

Taxonomy of effective strategies to reduce unnecessary caesareans: a systematic review

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Abstract

Background: The increasing trend in unnecessary caesarean sections has caused maternal and neonatal health concerns worldwide. Various medical and non-medical interventions have been designed and implemented to reduce caesarian section overuse. However, their efficacy is questionable.

Aims: This study aimed to identify and classify effective interventions to reduce unnecessary caesarian sections.

Methods: We searched EMBASE, MEDLINE, Web of Knowledge and Scopus databases for articles, using appropriate search strategies, up to 2 June 2020. Overall, 7951 identified articles were screened and assessed using a valid quality assessment checklist. Finally, 109 eligible studies were included in this review. Thematic content analysis was used to identify and classify the effective interventions.

Results: Overall, 188 effective caesarian section reduction measures were identified. They were categorized into 45 actions, 16 intervention groups and 6 WHO building blocks, including “governance and leadership”, “financing”, “health workforce”, “medical products and technologies”, “information” and “service delivery”. Using qualified and competent staff, intra-partum services, and oversight were the most commonly applied interventions to reduce unnecessary caesarian sections.

Conclusions: A taxonomy of effective strategies to reduce unnecessary caesarian sections was developed in this study. A holistic approach is crucial to addressing the new epidemic of unnecessary caesarian section. Multiple interventions based on the underlying causes of caesarian section overuse should be designed and implemented at local and global levels.

Keywords: pregnancy, caesarean section, caesarean reduction interventions, unnecessary procedures

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Introduction

Caesarean section (CS), the surgical mode of birth, was introduced to save the lives of mothers and infants, and having access to this procedure is a vital part of comprehensive emergency obstetric care (1). According to the World Health Organization (WHO) statement of 1985, a CS rate of 10–15% at the population level is accepted and there is no justification for having more CSs in any region in the world (2). The WHO readdressed this issue due to the controversy on the optimum CS rate in 2015 and emphasized that a rate greater than 10% had no benefit for reducing maternal and neonatal mortality. Considering the potential risks, it was strongly recommended to restrict performing the procedure to medically indicated reasons and applying appropriate interventions to prevent unnecessary CSs.

Moreover, more research has been called for to investigate the immediate and future effects of CS on health (3). However, the global figures show an increasing trend worldwide. The average CS rate rose from 6.7% in 1990 to 21% in 2015, with a 3.7% average annual increase

from 2000 to 2015 (4). The WHO experts estimated that a third of CS procedures, about 6 million worldwide each year, were unnecessary in 2010 (5).

A variety of reasons, from health system-related issues to health care user's concerns, affect the rising trend of CS (6). Fear of labour pain or assumed damage to the body and baby or even the temptation of choosing the baby's date of birth are some reasons for a women to request CS (7,8). In addition, private practice, defensive medicine, financial incentives and convenience induce physicians to perform more CSs (9). Generating revenues for hospitals, financial reimbursements and quality of maternity services are some of the reasons rooted in the health system (9).

There is robust evidence that costly unnecessary CSs (5) are associated with increased maternal and neonatal mortality and morbidity. More surgical complications, hospital readmissions and problems in subsequent pregnancies such as uterine rupture, abnormal placentation, ectopic pregnancy, stillbirth, and preterm birth have been reported after a CS (9,10). Surgically born

babies are more prone to neonatal death and neonatal intensive care unit (NICU) admissions due to serious complications. They might also suffer from short-term health risks like altered immune development, allergy, atopy, asthma, and reduced intestinal gut microbiome diversity and long-term risks such as type 1 diabetes, asthma, overweight and even cognitive and educational problems (10).

Target 3.1 of the United Nations Sustainable Development Goals asks states to reduce their maternal mortality ratio by 2030 (11). Obviously, preventing unnecessary caesareans would protect women and babies from the adverse effects of this surgical procedure. Various strategies have been introduced and applied worldwide to combat the epidemic of unnecessary CS. There have been some systematic reviews on solo interventions such as continuous support during childbirth (12) or controlling mothers' fear of labour (13). Valuable studies on antenatal and intrapartum interventions (14) and nonclinical interventions (15) have been published in recent years too, which have provided robust evidence for designing caesarean reduction strategies. However, considering the complex and complicated nature of CS overuse, a holistic approach is needed to control the increasing trend worldwide.

The 6 building blocks of the health system, governance and leadership, financing, health workforce, medical products and technologies, information and service delivery (16), should be considered in any comprehensive health related plan. Hence, this study aimed to identify effective interventions to reduce unnecessary caesareans and classify them using the WHO 6 building blocks framework.

Methods

This was a systematic review of studies. It followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline (17). Studies were searched systematically, identified, screened and reviewed. We systematically searched 4 electronic databases, EMBASE, PubMed (MEDLINE), Web of Knowledge and Scopus, and 2 search engines (Google scholar and Google) to identify relevant articles published up to 2 June 2020. The PICO (population, intervention, comparison, and outcome) search strategy tool was used to develop an effective strategy. English language original quantitative studies in which the participants were pregnant women, with any intervention aiming to decrease caesarean or increase vaginal births and with statistically

significant results were included in this study. The search strategy involved 3 components (caesarean, reduction and strategies). In addition, medical subject headings (MeSH) terms were used. Table 1 shows the search strategy in the PubMed database.

The initial search identified 7951 articles. After deleting duplicates, initial assessment of 7682 titles and abstracts was done by screening them against the inclusion and exclusion criteria by 2 researchers (all by LE and 20% by ST). Disagreements were resolved through discussion or by consulting a third reviewer (AMM). Then, the quality of articles was assessed using a quality assessment checklist (18). This tool evaluates the quality of articles in 5 areas (literature review and identification of research gaps, research questions and design, population and sampling, data collection and capture, and analysis and results). All articles were scored on a 4-point Likert scale: 0 (not present/not reported), 1 (present but low quality), 2 (present and midrange quality) and 3 (present and high quality). Each article was rated independently by 2 researchers and disagreements were resolved through discussion or by consulting a third reviewer if necessary. Those articles with a core of ≥ 10 out of 15 were included in this study. Ultimately 109 studies were eligible (Figure 1).

A data extraction form covering the authors' names, publication year, country, research method, sample size, interventions, results and article quality scores was used in this study. Thematic content analysis was applied for data analysis. First the interventions were read and data were coded according to their content. Then, similar codes were grouped into themes called actions; similar actions were grouped as intervention groups. Finally, similar interventions were grouped and classified under the WHO 6 building blocks.

Results

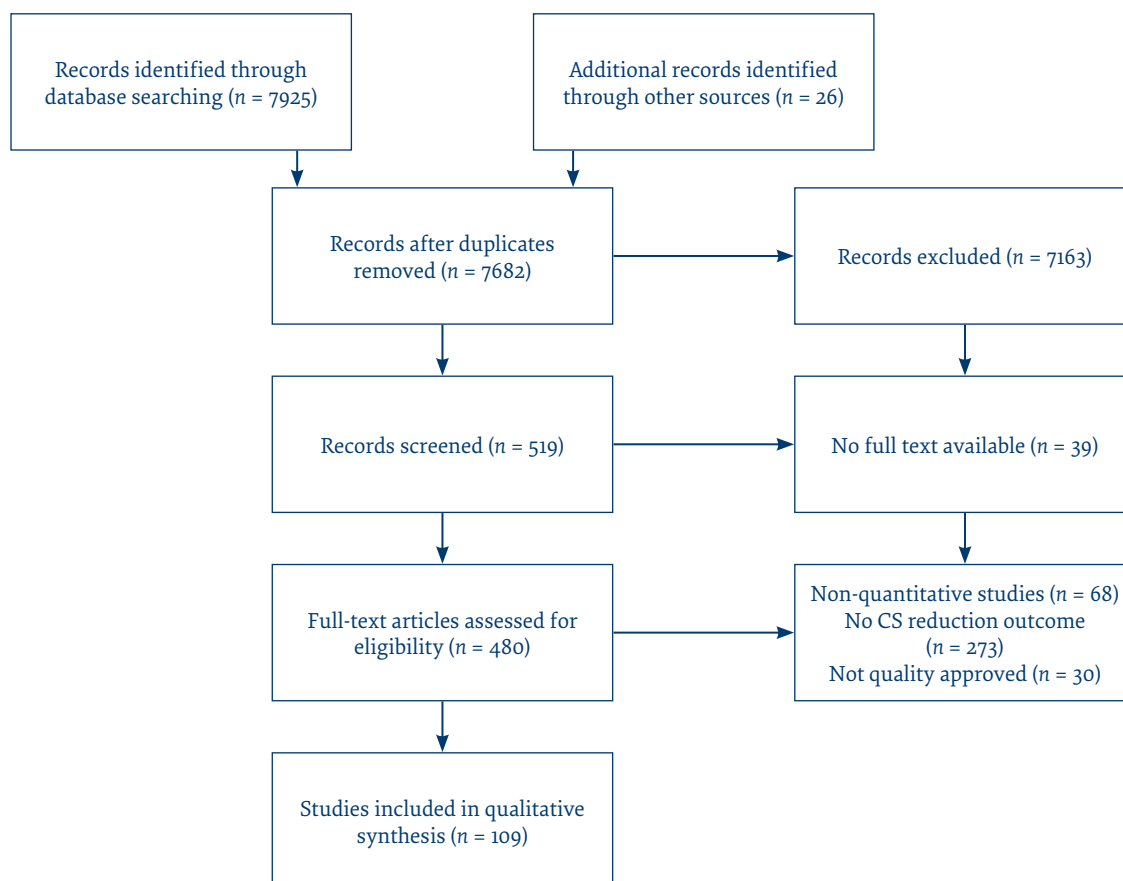
Overview

One hundred and nine (109) original quantitative studies employing observational (75.2%), experimental (22.9%) and quasi-experimental (1.8%) methods were included in this review. They were published from 1988 to 2020, mostly 2010–2020 (70%). The majority of studies were carried out in the United States of America (USA) (29%), followed by the Islamic Republic of Iran (11.2%) and Canada (8.4%). Considering the WHO regions, these studies were conducted in the Americas (41.3%), Europe (23.9%), Western Pacific (17.4%), Eastern Mediterranean (11.9%),

Table 1 Search strategy terms in PubMed

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(((Intervention? OR program OR project OR "evidence based" OR policy OR education adj2 (program OR meeting? OR session? OR strateg OR workshop? OR visit?))) AND ("Caesarean Section"[Mesh] OR "Parturition"[Mesh] OR "Delivery, Obstetric"[mesh] OR "Caesarean Sections"[tiab] OR "Delivery, Abdominal"[tiab] OR "Abdominal Deliveries"[tiab] OR "Deliveries, Abdominal"[tiab] OR "Caesarean Section"[tiab] OR "Caesarean Sections"[tiab] OR "Abdominal Delivery"[tiab] OR "C-Section (OB)"[tiab] OR "C Section (OB)"[tiab] OR "C-Sections (OB)"[tiab] OR "Postcesarean Section"[tiab] OR "Delivery, Obstetric"[tiab] OR "Deliveries, Obstetric"[tiab] OR "Obstetric Deliveries"[tiab] OR "Obstetric Delivery"[tiab] OR "Parturition"[tiab] OR "Parturitions"[tiab] OR "Birth"[tiab] OR "Births"[tiab] OR "Childbirth"[tiab] OR "Childbirths"[tiab] OR VBAC OR "Vaginal Birth After Cesarean")) AND ((Elective OR voluntary OR chosen OR willing OR Elective Cesarean?))
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Figure 1 Flow chart outlining search strategy and selection of articles on caesarean section (CS) up to 2 June 2020



Africa (3.7%) and South-East Asia (1.8%) regions. A descriptive summary of the studies is presented in Table 2.

