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Economic Evaluation of Elective Cesarean Section on Maternal Request Compared With Planned Vaginal Birth—Application to Swedish Setting Using National Registry Data

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ABSTRACT

Objectives: There is a lack of consensus around the definition of delivery by cesarean section (CS) on maternal request, and clinical practice varies across and within countries. Previous economic evaluations have focused on specific populations and selected complications. Our aim was to evaluate the cost-effectiveness of CS on maternal request compared with planned vaginal birth in a Swedish context, based on a systematic review of benefits and drawbacks and national registry data on costs.

Methods: We used the results from a systematic literature review of somatic risks for long- and short-term complications for mother and child, in which certainty was rated low, moderate, or high using the Grading of Recommendations Assessment, Development and Evaluation. Swedish national registry data were used for healthcare costs of delivery and complications. Utilities for long-term complications were based on a focused literature review. We constructed a decision tree and conducted separate analyses for primi- and multiparous women. Costs and effects were discounted by 3% and the time horizon was varied between 1 and 20 years.

Results: Planned vaginal birth leads to lower healthcare costs and somatic health gains compared with elective CS without medical indication over up to 20 years. Although there is uncertainty around, for example, quality-of-life effects, results remain stable across sensitivity analyses.

Conclusions: CS on maternal request leads to increased hospitalization costs in a Swedish setting, taking into account short- and long-term consequences for both mother and child. Future research needs to study the psychological consequences related to different delivery methods, costs in outpatient care, and productivity losses.

Keywords: cesarean section on maternal request, economic evaluation, registry, Sweden, systematic review.

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Introduction

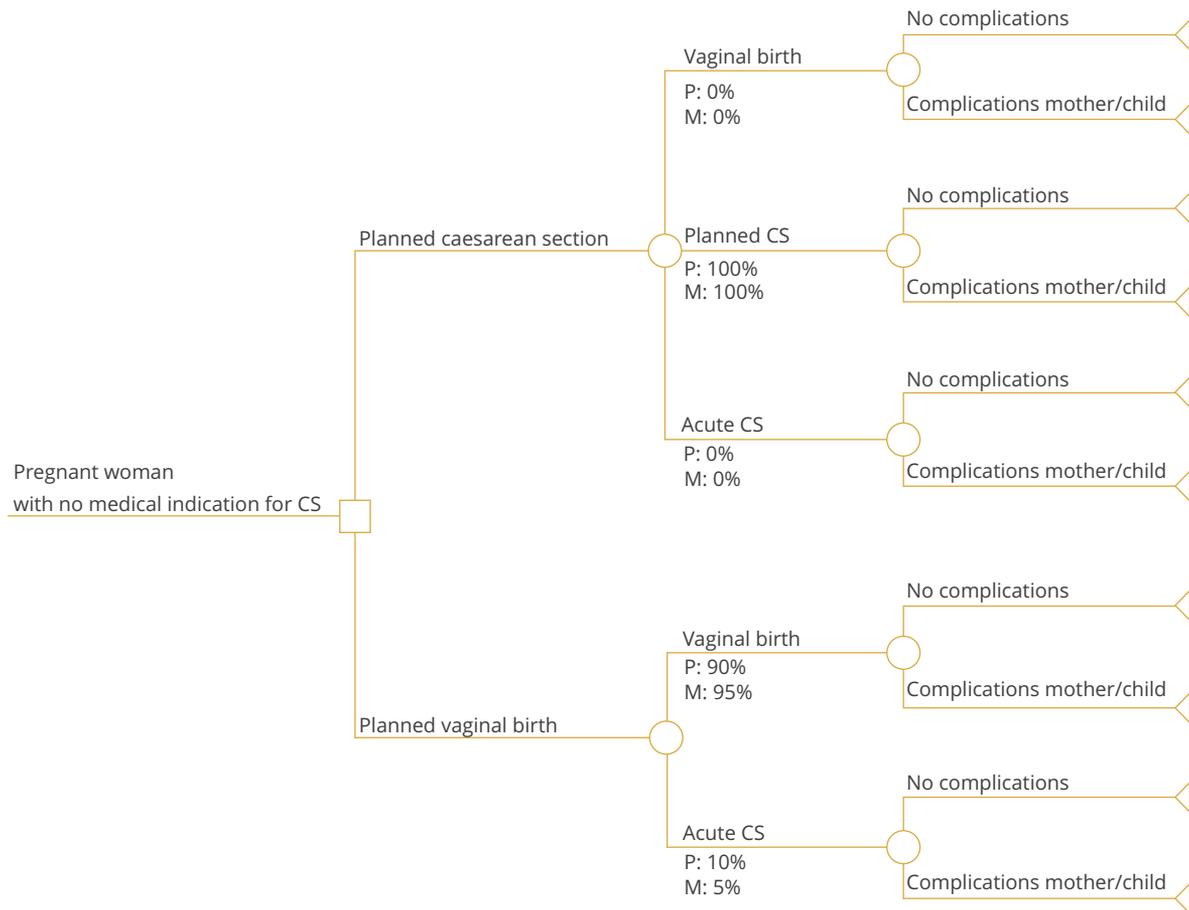
The increase in rates of delivery by cesarean section (CS) has attracted wide interest globally. In certain countries, the share of CS is very high (eg, 44% of births in Latin America), whereas other countries can be considered to have a low share (4% in parts of Africa).¹ Both over- and underuse of CS may be associated with increased risks for mother and child (eg, complications from surgery, injuries from vaginal birth, and possible long-term effects for the child). The global increase can partly be explained by a lack of midwives and economic incentive systems (eg, private caregivers).²

