



MATERNAL DEATHS IN FRANCE: BETTER UNDERSTANDING FOR BETTER PREVENTION

6th report of the National Confidential Enquiry on
Maternal Mortality (ENCMM) 2013-2015*

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Abstract

Maternal mortality in France: better understanding for more effective prevention

Report of the National Confidential Enquiry into Maternal Deaths (ENCMM) 2013-2015

For the period 2013-2015, 262 maternal deaths occurred in France, one every four days each year in France from a cause related to pregnancy, childbirth or their consequences, i.e a maternal mortality ratio (MMR) of 10.8 deaths up to one year, and a MMR of 8.1 deaths up to 42 days per 100 000 live births, which is stable compared to the previous period of 2010-2012, and averages the rate observed in European countries. However, 58 % of these deaths are considered "preventable", and in 66 % of cases the care provided was not optimal, indicating room for improvement.

Some inequalities in maternal mortality remain unchanged. There are territorial disparities -the maternal mortality ratio in the French overseas departments is 4 times higher than in metropolitan France-, and social disparities -the mortality of migrant women remains higher than that of women born in France, particularly for women born in sub-Saharan Africa whose risk is 2.5 times higher than that native women.

A striking result of the 2013-2015 period is the preponderance of cardiovascular diseases and suicides, the two leading causes of maternal mortality, each responsible for approximately one death per month. Another important result is the continued decrease in mortality from obstetric hemorrhage, halved in 15 years, particularly the decrease in fatal hemorrhages due to uterine atony.

Beyond these figures, the authors identified 30 key messages from the analysis of all maternal deaths in France in 2013-2015. According to the general principle of the survey, "better understanding for more effective prevention", they target aspects of the content or of the organization of health care which are involved in the preventability of these deaths and can be improved, and that have been repeatedly identified in this series of stories both unique and exemplary.

KEY WORDS: MATERNAL MORTALITY; MATERNAL HEALTH; PERINATAL HEALTH; EPIDEMIOLOGICAL SURVEY; SURVEILLANCE; AUDIT; QUALITY OF CARE; FRANCE

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Abbreviations

AD	Aortic dissection
BMI	Body mass index
CepiDc	Center for the epidemiology of causes of death
CNEMM	National Expert Committee on Maternal Mortality
CT	Computed tomography (scanner)
ECG	Electrocardiogram
ECMO	Extracorporeal membrane oxygenation
ED	Emergency department
EMS	Out-of-hospital emergency medical services (ambulance, firefighters, etc)
ENCMM	National confidential enquiry on maternal mortality
EPOPé	Obstetric, perinatal, and pediatric epidemiology (Inserm)
ESPIC	Private health care establishment of collective interest
GHU	University hospital group
GP	General practitioner
HAS	French national authority for health
IADE	Registered nurse-anesthetist
IBODE	Registered operating room nurse
ICD	International Classification of Diseases
INSEE	National institute of statistics and economic studies (Institut national de la statistique et des études économiques)
INSERM	National institute for health and medical research (Institut national de la santé et de la recherche médicale)
InVS	Institute of public health surveillance (now a component of SPF)
LBs	Live births
LF	Low flow (period of low cardiac output generated by cardiac massage (between the beginning of the massage and recovery of cardiac activity))
LVEF	Left ventricular ejection fraction
MAR	Medically assisted reproduction
MMR	Maternal mortality ratio
NPS	National perinatal survey
PAHT	Pulmonary artery hypertension
PPCM	Peripartum cardiomyopathy
PMI	Maternal and child protection program
RHC	Regional hospital center
SAD	Sudden adult death
SAH	Subarachnoid hemorrhage
SAMU	A French out-of-hospital mobile emergency medical service
SBP	Systolic blood pressure
SFAR	French Society of anesthesiology and resuscitation
SGA	Small-for-gestational-age
SMD	Sudden maternal death
SMUR	French out-of-hospital mobile emergency and resuscitation service
TOP	Medically-indicated termination of pregnancy
UCDI	Unit for the collection of disturbing information
UHC	University hospital center
WHO	World Health Organization
Zero Flow	Period with no cardiac output (between collapse and the start of cardiac massage)

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Foreward

From 2013 through 2015, 87 women in France died each year of causes related to pregnancy, childbirth, or their sequelae, and more than half of these deaths could have been avoided. The analysis of these serious but rare events makes it possible to describe the care pathway, identify the aspects of care that can be improved, and the priorities for action: cardiovascular health and mental health.

The changes observed point out the need to reinforce — always and more — actions of health promotion and prevention from a young age, before procreation, to prevent these risks. It is accordingly essential to promote in particular a balanced diet and physical activity to limit the development of overweight and obesity in young women, to combat early smoking and support the cessation of the use of tobacco and other addictive substances, but also to develop their psychosocial and stress management skills to enable not only physical but also mental well-being.

Public Health France (Santé publique France) works in these different fields to support future and young parents in their desire to create a favorable environment for their child while taking into account the challenges posed by social and geographic inequalities.

Because all future mothers are not equal against the risk of maternal mortality, this report reminds us that the women living in the overseas districts still have a risk of maternal mortality 4 times higher than that of women in metropolitan France. The objective of the national 2018-2022 health strategy is to reduce geographic inequality in these districts, where economic difficulties and high prevalence rates of chronic disease are concentrated.

The histories of these women who died recount other vulnerabilities as well. The mortality of migrant women born in sub-Saharan Africa is 2.5 times that of women born in France. This may result from social disadvantages and low literacy, in the broad sense of the term, or in health or digital skills, from ethnic discrimination or other issues... all factors whose mechanisms of action must be better understood to better combat them. To this is added the question of the psychological vulnerability brought to light by a detailed analysis of the deaths by suicide, performed for the first time in this new report. Maternal mental health thus appears here in its most severe and most tragic dimension. Beyond these dramatic situations, a substantial proportion of women face psychological difficulties during pregnancy and postpartum. The 2021 national perinatal survey (NPS) and the Epifane study will make it possible to quantify more precisely the burden of postpartum depression and describe its trajectories. It is essential to pay special attention to women's mental health during their pregnancy and postpartum, and when necessary, to set up appropriate care for them. In its report, the Committee for the first 1000 days forcefully underlined the need to support parents before, during, and after pregnancy to promote their child's harmonious development. Public Health France thus remains more than ever mobilized to contribute to the good health of mothers.

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Online Resources

Agir pour bébé

<https://www.agir-pour-bebe.fr/>

Étude nationale [Épifane 2011-2013](#) (Épidémiologie en France de l'alimentation et de l'état nutritionnel des enfants pendant leur première année de vie)

<https://www.santepubliquefrance.fr/etudes-et-enquetes/epifane-2021>

Enquête nationale périnatale

<https://enp.inserm.fr/>

Rapport des 1 000 premiers jours

<https://solidarites-sante.gouv.fr/affaires-sociales/familles-enfance/pacte-pour-l-enfance/1000jours/article/le-rapport-des-1000-premiers-jours-une-commission-d-experts-a-l-appui>

Stratégie nationale de santé 2018-2022 (SNS)

<https://solidarites-sante.gouv.fr/systeme-de-sante-et-medico-social/strategie-nationale-de-sante/>

Cardiovascular diseases, the leading cause of maternal deaths: Action is urgent!

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The cumulative number of maternal deaths of cardiovascular origins, including cardiac and venous thrombotic or embolic events, strokes, and pregnancy-related hypertensive complications, makes cardiovascular disease by far the leading cause of maternal deaths in France from 2013 through 2015.

The number of women of child-bearing age with a cardiovascular disease is estimated at 150 000 in France. If they are not correctly managed, the risk of complications for their child is 15 times higher, and their own risk of death 100 times higher.

Pregnancy is a true physiological cardiovascular stress test! During pregnancy and after delivery, the heart and arteries are under great strain. The body has an unsuspected capacity for physiological adaptation to allow the harmonious development of the placenta, a specific new vascular organ that enables fetal growth from conception. Pregnancy can also be likened to an endurance exercise, a real marathon lasting several months.

Very early, the size of the cardiac cavities increases, the vessels are dilated, and the heart rate and cardiac output increase to meet the growing demands of the new fetoplacental unit. Delivery also represents a considerable supplementary cardiac burden, due to the contractions and exertion of expulsion, pain, bleeding, and anesthesia. At the same time, the coagulation systems are physiologically activated to prevent postpartum hemorrhage. The increase in cardiac workload and of the volume load can then decompensate a cardiac or arterial disease, sometimes even reveal it, most often during the third trimester, when strain on the heart becomes strongest. Moreover, in 10% to 15% of cases, the placenta, a new nourishing vascular organ, may not develop correctly, and placental ischemia may occur from the end of the second trimester, with consequences that may be fetal (growth restriction, preterm birth, fetal death) and maternal — and sometimes lethal.

The current increase in the age at pregnancy contributes to the growing risk of placental ischemia. Women are also exposed at ever younger ages to a host of environmental risk factors that act insidiously over the years: smoking, stress, sedentariness, unbalanced diet, overweight, obesity, diabetes, cholesterol, chronic hypertension, and more. All of these make placentation more difficult and underline the key role of more systematic screening at this key period in a woman's life. In those with a known cardiovascular disease, pregnancy increases the risk of its progressive complication, the frequency and severity of which depend on the type of disease. Several scores can grade in advance the risk of these women's exposure to serious cardiovascular complications during an envisioned pregnancy.

We must recognize the three stunning warnings sounded by this sixth survey in France and we must act:

- **First warning:** cardiovascular diseases have become the leading cause of maternal mortality. This is a major turning point in the epidemiology of this risk.

- **Second warning:** 66% of the maternal deaths from cardiovascular causes are preventable! This is disturbing, for it calls our practices into question. It also underlines the enormous margin for improvement in our health care system, which faces a true challenge — to develop more rapidly toward preventive maternal medicine.

- **Third warning:** the loss of chance for the women in precarious situations, psychologically and financially, for whom pregnancy is the most important problem they face. These women have exited the health care pathway for different social reasons: unemployment, intimate partner violence, social isolation, single motherhood, or immigrant status; they are more exposed to such cardiovascular risk factors as obesity, sedentariness, hypertension, and smoking. Nearly 25% of maternal deaths occur to women in situations of vulnerability. Among the explanatory causes identified are refusal of care, insufficient adherence, and more frequent comorbidities, such as obesity. We cannot remain passive in the face of these observations. We owe it to ourselves to act, to inverse this trend, to save the lives of these young and fragile women, and to help them to have healthy pregnancies.

It is to act concretely for all of these women that we cofounded in May 2020 with Thierry Drilhon, administrator and business leader, the Women's Cardiovascular Healthcare Foundation, (www.agirpourlecoeurdesfemmes.com), to focus on the 3 As: Alert, Anticipate, Act. We must all fight together to develop preventive medicine that we hope will be effective, especially during pregnancy, in developing the 3 As of the heart:

- **Alert** women at cardiovascular risk or with a heart defect that it is necessary to prepare for the onset of a pregnancy, to modify some treatments that are teratogenic, to reevaluate the cardiovascular situation before becoming pregnant, working with the general practitioner (GP), the cardiologist, and the obstetrician. It is essential to inform health care professionals, as well as women of the cardiovascular alert symptoms during pregnancy or postpartum, before it is too late.

- **Anticipate** through the preconception and postpartum consultations, as recommended by the French Hypertension Society (www.sfhta.eu). Preventive medicine for women must simultaneously motivate them to talk about their desire for pregnancy with their GP or their gynecologist and encourage these health care professionals to question their patients who are young women of childbearing age. For women at cardiovascular risk, the cardiologist decides on the specific workup necessary. Depending on the cardiovascular risk level, the case will be discussed together by cardiologists and obstetricians, relying on the WHO stratification to determine if pregnancy is contraindicated.

Women with a cardiovascular disease must be able to prepare a pregnancy plan, in a concerted and reasoned manner, relying on the expertise of a multidisciplinary team working in optimal safety conditions, to avoid a fatal accident at all cost. After the delivery, the cardiovascular situation will be reevaluated, the treatment adapted, and the cardio-gynecologic follow-up structured.

- **Act** on the management of these women at risk for their entire pregnancy in a center of obstetric and cardiovascular experts, with sustained prenatal care. Regular follow-up of the pregnancy will be established through specific coordinated pathways, associating all of the health care professionals and patients to avoid the unacceptable — the death of a young woman. Also act beyond the pregnancy, by a long-term cardiovascular and gynecologic follow-up to avoid late events, by medicine that is preventive, proactive, and positive. We must

reverse this dramatic epidemiology: 200 women die in France daily from cardiovascular disease and among them, young mothers for whom this event could have been avoided in many cases.

Together, we can move forward toward a medical practice that is more preventive, with special vigilance for these women while they are pregnant. The results of this enquiry disturb us, challenge us, interrogate us — we the care providers, whose vocation it is to alleviate pain and save lives. They underline the urgency of developing multidisciplinary health care pathways, oriented more to preventive medicine through medical and social actions taken in neighborhoods identified to have high levels of precarity.

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Does a mother have the right to die?

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We are trapped by desires that make us see what we believe.

For millennia, motherhood has been so exalted that we have been unable to see that some women perceive it as an immense ordeal. We were so pleased to believe that giving birth was a transcendent creation that we avoided noticing the distress of some women. Since we did not believe it, we did not talk about it, thus depriving our culture of collective narratives that might have induced awareness. We would have seen that some women found childbirth so intolerable that they preferred death.

Certainly, we were able to see without difficulty pathological pregnancies, deaths in childbirth, postpartum infections, and the mysterious fatigue that followed some births, but we resigned ourselves, we talked about the nature of women, of their unenviable fate, and, well, that's life.

It required a clinical and scientific approach to dare to see the unthinkable: motherhood can be experienced as an enormous misfortune. I should have written "the conditions of motherhood" can induce an intense feeling of unhappiness.

Long ago, we searched in the cultural context for what might explain this scandal and in the universe of fault that characterizes Western thought, and we found the idea of sin: the woman is not pious enough, she is punished; this explains her distress.

In the 17th century, Louise Boursier provoked aggressive incredulity when she stated that childbirth must be studied from a technical perspective — the pelvic bones, uterine contractions, and positions that facilitated or impeded fetal expulsion. It was said that this craft demeaned the magical knowledge of birth attendants.

Later, Semmelweis transformed the danger of childbirth by reporting in 1861 that it was necessary to wash one's hands before entering a labor room. This affirmation, the self-evidence of which makes us smile today, was nonetheless the result of a rigorous scientific procedure, in which he compared the mortality of women in a department where physicians washed their hands — 1.3% — to that of departments where they moved directly from the autopsy room to the delivery room — 18%. This discovery, as often, was perceived as a transgression, as an accusation of colleagues. Hospitalized for what may have been the onset of Alzheimer disease, he was beaten to death by care providers.

Those who have no method see what they think. When Lamaze, a French communist obstetrician, saw a woman giving birth in Moscow while smiling in 1951, he immediately concluded that it was confirmation of the truth of Marxism. He published this observation in France when he returned and was prosecuted for it 3 times. Only the CGT opened the Bleuets clinic to develop delivery (said to be) without pain.

Today, maternal mortality has become very rare, to the point that observations of peaks are an indication of the disorganization of a health care system. The data collection method used by the national confidential enquiry on maternal mortality (ENCMM) in France makes it possible to assess the conditions of death: deaths from heart failure or hemorrhage still occur and can be prevented by improving care.

But this survey also discovered the poignant problem of young women who kill themselves on becoming mothers. These suicides, their numbers increasing regularly, are determined by

impaired family relationships and social disorganization. Some countries have high rates of suicide among young mothers, including sub-Saharan Africa, Haiti, and China; these rates reveal the difficulty of becoming a mother in these places. It is easy to understand that cultural barriers or social collapse prevent happiness in motherhood, but it is surprising to discover that modernity is not a protective factor when it isolates a young mother and deprives her of the security provided by her family and friends.

To understand this phenomenon, it is more useful to reason in terms of ecosystems. A convergence of exterior causes is what structures the mother's interior world. When a young woman grows up in a secure, stable family open to friendships and cultural relationships, a wanted pregnancy is a protective factor. But when during her childhood, she is isolated or assaulted, she acquires factors of vulnerability that lead her to perceive her pregnancy with anxiety.

Perinatal depression, before delivery or in the year that follows, occurs when a woman has acquired such factors of vulnerability during her childhood. When she finds herself alone, without a supportive family, in a culture that devalues her, suicidal ideas can enter her mind.

But it is possible to act on the environment that acts on these women. Families can be helped to become supportive. Home visits, social assistance, and inviting the father to participate in the event of motherhood can help to prevent these disorders. Perinatal suicides are often preventable.

This is what the work of the ENCMM teaches us in this work both clinically and scientifically enlightening.

Chapter 1.

National confidential enquiry on maternal mortality (ENCMM) in France: CONTEXT AND METHOD

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1.1 Justification

1.1.1 Value of surveillance of maternal mortality

Although maternal death has become a very rare event in high-resource countries, the maternal mortality ratio (MMR) (often called the maternal mortality rate) in these countries always remains an important indicator of health in general and of maternal health in particular.

That is, maternal mortality is considered to be an indicator of the performance of the health care system. As part of a process begun some 40 years ago in industrialized countries [1] and developed more particularly in Europe since the end of the 1980s [2], maternal deaths have been included in the health events considered *preventable*, that is, events that when they occur in excess numbers are evidence of the poor performance (dysfunction) of a health care system, whether this failure concerns prevention or the organization and/or provision of care.

Moreover, and more specifically, maternal mortality always remains a key indicator of maternal health [3], despite recent proposals of indicators of severe maternal morbidity, though without standardized definitions or measurements. As such, it is a sentinel event, evidence of the existence of earlier morbid events arising from the same mechanisms, more frequent but also more difficult to monitor.

The maternal mortality profile therefore provides information not only about the risks attributable to pregnancy and childbirth, but also about the performance of the health care system. From these dual standpoints, the variations in the characteristics of maternal mortality between countries and over time within the same country must constitute a signal to which health care professionals and policy-makers must pay attention. Its surveillance therefore remains fully relevant [4].

