Vaginal Uncomplicated Delivery Rate as a Quality Indicator Compared to Cesarean Delivery Rate: A Quantitative Analysis of a Population Database

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ABSTRACT

Objectives: The objective of this study is to compare the vaginal uncomplicated delivery (VUD) rate, defined as all vaginal deliveries (including forceps and vacuum) without an adverse maternal or neonatal labour outcome, to the cesarean delivery (CD) rate, as a performance indicator.

Methods: This is a retrospective cohort analysis from a provincial database of all term deliveries by an obstetrician in a single year, excluding diagnoses preventing active labour. Most obstetricians in this jurisdiction practice consultative obstetrics, focused on supporting primary maternity care. We investigated the association of adverse delivery (AD), measured by the adverse outcome index, with CD and VUD rates.

Results: We report 16 620 deliveries by 210 obstetricians, with a vaginal delivery rate of 39.6%, of which 36.6% were operative vaginal delivery. The overall AD rate was 9.9%, and the overall VUD rate was 34%. While the CD and VUD both correlated with the mode of delivery, only the VUD rate was correlated to the AD rate.

Conclusions: Quality assurance in obstetrics must balance the needs of 2 patients based on limited data. Our data shows the shortcomings of the prevailing performance indicator, CD rate, which does not correlate with birth outcomes for the pregnant patient or infant. The VUD rate provides an alternative that assesses both mode of delivery and labour outcomes. Shifting the quality lens to focus on the VUD rate will provide a better metric that measures optimal outcomes for pregnant people and their babies.

Keywords: quality assurance; performance indicator; adverse labour outcomes; adverse delivery; cesarean delivery; vaginal uncomplicated delivery

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RÉSUMÉ

Objectif : Cette étude vise à comparer le taux d'accouchement vaginal sans complications (AVSC), défini comme la proportion d'accouchements vaginaux (y compris par forceps ou ventouse) sans issue maternelle ou néonatale défavorable, au taux de césariennes en tant qu'indicateur de performance.

Méthode : Il s'agit d'une analyse de cohorte rétrospective de données extraites d'une base de données provinciale sur tous les accouchements à terme pratiqués par un obstétricien dans une année, à l'exclusion des diagnostics empêchant le travail actif. La plupart des obstétriciens de cette province ont une pratique de consultation en obstétrique, principalement pour la prestation de soins de maternité primaires. Nous avons étudié la corrélation du taux d'événements indésirables (EI) à l'accouchement, mesuré par l'indice des issues défavorables (AOI), avec le taux de césariennes et le taux d'AVSC.

Résultats : Nous avons recensé 16 620 accouchements réalisés par 210 obstétriciens, pour un taux d'accouchement vaginal de 39,6 %; de ces accouchements vaginaux, 36,6 % étaient des accouchements assistés. Le taux global d'EI était de 9,9 %; le taux global d'AVSC, de 34 %. Alors que la césarienne et l'AVSC sont tous deux corrélés avec le mode d'accouchement, seul le taux d'AVSC est corrélé avec le taux d'EI.

Conclusions : L'assurance de la qualité en obstétrique doit trouver un équilibre entre les besoins de deux patientes sur la base de données limitées. Nos données montrent les lacunes du taux de césariennes comme indicateur de performance dominant, car ce taux n'est pas corrélé avec les issues maternelles ou néonatales. Le taux d'AVSC serait une meilleure option, car il évalue à la fois le mode d'accouchement et les issues de l'accouchement. En considérant la qualité des soins à travers le prisme du taux d'AVSC, on obtiendrait un meilleur indicateur des issues optimales pour les personnes enceintes et leurs bébés.

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INTRODUCTION

The last 2 decades have seen a worldwide increase in the use of cesarean delivery (CD) and ensuing concerns about its impact on the quality of maternity care have focused attention on using CD rate as a performance indicator. It has been widely adopted as a performance indicator despite clearly recognized limitations.[1–4] While CD is an established means to decrease morbidity and mortality, its appropriate use varies by population, which is the major barrier to establishing an optimal CD rate.[5] Efforts to improve its utility as a performance indicator have focused on risk adjustment, through limiting assessment to a nulliparous, term, singleton, vertex (NTSV) population. Nevertheless, efforts to define an evidence-based benchmark for CD rate have been elusive, resulting in reliance on expert opinion.[5] Recent efforts to incorporate patient-centred decision-making into practice, is another perceived barrier.[6] Benchmarking of CD rate has also been associated with higher adverse labour events, hypothetically due to maternity providers incentivized to push for vaginal delivery to the patients' detriment.[5,7]

