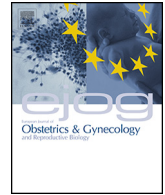




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# European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: [www.elsevier.com/locate/ejogrb](http://www.elsevier.com/locate/ejogrb)

## Frequency, causes and avoidability of outborn births in a French regional perinatal network



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## ARTICLE INFO

## Article history:

Received 7 February 2014

Received in revised form 21 April 2014

Accepted 9 May 2014

## Keywords:

Prematurity

Outborn

Inborn

Assessment

Perinatal network

## ABSTRACT

**Objectives:** To evaluate the rate and circumstances of outborn deliveries within a French perinatal network, and to determine their avoidability.

**Study design:** Cohort study including preterm infants <33 weeks gestation and/or weighing <1500 g born outside a level III maternity unit in Lower Normandy region, France, in 2008–2010. In 2008 and 2009, only neonates transferred to the Caen University Teaching Hospital (CHU) were included. In 2010, all outborn neonates in the region were included by means of a medical information system program. A panel of 7 experts was set up to determine the avoidability of each outborn case using a two-stage modified Delphi procedure. Inter-expert agreement was evaluated using the kappa index.

**Results:** Sixty-four cases (71 neonates) were included. The outborn rate in 2010 was 16.1% (40/248, 95% CI (116–207%)). The most common reason for delivery was spontaneous onset of labour (57.8%). In 12 cases, the place of birth (level 2b maternity unit) was considered to be appropriate by the experts (term  $\geq 32$  WG)

, but 8 cases involved infants of low birth weight (<1500 g). For the 52 cases born in inappropriate sites, 9.6% were considered to be avoidable (kappa index = 0.42 ( $p < 10^{-3}$ )).

**Conclusion:** Our outborn rate meets regionalisation targets. Our method of expert evaluation identified a small percentage of avoidable births in inappropriate sites. Regular reassessment of obstetric practices and good coordination between network actors are crucial to improve the management of pregnancies at risk of outborn delivery.

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## Introduction

The aim of regionalizing perinatal care is to organize the birth of those neonates who are most at risk, principally very preterm (VPT) and very low birth weight (VLBW) infants, in centers adapted

for their management by promoting in utero transfer (IUT). In 2008, the meta-analysis by Lasswell [1] pooling the results of more than 30 years of published studies once again showed that the risk of neonatal death was significantly higher for VPT and VLBW infants born outside a maternity unit of the appropriate level (“outborn” infants).

Regional organization of perinatal care developed in the 1970s in the United States with the publication of the report “Toward Improving the Outcome of Pregnancy” [2], which categorized maternity units into three levels and advocated the utility of in utero transfer.

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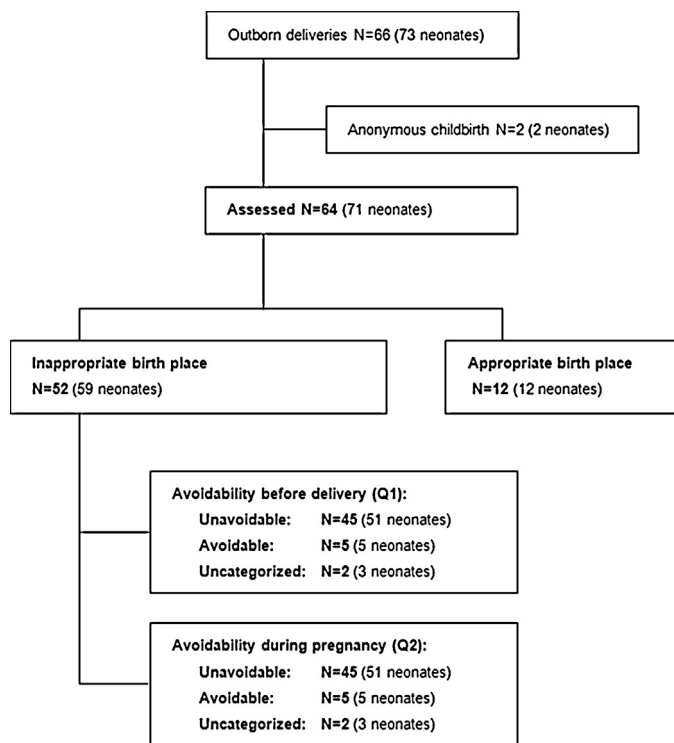


Fig. 1. Flow chart and assessment results.