Overall, 188 codes (measures) were identified and classified into 45 effective actions to reduce unnecessary

CSs. These actions were grouped into 16 intervention groups and finally classified into the WHO 6 building blocks (Table 3). The most commonly used interventions were: using qualified and competent staff (17.4%),

Table 2 Descriptive summary of the studies reviewed

Element	Details
Publication year	Range: 1988–2020 Mode: 2017 (16 studies)
Sample size	Range: 67–10 171 742 deliveries Median: 5201
Method (No.)	
Observational (82)	Case-control (5), cross sectional (7), prospective cohort (10), retrospective cohort (60)
Experimental (25):	Cluster randomized controlled trial (4), non-randomized controlled trial (1), randomized controlled trial (20)
Quasi-experimental (2)	Natural experiment design (1), before-after (1)
Country (No.)	
Single country studies (107)	USA (31), Islamic Republic of Iran (12), Canada (9), China (9), Australia (5), Sweden (5), Taiwan (3), UK (3), Brazil (2), India (2), Ireland (2), Israel(2), Italy (2), Spain (2), Turkey (2), Burkina Faso (1), Lithuania(1), Chile (1), Denmark (1), Ecuador (1), Egypt (1), Finland (1), Jordan (1), Lithuania (1), New Zealand (1), Pakistan (1), Portugal (1), Singapore (1), The Netherlands (1), Ukraine (1), Zimbabwe (1)
Studies in > 1 country (2)	UK and the Netherlands (1), Latin America (1)
WHO Region (No.)	Americas (45), Europe (26), Western Pacific (19), Eastern Mediterranean (13), Africa (4), South-East Asia (2)
No. of interventions applied in each study	1: 60 studies ≥ 2: 49 studies
Quality assessment score (15 scores)	Range: 10–15 Median: 13

Table 3 A taxonomy of interventions to reduce unnecessary caesarean section (CS)

Building block	Intervention	Action
Governance & leadership	Legislation	Laws, regulations
	Policy-making	CS rate goal setting, policies
	Planning	Care models, quality improvement plans, patient safety plans
	Promotion	Use of media for promoting normal birth, nongovernmental organization collaboration
	Oversight	Audit, peer review, second opinion, evaluating and ranking obstetrics centres
	Leadership	Leading by obstetricians, leading by midwives
Financing	Institution reimbursement	Fixed per patient reimbursement, pay-for-performance
	Provider reimbursement	Fixed per patient reimbursement, pay-for-performance
Health workforce	Qualified & competent staff	Optimizing health workforce, staff education and training, supervising obstetrics residents, changing staff attitude towards normal delivery
	Team work	Group health providers, collaborative care
Medical products & technologies	Medicine	Using induction drugs, using medicines for regional anaesthesia
	Equipment & technology	Using equipment and techniques to facilitate birth, using fetal wellbeing assessment technologies
Information	Data gathering & analysis	Electronic medical records, measuring indicators, classification of CS
	Information dissemination	Giving feedback to obstetricians, external dissemination of information
Service delivery	Prenatal services	Dietary counselling, exercise plan in prenatal period, control the woman's fear, prenatal education, prenatal special clinics
	Intra-partum services	Protocol (evidence)-based practice, continuous care, physical and emotional support, physiologic birth, pain control services, vaginal birth after caesarean delivery

intra-partum services (14.1%) and oversight (13.7%). The interventions reported in the articles we reviewed for this study are summarized in Table 4 and some examples are described below.

Governance and leadership

Legislation, policy-making, planning, promotion, oversight and leadership interventions were classified as sub-groups of the governance and leadership building block. Laws and regulations enforced the reduction of unnecessary CSs in some countries. In Texas (USA), a law was passed to eliminate Medicaid payment for early elective deliveries in 2011; this was followed by Georgia, Michigan, New Mexico, New York and South Carolina in 2013 (19). In China, rules and regulations were also applied to control caesarean delivery on maternal request, and obliged providers to encourage mothers to choose vaginal delivery (20).

Policy-making, including setting goals and defining policies, was also employed. In North Carolina, a target of 28.5% reduction in CS (27.9% to 21.7%) for nulliparous women with a term, singleton pregnancy and vertex presentation was set in 3 hospitals in 2015. The hospitals achieved a 19.7% CS rate, beyond the established goal (21). National and provincial policies were established in some countries such as the Normal Delivery Promotion Plan in the Islamic Republic of Iran (22) and the Healthy Texas Babies initiative in the USA (19).

Planning included designing different models of care, quality improvement or patient safety programmes. The community-based model for continuity of care (23) and

the team-based shared-care model (24) were successful in reducing caesareans in Australia and Canada. The Lean Six Sigma technique was adopted in Tiazhou, a tertiary hospital in Zhejiang province, China in 2014. Using the Lean Six Sigma methodology (define, measure, analyse, improve and control) reduced the CS rate from 41.8% to 32% over a period of 10 months (25). The Patient Safety Bundle™ is a patient safety programme implemented in 3 hospitals in North Carolina, USA. It comprised 4 stages: readiness, recognition and prevention, response, and reporting and systems learning, and resulted in a reduction in the CS rate from 27.9% to 19.7% (21).

Promotional interventions through collaboration with media and nongovernmental organizations were also influential in reducing the CS rate. Public campaigns to raise awareness about caesarean like the “Go the Full 40” campaign in the USA were launched (26). Social media and nongovernmental organization collaboration, creating a special WeChat group, holding professional forums on www.dxy.cn (the largest Chinese biomedical blog), and providing a monthly webinar called “Modern L&D Virtual Lecture Hall” via YY Voice, a Chinese web-based education application, were used to promote a CS reduction plan in China (27).

Oversight was one of the most commonly used interventions, employed in almost every plan to reduce caesarean overuse. It was implemented by conducting medical audits and peer reviews and asking for second opinions (28,29). The performance of birth facilities was also evaluated, ranked and reported to the public in some countries like China and the USA (21,30).

Table 4 Characteristics of the studies reviewed (n = 109)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Bartusevičienė et al. (2018)	Retrospective cohort 2667	Lithuania	Midwifery-led care	CS rate was 4.4 and 5.2% in the midwife-led and 10.7 and 11.8% in the obstetrician-led group in 2012 and 2014 ($P < 0.001$)	14
Pérez et al. (2018)	Retrospective cohort 53 338	Spain	Standardized multifaceted strategy, defining indications for emergency and scheduled CSs, encouraging protocol-based practice, continuous monitoring the indicators, external audit, feedback to providers, professional training and publishing the CS results	CS rate decreased by 1.19 percentage point (from 22.69% to 21.50%; 95% CI: 0.48–1.90).	11
Davies-Tuck et al. (2018)	Retrospective cohort 833 231	Australia	Planned home birth	Unplanned CS for low risks was 2.5% in home birth group compared to 12.5% in hospital ones ($P < 0.001$) and for high risks 8.9% vs 39.4% ($p < 0.001$).	14
De Jonge et al. (2017)	Retrospective cohort 141 472	UK & the Netherlands	Providing maternity services for low risk women in midwife-led settings	CS rates were higher among low risk English obstetric unit births compared to Dutch midwife-led hospital births (AOR 1.89 (95% CI: 1.64 to 2.18) and 3.66 (2.90 to 4.63) respectively).	14
Fisch et al. (2009)	Retrospective cohort 15 329	USA	Induction audit: development and enforcement of induction guidelines, peer review, medical staff education	CS rate in nulliparas with elective induction dropped 60% from 34.5% to 13.8% ($P = 0.01$).	14.5
Gardner et al. (2014)	Prospective cohort 396	Australia	"Next birth after caesarean" clinic run by 3 high-risk obstetric consultants to counsel and support women deciding on mode of birth for their next pregnancy after a primary CS	Overall vaginal birth after caesarean delivery (VBAC) rate improved from 17.2% to 27.0% ($P < 0.001$).	13
Gilbert et al. (2013)	Prospective cohort 15 800	USA	Improving hospital obstetric quality measures by improving data collection, providing consistent and accurate data reporting and making physicians' performance transparent	CS rate in nulliparous term singleton vertex decreased from 31.3% to 24.7% ($R^2 = 0.28$; $P < .001$).	15
Grigg et al. (2017)	Prospective cohort 692	New Zealand	Freestanding midwifery care for low risk births	More spontaneous vaginal birth in freestanding midwifery care group (77.9% vs 62.3%, adjusted OR 1.61; 95% CI: 1.08–2.39).	15
Hickland et al. (2018)	Retrospective cohort 356	Ireland	Breech clinic to counsel women on management of breech presentation and performing external cephalic versions	Number of breech term CSs decreased from 199 to 154.	10
Kaboré et al. (2016)	Cluster randomized controlled trial 4174	Burkina Faso	Use of clinical algorithms for CS decision-making, in-site training, audits and feedback of caesarean indications	CS rate decreased in the intervention group (18.96 to 6.56%) compared with the control group (18.27 to 23.30%); OR for incremental change over time, adjusted for hospital and patient characteristics, 0.22; 95% CI, 0.14 to 0.34; ($P < 0.001$)	15
Kozhimannil et al. (2018)	Retrospective cohort 671 177	USA	Blended payment policy, which is single payment for birth regardless of mode of delivery to reduce financial incentives for performing CS	CS rate in intervention state decreased 3.24 percentage points, compared with control states ($P = 0.01$).	15
Lesieur et al. (2018)	Retrospective cohort 250 564	USA	CS audit and provision of training to trainee doctors at the maternity facility	Audits (19.83%, $\beta = -2.48$, $P = 0.03$) and training the trainee doctors (20.28%, $\beta = -1.08$, $P = 0.04$) were associated with CS reduction over the 4 years.	13
Liao et al. (2019)	Cross sectional 93745	China	Introducing 2-child policy	Overall CS rate of 2 provinces decreased from 45.1% to 38.9% ($p < 0.001$).	14

