Hospital discharge data can be used for monitoring procedures and intensive care related to severe maternal morbidity.

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Abstract

Objective: To estimate the accuracy and reliability of the reporting of diagnoses and procedures related to severe acute maternal morbidity in French hospital discharge data.

Study design and setting**:** The study, conducted in four French tertiary teaching hospitals, covered the years 2006 and 2007 and 30,607 deliveries. We identified severe maternal morbid events – eclampsia, pulmonary embolism, procedures related to postpartum hemorrhages, and intensive care – in administrative hospital discharge data and medical records and compared their recording. Information from medical records was the gold standard. Sensitivity, specificity, positive and negative predictive values of the hospital discharge data for these events were calculated. False positives and false negatives were examined to identify the reasons for misrecorded information.

Results**:** The positive predictive value of the hospital discharge data was 20% for eclampsia. For procedures related to postpartum hemorrhages, their positive predictive values were high, but sensitivities were lower; however, 95% of recording errors could be corrected. All indicators for intensive care exceeded 98%.

Conclusion**:** Intensive care and procedures seem reliably reported in the hospital administrative database, which therefore can be used to monitor them. Use these data for monitoring diagnoses will require a greater investment by clinicians in the accuracy of their reporting.

Key words**:** Severe maternal morbidity - Hospital discharge data – Validity – Sensitivity - Positive predictive value - Medical records.

Running title: Validity of obstetric hospital discharge data.

Word count: *200 words.*

What is new ?

- Key finding

Intensive care and procedures for postpartum hemorrhages seem reliably and accurately reported in the hospital discharge database.

- What this adds to what we know?

Hospital discharge data could be used for monitoring several events related to severe maternal morbidity.

- What should change now?

Monitoring diagnoses in hospital discharge databases will require a greater investment by clinicians in the accuracy of their reporting and regular internal quality controls.

Introduction

Hospital administrative databases are a useful tool for measuring hospital activity [1]. They are employed to define health priorities, assess the costs of providing health care, and optimize the organization of healthcare facilities [2,3]. For some 20 years, these routinely collected data have also been used for research purposes to measure disease incidence [4,5] or procedure frequencies, assess the rate of complications of hospitalizations or surgery [6,7] and identify the determinants of medical conditions [8-10]. The validity of these data depends simultaneously on the reliability of the information recorded and the accuracy of their coding at different stages of processing. Studies to validate hospital administrative data in the United States [11,12], Canada [6], Australia [9,10,13] and Scandinavia [5,14,15] have generally concluded that they can be used, but underline their numerous limitations, including substantial inter-facility variability in coding quality [16-19], better coding for more serious complications and diseases [7,20], and better recording of procedures than diagnoses [16,21,22]. Most reports on the validation of these data come from English-speaking countries. They are relatively sparse in Europe. Such studies in France have covered the fields of oncology [4,10,23,24], intensive care [25] and vascular disease [26], but not obstetrics.

Routine childbirth in France takes place within the hospital system. Although no disease is present in most obstetric hospitalizations, a non-negligible but unknown number involve complications of pregnancy, delivery or the postpartum period. Today, changing trends in obstetric practices and in maternal profiles require the development of indicators that can measure and monitor severe maternal morbidity.

Hospital databases are a potential tool for estimating the frequency of severe maternal morbidity and following its trends over time because women with such morbidity are always hospitalized and administrative records are supposedly exhaustive, rapidly available and

inexpensive to use. However, before this information can be used, its validity must be assessed.

Several studies in Australia and in the USA sought to validate hospital discharge data for numerous obstetrical complications (as many as 50) [13], or on the contrary, have concentrated on only one or two [20,27,28]. Because there is no consensual definition for severe maternal morbidity, we focused on the severe maternal morbid events (SMME) that are the most frequent causes of maternal mortality [29-31].

Our objective was to study the validity of French hospital discharge data from the Programme of Medicalization of Information System (PMSI) for some SMME. More specifically, our aim was to evaluate whether the SMME were transcribed in the PMSI as they were described in the medical records.