**Table 1**  
Characteristics of mothers, pregnancies and neonates.

Characteristics	
Mothers (N = 64)	
Age, mean (SD) (years)	27.2 (5.7)
Gestational age, median (25th–75th percentile) (weeks)	31 (29–32)
Gravidity, N (%)	
1	22 (34.4)
2–4	35 (54.7)
≥5	7 (10.9)
Parity, N (%)	
1	25 (39.1)
2–4	34 (53.1)
≥5	5 (7.8)
History of miscarriage, N (%)	15 (23.4)
Previous obstetric pathology <sup>a</sup> , N (%)	12 (18.8)
Smoking during pregnancy, N (%) (missing: 12)	
No	21 (40.4)
<10/day	5 (9.6)
≥10/day	26 (50.0)
Working during pregnancy, N (%) (missing: 11)	28 (52.8)
Pregnancies (N = 64)	
Multiple pregnancy, N (%)	7 (10.9)
No consultation during pregnancy, N (%)	6 (9.4)
Obstetric pathology <sup>b</sup> , N (%)	23 (35.9)
Hospitalization during pregnancy, N (%)	21 (33.3)
Neonates (N = 71)	
Birthweight, mean (SD) (g)	1400 (359)
Severe complications during hospitalization, N (%) (N = 68)	
Death	7 (10.3)
Fetal heart rate abnormalities	2 (2.9)
Bronchopulmonary dysplasia	7 (10.3)
Necrotizing enterocolitis	1 (1.5)

<sup>a</sup> Fetal death, preterm birth, fetal malformation, uterine abnormality, fetal growth restriction, preeclampsia.

<sup>b</sup> Premature obstetric labor, fetal growth restriction, metrorrhagia, placental or uterine abnormality, preeclampsia.

**Table 2**  
Reasons for delivery and contraindications to in utero transfer.

	N	%
Reasons for delivery (N = 64)		
Spontaneous labor	37	57.8
Fetal growth restriction	8	12.5
Placenta abruptio	6	9.4
Pre-eclampsia (+HELLP)	5	7.8
Suspicion of chorioamnionitis	4	6.3
Severe bleedings	3	4.7
Fetal heart rate abnormalities	1	1.6
Contraindications to in utero transfer (N = 51)		
Risk of imminent delivery	36	70.6
Placenta abruptio (certain or suspected)	5	9.8
Severe fetal heart rate abnormalities	5	9.8
Praevia placenta hemorrhagic	3	5.9
Home delivery	2	3.9

Percentages may not add up to 100 due to rounding.

Little by little, this regionalisation policy spread to Europe, but it was only in the 1990s that its organization developed in France in response to the mediocre perinatal outcomes observed [3]. The first government decrees to make regionalisation and functioning perinatal networks obligatory in our country came into force in 1998.

In Lower Normandy region, France, a perinatal network was set up in 1999. One of its objectives was to organize in utero transfers at the regional level. Follow-up of the rate of infants born in a maternity unit appropriate to their management was one of the various indicators which allowed the network to be evaluated. This rate has been over 80% for several years [4], but a systematic review of cases of outborn births had, until the present study, not been conducted.

Our goals were to quantify outborn births, to identify their causes, and to assess their avoidability.

## Materials and methods

### Study population

The study population consisted of VLBW (<1500 g) and VPT infants (<33 WG) born outside of a level III hospital in lower Normandy, France. Lower Normandy is a region located in the northwestern part of France with 1,500,000 inhabitants and 17,000 annual births. Of the 15 maternity units of the region, 2 are located in level III hospitals, i.e. equipped to handle serious neonatal illnesses and abnormalities.

In 2008 and 2009, only children born outside of one of the two level III hospitals (Caen Regional University Hospital) were included. In 2010, we were able to include both level III maternities and outborn births that were not followed by a neonatal transport (hospitalization in the delivery hospital, or neonatal death before transport).

