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Five years of an Alongside Midwifery Unit at a Swiss Perinatal Centre: a retrospective descriptive study

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Summary

BACKGROUND: Overmedicalisation during childbirth, especially in low-risk pregnancies, is an increasing issue. Alongside Midwifery Units (AMUs) are a midwife-led, low-intervention option that maintains access to hospital resources. However, in 2022, only 3.7% of births in Switzerland took place outside hospitals. The UK has emphasised educating women about their birth choices, notably through the "Birthplace in England" programme and NICE guidelines. Evidence shows that out-of-hospital births in low-risk pregnancies are safe for mother and child. This retrospective descriptive study analyses maternal and neonatal outcomes, transfer rates and indications for transfer over a 5-year period at the AMU of the Cantonal Hospital Aarau.

METHODS: All women registering for delivery at the AMU between May 2017 and December 2022 were considered. Strict inclusion criteria ensured a low-risk cohort (singleton, cephalic presentation, $37^{0/7}$ to $42^{0/7}$ weeks, uncomplicated pregnancy). Exclusion criteria were pre-existing maternal or fetal disease, prior caesarean section and need for continuous maternal or fetal monitoring. Data were extracted from electronic medical records and included maternal characteristics, mode of delivery, transfer indications, and maternal and neonatal outcomes. Statistical analyses were primarily descriptive. Comparisons between women delivering at the AMU and those transferred to the maternity ward used Wilcoxon rank-sum and Fisher's exact tests ($\alpha = 0.05$, unadjusted). The study was approved by the regional ethics committee (BASEC-Nr. 2023-00745).

RESULTS: Of 1196 women registered, 1034 were included in the analysis. Among 838 women who started labour at the AMU, 75% (n = 627) delivered there, while 25% (n = 211) were transferred peripartum, mainly due to failure to progress (53.1%) or analgesia request (34.6%). Most transferred women (74.8%) still had a vaginal birth. At 48.3% vs 17.7%, women who gave birth at the AMU were significantly more likely to have no birth injury. The postpartum transfer rate was 7.7%, primarily for retained placenta, perineal repair or uterine atony. Neonatal outcomes were favourable: 0.6% of AMU births had a 5-minute APGAR <7 and 0.8% required NICU admission.

CONCLUSION: The AMU with the continuity-of-care model at a Swiss Perinatal Centre provides a safe, low-intervention birth option for low-risk pregnancies, with high rates of vaginal birth and low rates of severe maternal or neonatal complications. Strict selection criteria and clear transfer protocols are essential. Further multicentre studies and comprehensive data collection are needed to compare outcomes with obstetrician-led units and to establish national benchmarks for AMUs in Switzerland.

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Background

In recent years, overmedicalisation of pregnancy and childbirth, especially in the low-risk cohort, has been a key issue. While interventions can be life-saving if used correctly, non-evidence-based use harbours potential risk [1]. In particular, the increase in section rates in 2018 prompted the World Health Organization (WHO) to issue a recommendation to reduce unnecessary caesarean sections [2]. Data show that out-of-hospital births in low-risk pregnancies are associated with a lower rate of caesarean sections and fewer interventions than in a comparable population in obstetric units (OU). However only 3.7% of all births in Switzerland in 2022 took place outside an OU [3–5].

In addition to midwife-led obstetric units in hospital, there are three out-of-hospital settings in Switzerland in which continuous care during pregnancy, birth and the postpartum period is the responsibility of an individual midwife or a team of midwives. These are home birth; free-standing midwifery units (FMU) as an independent institution; and alongside midwifery units (AMU) on a hospital campus with an obstetric unit available. Midwifery units such as AMUs and FMUs offer a family atmosphere, but physical transfer is necessary if assistance from an obstetrician, anaesthetist or neonatologist is required. In the case of the AMU, which is attached to the hospital campus of an OU, distances are short and resources are easily accessible. Transfer to the obstetrical unit is usually done by ambulance, car or wheelchair.

Another important aspect, besides the place of birth, is the care provided. Various models exist, including collaboration between physicians and midwives. In the midwifery continuity-of-care model, women are looked after by a consistent midwife (caseload model) or small midwifery team throughout pregnancy, childbirth and the postpartum period. According to the 2017 guidance "Implementing Better Birth: Continuity of Carer" by the UK's National Health Service (NHS), in the team-continuity model, an individual midwife coordinates the care and works in teams of up to eight midwives who deputise for one another [6]. During her pregnancy, the woman gets to know all the members of the team. In the caseload model, each midwife is assigned a specific number of women (the caseload) and structures her work to meet their needs. Support is provided by a core midwifery team, with whom the woman is unlikely to have had prior contact. This approach is likely to be particularly beneficial for women with complex medical or social needs [4, 6, 7]. Evidence from randomised controlled trials indicates that the midwife continuity-of-care model is linked to fewer caesarean sections, instrumental vaginal deliveries and episiotomies, as well as an increase in spontaneous vaginal births [4]. The caseload model in particular showed a lower rate of unplanned sections and a higher probability of spontaneous vaginal births, especially in primiparous women of low risk [8]. Emphasis should also be placed on the couples' birthing experience. According to a Cochrane Review, couples are more likely to report a positive experience of labour with midwife-led delivery [4].

The UK has invested in educating women about how to make an informed choice about where to deliver. The "Birthplace in England Research Programme", commissioned in 2007, examined the safety of childbirth across different settings at the onset of labour care: in OUs, AMUs, FMUs and at home. This Collaborative Group published several studies on maternal and neonatal outcomes, safety and cost-effectiveness [5, 9]. Furthermore, the 2014 NICE guideline "Intrapartum care for healthy women and babies" also addresses this important issue and the NHS even published "A best practical toolkit" to increase the number of births at home and in midwifery-led units [9, 10]. In Switzerland, the integration of AMUs is shaped by cantonal hospital planning; accreditation and inclusion occur regionally through the cantonal hospital lists. However, there is a substantial evidence gap regarding AMUs, as maternal and neonatal outcomes are not systematically recorded. Current hospital administrative data *Statistique médicale des hôpitaux* cover most births but were designed for financial purposes and do not differentiate between models of care such as AMUs. This limitation was highlighted by the Swiss Peristat Project, which aims to assess and improve the validity of national perinatal data for epidemiological and quality-monitoring purposes [11]. In contrast, the UK integrates AMUs as a fully regulated, nationally standardised and routinely monitored part of the maternity care system, with systematic outcome reporting and quality assurance.

The Cantonal Hospital Aarau has been offering midwife-led deliveries at an AMU on the campus of the Cantonal Hospital since mid-2017. It combines midwife continuity of care and low-intervention birth, according to the S3 guidelines "Vaginal birth at term", with the safety and infrastructure of a Perinatal Centre [12].

Since 2022, three more hospitals in Switzerland have opened AMUs based on our concept.

The aim of the present retrospective descriptive study was to present our concept and to analyse maternal and neonatal outcomes among low-risk women who registered for midwife-led births at the AMU at the Cantonal Hospital Aarau, Switzerland, between May 2017 and December 2022.