Material & methods

PMSI

Inspired by the American DRG (diagnosis-related groups) model [2], the PMSI was established in France in 1991 [3] and extended in 1997 to all French healthcare facilities [32]. Initially designed to analyze hospital activity and contribute to the strategic elaboration of facility plans, it has become an instrument of financial management. Since 2008, each hospital's budget has depended on the medical activity described in this PMSI [33], which compiles discharge abstracts for every admission. Information in these abstracts is anonymous and covers both administrative (age, sex, geographic code of residence, year, month and type of admission, year, month, and type of discharge, facility status) and medical data. Diagnoses identified during the admission are coded according to the 10th edition of the International Classification of Diseases (ICD10). The condition occasioning the greatest use of resources during the hospitalization is recorded as the main diagnosis, with other diseases listed as associated diagnoses [34]. All procedures performed during the hospitalization are coded according to the French Common Classification of Medical

Procedures (CCAM). PMSI rules are national and imposed by the government. Each facility produces its own anonymous standardized data, which are then compiled at the national level. Our validation study was conducted on this PMSI database.

Selection of the study population

First, PMSI abstracts from the four study hospitals (Caen, Cochin [AP-HP, Paris], Grenoble and Lille, university hospitals) were extracted from the national database. Then, we selected hospitalizations of women of reproductive age (14 to 50), with at least one code related to pregnancy, delivery, or the postpartum period, and who were discharged from 1 January 2006 through 31 December 2007 (Figure 1). Women who did not give birth in one of the study hospitals were excluded because the content of their medical records was incomplete.

Selection of hospitalizations

Within the selected PMSI database (= 64,061 abstracts), we identified abstracts including at least one of the following SMME: diagnosis of eclampsia; diagnosis of pulmonary embolism; one of the following procedures for treating postpartum hemorrhages: uterine artery embolization, uterine artery ligation, uterine vascular pedicle ligation, or hysterectomy; or finally, intensive care. In the PMSI, the intensive care variable is defined by admission to intensive care unit and/or a simplified acute physiology score (SAPS II) ≥ 15 associated with at least one specific procedure. The hospitalizations were selected from the PMSI by searching for specific codes for each of these SMME (figure 1) which occurred during the whole maternal risk period as defined by the WHO (pregnancy, delivery and post-partum).
When several abstracts described the same event for the same woman, the event was counted only once.

Validation of the PMSI recorded data

The medical record was considered to be the gold standard. The term or name of each of the SMME under study was used to search for it in the medical records.

The SMME identification in the medical records was made possible by querying an additional database: the database of computerized medical records available in all four centers. For 2006-2007, 30,614 deliveries were recorded in this database. In centers 1 and 3, the medical records and computerized medical records were combined. In centers 2 and 4, the computerized records consisted of a complementary database where information was entered daily by clinicians during hospitalization. SMME were identified in the computerized databases by searching for their terms.

This computerized medical records database has been linked with the database extracted from the PMSI using the following variables: patient's age, month and type of admission to hospital, month and type of discharge, length of stay and geographic code of residence.

The cases selected from the PMSI were compared with the data from the matching medical records. This comparison involved a simple reading of the source medical record with all its components: discharge letters (to referring and primary care physicians), nursing records, hospital and surgical reports. Specifically, we did not interpret any examinations or judge any diagnoses. The SMME we sought was either specifically mentioned in the record or it was not.

The true positives were the SMME identified simultaneously in the PMSI abstracts and in the corresponding medical records. Inversely, false positives were events recorded in the PMSI that did not exist as such in the patients' records.

False negatives were the SMME experienced by patients and listed in their medical records, but not reported in the PMSI. On the contrary, true negatives corresponded to all the situations in which no SMME was listed in either the patient's record or the PMSI abstract.

The causes of both false positives and false negatives were further analyzed by reading the complete medical chart and examining all the codes of the hospital discharge abstract.

The National Data Protection Authority (Commission Nationale de l'Informatique et des Libertés) approved the study (n° 1004749).