The impressive international inequalities in maternal mortality (the most important of the classic health indicators) imply that efforts aimed at reducing maternal mortality must be massively directed toward the developing countries and in particular to sub-Saharan Africa [5]. Nonetheless, the persisting heterogeneity in the MMR within the developed countries [5, 6] and the high proportion of these deaths considered preventable in these settings [7, 8] show that in this group of countries as well, improvement is possible and desirable. In France, this need for improvement has been set in writing in the form of objectives: a reduction in maternal mortality is 1 of the 100 public health objectives [9]. Only a detailed study of maternal deaths can enable pathways of improvement to be identified. Finally, the current trends in obstetrics, notably in France [10], in terms of mothers' social, demographic, and medical profiles (specifically, older women, more often obese), obstetric practices (more cesareans), and organization of obstetrics care (fewer and larger maternity

units), reinforce the need for an indicator that allows the impact of these changes on maternal health to be assessed.

1.1.2 Value of a specific system for studying maternal mortality

The official mortality statistics, based on an analysis of the contents of death certificates, do not allow maternal mortality to be studied satisfactorily.

The reasons for these limitations are found at 2 distinct points, during the physician's completion of the death certificates and during the coding of the causes of death, applying the ICD (International Classification of Diseases) [11] to the certificate's contents.

At the certification stage, the accuracy and pertinence of the information provided by the physician completing it, especially concerning any recent or current pregnancy, are obviously determinant. To the insufficiency of the certification in general [12], we must add the specific difficulties of maternal mortality: recent pregnancy not always known to the certifier, inadequate training of physicians about the specificity of the certification of this rare cause of death, inadequate knowledge of the causal association between pregnancy and some diseases, and fear of legal action. This content is then synthesized and converted to ICD codes. If the code of the *initial* cause of death belongs to the obstetric section of the ICD ("Pregnancy, childbirth, and the puerperium", codes "O" of the ICD-10, used since the year 2000 for French death statistics), the deaths will be classified as a maternal death. This coding is therefore *constrained* by the ICD for a domain where knowledge about the causal association between disease and pregnancy is evolving and is further based on a limited quantity of information, which can be insufficient to characterize the causal role of pregnancy.

These points explain why the use of routine mortality data generally leads to an underestimation of maternal mortality, as demonstrated in several previous studies, especially in France [13, 14], and as this report shows is still the case (see chapter 2 and Table 1). Moreover, these routine mortality data provide a biased profile of the causes of maternal deaths, in that some causes are overrepresented among the maternal deaths not identified as such (especially pulmonary embolisms, indirect maternal deaths associated with preexisting diseases in pregnancy, and suicides) [15, 16, 17]. Finally, these data do not enable an in-depth study of the circumstances of the onset of death and therefore cannot pinpoint the preventable factors, from a perspective of prevention.

Given these limitations of routine mortality statistics, the need to develop an "ad hoc" system to study maternal mortality appears clear [18, 19]. Such a system must make it possible to draw out all the information useful for studying maternal deaths as a sentinel event, that is, with a *dual objective*, on the one hand, epidemiologic, with a quantitative, approach, and on the other hand, an examination of the care provided and the preventable circumstances that led to the death, applying a principally qualitative approach close to that of the clinical audit.

1.2 Methods: National confidential enquiry (ENCMM) with a committee of experts (CNEMM)

1.2.1 Establishment and objectives

In response to this situation, in 1995, the Ministry of Health created by decree (*J.O.* dated 2 May 1995) the national committee of experts on maternal mortality (CNEMM) and assigned to it the mission of examining the maternal deaths documented by a confidential enquiry, identifying the factors involved in the onset of these deaths and proposing measures to prevent their recurrence [20].

This mission implied a specific system of information collection, for the reasons mentioned above. The establishment and functioning of this system, as well as the scientific responsibility for it, the national confidential enquiry on maternal mortality (ENCMM), were assigned to INSERM Unit 149, which subsequently became Unit 953 in 2009 and then U1153 EPOPé team in 2014.

The CNEMM's detailed analysis began with the deaths that occurred in 1996. A first report was produced in 2001 for the deaths in 1996-1998, a second in 2006 for 1999-2001 [21], a third in 2010 for 2001-2006 [22], the fourth for 2007-2009 [23], the fifth for 2010-2012 [24], and the sixth and current report covers the period 2013-2015.

The CNEMM initially reported directly to the Directorate-General of Health, and then to InVS (the Institute of public health surveillance) from 2006 through 2010, to the HAS (French national authority for health) from 2011 to June, 2014, when it was assigned to report again to the InVS, which in 2016 became Public Health France.

These different supervising authorities reflect the clear existence of the current system's *dual objective* for studying maternal deaths: on one hand, the epidemiologic characterization of maternal mortality and its trends — in level, risk factors, and profile of causes — and, on the other hand, the analysis of the circumstances of onset of the morbid event, its management, and its fatal outcome; to identify the pathways for improvement, especially, of care and its organization.

The current CNEMM was named in 2017 by Public Health France after a call for candidates (the members are listed at the start of this report). It comprises 15 qualified experts (6 obstetricians-gynecologists, 5 anesthesiologists-resuscitation specialists, 1 resuscitation specialist, 2 midwives, and 1 specialist in internal medicine), as well as 3 *ex officio* members (an epidemiologist from INSERM-EPOPé, which provides the committee's scientific coordination, an epidemiologist from the CepiDC epidemiology center, and an epidemiologist at Public Health France). These qualified experts are appointed for a 3-year period, renewable once. The associated experts also participate in the analysis of the maternal deaths on specific subjects. A psychiatrist participated in the analysis of the maternal suicides, and an obstetrician with expertise in forensic medicine in the analysis of those maternal deaths for which an autopsy was performed.

The initial work concentrated on the effective collection of information and its analysis by the Committee of experts. Focus then moved to include the need to ensure the exhaustiveness of the identification of deaths by combining diverse sources of case identification (detailed below). The most recent methodological trends aim to better document the women's social context and the pathways of the women who died by suicide. The coverage of the events and factors considered for the ENCMM analysis of maternal mortality has expanded to integrate psychosocial vulnerability and its maternal health consequences.

1.2.2 A three-stage enquiry procedure

Stage 1: Identification of deaths "associated with pregnancy"

The first stage involves the inclusion of all deaths "associated with pregnancy," that is, that occurred during pregnancy or up to 1 year after it ended, regardless of the cause of death and how the pregnancy ended.

Three sources are used, all covering metropolitan France and the overseas districts:

- direct reports by the perinatal health networks: all of these networks are invited to report to the ENCMM coordination (encmm@inserm.fr) any death associated with pregnancy in their territory (up to 1 year after pregnancy ended, regardless of its cause). This voluntary report is made spontaneously or after a quarterly reminder to the network liaisons by email. It uses a standardized form that ensures the principle of confidentiality by not including the woman's name. On receipt of a form reporting a death associated with pregnancy, a response will be sent to the network liaison requesting further information to enable the initial information to be collected and to obtain the contact information of the physicians involved. This direct report method has not identified deaths that would not have been included secondarily via the sources listed below, but it has accelerated the enquiry process considerably, by starting before the consolidation of the health-related administrative databases.
- Death certificates: the CepiDc, responsible for the treatment of death certificates and for the production of the national mortality statistics in France, selects all the death certificates of women that include: 1) a mention of a pregnancy underway or recent, or of a morbid event associated with pregnancy in the section describing the causes of death, 2) and/or a checkmark in the "pregnancy box", which was added to French death certificates in 2000 and enables the mention of any pregnancy at death or ended within the past year.
- The INSEE (national institute of statistics and economic studies) national database of birth certificates: linking this database with that of the RNIPP (National register of natural persons, *Repertoire national d'identification des personnes physiques*) makes it possible to identify the women who died *in the year after they gave birth*. The death certificates of these women are then selected by a second linkage to the death certificate database.
Given the delay in the treatment of death certificates (still overwhelmingly in paper form in France), the last 2 selections are available only about 3 years after the deaths. As we finalize this report, the last year available is 2016. It is this delay that explains the gap between the occurrence of the deaths and release of the report.
- The hospital medical information system program groups together all discharge summaries for all hospitalizations in health care facilities to identify the *inhospital deaths* of women in an obstetric context or within a year after a preceding hospitalization involving pregnancy or childbirth by linking the hospitalizations of the same patient.

This multisource identification ensures the exhaustiveness of the identification of the deaths with a *temporal* association with pregnancy. Among these deaths, the subgroup for which pregnancy played a *causal* role — that is, the maternal deaths — will be secondarily selected, at the end of the following stages.

Innovations for 2013-2015:

- Inclusion of deaths in Mayotte began for 2013.

Stage 2: Documentation of deaths

This is the confidential enquiry, in the strict sense of the term. The physicians who managed each death associated with pregnancy identified in stage 1 are informed of the ENCMM procedure. The inclusion in 2017 of the study of maternal mortality within the national public health network confers on this enquiry data the status of data essential for public health surveillance and make it mandatory for all health care professionals and facilities to transmit data for each maternal death as part of the ENCMM.

For each case reported or identified, the ENCMM coordination (Inserm-Epopé) retraces the woman's care pathway through all the physicians involved in her management: GP, maternity ward for prenatal care, maternity ward of delivery, SAMU-SMUR (out-of-hospital emergency medical services), and hospital department in which death occurred, etc.). It then notifies a pair of assessors, who will be responsible for collecting the information. This pair comprises 2 volunteer clinicians, one an obstetrician or a midwife, and the other an anesthesiologist-resuscitation specialist or a psychiatrist or child psychiatrist, depending on details of the death. The assessors are chosen after consultation with the professional societies, that is, CNGOF (French national college of gynecologists and obstetricians), the CNSF (national college of Midwives, and the SFAR (French society of anesthesiology and resuscitation), or with the perinatal health networks. They are a key element of this procedure.

The information concerning the woman's history, the course of her pregnancy, the circumstances of onset of the event that led to death, and its management, are collected after examining the medical documents and discussions with the team members involved. A standardized questionnaire is completed (Appendix 1), including multiple-choice questions and spaces for descriptions in free text, with copies of the important medical documents. For each death for which an autopsy is mentioned, the ENCMM coordination requests from the appropriate county court an anonymized report of the examinations performed. All of these items are centralized by the ENCMM coordination and de-identified before their consultation by the committee of experts.

This stage is essential and the role of the assessors is key, because the wealth and objectivity of the information collected will determine the quality of the experts' conclusions. Once the file has been de-identified and centralized at INSERM, it is no longer possible to return to the source to request additional information.

Despite the mandatory nature of the ENCMM, a small proportion of cases (currently 5%) cannot be investigated by the assessors (see chapter 3.1, Table 8). This may be due to the failure of the departments or physicians concerned to respond to multiple requests from the ENCMM coordination to make the medical file available to the assessors, or to the medicolegal context, where secrecy during an investigation prevents access to the file until its conclusion. For these cases, it has nonetheless been possible to obtain some information from the contents of the death certificate, the birth certificate, or the hospital discharge data (when available). This information makes it possible to attribute a cause of death and to be able to classify the death as "maternal" or not.

Innovations for 2013-2015:

- The data collection questionnaire was updated to be more relevant to changes in clinical practice but also to provide more information about the women's **social context**. A **specific form for suicide** has also been introduced.
- Moreover, the ENCMM coordination has mobilized the perinatal health networks to include volunteer **psychiatrists and child psychiatrists** for the assessor "pool". Paired with a midwife or obstetrician/gynecologist assessor, they are assigned to study the maternal suicides.

Stage 3: Review and classification of deaths

This is the specific mission of the CNEMM. In plenary meetings, each death that was investigated is discussed collegially, based on all of the information available. All committee members receive a complete copy of all files, thoroughly de-identified. Two rapporteurs are more specifically responsible for reporting the case at the meeting to lead off the discussion. After reporting the case, the committee reaches a consensual judgment about:

1. The cause of death, which makes it possible to classify the death as maternal (causal association with pregnancy) or nonmaternal (a temporal but not causal association);

2. For the maternal deaths:

- the association with the pregnancy — direct, indirect, or not determined — according to the cause of death.
- the adequacy of the care provided, classified as optimal or nonoptimal; if pertinent, this judgment is made separately for preconception care, prenatal follow-up, and concerning the management of the fatal event for the initial care, obstetric care, anesthesia, resuscitation, and other specific types of care (cardiac, psychiatric, etc.). This analysis is made based on the clinical practice guidelines and the knowledge available at the time of death. When the information collected did not allow an informed judgment, the conclusion was considered "not established."
- the preventability of the death: each death was classified as "not preventable," "perhaps preventable," or "probably preventable," according to whether there were circumstances that, if corrected, could have prevented the fatal outcome. For the deaths considered perhaps or probably preventable, the factors related to preventability are detailed; they might concern aspects of the management and be part of the judgment of care, but could also concern other aspects, such as factors associated with the patient and her environment (context of precarity or psychosocial vulnerability). When the information collected did not allow an informed judgment, the conclusion concerning preventability was stated as "not established."

The conclusions concerning the adequacy of care and preventability were often linked, but not always identical. For example, the care might have been adequate but the death could have been avoided if the patient had not refused to be hospitalized; inversely, the care might have been considered not optimal while the death was nonetheless inevitable because the inadequate or nonoptimal care probably did not influence the prognosis.

A synthesis of the experts' conclusions is attached as Appendix 2.

The information from the confidential enquiry and the experts' conclusions have been compiled for all of the deaths considered maternal deaths, and they are summarized in this report for the period 2013-2015. Beyond this report, the database makes it possible to study the series of cases of each given etiology over a longer period and also to approach specific research questions.

This is thus a complex enquiry process, involving many participants, but only such a system can extract all the useful information that can be gained from studying maternal deaths, from the perspective of prevention.

Innovations for 2013-2015:

- An **expert psychiatrist** was associated with the CNEMM for the analysis of the maternal suicides and maternal deaths from other causes in women with mental illness.
- The CNEMM seeks specialized opinions when appropriate for complex cases for which specific expertise is necessary to understand the events.

1.3 Definitions and indicators

1.3.1 Definitions

Maternal death

According to the International Classification of Diseases (ICD):

- **maternal death** is "the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes;
- **late maternal death**, a concept introduced in ICD 10 [11] is defined as the death of a woman resulting from direct or indirect obstetric causes occurring more than 42 days, but less than a year after the pregnancy ended.

Maternal deaths are divided into 2 groups: deaths from a direct obstetric cause, that is, "resulting from obstetric complications of the pregnant state (pregnancy, labor, and puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above." Death from an indirect obstetric cause is that which "result[s] from previous existing disease or disease that developed during pregnancy and which was not due to direct obstetric causes, but which was aggravated by the physiologic effects of pregnancy."

Specificities of the ENCMM: when the direct or indirect nature of the causal association between pregnancy and death is difficult to establish, it is characterized as "not established." This category contains the maternal suicides and the maternal deaths of unknown causes.

The current international trend is to extend the study window for maternal mortality to up to 1 year after the end of the pregnancy; this is what the ENCMM does in France. Nonetheless, and especially for international comparisons, maternal mortality occurring within 42 days must still be distinguished because most maternal deaths occur during this period, and the quality

of the identification of the late maternal deaths is more random. Some epidemiologic results in this report are presented for both maternal mortality up to 42 days and that up to 1 year.

Death associated with pregnancy

Death associated with pregnancy is the death of a woman occurring during pregnancy or within 1 year after its termination, *regardless of the cause*. These deaths therefore have a temporal association with pregnancy, but not necessarily a causal association. Maternal deaths are a subgroup of the deaths associated with pregnancy.

This concept makes it possible to define an "easily" identifiable group within which more detailed information will permit the maternal deaths to be isolated.

1.3.2 Indicators

Maternal mortality ratio (MMR): the ratio of the number of maternal deaths to the number of live births (LBs) over the same period. By international convention, it is expressed per 100 000 LBs, because it is the most reliable denominator for most countries. Some countries report the number of maternal deaths divided by the number of total deliveries (whether they led to a live-birth or a stillbirth), which is more exact. In France, because of a 2008 modification of the rules governing the declaration of stillbirths, this calculation was not possible for several years; it is once again possible based on the hospital discharge database, which can again express the MMR related to the total number of deliveries (see Figure 6 and chapter 2.5). Nonetheless, given the rarity of maternal deaths in France, this adjustment of the denominator, while interesting theoretically, does not change the MMR level.

MMR can be global, calculated for all maternal deaths, or reported by cause or age group, etc.; we then talk about the specific MMR by cause, by age, etc.

Proportions: They are used to describe the distribution of the causes or the proportion of a cause (or another characteristic of the deaths) among all maternal deaths.

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Chapter 2.

MATERNAL MORTALITY IN FRANCE 2013-2015: FREQUENCY, CAUSES, AND WOMEN'S PROFILES

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2.1 Frequency and trends

For 2013-2015, the ENCMM identified **262 maternal deaths in France** (France as a whole: metropolitan France and the DOM, Guadeloupe, Martinique, French Guyana, Réunion; and Mayotte) up to 1 year after the pregnancy ended, or **approximately 87 annual deaths, 1 every 4 days**.

These figures produce an MMR of **10.8 deaths per 100 000 LBs** (95% CI, 9.5-12.1), stable compared to the 2 previous 3-year periods 2010-2012 and 2007-2009 (Table 1). Figure 1 shows the annual MMR since 2001. The notable annual fluctuations underline the importance of the 3-year triennial grouping for observing trends.

This global stability, disappointing at first view, must nonetheless be considered while taking into account the progress in the surveillance system, which tends to increase the number of maternal deaths. On the one hand, the area covered has increased, with Mayotte included as an overseas district officially since 2011 but only from 2013 in the national birth and mortality statistics; this report is the first to include maternal mortality in Mayotte. Moreover, the very definition of maternal mortality (that is, the deaths classified as maternal deaths) is changing, with our adoption of an inclusive approach to maternal suicides (see chapters 1 and 4.2), in accordance with international guidelines (1), changes that, in particular, increase maternal mortality after 42 days. These changes in method underline the importance of considering in priority, beyond the global MMR, the specific MMRs by cause, and the factors related to preventability identified for each cause, as mentioned in section 2.4 of this chapter.

This inclusive approach to the classification of maternal deaths could have resulted in increasing the level of maternal mortality. If the global MMR is unchanged in this context, it is because this methodological change is offset by other favorable trends, such as the reduction in maternal mortality for direct causes (see chapter 2.4 below).

Moreover, this stability can also be interpreted as a "good" result in view of the overall increase in the prevalence of most of the risk factors for maternal mortality (see 2.2), which places the general population of French parturients at a higher risk of maternal mortality; in this context, the absence of an increase in the global MMR can also be interpreted as the capacity of the health care system to counterbalance this higher risk level.