Children of gestational age less than 24 weeks gestation were excluded, as well as stillbirths, regardless of gestational age.

### Data source

The data source for identifying cases was hospital discharge data from the French medical information system program (PMSI). The PMSI routinely collects information about patient hospitalization, with regular cross-checks for consistency and completeness. For each identified case, medical records from maternity wards and neonatal units were consulted to collate additional information. Data collected included demographics (for mother and child), history of previous pregnancies, monitoring of the current pregnancy, antenatal and intrapartum care, and hospitalization of neonates.

**Table 3**  
Inter-expert agreement after round 1 of the modified Delphi procedure (52 cases assessed).

Question	$\kappa$ mean (minimum–maximum)	$p_o$ %	$\kappa_m$
Q2. Do you think a transfer of the mother could have been performed just before the delivery?	0.43 (0.25–0.68)	55.8	0.42
Q3. Do you think a transfer of the mother could have been anticipated during pregnancy?	0.20 (–0.06–0.45)	40.3	0.21

$\kappa$ : kappa index,  $p_o$ : overall agreement,  $\kappa_m$ : multiple observers kappa index. Yes certainly and yes probably combined.

### Avoidability assessment

For the assessment of the avoidability of outborn births, we used a modified Delphi procedure [5]: a panel of experts participated in a two-round decision procedure between January and September 2012 followed by a round-table to which all panelists were convened.

Our panelists were members of the perinatal network who volunteered to participate in the assessment. We selected 7 panelists with a broad range of ages and experience levels. Of the panelists, 6 were obstetricians/gynecologists and one was a public health specialist. The obstetricians were chosen to represent the different levels of maternity units (level I, II or III) and both the public and private sector.

During the first round, an anonymous case summary and a questionnaire were mailed to each expert. The case summary consisted in a description of maternal history, pregnancy progress, and details of events occurring between admission and delivery (cervical dilation, treatments and tests). Each event's chronology was specified. The panelists were asked three questions: Q1 – Was the place of birth appropriate (yes/no)? Q2 – Do you think a transfer of the mother could have been performed just before the delivery (yes certainly/yes probably/no/not evaluable)? Q3 – Do you think a transfer of the mother could have been anticipated during pregnancy (yes certainly/yes probably/no/not evaluable)? For Q1, the reference was the regional in utero transfer protocol, which states that newborn less than 31 weeks should be born in level III hospitals (neonatal intensive care unit), and newborn of 32 weeks in level III or in level “IIb” (neonatal reanimation unit). Experts had to answer to Q2 and Q3 only if they thought that the place of birth was not appropriate (Q1).

In the second round, each panelist received the aggregated results of the first round and had to re-answer the same three questions based on their own opinion and the group response to the previous round.

Finally, cases without consensus were discussed during a round-table discussion in September 2012. The meeting was chaired by 2 of us (CL, PT). The panelists were informed of the results of the 2 rounds, and each case was reviewed and discussed to identify disagreement and reach a final consensus.

### Statistical analysis

Population characteristics are reported as mean (standard deviation) or median (first and third quartiles) for continuous variables, and as number (percentage) for categorical variables. Outborn rates with their 95% confidence intervals (95% CI) were computed by dividing the number of outborn infants by the total number of VLBW and VPT infants. The Chi<sup>2</sup> test was used to test differences between annual outborn rates, with a significance level of 0.05.

When analyzing expert agreement in regard to questions 2 and 3, the answers “yes certainly” and “yes probably” were combined as “avoidable”, while the answer “no” was regarded as unavoidable. The proportion of agreement between each pair of observers for each question after the first round of the modified Delphi

procedure was measured using unweighted kappa ( $\kappa$ ). Agreement within the group as a whole was measured using 2 indices: the overall proportion of agreement, and the kappa statistic for multiple observers ( $\kappa_m$ ) [6,7].

Statistical analyses were performed using SAS software (SAS Institute Inc., Cary, NC, USA).

### Results

We included 73 neonates (66 mothers) born outside of a level III hospital during the study period. Among them, 2 cases were anonymous childbirths with no data available for 2 mothers and were not included in the assessment of the avoidability (Fig. 1).

