, Other ^a	Process of care, Balancing, Clinical	Fewer hours receiving oxytocin (primigravidas: 9.9 to 8.8 (sig.), multigravidas: 7.8 to 6.2 (sig.)); decreased incidence of tachysystole (52.0% to 19.2% (sig.)); decreased primary C-section rate (61% to 56%, sig. not provided)
Rhinehart-Ventura 2014 ⁷⁰	Induction and augmentation	Pre-post with control group, Retrospective cohort / 2008-2011	Academic, Tertiary care / 4,000	Standardized protocol, Training not stated	Clinical, Process of care, Balancing	Failed induction rates were lower in the protocol-adherent (1.4%) compared to protocol non-adherent (7.8%) group (sig.)

First author, publication year	Medical-legal high risk area of practice	Study design / Years of data collection	Type of hospital / Annual number of births	Type of intervention	Type of outcome	Main results of the intervention
Rohn 2015 ⁷⁴	Induction and augmentation	Pre-post / Not stated	Tertiary care / Not stated	Checklist, Policy, Standardized protocol, Training – other, ^b Other ^a	Process of Care, Clinical, Balancing	Decrease in overall C-sections (15.2% to 14.8%, not sig.) and C-sections for fetal distress (38.7% to 32.5%, sig.); increase in chorioamnionitis (6.0% to 7.5%, sig.), time from admission to delivery (462 to 524 min., sig.), and C-sections due to labour dystocia (40.9% to 50.6%, sig.)
Beckett 2009 ¹⁵	Collaborative care	Pre-post / 2007-2009	Community / Not stated	Training - didactic, Training – other, ^b Other - unspecified	Perceptions	Enhanced physician-nurse communication (qualitative analysis); in culture survey 6 of 14 teamwork items, 6 of 13 safety climate items showed sig. improvement
Budin 2014 ²⁰	Collaborative care	Pre-post / Not stated	Academic / 4,600	Chain-of-command policy, Huddle, Staff changes, Technology changes, Training - CRM	Perceptions	Significant improvements in perceptions of teamwork and safety climate for nurses and physicians
Phipps 2012 ⁸⁵	Collaborative care	Cohort, Pre-post / 1999-2006	Not stated / 9,200	Champions, Coaching, Debrief, Training - CRM, Training - didactic, Training – simulation, Other ^a	Clinical, Perceptions	The Adverse Outcomes Index dropped from 0.052 to 0.043 (sig.); increased favourable responses to questions on organizational learning and continuous improvement (46% to 59%, sig.), teamwork (63% to 75%, sig.), communication openness (42% to 59%, sig.), and non-punitive response to error (16% to 26%, sig.)
Ralyea 2013 ⁸⁸	Collaborative care	Cohort / 2002-2007	Not stated / Not stated	Chain-of-command policy, Champions, Checklist, Coaching, Debrief, Guideline, Huddle, Policy, Standardized forms, Standardized protocol, Training - didactic, Training – TeamSTEPS, Training - other, ^b Other ^a	Perceptions, Process of care	Improvements in mean scores for overall culture survey (sig.) and subgroups including team structure, leadership, situational monitoring, and communication; improved patient perceptions of teamwork, quality of work, and likelihood to recommend facility
Grobman 2011 ³⁸	Shoulder dystocia	Pre-post / 2005-2007	Tertiary care / Not stated	Debrief, Standardized protocol, Training - didactic, Training - simulation	Process of care, Clinical, Balancing	Increased complete and consistent shoulder dystocia documentation (14% to 92%, sig.); decreased brachial plexus injury incidence (at birth: 10.4% to 2.6%, sig.; at discharge: 7.8% to 1.3%, sig.)
Inglis 2011 ⁴⁵	Shoulder dystocia	Pre-post, Retrospective cohort / 2003-2009	Not stated / Not stated	Standardized protocol, Training – simulation, Training - other ^b	Clinical, Process of care	Brachial plexus injury incidence declined (0.4% to 0.14%, sig.); shoulder dystocia incidence remained unchanged (1.3%, not sig.)
Scavone 2010 ⁷⁶	Timing to perform urgent C-section	RCT / Not stated	Academic / Not stated	Training didactic, Training simulation, Training other, Other - unspecified	Process of care measures , Clinical	Students who underwent training showed better performance in subsequent training exercises based on observer scores

^a Interventions classified as “Other” (due to low frequency) were as follows: audit, committees (oversight / peer-review / planning) or task force, monthly updates, peer feedback, or standardized oxytocin solution.

^b Interventions classified as “Training – other” (due to low frequency) were as follows: departmental presentation, practical training and examinations, role play, self-study materials (DVDs, reading), or small group work.

CRM, Crew Resource Management; NICU, neonatal intensive care unit; not sig., indicates a result that was not statistically significant at a 95% confidence level; sig., indicates a result that was statistically significant at a 95% confidence level. See appendix* for sample sizes.

Types of initiatives

Of 73 articles, 55 (75%) addressed at least one area of high medical-legal risk. The most common area of focus was collaborative care (31 articles) followed by induction and augmentation (30 articles). Among the latter, 22 involved elective inductions^{13,17,18,25,26,28,29,31,32,34,43,48,49,58,60,61,69,72,74,79,80,86} and 20 involved augmentation or non-elective inductions.^{13,18,24,32,34,35,39,40,43,49,50,58,63,70,72,74,79,80,83,86} Nineteen articles focused on managing shoulder dystocia, and 8 on assisted vaginal deliveries. Timing of decisions to perform an urgent caesarean section was the least common focus, in only 2 articles. While no article targeted all 5 areas of high medical-legal risk simultaneously, 4 articles addressed 4 areas.^{26,35,58,72} Other articles described areas of practice that were not the focus of this review, but were common; namely, maternal obstetrical hemorrhage (23 articles), electronic fetal monitoring (15 articles), and other aspects of caesarean sections besides the timing of decisions (22 articles).

