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# Evaluation of the Quality of French Hospital Data for Perinatal Algorithms

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**Abstract.** The aim of our validation study was to assess the quality of hospital data for perinatal algorithms on a national level. In each hospital, we selected 150 discharge abstracts of delivery (after 22 weeks of gestation), in 2014, and their corresponding medical records. Overall, 23 hospitals were included and 3,246 discharge abstracts were studied.
This first national validation study of several case-funding algorithms using various perinatal variables suggests that the French national hospital discharge abstracts database is an appropriate data source for epidemiological studies.

**Keywords:** hospital data, perinatal indicators, validation study.

## 1. Introduction

Administrative data, such as hospital or care consumption, that are collected primarily for reimbursement, contain several clinical diagnoses and procedures, which can be used to provide epidemiologic information (1). In France, 99.6% of the 800,000 annual births in France take place in hospitals (2). This renders the French hospital database particularly interesting for the investigation of perinatal Nonetheless, the researchers using the medico-administrative databases are required to evaluate data quality via a validation study (3–7). In validation studies of case-finding algorithms, validity indices are used to assess data quality by comparing an algorithm in the simpler and easier-to-use data set versus a more elaborate, robust and reliable data set that is considered to be a "gold standard". Furthermore, other validity indices are used to aid the selection of the best algorithms. In contrast to the less frequently conducted national surveys, the use of routinely collected health data in hospitals saves time and money when identifying infrequent and unfavorable delivery outcomes and improves health surveillance of women and their offspring (1).

The aim of our validation study was to assess the hospital data quality for perinatal algorithms on a national level.

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## 2. Methods

The principle of this transversal multicenter study was to compare discharge abstract data entered into the French hospital database with the corresponding data from medical records, where we considered the latter to be the gold standard.

### *2.1. Population*

Fifty health hospitals with a maternity unit were randomly selected in metropolitan France (other than Paris and Paris region), irrespective of the level of the unit. We developed a software program to randomly select 150 perinatal discharge abstracts per hospital (≥ 22 weeks of gestation) in 2014, from all discharge abstracts that contained a Z37 code and/or a delivery procedure. The same investigator collected data in each hospital from hospital paper-based or electronic medical records of pregnancy (prenatal care, the delivery and the post-delivery stay, and a discharge letter). Then, a comparison between data from medical records and data from discharge abstracts was made.

### *2.2 Statistical analysis*

We explored several algorithms, including different combinations of codes in discharge abstracts from delivery stay, pregnancy stay, or hospitalization over the past 2 years before delivery. To evaluate the quality of the hospital database of discharge abstracts versus the hospital medical records (our gold standard), two validity indices the positive predictive value (PPV) and the sensitivity were calculated for dichotomous data. Continuous data were assessed by the concordance rate as the validity index. The rates of false negatives (FN) and false positives (FP) were also calculated in order to select the best algorithms with regards to the likelihood ratio (balancing specificity and sensitivity). This study was approved by the French National Committee for Data Protection (registration number 9132091). To meet the requirement of the data protection agency, the family names and first names were removed, the date of birth was replaced by the age at delivery, and the dates of admission and discharge were replaced by the length of stay.

## 3. Results

Twenty-two hospitals were finally included. Among them, 5 maternity units had less than 1,000 deliveries, 4 units had between 1,000 and 2,000 deliveries, 5 units had between 2,000 and 3,000 deliveries and 8 maternity units had more than 3,000 deliveries. Overall, 3,246 discharge abstracts were compared with their corresponding medical records.

### *3.1. Maternal indicators*

The concordance rate of maternal age at delivery was 94.8%, with a 95% confidence interval (CI) [93.8-95.4]. The maternal characteristics and several types of morbidity are presented in Table 1.