Ultimately, the shortcoming of CD rate as a performance indicator is its inability to discriminate between CDs done for appropriate indications, where potential benefits outweigh potential risks and those that are not. The Institute of Medicine (IOM) states that performance indicators should measure both processes and outcomes, but the CD rate only measures processes, highlighting that an alternative to CD should balance the mode of delivery with outcomes.[8] It should also focus on vaginal delivery based on a trend towards increased vaginal birth following the introduction of a similar measure in the United Kingdom.[9,10]

Reporting mode of delivery, stratified by adverse labour outcomes creates a performance indicator matrix that achieves these quality goals (Figure 1). We chose to focus on positive outcomes through reporting the Vaginal Uncomplicated Delivery (VUD); that part of the matrix where vaginal delivery is accomplished without adverse events for either the pregnant person or baby. We used the Adverse Outcomes Index (AOI), a well-established consensus-based metric of adverse labour outcomes to define adverse labour outcomes.[11] It includes both neonatal outcomes:

- intrapartum or neonatal death >2500 g,
- birth trauma,
- admission to neonatal intensive care unit (NICU) >2500 g and for >24 hours,
- Apgar <7 at 5 minutes,

as well as outcomes for the pregnant patient including:

- maternal death,
- uterine rupture,
- admission to the intensive care unit,
- return to operating room/labour and delivery,
- blood transfusion,
- third or fourth-degree perineal tear.

Prior work showed that the AOI derived from a population-based database, can successfully monitor longitudinal trends in safety of labour and delivery between hospitals.[12]

The VUD includes all vaginal deliveries, without an adverse labour outcome as defined by the AOI. Under this construct, providers that use forceps or vacuum without complications should benefit from a favourable rise in the VUD rate, while those that have adverse events from overuse will not. Providers that underutilize Vaginal Birth After Cesarean delivery (VBAC) or encourage non-medically indicated CD will have a low VUD rate. The VUD promises value as a performance indicator that combines outcomes with the mode of delivery and meets the IOM's goals.

We hypothesize that while the VUD and CD rate both assess the mode of delivery, by assessing adverse labour outcomes in addition to mode of delivery, the VUD rate will provide a better assessment of quality labour care than CD rate alone.

METHODS

The aim of this study is to assess the VUD rate as a performance indicator in a large population of deliveries by obstetricians (OB). This study is a retrospective cohort analysis of a de-identified population drawn from a large provincial (British Columbia Perinatal Data Registry) population-based perinatal data registry linked with data from the Vital Events Deaths from Population Data British Columbia and the British Columbia Medical Services Plan to permit identification of the provider

Figure 1. Performance indicator Matrix, combining mode of delivery with absence or presence of labour-related adverse events (the numbers are for example only).

	Uncomplicated	Adverse	Total
Vaginal	***VUD Rate = A%***	B%	A+B%
Cesarean	C%	D%	**CD rate =C+D%**
Total	A+C%	**AD Rate = B+D%**	100%

VUD: vaginal uncomplicated delivery.

responsible for each delivery.[13–15] The study was approved by the Providence Health Care Research Ethics Board (H16-02490) which waived informed consent as the data was anonymized. We followed the STROBE Guidelines in the design and implementation of the study and the SQUIRE Guidelines for reporting quality improvement in health care. Inclusion criteria included all full-term (≥37 weeks) singleton deliveries by an OB who performed ≥10 deliveries between April 01, 2015, and March 31, 2016. Exclusion criteria included contraindications to vaginal delivery: presentation in transverse lie, placenta previa, placenta abruption, a prior uterine scar precluding labour, dehiscence of uterine scar, and fetuses with identified congenital malformations (International Statistical Classification of Diseases, Tenth Revision [ICD-10] codes listed in Supplementary Table 1). Breech presentations and prior CDs were not excluded, as they are not considered a contraindication to vaginal delivery. Most OBs in BC practice consultative obstetrics that is not focused on primary maternity care, but instead, supports primary care maternity providers, including midwives and family practitioners. Consequently, the population does not include deliveries typical of a "low-risk" NTSV population.

Our primary exposure of interest was OBs with the highest versus the lowest quintile of CD or VUD. Our primary outcome was experiencing an adverse event in delivery (AD) as defined by the AOI. We stratified OBs into quintiles based on their AD percentage and examined patient characteristics and labour outcomes, including CD, and VUD by AD quintile.

We then stratified OBs into quintiles (lowest to highest) based on CD rate and VUD rate to further explore the relationships between AD and CD and VUD rates.

The association between AD rate quintile, provider's CD quintiles, provider's VUD quintile and pregnant people' characteristics, as well as their labour outcomes, were tested using chi-square test for categorical variables and analysis of variance for continuous variables.