Maternal mortality limited to 42 days after the end of pregnancy remains the reference indicator for international comparisons, as recommended by WHO (2). In France for 2013-2015, there were **196 maternal deaths** in this window, **for an MMR of 8.1 per 100,000 LBs** (95% CI, 7.9-10.4). This MMR at 42 days was 9.5 in 2007-2009 and 9.1 in 2010-2012; these reductions are not statistically significant (Table 1).

The late maternal deaths, that is, those occurring between 43 days and 1 year after the pregnancy ended, accounted for 25% of the maternal mortality in 2013-2015, compared with 11% in 2010-2012, and 8% in 2007-2009 -- a statistically significant increase. This trend simultaneously reflects changes in the profile of causes and in the enquiry methods.

In the absence of the data from the ENCMM, which is an enhanced method of monitoring maternal mortality, the MMR available would be that from the national cause-of-death statistics, exclusively from the death certificates (CepiDc), or 5.1 deaths/100 000 LBs (95% CI 4.3-6.1) for the 125 maternal deaths identified (Table 1). The MMR based on this statistic is therefore underestimated by 48% compared with the ENCMM. This major difference underlines the need to maintain this enhanced system for monitoring maternal mortality in France.

I TABLE 1 I

Maternal mortality, France 2007-2015, sources: death certificates and ENCMM; annual number of maternal deaths and maternal mortality ratio per 100 000 live births

		Death certificate ¹		ENCMM			
		Maternal mortality		Maternal mortality up to 42 days		Maternal mortality up to 1 year	
Years	Live births ²	Deaths ³	MMR ⁴ [95% CI]	Deaths ³	MMR ⁴ [95% CI]	Deaths ³	MMR ⁴ [95% CI]
2007	819 605	69	8.4 [6.6-10.7]	91	11.1 [8.9-13.6]	99	12.1 [9.8-14.7]
2008	828 404	61	7.4 [5.6-9.5]	72	8.7 [6.8-11.0]	80	9.7 [7.7-12.0]
2009	824 641	80	9.7 [7.7-12.1]	71	8.6 [6.7-10.9]	75	9.1 [7.2-11.4]
2010	832 799	71	8.5 [6.7-10.8]	85	10.2 [8.2-12.6]	92	11.1 [8.9-13.5]
2011	823 394	50	8.6 [4.5-8.0]	69	8.4 [6.5-10.6]	82	10 [8.0-12.4]
2012	821 047	52	6.3 [4.7-8.3]	71	8.7 [6.8-10.9]	80	9.7 [7.7-12.1]
2013	818 070	45	5.5 [4.0-7.4]	73	8.9 [7.0-11.2]	87	10.6 [8.5-13.1]
2014	818 565	42	5.2 [3.7-7.0]	62	7.6 [5.8-9.7]	85	10.5 [8.4-13.0]
2015	798 948	38	4.8 [3.4-6.5]	61	7.6 [5.8-9.8]	90	11.3 [9.1-13.9]
2007-2009	2 472 650	210	8.5 [7.4-9.7]	234	9.5 [8.3-10.8]	254	10.3 [9.1-11.6]
2010-2012	2 477 240	173	7.0 [6.0-8.1]	225	9.1 [7.9-10.4]	254	10.3 [9.0-11.7]
2013-2015	2 435 583	125	5.1 [4.3-6.1]	196	8.1 [7.0-9.3]	262	10.8 [9.5-12.1]

ENCMM National confidential enquiry on maternal mortality

¹ Source: Inserm CepiDc (<http://cepidc-data.inserm.fr>)

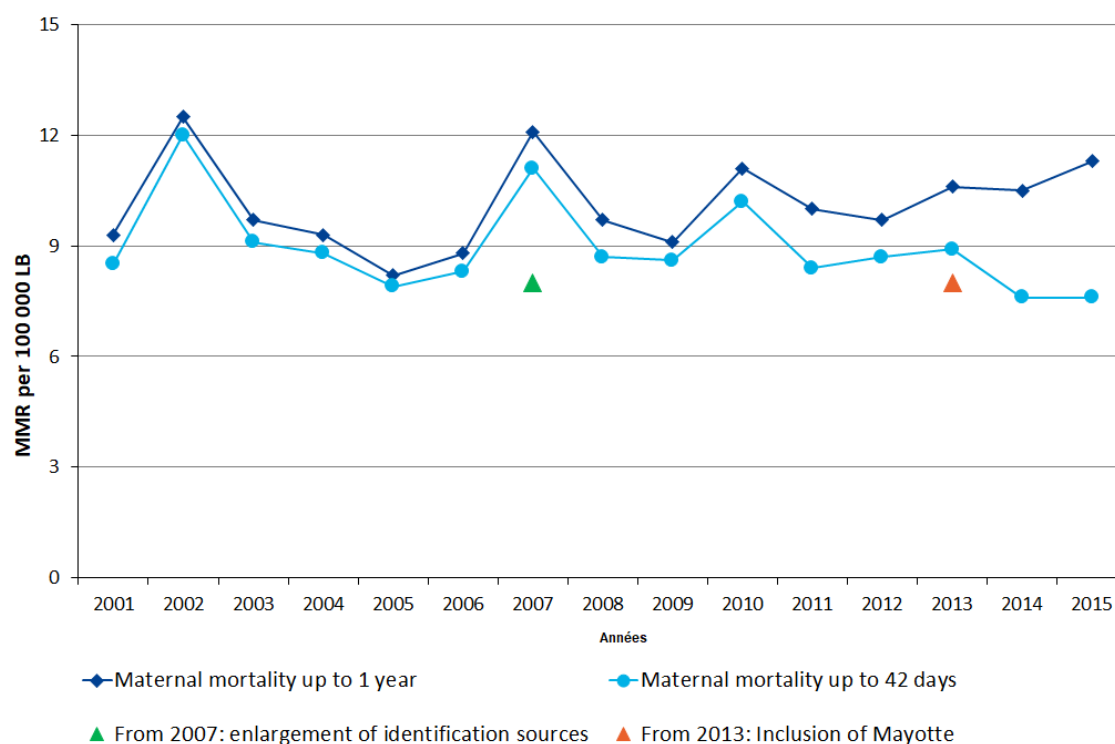
² Source: INSEE (<https://www.INSEE.fr>)

³ Deaths in Mayotte are first included in 2013 I

⁴ Maternal mortality ratio per 100 000 LBs

I FIGURE 1 I

Trends in the annual maternal mortality ratio from 2001 to 2015, France, ENCMM data



2.2 Characteristics of the women who died

2.2.1 Women's age

Women's age is a recognized risk factor for maternal mortality. From 2013 through 2015, nearly 28% of the maternal deaths occurred among women aged 35 to 39 years (an age group accounting for only 18% of the LBs), and 12% of the women aged 40 years and older (who accounted for 5% of all LBs).

The lowest MMR up to 1 year after pregnancy ended was recorded in the group aged 25 to 29 years, or 5.9/100 000 LBs (Table 2). Compared with the 25-29 year-old age group, risk climbed statistically significantly starting at the age of 30 years: the risk of maternal mortality was multiplied by 1.9 for the women aged 30-34 years, by 3 for those aged 35-39 years, and by 4 above 40 years (Figure 2).

I TABLE 2 I

Maternal mortality by women's age group, France, 2013-2015, ENCMM data

Age group	Live births ¹		Mortality up to 42 days				Mortality up to 1 year			
	n	%	Deaths	%	MMR ²	95% CI	Deaths	%	MMR ²	95% CI
<20 years	42 857	1.8	4	2.0	9.3	[2.5-23.9]	4	1.5	9.3	[2.5-23.9]
20-24	287 307	11.8	11	5.6	3.8	[1.9-6.8]	21	8.0	7.3	[4.5-11.2]
25-29	731 248	30.1	33	16.8	4.5	[3.1-6.3]	43	16.4	5.9	[4.3-7.9]
30-34	818 251	33.7	63	32.2	7.7	[5.9-9.9]	91	34.7	11.1	[9.0-13.7]
35-39	425 516	17.5	60	30.6	14.1	[10.8-18.2]	73	27.9	17.2	[13.5-21.6]
≥40	123 844	5.1	25	12.8	20.2	[13.1-30.0]	30	11.5	24.2	[16.3-34.6]
All	2 429 023	100.0	196	100.0	8.1	[7.0-9.3]	262	100.0	10.8	[9.6-12.2]

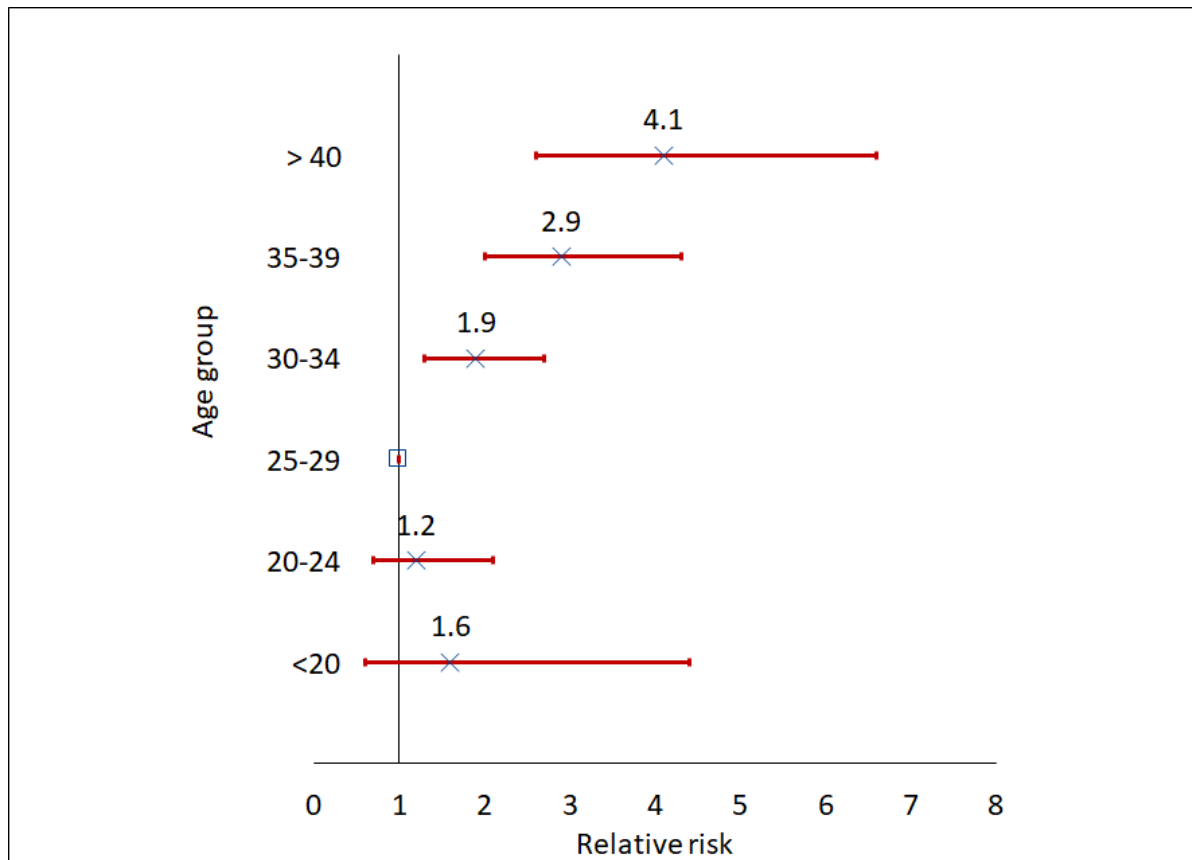
¹ Source INSEE (<https://www.INSEE.fr>)

² Maternal mortality ratio per 100 000 LBs

Note: Age range recorded among the maternal deaths: 16 and 51 years

I FIGURE 2 I

Risk of maternal mortality by women's age. France, 2013-2015, ENCMM data



Note: Relative risk compared with the reference category aged 25-29 years

2.2.2 Women's country of birth

Women born in a country outside France are generally immigrants (3). This dimension of social position is a recognized risk factor for maternal mortality, with migrants classically at greater risk than native French women; nonetheless the excess risk varies according to geographic origin (4).

In 2013-2015, 31% of maternal deaths occurred in women born outside France, although this group accounted for only 21% of LBs (Table 3) (5). This excess risk differs according to region of birth. Accordingly, the MMR of women born in North Africa or in European countries other than France is similar to that of women born in France. Inversely, the **women born in sub-Saharan Africa** have the highest MMR, 24.8 per 100 000, nearly **3 times that of women born in France** (Table 3 and Figure 3); this gap relative to native-born French women has remained stable since 2007-2009, when the routine collection of this data item began). A more heterogeneous group, that of **women born in "other countries" (that is, outside Europe and Africa)**, also showed an excess risk of maternal mortality — **2.7 times higher than that of women born in France** (Table 3 and Figure 3); this group stood out for the first time in 2010-2012, with a disparity of a similar scale. Given the small number of individuals and the heterogeneity of their native countries (see the note below Table 3), it is difficult to discern a dominant profile in this group; we note nonetheless that the groups most frequently represented among these deaths are those born in Haiti and in China. These variations of risk of maternal mortality of migrants according to their country of birth may reflect differences in when different migration waves began and on their conditions of migration and integration.

I TABLE 3 I

Maternal mortality by women's country of birth, France, 2013-2015, ENCMM data

Country of birth	LB		Mortality up to 42 days				Mortality up to 1 year			
	n	%	Deaths	%	MMR	[95% CI%]	Deaths	%	MMR	95% CI
France	1 916 321	78.9	117	62.2	6.1	[5.1-7.3]	171	68.7	8.9	[7.6-10.4]
Other European countries	91 016	3.7	7	3.7	7.7	[3.1-15.9]	7	2.8	7.7	[3.1-15.9]
North Africa	190 564	7.8	13	6.9	6.8	[3.6-11.7]	14	5.6	7.4	[4.0-12.3]
Sub-Saharan Africa	125 168	5.2	27	12.8	21.6	[14.2-31.4]	31	11.2	24.8	[16.8-35.2]
Other ¹	105 954	4.4	24	14.4	22.6	[14.5-33.7]	26	11.7	24.5	[16.1-35.9]
All ²	2 429 023	100.0	196	100.0	8.1	[7.0-9.3]	262	100.0	10.8	[9.6-12.2]

LB: live births, source INSEE (<https://www.INSEE.fr>)

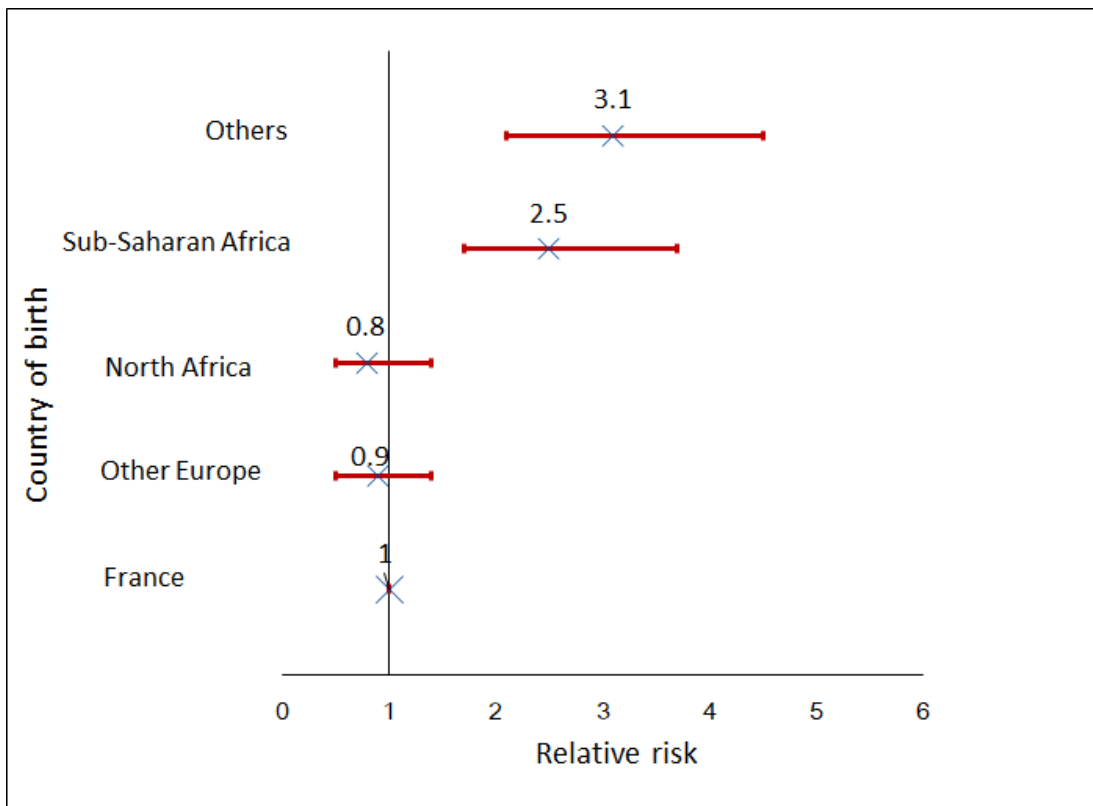
Maternal mortality ratio per 100 000 LBs

¹ "Other" country of birth for the maternal deaths: Haiti n=5, China n=4; India n=3; Indonesia n=2; Armenia n=2; and 1 case each for Cambodia, Sri Lanka, Thailand, Colombia, Dominica, Surinam, Peru, Santa Lucia, Uzbekistan, and Turkey

² Country of birth not reported for 13 deaths

I FIGURE 3 I

Risk of maternal death by country of birth. France, 2013-2015, ENCMM data



Note: Relative risk compared with the reference category of "women born in France"

2.2.3 The women's social vulnerability

A change in the questionnaire for this 3-year period is the inclusion of items providing specific information about various dimensions of social status: work, health and other social insurance coverage, housing, isolation, etc.. Although the proportion of missing data for these items remains high (a reflection of their frequent absence from the medical file), they do allow a better picture of these women's social status.

Two approaches are reported here. On the one hand, we used a categorization based on a composite variable to identify the women with at least one element of *socioeconomic vulnerability* from the following: CMU (health insurance for very low-income individuals) or AME (health insurance for undocumented individuals) or the total absence of health insurance coverage; unemployment; social isolation; precarious housing; or living with no partner during the pregnancy (6). This epidemiologic approach has the merit of being reproducible. On the other hand, the committee reached a global judgment on the existence of *social vulnerability* (yes or no), in light of all the information available for a woman. This judgment, partly subjective, has the advantage of providing an overall impression in a specific case, in integrating the explicit and implicit data, but its reproducibility and comparability are limited.