Sixty one neonates (83.6%) were VPT, 50 (68.5%) were VLBW and 40 (54.8%) were both VPT and VLBW. Of the 66 deliveries, 20 (30.3%) took place in a level I and 46 (69.7%) in a level II maternity unit.

The outborn rate for the Caen Regional University Hospital for 2008–2010 was 12.2% (54/441, 95% CI (92–153%)), with no difference between annual rates for this period (2008: 10.3%, 2009: 14.0%, 2010: 12.7%,  $p=0.64$ ). The regional outborn rate (including non-transferred neonates and deaths before neonatal transport) for year 2010 was 16.1% (40/248, 95% CI (116–207%)).

In 2010, 3 neonates died before neonatal transport (7.5%), all had a gestational age less than 30 weeks. Five children (12.5%) were not transferred and were hospitalized in the neonatal unit of the hospital where they were born. Antenatal corticosteroids were administered to 23 mothers (57.5%, missing: 6).

Assessment of avoidability focused on 64 cases (71 neonates) and a consensus was reached in all cases. Maternal and neonatal characteristics are summarized in Table 1. The main reasons for delivery were spontaneous labor, fetal growth restriction and placenta abruption, and the main contraindication to maternal transfer was the risk of imminent delivery (cervical dilation  $\geq 4$  cm) (Table 2). Among these women, 13 (36.1%) were considered as low-risk pregnancies, 6 were twin pregnancies and 6 had been hospitalized during pregnancy for threatened preterm delivery.

In 12 cases (18.8%, 12 neonates), the place of birth was considered as appropriate, with an agreement of all experts after round 1, and no further assessment of avoidability. All 12 neonates had a gestational age of at least 32 WG, in accordance with the regional protocol, and 8 were VLBW infants.

When the birth place was considered as inappropriate ( $N=52$ ), the multiple kappa index for agreement between the panelist after round 1 was 0.42 ( $p < 10^{-3}$ ) for Q1 and 0.20 ( $p < 10^{-3}$ ) for Q2 (Table 3). After the consensus meeting, the panelists agreed that the outborn birth could have been avoided during pregnancy in 5 cases (9.6%, 5 neonates), and before delivery in 5 cases (9.6%, 5 neonates) (Fig. 1). Three cases were considered avoidable both during pregnancy and before delivery, 2 cases avoidable during pregnancy but not before delivery, and 2 cases avoidable before delivery but not during pregnancy.

For the avoidable cases before delivery, the clinical history was as follows: (Case 1) threatened premature delivery at 31 WG + 1 day with ineffective tocolytic treatment and reassessment of the situation when it was too late; (Case 2) pre-eclampsia at 32 WG +

4 day with rapid deterioration and onset of a HELLP syndrome; (Case 3) threatened premature delivery and premature rupture of membranes at 30 WG + 3 day, medicalized transport refused by the SAMU (emergency medical assistance) and non-medicalized transport refused by the obstetrician; (Case 4) deterioration of fetal cardiac rhythm and uterine contractions at 29 WG + 6 day with incorrect management; (Case 5) delayed intra-uterine growth at 34 WG + 3 day undergoing Caesarean because of deteriorating fetal cardiac rhythm with a birth weight of 1315 g.

### Comment

To our knowledge very few data have been published on the causes and avoidability of outborn births. In our study, the regional outborn rate was 16.1%, and 90% of cases were avoidable. The most frequent cause was spontaneous onset of labour, which accounted for more than half of all cases. The risk of imminent delivery was responsible for almost three-quarters of the contraindications to an IUT.

Regionalisation is of capital importance in the management of VLBW and VPT infants, and numerous studies have already demonstrated the excess risk for outborn infants [8–13]. In the meta-analysis by Lasswell [1], the risk of death was higher in the population of infants born outside a level II maternity both for VLBW (adjusted odds ratio: 1.62, 95% CI (144–183)) and VPT infants (adjusted odds ratio: 1.55 95% CI (121–198)). In France, regionalisation is a relatively recent phenomenon: perinatal networks were first set up in the 1990s and aim to achieve more than 80% of premature deliveries in maternity units of the appropriate level [3,14]. In the United States, the target of 90% VLBW infants born in a level III maternity [15] was achieved in 2008 in only 5 states, and 10 states had a rate of less than 70% [1]. In Australia, the outborn rate was 9.3% for the period 1997–2002 after a reform of the organization of in utero and neonatal transfers [16].