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Meng et al. (2019)	Natural experiment design 17 322	China	Episode-based bundled payment (EBP) for childbirth by lowering uncomplicated caesarean tariff (from ¥5352 to ¥3600) and increasing uncomplicated vaginal birth tariff (from ¥1591 to ¥2000) and payment for complex conditions still on a fee-for-service basis	The EBP reform was associated with a 33.97% (= 1-EXP-0.4150, $P < 0.01$) decrease in the probability of caesarean delivery	11
Miuto et al. (2018)	Retrospective cohort 187 704	USA	Hard stop policy limiting elective early delivery, required review and approval for scheduled caesareans and inductions of labour, occurring prior to 39 weeks gestation with no documented medical indication	Overall CS prevalence dropped from 26.8% to 25.8% ($P < 0.001$)	13.5
Ogunyemi et al. (2018)	Prospective cohort 11 715	USA	Safety bundle with a focus on natural labour consisting of research on local CS risk factors, provider and patient education, multidisciplinary reviews based on published guidelines, feedback, provider report cards and encouraging commitment to labour duration guidelines	CS rate in primary singleton vertex decreased from 23.4% to 14.1% and the nulliparous term singleton vertex rate decreased from 34.5% to 19.2% ($P < 0.0001$)	13
Overgaard et al. (2018)	Retrospective cohort (with matched control group) 1678	Denmark	Freestanding midwifery unit versus obstetric unit for low risks	More spontaneous vaginal birth among women managed in freestanding midwifery units (1.06, 1.03 to 1.09) $P < 0.0001$	14.5
Ozdemir et al. (2018)	Case-control 100	Turkey	Systematic birth preparation programme, including prenatal, postnatal, and neonatal care, providing information about changes in pregnancy, possible emergencies, physical exercise programme, breathing techniques, hydrotherapy, aromatherapy, and reflexology, newborn care and breastfeeding	More vaginal delivery (group A: 78%, group B: 56%) and less maternal request for elective CS (group A: 8%, group B: 28%).	10
Rasouli et al. (2017)	Randomized controlled trial 234	Iran	Motivational interviewing	1.4 times higher natural delivery (68.4% vs 48.1%, 95% CI: 1.1–1.8)	14
Rouhe et al. (2013)	Randomized controlled trial 371	Sweden	Psychoeducative group therapy starting at 26 weeks pregnancy	More spontaneous vaginal delivery (63.4% vs 47.5%, $P = 0.005$) and fewer CSs (22.9% vs 32.5%, $P = 0.05$)	13
Runmei et al. (2012)	Retrospective cohort 25 280	China	Quality improvement programme including staff education, pay cut for nonindicated CSs, daily CS audit, protocol, prenatal education, non-medical CS stated as unnecessary CS in hospital records, filling consent for mothers insisting on CS, goal setting, evaluating maternal and perinatal outcomes	Significant CS reduction from 54.8% to 40.3% (OR 0.56; 95% CI: 0.52–0.59; χ^2 test: $P < 0.001$).	15
Safari-Faramani et al. (2016)	Retrospective cohort 33 888	Iran	Normal delivery promotion plan	Overall CS and first time CS decreased from 54.5 and 54.1% to 49.6 and 47% at the end of the period ($P < 0.0001$).	11
Shaffer et al. (2011)	Retrospective cohort 3258	USA	Trial of manual cephalic rotation for occiput posterior (OP) or transverse (OT) position in the second stage of labour	Less likelihood of CS in manual cephalic rotation group [adjusted OR 0.12; 95% CI: 0.09–0.16].	10
Shakiba et al. (2020)	Single-blind clinical trial 120	Iran	Prenatal motivational interview	Less CS in intervention group ($P = 0.03$).	10

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Taberi et al. (2014)	Case-control 130	Iran	Self-efficacy education with discussions, lectures, exercise and sharing the experience of normal deliveries by other new mothers	More normal delivery in intervention group (71.4%) compared to control group (53.8%) $P < 0.001$.	12
Thuillier et al. (2018)	Retrospective cohort 6351	USA	Introducing new guidelines and redefining the threshold of active labour (from 4 to > 6 cm) and arrest of first and second stage of labour	CS rate decreased from 9.4% to 6.9% (OR 0.71, 95% CI: 0.59-0.85; $P < 0.01$).	13,5
Vadnais et al. (2017)	Retrospective cohort 15 144	Israel	Quality Improvement Initiatives including provider education, guideline-based practice, CS audit and feedback	Total and nulliparous term single vertex CS decreased from 40.0% and 34.8% to 29.1% and 21.2% in 2015 ($P < 0.05$).	11
Van Dillenet al. (2008)	Retrospective cohort 2437	Netherlands	Daily CS audit in report meetings	Total CS rate decreased from 23.4% to 18.7% ($P < 0.01$)	14
Wong et al. (2015)	Retrospective cohort 1646	Australia	Continuity midwifery model in which a designated midwife provides all care in pregnancy, is 'on call' for and cares for her in labour and provides postnatal support for 2 weeks	Increased rates of normal vaginal birth (57.7% vs 48.9% $P = 0.002$) and spontaneous vaginal birth (38% vs 22.4% $P < 0.001$), decreased rates of instrumental birth (23.5% vs 28.5% $P = 0.050$) and CSs (18.8% vs 22.5% $P = 0.115$) in the midwifery continuity cohort	15
Xia et al. (2019)	Repeated cross-sectional 1 921 932	China	Professionals training, including health education professionals, obstetricians, paediatricians, neonatologists, anaesthesiologists, neonatal nurses, public education, mothers' education, near-miss centre capacity-building, use of film, posters, leaflets, TV, newsletters, social network, city LCDs	Monthly CS rate declined across the intervention stages ($Z = 75.067$, $P < 0.001$), with an average rate of 42.4% at baseline, 39.8% at Stage 1, and 35.0% at Stage 2	15
Ziadeh et al. (1995)	Retrospective cohort 58 979	Jordan	Guidelines for managing dystocia, previous caesarean delivery, fetal distress and breech presentation, an anaesthesiologist available 24/7 and epidural anaesthesia to 30% of patients	CS rate decreased from 15.5% in 1987 to 8.7% in 1993	10
Lokugamage et al. (2020)	Prospective cohort 6335	UK	Birth preparation and weekly acupuncture sessions from 37 weeks of gestation	More normal births (OR 0.76, 95% CI: 0.64–0.91)	13
Abdel-Aleem et al. (2005)	Randomized controlled trial 438	Egypt	Therapeutic amniocentesis	Significant CS reduction for fetal distress in the amniocentesis group (RR, 0.7; 95% CI, 0.6–0.83)	10,5
Acanfora et al. (2013)	Single-blind randomized controlled trial 80	Italy	Use of the Baby-guard system	Fewer caesarean deliveries ($P < 0.02$)	12
Aghlmand et al. (2008)	Retrospective cohort 100	Iran	Quality improvement care model including use of admission and care guidelines and patient education	CS rate decreased from 42% to 30%, the relative risk of CS was significantly higher before the plan (RR = 3.55, 95% CI: 2.07–6.07)	12
Alkoury et al. (1998)	Case-control 1105	Canada	Active management of labour	CS rate decreased from 13% to 4.3% ($P < 0.005$)	11
Altman et al. (2017)	Retrospective cohort 1441	USA	Labour and delivery care managed by midwives or nurse-midwives	Lower CS in women managed by nurses and midwives (OR, 0.29, 95% CI, 0.12-0.69, $P = 0.005$)	13

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Annapoorna et al. (1997)	Non-randomized controlled trial 478	Singapore	External cephalic version with the use of tocolysis and vibroacoustic stimulation for breech pregnancies	Overall CS rate in the study group was 32.5% comparing to 51.4% in control group. The study group had significantly lower CSs (nulliparas $P < 0.007$, multiparas $P < 0.005$)	12
Arefi et al. (2015)	Case-control 140	Iran	Prenatal education (BASNEF method)	Lower CS rate in case group (25.7%) than control group (60%), $P < 0.001$	14
Attanasio et al. (2018)	Cross-sectional 16 4653	USA	Labour and delivery care managed by midwives	Lower odds of birth by CS (a OR, 0.70, 95%CI, 0.59-0.82) in the setting with 15-40% of birth attended by midwives compared to no midwife attended births	15
Ayres De Campos et al. (2015)	Retrospective cohort 133 228	Portugal	National action: protocol-based practice, no unnecessary labour inductions before 41 weeks of gestation, promotion of VBAC, use of external cephalic version, regular CS audits, dissemination of obstetric indicators, staff training (fetal monitoring and simulation-based training of obstetric emergencies), an important percentage of hospital funding was in dexed to the annual CS rate, CS issue presented in national scientific meetings and scientific publications	CS rate decreased 15.4%, from 33.2 to 28.1%, time trend ($P < 0.001$)	11
Bala et al. (2018)	Randomized controlled trial 150	India	Delayed amniotomy	Overall CS rate was higher in the early amniotomy group (10.7%) comparing with delayed amniotomy (2.7%), $P < 0.0495$	13
Barakat et al. (2012)	Randomized controlled trial 290	Spain	Structured, moderate-intensity exercise programme including light resistance, toning, aerobic dance and pelvic floor exercises during the entire length of pregnancy	CS rate in the exercise group were lower than in the control group (15.9%, $n = 22$; vs 23%, $n = 35$, $P = 0.03$)	13
Bardos et al. (2017)	Retrospective cohort 5201	USA	Senior obstetrician-gynaecologist coverage on the labour floor during the daytime to supervise resident deliveries and help teach operative, specifically forceps deliveries.	CS rate significantly decreased from 27.3% to 24.5% (adjusted OR 0.68, 95% CI: 0.55-0.83)	15
Bastani et al. (2006)	Randomized controlled trial 110	Iran	Applied relaxation training (6 sessions)	CS rate in intervention group was 15.4% comparing to 40.4% in control group ($P = 0.001$)	15
Beigi et al. (2003)	Double-blind randomized controlled trial 156	Iran	Cervix ripening by 200 µg oral mesoprostol	CS rate was significantly lower in the misoprostol group 12.8% vs 28.2 ($P < 0.05$)	14
Bell et al. (2017)	Retrospective cohort 834	USA	Patient safety bundle: building culture of spontaneous vaginal birth, goal setting (21.7%), adapting protocols (admission, induction, dystocia, fetal distress, assessment of hospitals and individuals, performance, training for physicians and nurses, leadership by 4 physician leaders, use of peanut ball, mother and family education, mothers' education and support during labour, data collection from electronic records	CS rate in nulliparous, term, singleton, vertex decreased from 27.9% to 19.7% (OR 0.63, 95% CI: 0.46-0.88).	13

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Benatar et al. (2013)	Retrospective cohort 423 859	USA	Delivery in birth centres and managed by freestanding midwives	Significantly less CS in the freestanding birth centre group compared with usual care (19.7% vs 29.4%, OR 0.59, $P < 0.01$)	14
Berglund et al. (2010)	Retrospective cohort 7227	Ukraine	Provision of training on "effective perinatal care", including clinical activities and a team approach to maternity care for all staff (obstetricians, neonatologists, midwives, paediatric nurses, paediatricians and anaesthesiologists)	CS rate dropped significantly in 2 maternity centres (from 30% and 33% to 18.4% and 12%, $P < 0.001$)	12
Bergström et al. (2010)	Retrospective cohort (secondary analysis of randomized controlled trial) 857	Sweden	Use of psychoprophylaxis	Lower risk of emergency CS (adjusted OR 0.57; 95% CI: 0.37–0.88)	13.5
Dahlen et al. (2017)	Retrospective cohort 10 171 742	USA	Healthy Texas Babies initiative, including payment reform was implemented; passing a law to eliminate Medicaid payment for early elective delivery, adding coding modifiers to billing codes to identify unnecessary delivery before 39 weeks gestation	Adjusted change of CS in Texas was -0.61 , $P < 0.001$, adjusted difference-in-differences change in Texas vs 3 states without collaborative efforts or legislative changes were: -0.51 , -0.68 , -1.12 , $P < 0.001$	15
Doyle et al. (2014)	Randomized controlled trial 233	Ireland	Ten prenatal home visits, providing information on healthy prenatal behaviours and the birthing experience	Less CS rate in intervention group (15.1%) compared to the control group (25%), OR 0.53, 95% CI: 0.27, 1.07 ($P < 0.05$)	15
Gagnon et al. (1999)	Retrospective cohort (secondary analysis of a randomized controlled trial) 100	Canada	Continuous one-to-one care to women by maternity nurses providing physical and emotional support and applying relaxation methods, training for maternity nurses every 3 months	56% reduction in the risk of total CS (RR of experimental vs control = 0.44, 95% CI: 0.19–1.01)	14
Gregory et al. (1999)	Prospective cohort 38 541	USA	Continuous quality improvement: physician education about CS indications in grand rounds and before the programme started, all clinical and non-clinical staff involvement in CS reduction programme (collaboration of leading obstetricians, nurse-physician meetings regarding alternative pain management strategies for latent phase and new arrivals: late active phase (> 8 cm), physicians, nurses and residents' focus groups on attitude about VBAC, feedback on pitocin protocol, formed department CS reduction task force, providing physician-specific data before intervention, dissemination of CS rate of physicians (anonymously) and hospital every 3 months, survey of nurse strategy for labour support, role play regarding nursing interventions for labour support, precertification for (elective) CSs and inductions, walking epidurals, ambulatory telemetry and development of department patient education and pamphlet on VBAC	CS rate decreased from 26% in 1993 to 20.5% in 1997 ($P < 0.05$)	10