Accordingly, during the 2013-2015 period, 26.5% of the maternal deaths in France (66/249) occurred to women with at least 1 criterion of socioeconomic vulnerability, based on the composite variable described above, compared with 22% in the overall population of parturients in the 2016 NPS. To keep the components of this composite variable homogeneous for socioeconomic status, we did not include in it other important dimensions of social context

systematically collected in the ENCMM questionnaire. This is the case for the language barrier reported in 22 cases (9% of maternal deaths) and domestic violence reported for 6 women. These are undoubtedly low estimates of the prevalence of these 2 characteristics, as their frequent lack of mention in medical files is well known.

The CNEMM's overall analysis identified 54 women in situations of social vulnerability (21.7%, 54/249), including 50 also identified by the composite variable, for a globally concordant characterization.

It can thus be concluded that **at least 1 maternal death in 4 or 5 occurs in a context of social vulnerability**. This overall proportion appears to differ with the nature of the death. That is, the proportion of socioeconomically vulnerable women is higher for some causes of death than others, in particular, 43%, especially high, among the maternal suicides. It was also twice as high among the preventable deaths: 27.7% among the maternal deaths assessed to be preventable (perhaps or probably) versus 13.7% among those considered unpreventable. Moreover, in this group of vulnerable women, the factors related to preventability were of course often linked to inadequate or nonoptimal care, like the maternal deaths as a whole (see chapter 3), but also to a flaw in the interaction between the patient and the health care system in 75% of cases (27/36) (lack of adherence, failure to keep an appointment, and/or refusal of hospitalization), a substantially higher proportion than that observed among all of the preventable maternal deaths (29%) (see chapter 3). This finding demonstrates the involvement of social vulnerability in the chain of events leading to death.

2.2.4 The women's region of residence

*To characterize the **geographical inequalities**, regional maternal mortality is presented in this report according to the woman's place of residence.* It can be assumed that the events related to the place of residence reflect the health status of the population in this residential environment, but also the health care system's ability to meet this population's needs. Inversely, the place of death is overly influenced by the supply of care. A region better endowed with hospitals and in particular specialized hospitals inevitably, both antepartum and postpartum, receives patients at higher risk (placenta accreta, preeclampsia) or secondarily transferred due to severe complications (amniotic fluid embolism, stroke, etc.).

The analysis of maternal mortality according to women's region of residence has shown, since the first ENCMM report and without any changes for the 2013-2015 period, that 2 regions stand out by their statistically significantly higher MMRs: the overseas districts and the Ile-de-France, which includes the Paris metropolitan area (Table 4).

The most marked difference is observed for the **overseas districts**, the region of residence for 14% of the women who died (vs 4.6% of the LBs) and with an MMR **3.4 times higher than that of metropolitan France**. Variations are found within these overseas districts, with MMRs highest in Mayotte and Martinique and lowest in Reunion, but the number of individuals is too small to be able to make useful comparisons.

In metropolitan France, the **Ile-de-France stands out with an MMR 55% higher than that of all of the other regions of metropolitan France**.

These regional disparities for the overseas districts and the Ile-de-France were already visible at a similar level in our last report, for 2010-2012. A particular analysis exploring these geographical inequalities in maternal mortality appears to suggest that they do not result solely from the heterogeneity of the women's individual characteristics (age, nationality, and parity) between regions but also from variations in the quality of care (7).

The small number of maternal deaths recorded in the other major regions of France leads to large fluctuations that do not allow us to measure significant differences or trends. Table 4 presents the MMRs by major regions, but also by the previous regional division, to make it possible to observe their changes from the previous period.

I TABLE 4 I

Maternal mortality by women's region of residence, France, 2013-2015, ENCMM data

Region	LBs	Deaths	MMR ¹	[95% CI%]
Auvergne-Rhône-Alpes	285 902	22	7.7	[4.5-11.7]
Auvergne	39 789	10	25.1	[12.1-46.2]
Rhône-Alpes	246 113	12	4.9	[2.5-8.5]
Bourgogne-Franche-Comté	90 068	14	15.5	[8.5-26.1]
Bourgogne	49 983	7	14.0	[4.3-16.6]
Franche-Comté	40 085	7	17.5	[7.0-36.0]
Bretagne	104 087	10	9.6	[24.6-17.7]
Centre-Val de Loire	85 853	8	9.3	[4.0-18.4]
Corse	8 769	1	11.4	[0.3-63.5]
Grand-Est	184 841	17	9.2	[5.4-14.7]
Alsace	65 050	8	12.3	[5.3-24.2]
Champagne-Ardenne	45 086	4	8.9	[2.4-22.7]
Lorraine	74 705	5	6.7	[2.2-15.6]
Hauts-de-France	233 611	17	7.3	[4.2-11.7]
Nord-Pas-de-Calais	162 547	12	7.4	[3.8-12.9]
Picardie	71 064	5	7.0	[2.3-16.4]
Île-de-France²	542 752	69	12.7	[9.9-16.1]
Nouvelle Aquitaine	174 088	14	8.0	[4.4-13.5]
Aquitaine	101 948	9	8.8	[4.0-16.8]
Limousin	19 842	0	0.0	[0-18.6]
Poitou-Charentes	52 298	5	9.6	[3.1-22.3]
Normandie	112 771	10	8.9	[4.3-16.3]
Haute-Normandie	67 374	8	11.9	[5.1-23.4]
Basse-Normandie	45 397	2	4.4	[0.5-16.0]
Occitanie	186 275	14	7.5	[4.1-12.6]
Languedoc-Roussillon	90 580	10	11.0	[5.3-20.3]
Midi-Pyrénées	95 695	4	4.2	[1.1-10.7]
Pays de la Loire	130 023	8	6.2	[2.7-12.1]
Provence-Alpes-Côte d'Azur	178 465	16	9.0	[5.1-14.6]
Départements d'outre-mer³	112 093	36	32.1	[22.5-44.5]
Guadeloupe	14 784	4	27.1	[7.4-69.3]
Guyane	19 871	6	30.2	[11.1-65.7]
La Réunion	42 108	9	21.4	[9.8-40.6]
Martinique	12 467	6	48.1	[17.7-104.7]
Mayotte	22 863	11	48.1	[24.0-86.1]
metropolitan France	2 317 505	220	9.5	[8.3-10.8]
metropolitan France excluding IDF	1 837 472	151	8.2	[7.0-9.6]
France⁴	2 431 552	256	10.5	[9.3-11.9]

LBs: live births, source: INSEE (<https://www.INSEE.fr>)

¹ MMR per 100 000 LB

² Significant difference relative to the MMR of all other regions combined of metropolitan France (excluding IDF); $P < 0.01$

³ Significant difference relative to the MMR of metropolitan France; $P < 0.01$

⁴ Among the 262 maternal deaths identified by ENCMM, 5 that occurred in women residing outside France, and 1 case in Saint Martin (Overseas community), are not included in this Table

2.2.5 Other risk factors for maternal mortality

Obesity

In most wealthy countries, the frequency of obesity is increasing within both the general population and the population of parturients. In France, the proportion of women with obesity at the start of pregnancy rose from 6% in 1998 to 11.8% in 2016 (NPS) (8). This rise is worrisome because obesity is associated with a higher risk of maternal complications (9-11).

In the ENCMM, information about obesity comes from the medical file — body mass index (BMI) ≥ 30 or qualitative mention of obesity — or, for the deaths that could not be studied in detail, by the mention of obesity on the death certificate or among diagnoses listed in the hospital discharge database.

From 2013 through 2015, among the maternal deaths with information available about obesity (227/262), **24.2% (55/227) occurred in women with obesity, that is, a proportion twice as high as their representation in the general population of parturients** (8); this disparity was stable compared with the preceding period. The mean BMI among these women with obesity who died was 35.5; most had moderate obesity: 56% had a BMI between 30 and 35, 27% between 35 and 40, and 17% above 40. During the preceding periods, the prevalence of obesity among the women who died was 21% for 2010-2012, and 18.7% for 2007-2009.

Multiple pregnancy

Multiple pregnancy is a risk factor for obstetric complications and severe maternal morbidity (12).

In 2013-2015, 9 maternal deaths occurred among women with a multiple pregnancy (all twins), for a specific MMR of 21.3 deaths per 100,000 multiple deliveries (95% CI 9.8-40.5), stable compared with that observed for 2010-2012 (18.5/100,000). Women with twin pregnancies thus have a **risk of maternal mortality twice as high** (relative risk 2.0, 95% CI 0.9-3.9) as women with singleton pregnancies.

The causes of maternal death in these 9 women were the following: 3 postpartum suicides, 2 strokes, 1 amniotic fluid embolism, 1 pulmonary embolism, 1 chorioamnionitis, and 1 dilated cardiomyopathy.

Medically assisted reproduction (MAR)

Although the survey questionnaire asked about all MAR methods, we consider that the information is not reliable for hormone therapy alone (often not collected in obstetric records). *For this reason, we discuss here only in vitro fertilization.* For the 2013-2015 period, 9 maternal deaths occurred in women who became pregnant by this method including 2 with oocyte donation, or 4% of the maternal deaths (among those mentioning MAR), a proportion close to that reported among all parturients (3.3% in the 2016 NPS) (8).

Among these 9 maternal deaths, 1 occurred after a spontaneous abortion following infection from a nongenital portal of entry (intestinal perforation); 6 took place after delivery, including 2 due to postpartum hemorrhage, 2 to amniotic embolisms, 1 pulmonary embolism, and 1 suicide. The other 2 deaths took places during ongoing pregnancies, without delivery; 1 involved a uterine rupture and the other an amniotic fluid embolism.

2.3 Context of the occurrence of maternal deaths

2.3.1 Moment of occurrence of death

A maternal death can take place during a period extending from conception to 1 year after the pregnancy ended. The ENCMM extends the postpartum (or postabortion) window, long limited to 42 days (a limit still used for international comparisons) to 1 year (for late maternal deaths) as in most countries with a specific enhanced surveillance of maternal mortality. Some periods during the course of pregnancy are more critical than others for women.

Table 5A presents the timing of death in relation to the chronology of the pregnancy (gestational age and mode of termination).

I TABLE 5A I

Moment of occurrence of maternal deaths, France, 2013-2015, ENCMM data

Timing of death		n	%
After early pregnancy loss¹		19	7.3
	Ectopic pregnancy	4	1.5
	Spontaneous abortion/elective abortion/TOP ²	15	5.7
During pregnancy		44	16.8
	< 22 weeks	18	6.9
	≥ 22 weeks	26	9.9
Postpartum³		199	76.0
	< 24 h	41	15.6
	≥ 1 d ≤ 7 d	50	19.1
	≥ 8 d ≤ 42 d	45	17.2
	≥ 43 d- ≤ 365 d	63	24.0
All		262	100.0

¹ Pregnancy loss < 22 weeks

² 11 spontaneous abortions; 3 elective terminations of pregnancy; 1 medically indicated termination of pregnancy

³ Deliveries ≥ 22 weeks, including medically indicated terminations of pregnancy

The majority of deaths — 52% — took place during the peripartum period, from delivery to 42 days postpartum. Within this window, **the most critical period was the early peripartum: 16% of the deaths occurred in the 24 hours after birth (immediate postpartum) and 35% in the 7 days after delivery.**

Nonetheless, 17% of women died during an ongoing pregnancy (without giving birth).

Moreover, 7% of the maternal deaths occurred in the context of relatively early pregnancy loss, before 22 weeks: 4 ectopic pregnancies, 11 spontaneous abortions, 3 elective abortions, and 1 medically indicated termination of pregnancy. In some cases, the death was a complication of a termination of pregnancy but in most cases, the disease that caused the death was the reason for the termination, spontaneous or other. Thus, among the 11 maternal deaths associated with a spontaneous abortion, 9 were due to the complications that caused this spontaneous abortion, in particular, infections: 4 infections from a genital portal of entry (3 chorioamnionitis and 1 septic shock with *Streptococcus A*), 2 infections from a nongenital portal of entry (1 influenza B and 1 peritonitis secondary to intestinal perforation); 2 deaths of cardiovascular origin (1 valve disease and 1 dilated cardiomyopathy) and 1 severe asthma. Two other deaths after spontaneous abortions were classified as unknown, although 1 occurred in a context of hemorrhagic shock after curettage for spontaneous abortion. We also note 1 medically indicated termination of pregnancy in a woman with eclampsia. There were also 3 maternal deaths after elective abortions: 1 sudden death unexplained (33 days afterwards); 1 pulmonary embolism (45 days later) and 1 suicide (65 days afterwards).

Finally, 24% of the maternal deaths occurred between 42 days and 1 year postpartum. This proportion has doubled since the 2010-2012 period (12%), in part because of the inclusive approach we adopted for maternal suicides (see chapter 1 and 4.1). The quantitative importance of these late maternal deaths as well as the specificity of their causes (approximately half due to suicide and a third due to disease preexisting at pregnancy, principally cancer) underlines the importance of extending surveillance to this period.

2.3.2 Mode of delivery (Table 5B)

Among the 199 women who died and whose pregnancy ended by birth, mode of delivery was reported for 193: 56% were cesareans. This high proportion of cesareans reflects above all the disease that caused the death and that might have been the indication for an emergency cesarean. As Table 5B shows, in 60% (66/109) of the cesareans, the complication that led to death occurred before or during labor. Nonetheless, the cesarean delivery itself is also a risk factor for severe maternal complications, as shown in analyses of French morbidity and mortality data that controlled for this indication bias (13, 14). This is shown in this 3-year period by the still elevated proportion of cesareans among the maternal deaths due to complications occurring after delivery: 38% versus 21% among all parturients (NPS 2016) (8). These involved especially deaths due to occult postoperative hemorrhage (see chapter 4.5) or pulmonary embolism (see chapter 4.6).

I TABLE 5B I

Mode of delivery among the maternal deaths occurring postpartum, France, ENCMM data

Mode of delivery ¹	Timing of onset of the complication that led to death							
	Before labor		During labor		Postpartum		All	
	n	%	n	%	n	%	n	%
Vaginal delivery, spontaneous	5	9.8	5	14.3	53	49.5	63	33.0
Operative vaginal delivery	1	2.0	7	20.0	13	12.2	21	10.8
Cesarean	42	88.2	24	65.7	43	38.3	109	56.2
All²	48	26.4	36	18.2	109	55.4	193	100,0

¹ Among the postpartum deaths, including TOP ≥ 22 weeks

² Missing data for 6 deaths; mode of delivery not reported for 4 cases and timing of the complication not reported in 2 cases.

2.3.3 Neonatal outcome

Among the 225 women who died after 22 weeks or more of gestation, the neonatal outcome at birth was available for 97.7% (220/225). The child was live-born in 80% of cases (176/220), stillborn in 8.2% (18/220), and died in utero with their mother (pregnancy without delivery) in 11.8% (26/220). Among those live-born, 6 more died during the first 7 days of life. Overall, therefore, **50 fetuses or newborns died before or within 7 days after delivery, that is, the infants of 22.7% of the mothers who died after 22 weeks.**

The child's sex was reported in 90% of the cases (180/199): 58% (104/180) were girls, and 42% boys.

2.3.4 Place and hospital department of death

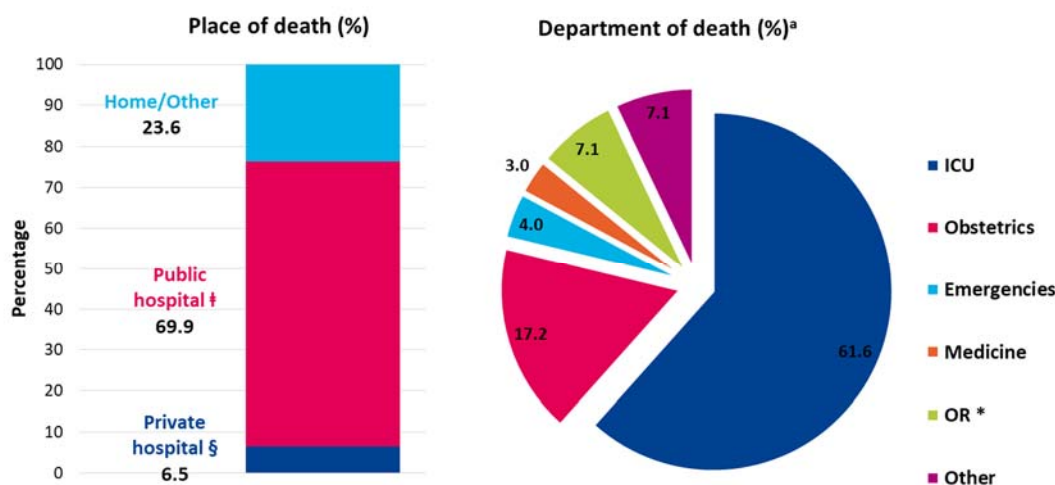
Among the maternal deaths, 69.9% occurred in public hospitals or Espic (private hospitals serving the public interest) (Figure 4), both of which have intensive care units appropriate to the management of severe complications. That is, because women with severe complications

are transferred there at the end of their health care pathway, ICUs are where the largest number of maternal deaths occur (61.6% of in-hospital deaths). This profile of the place of death does not prejudice the place where the finally lethal complication first began. Accordingly, 92% of the deaths in health care facilities took place in public hospitals or Espic, but 30% of these cases had been transferred from another facility before the death (55/183). Inversely a marginal proportion of the deaths in private facilities involved women transferred there before death (12%, 2/17).

The proportion of deaths taking place elsewhere than a health care facility (most often, at home) is notable: 23.6% *versus* 16% in 2010-2012 and 12% in 2007-2009. This increase is explained mainly by the larger number of suicides identified for the 2013-2015 period; this cause of death accounted for 45% of the deaths outside health care facilities (28/62). The other dominant picture among these noninstitutional deaths is that of sudden deaths (15/62), whether the cause was identified (n= 6, principally cardiovascular) or not (n=9) (see chapter 4.2).

I FIGURE 4 I

Place of the occurrence of maternal deaths, France, 2013-2015, ENCMM data



† Including ESPIC (private establishments of public/community interest)

§ Private, profit-making hospital

ª % among 183 maternal deaths in health care facilities

* Including recovery rooms

Other: palliative care post-acute care and rehabilitation.

2.3.5 Autopsies

Only 29.7% of maternal deaths led to an autopsy, a proportion that has not changed from the preceding periods. Proportionally, autopsies were more frequent when the death occurred at home (or somewhere other than a health care facility) (Table 6A). In public hospitals, 1 maternal death of 4 undergoes an autopsy. Globally, more than half the autopsies were demanded in medicolegal contexts. Analysis by cause of death shows that **the proportion of autopsies is low** regardless of the cause, except for deaths by infection from a genital portal of entry (83%) (Table 6B).