It is important to specify which perspective is adopted when calculating the rate of outborn infants. We were able to adopt two perspectives: firstly that of the two regional neonatal resuscitation departments, and secondly that of the region as a whole due to the creation of a birth database which first became operational in 2010. In the latter case, we were able to register VPT and/or VLBW infants not transferred to a neonatal resuscitation unit after birth (whether they had been hospitalized in the neonatology department of the hospital in which they had been born or died before transport).

Our study is one of the first to describe the causes of outborn births. One of its limitations is not to have studied the risk factors for these births, especially in relation to maternal characteristics and gestational progress. These factors ought to be more clearly determined in such a way that they can be prevented.

The benefit of antenatal corticotherapy has been widely demonstrated [17], but several studies have shown that it is less often administered to outborn infants [10,18]. In France, a national cross-sectional study in 2010 showed that 54.3% of infants born before 34 WG had received at least one dose of corticosteroids [20]. Our results are therefore encouraging but will be difficult to improve due to the frequency of imminent deliveries in this population group.

With regard to evaluating the avoidability of cases, the low levels of agreement between experts in our study validate our method of expert case evaluation. A limitation of our Delphi procedure is that results may be influenced by the selection of experts: it may be presumed that each expert addresses a clinical situation based on the type of maternity in which he works, the distance between his unit and the referral center, and the available means. The kappa index measuring inter-expert agreement at the

end of the first round of expert evaluation was 0.43 for the avoidability of outborn birth prior to delivery, indicating moderate agreement, and only 0.20 for avoidability during pregnancy, indicating low agreement. This makes it necessary to involve several regional experts representing each maternity level, as well as the private and public sectors, in every case evaluation. Another limitation is the small number of selected experts, which were all members of our perinatal network. Selecting experts outside our region would have allowed more neutrality, but with a greater risk of poor participation. However, use of the Delphi method allows individual expert perspectives to be ascertained, and avoids the opinion of a minority influencing the group decisions [5]. Ultimately, the consensus round-table enabled each expert to defend his point of view and to discuss each case.

Although our outborn rate meets national targets, it could be improved further by orienting efforts toward the prevention of avoidable cases, which are essentially related to management shortcomings or organizational problems. Intrauterine growth restrictions observed on third-semester ultrasonography, a normal part of routine antenatal surveillance in France, merit particular vigilance. Birth weight is a risk factor for morbidity and mortality independently of outborn births [19], but was not incorporated in the protocol setting out the indications for in utero transfer discussed between all the regional obstetricians. Our study enabled this protocol to be developed to include management of neonates  $\geq 32$  WG as well as VLBW in level III maternity units.

Avoidable outborn births are rare. It is difficult to find a common factor which characterizes them all. At their source, it may sometimes be possible to find a lack of reactivity on the part of the obstetric team, for instance in the case of threatened premature delivery for which an in utero transfer was not requested straightaway, or the case of pre-eclampsia that could have been transferred on admission but which deteriorated subsequently. Underestimating the seriousness of the fetal state may also be implicated, for instance in the case of restricted intrauterine growth the outcome of which was adapted to the maternity unit in which birth took place but for which potential complications linked to major hypotrophy ought to have led to delivery in a level III maternity unit.

Coordination and discussion between the different professionals in the network, as well as regular evaluation of practices, are key elements in improving the organization of regionalized perinatal care.

### Acknowledgements

Special thanks to: Magali Varangot, Ms., CHU de Caen, Réseau de périnatalité, Caen, F-14,000, France; Cécile Caze, Ms., CHU de Caen, Réseau de périnatalité, Caen, F-14,000, France.