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Grunebaum et al. (2013)	Retrospective cohort 45 655	USA	Patient safety programme: elimination of scheduled labour induction below 39 weeks without medical indications, define protocols (standardized oxytocin protocol, oxytocin initiation checklist, chain of communication protocol, electronic templates for shoulder dystocia and operative deliveries, labour and delivery team training, staff training (electronic fetal monitoring interpretation certification, obstetric emergency drills, Internet-based reading assignment and testing), recruitment of labourist, physician assistants added to labour and delivery staff, dedicated gynaecology attending, obstetric patient safety nurse, postpartum haemorrhage kit, risk management measures and consultant review	CS rate decreased from 41.6% to 32.7% ($P < 0.001$)	10
Hannah et al. (1996)	Retrospective cohort (secondary analysis of a randomized controlled trial) 3407	Canada	Induction of labour after 41 weeks gestation	Less CS in induction group (21.2%) versus expectant group (24.5%) $P = 0.03$	11
Hollinghurst et al. (2010)	Randomized controlled trial 742	UK	The decision analysis programme including educating women about advantages and disadvantages of normal delivery and CS using an educational software	Less CS in decision analysis programme group (63%) comparing to usual care (70%)	13
Homer et al. (2001)	Randomized controlled trial 1089	Australia	Community-based model of continuity of care: define standard of collaborative continuous care (low risk mothers managed by midwives and high risks by obstetricians), assign an on-call midwife to answer mother's questions, continuous one to one care during labour and delivery, mothers meet all midwives in a session to know them, midwife accompanies mother in operation room, if CS needed	Significant difference in CS rate between community-based group (13.3%) and control group (17.8%). This difference was maintained after controlling for known contributing factors to CS (OR 0.6, 95% CI: 0.4–0.9, $P = 0.02$)	14.5
Hoskins et al. (2017)	Retrospective cohort 6991	USA	Multi-strategy approach for CS reduction including second opinion for both scheduled and medically indicated CS, audit, dissemination every obstetrician's CS rate, educational evening sessions about VBAC for mothers with previous CS by obstetricians	CS rate decreased from 39% to 29% ($P < 0.05$)	11
Hu et al. (2016)	Retrospective cohort 54 930	China	No pain labour and delivery (NPLD) programme, including regional anaesthesia for normal delivery, obstetric anaesthesia protocols and professional responsibility protocols for anaesthesia services and nursing care, care providers' education with books and lectures, on-site training for maternity team including physicians, residents and nurses, use of social media to promote NPLD, 9 bilingual labour analgesia documents and epidural analgesia protocols, patient's education books and lectures, collaboration with nongovernmental organizations to inform community about NPLD	CS rate decreased from 41% to 34% ($P = 0.002$)	10

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Iglesias et al. (1991)	Cross sectional 1161	Canada	Protocol for VBAC, dystocia and breech deliveries	CS rate decreased from 23% in 1985 to 13% in 1989 (P = 0.001).	10
Iriye et al. (2013)	Retrospective cohort 6206	USA	Recruitment of full-time labourist	CS rate decreased from 39.2% (no labourist) to 33.2% (full-time labourist), P < 0.01	11
Javerick et al. (2017)	Retrospective cohort: Pre and post measure design 994	USA	Quality improvement project including a defined policy on limited non-medically indicated induction of labour before 41 weeks, intermittent auscultation (instructing the providers, design posters for nurses on intermittent auscultation), staff education on counselling women about policy of induction), triage flow sheet for admission (not less than 4 cm), calculate each obstetrician's primary and total caesarean birth rates, audit and feedback on each obstetrician's primary and total caesarean birth rates, feedback on each obstetrician's performance in monthly meetings, via email and on the hospital managerial dashboard, counselling women at their 36-week visit about policy of limited non-medically indicated induction of labour before 41 weeks, a handout of the "Go the Full 40" campaign for mothers, audit patient consultation, using a pre- and post-quality-improvement-process-measures tool for evaluation	Primary CS rate decreased from 28.9% to 12.2% (OR, 0.345; z = 6.52, P = 0.001; 95% CI, 0.249-0.479).	12
Johri et al. (2017)	Cluster randomized trial 105 351	Canada	Onsite training, capacity building, 3-month audit cycles, using local data to assess the appropriateness of caesarean delivery, engage in collective learning, provide feedback to clinicians, and implement best practices based on the results	The intervention group experienced per-patient reductions of 0.005 CS (95% CI: -0.015 to 0.004, P = 0.09) and \$180 (95% CI: -\$277 to -\$83, P < 0.001)	15
Kacerauskiene et al. (2017)	Retrospective cohort: Before-after 48 395	Lithuania	CS audit based on Robson classification	CS rate decreased from 26.9% to 22.7% (P < 0.001). The greatest contributions to the overall CS rate were made by groups 1, 2 and 5	13
Kashanian et al. (2010)	Randomized controlled trial 100	Iran	Continuous labour support by a midwife	CS deliveries were significantly lower in intervention group (4 vs 12, P = 0.003)	10
Poma (1998)	Retrospective cohort 12 912	USA	Protocol for labour pain control, adopted labour management and caesarean delivery guidelines, review of every caesarean delivery that did not meet guidelines and confidential individual feedback, educating providers on advantages and disadvantages of natural vaginal delivery and CS, public education on advantages and disadvantages of natural vaginal delivery and CS	Total and primary CS rates decreased from 22.5% and 13.5% to 18.6% (P = 0.001) and 10.6% (P = 0.001) respectively	12
Kozhimannil et al. (2016)	Retrospective cohort: secondary data analysis 67 082	USA	Doula services	Doula support was associated with substantially lower odds of caesarean among full-term births (adjusted OR 0.44, 95% CI: 0.39-0.49)	15
Kozhimannil et al. (2013)	Cross sectional 280 087	USA	Doula services	Less CS rate among doula-supported births (22.3%) comparing to Medicaid beneficiaries nationally (31.5%). After control for clinical and sociodemographic factors, odds of caesarean delivery were 40.9% lower for doula-supported births (AOR 0.59; P < 0.001)	13.5

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Lagrew et al. (1996)	Retrospective cohort 12 118	USA	Changes in guidelines, training for nurses on electronic fetal monitoring and active labour management, monthly CS rate report, analysis, feedback and confidential report to obstetricians every 6 months	Total and primary CS rate decreased from 31.1% and 17.9% to 15.4% and 9.8%; repeat CS and nulliparous CS rate fell from 13.2% and 28.1% to 5.7% and 16.9% respectively ($P < 0.00001$)	12.5
Liu et al. (2013)	Retrospective cohort 35 616	Taiwan	Hospital-based self-management including postoperative CS peer reviews and audits and the hospital global budget system consisting of a prospective direct and complete government funding of hospital	Immediate CS improvement and then be maintained at same value (RR 0.9109; 95% CI: 0.8430–0.9845, $P = 0.0183$)	13
Liu et al. (2016)	Retrospective cohort 81 495	China	Ranking obstetric centres by performance (with CS rate and lowering that rate), ranking performance of attending physicians within the hospital (with CS rate used as one of 4 perinatal indicators, along with case mix, number of discharges, length of stay, and complication rate), the fixed per-patient reimbursement by government regardless of mode of delivery (for women with social insurance and in the regular care model), instituted pay-for-performance, bonus and financial support from government to obstetrics centres that had a better rank (to support the hospital's infrastructure), a larger salary bonus for providers with a favourable ranking (having a low CD rate), free perinatal health care classes for mothers (advantages and benefits of vaginal delivery were emphasized), companionship of family and an experienced midwife during labour, epidural available if needed	CS rate decreased from 51.5% in 2008 to 36.1% in 2014, mostly due to a reduction in non-indicated antepartum CS from 27.9% in 2010 to 11.9% in 2014; after adjustment, a period effect remained with delivery between 2011 and 2014 associated with a 31% reduction in the odds of CD compared with delivery between 2007 and 2010 (OR: 0.69, 95% CI: 0.66–0.71) and a 33% reduction in the odds of antepartum CD (OR 0.67, 95% CI: 0.64–0.69)	15
Maet al. (2012)	Randomized clinical trial 1966	China	Bionic midwifery airbag	CS in the intervention group (14.39%) were lower than those in the controls (23.04%) $P = 0.048$	14
Mahomed et al. (1991)	Randomized controlled trial 208	Zimbabwe	External cephalic version with tocolysis for breech pregnancies	CS decreased from 33% to 13%; no troublesome complications from the procedure ($P < 0.001$)	11
Mawson (2004)	Multicentre cluster randomized controlled trial 149 276	Latin America (Argentina, Brazil, Cuba, Guatemala, Mexico)	Mandatory second opinion for non-emergency CSs and CS guidelines	Small but significant reduction in rates of CS (mean difference in CS rate change between groups: -1.9% ; 95% CI: -3.8 to -0.1 ; $P = 0.044$; relative rate reduction 7.3%; 0.2–14.5)	15
Mohammadi et al. (2012)	Retrospective cohort: before–after 3494	Iran	Individual case reviews by 4 evaluators consisted of 2 board-certified obstetricians, a senior midwife and a GP, review of 25% of all primary CS patient records in monthly meetings, written feedback to doctors if CS not indicated, financial incentives to practitioners who matched clinical criteria and achieved the lowest percentage of CS	Overall CS rate decreased from 40% to 33% ($P < 0.001$)	14
Navaee et al. (2015)	Blind clinical trial 67	Iran	Educating mothers to overcome fear of pain by role playing	There was a significant difference between the 2 groups (lecture and role play) concerning reduction of elective CS and decision on mode of delivery at the time of admission in the labour room ($P < 0.0001$)	10

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Oshiro et al. (2013)	Retrospective cohort 29 030	USA	Quality improvement programme including a "hard stop" policy to reduce early elective inductions and CSs by defining related protocols, composing a quality improvement team (consisting of a physician champion, nursing leader(s), scheduler, and quality improvement staff member), quality improvement team's training, reviewing scheduled deliveries before 39 weeks of gestation without a listed medical indication by a nurse and referred to physician leadership if necessary, evaluation the rate of scheduled singleton elective early-term deliveries and early-term medically indicated and unscheduled deliveries, neonatal intensive care unit admissions, and singleton term fetal mortality rate	Elective CSs decreased 8.4% from 43.5% to 35.1% (P < 0.001)	10
Pavlic et al. (2009)	Retrospective cohort 1367	Canada	Expectant management before 41 weeks	CS rate in expectant management group was 17.7% and 21.3% in induction group (P = 0.09)	13
Peng et al. (2016)	Retrospective cohort 3781	Taiwan	CS audit including defining dystocia, fetal distress and indications of induction, screen high risk women in post term pregnancies (fetal ultra sound, non-stress test and biophysical profile and umbilical wave form studies), clinical audit and feedback in triweekly obstetric morning meetings (all cases briefly) and monthly audit conferences (cases with ambiguous caesarean indications), monthly reporting of the audit's results were submitted to the hospital president, feedback to all obstetric staff	CS rate was lower in audit group (31.1%) than pre-audit group (34.5%), OR = 0.85, 95% CI: 0.74–0.97, P = 0.02	13
Ragusa et al. (2016)	Prospective cohort 419	Italy	The comprehensive management of labour including periodical meetings to standardize the clinical activity of doctors and midwives and to enforce the commitment to change, daily audit and discussion of clinical cases by medical and midwifery staff, intrapartum ultrasonography alongside traditional clinical assessment to determine fetal head and trunk position accurately, epidural analgesia on request, encouraging upright position, walking during labour and give birth in the most comfortable position, manual rotation of the fetal head if needed, attention to psychological well-being by continuous midwifery care and support, change of midwife if the midwife-patient relationship was deemed unsatisfactory, encouraging the presence of a partner, assessment of the nutritional status, free access to caloric snacks and foods and water	CS rate was 10.3% and lower in the comprehensive management group comparing to 22.2% in the standard management group (P = 0.001)	14
Reisner et al. (2009)	Prospective cohort 20 037	Sweden	Goal-setting to reduce elective inductions, induction protocol and consent form designed and trialled, commitment of obstetric team including obstetricians, midwives, nurses, unit staff and management, meeting with practice managers from all office prior to initiation of programme to inform them about the rationales of caesarean reduction specially in nulliparous, staff education on induction of labour	Elective unplanned primary CS rate in nulliparous was 26.9% before project and decreased to 17.9% [RR = 0.66, (0.4–1.1)] after project: 4% in multiparas before and 1.9% after [RR = 0.47 (0.25–0.87)]	12