The **appendix*** summarizes the settings for the quality improvement initiatives. Nearly all took place in the U.S. with 4 in Canada.^{23,30,44,83} Academic or tertiary care hospitals were the most common settings (39 articles) and most often involved single-site studies (29 of 39). Multi-site studies were common in community hospitals (12 of 18 articles), non-profit hospitals (6 of 7), and rural hospitals (9 of 10). We identified both single- and multi-site initiatives in all areas of high medical-legal risk, with the exception of timing of decision to perform an urgent caesarean section, studied only at single sites. The high-risk areas varied across hospital settings: community hospitals were more likely than others to address induction and augmentation (13 of 18); hospitals described as non-profit had the highest proportion of electronic fetal monitoring initiatives (3 of 7); and academic or tertiary care centres were the most likely to address management of shoulder dystocia (15 of 39).

The articles in our review typically described multiple types of interventions within the same initiative appendix*. When considered individually, the most common type of intervention was a standardized protocol (38 articles) followed by a policy (29 articles). Training was also

common: 26 articles described didactic training and 25 described training using simulation. Ten articles described TeamSTEPPS⁸⁹ and 9 described Crew Resource Management training,⁹⁰ often with goals to improve collaborative care (13 of 19 articles). Crew Resource Management was frequently implemented in academic or tertiary care hospitals (7 of 9). Other trends are noteworthy as well. The majority of articles that addressed shoulder dystocia (14 of 17) involved simulation. Moreover, evaluations of coaching, huddles, and audit and feedback were rare. Nearly all initiatives involving coaching (6 of 7) or huddles (5 of 6) focused on improving collaborative care, among other areas.

Impact of the initiatives

We appraised the overall impact of the initiatives on patients, obstetrical teams, and systems based on the main results (**Table 1** and **appendix***). In nearly all articles, authors reported favourable changes or positive healthcare provider behaviours by the end of study.

Outcome measures

There were numerous outcomes in the articles, which we grouped into categories. Clinical outcomes were the most common category, with 43 articles reporting at least one. These outcomes frequently related to shoulder dystocia, timing of decisions to perform urgent caesarean sections, and assisted vaginal deliveries. Notably, of 17 articles that addressed shoulder dystocia, only 6 reported shoulder dystocia-specific outcomes.^{22,37,38,45,63,75} Clinical outcomes were also frequent among initiatives that addressed maternal obstetrical hemorrhage, electronic fetal monitoring, and other caesarean section issues. A common clinical measure was the rate or frequency of adverse outcomes for mothers and infants. For example, multiple articles described using a severity index or a composite score such as the Adverse Outcomes Index (AOI) or one of its variants (e.g. modified-AOI).^{35,56,63,65,66,71,84,86}

Process of care outcomes were also common, with 42 articles reporting at least one of these outcomes (**appendix***). Most often, these outcomes were direct measures of compliance (e.g. protocol adherence) or indirect measures resulting from compliance (e.g. proportion of elective inductions <39 weeks gestation). Process of care outcomes were particularly common among studies featuring induction and augmentation (e.g., reducing labour times, use of an augmentation/elective induction bundle, or the dose of oxytocin administered).

Articles frequently described the perceived impact of the quality improvement initiative: 23 reported staff perceptions^{13,15,16,20,21,27,31,36,43,54,63-68,71,73,77,79,82,85,86} and 3 reported patient perceptions,^{65,68,86} often pertaining to collaborative care. For instance, patients were asked if they would recommend a hospital to others,^{68,86} or about the quality of care or teamwork in an obstetrical unit.^{65,68} Staff perceptions were usually captured in a safety culture survey such as the Safety Attitudes Questionnaire (SAQ).⁹¹

Twenty articles addressed balancing measures, the most common being the incidence of caesarean sections after introducing a policy or protocol. Medical-legal outcomes were reported in 8 articles. All of these studies showed a post-intervention reduction in patient safety events, number of claims, or costs.

Quality appraisal

The **appendix*** shows results from our quality appraisal. Overall, the articles met a median of 12 out of 18 criteria in the QI-MQCS tool (range, 7 to 16); the median was similar for each area of high medical-legal risk. Overall, the most commonly met criteria related to describing the initiative; in particular, stating a rationale (66 articles), describing the data source (66 articles), and describing the implementation approach (62 articles described ≥ 1 approach to introduce the initiative).

The least commonly met criteria were describing the potential for spread (31 articles), reporting adherence (34 articles), and describing processes before practice change (38 articles).

The majority of articles in our review (52 of 73) described a pre-post study design (**appendix***); 3 of these had a control group and another 32 had a historical care comparison. Of the 49 pre-post studies with no control group, 23 lacked an adequate description of the historical care process, and 3 of those articles did not describe the initiative sufficiently. Two articles described randomized controlled trials. Overall, 43 articles discussed the potential sustainability of the initiative or included at least 1.5 years of post-intervention follow-up.

DISCUSSION

Our systematic review identified 73 articles, published between 2005 and 2016, describing various evaluated quality improvement initiatives in hospital labor and delivery units. Most articles (75%) addressed at least one area of high medical-legal risk, often in academic or tertiary care hospital settings.