Materials and methods

Concept

Midwife-guided birth in an AMU was integrated into the department of obstetrics of the Cantonal Hospital in mid-2017. The aim was to enable a low-risk clientele to have a low-intervention birth. At the same time, the highly specialised resources of the maternity ward of the Perinatal Centre could be focused on high-risk pregnancies.

The midwives of our AMU are employed as attending midwives and work independently and under their own professional responsibility. They organise themselves in either the caseload or team continuity-of-care model which is equivalent to that of a planned home birth. The Team comprises home-birth midwives, birth-centre midwives and former hospital midwives who have transitioned to out-of-hospital care. In addition, newly qualified midwives may join the team as employees under supervision of experienced colleagues, following the successful completion of internship at the AMU.

The care begins during pregnancy and continues through birth until the subsequent postpartum period. Responsibilities were assigned to the individual parties involved with the help of a medical lawyer. The liability insurance taken out by the midwife has a coverage amount of 20 million Swiss francs; an additional coverage amount of 20 million Swiss francs is provided by the Cantonal Hospital.

Women who wish to give birth in the AMU can contact the midwives directly or be registered by the gynaecologist in charge. The registrations are checked for contraindications by the management of the AMU. Contraindications arising subsequently during pregnancy will be reported to the management by the midwives of the AMU and will result in exclusion of the pregnant woman. Requirements for giving birth at the AMU are a singleton pregnancy with a fetus in cephalic position at a gestational age of $37^{0/7}$ to $42^{0/7}$ with an uncomplicated pregnancy course. Pre-existing conditions of the mother or the child requiring continuous monitoring during delivery or postpartum are exclusion criteria. This includes pre-existing diabetes or gestational diabetes requiring insulin. Further exclusion criteria are the use of psychopharmaceuticals, previous caesarean section, placental disorders and abnormal quantity of amniotic fluid.

Proceeding during birth

During birth, the mother is accompanied by two midwives. The fetus is monitored by means of Intelligent Intermittent Auscultation (IIA). This ensures that deviations from the norm, which indicate a possible fetal compromise or the need for more-intensive monitoring, are identified [13, 14].

The woman in labour is transferred to the maternity ward if any of the following irregularities occur: abnormal bleeding during labour, failure to progress as per AWMF S3 guideline, fetal distress, the patient's wish or the midwife's decision for other reasons [12]. Also, the need to administer medications like analgesics or oxytocin are criteria for a transfer during labour. Antibiotics for Group B Streptococcus are given in the AMU. Oxytocin in the 3rd stage of labour and misoprostol in case of uterine atony are administered to stabilise the situation if transfer to the maternity ward is necessary. Furthermore, the need to consult a paediatrician, an irregular placental period or a complex birth injury such as 3rd or 4th degree perineal lacerations are indications for a postpartum transfer. The outcome definitions for failure to progress, perineal lacerations, postpartum haemorrhage including retained placenta strictly follow the AWMF S3 guideline "Vaginal Birth at Term", ensuring standardised reporting and international comparability [12]. In accordance with the guideline, women were offered active or passive management of the 3rd stage of labour as part of the individualised care.

Study design

All women registering for delivery in the AMU from May 2017 to December 2022 were routinely recorded in an Excel spreadsheet by the clinical administration with their name, date of birth and expected due date. The attending midwife documented any reasons for exclusion, successful delivery in the AMU, or transfer peri- or postpartum. Women who did not give birth at the AMU or the maternity ward of the Cantonal Hospital after registering were excluded.

The Cantonal Hospital asks each patient for general consent at their first visit. By granting consent, the patient agrees that all medical history data may be used for future not-yet-defined research projects. All women who registered in our AMU during the study period (and for whom gen-

eral consent was not available) were contacted, informed about the purpose of the study and invited to consent. Women who did not respond – and therefore did not refuse the general consent form – were included. All women who refused our institution's general consent were excluded.

For internal quality management purposes, data of interest were extracted from the patients' electronic medical chart. We used this extracted data i.e. maternal characteristics, modus of delivery, transfer to maternity ward, perineal laceration and fetal characteristics for our retrospective study. Data entry was subsequently completed by the authors based on the hospital's electronic medical records and all data for analysis were entered into a password-protected Excel spreadsheet. For 15.5% of the women, the BMI at the time of delivery was not documented in the electronic clinical information system, and in 3.8% of the births in the maternity ward, the arterial pH could not be measured due to collapsed umbilical arteries. These were listed as unknown in the results. All data collection was performed by one author and checked for plausibility and completeness by a second author. The study was approved by the Ethics Committee Northwest and Central Switzerland (BASEC-Nr. 2023-00745).