In Sweden, the share of CS has been stable at around 18% since 2006, although there is a large variation among the 21 regions (13%-21%).³ Approximately half of CS are planned, most with medical indications (such as placenta previa or breech

presentation), and the other half are acute. Multiparous women constitute the largest group of women who request CS without a medical indication. Reasons for requesting a CS include a previous traumatic delivery, worry about complications, or fear of not receiving adequate support during birth.⁴ In Sweden, socioeconomic factors do not play any major role in the request.³

No legislation confers the right to demand a medical procedure in Sweden (except for abortion and sterilization), only to abstain from an intervention. Nevertheless, since medical care should be decided in consultation between caregiver and patient, the question arises regarding how much weight should be given to the woman's request. This contrasts with the situation in other countries—for instance, in England, where women, for a few years now, have the legal right to demand a CS.

There is a lack of consensus on what should be considered a CS on maternal request, leading to uncertain statistics in this area.

Figure 1. Model structure.

CS indicates cesarean section; M, multiparous women; P, primiparous women.

Despite the existence of an International Classification of Diseases Tenth Revision diagnostic code often used in Sweden (O82.8), it is not applied consistently in clinical practice. This is interconnected with a general lack of binding guidelines in Sweden, leaving room for practice variations between clinics and regions. Therefore, the most common approach to evaluating outcomes after planned CS on maternal request is to exclude pregnancies in which a medical indication for planned CS can be discerned. In Sweden, an estimated 1% to 2% of primiparous women deliver with a planned CS on maternal request, compared with approximately 3% to 7% among multiparous women.³

In addition to research on the medical implications of planned CS on maternal request compared with vaginal delivery, there has been a sizable amount of research on the costs and cost-effectiveness in different populations and settings. Most of these studies⁵⁻⁸ have been conducted in contexts with high rates of CS, specifically the United States (33%),⁹ Brazil (56%),⁹ and Taiwan (35%).⁹ The precise features of treatment practices and healthcare systems mean that results from these economic evaluations have low transferability to countries with lower rates of CS, such as Sweden. A few studies from a European context have been conducted, including 1 analysis in primiparous women in the United Kingdom¹⁰ and 2 studies on multiparous women with a previous CS in Ireland¹¹ and 4 European countries.¹² Moreover, these studies used varying time horizons and included different complications and types of costs. When applying a longer timeframe (more than 6 weeks postpartum), the overall conclusions changed

with vaginal delivery remaining cost-saving in 2 of 4 countries,¹² underlining the importance of the local context in this field.

This study is part of a health technology assessment on the benefits and drawbacks of a CS on maternal request performed by the Swedish Agency for Health Technology Assessment and Assessment of Social Services (SBU).¹³ Whereas SBU does not provide policy recommendations, its reports form a basis for decision-making both on a national and regional level. The focus of this article is on the health economic consequences of CS on maternal request compared with planned vaginal delivery, applied to a Swedish context. The results may be used by the government, care providers, and national organizations using knowledge-based management to inform treatment guidelines and recommendations.

Methods

Model Structure

We constructed a decision tree using Microsoft Excel (Microsoft, Redmond, WA) (Fig. 1). The population covered low-risk women and singletons. Outcomes for both mother and child included short-term complications (within 6 weeks of delivery for the mother, 28 days of birth for the child), and long-term complications occurring more than 1 year after delivery or birth, respectively. Complications related to mental health were

Table 1. Maternal and child complications used in the model: baseline risks and relative risks with corresponding 95% CI.