Both the volume and breadth of studies varied between the medical-legal high-risk areas. Collaborative care was the most frequent high-risk area of inquiry, often in academic or tertiary care hospitals. The interventions in these studies were diverse, including didactic training, chain-of-command policies, and huddles, for example. The outcomes were also diverse and collaborative studies were, notably, the only ones to include patient perceptions. Shoulder dystocia was frequently addressed concurrently with collaborative care, often in studies involving simulation training. Induction and augmentation was another common focus—with interventions such as protocols, guidelines, and standardized forms—in a variety of settings; some of these studies met nearly all of the criteria in our quality appraisal tool.^{28,29,34,60,63} In contrast, very few articles addressed assisted vaginal delivery or the timing of decision to an urgent caesarean section.

Accordingly, there are opportunities for further research. In particular, there is a sound clinical basis (reducing fetal hypoxia) and a medical-legal one⁷ for improving the decision-to-incision times for urgent cesarean delivery. As well, there is a basis for targeting assisted vaginal delivery in quality improvement studies given related risks to patient safety^{14,92} and medical-legal risks for physicians.⁷ The emphasis on team training in our review (e.g., using TeamSTEPPS or Crew Resource Management) is encouraging. Yet there may be opportunities to enhance these interventions and others, for example, by adding coaching or audit and feedback, which were not widely evaluated across the articles we reviewed. Moreover, as community and rural settings face distinct challenges in obstetrical care,^{49,93} these settings deserve more attention in the literature.

Ultimately the success of these interventions may hinge on their alignment with institutional needs and key facilitators for change, such as pre-existing cultures of safety, adequate resources for intervention, and buy-in from institutional leadership.⁹⁴ Many articles in our review (28 of 73) did not describe readiness for change (**appendix***), but this finding might reflect the quality of reporting rather than a lack of readiness.

To accelerate quality improvement in obstetrical care, there is a need for meaningful quality indicators for multiple types of outcomes.^{95,96} Process of care outcomes were common in our review and offer the ability to show significant improvement in relatively short periods of time. Clinical outcomes are also important, but they may be less effective measures in obstetrical care when adverse events are rare. A patient-centered approach to evaluation can foster organizational learning⁹⁷ and aligns with the Institute of Medicine's framework for healthcare quality, which includes patient-centered care.⁹⁸ Patient perceptions were only assessed in three of the articles we reviewed, but could be assessed in all areas of high medical-legal risk. For meaningful quality improvement, there is also a need for outcomes tied directly to study objectives, such as the incidence of brachial plexus injury when aiming to improve management of shoulder dystocia.

The fact that many articles did not describe historical care processes pre-intervention is limiting. Without this information, obstetrical teams seeking quality improvement are unable to assess the utility of the intervention for their own settings, which may deter spread. Wider use of quality improvement reporting guidelines, such as SQUIRE,⁹⁹ may lead to more efficient translation of knowledge from implementers to researchers and policy makers.⁴¹

There are important limitations of our study. First, publication bias is likely since the study outcomes were overwhelmingly positive. In fact, much quality improvement goes unpublished given hospital cultures that may be improvement-oriented rather than research-oriented,⁴¹ and institutional barriers to publishing. Second, the quality appraisal tool by Hempel *et al.*¹¹ may not capture all aspects of interest in quality appraisal; we added two of our own criteria in response to this. A third limitation was reliance on our own judgment when applying the quality appraisal tool, when identifying and classifying study outcomes, and when categorizing articles into areas of high medical-legal risk. We therefore included a third reviewer as needed to reach consensus. Fourth, we recognize that our emphasis on medical-legal risk limited the depth of our review for other important areas of obstetrical practice.

CONCLUSIONS

Between 2005 and 2016, the majority of published, evaluated obstetric quality improvement initiatives in the U.S. and Canada addressed at least one area of practice posing high medical-legal risk to physicians. The large body of work in some areas with favourable outcomes, especially to improve collaborative care and induction and augmentation, is encouraging. We urge obstetrical teams to implement quality improvement interventions by considering their own context, selecting from the variety of interventions already evaluated, and drawing insights from our review. Quality improvement methodologists can assist in these efforts. Clinical outcomes are important to measure, but process of

care outcomes will signal progress more rapidly. Regardless of study findings, we encourage obstetrical teams to publish their quality improvement efforts for efficient quality improvement. A strategic approach to quality improvement that considers medical-legal risk may help physicians to engage in meaningful process improvements while mothers and infants potentially receive safer care.

REFERENCES

1. Delivery in focus: Strengthening obstetrical care in Canada. Ottawa, Ontario: Healthcare Insurance Reciprocal of Canada and the Canadian Medical Protective Association, 2018.
2. Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion. Severe maternal morbidity in the United States. In: Prevention CfDCa, ed.: U.S. Department of Health and Human Services, 2014.
3. Committee on Quality of Health Care in America, Institute of Medicine. To Err is Human: Building a Safer Health System. Washington, D.C.: National Academy Press 2000.
4. D'Alton ME, Main EK, Menard MK, et al. The National Partnership for Maternal Safety. *Obstet Gynecol* 2014;123(5):973-7. doi: 10.1097/AOG.0000000000000219
5. Yang Q, Zhang C, Hines K, et al. Improved hospital safety performance and reduced medico-legal risk: an ecological study using 2 Canadian databases. *CMAJ Open* 2018;6(4):E561-6. [published Online First: 20 Nov 2018]
6. Schaffer AC, Jena AB, Seabury SA, et al. Rates and characteristics of paid malpractice claims among US Physicians by Specialty, 1992-2014. *JAMA Internal Medicine* 2017;177(5):710-18. doi: 10.1001/jamainternmed.2017.0311
7. Obstetrics Services in Canada: Advancing Quality and Strengthening Safety. Ottawa, Ontario: Accreditation Canada, the Healthcare Insurance Reciprocal of Canada, the Canadian Medical Protective Association, Salus Global Corporation, 2016.
8. Moher D, Liberati A, Tetzlaff J, et al. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLOS Medicine* 2009;6(7):e1000097. doi: 10.1371/journal.pmed.1000097
9. Batalden PB, Davidoff F. What is "quality improvement" and how can it transform healthcare? *Qual Saf Health Care* 2007;16(1):2-3. doi: 10.1136/qshc.2006.022046