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Robertson et al. (2018)	Retrospective cohort 174	Australia	Individual nutritional assessment and dietary counselling conducted by a dietitian for women with body mass index > 35 kg/m ²	CS rate were lower among participants (35.5%) compared to obese populations in comparable studies (48.7%)	10
Rudge et al. (2011)	Cross sectional 27 387	Brazil	The safe motherhood referral system based on the exchange of patients from the level II to the level III hospital (all high-risk pregnant women were planned to deliver at the level III hospital, and all low-risk pregnant women were planned to deliver at the level II hospital), a separate cadre of level III with better-paid health workers comprised of obstetricians, anaesthesiologists, neonatologists, residents and medical and nursing students, more specified responsibilities was established, providing supplemental compensation for health care in level III hospitals, service availability, referral and other communication systems, transport between level II and level III hospitals	CS rate decreased from 46.5% to 23.4% at the level II hospital while remaining unchanged at the level III hospital (P < 0.001)	11
Saisto et al. (2001)	Randomized controlled trial 176	Finland	Intensive therapy for women with fear of labour consisted of provision of information and conversation regarding previous obstetric experiences, feelings and misconceptions during routine obstetric check-ups to assure the normal course of the pregnancy, combined with cognitive therapy	CS rate was lower in intensive therapy group (27%) compared to r those who refused to fill in the questionnaires (57%), P = 0.001	11
Scarella et al. (2011)	Prospective cohort 4813	Chile	Implementation of 10-group classification and data-gathering system, meeting with staff to inform them about the Ten□ Group classification system (TGCS) and statistics related to CS and its indications, medical- midwifery staff meeting every 3 months to report changes in TGCS and overall CS rate, tables and figure showing TGCS changes and overall CS rate distributed to all staff by letter	CS rate decreased from 39.4% (basal period) to 27.4% (intervention period). In total a decrease of 5.08% from the basal period (RR 0.86 95% CI: 0.76–0.97)	11
Shoemaker et al. (2017)	Prospective Cohort 6226	Canada	Care strategy including developing guideline to define and support normal physiological birth, reviewing women's educational tools, updating admission and labour induction policies, reviewing all induction requests by the on-call physician and facilitating nurse, providing a comfortable space in the triage area for women who are not yet in full labour, updating maternity staff by the chief of obstetrics about the initiative, baseline rates, and targets, staff education on the benefits of supportive care, providing facilities in every labour and delivery room to encourage nurses to remain close to women in labour, use of auscultation instead of electronic fetal monitoring during labour, monthly audit and feedback on indicators such as rate of CS, VBAC and induction for the unit overall and individual physicians (blinded for the first 3 months, then unblinded among peers), public education campaign to increase awareness of the CS reduction initiative, VBAC counselling	At the intervention hospital, 30.3% (964/3181) of women underwent CS in 2009–2010, compared with 26.4% (803/3045) in 2012–2013 (difference –3.9%, P < 0.001). By contrast, no significant difference was recorded in control hospitals [28.1% (23 694/84 361) vs 28.2% (23 683/83 895); difference 0.1%, P = 0.5157]	13

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Sloan et al. (2000)	Quasi experimental: before-after 27 094	Ecuador	Policy to provide patient co-management for CS candidates, second opinion from a supervising obstetrician or resident for all caesarean candidates, spot checks, staff training, supervising residents by two senior obstetricians including a co-principal investigator, discussion in a grand rounds seminar regarding CS, appropriate indications, and consequences of inappropriate surgical delivery and providing copies of a Spanish translation of CS-related articles	CS rate declined by 4.5% ($P = 0.001$) in the intervention hospital	14
Wilson-Leedy et al. (2016)	Retrospective cohort: before-after 200	USA	Labour management's guideline was defined, the induction policy was presented at departmental meetings and circulated to all faculty and residents by e-mail, also included among nursing policies, and made available online for reference	Among women delivering after induction or augmentation, the CS rate decreased from 35.5% to 24.5% (OR 0.59, 95% CI: 0.38–0.91). The overall CS rate decreased from 26.9% to 18.8% (AOR 0.59, CI: 0.38–0.92)	13.5
Xirasagar et al. (2006)	Cross sectional 253 618	Taiwan	Group private obstetrics/gynaecology practices versus solo ones	Solo practices have 7% excess caesarean cases relative to large group practices; after controlling for covariants, solo practice physicians were 5.38 times (CI: 4.18–6.93), 2-physician practices 3.87 times (CI: 2.99–5.01) and 3-physician practices 2.72 times (CI: 2.06–3.59) as likely as 4+ physician practices to provide CS	13
Ma et al. (2017)	Retrospective cohort: pre-post intervention 131 312	China	Policies to decrease the high CS rate by controlling the CDMR rate, specific CS indications and guidelines, the regulation on the Management of Maternal Health Care and the Norms of Maternal Health Care (to encourage mothers to choose vaginal delivery, control indications for CS, strictly control CDMR), a multifaceted strategy to tackle the high CDMR rate, annually obstetricians and midwives' training programmes (necessary skills for problematic child delivery and procedures for emergency obstetric care), the CS rate included among patient safety indicators, a monthly audit of whether medically unnecessary CS procedures were performed, providing services such as painless childbirth through intervertebral anaesthesia, one-to-one doula, delivery by midwives, face-to-face health education was provided by doctors, nurses, and nutritionists to mothers and their families once or twice a week in a hospital, women educational contents displayed on TV and billboards at hospital outpatient service halls and inpatient wards at the obstetrics departments, when preparing for CDMR, obstetricians shared the potential risks of CS with mothers, and then the mothers were asked to sign a medical informed consent form for CDMR	After institutional interventions, overall CS rate declined by 1.29% ($P = 0.002$) and average annual growth rate of the CS decreased from 0.29% to –6.73%	13

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Naiden and Deshpande (2001)	Retrospective cohort 27 780	USA	Goal setting to reduce operative deliveries, encouraging vaginal birth after caesarean delivery (VBAC) as a standard of care, feedback to physicians their own delivery statistics, asking physicians with higher rates to review the literature, defining active management of labour protocol including applying Oxytocin only under the supervision of the attending physician by experienced labour and delivery nurses and experts in the assessment of fetal heart rate patterns and initial treatment of abnormal patterns	The overall CS rate decreased from 16.59% to 10.92%, the primary CS rate decreased from 9.22% to 7.11% and the repeated CS rate from 7.37% to 3.81%. All significant differences	12
Socol et al. (1993)	Retrospective cohort 26 619	USA	Use of delivery data, calculation of indicators such as primary and repeat CSs, VBAC, neonatal intensive care unit admissions, neonatal and perinatal mortality rates, Apgar scores, and umbilical cord arterial pH values, encouraging vaginal birth after one prior low-transverse CS, annual feedback to physicians about their performance, defining and implementing the protocol of the active management of labour for term nulliparous patients based on the results of a randomized trial	Total, primary, and repeat CS rates declined from 27.3%, 18.2% and 9.1% to 16.9%, 10.6% and 6.4%, respectively; perinatal mortality dropped from 19.5 to 10.3; significant reductions in abdominal deliveries occurred for both private patients (30.3% to 19.1%, $P < 0.0001$) and clinic patients (20.8% to 11.5%, $P < 0.0001$)	11
Sanchez-Ramos et al. (1990)	Retrospective cohort 18 291	USA	Calculating indicators such as proportion of primary and repeat CSs, review of each CS and its indications at weekly conferences, participating departmental resident and obstetric faculty physicians, establishing new guideline for performing primary CS, intrapartum management of women with prior CSs, diagnosis of dystocia, using electronic fetal monitoring records, umbilical cord gas results, Apgar scores, fetal acoustic stimulation to assess fetal well-being	Overall CS rate decreased steadily from 27.5% of deliveries to 10.5% ($P < 0.0001$)	10
Santerre (1996)	Retrospective cohort 47 480	USA	Implementing ACOG guideline on VBAC, promoting the guideline by publishing a number of influential books on CS, important information dissemination by popular press and, large number of newspaper articles on excess CS	VBAC rate increased from 6.6% in 1985 to 25.4% in 1993	10.5
Robson et al. (1996)	Retrospective cohort 21 125	UK	Pre-intervention survey on CS reasons classification, developing guidelines for spontaneous labour in nulliparous women by senior obstetricians and midwives, guideline education by simultaneous in-service training, improving cooperation and under-standing between midwives and physicians, reviewing CS cases and the quality of labour and delivery management, antenatal classes to enable women to make better-informed choices, collection, publication and prompt distribution of monthly results to inform everybody involved of the effect of the new guidelines, monthly medical audit meetings to review the results	Overall CS rate decreased from 12% to 9.5% ($P < 0.0001$)	10

Table 4 Characteristics of the studies reviewed (n = 109) (continued)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Sheikh et al. (2008)	Retrospective cohort 1409	Pakistan	Gathering information, introducing strategies related to acceptable standards for obstetric practice and universally defined criteria for principal indications for inductions and CSs, audit	Primary emergency CS rate decreased from 17% to 12%	10
Amer & Wählén et al. (2000)	Retrospective cohort 85 691	Sweden	Use of sufentanil for epidural analgesia	Fewer risk of CS for nulliparae (OR 0.79; 95% CI: 0.72–0.88) but not for multiparae (OR 0.93; 95% CI: 0.80–1.07)	11
Bleichner et al. (2017)	Retrospective cohort	Israel	Policy for induction of labour at 41 weeks to reduce caesarean rate	CS rate was lower, 15% versus 19.4% (P = 0.0135)	12
Blomberg (2016)	Retrospective cohort 8100	Sweden	Clinical quality improvement project, including monitoring of obstetric results, recruitment of a midwife coordinator, risk classification of women (according to a traffic-light model), combining level of midwife competence with risk assessment of women in labour, obstetrician–midwife team work, obstetrical morning rounds, improving staff skills on fetal monitoring summaries and obstetrical skills by simulation training on a regular basis and public promotion of the strategy via lectures for women and their partners by a group of dedicated midwives, being open towards journalists, which resulted in positive stories in the media, presenting several quality variables on their official website	CS rate in nulliparous women at term with spontaneous onset of labour decreased from 10% in 2006 to 3% in 2015; during the same period overall CS rate fell from 20% to 11%	10
Boylanet et al. (1991)	Retrospective cohort 3900	USA	Protocol of active management of labour	Significant 4.4% reduction (95% CI: = 1.3–7.5) in CS incidence between the 12 month control period and the initial 6-month active management of labour intervention period	10
Burns (2013)	Randomized controlled trial 102	USA	The HEM-AVERT device to be used during the second stage of labour	Lower CS rate (12.0% for HEM-AVERT patients versus 39.6% for control patients, P = 0.0017)	12
Caliskan et al. (2009)	Randomized controlled trial 230	Turkey	Fetal heart rate monitoring and intermittent pulse oximetry after induction of labour with misoprostol	There was a reduction both in the overall CS [study n = 18, (15.7%); vs control n = 31 (26.7%); P = 0.04] and the rate of CS performed for non-reassuring fetal status in the study group [study n = 11, (9.6%); vs control n = 23 (19.8%); P = 0.03]	14
Chai et al. (2017)	Retrospective cohort 2140	China	Using Lean Six Sigma methodology (a 5-phase roadmap consisting of define, measure, analyse, improve, and control), the principal causes of CS identified, enhanced midwifery team building, improved parturient women assessment system, strengthened pregnancy nutrition guidance and implementation of painless labour techniques	CS rate decreased from 41.83% to 32% and the 6 sigma score increased from 1.706 to 1.967 (P < 0.001)	12
Chaillet et al. (2015)	Cluster randomized trial 18 4952	Canada	Quality of Care, Obstetrics Risk Management, and Mode of Delivery (QUARISMA) trial including empowering the health professionals (training on monitoring indications for caesarean delivery and managing intrapartum care and conducting audits) 4 3-month audit cycles (information gathering, analysis according to standards, feedback), feedback the results	Significant but small reduction in CS rate before and after intervention (21.5% to 21.8% intervention group; 23.2% to 23.5% control group); OR for incremental change over time, adjusted for hospital and patient characteristics, 0.90; 95% CI: 0.80–0.99; P = 0.04; adjusted risk difference, –1.8%; 95% CI: –3.8 to –0.2)	13.5