Complication	Baseline risk (planned VD), %	Relative risk (planned CS)	95% CI
Mother*			
Short-term:			
Excessive bleeding during birth	1.40	6.18	6.00-6.37
Wound infection	0.60	2.6	2.47-2.75
Pulmonary embolism	0.04	1.72	1.38-2.14
Mastitis	1.80	1.53	1.48-1.59
Urinary tract infection	0.60	1.41	1.32-1.52
Endometritis	1.20	1.12	1.07-1.19
Anal sphincter injury	†	†	N/A
Long-term:			
Hernia	0.30	3.20	3.00-3.40
Adherences	0.20	2.80	2.60-3.10
Ileus	0.20	2.25	2.15-3.00
Urinary incontinence (surgery)	0.50	0.30	0.20-0.30
Prolapse (surgery)	0.60	0.20	0.10-0.20
Child‡			
Short-term:			
Respiratory morbidity	1.40	2.02	1.49-2.73
Neonatal intensive care treatment	5.60	1.92	1.44-2.56
Long-term:			
Hospitalization for gastroenteritis	3.70	1.21	1.16-1.25
Hospitalization for respiratory tract infection	5.80	1.14	1.09-1.19
Asthma	4.30	1.19	1.17-1.21
Food allergy	2.50	1.16	1.11-1.21
Rheumatoid arthritis	0.35	1.17	1.06-1.28
Inflammatory bowel disease	0.70	1.16	1.03-1.30
Diabetes	0.50	1.11	1.04-1.17

CI indicates confidence interval; CS, cesarean section; N/A, not applicable; VD, vaginal delivery.

*Notes on maternal complications: antibiotic treatment was not included as related costs were expected to be negligible. The following maternal complications were not included to avoid double-counting of complications: symptoms owing to prolapse and urinary stress incontinence and pelvic surgery. The model includes surgery owing to prolapse and urinary stress incontinence.

†2.9% for VD, 0% for CS.

‡Notes on child complications: some child complications were only included in sensitivity analyses due to their short duration (hospitalizations for gastroenteritis or respiratory tract infection) or because the project experts thought that further research on the associations with the method of birth was required (rheumatoid arthritis, inflammatory bowel disease, and diabetes). Overweight was not included in the model, as data on its relationship with costs and quality of life in children are inconclusive.

excluded. More details on the Population, Intervention, Control, and Outcomes format for the systematic review are available in the [Supplemental materials \(Appendix Table 1 in Supplemental Materials found at https://doi.org/10.1016/j.jval.2022.10.003\)](https://doi.org/10.1016/j.jval.2022.10.003). For this article, we followed the Consolidated Health Economic Evaluation Reporting Standards 2022.¹⁴ A health economic analysis plan was developed following the initiation of the systematic review on effects. There was no patient engagement during the project.

The planned mode of delivery can result in different actual modes of delivery, as illustrated in the decision tree (Fig. 1). In the case of a planned CS, actual delivery most often occurs as an elective (planned) CS, but may, in some cases, end up as a vaginal delivery (eg, before the planned date) or as an acute CS. A planned vaginal delivery can either end up as vaginal delivery or as an acute CS. Reflecting the selection criteria of the systematic review, short-term complications were assumed to occur during the first

year after delivery (given yearly modeling units), whereas long-term complications were assumed to occur during the second year after delivery. Since the systematic review of effects revealed no difference in mortality for the mother or child between the 2 methods of delivery, mortality was not included in the model.

Perspective, Populations, and Method of Delivery

The economic analysis has a healthcare perspective, focusing on direct medical costs, reflecting the outcomes investigated in the systematic review. Analyses were conducted for different time horizons: 1 year, 10 years, and 20 years. For time horizons beyond 1 year, costs and effects were discounted by 3% annually.¹⁵

Analyses were conducted for primiparous and multiparous women separately. The main difference between the populations lies in the probability of the actual method of delivery. An approximation of the planned method of delivery was performed

Table 2. Costs of delivery and inpatient care for maternal and child complications, Swedish registry data (EUR, 2019).

Type of cost	ICD-10 code	Number of care episodes	Mean cost	SD (costs)
Method of delivery (singleton births)				
Vaginal delivery	O80, O81	91 855	3213	2150
Acute CS	O82.1	9582	7490	4523
Planned CS	O82.0	6187	5324	3073
CS without medical indication	O82.8	3562	5256	2358
Mother, short-term complications				
Excessive bleeding during birth	O67	1957	7287	5294
Wound infection	O86.0, O86.1	289	6287	6372
Pulmonary embolism	O88.2	63	4839	4553
Mastitis	O91.1, O91.2	188	3687	6887
Urinary tract infection	O86.2	230	5752	5858
Endometritis	O85	1169	5112	5475
Anal sphincter injury	O70.2, O70.3	307	5516	2038
Mother, long-term complications*				
Hernia	K43	2007	7521	13 253
Adherences [†]	K66, N73.6, N99.4; JAP01	1409	8897	8465
Ileus	K56.5	689	13 089	18 548
Urinary incontinence (surgery)	N39.3	158	4536	6291
Prolapse (surgery) [†]	N81; LEF00, LEF03, LEF40, LEF50, LEF10, LEF13, LEF96, LDC10, LEF20, LEF23	2229	5278	3327
Child, short-term complications				
Respiratory morbidity	P22.1, P22.8, P22.9, P24.0	3728	11 453	17 751

Note. Source: Swedish Association of Local Authorities and Regions, Cost-per-patient database.