10. Enhancing Interdisciplinary Collaboration in Primary Health Care. The principles and framework for interdisciplinary collaboration in primary health care. Ottawa, ON: The Conference Board of Canada, 2005.
11. Hempel S, Shekelle PG, Liu JL, et al. Development of the Quality Improvement Minimum Quality Criteria Set (QI-MQCS): a tool for critical appraisal of quality improvement intervention publications. *BMJ quality & safety* 2015;24(12):796-804. doi: 10.1136/bmjqs-2014-003151 [published Online First: 08/26]
12. Health Quality Ontario. Measurement for Quality Improvement. Quality Improvement Primers. Toronto, ON: Health Quality Ontario, 2013.
13. Altimier L, Straub S, Narendran V. Improving Outcomes by Reducing Elective Deliveries Before 39 Weeks of Gestation: A Community Hospital's Journey. *Newborn & Infant Nursing Reviews* 2011;11(2):50-55. doi: 10.1053/j.nainr.2011.04.011
14. Bailit JL, Iams J, Silber A, et al. Changes in the indications for scheduled births to reduce nonmedically indicated deliveries occurring before 39 weeks of gestation. *Obstet Gynecol* 2012;120(2 Pt 1):241-5. doi: 10.1097/AOG.0b013e318260d9b2
15. Beckett CD, Kipnis G. Collaborative communication: integrating SBAR to improve quality/patient safety outcomes. *Journal for healthcare quality : official publication of the National Association for Healthcare Quality* 2009;31(5):19-28.
16. Beitlich P. TeamSTEPPS implementation in the LD/NICU settings. *Nurs Manage* 2015;46(6):15-8. doi: 10.1097/01.NUMA.0000465404.30709.a5
17. Berrien K, Devente J, French A, et al. The perinatal quality collaborative of North Carolina's 39 weeks project: a quality improvement program to decrease elective deliveries before 39 weeks of gestation. *N C Med J* 2014;75(3):169-76.

18. Berry SA, Laam LA, Wary AA, et al. ProvenCare perinatal: a model for delivering evidence/ guideline-based care for perinatal populations. *Jt Comm J Qual Patient Saf* 2011;37(5):229-39.
19. Bolstridge J, Bell T, Dean B, et al. A quality improvement initiative for delayed umbilical cord clamping in very low-birthweight infants. *BMC Pediatr* 2016;16(1):155. doi: 10.1186/s12887-016-0692-9
20. Budin WC, Gennaro S, O'Connor C, et al. Sustainability of improvements in perinatal teamwork and safety climate. *J Nurs Care Qual* 2014;29(4):363-70. doi: 10.1097/NCQ.000000000000067
21. Burke C, Grobman W, Miller D. Interdisciplinary collaboration to maintain a culture of safety in a labor and delivery setting. *J Perinat Neonatal Nurs* 2013;27(2):113-23; quiz 24-5. doi: 10.1097/JPN.0b013e31828cbb2a
22. Burstein PD, Zalenski DM, Edwards JL, et al. Changing Labor and Delivery Practice: Focus on Achieving Practice and Documentation Standardization with the Goal of Improving Neonatal Outcomes. *Health Serv Res* 2016;51 Suppl 3:2472-86. doi: 10.1111/1475-6773.12589
23. Chaillet N, Dumont A, Abrahamowicz M, et al. A cluster-randomized trial to reduce cesarean delivery rates in Quebec. *N Engl J Med* 2015;372(18):1710-21. doi: 10.1056/NEJMoa1407120
24. Clark S, Belfort M, Saade G, et al. Implementation of a conservative checklist-based protocol for oxytocin administration: maternal and newborn outcomes. *Am J Obstet Gynecol* 2007;197(5):480 e1-5. doi: 10.1016/j.ajog.2007.08.026
25. Clark SL, Frye DR, Meyers JA, et al. Reduction in elective delivery at <39 weeks of gestation: comparative effectiveness of 3 approaches to change and the impact on neonatal intensive care admission and stillbirth. *Am J Obstet Gynecol* 2010;203(5):449 e1-6. doi: 10.1016/j.ajog.2010.05.036
26. Clark SL, Meyers JA, Frye DK, et al. Patient safety in obstetrics--the Hospital Corporation of America experience. *Am J Obstet Gynecol* 2011;204(4):283-7. doi: 10.1016/j.ajog.2010.12.034