Although maternal autopsies are strongly recommended or even routine in some countries, their need varies according to the cause of death, and whether or not the causal diagnosis could or could not be supported by other examinations. Thus, all the deaths by stroke in this report underwent cerebral imaging (see chapter 4.7). On the other hand, it is particularly regrettable that only 25% of the deaths of unknown causes led to an autopsy. Similarly, the proportion of 53% for autopsies among the deaths due to amniotic fluid embolism is low given the diagnostic challenge of this complication.

Among the maternal deaths with an autopsy, the autopsy report was available for the ENCMM in 50 cases (of the 74 autopsies performed). Among them, nearly half (20/50) were of an **inadequate quality** and did not adhere to the practice guidelines for autopsy (15). The nonconformity was due to: failure to open the skull and study the encephalic contents; failure to study the neck organs; failure to weigh the organs; failure to study the lumina of the iliac veins and/or the vena cava; excessively succinct or incomplete drafting of the report; and autopsies limited to opening the abdomen. Beyond the purely macroscopic observations, of the 50 autopsies practiced, 14 did not take samples and perform histologic examinations. For 9 of these 14 cases, this omission impeded an etiological diagnosis.

The case files do not routinely note the reasons an autopsy was not performed. Nonetheless among the maternal deaths without an autopsy, in 21 cases, the medical team proposed it but the family refused. Five other cases involved deaths with a "medicolegal obstacle," that is, they were under the jurisdiction of the Prosecutor's office, which considered that an autopsy was unnecessary (3 suicides, 1 hypertensive cardiopathy, and 1 heart rhythm disorder in a woman with pregnancy-related hyperemesis).

Besides autopsies, postmortem imaging examinations can establish some causes of death. Thus, in this 3-year period, a postmortem computed tomography (CT) scan enabled a diagnosis for 4 deaths: 2 aortic dissections (ADs) and 2 pulmonary embolisms.

This low global proportion of maternal autopsies in France is regrettable because these examinations often enable a definitive diagnosis of the cause of death. The absence of certainty about diagnosis negatively affects the relevance of the prevention messages identified by this analysis of maternal deaths. Moreover, the autopsy can provide information that can be useful to the family in the cases of hereditary or other familial diseases.

This situation in France contrasts with those in other countries that use enhanced surveillance of maternal mortality, in particular in Europe, where autopsies are very frequent or even routine for maternal deaths, which are one of the situations in which an autopsy is strongly recommended (European directives) (16). An analysis is needed of the organizational, financial, and cultural obstacles to the extensive practice of autopsies of maternal deaths in France.

I TABLE 6A I

Autopsy performance for maternal deaths, globally and by place of death, France, 2013-2015, ENCMM data.

Place of death	All autopsies		Medicolegal autopsies ¹	
	n	%	n	%
Public hospital ² (N= 178)	47	26.4	14	29.8
Private hospital ³ (N =15)	3	20.0	1	33.3
Domicile and other locations (N =56)	24	42.9	22	91.7
All⁴ (N =249)	74	29.7	37	50.0

¹ Unspecified for 4 deaths

² Including ESPIC (private health care facilities of collective interest)

³ Private, profit-making hospital

⁴ Missing data about the performance of an autopsy for 13/262 maternal deaths

I TABLE 6B I

Autopsy performance by maternal cause of death, France, 2013-2015, ENCMM data

Cause of death	Autopsy	
	n	%
First-trimester hemorrhage (N=4)	1	25.0
Obstetric hemorrhage (N=19)	5	26.3
Amniotic fluid embolism (N=28)	15	53.6
Venous thromboembolism (N=23)	6	26.1
Hypertensive complications (N=6)	0	0.0
infection from a genital portal of entry (N=11)	9	81.8
Anesthesia complication (N=4)	0	0.0
Stroke (N=13)	1	7.1
Cardiovascular diseases ¹ (N=36)	11	30.6
Infections from a nongenital portal of entry (N=10)	2	20.0
Preexisting diseases ² (N=24)	2	8.3
Suicide (N=29)	9	31.0
Unknown cause (N=33)	9	27.3
All (N=249)³	74	29.7

¹ Including peripartum cardiomyopathy

² Preexisting diseases, excluding stroke, cardiovascular diseases, and infections, known or discovered during pregnancy

³ Missing data about the performance of an autopsy for 13/262 maternal deaths

The textbox below describes 2 maternal deaths where the cause, not previously considered, was established by autopsy.

**Of the importance of "anatomical" or "clinicopathologic" verification
(textbox by Etienne Beaumont)**

Anatomical verification involves the meticulous description of organs and tissues, both macroscopic (by sight and imaging) and microscopic. Anatomical verification has 2 advantages: 1) when it is positive, it establishes the diagnosis; and 2) when it is negative, it guides the diagnostic process toward metabolic, toxic, or even genetic, diseases and reorients appropriate investigations.

Case N°1

A nulliparous patient in her first pregnancy presented with abdominal pain at 40 weeks + 5 days. Several minutes after her admission, she lost consciousness and became cyanotic. Resuscitation maneuvers kept her alive for 2 hours, enabling an emergency cesarean; disseminated intravascular coagulation developed, and ECMO was envisioned. Cardiac ultrasound showed an overload of the right chambers and a "fine layer of pericardial effusion." She died 2 hours after losing consciousness.

The autopsy documented an AD, with a dissecting hematoma of the ascending aorta and 200 mL of blood in the hemopericardial space. The cause of death here, by cardiac tamponade, was clearly established. At first glance and without subsequent anatomical verification, however, it could have been attributed to an amniotic fluid embolism, and the imaging performed was not sufficient for diagnosis.

Case N°2

A 35-year-old woman, with her second pregnancy, had delivered her first infant by cesarean for breech presentation, had no preexisting disease except for overweight (BMI 27.6), and went into labor spontaneously at term. At 8 centimeters of dilation, she went into cardiac arrest, with no prodrome. Resuscitation maneuvers were undertaken, and an emergency cesarean in the third minute after the cardiac arrest, enabled the live birth of the neonate. The resuscitation maneuvers did not enable restoration of effective cardiac activity. The cesarean was followed by a hemorrhage due to coagulation disorders. Diagnoses considered included an amniotic fluid embolism and then a pulmonary embolism. The mother died after 5.5 hours of resuscitation maneuvers.

The anatomical verification showed an excessively heavy heart, and the right ventricle wall presented characteristics of arrhythmogenic dysplasia. The unexpected onset of the fatal arrhythmia turned out to be explained by an inherited disease, transmitted as an autosomal dominant trait. Stress, exertion, and use of adrenergic medication can trigger irreparable ventricular arrhythmias in someone with this gene.

The consequence of ascertaining this diagnosis are important: on the one hand, the obstetric team cannot be held responsible; on the other hand, the discovery of this inherited disease requires a family investigation.

2.4 Causes of maternal deaths

Table 7 presents the distribution of the causes of maternal deaths in 2013-2015. It also shows the distribution of causes for the previous period for comparison's sake. This distribution is shown for total maternal mortality, that is, up to one year after the end of pregnancy, but also for mortality up to 42 days postpartum. We show the latter for international comparisons, because some countries do not collect these data after 42 days. The new approach adopted for suicides, which increases the number of late maternal deaths, has little effect on deaths up to 42 days, for the great majority of suicides occur after this point in time.

Several results are notable for this 2013-2015 period.

Two causes dominate, in almost identical numbers: cardiovascular diseases and suicides.

Cardiovascular diseases, one of the 2 leading causes of maternal mortality, are responsible for 36 deaths over the 3-year period: 30 among the indirect deaths, and 6 peripartum cardiomyopathies (PPCMs), classified as direct maternal deaths. They thus account for 13.7% of the maternal deaths, at an MMR stable relative to the preceding 3-year period. In this group, the most frequent causes were preexisting cardiomyopathy (n=10), AD (n=9), and PPCM (n=6). Chapter 4.1 specifies the clinical aspects of these cases and their preventability.

Suicide has now become 1 of the 2 leading causes of maternal mortality, with 35 suicides over the 3-year period, approximately 1 a month, for 13.4% of maternal deaths. The marked increase in the contribution of suicides to maternal mortality compared with the preceding period, both proportionally but also as a specific rate, is of course explained by the new approach adopted for this class of deaths and the efforts made to identify them (see chapter 1). It is nonetheless the case that this report provides a much better reflection of the reality of maternal suicides and underlines the major role that mental health (mental illness) plays in maternal mortality. It also shows the importance of analyzing these women's pathways to identify methods of prevention (see chapter 4.2).

Amniotic fluid embolism is the third leading cause of mortality for this period, responsible for 28 maternal deaths, for an MMR stable from the preceding period.

Venous thromboembolisms (n=23) and obstetric hemorrhages (n=22) essentially tied for fourth position. **A consequential result of this 3-year period is that for the first time since the ENCMM began, obstetric hemorrhages are no longer the leading cause of maternal deaths.** The 2 leading causes of hemorrhages were cesarean wounds (n=5) and placental abruption (n=5), rather than uterine atony as in the preceding periods.

The other causes — including but not limited to stroke, pregnancy-related hypertensive complications, and infections by either a genital (direct infection) or a nongenital (indirect) entry portal — each accounted for less than 5% of the maternal deaths. Nonetheless, the increased contribution of genital infections for the 2013-2015 period — 11 deaths (4.2%) versus 6 deaths (2.4%) for 2010-2012 — is a worrisome result and doubled the MMR; this rise was nonetheless not statistically significant because of the small number of individuals.

Complications of anesthesia and resuscitation caused 4 (1.5%) maternal deaths during this period (see the textbox below).

Maternal mortality by complications of anesthesia-resuscitation

During this study period, 4 deaths were attributed to either a complication of anesthesia or to management of resuscitation; this constituted 1.5% of the maternal deaths and a specific MMR of 0.16 maternal deaths per 100 000 LBs, stable over time. These cases were:

- cardiorespiratory arrest on a sympathetic block secondary to excessive doses of spinal anesthesia: a patient with morbid obesity, who gave birth at 38 weeks by emergency cesarean due to a fetal heart rhythm disorder during induction of labor for proteinuria. Hypotension occurred immediately after spinal anesthesia.

- An acute subdural hematoma the day after regional anesthesia: A planned cesarean at 38 weeks for a nonhemorrhagic low-lying placenta, and, 24 hours later, thunderclap headaches, followed by blindness, loss of consciousness, and hypotension. The acute subdural hematoma was found on the CT scan. The association with spinal anesthesia the day before (hypotension due to CSF) is hypothetical but has been described in the literature.

- A laceration of the subclavian artery by placement of an ECMO cannula for acute respiratory syndrome secondary to H1N1 influenza: an obese woman, hospitalized at 31 weeks for hyperthermia and coughing. An emergency cesarean was performed for a fetal heart rate anomaly. At D3 postpartum, under noninvasive 60% ventilation, it was decided to switch rapidly to mechanical ventilation in view of the severity of the respiratory involvement and then to ECMO for refractory hypoxia.

- Anaphylactic shock from exposure to beta-lactams: a patient who gave birth at term. She received an injection of Augmentin® for a manual uterine examination; it was followed rapidly by signs of anaphylaxis and cardiac arrest. Resuscitation was complicated by substantial laryngeal edema that prevented orotracheal intubation.

Moreover, anesthesia contributed to another death due to a postcesarean hemorrhage: the administration of a strong dose of adrenaline (2 mg IV in a woman with hypotension but not in cardiac arrest) could have triggered a heart rhythm disorder and circulatory failure.

Finally, no cause could be established for 14% (n=37) of maternal deaths. In more than half the cases, these unexplained deaths fulfilled the criteria for sudden death, that is, a nontraumatic death with a rapid onset in less than an hour after symptoms began, and unexpected (terminal-stage chronic diseases were ruled out) (see chapter 4.1). The high number of these maternal deaths of unknown causes again underlines the importance of promoting autopsies in these cases: only 27% of these women who died of unknown causes were autopsied.

The profile for maternal mortality up to 42 days shows few differences, beyond the differential contribution of suicides. Its principal causes were cardiovascular diseases and amniotic embolisms, followed by obstetric hemorrhages and then venous thromboembolisms. We note that among the 35 maternal suicides, only 8 occurred during pregnancy or in the 42 days that followed the end of the pregnancy. This finding underlines the importance of not being limited to this period for the study of maternal mental health.

The sections of chapter 4 of this report detail the clinical aspects of maternal mortality by cause.

I TABLE 7 I
Maternal mortality by cause of death, France, 2010-2012 and 2013-2015, ENCMM data

CAUSES	2010-2012						2013-2015					
	Up to 42 days		Up to 1 year		Up to 42 days		Up to 1 year		Up to 42 days		Up to 1 year	
	n/%	MMR	n/%	MMR	n/%	MMR	n/%	MMR	n/%	MMR	n/%	MMR
DIRECT CAUSES	107	47.6	4.3	119	46.9	4.9	101	51,5	4,2	111	42,4	4,5
First-trimester hemorrhages	5	2.2		5	2.0	0.2	4	2.0		4	1.5	
Following an ectopic pregnancy	3	1.3		3	1.2		4	2.0		4	1.5	
Following an elective abortion ¹	2	0.9		2	0.8		0	0.0		0	0.0	
Obstetric hemorrhage	29	12.9	1.2	29	11.4	1.2	21	10.7	0.9	22	8.4	1.0
Uterine atony	12	5.3		12	4.7		4	2.0		4	1.5	
Uterine rupture	6	2.7		6	2.4		2	1.0		2	0.8	
Surgical wounds and injuries	6	2.7		6	2.4		5	2.5		5	1.9	
Placenta accreta/percreta	2	0.9		2	0.8	0.5	2	1.0		2	0.8	
Placenta previa	0	0.0		0	0.0		2	1.0		2	0.8	
Placental abruption ²	1	0.4		1	0.4		4	2.0		5	1.9	
Unspecified cause	2	0.9		2	0.8		2	1.0		2	0.8	
Amniotic fluid embolisms	24	10.7	1.0	24	9.4	1.0	28	14.3	1.2	28	10.7	1.2
Venous thromboembolisms	24	10.7	1.0	26	10.2	1.1	19	9.7	0.8	23	8.8	1.0
Pulmonary embolism	22	9.8		24	9.4		17	8.7		20	7.6	0.8
Cerebral venous thrombosis	2	0.9		2	0.8		2	1.0		3	1.1	
Pregnancy-related hypertension	10	4.4	0.4	12	4.7	0.5	5	2.6	0.2	6	2.3	
Preeclampsia	3	1.3		4	1.6		0	0.0		0	0.0	
Eclampsia	2	0.9		3	1.2		2	1.0		3	1.1	
HELLP syndrome	4	1.8		3	1.2		2	1.0		2	0.8	
Other	1	0.4		2	0.8		1	0.5		1	0.4	
Infections from a genital portal of entry	6	2.7	0.2	6	2.4	0.2	11	5.6	0.5	11	4.2	0.5
Complications of anesthesia	4	1.8	0.16	4	1.6	0.16	3	1.5	0.12	4	1.5	0.16
Peripartum myocardopathy	0	0.0		5	2.0		4	2.0		6	2.3	
Other direct												
Choriocarcinoma	0	0.0		4	1.6		1	0.5		2	0.8	
Complication of obstetric surgery	1	0.4		1	0.4		1	0.5		1	0.4	
Other ³	4	1.8		4	1.3		4	2.0		4	1.5	

MMR: Maternal mortality ratio per 100 000 LBs

¹ 2 Elective abortions in 2010-2012 including 1 clandestine

² Among the 5 cases of placental abruption in the 2013-2015 period, no confidential enquiry could be conducted for 2 cases in Mayotte; the diagnosis of placental abruption is that mentioned on the death certificate

³ 2013-2015: 2 deaths associated with a hidden delivery at home without health care utilization, 1 with thrombocytopenic thrombotic purpura; and 1 with electrolyte disorders associated with uncontrollable vomiting in early pregnancy

CAUSES	2010-2012						2013-2015					
	Up to 42 days			Up to 1 year			Up to 42 days			Up to 1 year		
	n/%	MMR	n/%	MMR	n/%	MMR	n/%	MMR	n/%	MMR	n/%	MMR
INDIRECT CAUSES	78	34.7	3.2	89	35.0	3.6	54	27.6	2.2	79	30.2	3.3
Diseases of the circulatory system												
Strokes ⁴	18	8.0	0.7	21	8.3	0.9	11	5.6	0.4	13	5.0	0.5
Cardiovascular diseases	20	8.9	0.8	23	9.1	0.9	26	13.3	1.0	30	11.5	1.2
Preexisting cardiomyopathy	8	3.6		10	3.9		8	4.1		10	3.8	
Valvular heart disease	3	1.3		4	1.6		4	2.0		4	1.5	
Ischemic heart disease	1	0.4		1	0.4		4	2.0		4	1.5	
Primary pulmonary hypertension	3	1.3		3	1.2		0	0.0		1	0.4	
Other ⁵	0	0.0		0	0.0		1	0.5		1	0.4	
Aortic dissection	0	0.0		0	0.0		8	4.1		9	3.4	
Other arterial rupture ⁶	5	2.2		5	2.0		1	0.5		1	0.4	
Infections from a nongenital portal of entry	14	6.2	0.6	16	6.3	0.6	8	4.1	0.3	10	3.8	0.4
Respiratory diseases	2	0.9		2	0.8		1	0.5		3	1.1	
Cancer	7	3.1		7	2.8		4	2.0		16	6.1	0.6
Epilepsy	4	1.8		4	1.6		1	0.5		1	0.4	
Metabolic and endocrine diseases	1	0.4		2	0.8		0	0.0		0	0.0	
Sickle-cell anemia	3	1.3		3	1.2		1	0.5		2	0.8	
Psychoactive substance abuse	0	0.0		0	0.0		1	0.5		2	0.8	
Other⁷	9	4.0		11	4.3		1	0.5		2	0.8	
SUICIDES	5	2.2	0.2	10	3.9	0.4	8	4.1	0.3	35	13.4	1.4
UNKNOWN CAUSES	35	15.6		36	14.2		33	16.8		37	14.1	
Sudden unexplained death	22	9.8	0.9	23	9.1	0.9	17	8.7	0.7	20	7.6	0.8
Other maternal deaths of unknown causes	13	5.8	0.5	13	5.1	0.5	16	8.2	0.6	17	6.5	0.7
ALL CAUSES	225	100.0	9.5	254	100.0	10.3	196	100.0	8.1	262	100.0	10.8

⁴ Does not include cerebral thrombophlebitis, classified as a venous thromboembolism (n= 2 for 2010-2012 and n=3 for 2013-2015)

⁵ 2013-2015: 1 arrhythmia of unknown cause

⁶ 2013-2015: 1 rupture of the splenic artery

⁷ 2013-2015: 1 autoimmune cirrhosis, 1 mixed connective tissue disease

2.4.1 Trends over time in the profile of causes of maternal mortality

The changes recorded must be interpreted while taking into account the advances in ENCMM's methods, which have sought to improve the identification and study of maternal deaths. For this reason, Figure 5 shows the trends in maternal mortality by cause (MMR) over the past three 3-year ENCMM periods, as we can consider that the general method between 2007 and 2015 is comparable. Several notable changes have appeared.