CS indicates cesarean section; ICD, International Classification of Diseases.

*Based on individuals of age \geq 16 years.

[†]Codes include classifications of care procedures.

based on data for full-term single vertex deliveries from the Swedish Medical Birth Register from 2015 to 2017.¹⁶ The register includes the type of labor onset (spontaneous, induction, or CS) and mode of delivery (vaginal noninstrumental, vacuum extraction, forceps delivery, or CS). The CS was considered planned if it was performed before the onset of labor, and acute if performed during ongoing labor. An assumption was made that all planned CS ultimately occurred as planned CS.

Primiparous women were assumed to have a mean age of 29 years and multiparous women, 32 years.³ The age affects the utility weights of the general population when using a long-term perspective.

Risks of Complications

The risks of complications were derived from the meta-analyses of results for the mother and child from the systematic review.¹³ Complications were included in the model if the results were statistically significant, and if certainty was rated low, moderate, or high using the Grading of Recommendations Assessment, Development and Evaluation.¹⁷ Some complications fulfilling these criteria were excluded to avoid double-counting, for instance, owing to the short duration and low impact (eg, antibiotic treatment) or to a need for more conclusive evidence (see Table 1). Baseline risks for complications after planned vaginal delivery were based on the frequency of cases in the total cohorts of studies included in the meta-analyses, as vaginal deliveries constituted the majority of all deliveries. Baseline and

relative risks are presented in Table 1; both types of data were varied in sensitivity analyses.

Costs

The costs of care per delivery method, as well as for short- and long-term complications for the mother were based on data for 2019 from the Cost-per-patient database held by the Swedish Association of Local Authorities and Regions. The database contains information on the healthcare costs per care episode for consecutive care contacts and medical care services in primary and specialist care¹⁸ but does not facilitate tracking of individuals over time. The costs reflect the length of stay, procedures, the time required per occupational category, care provided, and patient-specific costs for pharmaceuticals and materials. When relevant, surgery costs reflect the duration and difficulty of the procedure.

Cost data was requested for all care episodes with relevant diagnostic or procedural codes during 2019. The codes were identified together with the project's clinical experts. The codes could refer to main or secondary diagnoses and the care occurrence was handled as a unique episode under the complication with the first match in the list of codes. Costs are reflected in Euros for the year 2019/2020 (conversion rate 1 SEK = 0.088 EUR; other conversions based on the Campbell and Cochrane Economics Methods Group–Evidence for Policy and Practice Information and Coordinating Centre Cost Converter, version 1.6). Table 2 details the number of care episodes and mean costs (including SDs) in 2019 for inpatient care related to delivery and complications.

Table 3. Description of sensitivity and scenario analyses.

Parameter	Sensitivity analyses
Complications: relative risks	95% CI (lower respectively upper limit), for all complications (short and long-term)
Risk of complications in comparator arm (VD)	Variation \pm 20% in baseline risk for complications where the relative risk was < 1 or > 2 (ie, lower risk with CS or halved risk with VD, respectively), testing the impact of complication risks that could change the direction of the results
Inclusion of yearly physician visits for prolapse and urinary incontinence, respectively	Assumption of 2 physician visits in primary care per year (352 EUR) for the respective complication, testing the role of complications mostly treated in outpatient care
Costs long-term complications for the child	Variation \pm 20% in yearly costs for asthma and food allergy
Costs short-term complications for the mother that are treated in outpatient care	Assumption that the mean cost for the complications such as wound infection, mastitis, urinary tract infection, endometritis, and anal sphincter injury is reduced by 90% given that the costs from national statistics focused on hospital care and these complications are often handled in outpatient care
Duration long-term complications	Acute: 2 respectively 4 weeks. Urinary incontinence: 3 respectively 7 years. Hernia: 5 respectively 15 years. Adherences, prolapse: 10 respectively 19 years. Asthma: 10 years (20 years in base case). Food allergy: 7 respectively 13 years.
Inclusion of additional chronic long-term complications for the child	Inclusion of relative risks for rheumatoid arthritis, inflammatory bowel disease, and diabetes, together with related costs and utility weights (see Table 1 footnote)
Inclusion of costs for temporary long-term complications for the child	Costs for hospitalization for respiratory tract infection and gastroenteritis during 2 and 3 years, respectively; 1 hospitalization per year (see Table 1 footnote)
Utility weights	Variation \pm 0.1 (utility weight for normal population in the relevant age group being upper limit)
Exclusion of acute long-term complications for the mother	Exclusion of relative risks for ileus, testing the impact of removing acute and costly complications of CS
Discount rate	Costs 0%, QALYs 0% Costs 5%, QALYs 5%

CI indicates confidence interval; CS, cesarean section; QALY, quality-adjusted life-year; VD, vaginal delivery.