We explored the association of CD and VUD quintiles with having an AD, in a univariate analysis using logistic regression and presented crude ORs. We then tested socio-demographic and pregnancy-related variables (pregnant patient's age, BMI categories, pre-existing diabetes, gestational diabetes, hypertension during pregnancy, pregnancy-induced hypertension, smoking during pregnancy, gravidity, proteinuria, nulliparity, and mode of delivery) for their role as confounders in this association, in a multivariate analysis using logistic regression. Variables were retained in adjusted regression models if their inclusion changed the coefficients for VUD and AD by 10% or more. The SEs were corrected for the clustering of multiple deliveries by the same OB. We repeated these models, excluding third and fourth-degree perineal tears to assess how they might be affecting the associations, as they were the most common adverse event reported in the AOI. We also performed a sensitivity analysis adjusting these models for hospital volume. All statistical analysis was performed using SAS 9.4 (SAS Institute, Cary, NC) and STATA 16.1 (StataCorp).

RESULTS

This study included all deliveries by OBs in BC that met our inclusion criteria during the fiscal year 2015. There were 16 620 deliveries, managed by 210 OBs, with a median annual delivery volume of 108 (IQR: 67–161). The pregnant population was typical for OBs practising consultative obstetrics, including 8632 (51.9%) nulliparous people, and 4552 (27.4%) with a prior CD. Deliveries included 6597 (39.6%) who delivered vaginally, of which 2420 (36.6%) were by operative vaginal delivery (including forceps 45.3%, vacuum 51.8%, and combined forceps and vacuum 2.9%), and 10 023 (60.4%) delivered by CD. The

overall VUD was 5647 (34%) (Table 1). The number of deliveries with at least one adverse event was 1646 (9.9%), with the most common adverse events being third or fourth-degree perineal tears 567 (34.4%), admission to the NICU 469 (28.5%), and maternal transfusion 163 (9.9%). The detailed pregnant patient characteristics and labour outcomes are summarized in Table 1. The overall CD rate that year, for all maternity patients, including primary maternity care, was 32.8%.

We present delivery characteristics stratified into quintiles based on an OB's number of ADs divided by their total number of deliveries (Table 1). There were important differences in characteristics across AD quintiles, with the higher AD quintiles showing a pregnant population with higher BMI ($P < 0.0001$), more smoking during the pregnancy ($P < 0.0001$) and a smaller number of people having proteinuria ($P = 0.02$). There were significant differences in CD rate by AD quintile as well, with the highest CD rates in the highest AD quintile (65.7%) and the lowest CD rates in the lowest AD quintile (58.3%) ($P < 0.0001$). The highest VUD rate (38.5%) was in the lowest AD quintile, while the lowest VUD rate (24.5%) was in the highest AD quintile ($P < 0.0001$).

There was a clear inverse relationship between CD and VUD, which reflects their inherent relationship to mode of delivery (as VUD is necessarily 1-CD-AD at vaginal delivery) (Figure 2). The VUD rate decreases as CD rate increases with the crossover of CD and VUD rates at 48.0% (Figure 2). The AD rate did not vary with the CD delivery rate (Figure 2).

Table 2 shows labour outcomes stratified by the provider's CD quintiles, with patient characteristics shown in Supplementary Table 2. The pregnant people in the highest CD quintile tended to be younger ($P < 0.0001$), with higher BMI ($P < 0.0001$), were more likely to have smoked during pregnancy ($P < 0.0001$), had pregnancy-induced hypertension ($P = 0.002$), proteinuria $P < 0.0001$), a prior preterm birth (0.004), and a prior CD ($P < 0.0001$). The VUD rates decreased with increasing CD quintiles ($P < 0.0001$), but there were no significant differences in AD rates by CD quintiles ($P = 0.10$). There were significant differences in components of the AD rate by CD quintile, including birth trauma ($P < 0.001$), and NICU admission ($P < 0.0001$), which both increased with increasing CD quintiles, and perineal tears, ($P < 0.0001$) which decreased with increasing CD quintile.

In contrast to Table 2, Table 3 presents labour outcomes stratified by VUD quintiles, with patient characteristics shown in Supplementary Table 3. In the highest VUD quintile, the CD rate is 40.9% and in the lowest VUD quintile 85.3%; ($P < 0.0001$) In the highest VUD quintile the AD rate was 8.7% compared to 11.9% in the lowest VUD quintile. Rates of individual components of the AOI decreased significantly with increasing VUD rate, including birth trauma ($P < 0.0001$), admission to the NICU ($P < 0.0001$), and Apgar <7 at 5 minutes ($P < 0.001$). Third and fourth-degree perineal tears increased in frequency with increasing VUD quintile ($P < 0.001$). Characteristics of the pregnant people also differed across VUD quintiles with obese BMI ($P < 0.0001$), pregnancy-induced hypertension ($P = 0.003$), any hypertension ($P < 0.001$), smoking ($P < 0.0001$), proteinuria, ($P < 0.0001$), and prior CD ($P < 0.0001$) all decreasing with increasing VUD quintile.