27. Dadiz R, Weinschreider J, Schriefer J, et al. Interdisciplinary simulation-based training to improve delivery room communication. *Simul Healthc* 2013;8(5):279-91. doi: 10.1097/SIH.0b013e31829543a3
28. Donovan EF, Lannon C, Bailit J, et al. A statewide initiative to reduce inappropriate scheduled births at 36(0/7)-38(6/7) weeks' gestation. *Am J Obstet Gynecol* 2010;202(3):243 e1-8. doi: 10.1016/j.ajog.2010.01.044
29. Doyle JL, Kenny TH, von Gruenigen VE, et al. Implementing an induction scheduling procedure and consent form to improve quality of care. *J Obstet Gynecol Neonatal Nurs* 2012;41(4):462-73. doi: 10.1111/j.1552-6909.2012.01380.x
30. Dunn S, Sprague AE, Fell DB, et al. The use of a quality indicator to reduce elective repeat Caesarean section for low-risk women before 39 weeks' gestation: the Eastern Ontario experience. *J Obstet Gynaecol Can* 2013;35(4):306-16. doi: 10.1016/S1701-2163(15)30957-9
31. Durham L, Veltman L, Davis P, et al. Standardizing criteria for scheduling elective labor inductions. *MCN Am J Matern Child Nurs* 2008;33(3):159-65. doi: 10.1097/01.NMC.0000318351.16106.b3
32. Ehrental DB, Hoffman MK, Jiang X, et al. Neonatal outcomes after implementation of guidelines limiting elective delivery before 39 weeks of gestation. *Obstet Gynecol* 2011;118(5):1047-55. doi: 10.1097/AOG.0b013e3182319c58
33. Einerson BD, Miller ES, Grobman WA. Does a postpartum hemorrhage patient safety program result in sustained changes in management and outcomes? *Am J Obstet Gynecol* 2015;212(2):140-4 e1. doi: 10.1016/j.ajog.2014.07.004
34. Fisch JM, English D, Pedaline S, et al. Labor induction process improvement: a patient quality-of-care initiative. *Obstet Gynecol* 2009;113(4):797-803. doi: 10.1097/AOG.0b013e31819c9e3d
35. Goffman D, Brodman M, Friedman AJ, et al. Improved obstetric safety through programmatic collaboration. *J Healthc Risk Manag* 2014;33(3):14-22. doi: 10.1002/jhrm.21131

36. Govindappagari S, Guardado A, Goffman D, et al. Is Communication Improved With the Implementation of an Obstetrical Version of the World Health Organization Safe Surgery Checklist? *J Patient Saf* 2016 doi: 10.1097/PTS.0000000000000327
37. Grobman WA, Hornbogen A, Burke C, et al. Development and implementation of a team-centered shoulder dystocia protocol. *Simul Healthc* 2010;5(4):199-203. doi: 10.1097/SIH.0b013e3181da5caa
38. Grobman WA, Miller D, Burke C, et al. Outcomes associated with introduction of a shoulder dystocia protocol. *Am J Obstet Gynecol* 2011;205(6):513-7. doi: 10.1016/j.ajog.2011.05.002
39. Grunebaum A, Chervenak F, Skupski D. Effect of a comprehensive obstetric patient safety program on compensation payments and sentinel events. *Am J Obstet Gynecol* 2011;204(2):97-105. doi: 10.1016/j.ajog.2010.11.009
40. Grunebaum A, Dudenhausen J, Chervenak FA, et al. Reduction of cesarean delivery rates after implementation of a comprehensive patient safety program. *J Perinat Med* 2013;41(1):51-5. doi: 10.1515/jpm-2012-0181
41. Hirschhorn LR, Ramaswamy R, Devnani M, et al. Research versus practice in quality improvement? Understanding how we can bridge the gap. *Int J Qual Health Care* 2018;30(suppl_1):24-28. doi: 10.1093/intqhc/mzy018
42. Hsu CD, Cohn I, Caban R. Reduction and sustainability of cesarean section surgical site infection: An evidence-based, innovative, and multidisciplinary quality improvement intervention bundle program. *Am J Infect Control* 2016;44(11):1315-20. doi: 10.1016/j.ajic.2016.04.217
43. Hullfish KL, Miller T, Pastore LM, et al. A checklist for timeout on labor and delivery: a pilot study to improve communication and safety. *J Reprod Med* 2014;59(11-12):579-84.

44. Hutcheon JA, Strumpf EC, Harper S, et al. Maternal and neonatal outcomes after implementation of a hospital policy to limit low-risk planned caesarean deliveries before 39 weeks of gestation: an interrupted time-series analysis. *BJOG* 2015;122(9):1200-6. doi: 10.1111/1471-0528.13396
45. Inglis SR, Feier N, Chetiyaar JB, et al. Effects of shoulder dystocia training on the incidence of brachial plexus injury. *Am J Obstet Gynecol* 2011;204(4):322 e1-6. doi: 10.1016/j.ajog.2011.01.027
46. Iverson RE, Jr., Heffner LJ. Patient safety series: obstetric safety improvement and its reflection in reserved claims. *Am J Obstet Gynecol* 2011;205(5):398-401. doi: 10.1016/j.ajog.2011.03.032
47. Kaimal AJ, Zlatnik MG, Cheng YW, et al. Effect of a change in policy regarding the timing of prophylactic antibiotics on the rate of postcesarean delivery surgical-site infections. *Am J Obstet Gynecol* 2008;199(3):310 e1-5. doi: 10.1016/j.ajog.2008.07.009
48. Kenny TH, Nicodemo JM, Fenton BW, et al. Does enhanced "bundling" criteria improve outcomes? A comparative study of elective inductions. *J Reprod Med* 2013;58(9-10):402-10.
49. Kozhimannil KB, Sommerness SA, Rauk P, et al. A perinatal care quality and safety initiative: are there financial rewards for improved quality? *Jt Comm J Qual Patient Saf* 2013;39(8):339-48.
50. Krening CF, Rehling-Anthony K, Garko C. Oxytocin administration: the transition to a safer model of care. *J Perinat Neonatal Nurs* 2012;26(1):25-6. doi: 10.1097/JPN.0b013e318248b1ba
51. Lappen JR, Seidman D, Burke C, et al. Changes in care associated with the introduction of a postpartum hemorrhage patient safety program. *Am J Perinatol* 2013;30(10):833-8. doi: 10.1055/s-0033-1333674
52. Lee AI, Wong CA, Healy L, et al. Impact of a third stage of labor oxytocin protocol on cesarean delivery outcomes. *Int J Obstet Anesth* 2014;23(1):18-22. doi: 10.1016/j.ijoa.2013.09.004
53. Lutgendorf MA, Schindler LL, Hill JB, et al. Implementation of a protocol to reduce occurrence of retained sponges after vaginal delivery. *Mil Med* 2011;176(6):702-4.