Statistical analyses

To estimate the accuracy and reliability of the PMSI database for the SMME studied, we analyzed sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the PMSI data relative to the source medical records.

Sensitivity was the probability that PMSI data correctly identified a woman with a SMME; specificity was the probability that PMSI data correctly identified a woman with no SMME. The PPV corresponded to the probability that a woman had a SMME given that SMME was also coded in the PMSI. The NPV, on the other hand, was the probability that a woman had not a SMME given SMME was also not coded in the PMSI.

Cohen kappa scores were calculated to assess the degree of agreement between the two databases, taking random agreement into account. The Kappa score proposes a neutral description of the agreement between the two data sources for each event, without attributing more importance to the database serving as a reference for the other analyses. Excellent agreement was defined as a score greater than 0.80, substantial from 0.80 to 0.60, moderate from 0.59 to 0.40, and poor below 0.40 [35]. Confidence intervals (CI) were determined with a type I risk of 5%.

Results

For 2006-2007, among the 64,061 PMSI abstracts, 1,022 abstracts identified an SMME. After the study of duplicates, 403 single SMME were identified in the PMSI.

In the PMSI, the three most frequent SMME were, in decreasing order: intensive care, eclampsia, and embolizations (Table 1). Comparison with the content of the corresponding medical files validated 314 SMME of the 403 identified in the PMSI. After validation, the order of frequency was modified, and eclampsia moved from the second most frequent event in the PMSI to the least frequent.

Considering the study population of 30,614 women who delivered during the study period, the analysis of the false positives and false negatives in the PMSI showed three distinct situations: a high proportion of false positives for diagnoses, false negatives for procedures, and few false positives or negatives for intensive care (Table 1).

The rate of false positives was 80% for eclampsia. Analysis of the medical records failed to validate 67 of the 84 cases of eclampsia identified in the PMSI. Similarly, 36% of the pulmonary embolisms, that is, 11 of 31 recorded in the PMSI, were not confirmed in the medical records.

There was only one case of false positive for postpartum hemorrhage procedures, for 1 of the 34 ligations mentioned in the PMSI. However, the proportion of false negatives for procedures was 44% for embolizations and 25% for hysterectomies and ligations. Overall, 56 embolizations, 8 hysterectomies and 11 ligations were not identified in the PMSI.

The PMSI and the medical records listed the same number of cases receiving intensive care, although there were three false positives and three false negatives.

For seven SMME identified in the PMSI, the corresponding computerized file was empty, and the accuracy of the information could not be checked. Consequently, these cases could not be classified as either true or false positive, and their status is described as “uncertain” (Table 1). This concerned five eclampsia and two embolisations.

The analysis of the content of medical records showed that the false positives for eclampsia in the PMSI corresponded to less severe situations, such as preeclampsia, isolated gestational hypertension or isolated proteinuria. The study of the PMSI false negatives for procedures found that 95% of them (71/75) were due to inappropriate coding of procedures for postpartum hemorrhage management that were mentioned in the PMSI but with codes not specific to the postpartum period. For example, medical records reported emergency hysterectomies for massive postpartum hemorrhage, whereas the corresponding PMSI abstract coded for a planned hysterectomy in a non-obstetric context (CCAM code JFKA015 instead of JNFA001). Another frequent error was miscoding of embolization of uterine

arteries for postpartum hemorrhage as embolization conducted as a preoperative phase for oncologic surgery, outside of pregnancy.

Table 2 presents the values of the indicators calculated for the PMSI, with the medical records as the reference, by type of SMME.

Because the PMSI had numerous false positive errors for eclampsia, its PPV for this disease was low, only 20%. Its PPV for pulmonary embolism was 65%. On the contrary, the PMSI was highly sensitive for these diagnoses, respectively, 85% and 83%. Inversely, the PPVs of the PMSI for procedures were very high, ranging from 97% to 100%, although values for sensitivities ranged from 56% to 75%, reflecting the false negative errors found in the preceding analysis. We considered these false negatives for procedures rectifiable since the context of pregnancy/delivery could be identified through other codes contained in the PMSI abstracts. In consequence, we secondarily considered these records as true positive cases of SMME in PMSI, and recalculated revised estimates for the validity indices (Table 2).The revised sensitivities of the PMSI exceeded 95% for embolizations as for ligations, and reached 100% for hysterectomies.