**Table 1**: Quality of the hospital database of discharge abstracts versus the hospital medical records

| | Medical records | | Discharge abstracts | | PPV | | FP | | FN | | Sensitivity | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | % | n | % | % | 95% CI | n | % | n | % | % | 95% CI |
| **Maternal characteristics and comorbidities** | | | | | | | | | | | | |
| Parity | | | | | | | | | | | | |
| Primiparous women | 981 | 40.2 | 971 | 39.8 | 93.3 | 92.3-94.3 | 65 | 2.7 | 75 | 3.1 | 92.4 | 91.3-93.5 |
| Multiparous women | 1,459 | 59.8 | 1,458 | 59.8 | 95.5 | 94.7-96.3 | 66 | 2.7 | 67 | 2.7 | 95.5 | 94.7-96.3 |
| Overweight or obesity ≥ 25 kg/m² * | 1,104 | 37.6 | 220 | 7.5 | 98.6 | 98.2-99.0 | 3 | 0.1 | 887 | 30.2 | 19.7 | 18.3-21.1 |
| Obesity≥ 30 kg/m² * | 507 | 17.3 | 216 | 7.4 | 91.7 | 90.7-92.7 | 18 | 0.6 | 309 | 10.5 | 39.1 | 37.3-40.9 |
| Uterus scar** | 464 | 14.4 | 384 | 11.9 | 94.8 | 94.0-95.6 | 20 | 0.6 | 100 | 3.1 | 78.5 | 77.1-79.9 |
| Diabetes Mellitus | | | | | | | | | | | | |
| Type 1 diabetes *** | 98 | 3.0 | 143 | 4.4 | 50.4 | 48.7-52.1 | 71 | 2.2 | 26 | 0.8 | 73.5 | 72.0-75.0 |
| Type 2 diabetes *** | 51 | 1.6 | 31 | 1.0 | 67.7 | 66.1-69.3 | 10 | 0.3 | 30 | 0.9 | 41.2 | 39.5-42.9 |
| Type 1 or type 2 diabetes | 148 | 4.6 | 170 | 5.2 | 65.9 | 64.3-67.5 | 58 | 1.8 | 36 | 1.1 | 75.7 | 74.2-77.2 |
| High blood pressure | 29 | 0.9 | 34 | 1.0 | 32.4 | 30.8-34.0 | 23 | 0.7 | 18 | 0.6 | 37.9 | 36.2-39.6 |
| **Pregnancy-related disorders** | | | | | | | | | | | | |
| Gestational diabetes | | | | | | | | | | | | |
| Code O24.4 | 482 | 14.9 | 469 | 14.5 | 80.6 | 79.2-82.0 | 91 | 2.8 | 104 | 3.2 | 78.4 | 77.0-79.8 |
| Codes O24.4-O24.9 | 482 | 14.9 | 474 | 14.6 | 80.8 | 79.4-82.2 | 91 | 2.8 | 99 | 3.1 | 79.5 | 78.1-80.9 |
| Hypertensive disorders | | | | | | | | | | | | |
| Previous or during pregnancy | 213 | 6.6 | 239 | 7.4 | 69.5 | 67.9-71.1 | 73 | 2.3 | 47 | 1.4 | 77.9 | 76.5-79.3 |
| Moderate or severe pre-eclampsia | 96 | 3.0 | 106 | 3.3 | 70.8 | 69.2-72.4 | 31 | 1.0 | 21 | 0.6 | 78.1 | 76.7-79.5 |
| Eclampsia | 2 | 0.1 | 8 | 0.2 | 12.5 | 11.4-13.6 | 7 | 0.2 | 1 | 0.0 | 50.0 | 48.3-51.7 |
| Premature labor*** (O60.0) | 141 | 4.3 | 87 | 2.7 | 57.5 | 55.8-59.2 | 37 | 1.1 | 91 | 2.8 | 35.5 | 33.9-37.1 |
| Premature labor***¥ | 141 | 4.3 | 326 | 10.0 | 32.5 | 30.9-34.1 | 220 | 6.8 | 35 | 1.1 | 75.2 | 73.7-76.7 |
| Premature delivery | 434 | 13.4 | 295 | 9.1 | 85.8 | 84.6-87.0 | 42 | 1.3 | 181 | 5.6 | 58.3 | 56.6-60.0 |