For short-term maternal complications (in particular, mastitis, endometritis, and urinary tract infection), the number of cases is considerably higher in outpatient than inpatient care. Given that the data refer to hospitalizations, this means that these costs are overestimated. Therefore, sensitivity analyses are performed in which the costs for all maternal short-term complications—except embolism and excessive bleeding during delivery (as these generally are treated as part of inpatient care)—are assumed to constitute 10% of the reported mean values. This scenario served to test the impact of lower costs in outpatient care for the named short-term complications.

The duration of long-term maternal complications was estimated based on the literature and input from the project's clinical experts. Urinary stress incontinence was assumed to last 5 years (before surgery); hernia, 10 years; adherences and prolapse, 20 years. As the costs were based on surgical procedures, they were only applied once after the respective number of years.

For child complications, the inpatient costs for treatment of respiratory morbidity were derived from the same database as maternal complications. Neonatal intensive care was calculated based on a daily cost for children aged 32 weeks or more of 2267 EUR¹⁹ and an average length of stay of 2.6 days.²⁰ Inpatient costs for treatment of respiratory tract infection and gastroenteritis were based on Diagnosis Related Groups²¹ at 2495 EUR and 2231 EUR, respectively. For the costs of long-term child complications, a focused literature search was performed to identify studies relevant to children and Sweden (Appendix Table 2 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003>). Except where noted in Appendix Table 3 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003>,

long-term child complications were assumed to last for the whole modeling horizon.

Utilities

A focused literature search was performed using terms for long-term complications for mother and child together with a search block for “health state utility values” (based on the precision-maximising filter by Arber et al²²). Searches were conducted in Medline (Ovid) and the Economic Evaluation Database in June 2021. A structured review and selection process was applied, with prioritization based on the relevance of the complication and patient population, and also a direct measurement using EQ-5D in the population of interest (to facilitate comparison across complications). The selected studies and values are detailed in Appendix Table 3 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003>. In the health economic model, the utility weights were applied during the assumed duration of the complications. For women and children without complications, the mean values for the Swedish general population were used^{23,24}: 0.87 for women aged 30 to 39 years, 0.84 for women aged 40 to 49, and 0.95 for children and adolescents.

Sensitivity Analyses and Model Validation

Sensitivity analyses were performed for all relevant input parameters, including complication risks, costs, utility weights, and duration of long-term complications. When possible, scenario analyses around model assumptions were conducted, such as the inclusion or exclusion of certain types of complications or costs. The details of the analyses and rationale can be found in Table 3.

Table 4. Cost-effectiveness of planned CS versus planned VD over different time horizons, primiparous women.

Result type	Planned CS	Planned VD	Incremental difference	ICER (EUR/QALY)
Time horizon: 1 year (discount rate 0%)				
Costs				
Mother	6275	4167	2108	
Child	958	539	419	
Total	7233	4706	2527	Not calculated*
Time horizon: 10 years (discount rate 3%)				
Costs				
Mother	6338	4214	2124	
Child	2593	2123	471	
Total	8932	6337	2595	
QALYs				
Mother	7.629	7.630	0.000	VD dominant [†]
Child	8.296	8.300	-0.004	VD dominant [†]
Total	15.925	15.930	-0.004	VD dominant [†]
Time horizon: 20 years (discount rate 3%)				
Costs				
Mother	6424	4263	2161	
Child	3645	3158	487	
Total	10 069	7421	2648	
QALYs				
Mother	13.141	13.138	0.003	815 477
Child	14.486	14.490	-0.004	VD dominant [†]
Total	27.627	27.628	-0.002	VD dominant [†]

CS indicates cesarean section; ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life-year; VD, vaginal delivery.
 *Because no health effects were estimated using utilities for the short-term perspective.
 †That is, planned VD leads to cost savings and health gains.

The results of the sensitivity analyses are presented using a time horizon of 10 years as a reference.

Model validation was performed in several ways. The medical experts gave feedback on face validity regarding model structure, data sources, assumptions, and results. A health economist external to the project team checked the model structure and coding. The model results were cross-validated through comparison with results from other modeling studies,^{10-12,25} while being mindful of differences in methods and assumptions. External validity was aimed for through the use of data from national registries and comparison of model-predicted events to observed events from the systematic review. Finally, all SBU assessments, including the health economic analyses, undergo structured internal, and external review processes.