The model to evaluate the association between any adverse event at the level of the individual delivery and the OB providers' CD and VUD quintile was adjusted for these characteristics and mode of delivery for the specific delivery. Standard errors were corrected for the clustering among deliveries to the same OB. After this correction, only the lowest CD quintiles (first quintile OR: 0.65 [0.51−0.82], Second quintile OR: 0.73 [0.58−0.93]) correlated with AD rates, while the majority of VUD quintiles correlated with the AD rate (Table 4). This inverse relationship saw decreasing AD rate with increasing VUD rates (lowest quintile OR 1.95 [1.53−2.50]; second highest quintile OR 1.55 [1.28−1.88]). This model was repeated after removing 3° and 4° perineal tears, and the VUD rate was still significantly correlated with AD rate (lowest quintile OR 1.92 [1.44−2.58]; second highest quintile OR 1.62 [1.27−2.05]). The sensitivity analysis that also adjusted for hospital volume, did not change the effect sizes by ≥10%, so we present the data uncorrected for hospital volume.

DISCUSSION

A recent study of what patients defined as appropriate outcomes for labour, identified good health outcomes for both pregnant people and their babies, and patient-centred care as the major values desired by participants.[16] Focusing on patient outcomes also supports the IOM call for patient-centred quality improvement.[9] Consistent with other research, our study showed no association between the CD and AD rate, highlighting the shortcoming of CD rate as a performance indicator that focuses quality assurance on mode of delivery only, neglecting patient outcomes.[17] In contrast, the VUD rate was more closely related to AD while also tracking mode of delivery.

Table 1. Quintile AD rate ranks of characteristics and outcomes: Q1 is lowest and Q5 the highest

	Provider's AD rate Q1–5, 5 is highest, n (%)						
Patient parameters	Entire cohort N = 16 620	Q1 n = 2943	Q2 n = 3843	Q3 n = 4308	Q4 n = 3458	Q5 n = 2068	*P* value
Pregnant person's characteristics							
Mean gestational age at delivery (wks)	38.8 ± 1.2 rng 37–44	38.8 ± 1.2 rng 37–43	38.8 ± 1.2 rng 37–43	38.8 ± 1.2 rng 37–44	38.9 ± 1.2 rng 37–44	38.8 ± 1.2 rng 37–43	<0.001[a]
Mean maternal age (yrs)	32.3 ± 5.1 rng 15–55	32.8 ± 5.0 rng 17–55	32.4 ± 4.9 rng 17–51	32.3 ± 5.0 rng 15–54	32.2 ± 5.0 rng 16–49	31.1 ± 5.2 rng 16–46	<0.0001[a]
Maternal age (yrs)							<0.0001[a]
15–17	33 (0.2)	<5 (0.03)	8 (0.2)	11 (0.3)	<5 (0.1)	9 (0.4)	
18–24	1288 (7.7)	174 (5.9)	259 (6.7)	321 (7.4)	290 (8.4)	244 (11.8)	
25–29	3884 (23.4)	684 (23.2)	863 (22.5)	979 (22.7)	801 (23.2)	557 (26.9)	
30–34	6447 (38.8)	1121 (38.1)	1524 (39.7)	1692 (39.3)	1333 (38.5)	777 (37.6)	
35–39	3903 (23.5)	727 (24.7)	938 (24.4)	1030 (23.9)	817 (23.6)	391 (18.9)	
40 plus	1065 (6.4)	236 (8.0)	251 (6.5)	275 (6.4)	213 (6.2)	90 (4.3)	
BMI (kg/m^2)[b]	N = 12 434	n = 2092	n = 3019	n = 3217	n = 2593	n = 1513	<0.0001[a]
Underweight	692 (5.6)	111 (5.3)	162 (5.4)	196 (6.1)	160 (6.2)	63 (4.2)	
Normal	7106 (57.1)	1262 (60.3)	1706 (56.5)	1862 (57.9)	1476 (56.9)	800 (52.9)	
Overweight	2662 (21.4)	421 (20.1)	652 (21.6)	696 (21.6)	544 (20.9)	349 (23.1)	
Obese	1974 (15.9)	298 (14.2)	499 (16.5)	463 (14.4)	413 (15.9)	301 (19.9)	
Gravida							0.51
≤4	15 571 (93.7)	2770 (94.1)	3592 (93.5)	4045 (93.9)	3241 (93.7)	1923 (92.9)	
>4	1,049 (6.3)	173 (5.9)	251 (6.5)	263 (6.1)	217 (6.3)	145 (7.1)	
Nulliparous	8632 (51.9)	1518 (51.6)	1947 (50.7)	2237 (51.9)	1826 (52.8)	1104 (53.4)	0.25
Previous CD	4552 (27.4)	795 (27.0)	1107 (28.8)	1130 (26.2)	921 (26.6)	599 (28.9)	0.03[a]
Prior preterm birth	624 (3.7)	105 (3.6)	132 (3.4)	161 (3.7)	148 (4.3)	78 (3.8)	0.40
Diabetes (pre-pregnancy)	126 (0.8)	23 (0.7)	21 (0.5)	38 (0.8)	27 (0.7)	17 (0.8)	0.50
Gestational diabetes	2466 (14.8)	482 (16.4)	610 (15.8)	671 (15.5)	487 (14.1)	216 (10.4)	<0.0001[a]
Hypertension during pregnancy	470 (2.8)	80 (2.7)	102 (2.6)	143 (3.3)	97 (2.8)	48 (2.3)	0.18
Pregnancy-induced hypertension	972 (5.8)	155 (5.3)	218 (5.6)	250 (5.8)	215 (6.2)	134 (6.5)	0.35
Any hypertension	1076 (6.5)	171 (5.8)	241 (6.3)	286 (6.6)	232 (6.7)	146 (7.1)	0.39
Proteinuria	175 (1.0)	31 (1.0)	55 (1.4)	48 (1.1)	30 (0.9)	11 (0.5)	0.02[a]
Smoked during pregnancy	779 (4.7)	123 (4.2)	162 (4.2)	174 (4.0)	162 (4.7)	158 (7.6)	<0.0001[a]
Antepartum hemorrhage (≥20 wks)	138 (0.8)	18 (0.6)	38 (0.9)	42 (0.9)	23 (0.7)	17 (0.8)	0.27
Labour outcomes							
CD rate	10 023 (60.4)	1717 (58.3)	2377 (61.8)	2526 (58.6)	2044 (59.1)	1359 (65.7)	<0.0001[a]
VUD rate	5647 (34.0)	1132 (38.5)	1306 (34.0)	1537 (35.7)	1166 (33.7)	506 (24.5)	<0.0001[a]
AD event	1646 (9.9)	136 (4.6)	278 (7.2)	411 (9.5)	425 (12.3)	396 (19.1)	<0.0001[a]
Maternal death	0	0	0	0	0	0	
Intrapartum neonatal death > 2500 gm	11 (0.1)	0	<5	<5	<5	<5	0.11