We observed a **significant reduction in direct maternal mortality** between 2007 and 2015 with an MMR/100 000 LBs falling from 5.9 in 2007-2009 to 4.5 in 2013-2015 (Figure 5).

The **significant diminution in deaths from obstetric hemorrhage** (MMR falling from 1.6 in 2007-2009 to 1.0 in 2013-2015) largely explains this trend, and especially the reduction in deaths due to uterine atony (dropping from 0.9 or 21 deaths in 2007-2009 to 0.2 or 4 deaths in 2013-2015, an MMR divided by 4). Hypertensive complications are the other entity to have shown a remarkable and significant reduction over time (MMR falling from 0.9 in 2007-2009 to 0.2 in 2013-2015), although their contribution to maternal mortality has always been less than that of hemorrhages. Finally, we also note within this direct mortality a nonsignificant increase, given the small number of individuals, of mortality by infections with a genital portal of entry between the last two 3-year periods, with the MMR rising from 0.2 in 2010-2012 to 0.5 in 2013-2015), while nonetheless remaining a small fraction.

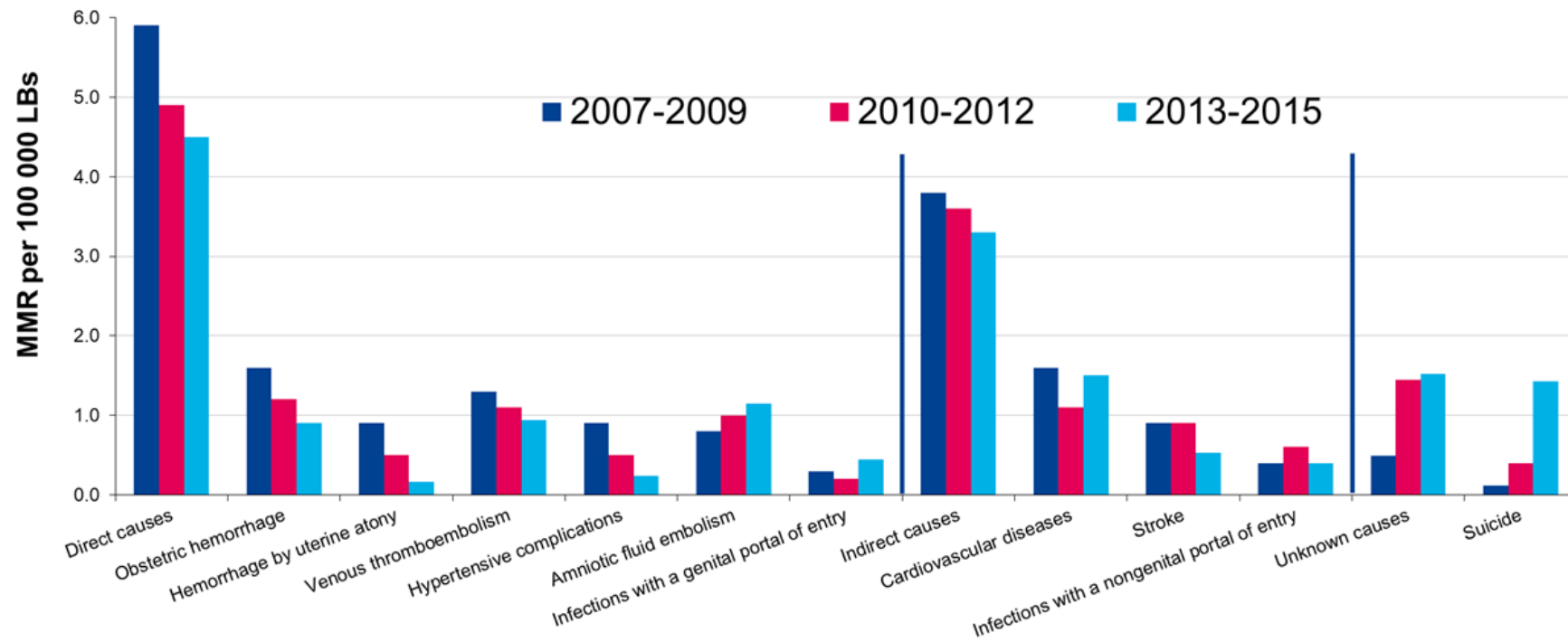
This **overall reduction in direct maternal mortality is a major result** because it is considered the most preventable type of mortality and **that most strongly associated with the quality of obstetric care as well as of obstetric anesthesia and resuscitation care**. It can thus be interpreted as the result of a comprehensive improvement in care.

This change is less clear for indirect maternal mortality, with an MMR that shows no significant change (Figure 5). Within the indirect maternal deaths, the cause with the strongest contribution is cardiovascular disease, with an MMR stable around 1.3 between 2007 and 2015. Strokes tended to fall, although this change was not statistically significant, with an MMR falling from 0.9 to 0.5 between 2007 and 2015.

Suicide is not included in Figure 5 because they can be considered to have been reliably identified only in the most recent period — 2013-2015. Interpretation of their substantial increase between 2007 and 2015 must take this fact into account.

I FIGURE 5 I

Trends in maternal mortality by cause of death over 9 years of triennial MMR, France, 2007-2015, ENCMM data



Note: * Including peripartum cardiomyopathy.

2.5 International comparisons

Comparison of maternal mortality between countries requires consideration of the methods of measurement and classification in each country to judge the comparability of the data. Only the countries or regions with a permanent and *enhanced* surveillance system — that is, with the most exhaustive possible identification of deaths and detailed documentation and expertise for the classification and study of maternal mortality to enable relevant comparisons. There are few such countries.

Figure 6 shows a comparison of the level of maternal mortality in France and in other wealthy countries with an enhanced surveillance system for a period close to that of this report. The United States and France are the only countries to report an MMR for a year after birth (17, 18). For the denominator, the United Kingdom (UK) and Australia use total deliveries ("*maternities*") and not live-births, but that makes very little difference, in view of the very low level of the numerators relative to the denominators (19, 20).

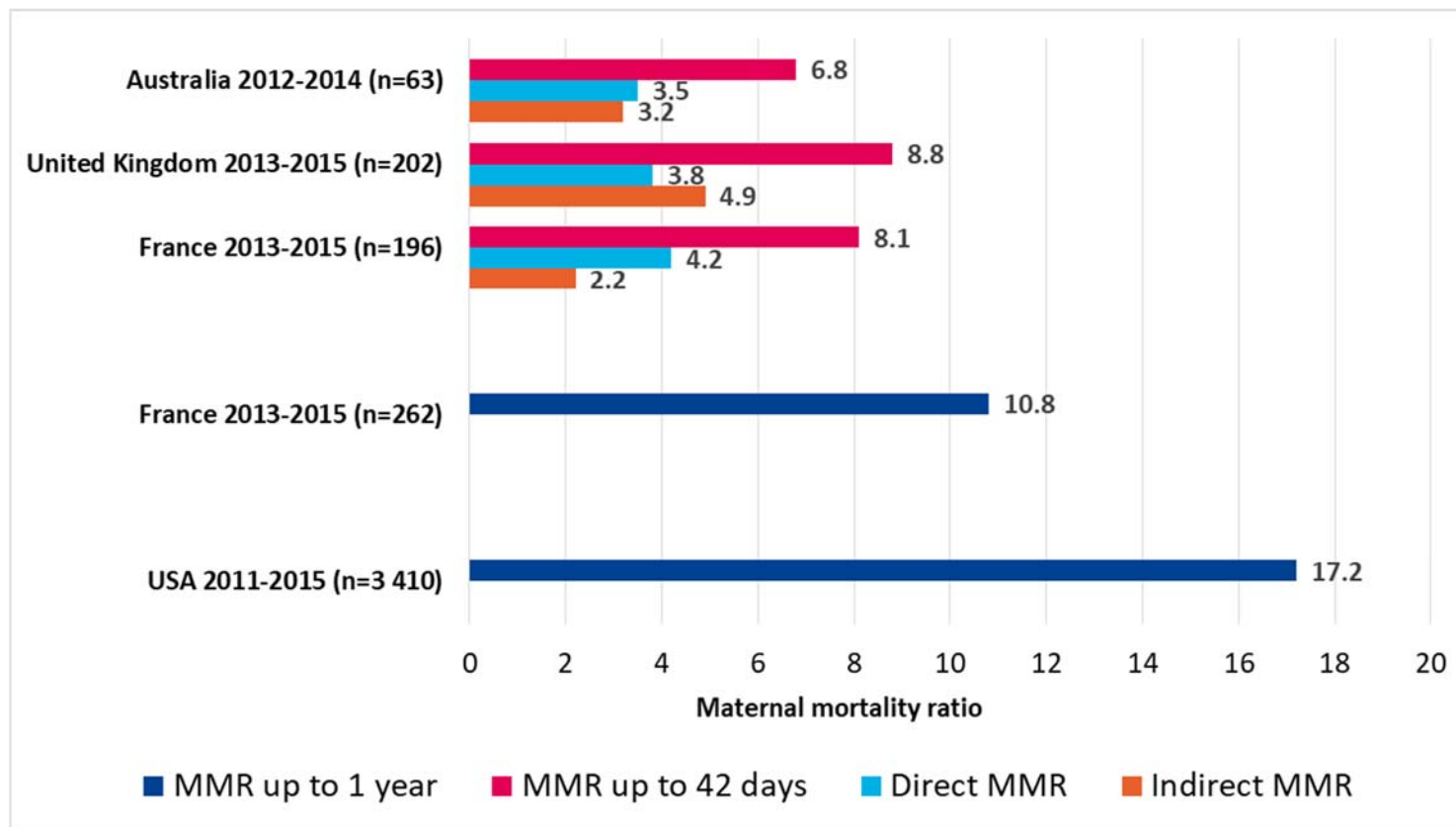
For maternal mortality limited to 42 days (top of Figure 6), the French MMR is similar to that of the UK (8.1 *versus* 8.8), but higher than that of Australia (8.1 *versus* 6.8). Direct mortality is predominant in France, although in other countries it is lower than indirect mortality. The MMR for indirect causes in the UK is nearly twice as high as that in France (4.9 *versus* 2.2); this difference is principally due to the very strong contribution of cardiovascular mortality in the UK.

The comparison of France and the USA for maternal mortality up to 1 year after the end of pregnancy shows a rate 1.5 times higher in the USA (17.2 vs 10.8) and rising. As in France, cardiovascular disease is the leading cause of maternal mortality, but its predominance is more marked because it is responsible for 26% of maternal deaths compared with 14% in France.

These differences between countries enable awareness of the specificity of maternal mortality profiles in a given national or regional setting. They can be due to variations in the risk profiles of parturients. In particular, this is the case for the frequency of obesity, a risk factor especially for cardiovascular diseases and hypertensive complications, which are clearly more prevalent in the UK and the USA than in France. They can also be explained by variations in factors linked to the health care system, especially concerning methods of prenatal follow-up and the management of delivery. Beyond their description, an understanding of the mechanisms involved in these disparities between countries requires particular analyses.

I FIGURE 6 I

International comparisons, maternal mortality ratios, and profiles in other countries with an enhanced system for the study of maternal mortality



MMR per 100 000 LBs or deliveries
 MMR up to 42 days, with as a denominator the total number of deliveries (LBs or stillbirths)
 MMR up to 1 year, with as a denominator the total number of LBs
 Data from (17-20)

Chapter 3.

ADEQUACY OF CARE AND PREVENTABILITY OF MATERNAL DEATHS

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This chapter presents the synthesis of the conclusions of the committee of experts (CNEMM) about, on the one hand, the adequacy of care provided to women before their deaths, and, on the other hand, the factors related to preventability for the maternal deaths identified for the period 2013-2015. Chapter 1 describes the CNEMM's process of evaluation and judgment.

Here we describe the global results. The lessons about these aspects of adequacy of care and preventability *by cause* of maternal death are described in chapter 4 for the two main causes, cardiovascular diseases (4.1) and suicides (4.2) (details for other causes in the French report).

While the ENCMM can succeed in identifying all of the possibly maternal deaths and collect for them a minimum of information making it possible to classify them as maternal deaths and to identify their cause, only the confidential enquiry itself can collect the detailed information necessary for the CNEMM to reach a judgment about the care and its preventability . When this survey cannot take place, a valid expert assessment of the care pathway for the women who died is not possible. This explains the discrepancy between the total number of maternal deaths as reported in chapter 2, and the number of deaths analyzed in this chapter and the next, which are limited to the deaths for which a confidential enquiry actually took place.

3.1 The number of maternal deaths analyzed by the CNEMM

For 2013-2015, sufficient information was collected by the confidential survey for 249 maternal deaths, that is, **95%** of the 262 identified to enable the Committee to conduct a valid expert assessment (Table 8). This **assessment rate** has improved substantially, from 73% for 2007-2009 and 83% for 2010-2012 (21).

This overall improvement is due to the increasing awareness of health care establishments and providers of the ENCMM's importance, to the institutional support of Public Health France, and to the involvement of the perinatal health networks in the functioning of the ENCMM. Together these have improved the collection of useful information and facilitated the field enquiries.

The 13 deaths for which the survey could not be completed are explained essentially by the very recent inclusion of Mayotte in this system (6 of the 13 deaths without enquiries occurred there) and by some medicolegal procedures still underway.

The rest of chapter 3 and chapter 4 concern the 249 maternal deaths with complete confidential enquiries and assessed by the CNEMM.

I TABLE 8 I

Proportion of maternal deaths with complete CNEMM assessments, globally and by place of death, France, 2010-2012 and 2013-2015, ENCMM data

Place of death	2010-2012			2013-2015		
	Total deaths	Deaths with expert assessments		Total deaths	Deaths with expert assessments	
		n	%		n	%
Home/Other out-of-hospital	39	30	76.9	62	58	93.5
Public hospital ¹	195	165	84.6	184	177	96.2
Private hospital ²	20	15	75.0	16	14	87.5
All	254	210	82.7	262	249	95.0

¹ Including ESPIC (private health care facility of collective interest)

² Private profit-making hospitals

3.2 Adequacy of care

Several aspects of care can be involved in the management of each maternal death. When it is relevant, the CNEMM experts judge each of the following 7 aspects of care: preconception management, prenatal care, primary and emergency care (at the ER or out-of-hospital emergency medical services (EMS), including the SAMU, SMUR, firefighters, etc.), and for the management of the complication itself, obstetric care, anesthesia care, resuscitation/intensive care, and other types of specialized care (psychiatry, cardiology, etc.).

3.2.1 Global level of nonoptimal care among the mothers who died

Table 9 presents the global results about the adequacy of care. The cases are classified as having received nonoptimal care if at least 1 aspect of management was considered nonoptimal. Among the 249 maternal deaths assessed, the CNEMM considered the information available insufficient to be able to judge the adequacy of care, regardless of the aspect, in 8 cases (3%) for which the conclusion was therefore not established. Nonetheless, this proportion varied according to the type of care considered; for example, preconception care was the category with the highest proportion without any conclusion: 52% (42/81).

Overall, for the 2013-2015 period, **care was judged nonoptimal for 66% (159/241) of the deaths assessed**, a proportion similar to that for the 2 preceding periods (60% in 2010-2012, 70% in 2007-2009).

3.2.2 Nonoptimal care according to the cause of death

The proportion of nonoptimal care varied according to the causal disease (Table 9). It was higher among the deaths due to direct obstetric causes, 74.5% (proportion similar to that in 2010-2012) than among the indirect deaths (58.8%).

Nonoptimal care was identified in **72% of the deaths from cardiovascular diseases**, 1 of the 2 leading causes of maternal mortality, and in **70% from the other principal cause — maternal suicides**. The identification of specific **opportunities for improvement** for these 2 causes is therefore a **priority for this report**; they are detailed in the specific subchapters devoted to them (see 4.1 and 4.2).

Within the deaths from direct causes, the causes for which nonoptimal care was found most often were hypertensive complications (100%), obstetric hemorrhages (84%), infections with a genital portal of entry (73%), and amniotic embolisms (74%). **Although the number of**

deaths by hemorrhage has fallen as a while, those that remain presented very largely nonoptimal care; this suggests that there is still a margin for improving management and reducing this mortality.

We note the **increase in the proportion of nonoptimal care among the deaths by amniotic fluid embolism**, which rose from 31% in 2007-2009, to 56% in 2010-2012, and 74% for 2013-2015, a trend that probably reflects a change in perspective on this disease, previously considered always fatal, and the progress made in treating its symptoms (cardiac arrest, hemorrhage). Unlike the profile of deaths due to hemorrhage, the MMR from amniotic fluid embolism has not decreased over the past 10 years and is now the third leading cause of maternal mortality. This strong contribution to maternal mortality, associated with the high proportion of nonoptimal care, makes this cause of death a priority in terms of prevention.

Finally, **the deaths due to infection from a genital portal of entry**, although a minority of maternal mortality, occur at an increasing frequency (see chapter 2.4) and involve a high proportion of nonoptimal care, around 80% and stable over the past decade. This worrying profile nonetheless suggests there is substantial room for improvement. This high rate of nonoptimal care is also noted for the infections with a nongenital portal of entry (90%).

With this still high rate of nonoptimal care, it is important to note that a single act of care that does not correspond to the guidelines means that the entire management is labelled nonoptimal and that nonoptimal care does not necessarily mean that the death was preventable (see chapter 1). Nonetheless, the proportion of deaths judged probably or perhaps preventable is close to the proportion considered to have received nonoptimal care, as mentioned below in chapter 3.3.