Results

Methods of Delivery and Associated Costs

Analyses of the Swedish National Birth Register revealed that, among primiparous women, approximately 90% (SD 0.08%) of those who had a planned vaginal delivery eventually gave birth vaginally, whereas the remainder had an acute CS. For multiparous women, the corresponding proportion was 95% (SD 0.05%).

Based on the Cost-per-patient database, the cost of care for a planned CS and CS without medical indication was around 5300 EUR (SD 3073 and 2358, respectively) in 2019. This compares to

about 3200 EUR (SD 2150) for a vaginal delivery and 7500 EUR (SD 4523) for an acute CS.

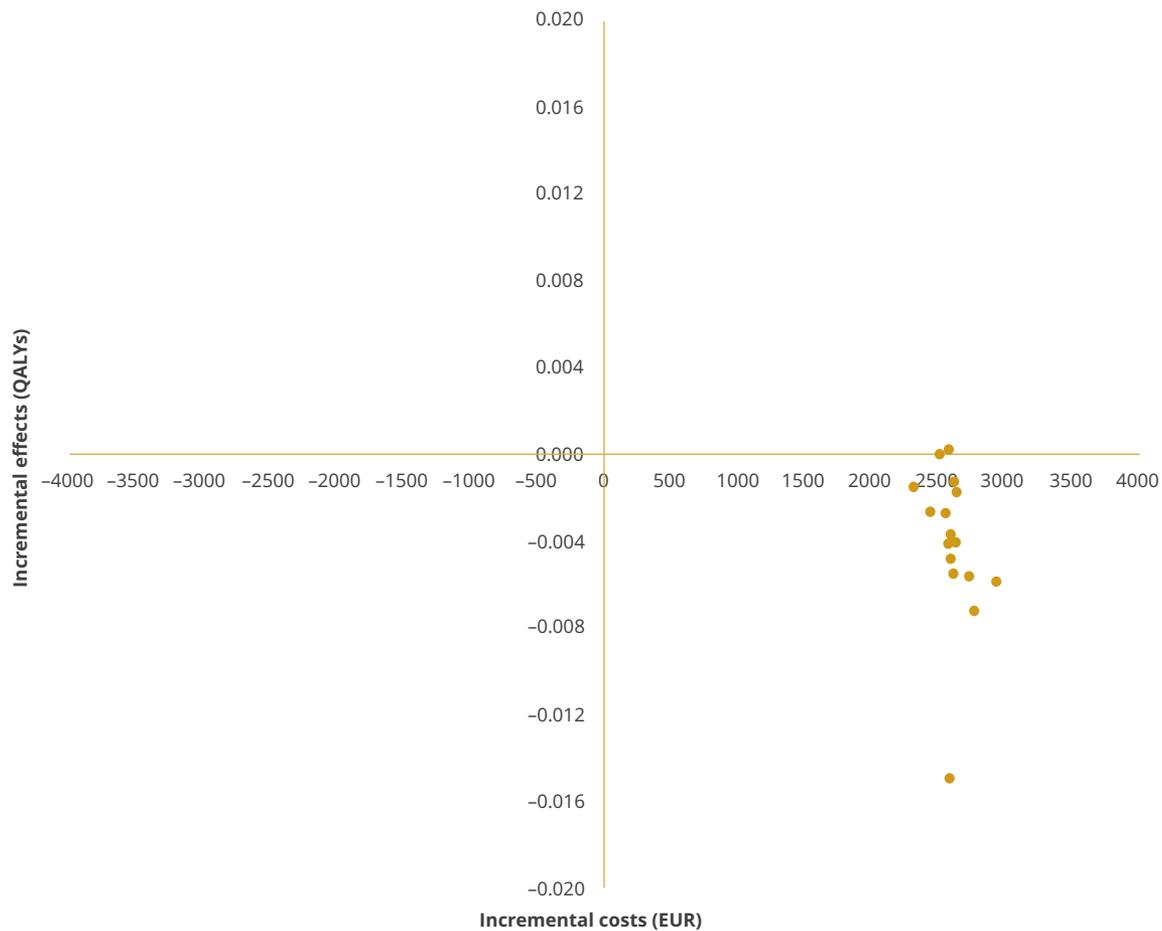
Base Case Cost-Effectiveness Results

When using a 1-year time horizon, the incremental cost for a planned CS compared with a planned vaginal delivery is around 2530 EUR in primiparous women (Table 4) and around 2820 EUR in multiparous women (Appendix Table 4 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003>). Going beyond 1 year, the utility losses associated with long-term complications, especially for the child, lead to an average total loss of 0.004 quality-adjusted life-years (QALYs) with planned CS over 10 years (Table 4). Over 20 years, there is a utility gain of 0.003 for the woman, which is largely due to the lower risk of prolapse following a CS. Nevertheless, when the child perspective is weighed in, there is an overall loss of 0.002 QALYs over 20 years. Both in primiparous (Table 4) and multiparous women (Appendix Table 4 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003>), planned vaginal delivery is, thus, associated with cost savings and somatic health gains in the long-term.