(continued)

Table 1. *(Continued)*

Patient parameters	Entire cohort N = 16 620	Provider's AD rate Q1–5, 5 is highest, n (%) Q1 n = 2943	Q2 n = 3843	Q3 n = 4308	Q4 n = 3458	Q5 n = 2068	*P* value
Uterine rupture[c]	37 (0.2)	<5	9 (0.2)	9 (0.2)	12 (0.3)	6 (0.3)	0.10
Maternal admission to ICU	6 (0.04)	0	<5	<5	<5	<5	0.48
Birth trauma	181 (1.1)	9 (0.3)	26 (0.7)	47 (1.1)	43 (1.2)	56 (2.7)	<0.0001[a]
Return to operating room	53 (0.3)	6 (0.2)	8 (0.2)	19 (0.4)	11 (0.3)	9 (0.4)	0.23
Admission to NICU >2500 g for >24 hrs	469 (2.8)	25 (0.8)	62 (1.6)	126 (2.9)	120 (3.5)	136 (6.6)	<0.0001[a]
Apgar <7 at 5 mins	360 (2.2)	34 (1.2)	74 (1.9)	75 (1.7)	95 (2.7)	82 (3.9)	<0.0001[a]
Maternal blood transfusion	163 (0.9)	21 (0.7)	35 (0.9)	33 (0.8)	41 (1.2)	33 (1.6)	0.007[a]
Perineal tear 3° or 4°	567 (3.4)	57 (1.9)	91 (2.4)	149 (3.5)	153 (4.4)	117 (5.7)	<0.0001[a]

[a]Indicate statistical significance.

[b]BMI (underweight: <18.5; normal: 18.5–24.9; overweight: 25–29.9; obese: ≥30).