3.2.3 Types of nonoptimal care

Table 10 presents for the 159 deaths with overall nonoptimal care, the type (or types) of care that were nonoptimal, globally and by cause of death. For each type of care considered, the proportion of nonoptimal care is calculated among the women who died who received such care. For example, preconception care is not relevant to a death by amniotic fluid embolism. Similarly, the out-of-hospital EMS is not in question if there was none for the acute complication.

As expected, the **proportion of nonoptimality was highest for obstetric care — 40%** (77/190) of deaths where this type of care was concerned, and for **anesthesia and/or resuscitation — 38%** (73/192). These categories of nonoptimal care are dominant in the deaths from direct causes, especially amniotic embolisms and hemorrhages.

Less well-known, **preconception management was judged nonoptimal in 36%** (14/39) of the women who died for whom it was relevant. This aspect is notable in the deaths due to **preexisting diseases** (preconception care not optimal in 26% of the cases — 12/47), and those from **cardiovascular causes** (approximately one third of the cases with nonoptimal management — 9/26). Preconception management is an essential aspect of care for women with preexisting diseases or a serious medical history, such as pulmonary arterial hypertension, some heart defects, or epilepsy — all situations in which the excess risk of maternal mortality is known (22). As a reminder, in 2009, the HAS issued guidelines concerning the referral of these women before conception (23). Chapter 4.1 approaches the improvable aspects of the care specific to these deaths.

Prenatal care was nonoptimal in 30% of the cases for which it was relevant (55/184). This inadequate prenatal care was more frequent among the indirect than among the direct maternal deaths (45% (21/47) versus 21% (17/79)).

This inadequate prenatal care was particularly present among the women who died of **cardiovascular causes** (46%, 12/26). This was due to flawed organization of multidisciplinary

prenatal management (obstetrics-cardiology) for the women with a known disease or, for cases discovered during pregnancy, to the focus of the prenatal medical examination on its obstetric aspects, which could lead to diagnostic error (see chapter 4.1).

The other category of deaths where prenatal care was often found to be nonoptimal concerned the **suicides** (52%, 11/21). Here, the problem was the absence of prenatal multidisciplinary management between the obstetrics professionals, the psychiatric professionals, and possibly the GP. It also involved communication between private and hospital-based practitioners. Finally another reason for this nonoptimal care was the focus of the medical examination on the obstetric situation to the detriment of the woman's mental health (see Chapter 4.2).

Primary care in emergency situations — out-of-hospital EMS, GPs, and the ED — were inadequate in 32% (39/121) of the deaths for which it was relevant. The 2 causes of death most concerned were **pulmonary embolisms** — (9/13), often caused either by diagnostic errors leading to diagnostic delay despite suggestive symptoms or by delay in starting the appropriate care (see chapter 4.6 of French report); **and cardiovascular disease** (39%, 10/26), especially due to failure to recognize such warning symptoms as orthopnea or chest pain.

Finally, other inadequate care, that is, other specialized care besides obstetrics, was identified in 72% (31/43) of the deaths involving them. This type of nonoptimal care concerned above all else the **suicides**.

I TABLE 9 I
Nonoptimal care among the maternal deaths, globally and by principal causes of death, France, 2010-2012 and 2013-2015, ENCMM data

Causes of death ¹	2010-2012				2013-2015			
	N	No conclusion (n)	Care Not optimal (n)	% ²	N	No conclusion (n)	Care Not optimal (n)	% ²
Direct	98	7	67	73.6	108	2	79	74.5
Obstetric hemorrhage	23	1	22	100.0	19	0	16	84.2
Amniotic fluid embolism	23	0	13	56.5	28	1	20	74.1
Venous thromboembolism	18	1	10	58.8	23	1	13	59.1
Complication of hypertension	10	1	7	77.8	6	0	6	100.0
Infections from a genital portal of entry	6	1	4	80.0	11	0	8	72.7
Indirect	82	6	42	55.3	80	0	47	58.8
Stroke	17	0	5	29.4	13	0	3	23.1
Cardiovascular diseases ³	23	1	11	50.0	36	0	26	72.2
Infections from a nongenital portal of entry	12	2	7	70.0	10	0	9	90.0
Preexisting diseases ⁴	18	1	12	70.5	24	0	12	50.0
Suicide	9	2	5	71.4	31	2	21	72.4
Unknown causes	30	4	5	19.2	31	4	13	48.1
All causes	210	17	115	59.6	249	8	159	66.0

¹ Selection of the principal causes of death

² Among all cases reaching a conclusion about the care

³ Including peripartum myocardial pathology

⁴ Preexisting diseases, excluding stroke, cardiovascular diseases, and infections, known before or discovered during pregnancy

I TABLE 10 I
Types of nonoptimal care, globally and by principal causes of maternal death, France 2013-2015, ENCMM data

Causes of death ¹	Care globally nonoptimal ²		Types of nonoptimal care (n) ³					
	n	%	Preconception	Prenatal	Primary emergency	Obstetric	Anesthesia and/or intensive care	Other
Direct	79	74.5	1	17	19	46	50	4
Obstetric hemorrhage	16	84.2	0	3	0	15	14	0
Amniotic fluid embolism	20	74.1	0	2	1	18	19	0
Venous thromboembolism	13	59.1	1	3	9	2	3	1
Complications of hypertension	6	100.0	0	3	0	3	5	0
Infections from a genital portal of entry	8	72.7	0	0	2	5	5	1
Indirect	47	58.8	12	21	16	18	15	9
Stroke	3	23.1	0	0	3	3	1	1
Cardiovascular diseases ⁴	26	72.2	9	12	10	9	10	2
Infections from a nongenital portal of entry	9	90.0	0	3	5	4	7	2
Preexisting diseases ⁵	12	50.0	2	8	1	4	0	3
Suicides	21	72.4	1	11	3	8	2	17
Unknown causes	13	48.1	0	6	1	5	6	1
All	159	66.0	14	55	39	77	73	31
Not applicable ⁶ (n)			168	21	119	43	45	191
No conclusion reached (n)			42	44	9	16	12	15
% nonoptimality by type (n/N)⁷			(14/39)	(55/184)	(39/121)	(77/190)	(73/192)	(31/43)
			35.9	29.9	32.2	40.5	38.0	72,1

¹ Selection of the principal causes of death

² At least 1 type nonoptimal

³ Several types could be applicable to the same case

⁴ Including peripartum cardiomyopathy

⁵ Preexisting diseases, excluding stroke, cardiovascular diseases, and infections, known before or discovered during pregnancy

⁶ Some types were not applicable in view of the specific event of the case; for example, preconception care is inapplicable to deaths by amniotic fluid embolism

⁷ Among the cases for which the category was applicable and for which a conclusion about the optimality of care was reached

3.3 The preventability of maternal deaths

The CNEMM concluded that a maternal death was probably preventable or perhaps preventable if the analysis of the patient history showed that 1 or more modifications of her health care pathway could have changed the fatal outcome. This is thus a different assessment from that of optimality of care. The conclusions concerning the adequacy of care and preventability were often linked, but not always identical. For example, the care might have been adequate but the death nonetheless probably preventable, if the patient had not refused hospitalization; inversely, the care might have been considered not optimal but the death nonetheless inevitable because this inadequacy did not influence the prognosis.

When the experts considered that the death was probably or perhaps preventable, they were making a judgment about the factors associated with preventability divided into 3 categories — factors associated with the content of care, with the organization of care, or with the patient's interaction with the health care system; each of these factors was subdivided into several subfactors (see Appendix 2). These factors were not exclusive; preventability could be associated with several factors for the same maternal death.

3.3.1 Global preventability of maternal deaths

Among the 249 maternal deaths assessed, the CNEMM considered that the information available was insufficient to be able to judge the death's preventability in 24 cases (10%) for which the conclusion was therefore not established. **Overall, for the 2013-2015 period, among the 225 maternal deaths for which preventability was established, 58% were judged preventable:** 17% probably and 41% perhaps (Table 11). This profile was globally stable relative to the preceding period (56% in 2010-2012). This finding that more than half the maternal deaths were potentially preventable shows that a further diminution of maternal mortality is still possible, as the objective is to prevent all preventable deaths.

3.3.2 Preventability of maternal deaths according to their cause

This global proportion of preventable deaths hides disparities according to the cause of death (Table 11). The analysis of preventability by cause makes it possible to identify the diseases with the greatest margin for improvement and which must be a priority for efforts, especially when these causes are responsible for a substantial proportion of the mortality.

The first striking result is that the vast majority, **91%** (21/23), of **maternal suicides were** considered probably (30%) or perhaps (61%) preventable. This point is considered in more detail in Chapter 4.2.

Another important result is the notable proportion — **66%**— of **the deaths of cardiovascular causes** judged probably (14.3%) or perhaps (51.4%) preventable. This proportion has increased considerably (and statistically significantly) since 2010-2012, when it was 35% (Table 12).

Like suicides, deaths from cardiovascular causes are therefore simultaneously numerous and mostly preventable.

The maternal deaths due to hemorrhage and to hypertensive complications, both groups in which the frequency has fallen, nonetheless remain in very great part preventable — 89% for the hemorrhages and 83% for the hypertensive complications. The deaths by infections from a genital portal of entry, which appear more frequent in this 3-year period, are also in majority preventable (54%).

Consistent with the trends noted for nonoptimal care, deaths by amniotic fluid embolism were determined to be preventable in 52% of cases in 2013-2015, compared with 35% in 2010-2012 (Table 12) and 12% in 2001-2003, a rise probably reflecting the advance in knowledge and progress in standards of management, rather than a degradation of care (increase statistically significant compared with 2001-2003).

3.3.3 Factors related to the preventability of maternal deaths

Beyond the sole proportion of preventable deaths, which quantifies the desirable improvement but does not indicate its pathway, Table 13 shows the nature of the factors related to them, globally and by cause of death.

The factor implicated most often, regardless of the cause of death, is the **inadequacy of the care provided** (56%), that is, a delayed or unmade diagnosis or delayed or inadequate treatment. The predominance of this category of factors was expected, because of the survey method — retrospective and conducted mainly from medical documents. We know that factors related to the organization of care are harder to pinpoint at a distance from the event and without being able to question the protagonists. Similarly, a detailed analysis of the woman's interaction with the health care system would require interviews with her family and friends, as she is unavailable. It is therefore possible that the contribution of the factors not directly related to care are underestimated because of the study method.

Despite this limitation, **flawed organization of care** appears to be an important factor in preventability (27%). It is most incriminated in some categories of death: suicides (74%), infections from a genital portal of entry, and obstetric hemorrhages (33%). It could concern, for example, the failure to refer a patient toward a site appropriate for her disease, a failure or delay in transferring her, or deficient cooperation between care providers.

Finally, the study of preventability showed flaws in the **interaction between the patient and the health care system** in 17% of deaths, and especially in suicides (65%). This might involve, for example, her lack of adherence to treatment or refusal of hospitalization, especially in a context of psychological and/or social vulnerability.

Suicides are the category of death in which the proportion of cases concerned by these 3 types of factors is highest (61%). This underlines both the scale of the improvements possible but also the complexity and multiplicity of the related factors.

To enhance our understanding of the mechanisms involved and identify specific avenues for prevention, a detailed analysis of the history of each maternal death is necessary to identify the repetitive preventable elements in these series of deaths. Chapter 4 will provide this analysis by the two principal causes of death.

TABLE 11 I
Preventability of maternal deaths, globally and by principal causes of death, France, 2013-2015, ENCMM data

Causes of death ¹	2013-2015						
	N	No conclusion ²	Not preventable	Perhaps preventable		Probably preventable	
				n	%	n	%
Direct	108	2	40	40	37.7	26	24.5
Obstetric hemorrhage	19	1	2	7	38.9	9	50.0
Amniotic fluid embolism	28	1	13	10	37.0	4	14.8
Venous thromboembolism	23	0	15	7	30.4	1	4.3
Complications of hypertension	6	0	1	4	66.7	1	16.7
Infections from a genital portal of entry	11	0	5	3	27.3	3	27.3
Indirect	79	3	37	33	43.4	6	7.9
Stroke	13	1	11	1	8.3	0	0.0
Cardiovascular diseases ³	36	1	12	18	51.4	5	14.3
Infections from a nongenital portal of entry	10	0	1	8	80.0	1	10.0
Preexisting diseases ⁴	24	1	13	9	39.1	1	4.3
Suicides	31	8	2	14	60.9	7	30.4
Unknown causes	31	11	16	4	20.0	0	0.0
All	249	24	95	91	40.5	39	17.3

¹ Selection of the principal categories of causes among the direct and indirect deaths.

² Death not included in the denominator of preventability.

³ Including peripartum cardiomyopathy.

⁴ Preexisting diseases, excluding stroke, cardiovascular diseases, and infections, known before or discovered during pregnancy.

TABLE 12 I
Preventability of maternal deaths by cause of death; France, 2010-2012 and 2013-2015, ENCMM data

Causes of death ¹	2010-2012					2013-2015				
	N	No conclusion ²	Not preventable	Probably or perhaps preventable ³		N	No conclusion	Not preventable	Probably or perhaps preventable ³	
				n	%				n	%
Direct	97	6	30	61	67.0	108	2	40	66	62.3
Obstetric hemorrhage	25	0	0	25	100.0	19	1	2	16	88.9
Amniotic fluid embolism	23	0	15	8	34.8	28	1	13	14	51.9
Venous thromboembolism	18	2	8	8	50.0	23	0	15	8	34.8
Complications of hypertension	10	2	2	6	75.0	6	0	1	5	83.3
Infections from a genital portal of entry	6	1	1	4	80.0	11	0	5	6	54.5
Indirect	74	6	36	32	47.2	79	3	37	39	51.3
Stroke	18	0	13	5	23.5	13	1	11	1	8.3
Cardiovascular diseases ⁴	23	3	13	7	35.0	36	1	12	23	65.7
Infections from a nongenital portal of entry	12	2	3	7	70.0	10	0	1	9	90.0
Preexisting diseases ⁵	18	1	5	12	70.5	24	1	13	10	43.5
Suicides	9	4	2	3	60.0	31	8	2	21	91.3
Unknown causes	30	17	9	4	30.8	31	11	16	4	20.0
All causes	210	33	77	100	56.5	249	24	95	130	57.8

¹ Selection of the principal categories of causes among the direct and indirect deaths.

² Death not included in the denominator of preventability.

³ Number of preventable or perhaps preventable deaths divided by the number of cases for which a conclusion could be established.

⁴ Including peripartum cardiomyopathy.

⁵ Preexisting diseases, excluding cardiovascular diseases and infections, known or discovered during pregnancy.

TABLE 13 I

Categories of factors related to the preventability of preventable deaths, globally and by principal causes of death, France, ENCMM data

Causes of death ¹	Deaths ² n	Probably or perhaps preventable %	Factors related to preventability ³					
			Inadequate content of care %	Flawed organization of care %	Flawed interaction between the health care system and the patient %	1 Factor ⁴ %	2 Factors ⁴ %	3 Factors ⁴ %
Direct	106	62.3	61.3	23.6	8.5	33.0	27.4	1.9
Obstetric hemorrhage	18	88.9	88.9	33.3	0.0	55.6	33.3	0.0
Amniotic fluid embolism	27	51.9	51.8	29.6	0.0	22.2	29.6	0.0
Venous thromboembolism	23	34.8	34.8	4.3	8.7	21.7	13.0	0.0
Complications of hypertension	6	83.3	83.3	33.3	0.0	50.0	33.0	0.0
Infections from a genital portal of entry	11	54.5	54.5	36.4	18.2	9.1	36.4	9.1
Indirect	76	51.3	47.4	22.4	17.1	25.0	17.1	9.2
Stroke	12	8.3	8.3	8.3	0.0	0.0	8.3	0.0
Cardiovascular diseases ⁵	35	65.7	62.9	31.4	22.9	25.7	28.6	11.4
Infections from a nongenital portal of entry	10	90.0	80.0	20.0	40.0	60.0	20.0	10.0
Preexisting diseases ⁶	23	43.5	39.1	8.7	8.7	30.4	13.4	0.0
Suicides	23	91.3	91.3	74.0	65.2	13.0	17.4	60.9
Unknown causes	20	20.0	15.0	10.0	5.0	10.0	10.0	0.0
All causes	225	57.8	55.6	27.1	17.2	26.2	21.3	10.2

¹ Selection of the principal categories of causes among the direct and indirect deaths.

² Number of cases for which a conclusion was established.

³ % of deaths with this factor among the deaths for which a conclusion was established.

⁴ Among the following 3 possible factors: inadequacy of care, flawed organization of care, flawed interaction between the patient and the health care system

⁵ Including peripartum cardiomyopathy ⁶ Preexisting diseases, excluding stroke, cardiovascular diseases, and infections, known before or discovered during pregnancy

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Chapter 4.

CLINICAL DESCRIPTION AND OPPORTUNITIES FOR IMPROVEMENT

The subchapters that follow describe, by major groups of causes of death, the principal clinical characteristics of the women who died and especially of their management. The objective here is to extract from this study of all the maternal deaths in France the information that can suggest opportunities to improve care and its organization, from dysfunctions identified repeatedly in these histories that are simultaneously singular and exemplary.

Beyond the numbers, the approach here is more qualitative, but no less rich in lessons complementary to those obtained from the epidemiologic analysis. This is the principle of the clinical audit, conducted here on a nationwide scale.

Each reader will be able to grasp these messages and adapt them to his or her own practice and setting.

The present report in English contains the subchapters for cardiovascular diseases and suicides; the French report covers all major groups of deaths.

4.1 Maternal deaths due to cardiovascular diseases

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- Leading cause of maternal deaths
 - 1 maternal death from cardiovascular causes each month
- Preventability 66% and large margin for improvement
 - Organize preconception counseling and multidisciplinary prenatal care for women with preexisting heart disease.
 - Recognize cardiovascular warning symptoms in a woman who is pregnant or postpartum — in emergency situations, whether in or out of hospital, in private practice, and at the maternity unit

4.1.1 Introduction

Cardiovascular diseases are currently 1 of the principal causes of maternal mortality in high-resource countries (1, 2).

The onset of a cardiovascular complication is a rare event, little known in the general obstetric population and occurring in 1% to 4% of pregnancies (3).

Hemodynamic modifications, hypercoagulability, or changes in the configuration of the elastic fibers of blood vessels during pregnancy are elements that promote cardiovascular events. The currently rising age of parturients and of the frequency of their comorbidities (obesity, chronic hypertension, and diabetes) contribute to increasing the risk of cardiovascular complications for this population.