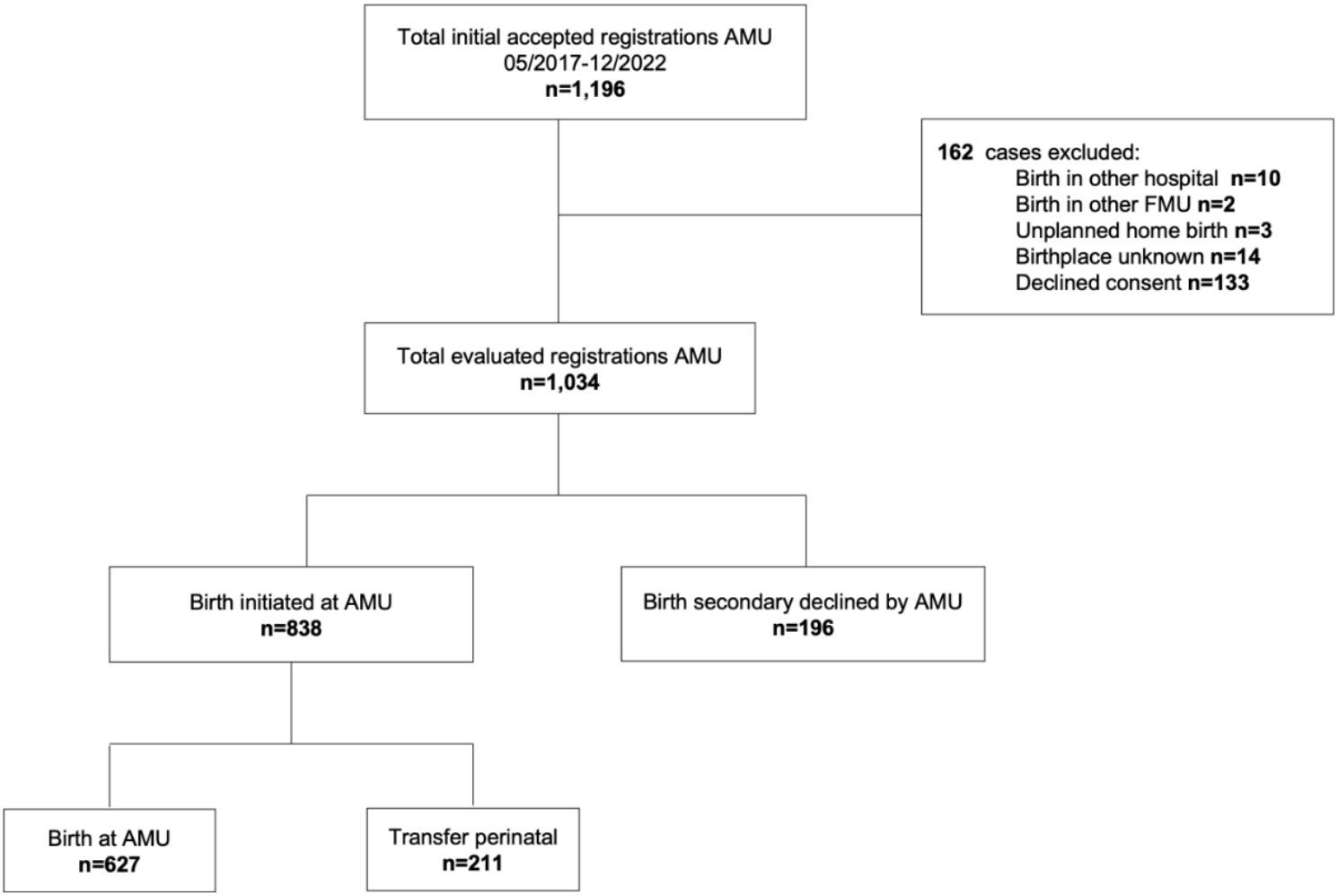
Statistical methods

The main analysis set included all evaluable cases of women with appropriate consent for data use, who were admitted to the AMU for the delivery and who either gave birth there or were transferred to the Cantonal Hospital peripartum. The analysis used primarily descriptive statistical methods. Exploratory statistical tests were conducted for descriptive purposes and a significance level of 5% was used without adjustment for multiplicity. Key analyses included the comparison of women with delivery at the AMU vs women who were transferred to the hospital. Unless otherwise specified, we used Wilcoxon's rank-sum test to compare continuous variables and Fisher's exact test for categorical variables. To identify independent predictors for giving birth at the AMU, a multiple logistic regression analysis was performed, taking parity, gestational age, maternal age and neonatal birthweight into account as covariates. Due to a lack of data on the maternal BMI, this was examined in a separate model. Missing data were not imputed, with specific exceptions indicated in the results. No sensitivity analyses were performed because no alternative analysis strategies were envisaged due to the descriptive study design and the complete inclusion of all analysable cases. The analysis was performed using R version 4.2.2. or later (R Foundation for Statistical Computing, Vienna, Austria).

Results

From May 2017 to December 2022, a total of 1196 patients were accepted for delivery after registration at the AMU. Of these patients, 133 declined general consent and 29 had to be excluded because they did not deliver at the Cantonal Hospital. Of the latter 29 women, 10 delivered in another hospital and 2 in another FMU, 3 had an unplanned home birth while in 14 cases the place of birth is unknown. After excluding these 162 cases, 1034 cases could be included in the analysis (figure 1).

Figure 1: Study flowchart. AMU: Alongside Midwifery Unit.



The women who registered for delivery at the AMU had a median age of 32 years and over half (53.8%) were expecting their first child.

In 196 women (18.9%), a contraindication developed during pregnancy or at the beginning of labour, thereby excluding them from delivery at the AMU (table 1); the most common reason was fetal malpresentation, which occurred in 19.9% of the 196 women or approximately 4% of the total cohort (n = 1034).

Table 1: Reasons for ineligibility for delivery at the Alongside Midwifery Unit (n = 196).

Reason	Refusal secondary
Position anomalies of the fetus	39 (19.9%)
Induction of labour in late-term and post-term pregnancies	36 (18.4%)
Fetal reasons (unspecified)	21 (10.7%)
Requested analgesia/admission from home	18 (9.2%)
Induction of labour upon premature rupture of membranes	17 (8.7%)
Prematurity/Preterm premature rupture of membranes	17 (8.7%)
Hypertensive pregnancy disorders	12 (6.1%)
Induction of labour upon oligo- / anhydramnios	9 (4.6%)
Fetal macrosomia	5 (2.6%)
Meconium-stained amniotic fluid	4 (2.0%)
Maternal disease	4 (2.0%)
Vaginal bleeding	3 (1.5%)
Suspected infection	1 (0.5%)

A total of 838 women started labour at the AMU, with 25.0% transferred to the maternity ward peripartum. Table 2 shows the indications for the transfer. The most common reasons were failure to progress in labour (53.1%) and need for analgesia (34.6%), with need for analgesia being higher in primiparas than in multiparas. After transfer, 78.7% received oxytocin and 59.2% received epidural anaesthesia (EDA). Considering women who started labour at the AMU (n = 838), only 14.9% received an EDA and only 8.7% were transferred because of requested EDA.

Even after transfer, 74.8% had a vaginal delivery at the maternity ward (50.2% spontaneous and 24.6% assisted). In 25.1%, a caesarean section was performed.

Table 2: Reason for peripartum transfer, interventions and delivery mode, by parity.

Reason / intervention / delivery mode		Primiparous	Multiparous	Overall	p-value
		(n = 182)	(n = 29)	(n = 211)	
Reason for peripartum transfer, n (%)	Requested analgesia	68 (37.4%)	5 (17.2%)	73 (34.6%)	0.063
	Arrest of labour	63 (34.6%)	10 (34.5%)	73 (34.6%)	
	Secondary uterine inertia	33 (18.1%)	6 (20.7%)	39 (18.5%)	
	Abnormal fetal heart on IIA (Intelligent Intermittent Auscultation)	5 (2.7%)	2 (6.9%)	7 (3.3%)	
	Fetal malpresentation	1 (0.5%)	1 (3.4%)	2 (0.9%)	
	Others	7 (3.8%)	3 (10.3%)	10 (4.7%)	
	Suspected chorioamnionitis	1 (0.5%)	0 (0.0%)	1 (0.5%)	
	Vaginal bleeding	1 (0.5%)	0 (0.0%)	1 (0.5%)	
	Meconium-stained amniotic fluid	2 (1.1%)	1 (3.4%)	3 (1.4%)	
	Preeclampsia	1 (0.5%)	1 (3.4%)	2 (0.9%)	
Epidural anaesthesia, n (%)		115 (63.2%)	10 (34.5%)	125 (59.2%)	0.004
Oxytocin in 1st/2nd stage, n (%)		148 (81.3%)	18 (62.1%)	166 (78.7%)	0.027
Mode of delivery, n (%)	Spontaneous vaginal delivery	84 (46.2%)	22 (75.9%)	106 (50.2%)	0.013
	Assisted vaginal delivery	48 (26.4%)	4 (13.8%)	52 (24.6%)	
	Caesarean delivery	50 (27.5%)	3 (10.3%)	53 (25.1%)	

Table 3: Reasons for postpartum transfer (n = 627).

Reason	AMU
Retained placenta/membranes, n (%)	19 (3.0%)
Perineal repair/ sutures, n (%)	14 (2.2%)
Uterine atony, n (%)	12 (1.9%)
NICU admission of the neonate, n (%)	2 (0.3%)
Syncope, n (%)	1 (0.2%)

NICU: neonatal intensive care unit.