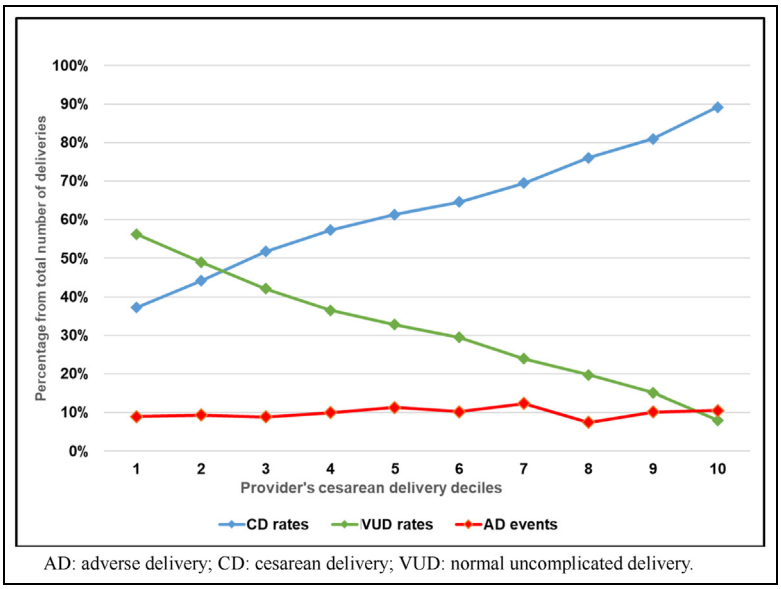
[c]Using ICD-10 codes: O71.1 during labour.

AD: adverse delivery; CD: cesarean delivery; ICD-10: International Statistical Classification of Diseases, Tenth Revision; ICU: intensive care unit; NICU: neonatal intensive care unit; Q1: quintile 1; Q2: quintile 2; Q3: quintile 3; Q4: quintile 4; Q5: quintile 5; VUD: normal uncomplicated delivery.

While optimizing the mode of delivery is an important element of quality maternity care, our results highlight that the CD rate falls short of measuring other labour outcomes.

The VUD rate has significant advantages, as it is correlated with mode of delivery but also with the patient priorities of no adverse outcomes. It meets the IOM's criteria of measuring both process and patient-centred outcomes for

Figure 2. Mode of delivery and adverse delivery rates by cesarean delivery deciles (1–10, 10 is highest).



AD: adverse delivery; CD: cesarean delivery; VUD: normal uncomplicated delivery.

Table 2. Quintile CD rate ranks: Q1 is lowest CD rate and Q5 the highest

	Provider's CD quintile, 1–5, 5 is highest n (%)					
Patient parameters	Q1 N = 4289	Q2 n = 3621	Q3 n = 3470	Q4 n = 2519	Q5 n = 2721	*P* value
Labour outcomes						
CD rate	1736 (40.5)	1972 (54.5)	2185 (62.9)	1818 (72.2)	2312 (84.9)	<0.0001[a]
VUD rate	2266 (52.8)	1426 (39.4)	1079 (31.1)	559 (22.2)	317 (11.6)	<0.0001[a]
AD event	391 (9.1)	341 (9.4)	373 (10.7)	260 (10.3)	281 (10.3)	0.10
Maternal death	0	0	0	0	0	
Intrapartum neonatal death >2500 g	6 (0.1)	<5	<5	<5	<5	0.25
Uterine rupture[b]	6 (0.1)	<5	8 (0.2)	10 (0.4)	9 (0.3)	0.08
Maternal admission to ICU	<5	0	<5	0	<5	0.32
Birth trauma	23 (0.5)	36 (0.9)	46 (1.3)	35 (1.4)	41 (1.5)	<0.001[a]
Return to operating room	21 (0.5)	9 (0.2)	9 (0.3)	≤5 (0.2)	9 (0.3)	0.19
Admission to NICU >2500 g for >24 hrs	67 (1.6)	103 (2.8)	124 (3.6)	71 (2.8)	104 (3.8)	<0.0001[a]
Apgar <7 at 5 mins	82 (1.9)	63 (1.7)	70 (2.0)	73 (2.9)	72 (2.6)	0.007[a]
Maternal blood transfusion	46 (1.1)	29 (0.8)	39 (1.1)	16 (0.6)	33 (1.2)	0.14
Perineal tear 3° or 4°	189 (4.4)	131 (3.6)	120 (3.5)	86 (3.4)	41 (1.5)	<0.0001[a]

[a]Indicate statistical significance.

[b]Using ICD-10 codes: O71.1 during labour.

AD: adverse delivery; CD: cesarean delivery; ICD-10: International Statistical Classification of Diseases, Tenth Revision; ICU: intensive care unit; NICU: neonatal intensive care unit; Q1: quintile 1; Q2: quintile 2; Q3: quintile 3; Q4: quintile 4; Q5: quintile 5; VUD: normal uncomplicated delivery.

labour and delivery. Importantly, it is also a metric that focuses on positive outcomes that align with patient-focused goals and are easily comprehended by both providers and patients.[8] We introduced the VUD as a performance indicator at the individual practitioner, hospital, and system level 10 years ago in our jurisdiction. It has been well accepted as part of an annual reporting through a physician performance enhancement program.[18]