Table 4 Characteristics of the studies reviewed (n = 109) (concluded)

Author (year)	Method sample size	Country	Intervention	Results	Quality score
Choudhary et al. (2010)	Case-control 292	India	Amnioinfusion for intrapartum passage of moderate or thick meconium	Significant reduction in CS incidence in the study group (31%) compared to control group (61%) $P = 0.001$	12
Mehdizadeh et al. (2005)	Randomized clinical trial 200	Iran	Birth preparation classes consisting of 8 sessions of education, counselling and neuromuscular exercises	Rate of vaginal delivery was significantly higher in trial group (97/100) than in control group (90/100; $P = 0.044$)	10
da Gama et al. (2016)	Retrospective cohort 23 894	Brazil	Participation of nurses and nurse-midwives in childbirth care	Less CS in women receiving birth care with participation of nurse midwives (OR 0.78, 95% CI: 0.62–0.98)	14
Harris et al. (2012)	Retrospective cohort 1238	Canada	Team-based shared-care model by midwives, family physicians, nurses and doulas and in case of any complication, referred to an obstetrician; 10 group prenatal sessions ranging from exercise and nutrition to labour and birth preparation and care of the newborn, meeting doulas once before labour and then provide one-on-one continuous support during latent and active phases of labour, postpartum home visits by midwife or physician the next day with additional home visits as needed, weekly drop-in clinic for up to 6 months postpartum, pooled medical services plan billings for midwives and physicians and remunerated at the same rate on a sessional basis for their services, free of charge for women	Less CS in the programme participants than in matched controls (RR 0.76, 95% CI: 0.68–0.84) and among those with a previous CS, more likely to plan a vaginal birth (RR 3.22, 95% CI: 2.25–4.62)	14

Leadership helped create confidence among the maternity team and encouraged a positive environment for adherence to protocols and cooperation in CS reduction plans. This was achieved by physician leaders and chiefs of obstetrics (31) or leading midwives (25).

Financing

The financing building block consisted of institution and provider reimbursement interventions. Institutions were paid via different methods, and some, e.g. fee-for-service, may drive CS overuse. Fixed payment and pay-for-performance strategies were associated with a decrease in caesareans. The blended payment method used in the USA (32) and the global budget system in Taiwan (33) are examples of fixed payments. In addition, pay-for-performance in the form of bonuses and financial support of obstetrics centres with appropriate CS rates (30) or a pay cut for non-medically indicated caesareans (34) were conducted.

Individual reimbursement was effective too. This also included fixed payment in form of blended payment (32) and pay-for-performance measures such as larger salary bonus for providers with a favourable CS ranking (30).

Health workforce

Interventions related to recruiting qualified and competent staff and teamwork are subgroups of the health workforce building block. Recruiting qualified and competent staff was the most commonly used intervention in the studies we reviewed. It was attained by optimizing the available workforce through employing freestanding midwives to care for low risk women (35), doulas for continuous support in labour (36), full-time labourists and obstetric patient safety nurses for hospitals (28). Another example, from Linköping hospital, Sweden, was assigning a mix of midwives with different levels of competency, ranging from midwife coordinator (highest level) to new graduate midwives (lowest level), in each working shift in order to combine the level of midwives' competence with the risk assessment of women in labour (37).

Staff education and training are essential to having a competent workforce. Courses such as clinical guidelines education (38), electronic fetal monitoring interpretation (28) and effective teamwork workshops (28) were found to be beneficial. For this purpose various methods of training such as lectures, drills, Internet-based assignment (28) and on-site training were used (27). Considering the role of obstetrics residents in providing quality maternity care, recruiting a senior obstetrician-gynaecologist to train and supervise staff (39) and including residents in staff training programmes (27) were noted. Moreover, as the attitude of staff towards normal delivery is of importance, measures such as periodical meetings to standardize clinical activities (40), asking staff to review literature on CS (41) and characterizing non-medical CS as "unnecessary CS" in hospital records (33) were employed.

Teamwork was the other essential component of this block. Group private practice compared to solo obstetricians was associated with a lower rate of CS (42).

Collaborative continuous care was another successful action in Australia, where a team of midwives and obstetricians provided antenatal and intra-partum care for women. Shifts were scheduled so one of the familiar providers was always on call to take care of women in hospital (23).

Medical products and technologies

Medicines, equipment and technology were classified under this building block. Some medicines, like misoprostol, used for labour induction, (43) and sufentanil combined with epidurals to relieve labour pain (44) were associated with a lower caesarean rate.

Some devices and techniques were also applied to facilitate normal birth. Techniques such as external cephalic version for breech pregnancies (45) and manual cephalic rotation in persistent transverse or posterior vertex position (46) increased the chance of normal vaginal delivery. Use of the “Baby-guard system” in Italy (47) and the “peanut ball” in the USA (21) were also reported as effective. Technologies to assess fetal well-being such as amnioinfusion, chemical fetal health assessment, fetal ultrasound, non-stress test, biophysical profile and umbilical wave were also used (48,49)

Information

Health information building blocks comprised interventions such as data-gathering and analysis, and information dissemination. To gather related data, electronic medical records were used (21) and indicators like total caesarean, primary caesarean, vaginal birth after caesarean (VBAC), induction rates and maternal and neonatal outcomes were measured (21,50–52). Caesarean classification groups such as the Robson CS classification, based on presentation of fetus, gestational age, parity, number of fetuses, previous uterine scar and initiation of labour, were used in a hospital in Chile and resulted in a 10% decrease in CS (52).

In a hospital in Colorado, USA, caesarean-related information was disseminated by providing individual feedback to physicians in hospital section meetings, via e-mail or on a dashboard (26). Additionally, measures such as releasing information via popular press agencies in the USA (53) or publishing it on the hospital's official website in Sweden (37) were found effective.

Service delivery

Prenatal and intra-partum services were categorized in the service delivery building block. Prenatal services such as dietary counselling, specifically for women with body mass index > 35 kg/m² in Australia (54), and the prenatal exercise plan in Spain were associated with lower CS rates (55). Fear control through cognitive therapy and psychoprophylaxis were also effective (55,56).

Pregnant women and their families participated in educational programmes such as birth preparation classes. They learnt about the physical and emotional changes in pregnancy, advantages and disadvantages of different modes of birth (57), nutrition in pregnancy (20),

controlling fear of pain (58), relaxation techniques (59) and VBAC (45). Considering the fact that safe VBAC and external cephalic version for breech pregnancies would result in fewer caesareans, special prenatal clinics like the Next Birth After Caesarean (NBAC) clinic in Australia and the Breech Clinic in Ireland were established (45,60).

Intra-partum services, including protocol-based practice, continuous care, physical and emotional support, physiologic birth, pain control and VBAC, were the most commonly used interventions to reduce CSs. Guidelines were developed and used for defining dystocia, fetal distress and indications for induction in Taiwan (49). Using guidelines for performing primary CS, intra-partum management of women with prior CS and a diagnosis of dystocia were beneficial in lowering the CS rate (from 28% to 11%) in a teaching hospital in the USA (61). Continuous care and physical and emotional support during labour, and delivery by a partner (40), midwife (23) or doula (36) were also effective.

The physiologic approach to birth, which defines pregnancy as a normal event in a woman's life with attempt to keep labour and delivery as natural as possible, with the least unnecessary medical interventions, was important (21). In Italy, encouraging the presence of the partner and free access to caloric snacks, foods and water along with other interventions resulted in a significant reduction in CS, from 22.2% to 10.3% (40).

Although a variety of pain relief services are available, most studies focused on regional anaesthesia such as epidurals (27,30). Likewise, providing VBACs also lowered the CS rate (31).

Discussion

This systematic review aimed to identify and classify interventions effective in reducing the number of unnecessary CSs using a health system approach. A systemic horizontal approach is indeed critical to addressing complex health problems such as excessive CSs and achieving the best sustained results. The WHO has proposed the 6 building blocks framework as the prerequisite to achieving the health systems goals (16). These building blocks interact with each other and also with external environment factors such as political, economic, social, technological and legal factors. The quality of these building blocks and their internal and external interactions affect the achievement of the health systems goals (62). An alphabetically arranged list of the full references for the studies we reviewed is given in Table 5.

Governance and leadership interventions were applied to reduce caesarean delivery on maternal request in China. This policy required maternity care providers to encourage mothers to choose vaginal birth, and rigorously to control CS indications. The caesarean rate was considered an important indicator, and professionals who did not maintain the CS rate within a reasonable range would face financial penalties. These measures resulted in an 8% reduction in CS (20). Financing interventions such as “blended payment” was adopted

for normal deliveries and uncomplicated caesareans in the USA. The payment for uncomplicated childbirth (both CS and normal vaginal delivery) was \$3528 for facilities and \$867.37 for individuals. Facility fees used to be \$3144 for normal vaginal delivery and \$5266 for CS, and professional fees for prenatal, delivery and postpartum care were \$776.62 for normal vaginal delivery and \$1147.42 for CS. Reducing financial incentives was effective in lowering unnecessary caesareans 0.27 percentage points per quarter after the intervention. Comparing with control states, the CS rate decreased 3.24% overall (32).

Recruiting the right health workforce proved to be effective too. Providing comprehensive and collaborative care by family physicians, community health nurses, midwives and doulas and referring pregnant women to an obstetrician if medically needed resulted in fewer caesareans (21.1%) compared with standard care (31.3%) in Canada (63). Additionally, applying medical technology such as electronic fetal monitoring, scalp pH sampling and fetal acoustic stimulation helped clinicians assess and manage dystocia and fetal distress, and reduced the overall CS from 27.5% to 10.5% in the USA (61).

The health information system enabled policy-makers to design and implement effective evidence-based interventions. The Robson CS classification system was used for assessing and monitoring caesareans in Chile. Each group caesarean rate, the relative size of groups and contribution of each group to the overall CS rate were assessed. Auditing caesareans based on this classification system reduced the numbers in groups 1, 5a and 10 significantly. Overall, the CS rate also dropped from 36.8% to 31.8% after this intervention (52). Providing the right health services such as protocol-based intrapartum services and supporting normal physiological birth and prenatal services like women's education and VBAC counselling lowered the CS rate by 4% in a hospital in Canada (31).