Table 4: Rates of transfer for mother and neonate.

Maternal (n = 838), n (%)		259 (31.0%)
	Intrapartum, n (%)	211 (25.0%)
	Postpartum, n (%)	48 (7.7%)
Neonate (n = 838), n (%)		20 (2.4%)
	AMU (n = 627) , n (%)	5 (0.8%)
	Maternity ward (n = 211) , n (%)	15 (7.1%)

After successful delivery at the AMU, 7.7% of 627 had to be transferred postpartum. Indications are shown in table 3. The overall transfer rates are shown in table 4.

The maternal characteristics of the two groups "Successful birth at the AMU" and "Transferred to the maternity ward" are summarised in table 5. There is a statistically significant difference regarding parity (2 vs 1, p <0.001), maternal age at delivery (32 vs 31 years, p <0.05) and BMI (26.6 vs 27.4 kg/m², p <0.05).

Table 5: Maternal characteristics of the "Successful birth at the Alongside Midwifery Unit (AMU)" and "Transferred to the maternity ward" groups, and overall.

Characteristics		AMU (n = 627)	Transferred (n = 211)	Overall (n = 838)	p-value
Age at delivery in years	Mean (SD)	32.5 (3.81)	31.9 (3.84)	32.3 (3.82)	0.047
	Range	20.0–45.0	23.0–45.0	20.0–45.0	
BMI at delivery in kg/m	Mean (SD)	27.3 (3.90)	28.0 (4.06)	27.5 (3.95)	0.035
	Range	18.9–46.6	20.7–45.0	18.9–46.6	
	Unknown, n (%)	113 (18.0%)	18 (8.5%)	131 (15.6%)	
Parity (numerical)	Median [IQR]	2.00 [1.00–2.00]	1.00 [1.00–1.00]	1.00 [1.00–2.00]	<0.001
	Range	1.00–5.00	1.00–5.00	1.00–5.00	
Parity (categorical), n (%)	Primiparous	269 (42.9%)	182 (86.3%)	451 (53.8%)	<0.001
	Multiparous	358 (57.1%)	29 (13.8%)	387 (46.2%)	
Week of gestation	Median [IQR]	40.0 [39.0–40.0]	40.0 [39.0–41.0]	40.0 [39.0–40.0]	0.006

IQR: interquartile range; SD: standard deviation.

The maternal and neonatal outcomes are summarised in tables 6 and 7. Among the cohort of women transferred peripartum to the maternity ward, the incidence of postpartum haemorrhage (PPH) with a blood loss ³500 ml was 25.6%, including both vaginal birth and c-sections. It is noticeable that 17.5% of all women who gave birth at the AMU experienced PPH. The transfer to the maternity ward due to one of the two main reasons for a PPH, placental retention or uterine atony, was 4.9%.

Birth injuries were considerably less frequent among women giving birth at the AMU, with 48.3% experiencing no birth injury, compared to those transferred to the maternity ward (13.3%). Notably, the rate of higher-degree perineal tears (grade ³3) was very low in both groups, at 0.7%.

A multiple logistic regression analysis confirmed the higher probability of AMU delivery associated with higher parity (odds ratio [OR] per additional birth: 6.0, 95% confidence interval [CI]: 4.1–8.9). The week of gestation also had a significant effect (OR: 0.81 per additional week, 95% CI: 0.68–0.96), whereas the effects of maternal age (0.955 per year, 0.911–1.00) and birthweight (0.72 per kg, 0.46–1.14) did not reach statistical significance.

The BMI of the mother, investigated in a separate model due to the rather high proportion of missing data, was not significant either (0.967 per kg/m^2, 0.925–1.010).

Neonatal birthweights were similar in both groups. However, admission to the neonatal unit and a 5- minute APGAR <7 were both significantly more frequent after transfer to the maternity ward (p <0.001). Five neonates were transferred from the AMU to neonatology. Severe neonatal complications remained rare in both groups.

One neonate was monitored for possible infection and discharged after one day. One showed a sudden unexplained collapse because of an unknown cardiac defect and could be discharged after 3 days of monitoring. Respiratory distress syndrome (RDS) occurred in the remaining 3 neonates, one because of pneumothorax and the other two due to meconium aspiration syndrome (table 8).

Seven women were transferred because of fetal heart rate abnormalities during auscultation, which were confirmed at the maternity ward with a CTG classified as FIGO "Suspicious" (table 9). In all cases, transfers occurred during the 2nd stage of labour. None of the newborns had a 5-minute APGAR <7. Two had an umbilical cord arterial pH <7.10 but adapted well and remained with their mothers. Two newborns were admitted to the neonatal unit: one because of a subgaleal haematoma following a complicated caesarean section and the other, delivered by forceps extraction, because of facial subcutaneous haematoma.

Table 6: Maternal outcomes of the "Successful birth at the Alongside Midwifery Unit (AMU)" and "Transferred to the maternity ward" groups, and overall.

Outcome		**AMU (n = 627)**	**Transferred (n = 211)**	**Overall (n = 838)**	
Blood loss in ml, n (%)	<500	495 (78.9%)	157 (74.4%)	652 (77.8%)	
		500 to <1000 ml	83 (13.2%)	37 (17.5%)	120 (14.3%)
		1000 ml	27 (4.3%)	17 (8.1%)	44 (5.3%)
		Unknown	22 (3.5%)	0 (0.0%)	22 (2.6%)
Lacerations, n (%)	No perineal tears and no other injuries	303 (48.3%)	28 (17.7%)	331 (39.5%)	
		No perineal tears and other injuries	102 (16.3%)	40 (25.3%)	142 (16.9%)
		1st degree	106 (16.9%)	25 (15.8%)	131 (15.6%)
		2nd degree	105 (16.7%)	42 (26.7%)	147 (17.5%)
		3rd/4th degree	5 (0.8%)	1 (0.6%)	6 (0.7%)
		Episiotomy	6 (1.0%)	22 (13.9%)	28 (3.3%)

Table 7: Neonatal outcomes of the "Successful birth at the Alongside Midwifery Unit (AMU)" and "Transferred to maternity ward" groups, and overall.

Outcome		AMU (n = 627)	Transferred (n = 211)	Overall (n = 838)	p-value
Birthweight in g	Mean (SD)	3450 (400)	3470 (410)	3460 (402)	0.596
	Range	2460–4650	2110–4750	2110–4750	
Birthweight percentile*	Mean (SD)	44.6 (26.6)	42.5 (26.0)	44.1 (26.4)	0.330
	Median [IQR]	41.0 [21.0–64.0]	40.0 [21.0–62.5]	41.00 [21.0–64.0]	
	Range	2.0–98.0	2.0–98.0	2.0–98.0	
5-min APGAR score, n (%)	<7	4 (0.6%)	9 (4.3%)	13 (1.6%)	<0.001
Umbilical cord arterial pH	Mean (SD)	NA	7.21 (0.0785)	7.21 (0.0785)	
	Median [IQR]	NA	7.21 [7.16–7.26]	7.21 [7.16–7.26]	
	Range	NA	6.99–7.41	6.99–7.41	
	Unknown, n (%)	627 (100%)	8 (3.8%)	635 (75.8%)	
Transfer to neonatology, n (%)		5 (0.8%)	15 (7.1%)	20 (2.4%)	<0.001

* For analysis, percentiles reported as <3% and >97% are imputed as 2% and 98%, respectively.
IQR: interquartile range; NA: not available; SD: standard deviation.