In contrast, despite more than 2 decades of concern about the rising CD rate, efforts to define the optimal evidence-based CD rate have been unsuccessful. Recognition of the limitations has led to efforts to classify CD, including by indication, urgency, and maternal characteristics.[19] While each of these have inherent limitations, the Robson Classification has advantages that led the WHO to advocate its use as a performance indicator for monitoring CD rates.[20] Its value is the ability to use maternal parameters to stratify populations into more homogenous subpopulations for direct comparison of CD rates. While this makes comparisons of CD rates more balanced, it still fails to account for the outcomes of the pregnant person and baby. Moreover, a large health service study to validate a risk-adjusted CD rate as a performance indicator showed that the lower CD rates were associated with higher-than-expected AD outcomes, including in an NTSV population.[7] Ultimately, the most important limitation of the CD rate as a performance indicator is its dissociation from labour outcomes, even when used with the Robson Classification. This is not a limitation of the VUD, which could easily be applied to the Robson Classification.

While the VUD rate is conceptually and practically better than CD rate as a performance indicator, it does not completely capture the patient-defined outcomes for labour. Even providers who achieve high VUD rates can have unreasonably high AD rates. This illustrates the value of multiple performance indicators including AD rate and even CD rate when combined with VUD. Completely avoiding adverse events is not possible, but an AD rate should not be increased simply to decrease the CD rate. Considering the AD along with VUD rate will address both possibilities.

External validity is a potential limitation of this study. We limited the study to OB births to avoid confounding by maternity care specialties, thus the sample does not reflect primary maternity care. Consequently, the CD rates are comparatively high by existing guidelines for general maternity populations.[2,3] We believe that VUD will have value in a primary care maternity population as well, where we would expect higher benchmarks for VUD and a similar benchmark for AD. Strengths of the study include the population-based nature of the data, a large sample, complete capture of obstetrician-managed deliveries in a geographic region,

Table 3. Quintile VUD rate ranks: Q1 is highest VUD rate and Q5 the lowest

Patient parameters	Provider's VUD[a] quintile1−5, 1 is highest VUD n (%)					
	Q1 N = 4448	Q2 n = 3711	Q3 n = 3384	Q4 n = 2815	Q5 n = 2262	*P* value
Labour outcomes						
VUD rate	2347 (52.8)	1452 (39.1)	1022 (30.2)	598 (21.2)	228 (10.1)	<0.0001[b]
CD rate	1819 (40.9)	2061 (55.5)	2136 (63.1)	2078 (73.8)	1929 (85.3)	<0.0001[b]
AD event	385 (8.7)	332 (8.9)	381 (11.3)	277 (9.8)	271 (11.9)	<0.001[b]
Maternal death	0	0	0	0	0	
Intrapartum neonatal death >2500 g	<5	<5	0	<5	<5	0.41
Uterine rupture[a]	6 (0.1)	6 (0.2)	7 (0.2)	10 (0.4)	8 (0.3)	0.18
Maternal admission to ICU[c]	<5	0	<5	0	<5	0.25
Birth trauma	23 (0.5)	31 (0.8)	48 (1.4)	40 (1.4)	39 (1.7)	<0.0001[b]
Return to operating room	20 (0.4)	11 (0.3)	7 (0.2)	9 (0.3)	6 (0.3)	0.40
Admission to NICU >2500g for >24 hrs[d]	67 (1.5)	105 (2.8)	120 (3.5)	81 (2.9)	96 (4.2)	<0.0001[b]
Apgar <7 at 5 mins	83 (1.9)	57 (1.5)	79 (2.3)	73 (2.6)	68 (3.0)	<0.001[b]
Maternal blood transfusion	44 (1.0)	33 (0.8)	36 (1.1)	22 (0.8)	28 (1.2)	0.51
Perineal tear 3° or 4°	187 (4.2)	119 (3.2)	128 (3.8)	79 (2.8)	54 (2.4)	<0.001[b]

[a]Vaginal uncomplicated delivery.

[b]Indicate statistical significance.

[c]Using ICD-10 code.s: O71.1 during labour

[d]Intensive care unit.

AD: adverse delivery; CD: cesarean delivery; ICD-10: International Statistical Classification of Diseases, Tenth Revision; ICU: intensive care unit; NICU: neonatal intensive care unit; Q1: quintile 1; Q2: quintile 2; Q3: quintile 3; Q4: quintile 4; Q5: quintile 5; VUD: normal uncomplicated delivery.

diversity of practice among OBs, and avoidance of reporting bias by third-party reporting from a provincial database

CONCLUSIONS

Birth creates complex medical scenarios requiring expeditious decisions based on limited data that must balance the needs of 2 patients. This practice environment demands quality assurance measures that allow providers to hone their care through objective assessment of experience. Successful quality assurance relies on effective performance indicators that accurately reflect patients' perspectives on quality.[8] The prevailing performance indicator, CD rate, fails in this respect. It also fails providers, who receive incomplete assessments of their performance through the CD rate. The VUD rate provides an alternative that is intuitive and better aligns with most patients' aspirations for a labour and delivery that is free of adverse events, and a mode of delivery that best serves meeting this goal. The VUD can be used to identify providers that overuse CD or underutilize VBAC. It can also be used to define rates within the Robson Classification. The VUD rewards providers that encourage safe VBAC or use forceps or vacuum without increasing adverse events. Shifting the quality lens to focus on vaginal deliveries without complications will promote better outcomes for providers, pregnant people, and their babies.