Sensitivity Analyses

The results were robust to changes in input parameters and assumptions around modeling scenarios (Fig. 2 and Appendix Fig. 1 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003> for primiparous and multiparous women,

Figure 2. Cost-effectiveness plane illustrating results of different sensitivity and scenario analyses for planned CS versus planned vaginal delivery (primiparous women, time horizon 10 years).



CS indicates cesarean section; QALY, quality-adjusted life-year.

respectively). The incremental costs of planned CS ranged between 2330 and 2950 EUR for primiparous women, and 2600 and 3260 EUR for multiparous women. Except for 1 scenario in which the utility weights for long-term complications were assumed to be 0.1 higher than in the base case, planned CS led to utility losses between 0.001 and 0.015 for primiparous women (between 0.001 and 0.016 for multiparous women). Relative complication risks had the highest impact on incremental costs, whereas utility weights for long-term complications carried the most weight for incremental effects (Appendix Fig. 2 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003>).

Model predictions for clinical outcomes for primiparous women and their children are detailed in Appendix Table 5 in Supplemental Materials found at <https://doi.org/10.1016/j.jval.2022.10.003>.

Discussion

We evaluated the cost-effectiveness of planned CS on maternal request compared with planned vaginal delivery in a Swedish setting. Our results revealed that planned vaginal birth leads to lower healthcare costs and somatic health gains compared with elective CS without medical indication over up to 20 years. The results are not generalizable to settings with other treatment practices, particularly in countries where the rates of CS are high.

Given the importance of the local context to the cost-effectiveness results in this area, it is a strength of our analysis that it is based not only on a comprehensive and systematic literature review and meta-analysis of the risk of complications but also Swedish registry data for method of delivery and healthcare costs. The model includes both short- and long-term complications for mother and child and has been analyzed using different time horizons. Utility weights for long-term complications are based on a focused literature search using structured selection criteria.

Uncertainty exists around the relative risks of complications, utilities, and duration of several long-term complications. We conducted a range of sensitivity analyses around parameter uncertainty and important model assumptions, which indicated stable overall results. For multiparous women, larger cost differences were seen than for primiparous women, owing to the lower share of acute CS and associated complications for planned vaginal delivery in this population. When comparing different time horizons, the cost difference between planned birth methods is relatively stable. This can be explained by the largest cost difference being incurred during the first year, arising from the method of delivery and different risks for neonatal intensive care.

According to results from the systematic review of effects, the risks of several maternal complications are reduced with planned CS, including urinary stress incontinence and prolapse. Nevertheless, in the health economic model, these positive effects are

offset by other maternal complications with a higher risk, and consistently increased complication risks for the child. Given the long duration of and utility losses associated with urinary stress incontinence and prolapse, which weigh in favor of a planned CS, assumptions around these complications play an important role in the model. In our analysis, we only included complications that need to be treated surgically, to avoid double-counting with symptomatic prolapse and urinary incontinence. We did not include any annual costs for maintenance treatment of urinary stress incontinence and prolapse, as nonsurgical treatment is generally limited to pelvic floor exercises, treatment with estrogen or a pessary, and absorbent pads for urinary stress incontinence. Overall results were not affected when we conducted sensitivity analyses assuming an annual cost of 350 EUR for both complications, which corresponds to 2 physician visits in primary care.

Previous economic evaluations have led to mixed results when urinary stress incontinence was included,²⁵ in some cases reducing the probability of planned vaginal delivery being cost-effective, and in others not affecting the results to any large extent. The economic evaluation for primiparous women by the National Institute for Health and Care Excellence¹⁰ included short- and long-term complications for the mother and child and focused on healthcare costs. In the base case, which did not include urinary stress incontinence, vaginal delivery was cost-saving and associated with a QALY gain of 0.03. When urinary stress incontinence was included (using annual maintenance costs of 497 EUR, mainly for absorbing materials and cleaning, based on Xu et al²⁶), the results changed to 495 EUR/QALY for planned CS versus planned vaginal delivery, in contrast to the results of our sensitivity analysis described in the previous paragraph.