54. MacEachin SR, Lopez CM, Powell KJ, et al. The fetal heart rate collaborative practice project: situational awareness in electronic fetal monitoring-a Kaiser Permanente Perinatal Patient Safety Program Initiative. *J Perinat Neonatal Nurs* 2009;23(4):314-23; quiz 24-5. doi: 10.1097/JPN.0b013e3181a1bf07
55. Mancuso MP, Dziadkowiec O, Kleiner C, et al. Crew Resource Management for Obstetric and Neonatal Teams to Improve Communication During Cesarean Births. *J Obstet Gynecol Neonatal Nurs* 2016;45(4):502-14. doi: 10.1016/j.jogn.2016.04.006
56. Mann S, Pratt S, Gluck P, et al. Assessing quality in obstetrical care: development of standardized measures. *Journal of Quality and Patient Safety* 2006;32(9):497-505.
57. Marshall NE, Vanderhoeven J, Eden KB, et al. Impact of simulation and team training on postpartum hemorrhage management in non-academic centers. *J Matern Fetal Neonatal Med* 2015;28(5):495-9. doi: 10.3109/14767058.2014.923393
58. Mazza F, Kitchens J, Kerr S, et al. Eliminating birth trauma at Ascension Health. *Joint Commission Journal of Quality and Patient Safety* 2007;33(1):15-24.
59. McKenna DS, Rudinsky K, Sonek J. Effects of a new patient safety-driven oxytocin dosing protocol on postpartum hemorrhage. *J Pregnancy* 2014;2014:157625. doi: 10.1155/2014/157625
60. Oshiro BT, Henry E, Wilson J, et al. Decreasing elective deliveries before 39 weeks of gestation in an integrated health care system. *Obstet Gynecol* 2009;113(4):804-11. doi: 10.1097/AOG.0b013e31819b5c8c
61. Oshiro BT, Kowalewski L, Sappenfield W, et al. A multistate quality improvement program to decrease elective deliveries before 39 weeks of gestation. *Obstet Gynecol* 2013;121(5):1025-31. doi: 10.1097/AOG.0b013e31828ca096

62. Pettker CM, Thung SF, Lipkind HS, et al. A comprehensive obstetric patient safety program reduces liability claims and payments. *Am J Obstet Gynecol* 2014;211(4):319-25. doi: 10.1016/j.ajog.2014.04.038
63. Pettker CM, Thung SF, Norwitz ER, et al. Impact of a comprehensive patient safety strategy on obstetric adverse events. *Am J Obstet Gynecol* 2009;200(5):492 e1-8. doi: 10.1016/j.ajog.2009.01.022
64. Pettker CM, Thung SF, Raab CA, et al. A comprehensive obstetrics patient safety program improves safety climate and culture. *Am J Obstet Gynecol* 2011;204(3):216 e1-6. doi: 10.1016/j.ajog.2010.11.004
65. Phipps MG, Lindquist DG, McConaughy E, et al. Outcomes from a labor and delivery team training program with simulation component. *Am J Obstet Gynecol* 2012;206(1):3-9. doi: 10.1016/j.ajog.2011.06.046
66. Pratt SD, Mann S, Salisbury M, et al. John M. Eisenberg Patient Safety and Quality Awards. Impact of CRM-based training on obstetric outcomes and clinicians' patient safety attitudes. *Jt Comm J Qual Patient Saf* 2007;33(12):720-5.
67. Raab CA, Will SE, Richards SL, et al. The effect of collaboration on obstetric patient safety in three academic facilities. *J Obstet Gynecol Neonatal Nurs* 2013;42(5):606-16. doi: 10.1111/1552-6909.12234
68. Ralyea CM. For Labor and Delivery staff, how does the implementation of TeamSTEPPS compared to current practice impact quality indicators over a six-month period? Capella University, 2013.
69. Reisner DP, Wallin TK, Zingheim RW, et al. Reduction of elective inductions in a large community hospital. *Am J Obstet Gynecol* 2009;200(6):674 e1-7. doi: 10.1016/j.ajog.2009.02.021