For intensive care, the sensitivity, specificity, PPV and NPV of the PMSI all exceeded 98% and the kappa score was close to 1.

Sensitivity analyses were conducted to evaluate the impact on the calculated indicators of the seven PMSI SMME cases for which the accuracy of information could not be checked in the medical records, and showed similar results.

The results by center point out two particular situations (Table 3). In centers 1 and 2, the sensitivity, specificity, PPV and NPV of the PMSI data were greater than 80% for identifying SMME. On the other hand, SMME were recorded less accurately in centers 3 and 4. In center 3 where most of the mis-coding errors for embolizations were found, the sensitivity of the PMSI data greatly improved after correction of these codes. In center 4, the sensitivity of the PMSI data also improved after correction of procedures codes not specific to the

obstetrical context, but its 57% PPV reflected the large number of false positives found for cases of eclampsia in this facility.

Discussion

This validation study of French hospital discharge database for severe maternal morbidity shows a various quality of data according to the types of event and centers. The PMSI appears to overreport diagnoses, although procedures are reported correctly on the whole. PMSI reporting of intensive care is very reliable. Two hospitals correctly transcribed their SMME data in hospital discharge abstracts, whereas two others require improvements: one for false negatives, the other because of false positives.

Our study has several limitations. First, there is no consensual definition of severe maternal morbidity. Our selected SMME do not cover all types of maternal morbidity, but they do cover those that are the most frequent causes of maternal deaths [29-31]. In addition, our combination of events makes it possible to analyze the validity of various types of hospital data, namely diagnoses, procedures and management codes.

The type of hospitals selected might have resulted in selection bias. All are tertiary teaching hospitals, chosen because they treat the most severe cases of maternal morbidity in their regions. Even though SMME are, obviously, not exclusive to these tertiary hospitals, this type of facility, which concentrates SMME, remains best for an initial study of PMSI validity related to severe maternal morbidity, given the low expected frequency of these events. Hsia *et al.* showed in a different context and field that data from small non-university hospitals are not reliable [11]. Inversely, Iezzoni *et al.* argued that level III hospitals, because they handle more complex cases, face greater difficulties in coding and may thus make more frequent errors [17]. In the obstetric field, Lydon-Rochelle *et al.* [36] found that type II maternity units (average size and able to care for moderately serious situations) have the most reliable

hospital discharge databases. Di Giuseppe *et al*. found no difference in data validity according to hospital size in a study of 20 maternity units [37].

The number of centers included in our study is small, and each has its own organization regarding collection and coding of hospital discharge data. Despite the national rules for treatment of these medical data, the quality of their PMSI differed. In our study, it is not the PMSI data processing system that seems inappropriate for dealing with severe maternal morbidity, but rather the rigor and quality of its application within each facility. This limitation prevents us from generalizing our results to the national level. However, this issue is less relevant for intensive care because the great majority of intensive care units are located in teaching hospitals; moreover, the intensive care variable is less error-prone due to its particular coding rules.

Our objective was to study the validity of the PMSI database for some SMME. More specifically, our aim was to know how accurately the PMSI database reflected diagnoses made and procedures performed by the team in charge of the case. In that context, we did not reinterpret a posteriori the whole medical information like other authors did [6-14,16,17,22,27,38-40], but we evaluated whether the SMME were transcribed in the PMSI as they were described in the medical records. Therefore, our study is based on the comparison of existing records, and the gold standard is represented by the diagnoses which justified and generated a specific management. In a different perspective, a study assessing the accuracy of diagnoses recorded in a series of randomly selected source medical files, by using a blinded recoding by experts would provide complementary information.