Table 8: Neonates born at the Alongside Midwifery Unit with Neonatal Intensive Care Unit admission (n = 5)

Neonate	Age of gestation (weeky)	Timing (minutes of life)	Indication	Duration (days)	Diagnosis at discharge
1	40 $^{2/7}$	50	RDS	4	Pneumothorax
2	41 $^{4/7}$	15	RDS	4	Mild meconium aspiration
3	37 $^{3/7}$	11	Bradycardia low oxygen saturation	3	Sudden unexplained neonatal collapse dysplastic thickened aortic valve with aortic insufficiency.
4	41 $^{3/7}$	180	Suspected infection	2	RDS
5	40 $^{5/7}$	158	RDS	14	Meconium aspiration; suspected neonatal infection.

RDS: respiratory distress syndrome.

Table 9: Transfer due to suspicious findings by intelligent intermittent auscultation (IIA) – Neonate outcomes.

	IIA	CTG FIGO classification		Mode of delivery	pHua	5-min APGAR	NICU	Diagnosis at discharge
		Admission to maternity ward	At delivery					
1	Suspicious	Suspicious	Suspicious	Spontaneous	7.16	8	No	
2	Suspicious	Suspicious	Suspicious	Spontaneous	7.13	9	No	
3	Suspicious	Suspicious	Suspicious	Spontaneous	7.16	9	No	
4	Suspicious	Suspicious	Suspicious	Spontaneous	7.04	8	No	
5	Suspicious	Suspicious	Suspicious	Ventouse delivery	7.18	9	No	
6	Suspicious	Suspicious	Pathological	Caesarean section	7.20	9	Yes	Subgaleal haematoma
7	Suspicious	Suspicious	Pathological	Forceps for face presentation	7.07	7	Yes	Subcutaneous haematoma

NICU: neonatal intensive care unit; pHua: umbilical cord arterial pH.

Discussion

This retrospective study analysed 1034 low-risk women who registered for delivery at the AMU in a Swiss Perinatal Centre. Of 838 women who started labour in the AMU, 75.0% experienced a successful midwife-led birth, while 25.0% were transferred peripartum, most commonly for failure to progress or analgesia request. Among those transferred, 74.8% still achieved vaginal delivery. Severe maternal complications were rare, with rates of higher-degree perineal tears at just 0.7% in

both groups. Notably, only 0.8% of neonates born at the AMU required admission to the neonatal intensive care unit (NICU) and 0.6% had a 5-minute APGAR <7, reflecting favourable neonatal outcomes in this setting.

In a study by the University of Bonn in which women were asked why they decided against giving birth in an AMU, 69.5% cited fear of maternal or neonatal adverse events and 34.0% quoted availability of paediatricians. On the other hand, one of the most important wishes was one-to-one care (30.8%) [15]. Our AMU, located alongside a Perinatal Centre, addresses these needs by providing continuous one-to-one midwifery care, with proximity and therefore immediate access to specialist resources in case of necessity, facilitated by integrated documentation and without unnecessarily utilising highly specialised obstetric services.

Transfer rates and indications

The transfer rate of 25.0% peripartum and 7.7% postpartum in our cohort aligns closely with rates reported by the Birthplace in England Collaborative and is also in the national average of other Swiss free-standing midwifery units [3, 5].

Data from Morr et al. about obstetrician involvement in planned midwife-led birth of a Swiss university hospital showed that 43.0% of the women needed obstetrician or anaesthetist involvement peripartum, which is much higher than in our cohort [16]. Another study, by Andraczek et al., comparing low-risk births in the obstetrician-led and midwife-led unit of their institution, showed a transfer rate of 56.0%, which is twice as high as in our study. The main reasons in both studies cited above were the desire for analgesia, CTG abnormalities and failure of progress in labour. It is notable that one of the studies found obstetrician involvement due to CTG abnormalities in 43.0% of the cases [16, 17]. In our study, only 3.3% were transferred because of abnormal fetal heart rate during intermittent auscultation. Although not using CTG for fetal monitoring, both the rate of admissions to the NICU (0.8%) and the incidence of 5-minute APGAR <7 (0.6%) remained low. This is further supported by the network meta-analysis of Al Wattar et al., which showed that intermittent auscultation significantly reduces the risk for emergency caesarean section without increasing adverse neonatal outcomes [18]. Our setting therefore supports the recommendation of the S3 guideline “Vaginal birth at term” for intermittent intelligent auscultation in low-risk pregnancies [12].

Having no spatial separation between midwife-led units and OUs could be another reason for high rates of obstetrician involvement, since no transfer is needed. In our setting, the transfer from the AMU to the maternity ward involved a change of location and staff. This assumption is supported by the fact that a greater proportion of women in midwife-led units within an OU were transferred for pain management than in our collective [17]. There is no criticism behind this statement, since a high transfer rate is not necessarily a sign of poor-quality care. It indicates that the midwives work cautiously and respect the needs of the women.

Perception, expectation and acceptance of labour pain

Two questions arise: Why was the desire for analgesia the reason for transfer in 10% of all primiparous started labour at the AMU in our study? Do women have a different perception of perinatal pain? A review of 35 studies with the topic “What matters to women during childbirth” summarises that most women worry or even fear the pain, strain and unpredictability of childbirth. However, they accepted these hurdles as part of the process of a positive birth experience for themselves and their babies [19]. A Scandinavian study on labour preparation and management reported that first-time mothers felt stressed by the uncertainty about what to expect. The same study highlighted that women primarily prepared themselves to cope with labour pain through non-pharmacological methods during pregnancy, and considered midwifery support in this context as essential [20]. However, a systematic review indicates that the actual pain experienced during labour often exceeds expectations [21]. These findings underscore the importance of comprehensive antenatal counselling regarding pain and available pharmacological and non-pharmacological pain management options. Clear information about which options are available within the AMU setting and when transfer to the OU may become necessary is essential to enable women to make informed decisions about their care.

Maternal outcomes

Maternal outcomes such as blood loss and incidence of severe perineal injuries are key indicators of safety in birth settings.

A common point of criticism in non-hospital births is the potential delay caused by transfer to a hospital in case of postpartum haemorrhage (PPH). Early recognition and immediate intervention are essential for managing this life-threatening condition. In our cohort, 3.0% of all women who delivered at the AMU presented a retained placenta and 1.9% developed a uterine atony. The rate of PPH with blood loss 500 ml was 17.5% in the AMU. This rate is higher than those reported in large UK cohort studies, where PPH rates in AMUs range from 6% to 11% for blood loss 500 ml and is 3.7% for cases requiring transfer to obstetrician care [22]. A study from Germany comparing low-risk births in an AMU and in the obstetric unit also found a significantly lower rate of PPH (7%) than in our setting. However, no information about the management of the third stage in both settings is provided here [23].