The most successful plans were those comprehensive plans which were organized in a systematic way. For example, the "Patient Safety Bundle" in North Carolina successfully reduced the CS rate in nulliparous women. It embraced several actions such as goal-setting, protocol-based labour management, staff education, mothers' education, facilitating physiologic birth, providing labour support and pain relief, gathering and analysing data, CS audit and feedback to the physicians (21).

The International Federation of Gynecology and Obstetrics (FIGO) also suggested governments, professional organizations, women's groups, and other stakeholders could help reduce unnecessary CSs through actions such as using the Robson CS classification, informing women, better care, pain relief, practical skills training for doctors and midwives, the reintroduction of vaginal instrumental deliveries, publishing annual hospital CS rates and financing partly based on CS rates (64). This would be more comprehensive by adding certain interventions such as optimizing the workforce, improving the attitudes of health care providers towards the culture of normality of pregnancy and birth, designing mother-centred models of care and developing proper financing.

Considering the fact that recent WHO statements and publications on CS have attracted global attention to the problem of overuse, it seems that governance and leadership interventions such as legislation, policy-making, planning, promotion, oversight and leadership by international organizations like WHO would strengthen national CS control plans. Periodic publications about CS, holding frequent regional and international conferences on this issue and naming one day of the year as "Birth is Normal" might be helpful promotional plans to cut unnecessary CSs. Considering the CS rate as a component of the Maternal Health Index combined with other main maternal health indicators to be monitored by WHO has also been suggested.

Last but not least, comprehensive CS reduction strategies at the hospital level covering governance, financing, human resources, equipment, information and service delivery processes should be supported by strengthening its subsystems, i.e. the involvement and commitments of professionals and mothers and the super systems, the health policy-makers.

This systematic review using an exploratory approach identified 16 effective interventions and 45 actions for reducing unnecessary CS by examining the findings of 109 related studies. More research should be conducted, particularly in the Africa, South-East Asia and Eastern Mediterranean regions of WHO to augment the findings of this study. Furthermore, it would be of interest to compare the efficacy of these interventions to see which are more effective at reducing unnecessary CS.

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Taxonomie des stratégies efficaces pour réduire les césariennes inutiles : une analyse systématique

Résumé

Contexte : La tendance croissante au recours à des césariennes inutiles a suscité des inquiétudes pour la santé maternelle et néonatale dans le monde entier. Diverses interventions médicales et non médicales ont été élaborées et mises en œuvre pour réduire le recours excessif aux césariennes. Cependant, leur efficacité reste contestable.

Objectifs : La présente étude visait à identifier et à classer les interventions efficaces pour réduire le nombre des césariennes inutiles.

Méthodes : Nous avons recherché des articles dans les bases de données EMBASE, MEDLINE, Web of Knowledge et Scopus, en utilisant des stratégies de recherche appropriées, jusqu'au 2 juin 2020. Au total, 7951 articles identifiés ont été analysés et évalués en utilisant une liste de contrôle valide pour l'évaluation de la qualité. Finalement, 109 études éligibles ont été incluses dans cette analyse. Une analyse de contenu thématique a été utilisée pour identifier et classer les interventions efficaces.

Résultats : Au total, 188 mesures efficaces visant à réduire le nombre de césariennes ont été identifiées. Elles ont été réparties en 45 mesures à prendre, 16 groupes d'intervention et 6 blocs constitutifs de l'OMS, notamment « gouvernance et leadership », « financement », « personnels de santé », « produits et technologies médicales », « information » et « prestation de services ». Parmi les interventions les plus couramment appliquées pour réduire le nombre de césariennes inutiles, on peut citer le recours à un personnel qualifié et compétent, aux services offerts pendant l'accouchement et à la surveillance.

Conclusions : Une taxonomie des stratégies efficaces pour réduire le nombre des césariennes inutiles a été mise au point dans cette étude. Une approche holistique est essentielle pour lutter contre la nouvelle vague de césariennes inutiles. Des interventions multiples basées sur les causes fondamentales du recours excessif aux césariennes devraient être élaborées et mises en œuvre aux niveaux local et mondial.

تصنيف الاستراتيجيات الفعّالة للحدّ من العمليات القيصرية غير الضرورية: استعراض منهجي

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الخلاصة

الخلفية: تسبّب الاتجاه المتزايد لإجراء العمليات القيصرية غير الضرورية في ظهور مخاوف على صحة الأمهات وحديثي الولادة في جميع أنحاء العالم. وتم تصميم العديد من التدخلات الطبية وغير الطبية وتنفيذها للحد من الإفراط في إجراء العمليات القيصرية. غير أن فعاليتها مشكوك فيها.

الأهداف: هدفت هذه الدراسة إلى تحديد التدخلات الفعّالة وتصنيفها للحدّ من العمليات القيصرية غير الضرورية.

طرق البحث: بحثنا في قاعدة بيانات EMBASE، ونظام استرجاع المعلومات البيولوجية الطبية والبيولوجية (قاعدة بيانات Medline)، وموقع شبكة المعرفة وقواعد بيانات Scopus للاطلاع على المقالات، باستخدام استراتيجيات البحث المناسبة، وذلك حتى تاريخ 2 يونيو/حزيران 2020. وبوجه عام، تم فحص 7951 مقالةً محدداً وتقييمها باستخدام قائمة مرجعية صالحة لتقييم الجودة. وأخيراً، أدرجت 109 دراسات مؤهلة في هذا الاستعراض. واستُخدم تحليل محتوى الموضوعات في تحديد التدخلات الفعّالة وتصنيفها.

النتائج: بوجه عام، تم تحديد 188 تدبيراً فعّالاً للحدّ من العمليات القيصرية. وتم تصنيفها إلى 45 إجراءً، و16 مجموعة من التدخلات، و6 مكونات أساسية لمنظمة الصحة العالمية، بما يشمل: "القيادة والحوكمة"، و"التمويل"، و"القوى العاملة الصحية"، و"المنتجات الطبية والتكنولوجيات"، و"المعلومات"، و"تقديم الخدمات الصحية". وكانت الاستعانة بالموظفين المؤهلين والأكفاء، والخدمات المقدمة أثناء الولادة، والرقابة أكثر التدخلات المطبقة شيوعاً للحدّ من العمليات القيصرية غير الضرورية.

الاستنتاجات: وُضِعَ في هذه الدراسة تصنيف للاستراتيجيات الفعّالة للحدّ من العمليات القيصرية غير الضرورية. ويعد اتباع نهج شمولي أمراً بالغ الأهمية للتصدي للوباء الجديد المتمثل في العمليات القيصرية غير الضرورية. وينبغي تصميم تدخلات متعددة قائمة على الأسباب الكامنة وراء الإفراط في إجراء العمليات القيصرية، وتنفيذها، على المستويين المحلي والعالمي.

References

1. Bailey P, Lobis S, Maine D, Fortney JA. Monitoring emergency obstetric care: a handbook. Geneva: World Health Organization; 2009.
2. No authors listed. Appropriate technology for birth. Lancet 1985;2(8452):436-467. PMID:2863457
3. WHO statement on caesarean section rates. Geneva: World Health Organization; 2015.
4. Betrán AP, Ye J, Moller A-B, Zhang J, Gülmezoglu AM, Torloni MR. The increasing trend in caesarean section rates: global, regional and national estimates: 1990-2014. PLoS One. 2016;11(2):e0148343. doi:10.1371/journal.pone.0148343
5. Gibbons L, Belizán JM, Lauer JA, Betrán AP, Meriardi M, Althabe F, et al. The global numbers and costs of additionally needed and unnecessary caesarean sections performed per year: overuse as a barrier to universal coverage. In: World Health Report (2010) – health systems financing: the path to universal coverage. Background Paper, No. 30. Geneva: World Health Organization; 2010:30(1):1-31.
6. WHO recommendations non-clinical interventions to reduce unnecessary caesarean sections. Geneva: World Health Organization; 2018.

7. Fenwick J, Staff L, Gamble J, Creedy DK, Bayes S. Why do women request caesarean section in a normal, healthy first pregnancy? *Midwifery*. 2010;26(4):394–400. doi:10.1016/j.midw.2008.10.011
8. Gamble JA, Creedy DK. Women's preference for a cesarean section: incidence and associated factors. *Birth*. 2001;28(2):101–10. doi:10.1046/j.1523-536x.2001.00101.x
9. Betrán AP, Temmerman M, Kingdon C, Mohiddin A, Opiyo N, Torloni MR, et al. Interventions to reduce unnecessary caesarean sections in healthy women and babies. *Lancet*. 2018;392(10155):1358–68. doi:10.1016/S0140-6736(18)31927-5
10. Sandall J, Tribe RM, Avery L, Mola G, Visser GH, Homer CS, et al. Short-term and long-term effects of caesarean section on the health of women and children. *Lancet*. doi:10.1016/S0140-6736(18)31930-5 2018;392(10155):1349–57.
11. Madeley J. Sustainable development goals. *Appropriate Technol*. 2015 Dec 1;42(4):32.
12. Hodnett ED, Gates S, Hofmeyr GJ, Sakala C. Continuous support for women during childbirth. *Cochrane database of systematic reviews*. 2013;7:CD003766. doi:10.1002/14651858.CD003766.pub5.
13. Weaver J, Browne J, Aras-Payne A, Magill-Cuerden J. A comprehensive systematic review of the impact of planned interventions offered to pregnant women who have requested a caesarean section as a result of tokophobia (fear of childbirth). *JBIS Libr Syst Rev*. 2012;10(28 Suppl.):1–20. doi:10.11124/jbisrir-2012-322
14. Smith V, Gallagher L, Carroll M, Hannon K, Begley C. Antenatal and intrapartum interventions for reducing caesarean section, promoting vaginal birth, and reducing fear of childbirth: an overview of systematic reviews. *PLoS One*. 2019 Oct 24;14(10):e0224313. doi:10.1371/journal.pone.0224313
15. Chen I, Opiyo N, Tavender E, Mortazhejri S, Rader T, Petkovic J, et al. Non clinical interventions for reducing unnecessary caesarean section. *Cochrane Database Syst Rev*. 2018 Sep 28;9(9):CD00528. doi:10.1002/14651858.CD00528.pub3
16. Everybody's business: strengthening health systems to improve health outcomes: WHO's framework for action. Geneva: World Health Organization; 2007.
17. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Int J Surg*. 2010 Jan 1;8(5):336–41. doi:10.1016/j.ijisu.2010.02.007
18. Mitton C, Adair CE, Perry BW. Knowledge transfer and exchange: review and synthesis of the literature. *Milbank Q*. 2007;85:729–68. doi:10.1111/j.1468-0009.2007.00506.x
19. Dahlen HM, McCullough JM, Fertig AR, Dowd BE, Riley WJ. Texas Medicaid payment reform: fewer early elective deliveries and increased gestational age and birthweight. *Health Aff*. 2017;36(3):460–7. doi:10.1377/hlthaff.2016.0910
20. Yu Y, Zhang X, Sun C, Zhou H, Zhang Q, Chen C. Reducing the rate of caesarean delivery on maternal request through institutional and policy interventions in Wenzhou, China. *PLoS One*. 2017;12(11):e0186304. doi:10.1371/journal.pone.0186304
21. Bell AD, Joy S, Gullo S, Higgins R, Stevenson E. Implementing a systematic approach to reduce caesarean birth rates in nulliparous women. *Obstet Gynecol*. 2017 Nov;130(5):1082–1089. doi:10.1097/AOG.0000000000002263
22. Safari-Faramani R, Haghdoost AA, Nakhaei N, Foroundia S, Mahmoodabadi Z, Safizadeh M. First birth caesarean proportion: a missed indicator in controlling policies. *Med J Islam Repub Iran*. 2016 Jul 10;30:394. PMID:27579285
23. Homer CS, Davis GK, Brodie PM, Sheehan A, Barclay LM, Wills J, Chapman MG. Collaboration in maternity care: a randomised controlled trial comparing community based continuity of care with standard hospital care. *BJOG*. 2001 Jan;108(1):16–22. doi:10.1111/j.1471-0528.2001.00022.x
24. Davies-Tuck ML, Wallace EM, Davey MA, Veitch V, Oats J. Planned private homebirth in Victoria 2000–2015: a retrospective cohort study of Victorian perinatal data. *BMC Pregnancy Childbirth*. 2018 Dec 1;18(1):357. doi:10.1186/s12884-018-1996-6
25. Chai ZY, Hu HM, Ren XL, Zeng BJ, Zheng LZ, Qi F. Applying Lean Six Sigma methodology to reduce caesarean section rate. *J Eval Clin Pract*. 2017 Jun;23(3):562–6. doi:10.1111/jep.12671
26. Javernick JA, Dempsey A. Reducing the primary caesarean birth rate: a quality improvement project. *J Midwifery Womens Health*. 2017 Jul;62(4):477–83. doi:10.1111/jmwh.12606
27. Hu LQ, Flood P, Li Y, Tao W, Zhao P, Xia Y, et al. No pain labor & delivery: a global health initiative's impact on clinical outcomes in China. *Anesth Analg*. 2016 Jun;122(6):1931–8. doi:10.1213/ANE.0000000000001328
28. Grunebaum A, Dudenhausen J, Chervenak FA, Skupski D. Reduction of caesarean delivery rates after implementation of a comprehensive patient safety program. *J Perinat Med*. 2013 Jan;41(1):51–5. doi:10.1515/jpm-2012-0181
29. Hoskins IA, Ellison T, Ruggiero R. A multi-strategy approach for Caesarean section reduction at an urban community medical center. *J Reproductive Med*. 2017 Sep 1;62(9–10):469–74.
30. Liu X, Lynch CD, Cheng WW, Landon MB. Lowering the high rate of caesarean delivery in China: an experience from Shanghai. *BJOG*. 2016;123(10):1620–8. doi:10.1111/1471-0528.14057
31. Shoemaker ES, Bourgeault IL, Cameron C, Graham ID, Hutton EK. Results of implementation of a hospital based strategy to reduce caesarean delivery among low risk women in Canada. *Int J Gynaecol Obstet*. 2017 Nov;139(2):239–44. doi:10.1002/ijgo.12263
32. Kozhimannil KB, Graves AJ, Ecklund AM, Shah N, Aggarwal R, Snowden JM. Caesarean delivery rates and costs of childbirth in a state Medicaid program after implementation of a blended payment policy. *Med Care*. 2018 Aug 1;56(8):658–64. doi:10.1097/MLR.0000000000000937