The use of computerized medical files was required to search easily and inexpensively for SMME that were described in records but not reported in the PMSI (false negatives). In half of the centers (n°1 and 3), these computerized medical files were the actual entire and only medical record. The search for false negatives in the PMSI was thus possible and even easy. In the other two centers (n°2 and 4), the computerized medical files were a supplementary document, completed bit by bit by the clinicians during the course of the hospitalization, and

verified daily by midwives specifically assigned to this function. They might therefore be considered a relevant source for false negatives searching. Our method therefore simplified the study of false negatives and allowed us to estimate the validity of PMSI coding for the SMME in a large sample of more than 30,000 deliveries. Nonetheless, it is possible that some SMME were not entered in the source medical record or in the computerized files. These false negatives may not have been identified, their number may have been underestimated, and consequently the sensitivities overestimated. It would have been possible to randomly sample hospitalizations to estimate the false negative rate in the medical records. Because SMME are rare events, however, to be valid, this method would have had to include a very large sample. The cost/benefit ratio of such a study appeared quite negative to us, and we did not chose this option.

However, in the two centers with complementary computerized medical files, midwives daily verify all the information reported in the computerized medical records, thereby minimizing the risk of errors and oversights. In addition, according to Altman, serious events are seldom forgotten during coding [41]. Thus, although this bias should be borne in mind, it is likely to remain marginal.

The analyses of the diagnoses in the PMSI show that their coding validity is poor. The numerous false positives indicate that diagnoses are overreported in the discharge abstracts. The low PPV of the PMSI for eclampsia — 20.2% — means that in this database, most so-called eclampsia cases are not. Detailed examination showed that these cases were instead severe preeclampsia or HELLP syndrome. Such coding errors are not unusual. Other authors have found PPVs for eclampsia in hospital databases ranging from 23.5% in an Australian multicenter study [13,39] to 41.7% for single-center study in Chicago [28], and 50% for a statewide validation in Washington [36].

Several factors may explain the overreporting or upcoding of diagnoses in hospital databases. First, the large variety of participants of diverse skill levels involved in coding leads to heterogeneity in the quality of the medical information [15,18,36,40,42,43]. Second,

the most serious cases, which involved the mobilization of the entire medical team, may be overcoded to indicate the seriousness of situation [39,40,44,45]. Finally, the payment system based on severity of diagnosis is a strong incentive to overcoding, that is, it increases remuneration for the hospital [11,43,46,47]. Our study confirmed these hypotheses for eclampsia and pulmonary embolisms. Coding at all four hospitals was routinely performed by employees with widely heterogeneous skill levels and with little or no training in this quite particular task: nurses, midwives, interns, residents, and sometimes even secretaries or students. Also in all centers, the cases of severe preeclampsia or deep venous thrombosis overcoded as eclampsia or pulmonary embolism corresponded to cases with prolonged hospitalizations or severe illness that required major and expensive treatment.

On the other hand, the high positive predictive value of the PMSI data for procedures indicates that these are not overreported. Analysis of the procedures does not show false positives but rather some false negatives, indicating moderate underreporting of their true number in the PMSI. The sensitivity of the PMSI for the procedures therefore varies. It is relatively elevated for hysterectomies and ligations (close to 75%), but lower (56%) for embolizations. An Australian multicenter study on the validity of administrative databases found a sensitivity of 28.3% for hysterectomy data in the context of postpartum hemorrhage and attributed this result to specific coding errors [13,20]. The quality of reporting is better in our study, but the same type of errors is still present. These errors, first mentioned in the 1990s [12,42-44] and reported still today [20,22], are the consequence of using a classification that is ever more specific and increasingly complicated Coding becomes extremely time-consuming, thus inciting physicians to record procedures in the hospital databases with the code they use most often, even though perfectly appropriate codes exist for the specific situation. A similar problem is seen with the use of the "thesaurus", a summary of codes of procedures performed regularly in the department, which facilitates coding, but does not describe rare and severe situations correctly [22,42]. Demlo [44,45]

predicted this type of problem at the implementation of the system of health-related administrative databases in the United States in the early 1980s.