Two studies have evaluated the cost-effectiveness of planned CS versus planned vaginal delivery in women with a previous CS in a European setting. Fawsitt et al¹¹ performed an analysis from a healthcare perspective in low-risk women with previous CS in Ireland up to 6 weeks post-delivery and found planned vaginal delivery to be dominant, which is in line with the results of our 1-year analysis. Fobelets et al¹² conducted a cost-effectiveness analysis using a societal perspective for low-risk women with previous CS in Belgium, Ireland, Italy, and Germany, with the latter 2 countries having high rates of CS, and thus, not being comparable to Sweden. Over a time horizon of 6 weeks, planned vaginal delivery was again dominant across all countries. When using a lifetime perspective, the overall result remained unchanged in Ireland (similar to our results), whereas in Belgium, the cost for a planned vaginal delivery was 3931 EUR per QALY compared with planned CS.

There are certain limitations that need to be kept in mind when using the study results. In our analysis of the data from the Swedish Medical Birth Registry, some of the deliveries that were planned as CS will have been misclassified as planned vaginal deliveries if the delivery occurred before the date of the planned CS. This is related to a general challenge in this field: studies tend not to have an intention-to-treat design, as it is usually the actual rather than the planned method of delivery that is registered in charts and databases. Consequently, the costs of planned CS tend to be overestimated and the costs of vaginal deliveries underestimated, as the costs of preparedness (eg, surgery, neonatal care) are allocated to patients who actually use the resources.²⁷ In a sensitivity analysis (not presented) we tested the extreme assumption that the costs of planned CS and vaginal deliveries are the same. Although the difference in total costs became much smaller, the overall results remained unchanged.

In our model, we have not been able to consider all possible subpopulations and complications reflecting, for example, the

number of previous deliveries, previous type of delivery, and earlier complications. Such a model quickly becomes complex, and we developed our model based on an assessment of accessible data, a need for methodological transparency, and clear communication to stakeholders in different parts of the healthcare system.

An important limitation of our study lies in the exclusion of possible complications related to mental health associated with different methods of delivery. To the best of our knowledge, this aspect has not been included in any previous health economic evaluations either. The possible implications of this limitation are difficult to assess. A systematic review by Olieman et al²⁸ on the effect of planned CS on maternal request on peripartum anxiety and depression among women with childbirth fear only found 3 studies of at least satisfactory study quality. Women who received a planned CS had higher antepartum depression scores compared with women who delivered vaginally.²⁹ Women who preferred a planned CS, but delivered vaginally, had significantly higher levels of childbirth fear, higher levels of antepartum anxiety, and higher scores of posttraumatic stress syndrome 2 months after delivery compared with women who did not have such a preference and who gave birth vaginally.²⁹ Moreover, post hoc analyses revealed that women whose request for a CS was not granted had higher levels of depression postpartum compared with women who did not request a CS and gave birth vaginally. In contrast, women whose request for a planned CS was granted reported normal levels of depression after delivery.²⁸

This suggests that there may be psychological aspects that influence the overall effect of planned CS on maternal request compared with planned vaginal delivery, which could increase the utility gain of a planned CS. Depression is costly in terms of both resource use and reduced quality of life. In a Swedish study, the annual cost per patient with moderate depression treated in primary care was estimated at 4645 EUR.³⁰ Moreover, depression has been associated with a utility weight of 0.44, compared with an average utility weight of 0.87 for women aged 30 to 39 years in the general Swedish population.²³

An argument that is sometimes put forward in favor of CS concerns complications that can occur if the child gets stuck in the birth canal (eg, clavicle fracture or nerve damage affecting the arms), and that these cannot occur with a planned CS. According to data from the Swedish Medical Birth Registry, the risk of a child getting stuck with its shoulders is 1/350 (0.3%) with planned vaginal delivery for pregnancies that have lasted 39 weeks or more. In a Swedish context, there is an important knowledge gap regarding the consequences of a child getting stuck and more research is needed.

Our health economic evaluation includes only direct medical costs as the systematic review of effects focused on the medical consequences of somatic complications. The registry data we used for costs of complications primarily contained information on hospital care episodes, which means that costs in outpatient care are not included. Nevertheless, sensitivity analyses in which outpatient care costs are included for complications with a reduced risk in the case of planned CS indicate that this type of cost likely does not have any major impact on results. Finally, the impact of different methods of delivery on productivity losses is also an area requiring further research.

Conclusions

Our economic evaluation indicates that, in a Swedish context, planned vaginal birth compared with CS on maternal request

leads to lower hospital care costs and somatic health gains over a time horizon of up to 20 years. This includes short- and long-term consequences for both mother and child. Although there is uncertainty around the relative risks of complications, the duration of several long-term complications, and their impact on quality of life, the overall results remained stable across a range of sensitivity and scenario analyses.

Supplemental Material

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.jval.2022.10.003>.

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