### References

- [1] Lasswell SM, Barfield WD, Rochat RW, Blackmon L. Perinatal regionalization for very low-birth-weight and very preterm infants. A meta-analysis. *JAMA* 2010;304:992–1000.
- [2] Ryan GM. Toward improving the outcome of pregnancy: recommendations for the regional development of perinatal health services. *Obstet Gynecol* 1975;46:375–84.
- [3] Papiernik E, Keith LG. The regionalization of perinatal care in France—description of a missing policy. *Eur J Obstet Gynecol Reprod Biol* 1995;61:99–103.
- [4] Thibon P, Cornu M, Lamendour N, Guillois B, Dreyfus M. Régionalisation des soins périnataux en Basse-Normandie: évolution sur cinq ans. *J Gynecol Obstet Biol Reprod* 2011;40:156–61.
- [5] Fink A, Kosecoff J, Chassin M, Brook RH. Consensus methods: characteristics and guidelines for use. *Am J Public Health* 1984;74(9):979–83.
- [6] Fleiss JL. *Statistical methods for rates and proportions*. 2nd ed. New York: Wiley; 1981. p. 212–36.
- [7] Donner A, Klar N. The statistical analysis of kappa statistics in multiple samples. *J Clin Epidemiol* 1996;49:1053–8.

- [8] Ozminkowski RJ, Wortman PM, Roloff DW. Inborn/outborn status and neonatal survival: a meta-analysis of non randomised studies. *Stat Med* 1988;7:1207–21.
- [9] Lubchenco LO, Butterfield LJ, Delaney-Black V, Golson E, Koops BL, Lazotte DC. Outcome of very-low birth weight infants: does antepartum versus neonatal referral have a better impact on mortality, morbidity, or long-term outcome? *Am J Obstet Gynecol* 1989;160:539–45.
- [10] Haupsy J, Jacquemyn Y, Van Reempts P, Buytaert P, Van Vliet J. Intrauterine versus postnatal transport of the preterm infant: a short-distance experience. *Early Hum Dev* 2001;63:1–7.
- [11] Truffert P, Goujard J, Dehan M, Vodovar M, Breart G. Outborn status with a medical neonatal transport service and survival without disability at two years. A population-based cohort survey of newborns of less than 33 weeks of gestation. *Eur J Obstet Gynecol Reprod Biol* 1998;79:13–8.
- [12] Arad I, Braustein R, Baroz B. Neonatal outcome of inborn and outborn extremely low birth weight infants: relevance of perinatal factors. *Isr Med Assoc J* 2008;10:457–61.
- [13] Shah PS, Shah V, Qiu Z, Ohlsson A, Lee SK. Improved outcomes of outborn preterm infants if admitted to perinatal center versus freestanding pediatric hospitals. *J Pediatr* 2005;146:626–31.
- [14] Mamelle N, David S, Lombraïl P, Roze JC. Indicateurs et outils d'évaluation des réseaux de soins périnataux. *J Gynecol Obstet Biol Reprod* 2001;30:641–56.
- [15] Stark AR. American academy of pediatrics committee on fetus and newborn. Levels of neonatal care. *Pediatrics* 2004;114:1341–7.
- [16] Lui K, Abdel-Latif ME, Allgood CL, et al. Improved outcomes of extremely premature outborn infants: effect of strategic changes in perinatal and retrieval services. *Pediatrics* 2006;118:2076–83.
- [17] Roberts D, Dalziel S. Antenatal corticosteroids for accelerating fetal lung maturation for women at risk of preterm birth. *Cochrane Database Syst Rev* 2006;19:CD004454, [comment in: *Obstet Gynecol* 2007; 109:189–190].
- [18] Lee K, McMillian D, Ohlsson A, et al. The benefit of preterm birth at tertiary care centers is related to gestational age. *Am J Obstet Gynecol* 2003;188: 617–22.
- [19] Blondel B, Lelong N, Kermarrec M, Goffinet F. La santé périnatale en France métropolitaine de 1995 à 2010: résultats des enquêtes nationales périnatales. *J Gynecol Obstet Biol Reprod* 2012;41:151–66.
- [20] Garite TJ, Clark R, Thorp JA. Intrauterine growth restriction increases morbidity mortality among premature neonates. *Am J Obstet Gynecol* 2004;191:481–7.