| Placental abruption | 41 | 1.3 | 40 | 1.2 | 75.0 | 73.5-76.5 | 10 | 0.3 | 11 | 0.3 | 73.2 | 71.7-74.7 |
| Delivery | | | | | | | | | | | | |
| Type of pregnancy | | | | | | | | | | | | |
| Singleton | 3,134 | 96.5 | 3,179 | 97.9 | 98.3 | 97.9-98.7 | 54 | 1.7 | 9 | 0.3 | 99.7 | 99.5-99.9 |
| Twin | 105 | 3.2 | 106 | 3.3 | 94.3 | 93.5-95.1 | 6 | 0.2 | 5 | 0.2 | 95.2 | 94.5-95.9 |
| Triple | 5 | 0.2 | 8 | 0.2 | 50.0 | 48.3-51.7 | 4 | 0.1 | 1 | 0.0 | 80.0 | 78.6-81.4 |
| **Delivery** | | | | | | | | | | | | - |
| Vaginal | 2,508 | 77.3 | 2,51 | 77.3 | 99.5 | 99.3-99.7 | 13 | 0.4 | 11 | 0.3 | 99.6 | 99.4-99.8 |
| Operative | 343 | 10.6 | 373 | 11.5 | 88.2 | 87.1-89.3 | 44 | 1.4 | 14 | 0.4 | 95.9 | 95.2-96.6 |
| Caesarean | 731 | 22.5 | 738 | 22.7 | 98.5 | 98.1-98.9 | 11 | 0.3 | 4 | 0.1 | 99.5 | 99.3-99.7 |
| Emergency caesarean | 450 | 13.9 | 516 | 15.9 | 83.0 | 81.7-84.3 | 88 | 2.7 | 22 | 0.7 | 95.1 | 94.4-95.8 |
| Planned caesarean | 238 | 7.3 | 250 | 7.7 | 80.4 | 79.0-81.8 | 49 | 1.5 | 37 | 1.1 | 84.5 | 83.3-85.7 |
| Episiotomy*** | 350 | 14.0 | 334 | 13.4 | 90.1 | 88.9-91.3 | 33 | 1.3 | 49 | 2.0 | 86.0 | 84.6-87.4 |
| Perineal tears*** | 1,231 | 49.3 | 1,092 | 43.7 | 86.2 | 84.8-87.6 | 151 | 6.0 | 290 | 11.6 | 76.4 | 74.7-78.1 |
| Postpartum hemorrhage*** (PPH) | | | | | | | | | | | | - |
| Immediate (O72.0, O72.1) | 286 | 8.8 | 278 | 8.6 | 77.7 | 76.3-79.1 | 62 | 1.9 | 70 | 2.2 | 75.5 | 74.0-77.0 |
| Diagnosis codes + manual removal of the placenta* | 191 | 5.9 | 31 | 1.0 | 80.7 | 79.3-82.1 | 6 | 0.2 | 166 | 5.1 | 13.1 | 11.9-14.3 |
| Severe PPH | | | | | | | | | | | | - |
| Relevant advanced interventional procedures | 120 | 3.7 | 143 | 4.4 | 67.8 | 66.2-69.4 | 46 | 1.4 | 23 | 0.7 | 80.8 | 79.4-82.2 |
| Relevant or general advanced interventional procedures | 120 | 3.7 | 158 | 4.9 | 68.4 | 66.8-70.0 | 50 | 1.5 | 12 | 0.4 | 90.0 | 89.0-91.0 |
| Medical abortion | 153 | 4.7 | 153 | 4.7 | 91.5 | 90.5-92.5 | 13 | 0.4 | 13 | 0.4 | 91.5 | 90.5-92.5 |
| Medical abortion, fetal pathology | 137 | 4.2 | 117 | 3.6 | 88.9 | 87.8-90.0 | 13 | 0.4 | 33 | 1.0 | 75.9 | 74.4-77.4 |
| Stillbirth | | | | | | | | | | | | - |
| Relevant Z37 codes¥¥, or O36.4 or O31.2 | 239 | 7.4 | 255 | 7.9 | 89.4 | 88.3-90.5 | 27 | 0.8 | 11 | 0.3 | 95.4 | 94.7-96.1 |
| Relevant Z37 codes + P95 | 239 | 7.4 | 391 | 12.0 | 60.6 | 58.9-62.3 | 154 | 4.7 | 2 | 0.1 | 99.2 | 98.9-99.5 |
| Tranfer in utero | 61 | 1.9 | 30 | 0.9 | 56.7 | 55.0-58.4 | 13 | 0.4 | 44 | 1.4 | 27.9 | 26.4-29.4 |