AVAILABILITY OF DATA AND MATERIALS

The datasets generated and/or analyzed during the current study are available in the British Columbia Perinatal Data Registry, www.perinatalservicesbc.ca/health-professionals/data-surveillance/perinatal data registry The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

- All data generated or analyzed during this study are included in this published article and its supplementary information files.
- The datasets generated and/or analyzed during the current study are not publicly available for privacy reasons but are available from PopData BC after application and data stewards review and approval.

ETHICS

Ethics approval was obtained from the University of British Columbia Clinical Research Ethics Board (H16-02490). The analysis was performed on

Table 4. Association between AD, and CD and VUD quintiles; quality decreases with higher quintiles

	Crude rate	Adjusted rate[a]
Quintiles	OR (95% CI)	OR (95% CI)
Number of records in the model	16 620	16 620
Outcome: Any adverse event (n = 1646)		
Ob/Gyns CD quintile (ranked from lowest to highest)		
CD Q1	0.97 (0.78–1.20)	0.65 (0.51–0.82)[b]
CD Q2	0.97 (0.78–1.20)	0.73 (0.58–0.93)[b]
CD Q3	1.12 (0.92–1.35)	0.90 (0.73–1.10)
CD Q4	1.00 (0.78–1.29)	0.87 (0.68–1.12)
CD Q5	1 [reference]	1 [reference]
Ob/Gyns VUD quintile (ranked from highest to lowest)		
VUD Q1	1 [Reference]	1 [Reference]
VUD Q2	1.00 (0.84–1.21)	1.15 (0.96–1.38)
VUD Q3	1.27 (1.05–1.54)[b]	1.55 (1.28–1.88)[b]
VUD Q4	1.03 (0.83–1.29)	1.41 (1.14–1.76)[b]
VUD Q5	1.26 (1.01–1.59)[b]	1.95 (1.53–2.50)[b]
Outcome: Adverse event except third or fourth-degree perineal tear (n = 1079)		
Number of records in the model	16 053	16 053
Ob/Gyns CD quintile (ranked from lowest to highest)		
CD Q1	0.58 (0.45–0.75)[b]	0.61 (0.47–0.81)[b]
CD Q2	0.69 (0.54–0.88)[b]	0.73 (0.56–0.95)
CD Q3	0.88 (0.71–1.10)	0.90 (0.72–1.13)
CD Q4	0.79 (0.59–1.05)	0.80 (0.60–1.06)
CD Q5	1 [reference]	1 [reference]
Ob/Gyns VUD quintile (ranked from highest to lowest)		
VUD Q1	1 [reference]	1 [reference]
VUD Q2	1.26 (0.98–1.63)	1.26 (0.99–1.60)
VUD Q3	1.67 (1.31–2.12)[b]	1.62 (1.27–2.05)[b]
VUD Q4	1.47 (1.12–1.92)[b]	1.42 (1.08–1.87)[b]
VUD Q5	2.04 (1.55–2.68)[b]	1.92 (1.44–2.58)[b]

[a]Model is adjusted for; maternal age, pre-existing diabetes, gestational diabetes, hypertension during pregnancy, pregnancy-induced hypertension, proteinuria, smoking, gravida, mode of delivery, practitioner volume, and SEs were corrected for the clustering on ob-gyn (210 practitioners in the data).

[b]Significant $P < 0.05$.

AD: adverse delivery; CD: cesarean delivery; Ob/Gyns: obstetrics and gynaecology; Q1: quintile 1; Q2: quintile 2; Q3: quintile 3; Q4: quintile 4; Q5: quintile 5; VUD: normal uncomplicated delivery.

de-identified administrative database. All inferences, opinions, and conclusions are those of the authors and do not reflect the opinions or policies of the Data Stewards.

AUTHORS CONTRIBUTIONS

GWC conceived of the performance indicator, vaginal uncomplicated delivery rate. PJ and GWC developed the research plan to compare it to the cesarean delivery rate using the British Columbia Perinatal Data Registry. GEH, PK, and PJ finalized the plan for data analysis. PK performed the data analysis. All authors participated in data interpretation and writing of the manuscript.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jogc.2024.102693.

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