According to the AWMF guideline "Vaginal Birth at Term", passive management of the third stage of labour is discussed with all women after counselling about potential risks [12]. This approach does not involve routine administration of oxytocin in low-risk deliveries, in contrast to the active management which is recommended by the World Health Organization (WHO), to reduce the risk of PPH [24]. Regardless of the chosen management, if PPH occurs, midwives have the option to administer oxytocin or misoprostol to stabilise the situation prior to transfer. To ensure safety, transfer is carried out by the ambulance service.

Data on duration and blood loss during transfer are not available. Furthermore, blood loss is usually underestimated without adequate measurement instruments. In our AMU, all items such as bed linen are weighed during PPH cases to objectively assess blood loss as accurately as possible. This practice may contribute to the higher rate of recorded blood losses 500 ml. Due to the lack of specific data regarding the proportion of woman with PPH who received passive management, no conclusion can currently be drawn about a potential association. Nevertheless, these findings indicate the need to re-evaluate the management of the third stage in our AMU.

In addition to haemorrhage, the occurrence of episiotomies or high-grade perineal tears are indicators of maternal safety. Our findings demonstrate low rates of episiotomy (1.0%) and severe perineal trauma (OASIS) (0.8%) in the AMU. This is significantly below the Swiss averages of 18% for episiotomies and 3% for OASIS [25]. Our findings may be attributable to the use of warm compresses during the active second stage of labour and hands-on perineal support. A key technique involves guiding the baby's head to support flexion and slow emergence. According to current evidence, warm compresses and perineal massage are considered effective techniques. However, there is no additional protective effect demonstrated for the hands-on technique to date [26]. To ensure quality, midwives are trained through targeted workshops, birth de-briefings and regular quality circles. A large nationwide cohort study in the Netherlands showed a slightly higher rate of OASIS among primiparous women in midwife-led care compared to obstetrician-led care, with the authors suggesting a correlation with the lower rates of episiotomies and emphasised the need for further studies [27]. A 10-year Austrian study reported significantly lower episiotomy rates in midwife-led care (9.0%) compared to obstetric-led care (14.0%), while OASIS rates in both groups were low, supporting our data [28]. Supporting the safety of a restrictive episiotomy approach, French national perinatal surveys have shown that episiotomy rates declined over a decade from 25.8% to 8.3%, while overall rates of OASIS remained stable, underscoring the potential benefits of cautious episiotomy use in preserving maternal outcomes [29].

These results suggest that the implementation of evidence-based perineal protection strategies in midwifery-led care settings may improve maternal safety and they support the broad adoption of restrictive episiotomy practice in spontaneous vaginal deliveries.

Neonatal outcomes

Neonatal outcomes in this study cohort were highly favourable, as adverse events remained low. Only 0.6% had a 5-minute APGAR score <7, and NICU admission was required in just 0.8%. In our setting, NICU admissions were predominantly precautionary, most indicated by transient postnatal adaption issues, respiratory distress or observation for suspected infection. A single case required evaluation of sudden unexplained collapse due to an unknown congenital cardiac anomaly. Four of the five admitted neonates were discharged within a few days.

The outcomes observed may reflect stringent inclusion criteria for planned AMU birth and vigilant intrapartum monitoring, facilitating timely involvement of neonatology. Furthermore, the rate of NICU transfer compares well with published international data. Andraczek et al. report a transfer rate of 4.1% from the AMU to the NICU, and The Birthplace in England study group reports

1.2% [5, 30]. Furthermore, a systematic review by Philippi et al. found no significant difference in neonatal morbidity or mortality between birth centre and hospital births among low-risk populations [31].

Our data indicate that there was no immediate compromise in neonatal outcomes, even in cases of transfer to the maternity ward because of suspicious fetal heart rate auscultation. Supporting these findings, there were no neonates with a 5-minute APGAR <7, and only two with a normal adaptionbut an umbilical cord artery pH <7.10. However, from this small sample size, no reliable conclusions can be drawn. To our knowledge, there are no published data on neonatal outcomes after transfer from the AMU due to suspicious intermittent auscultation, where the auscultation standards are known, like in our setting.

Neonatal adaption in our AMU was primarily assessed via the 5-minute APGAR, following standard clinical practice. Although an APGAR <7 at 5 minutes is recognised as a predictor of increased short-term risk and NICU admission, its correlation with umbilical artery pH and long-term outcomes is limited [32, 33]. Evidence shows that even a 5-minute APGAR ≥7 does not exclude the risk of neonatal acidosis. Ideally both parameters should be considered for comprehensive risk assessment [34, 35]. However, in low-risk midwifery-led settings, immediate clinical adaption as measured by the APGAR score remains the most practical tool [36].

The significantly higher number of admissions to the NICU and an APGAR <7 at 5 minutes after transfer to the maternity ward indicate that transfers usually occur in complications.

Neonatal outcomes in low-risk births remain favourable across settings, with consistently low rates of adverse events and NICU admissions. However, direct comparison between countries, hospitals or AMUs is limited by differences in risk selection, local protocols and care organisations [37, 38].

Strengths and limitations

It must be clearly stated that this is a descriptive study. No conclusions can be drawn on the comparison of low-risk births in the obstetrician-led unit or the AMU. After the transfer to the maternity ward due to deviations from physiology, the group can no longer be considered low-risk, and outcomes for both mother and neonate are inevitably influenced by this selection. Therefore, it is not possible to draw any conclusions e.g. based on the amount of blood loss or transfer to NICU. Further studies with matched cases are required. The small number of rare events may affect statistical power and interpretation of infrequent complications.

Although the study overlapped with the COVID-19 pandemic, which may have influenced healthcare processes, patient selection and clinical outcomes, the demand for the AMU may have been positively affected by the possibility for continuous accompaniment through the partner, in contrast to restrictions in other settings, as data from the Netherlands and the UK have shown [39, 40].

Furthermore, these data originate from a single AMU and generalisability is limited by specific demographic characteristics, potential selection bias, hospital-specific guidelines and local circumstances. Retrospective data collection from clinical documentation carries the risk for incomplete or inaccurate documentation, e.g. in the case of estimated blood loss or APGAR scores.

Another limitation is the lack of comparable data from Swiss AMUs with a similar concept. To this point, birth in Swiss AMUs, whether within a separate building or as part of an in-house midwife-led unit, have not been systematically recorded as a separate category. The Optimality Index (OI) would be a valuable tool for standardised measurement of the quality of care and outcomes in low-intervention birth settings. This requires comprehensive, standardised clinical documentation for its application [41]. Our retrospective dataset lacked some of the necessary parameters, making OI calculation unfeasible. We recommend considering the OI in future Swiss studies on AMUs to improve international comparability.

The strength of this study lies in its large sample size, the well-defined care model and its adherence to a standardised clinical protocol. Furthermore, the real-world setting enhanced the relevance and transferability of these findings to everyday midwife-led care. However, given the descriptive nature of this study, caution must be exercised when interpreting the results.