PPV (Positive predictive value), FP (false positives), FN(false negatives), CI(confidence Interval) ; * Missing Data (MD) – 309 ; ** MD=24 ; *** MD<10

¥ codes O60.0, O60.1, O60.2, O47.0 ; ¥¥ codes Z37.1, Z37.3, Z37.4, Z37.6, Z37,7

The pregnancy-related disorders are presented in Table 1. The concordance rate of gestational age at delivery was 91.8% [90.9-92.7]. Rounding up or down to the nearest whole number of WG (< 1 week), the concordance rate increased to 98.3%.

The indicators of delivery are presented in Table 1. Regardless of the algorithm explored, the PPV for vaginal delivery was over 99%. In order to select severe postpartum hemorrhage, we explored advanced interventional procedures which indicated a second-line therapy (arterial embolization, uterine or hypogastric artery ligation, hemostasis hysterectomy).

The concordance rate between the vital status and the diagnosis codes for stillbirth from newborn discharge abstracts was 95.4% [94.7-96.1] for singleton pregnancy. For multiple pregnancies, the rate was 99.7% for the first- or the second-birth child, and 100% for the third-born child.

### *3.2. Newborn indicators*

The concordance rate of newborn weight was 91.3% [90.3-92.3] in singleton pregnancy. The rate was 79.1% [70.5-87.5] for first- and second-born in cases of multiple pregnancies. As regards the first-born child, the median gap between the newborn weight mentioned in the medical record and the weight specified in the discharge abstract was 100g.

## 4. Discussion

### *4.1. Main findings*

Our study has shown that the French hospital perinatal discharge abstracts database, when compared with hospital medical records (our gold standard), regarding parturient women, pregnancy and delivery is highly accurate. Gestational diabetes had a higher metrological quality than the other types of diabetes. Several algorithms were studied using the data of hospital stay during pregnancy or during delivery. They did not improve the identification of women who had gestational diabetes. The algorithm including one of two gestational diabetes diagnosis codes (O24.4, O24.9) from the hospital stay of delivery remains the most performant. The algorithms for stillbirths and termination of pregnancy for medical reasons were found to be accurate.

### *4.2. Strengths and limitations*

Our national study included maternity units of all types and all volumes of deliveries. Moreover, in France almost all deliveries occur in a hospital. We explored a large number of perinatal indicators: 70 items were collected for each hospital stay by a single technician specialized in clinical studies. Some limitations also have to be acknowledged. The data collection was performed by a technician, perfectly trained, but not by a health professional. The maternity units included in our study were geographically not distributed uniformly throughout the French territory. It is very important to assess the data quality in case-finding algorithms so that the design of an envisaged study can be adjusted according to the quality of data (4,8). Our results suggest that it seems possible and worthwhile to conduct studies on women with a history of gestational diabetes. The use of a complementary French database for ambulatory care (treatment, biology) has been suggested as a means to identify women with gestational diabetes or pre-existing diabetes, but it is necessary to assess the data

quality of this algorithm (9,10). The quality of the French hospital database for stillbirth and medically indicated abortion was high. Thus, it seems possible to use these two indicators not only for descriptive studies, but also for longitudinal studies.

## Conclusion

This first national validation study of a large set of perinatal algorithms has shown that French hospital database is an appropriate data source for subsequent epidemiological studies. The choice of the algorithm may vary, depending on the aim of the study. Nevertheless, the data quality of the algorithms should be taken into account to define the design of the study.

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