In our study, most of these false negatives could be easily identified because the hospital discharge summaries with the non-specific procedure code also contained codes indicating the context of pregnancy/delivery. In consequence, such a correction could be introduced in routine, Overall, the high PPV and sensitivity of the PMSI for most of the procedures studied indicates that their coding is relatively valid and that errors are rectifiable. In these conditions, it appears acceptable to us to monitor their frequencies from the PMSI.

Our findings are consistent with those from international studies that validated similar types of databases. In obstetrics as in other field, the coding in hospital databases is more reliable for procedures than for diagnoses [16,19-22,38]. This research appears to us to be an essential prerequisite to any use of administrative databases. Nonetheless, because they are easy to access, they are regularly used in hospital departments for research purposes, without validation. Erroneous data leading to biased results, incorrect conclusions and thus flawed proposals cannot improve either quality of care or patient health. Like Pollock and Hadfield [10,48], we hope that other teams across the world will make an effort to validate their hospital administrative data, especially in the field of severe maternal morbidity, to facilitate comparisons between countries.

An original aspect of our study is to have sought to validate the coding for intensive care in hospital data. Their sensitivity, specificity, PPV and NPV in the PMSI are very high (>98%). Related PMSI data are both accurate and reliable. In obstetrics, such intensive care can therefore be used as a marker of the severity of maternal morbidity, and our results are the first to show its validity.

Our study is one of the first to estimate the validity of hospital administrative databases in Europe [15,19,26]. Although the only moderate validity of the hospital data means that

research cannot be based exclusively on them, it appears likely that the system in France will improve. Because the reimbursement of medical services is directly correlated with PMSI data, the national health insurance fund is multiplying external audits to identify coding errors and overcoding. Facilities where abuses are identified will be required to reimburse payments for unjustified services. The increase in these external quality controls, in addition to the internal controls organized by the hospitals, should surely lead to improvements in data quality.

Conclusion

Hospital discharge data can be used for monitoring the frequencies of procedures for postpartum hemorrhages and intensive care related to severe maternal morbidity. The utilization of PMSI data about diagnoses will require a greater investment by clinicians in the accuracy of their reporting and regular internal quality controls.

Count of words : 4,013 words.

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Titles of figure and tables:

- **Figure 1** - Algorithm for selection of the PMSI abstracts

- **Table 1** - Severe maternal morbid events (SMME) identified in the PMSI database and in the medical records, 4 centers, 2006-2007: number, false positives and false negatives *.
- **Table 2** - Validity of the PMSI data for severe maternal morbid events (SMME): kappa score, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) *.
- **Table 3** - Validity of the PMSI data for severe maternal morbid events (SMME), per center: sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) *.