Conclusion

This retrospective descriptive study confirms that an Alongside Midwifery Unit (AMU) affiliated with a Swiss Perinatal Centre can ensure safe obstetric care with low-intervention birth and a high rate of spontaneous vaginal births with favourable maternal and neonatal outcomes for a selected

low-risk population. The generalisability of these results is limited due to the lack of a matched comparison group and the single-centre design. Further multicentre studies and the establishment of a national database are needed to better evaluate and compare midwife-led care in Switzerland.

Data sharing statement

Data are not publicly available. According to Swiss law, data sharing is restricted to the Federal Statistical Office in Switzerland.

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Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

References

1. Miller S , Abalos E , Chamillard M , Ciapponi A , Colaci D , Comandé D , et al. Beyond too little, too late and too much, too soon: a pathway towards evidence-based, respectful maternity care worldwide. Lancet. 2016 Oct;(10056):2176–92. https://doi.org/10.1016/S0140-6736(16)31472-6 27642019 1474-547X
2. World Health Organization. WHO recommendations: non-clinical interventions to reduce unnecessary caesarean sections. 2018. Available from: https://www.who.int/publications/i/item/9789241550338
3. Gaille A , Brodbekc S , Ruf B . Statistikbericht der Schweizer Geburtshäuser: Interessengemeinschaft der Geburtshäuser Schweiz 2023 Available from: https://www.geburtshaus.ch/uploads/news/IGGH_Statistik_Bericht_2023_DE_final.pdf
4. Sandall J , Fernandez Turienzo C , Devane D , Soltani H , Gillespie P , Gates S , et al. Midwife continuity of care models versus other models of care for childbearing women. Cochrane Database Syst Rev. 2024 Apr;(4):CD004667. https://doi.org/10.1002/14651858.CD004667.pub6 38597126 1469-493X
5. Brocklehurst P , Hardy P , Hollowell J , Linsell L , Macfarlane A , McCourt C , et al.; Birthplace in England Collaborative Group . Perinatal and maternal outcomes by planned place of birth for healthy women with low risk pregnancies: the Birthplace in England national prospective cohort study. BMJ. 2011 Nov; nov23 4:d7400. https://doi.org/10.1136/bmj.d7400 22117057 1756-1833
6. National Health Services (NHS) England. Implementing Better Births: Continuity of Carer. 2017. Available from: https://www.england.nhs.uk/publication/implementing-better-births-continuity-of-carer/2017
7. Callander EJ , Jackson H , McLachlan HL , Davey MA , Forster DA . Continuity of care by a primary midwife (caseload midwifery): a cost analysis using results from the COSMOS randomised controlled trial. Gynecol Obstet Clin Med. 2024;(2):e000008. https://doi.org/10.1136/gocm-2024-000008 2097-0587
8. McLachlan HL , Forster DA , Davey MA , Farrell T , Gold L , Biro MA , et al. Effects of continuity of care by a primary midwife (caseload midwifery) on caesarean section rates in women of low obstetric risk: the COSMOS randomised controlled trial. BJOG. 2012 Nov;(12):1483–92. https://doi.org/10.1111/j.1471-0528.2012.03446.x 22830446 1471-0528
9. National Health Services (NHS) England. Increasing the number of births at home and in midwifery led units: A best practice toolkit. 2015. Available from: https://www.england.nhs.uk/london/wp-content/uploads/sites/8/2019/11/Increasing-the-number-of-births-at-home-and-in-midwifery-led-units_A-best-practice-toolkit.pdf
10. National Institute for Health and Care Excellence. NICE Clinical Guideline 190: Intrapartum care for healthy women and babies. 2014. https://www.england.nhs.uk/london/wp-content/uploads/sites/8/2019/11/Increasing-the-number-of-births-at-home-and-in-midwifery-led-units_A-best-practice-toolkit.pdf
11. Desplanches T . Swiss Peristat Project: Swiss National Science Foundation; 2023 [SNF grant 222882. Available from: https://www.hesge.ch/heds/rad/projets/swiss-peristat-care-quality-indicators
12. Arbeitsgemeinschaft der Wissenschaftlichen Medizinischen Fachgesellschaften (AWMF). S3-Leitlinie Vaginale Geburt am Termin (AWMF Registernummer. 015/083). AWMF online; 2020. https://www.awmf.org/leitlinien/detail/ll/015-083.html
13. Maude RM , Skinner JP , Foureur MJ . Putting intelligent structured intermittent auscultation (ISIA) into practice. Women Birth. 2016 Jun;(3):285–92. https://doi.org/10.1016/j.wombi.2015.12.001 26710972 1878-1799
14. National Institute for Health and Care Excellence. NICE Guideline 229: Fetal monitoring in labour. 2022. Available from: https://www.nice.org.uk/guidance/ng229/resources/fetal-monitoring-in-labour-pdf-66143844065221
15. Gerzen L , Tietjen SL , Heep A , Puth MT , Schmid M , Gembruch U , et al. Why are women deciding against birth in alongside midwifery units? A prospective single-center study from Germany. J Perinat Med. 2022 May;(8):1124–34. https://doi.org/10.1515/jpm-2022-0041 35611852 1619-3997
16. Morr AK , Malah N , Messer AM , Etter A , Mueller M , Raio L , et al. Obstetrician involvement in planned midwife-led births: a cohort study in an obstetric department of a University Hospital in Switzerland. BMC Pregnancy Childbirth. 2021 Oct;(1):728. https://doi.org/10.1186/s12884-021-04209-2 34706693 1471-2393
17. Andraczek T , Magister S , Bautzmann S , Poppke S , Stepan H , Tauscher A . [Birth in the Midwife-Led Delivery Room of a Perinatal Center - Learning Curve, Outcomes and Benchmark]. Z Geburtshilfe Neonatol. 2023 Oct;(5):364–76. https://doi.org/10.1055/a-2082-2176 37279799 0948-2393
18. Al Wattar BH , Honess E , Bunnewell S , Welton NJ , Quenby S , Khan KS , et al. Effectiveness of intrapartum fetal surveillance to improve maternal and neonatal outcomes: a systematic review and network meta-analysis. CMAJ. 2021 Apr;(14):E468–77. https://doi.org/10.1503/cmaj.202538 33824144 1488-2329
19. Downe S , Finlayson K , Oladapo OT , Bonet M , Gülmezoglu AM . What matters to women during childbirth: A systematic qualitative review. PLoS One. 2018 Apr;(4):e0194906. https://doi.org/10.1371/journal.pone.0194906 29664907 1932-6203
20. Karlsdottir SI , Halldorsdottir S , Lundgren I . The third paradigm in labour pain preparation and management: the childbearing woman's paradigm. Scand J Caring Sci. 2014 Jun;(2):315–27. https://doi.org/10.1111/scs.12061 23815344 1471-6712
21. Lally JE , Murtagh MJ , Macphail S , Thomson R . More in hope than expectation: a systematic review of women's expectations and experience of pain relief in labour. BMC Med. 2008 Mar;(1):7. https://doi.org/10.1186/1741-7015-6-7 18366632 1741-7015
22. Elkington M , Kurinczuk JJ , Pasupathy D , Plachcinski R , Rogers J , Williams C , et al.; UK-MidSS Steering Group . Postpartum haemorrhage occurring in UK midwifery units: A national population-based case-control study to investigate incidence, risk factors and outcomes. PLoS One. 2023 Oct;(10):e0291795. https://doi.org/10.1371/journal.pone.0291795 37796876 1932-6203
23. Merz WM , Tascon-Padron L , Puth MT , Heep A , Tietjen SL , Schmid M , et al. Maternal and neonatal outcome of births planned in alongside midwifery units: a cohort study from a tertiary center in Germany. BMC Pregnancy Childbirth. 2020 May;(1):267. https://doi.org/10.1186/s12884-020-02962-4 32375692 1471-2393
24. Gülmezoglu AM , Lumbiganon P , Landoulsi S , Widmer M , Abdel-Aleem H , Festin M , et al. Active management of the third stage of labour with and without controlled cord traction: a randomised, controlled, non-inferiority trial. Lancet. 2012 May;(9827):1721–7. https://doi.org/10.1016/S0140-6736(12)60206-2 22398174 1474-547X
25. Moser D . Quality aspects relating to giving birth in Switzerland: an analysis of quality indicators in inpatient obstetrics from 2013 to 2017. Front Public Health. 2022 Oct;:1009412. https://doi.org/10.3389/fpubh.2022.1009412 36311608 2296-2565
26. Aasheim V , Nilsen AB , Reinar LM , Lukasse M . Perineal techniques during the second stage of labour for reducing perineal trauma. Cochrane Database Syst Rev. 2017 Jun;(6):CD006672. https://doi.org/10.1002/14651858.CD006672.pub3 28608597 1469-493X
27. Seijmonsbergen-Schermers AE , Peerdeman KM , van den Akker T , Titulaer LM , Roovers JP , Peters LL , et al. Differences in rates of severe perineal trauma between midwife-led and obstetrician-led care in the Netherlands: A nationwide cohort study. Heliyon. 2024 Jan;(2):e24609. https://doi.org/10.1016/j.heliyon.2024.e24609 38312656 2405-8440
28. Bodner-Adler B , Kimberger O , Griebaum J , Husslein P , Bodner K . A ten-year study of midwife-led care at an Austrian tertiary care center: a retrospective analysis with special consideration of perineal trauma. BMC Pregnancy Childbirth. 2017 Oct;(1):357. https://doi.org/10.1186/s12884-017-1544-9 29037175 1471-2393
29. Houlbracq R , Le Ray C , Blondel B , Lelong N , Chantry AA , Desplanches T ; ENP2021 Study Group . Episiotomies and obstetric anal sphincter injuries following a restrictive episiotomy policy in France: An analysis of the 2010, 2016, and 2021 National Perinatal Surveys. PLoS Med. 2025 Jan;(1):e1004501. https://doi.org/10.1371/journal.pmed.1004501 39808593 1549-1676