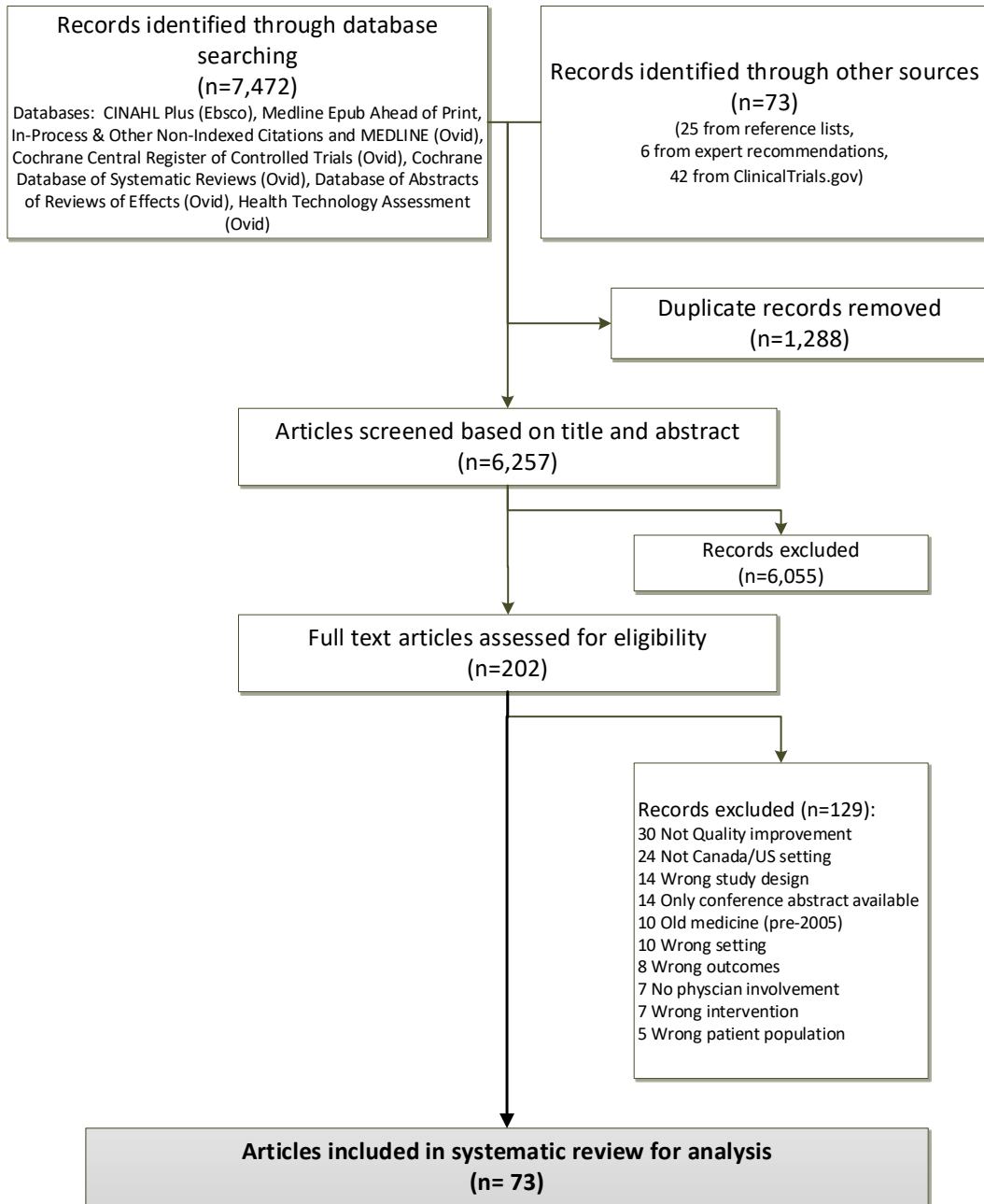
70. Rhinehart-Ventura J, Eppes C, Sangi-Haghpeykar H, et al. Evaluation of outcomes after implementation of an induction-of-labor protocol. *Am J Obstet Gynecol* 2014;211(3):301 e1-7. doi: 10.1016/j.ajog.2014.05.007
71. Riley W, Davis S, Miller K, et al. Didactic and simulation nontechnical skills team training to improve perinatal patient outcomes in a community hospital. *Jt Comm J Qual Patient Saf* 2011;37(8):357-64.
72. Riley W, Meredith LW, Price R, et al. Decreasing Malpractice Claims by Reducing Preventable Perinatal Harm. *Health Serv Res* 2016;51 Suppl 3:2453-71. doi: 10.1111/1475-6773.12551
73. Robertson B, Schumacher L, Gosman G, et al. Simulation-based crisis team training for multidisciplinary obstetric providers. *Simul Healthc* 2009;4(2):77-83. doi: 10.1097/SIH.0b013e31819171cd
74. Rohn AE, Bastek JA, Sammel MD, et al. Unintended clinical consequences of the implementation of a checklist-based, low-dose oxytocin protocol. *Am J Perinatol* 2015;32(4):371-8. doi: 10.1055/s-0034-1387932
75. Santos P, Ritter GA, Hefele JL, et al. Decreasing intrapartum malpractice: Targeting the most injurious neonatal adverse events. *J Healthc Risk Manag* 2015;34(4):20-7. doi: 10.1002/jhrm.21168
76. Scavone BM, Toledo P, Higgins N, et al. A randomized controlled trial of the impact of simulation-based training on resident performance during a simulated obstetric anesthesia emergency. *Simul Healthc* 2010;5(6):320-4. doi: 10.1097/SIH.0b013e3181e602b3
77. Shields LE, Smalarz K, Reffigee L, et al. Comprehensive maternal hemorrhage protocols improve patient safety and reduce utilization of blood products. *Am J Obstet Gynecol* 2011;205(4):368 e1-8. doi: 10.1016/j.ajog.2011.06.084