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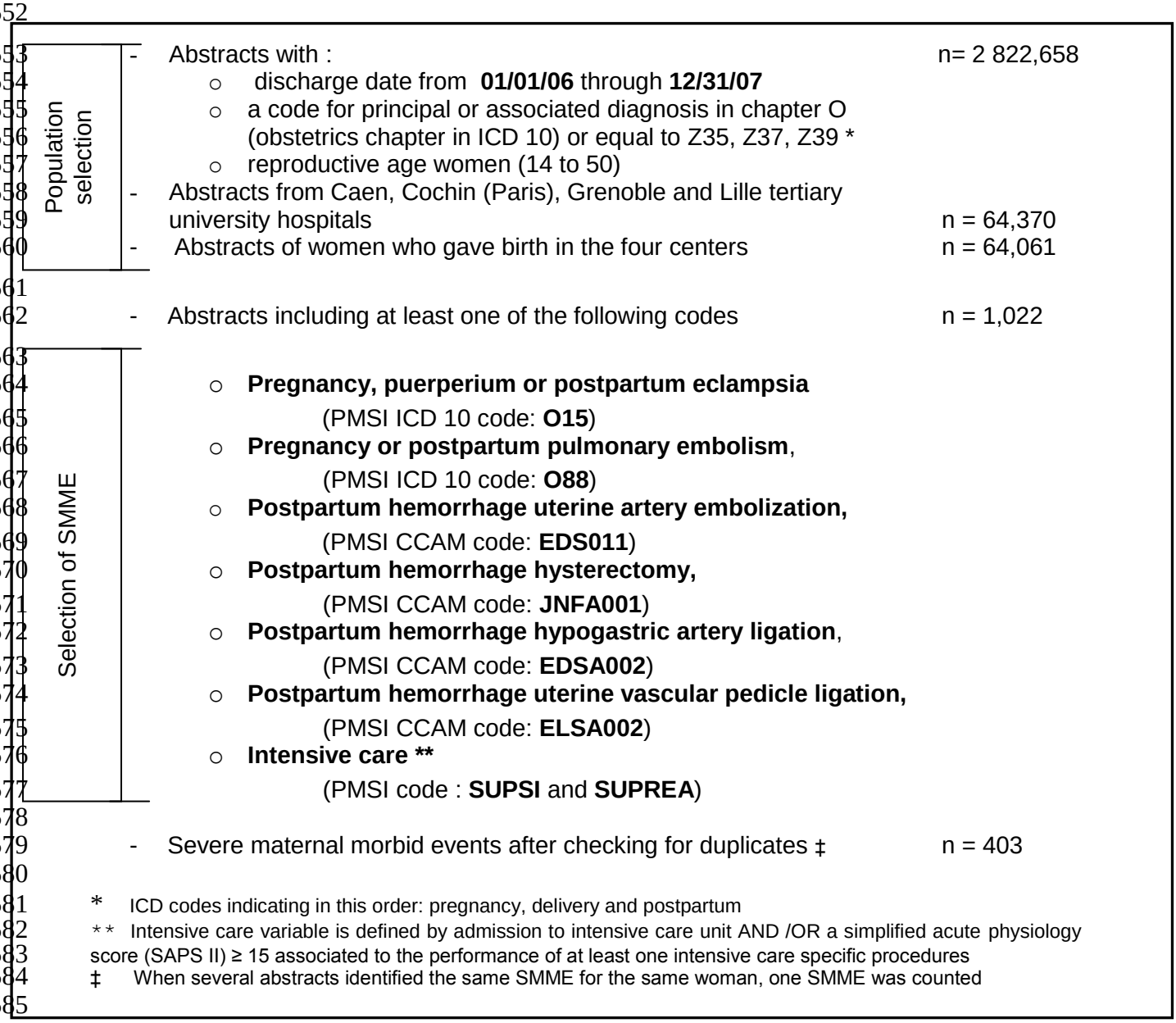
Figure 1- Algorithm for the selection of the PMSI abstracts



* ICD codes indicating in this order: pregnancy, delivery and postpartum

** Intensive care variable is defined by admission to intensive care unit AND /OR a simplified acute physiology score (SAPS II) ≥ 15 associated to the performance of at least one intensive care specific procedures

‡ When several abstracts identified the same SMME for the same woman, one SMME was counted

Table 1 - Severe maternal morbid events (SMME) identified in the PMSI database and in the medical records, 4 centers, 2006-2007 : number, false positives and false negatives *.

	Single SMME identified in PMSI	SMME in medical records	SMME identifed in PMSI and validated in medical records	False-positives	False-negatives	Uncertain status
	n (%)	n (%)	n (%)	n	n	n
Total	403 (100%)	399 (100%)	314 (100%)	82	85	7
Eclampsia	89 (22)	20 (5)	17 (5)	67	3	5
Pulmonary embolism	33 (8)	24 (6)	20 (6)	11	4	2
Uterine artery embolization	72 (18)	128 (32)	72 (23)	0	56	-
Hysterectomy	23 (6)	31 (8)	23 (7)	0	8	-
Uterine artery and pedicle ligation	34 (8)	44 (11)	33 (11)	1	11	-
Intensive care	152 (38)	152 (38)	149 (48)	3	3	-

* on the basis of 30,614 deliveries, medical record as reference.