30. Andraczek T , Tauscher A , Kabbani N , Todorow H , Stepan H . Comparison of intrapartum transfer from out-of-hospital births with intrapartum transfer from an alongside midwifery unit: a real-world data analysis of a German cohort. J Perinat Med. 2025 Jun;(8):1077–88. https://doi.org/10.1515/jpm-2025-0141 40574705 1619-3997

31. Phillippi JC , Danhausen K , Alliman J , Phillippi RD . Neonatal Outcomes in the Birth Center Setting: A Systematic Review. J Midwifery Womens Health. 2018 Jan;(1):68–89. https://doi.org/10.1111/jmwh.12701 29419926 1542-2011

32. Iliodromiti S , Mackay DF , Smith GC , Pell JP , Nelson SM . Apgar score and the risk of cause-specific infant mortality: a population-based cohort study. Lancet. 2014 Nov;(9956):1749–55. https://doi.org/10.1016/S0140-6736(14)61135-1 25236409 1474-547X

33. Razaz N , Cnattingius S , Joseph KS . Association between Apgar scores of 7 to 9 and neonatal mortality and morbidity: population based cohort study of term infants in Sweden. BMJ. 2019 May;:l1656. https://doi.org/10.1136/bmj.l1656 31064770 1756-1833

34. Sabol BA , Caughey AB . Acidemia in neonates with a 5-minute Apgar score of 7 or greater - What are the outcomes? Am J Obstet Gynecol. 2016;215(4):486 e1-6. https://doi.org/10.1016/j.ajog.2016.05.035

35. Anyaegbunam A , Fleischer A , Whitty J , Brustman L , Randolph G , Langer O. Association between Umbilical Artery Cord pH, Five-Minute Apgar Scores and Neonatal Outcome. Gynecologic and Obstetric Investigation. 1 April 1991;(32 (4):):220–3. https://doi.org/https://doi.org/10.1159/000293036

36. Casey BM , McIntire DD , Leveno KJ . The continuing value of the Apgar score for the assessment of newborn infants. N Engl J Med. 2001 Feb;(7):467–71. https://doi.org/10.1056/NEJM200102153440701 11172187 0028-4793

37. Scarf VL , Rossiter C , Vedam S , Dahlen HG , Ellwood D , Forster D , et al. Maternal and perinatal outcomes by planned place of birth among women with low-risk pregnancies in high-income countries: A systematic review and meta-analysis. Midwifery. 2018 Jul;:240–55. https://doi.org/10.1016/j.midw.2018.03.024 29727829 1532-3099

38. Goodarzi B , Walker A , Holten L , Schoonmade L , Teunissen P , Schellevis F , et al. Towards a better understanding of risk selection in maternal and newborn care: A systematic scoping review. PLoS One. 2020 Jun;(6):e0234252. https://doi.org/10.1371/journal.pone.0234252 32511258 1932-6203

39. Gravesteijn BY , Boderie N , Beijers R , Bertens L , van den Akker T , van Dillen J , et al.; PREPARE consortium . Choosing for a Homebirth during COVID-19 Lockdown in The Netherlands, who and why: A national prospective questionnaire study. Midwifery. 2025 May;:104361. https://doi.org/10.1016/j.midw.2025.104361 40068245 1532-3099

40. van den Berg LM , Akooji N , Thomson G , de Jonge A , Balaam MC , Topalidou A , et al.; ASPIRE COVID-19 research team . Making maternity and neonatal care personalised in the COVID-19 pandemic: Results from the Babies Born Better survey in the UK and the Netherlands. PLoS One. 2022 Nov;(11):e0267415. https://doi.org/10.1371/journal.pone.0267415 36449488 1932-6203

41. Hermus M , Boesveld I , van der Pal-de Bruin K , Wiegers T . Development of the Optimality Index-NL2015, an Instrument to Measure Outcomes of Maternity Care. J Midwifery Womens Health. 2017 Sep;(5):580–8. https://doi.org/10.1111/jmwh.12650 28950442 1542-2011