78. Shields LE, Wiesner S, Fulton J, et al. Comprehensive maternal hemorrhage protocols reduce the use of blood products and improve patient safety. *Am J Obstet Gynecol* 2015;212(3):272-80. doi: 10.1016/j.ajog.2014.07.012
79. Simpson KR, Knox GE, Martin M, et al. Michigan Health & Hospital Association Keystone Obstetrics: a statewide collaborative for perinatal patient safety in Michigan. *Jt Comm J Qual Patient Saf* 2011;37(12):544-52.
80. Simpson KR, Kortz CC, Knox GE. A comprehensive perinatal patient safety program to reduce preventable adverse outcomes and costs of liability claims. *Jt Comm J Qual Patient Saf* 2009;35(11):565-74.
81. Skupski DW, Lowenwirt IP, Weinbaum FI, et al. Improving hospital systems for the care of women with major obstetric hemorrhage. *Obstet Gynecol* 2006;107(5):977-83. doi: 10.1097/01.AOG.0000215561.68257.c5
82. Sweeney J, Maietta R, Olson K. An analysis comparing "Sim Huddles" to traditional simulation for obstetric emergency preparedness. *Nurs Womens Health* 2015;19(1):16-25. doi: 10.1111/1751-486X.12172
83. Thanh NX, Jacobs P, Wanke MI, et al. Outcomes of the introduction of the MOREOB continuing education program in Alberta. *J Obstet Gynaecol Can* 2010;32(8):749-55.
84. Tolcher MC, Torbenson VE, Weaver AL, et al. Impact of a labor and delivery safety bundle on a modified adverse outcomes index. *Am J Obstet Gynecol* 2016;214(3):401 e1-9. doi: 10.1016/j.ajog.2016.01.155
85. Ventre KM, Barry JS, Davis D, et al. Using in situ simulation to evaluate operational readiness of a children's hospital-based obstetrics unit. *Simul Healthc* 2014;9(2):102-11. doi: 10.1097/SIH.0000000000000005

86. Wagner B, Meirowitz N, Shah J, et al. Comprehensive perinatal safety initiative to reduce adverse obstetric events. *Journal for healthcare quality : official publication of the National Association for Healthcare Quality* 2012;34(1):6-15. doi: 10.1111/j.1945-1474.2011.00134.x
87. Young BC, Hacker MR, Dodge LE, et al. Timing of antibiotic administration and infectious morbidity following cesarean delivery: incorporating policy change into workflow. *Arch Gynecol Obstet* 2012;285(5):1219-24. doi: 10.1007/s00404-011-2133-1
88. Clark S, Belfort M, Saade G, et al. Implementation of a conservative checklist-based protocol for oxytocin administration: maternal and newborn outcomes. *Am J Obstet Gynecol* 2007;197:480.e1-80.e5. doi: 10.1016/j.ajog.2007.08.026
89. King HB, Battles J, Baker DP, et al., editors. *TeamSTEPPS™: Team Strategies and Tools to Enhance Performance and Patient Safety BTI - Advances in Patient Safety: New Directions and Alternative Approaches (Vol. 3: Performance and Tools)*: Agency for Healthcare Research and Quality (US) CTI - Advances in Patient Safety, 2008.
90. Gross B, Rusin L, Kiesewetter J, et al. Crew resource management training in healthcare: a systematic review of intervention design, training conditions and evaluation. *BMJ open* 2019;9(e025247):1-13. doi: 0.1136/bmjopen-2018-025247
91. Sexton JB, Helmreich RL, Neilands TB, et al. The Safety Attitudes Questionnaire: psychometric properties, benchmarking data, and emerging research. *BMC Health Serv Res* 2006;6:44. doi: 10.1186/1472-6963-6-44
92. Muraca GM, Sabr Y, Lisonkova S, et al. Morbidity and Mortality Associated With Forceps and Vacuum Delivery at Outlet, Low, and Midpelvic Station. *J Obstet Gynaecol Can* 2019;41(3):327-37. doi: 10.1016/j.jogc.2018.06.018
93. Joint Position Paper Working Group. Joint position paper on rural maternity care. *Canadian Journal of Rural Medicine* 2012;17(4):135-41.

94. Bates DW, Singh H. Two decades since to Err is Human: an assessment of progress and emerging priorities in patient safety. *Health Affairs* 2018;37(11):1736-43.
95. Institute for Healthcare Improvement. Science of Improvement: Establishing Measures. Boston, MA: Institute for Healthcare Improvement, 2012.
96. Calder L, Yang Q, Gondocz T, et al. Developing quality improvement indicators for a patient safety program in obstetrics. Towards an Accord for Change, Annual CAHSPR Conference. Toronto, ON, 2017.
97. Groene O. Patient centredness and quality improvement efforts in hospitals: rationale, measurement, implementation. *International Journal for Quality in Health Care* 2011;23(5):531-37.
98. Institute of Medicine. Crossing the quality chasm: a new health system for the 21st century. Washington, D.C.: Institute of Medicine, 2001.
99. Ogrinc G, Davies L, Goodman D, et al. SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. *BMJ Qual Saf* 2016;25(12):986-92. doi: 10.1136/bmjqs-2015-004411 [published Online First: 2015 Sep 14]
100. MacEachin SR, Lopez CM, Powell KJ, et al. The fetal heart rate collaborative practice project: Situational awareness in electronic fetal monitoring - A Kaiser Permanente perinatal patient safety program initiative. *J Perinat Neonatal Nurs* 2009;23(4):314-23.

FIGURE 1: PRISMA flow diagram



***Appendix** – The appendix including all supplementary tables and figures for this publication are available by request. If you are interested receiving copies, please contact: research@cmpa.org

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