Table 2 - Validity of the PMSI data for severe maternal morbid events (SMME): kappa score, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) *.

	Kappa	Sensitivity % [95% CI]	Specificity % [95% CI]	PPV % [95% CI]	NPV % [95% CI]
Eclampsia	0,33	85,0 [69,3-100,0]	99,7 [99,6-99,8]	20,2 [11,6-28,8]	99,9 [99,9-100,0]
Pulmonary embolism	0,73	83,3 [68,4-98,2]	99,9 [99,9-100,0]	64,5 [47,6-81,3]	99,9 [99,9-100,0]
Embolization	0,72	56,2 [47,6-64,5]	100,0 -	100,0 -	99,8 [99,7-99,8]
*revised results **	*0,98*	*95,3 [91,6-98,9]*	*100,0* -	*100,0* -	*99,9 [99,8-100,0]*
Hysterectomy	0,85	74,2 [58,8-89,6]	100,0 -	100,0 -	99,9 [99,9-100,0]
*revised results **	*1*	*100,0* -	*100,0* -	*100,0* -	*100,0* -
Ligation	0,84	75,0 [62,2-87,8]	99,9 [99,9-100,0]	97,6 [92,4-100,0]	99,9 [99,9-100,0]
*revised results **	*96,5*	*95,5 [89,4-100,0]*	*99,9 [99,8-100,0]*	*97,7 [93,2-100,0]*	*99,9 [99,8-100,0]*
Intensive care	0,99	98,0 [95,8-100,0]	99,9 [99,9-100,0]	98,0 [95,8-100,0]	99,9 [99,9-100,0]

** 4 centers, 2006-2007, on the basis of 30,607 deliveries, medical record as reference.*

*** : revised results after correction of procedure codes not specific to the obstetrical context*

Table 3 - Validity of the PMSI data for severe maternal morbid events (SMME) per center: sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) *.

	Deliveries	Single SMME in PMSI	Sensitivity	Specificity	PPV	NPV
	n	n	% [95% CI]	% [95% CI]	% [95% CI]	% [95% CI]
All centers	30 607	396	78,7 [74,6-82,7]	99,7 [99,6-99,8]	79,3 [75,3-83,3]	99,7 [99,6-99,8]
*revised results **		*465*	*96,7 [94,9-98,4]*	*99,7 [99,6-99,8]*	*83,0 [79,6-86,4]*	*99,9 [99,9-100,0]*
Center 1	6555	74	97,3 [93,6-100,0]	99,9 [99,8-99,9]	97,3 [93,6-100,0]	99,9 [99,8-99,9]
*revised results **		*74*	*97,3 [93,6-100,0]*	*99,9 [99,8-99,9]*	*97,3 [93,6-100,0]*	99,9 *[99,8-99,9]*
Center 2	10 486	126	84,4 [78,4-90,4]	99,9 [99,8-100,0]	94,4 [90,4-98,4]	99,8 [99,7-99,9]
*revised results **		*141*	*95,0 [91,4-98,6]*	*99,9 [99,8-100,0]*	*95,0 [91,4-98,6]*	*99,9 [99,8-100,0]*
Center 3	3970	38	51,5 [39,4-63,6]	99,9 [99,8-100,0]	89,4 [79,6-99,2]	99,2 [98,9-99,5]
*revised results **		*70*	*97,0 [92,9-100,0]*	*99,9 [99,8-100,0]*	*94,2 [88,7-99,7]*	*99,9 [99,8-100,0]*
Center 4	9596	158	75,4 [67,6-83,2]	99,3 [99,1-99,5]	57,4 [49,6-65,2]	99,7 [99,6-99,8]
*revised results **		*181*	98,3 *[95,9-100,0]*	*99,3 [99,1-99,5]*	*63,5 [56,5-70,5]*	100,0 -

** 4 centers, 2006-2007, on the basis of 30,607 deliveries, medical record as reference.*

*** : revised results after correction of procedure codes not specific to the obstetrical context*