33. Liu CM, Lin YJ, Su YY, Chang SD, Cheng PJ. Impact of health policy based on the self-management program on cesarean section rate at a tertiary hospital in Taiwan. *J Formos Med Assoc.* 2013 Feb;112(2):93-8. doi:10.1016/j.jfma.2011.12.005
34. Runmei M, Terence T, Yonghu S, Hong X, Yuqin T, Bailuan L, et al. Practice audits to reduce caesareans in a tertiary referral hospital in south-western China. *Bull World Health Organ.* 2012 Jul 1;90(7):488-94. doi:10.2471/BLT.11.093369
35. Grigg CP, Tracy SK, Tracy M, Daellenbach R, Kensington M, Monk A, et al. Evaluating maternity units: a prospective cohort study of freestanding midwife-led primary maternity units in New Zealand—clinical outcomes. *BMJ Open.* 2017 Aug 1;7(8):e016288. doi:10.1136/bmjopen-2017-016288
36. Kozhimannil KB, Hardeman RR, Alarid Escudero F, Vogelsang CA, Blauer Peterson C, Howell EA. Modeling the cost effectiveness of doula care associated with reductions in preterm birth and cesarean delivery. *Birth.* 2016;43(1):20-7. doi:10.1111/birt.12218
37. Blomberg M. Avoiding the first cesarean section: results of structured organizational and cultural changes. *Acta Obstet Gynecol Scand.* 2016 May;95(5):580-6. doi:10.1111/aogs.12872
38. Berglund A, Lefevre-Cholay H, Bacci A, Blyumina A, Lindmark G. Successful implementation of evidence-based routines in Ukrainian maternities. *Acta Obstet Gynecol Scand.* 2010;89(2):230-7. doi:10.3109/00016340903479894
39. Bardos J, Loudon H, Rekawek P, Friedman F, Brodman M, Fox NS. Association between senior obstetrician supervision of resident deliveries and mode of delivery. *Obstet Gynecol.* 2017 Mar;129(3):486-90. doi:10.1097/AOG.0000000000001910
40. Ragusa A, Gizzo S, Noventa M, Ferrazzi E, Deiana S, Svelato A. Prevention of primary cesarean delivery: comprehensive management of dystocia in nulliparous patients at term. *Arch Gynecol Obstet.* 2016;294(4):753-61. doi:10.1007/s00404-016-4046-5
41. Naiden J, Deshpande P. Using active management of labor and vaginal birth after previous cesarean delivery to lower cesarean delivery rates: a 10-year experience. *Am J Obstet Gynecol.* 2001 Jun;184(7):1535-41; discussion 1541-3. doi:10.1067/mob.2001.114865
42. Xirasagar S, Lin HC, Liu TC. Do group practices have lower caesarean rates than solo practice obstetric clinics? Evidence from Taiwan. *Health Policy Plan.* 2006;21(4):319-25. doi:10.1093/heapol/czl015
43. Beigi A, Kabiri M, Zarrinkoub F. Cervical ripening with oral misoprostol at term. *Int J Gynecol Obstet.* 2003;83(3):251-5. doi:10.1016/s0020-7292(03)00275-3
44. Amer-Wählin I, Christoffersson M, Dahlgren N, Rydhstroem H. Epidural analgesia with sufentanil during labor and operative delivery. *Acta Obstet Gynecol Scand.* 2000 Jul;79(7):538-42. PMID: 10929951
45. Hickland P, Gargan P, Simpson J, McCabe N, Costa J. A novel and dedicated multidisciplinary service to manage breech presentation at term; 3 years of experience in a tertiary care maternity unit. *J Matern Fetal Neonatal Med.* 2018 Nov;31(22):3002-8. doi:10.1080/14767058.2017.1362382
46. Shaffer BL, Cheng YW, Vargas JE, Caughey AB. Manual rotation to reduce cesarean delivery in persistent occiput posterior or transverse position. *J Matern Fetal Neonatal Med.* 2011 Jan;24(1):65-72. doi:10.3109/14767051003710276
47. Acanfora L, Rampon M, Filippeschi M, Marchi M, Montisci M, Viel G, Cosmi E. An inflatable ergonomic 3 chamber fundal pressure belt to assist vaginal delivery. *Int J Gynaecol Obstet.* 2013 Jan;120(1):78-81. doi:10.1016/j.ijgo.2012.07.025
48. Choudhary D, Bano I, Ali SM. Does amnioin fusion reduce cesarean section rate in meconium-stained amniotic fluid. *Arch Gynecol Obstet.* 2010 Jul;282(1):17-22. doi:10.1007/s00404-009-1196-8
49. Peng FS, Lin HM, Lin HH, Tu FC, Hsiao CF, Hsiao SM. Impact of clinical audits on cesarean section rate. *Taiwan J Obstet Gynecol.* 2016 Aug;55(4):530-3. doi:10.1016/j.tjog.2014.12.015
50. Gregory KD, Hackmeyer P, Gold L, Johnson AI, Platt LD. Using the continuous quality improvement process to safely lower the cesarean section rate. *Jt Comm J Qual Improv.* 1999 Dec;25(12):619-29. doi:10.1016/s1070-3241(16)30476-x
51. Mohammadi S, Källestål C, Essen B. Clinical Audits: a practical strategy for reducing cesarean section rates in a general hospital in Tehran, Iran. *J Reprod Med.* 2012;57(1-2):43-8. PMID: 22324267
52. Scarella A, Chamy V, Sepúlveda M, Belizán JM. Medical audit using the Ten Group Classification System and its impact on the cesarean section rate. *Eur J Obstet Gynecol Reprod Biol.* 2011 Feb;154(2):136-40. doi:10.1016/j.ejogrb.2010.09.005
53. Santerre RE. The effect of the ACOG guideline on vaginal births after cesarean. *Med Care Res Rev.* 1996 Sep;53(3):315-29. doi:10.1177/107755879605300306
54. Robertson N, Ladlow B. Effect of individual dietetic intervention on gestational weight gain and associated complications in obese pregnant women. *Aust N Z J Obstet Gynaecol.* 2018 Jun;58(3):274-7. doi:10.1111/ajo.12711
55. Barakat R, Pelaez M, Lopez C, Montejó R, Coterón J. Exercise during pregnancy reduces the rate of cesarean and instrumental deliveries: results of a randomized controlled trial. *J Matern Fetal Neonatal Med.* 2012 Nov;25(11):2372-6. doi:10.3109/14767058.2012.696165
56. Bergström M, Kieler H, Waldenström U. Psychoprophylaxis during labor: associations with labor-related outcomes and experience of childbirth. *Acta Obstet Gynecol Scand.* 2010 Jun;89(6):794-800. doi:10.3109/00016341003694978
57. Poma PA. Effect of departmental policies on cesarean delivery rates: a community hospital experience. *Obstet Gynecol.* 1998 Jun 1;91(6):1013-8. doi:10.1016/s0029-7844(98)00077-5
58. Navaee M, Abedian Z. Effect of role play education on primiparous women's fear of natural delivery and their decision on the mode of delivery. *Iran J Nurs Midwifery Res.* 2015 Jan-Feb;20(1):40-6. PMID: 25709689

59. Bastani F, Hidarnia A, Montgomery KS, Aguilar-Vafaei ME, Kazemnejad A. Does relaxation education in anxious primigravid Iranian women influence adverse pregnancy outcomes?: a randomized controlled trial. *Perinat Neonatal Nurs.* 2006 Apr–Jun;20(2):138–46. doi:10.1097/00005237-200604000-0000
60. Gardner K, Henry A, Thou S, Davis G, Miller T. Improving VBAC rates: the combined impact of two management strategies. *Aust N Z J Obstet Gynaecol.* 2014 Aug;54(4):327–32. doi:10.1111/ajo.12229
61. Sanchez-Ramos L, Kaunitz AM, Peterson HB, Martinez-Schnell B, Thompson RJ. Reducing cesarean sections at a teaching hospital. *Am J Obstet Gynecol.* 1990;163(3):1081–8. doi:10.1016/0002-9378(90)91132-v
62. Mosadeghrad AM. [Health strengthening plan, a supplement to Iran health transformation plan: letter to the editor]. *Tehran Univ Med J.* 2019;77 (8):537–8 (in Farsi)
63. Harris SJ, Janssen PA, Saxell L, Carty EA, MacRae GS, Petersen KL. Effect of a collaborative interdisciplinary maternity care program on perinatal outcomes. *CMAJ.* 2012 Nov 20;184(17):1885–92. doi:10.1503/cmaj.111753
64. Visser GH, Ayres-de-Campos D, Barnea ER, de Bernis L, Di Renzo GC, Vidarte MF, et al. FIGO position paper: how to stop the caesarean section epidemic. *Lancet.* 2018 Oct 13;392(10155):1286–7. doi:10.1016/S0140-6736(18)32113-5