Among women with a preexisting heart disease, pregnancy increases the risk of a cardiovascular complication. The frequency and severity of these complications depend on the type of disease. Several scores can be used to classify the risk level of these diseases during pregnancy. They help to guide management from preconception to postpartum (4, 5). European and international (WHO) guidelines have been published to counsel professionals (Appendix A) (6). The presence in specialized centers of a "pregnancy heart team", that is, a multidisciplinary referral team, is part of these guidelines.

Peripartum cardiomyopathy (PPCM), a disease that occurs during or after pregnancy, can be diagnosed after ruling out other causes of heart disease (hypertensive, dilated, valvular, ischemic, and arrhythmic).

4.1.2 Epidemiology

In the 2013-2015 period, cardiovascular diseases became **1 of the 2 leading causes of maternal mortality**, responsible for 36 deaths: 30 indirect, and 6 with PPCM, which are classified as direct maternal deaths. To these 36 deaths must be added 6 due to another principal cause but where the cardiovascular disease contributed to the death.

These 36 deaths account for 14% of the maternal mortality. The global MMR for cardiovascular diseases is 1.5 per 100 000 LBs (95% CI 1.0-2.1), stable compared with the 2010-2012 period which had an MMR of 1.1 per 100 000 LBs (with 28 deaths). The causes in order of decreasing frequency are: preexisting cardiomyopathies (n=10), aortic dissection (AD) (n=9), PPCMs (n=6), myocardial infarctions (n=4), valvular heart disease (n=4), pulmonary arterial hypertension (PHT) (n=1), splenic artery rupture (n=1), and an arrhythmia of an unknown cause (n=1).

Women's characteristics

Their mean age was 32.4 years, and 16 (44%) were aged 35 years or older, that is, twice the rate of the general population of parturients in France (21% in the 2016 NPS) (6). Among the other cardiovascular risk factors, compared with the women in the 2016 NPS, 25% (9/36) had hypertension (versus 0.7%), 6% (2/36) diabetes (vs 0.2%), 38% (13/34) had obesity (vs 11.8%), while 41% (14/34) smoked (vs 30%). (6). Among the women whose country of birth was reported (35/36), 13 (47%) were born outside France, or more than twice the rate in the 2016 NPS. In all, there were 13 (36%) nulliparas (42% in the 2016 NPS), 9 (25%) women with 1 previous delivery, 10 (28%) 2-3, and 4 (11%) from 4 to 6.

Deaths assessed

The CNEMM conducted expert analyses of all of the maternal deaths from cardiovascular causes. The rest of this chapter thus concerns these 36 maternal deaths.

4.1.3 Epidemiology by type of cardiovascular disease, case studies, and analysis

Preexisting cardiomyopathies

Of the 10 deaths due to a cardiomyopathy not considered PPCM (whether known before the pregnancy or discovered at decompensation), 2 (20%) took place during pregnancy (both before 22 weeks), and 8 (80%) after delivery. Among the latter, decompensation began before delivery for 4 women, and after delivery for the final 4.

These 10 cases include 3 women with dilated cardiomyopathy and 2 who had experienced rejection of heart transplants very early in pregnancy, at 14 and 18 weeks; in the latter 2 cases, the physicians had informed the women that pregnancy was medically not recommended. One woman had a history of surgery for an atrial septal defect (interatrial communication), while the other 4 had preexisting hypertension with a potential diagnosis of hypertensive cardiomyopathy, although it had not been formally demonstrated.

Five of the women who died of cardiomyopathy (50%) had chronic hypertension. Chronic high blood pressure (hypertension) is a disease that has a strong impact on pregnancy, with

maternal complications 5 to 6 times more frequent than in pregnant women without hypertension (7). We recommend checking for left ventricular hypertrophy and coronary disease on the discovery of pregnancy in women with hypertension that is poorly controlled or long-term (8, 9).

Case report 1

This woman, aged between 35 and 40 years, had long had hypertension, treated by 2 disease-modifying drugs: an angiotensin-converting enzyme inhibitor and a calcium channel blocker. Her care has been discontinuous, with several successive GPs and no cardiologist. At the start of pregnancy, she consulted her GP, who measured very severe hypertension — 200/100. He referred her to the obstetrics emergency department at a university hospital center for cardiovascular management. She was seen at the maternity ward ED by a resident who performed an electrocardiogram (ECG) (not interpreted in the file), which found left ventricular hypertrophy with tachycardia at rest of 105 BPM. The ACE inhibitor was replaced by methyldopa. He did not request the opinion of a cardiologist, and the patient returned home with a letter intended for her GP to institute follow-up for her hypertension with a cardiologist. Two weeks later, she had a cardiac arrest at home. A resuscitation begun by her husband was continued for 40 minutes by the emergency medical technician without enabling the return of spontaneous circulation. A postmortem chest CT scan found substantial cardiomegaly.

Comments

In view of long-term and severe (treated by 2 drugs) hypertension, and in this context of an acute flare, a rapid cardiologist opinion and close monitoring were both desirable. It appears that the seriousness of this clinical picture was not understood. The initial referral of this patient to an obstetrics ED is questionable, given that the patient required cardiologic management.

Case report 2

This woman, older than 40 years and a current smoker, regularly attended prenatal care for her twin pregnancy. Vaginal delivery at term was complicated by a postpartum hemorrhage (<1000 mL), resolved by sulprostone, and associated with respiratory distress that led to her admission to the ICU for febrile acute respiratory distress syndrome. The cardiac ultrasound found an impaired left ventricular ejection fraction (LVEF), with moderate mitral insufficiency. Her condition stabilized under probabilistic antibiotic therapy. Her hospitalization in the maternity ward after 6 days in the ICU was marked by agitation, nocturnal anxiety, feelings of suffocation, tachypnea, and tachycardia. She was seen by the psychiatric team and placed on psychotropic medication. She returned home after 5 more days in the maternity ward. Cardiac arrest occurred several hours after she returned home. The autopsy concluded that death was due to dilated cardiomyopathy.

Comments

A diagnosis of heart disease does not appear to have been mentioned for this patient older than 40 years. Several noncardiac symptoms contributed to the diagnostic errors causing diagnostic delay: the fever suggested an infectious lung disease, while the agitation, anxiety, and sense of suffocation suggested a psychiatric disease. A somatic origin, especially in the presence of other symptoms, including tachycardia, tachypnea, and chest tightness, should have been ruled out before any psychiatric diagnosis. The discharge from the maternity ward was premature given the persistence of worrisome symptoms.

Analysis

A picture of dyspnea and malaise, even in the presence of distracting symptoms (slight fever, coughing, anxiety), must suggest acute lung edema and the need to look for signs of left heart failure.

Any dyspnea progressively worsening and any orthopnea, especially at the end of pregnancy and in the postpartum period, should be managed by a cardiologic work-up (transthoracic ultrasound, Nt-proBNP assay, and consultation with a cardiologist) to look for decompensation.

Aortic dissection (AD)

Among the 10 maternal deaths due to ruptured arteries, 9 were due to aortic dissection and 1 to rupture of the splenic artery.

In this period, AD was responsible for 9 maternal deaths. These deaths occurred during the last trimester of pregnancy for 7 women and postpartum for the other 2 (between D4 and D10). Marfan syndrome was known in 1 patient and suspected in another. One woman had chronic hypertension. The other 6 had no known risk factors.

For 4 women, the typical chest pain had appeared several hours or days earlier and led to a visit to the ED or the GP. Two women presented atypical manifestations: 1 had disabling low back pain at 33 weeks, and another began by convulsions. Perimortem cesareans for fetal and maternal salvage were performed for 5 women in refractory shock or with convulsions. In only 1 case did the team know the woman had AD. Two women died suddenly during the third trimester. Two others gave birth by vaginal delivery at term; 1 died on D3 without any prodrome, and the other on D17, although she had reported chest pain since the end of pregnancy.

Pregnancy is a period at high risk of AD, especially among women with an aortopathy syndrome (Marfan, Loeys-Dietz, vascular Ehlers Danlos, or Turner syndrome). Some risk factors can be identified (coarctation of the aorta, bicuspid aorta, hypertension, or advanced age), but AD can also occur in the absence of risk factors. As in our series of fatal cases, the data from the literature report that AD is most frequent in the third trimester (50%) and in the postpartum (33%) (3). The hormonal and hemodynamic modifications of pregnancy increase the risk of AD even though the effect of pregnancy on aortic dilation has not been clearly established. Patients with a known syndromic disease should have the entire aorta visualized by magnetic resonance imaging and be monitored regularly during pregnancy to define the mode of delivery (3).

Case report 3

This woman was nearly 30 years old and pregnant for the first time. At the end of her pregnancy, she came to the ED several times for abdominal pain and retrosternal nonradiating chest pain. Her vital and laboratory values were normal, and the ECG and chest radiography unremarkable. She returned to the obstetric ED at term, for chest pain associated with uterine contractions that were considered to be the onset of labor. She had a cardiac arrest in front of a witness, and a cesarean was performed in the ED 10 minutes after the malaise. A cardiac ultrasound found asystole with pericardial effusion; the Hémocue® noted profound anemia, and ECMO placement did not restore circulatory flow. The autopsy found a tamponade (600 mL) on dissection and rupture of the ascending aorta up to the brachiocephalic trunk, a diagnosis not mentioned before the autopsy.

Comments

This case report is typical of an undiagnosed AD; it developed suddenly and rapidly and had a poor prognosis. This picture of refractory pain that motivated an emergency hospital consultation was found in 5 cases during this period. These cases illustrate the need to consider AD even in the absence of a connective tissue disease.

Case report 4

This woman in her 30s called the EMS at the end of her pregnancy for chest and back pain that had begun 2 hours earlier. The EMS supervisor decided on an ambulance to the maternity ward (one with <500 deliveries/year), where she arrived 45 minutes later. The pain was intense (numeric scale 7/10) and transfixing, in the sternum and upper back. The ECG and the maternal vital signs taken by the midwife were normal. The patient was transferred to the general ED where the clinical examination was identical, the second ECG and troponin normal, and the D Dimers elevated. She was hospitalized and treated by analgesics and antacids that did not relieve her back pain. She was found several hours later in a state of shock and

transferred for stabilization; cardiac arrest and asystole occurred, with ST elevation on the ECG. A cesarean was performed in the operating suite 20 minutes after the cardiac arrest, but did not enable the return of spontaneous circulation. The autopsy found an extensive dissection of the thoracic aorta, associated with a peri-aortic hematoma and hemopericardium; the team had not considered this diagnosis.

Comments

This case report shows that in neither a general nor a specialized ED is AD systematically considered for pregnant women reporting chest pain, unlike myocardial infarction and pulmonary embolism. The intensity of the pain, which is moreover typical of AD (epigastric, sternal, transfixing) should have alerted the ED staff to a serious cardiovascular disease, which would have permitted further investigation. In the absence of onsite imaging, an opinion should have been sought from a cardiologist or from the perinatal network's reference center for diagnostic aid and guidance.

Analysis

AD should be mentioned in cases of chest pain or abdominal pain with the same degree of urgency as a pulmonary embolism and myocardial infarction would be. Some characteristics of the pain must call to mind a rupture of great vessels: extreme intensity, resistance to level-1 and 2 analgesics, sudden transfixing pain, radiating between the shoulder blades or in the back, resembling laceration, associated with agitation, anxiety, dyspnea, orthopnea, or malaise. AD is not diagnosed by standard examinations (ECG, blood gases, chest radiography, or blood tests) (Appendix B). The asymmetry of the blood pressure between the 2 arms is inconstant, as is hypertension. A chest CT scan with contrast product can make this diagnosis and stage it (extension to vessels of the neck, hemopericardium or hemothorax, or gastrointestinal ischemia). This diagnostic CT is not contraindicated during pregnancy (10) and enables implementation on an emergency basis of the treatment (strict blood pressure control and management in a hospital offering cardiovascular surgery).

Peripartum cardiomyopathy (PPCM)

Among the 6 deaths from PPCM, the diagnosis was made at the end of pregnancy in a single case, while the other 5 were diagnosed postpartum between D1 and D42. All 6 women died postpartum, including 1 after D42.

Four of these women had risk factors for PPCM (born in sub-Saharan Africa, diabetes, advanced age, or smoker) and 2 had none. For 5 of these 6 women, the principal symptom was dyspnea (asthma was incorrectly diagnosed in 2). Three showed symptoms before delivery but the diagnosis was only envisioned afterwards. The delays between symptom onset and the diagnostic cardiac ultrasound ranged from several days to several weeks. The diagnosis was confirmed by autopsy for 2 women.

PPCM is defined by left ventricular dysfunction occurring at the end of pregnancy or in the months afterwards, after ruling out other diagnoses (11). A threshold LVEF value is no longer included in the definition because it leads to underdiagnosis (12). Decompensation, of which dyspnea is the principal symptom, occurs especially in the first month postpartum (13). Predisposing factors are reported to be birth in sub-Saharan Africa, smoking, diabetes, preeclampsia, malnutrition, multiparity, and an extreme age for maternity (3).

The pathophysiologic hypotheses recently mentioned include, on the one hand, an imbalance of pro- versus anti-angiogenesis factors, favoring the latter (e.g., high sFlt-1 level in PPCM as in preeclampsia); on the other hand, prolactin, which is associated with the oxidative stress of pregnancy, leads to the secretion of 16 kDa prolactin, which is both proapoptotic and angiostatic. Endothelial myocardial dysfunction then results (14). The course is unpredictable and can be extremely serious, requiring management in a hospital that can provide circulatory assistance. Mortality at 6 months ranges from 2% to 24% (3). Failure to recover a normal LVEF is a risk factor for cardiac events in a subsequent pregnancy (15). The European Society of

Cardiology recommends cardiac monitoring for at least 6 months and a preconception evaluation before a new pregnancy (3). Bromocriptine associated with specific cardiac treatment may improve the recovery of a normal LVEF (15).

The case reports detailed below were chosen because they illustrate the difficulty of diagnosing PPCM.

Case report 5

This heavy current smoker was nearly 30 years old with class III obesity and regular prenatal care. Her GP, consulted several times for progressively worsening dyspnea, diagnosed her with asthmatic bronchitis and initiated a multimodal treatment (β 2 mimetic, corticosteroids, antibiotic, and anti-gastric reflux agents). At the end of pregnancy, she consulted at the obstetric ED for aggravation of the dyspnea, which had become constant for 3 days. She was hospitalized in the ICU for intense hypoxia and tachycardia. PPCM was diagnosed in view of the severe left heart failure (LVEF at 25%) on cardiac ultrasound, and a salvage cesarean performed. In the postoperative period, treatment combined diuretics and nitrates with spontaneous ventilation. The patient deteriorated rapidly, was intubated for transfer to the cardiovascular ICU, where she died, despite ECMO.

Comments

This case report illustrates the diagnostic delay associated with the underestimation, even the very frequent trivialization by medical professionals of dyspnea in pregnant women, all the more so when she has morbid obesity.

Several aspects of management that can be improved can be underlined: the ineffectiveness of the treatments and the repeated consultations should have led to reconsideration of the asthma diagnosis, especially in the presence of cardiovascular risk factors (obesity, smoking); noninvasive ventilation could have been part of the management of the acute pulmonary edema, and bromocriptine could have been prescribed (3).

Case report 6

This overweight nulliparous woman in her 30s, with a history of asthma treated by on-demand β 2 mimetics, had a vaginal delivery at term. Anemia at 7.6 g/dL was noted postpartum. During the first week postpartum, on return home, the patient called the EMS for persistent dyspnea associated with a sensation of anxiety. With a pulmonary embolism suspected, the patient received an injection of low molecular weight heparin and oxygen at home by the EMS. On arrival at the general ED, the patient had a fever of 38°C, hypertension, and tachycardia, with crackles on lung auscultation and anemia. The provisional CT angiography report found no pulmonary embolism. The patient was admitted to the medical department. A rereading of the examination and the final report concluded that interstitial bilateral alveolar involvement required a cardiology consultation. This modification of the report was not transmitted by the radiologist to the medical team and a computer failure prevented online access to the definitive conclusion. The patient returned home after stabilization of her condition.

Two days later, after she reports a new "asthma attack," the EMS began β 2 mimetic aerosol treatment with intravenous corticosteroids. Hypoxic cardiac arrest (in a context of profuse foamy sputum) occurred 15 minutes after the arrival of the EMS. During resuscitation, she was transferred to the ED for ECMO, which was finally not placed due to a massive pulmonary hemorrhage. Thrombolysis and massive doses of adrenaline (115 mg overall) did not restore an effective heart rhythm.

Comments

This case illustrates the flawed diagnosis of PPCM, associated with the difficulty of calling into question a diagnosis already made ("tunnel vision"). The history of asthma obscured the possibility of heart failure; the pulmonary embolism initially envisioned by the EMS was not mentioned after the provisional CT angiography report. The β 2 mimetic (tachygenic) treatment of asthma might have aggravated the acute lung edema. Several dysfunctions in

communication and organization can be underlined: radiologist's failure to transmit to the ER the change in the report (which required rapid action), and IT failure.

Valvular heart disease

During this period, 4 maternal deaths were associated with valvular heart disease, a number stable relative to the previous 3-year periods.

Two women had a social vulnerability. The other 2 had undergone surgery in childhood and in their native countries (China and Comoros), 1 mitral stenosis, and the other for a post-infectious endocarditis mitral insufficiency, without subsequent cardiologic follow-up, including during their pregnancies. Valve diseases in young adults are most often secondary to either rheumatic fever in childhood (particularly in low-resource countries), or associated with a congenital heart disease (3). Decompensation during pregnancy depends on the severity of the valvular stenosis or regurgitation.

Case report 7

This woman was in her 30s and seen by a private practitioner for her pregnancy. Thirteen years before this pregnancy, she had had a biological mitral valve placed together with tricuspid reconstruction, and the closure of an interatrial communication. She had previously given birth by an unremarkable cesarean. She received no regular cardiologic follow-up, during or outside of pregnancy. At the end of the second trimester, the obstetric ED referred her to a cardiologist in private practice after finding isolated tachycardia at 126 BPM and programmed close monitoring by a midwife at her home. She was hospitalized 4 days later for preterm premature rupture of the membranes. A cardiac ultrasound on D5 of this hospitalization found severe mitral stenosis with degeneration of her biological prosthesis, together with pulmonary arterial hypertension and resulted in her transfer to the cardiology department. A perimortem cesarean was performed several days later on an emergency basis under epidural anesthesia. Immediately afterwards, she went into cardiogenic shock (LVEF <25%) followed by cardiac arrest from which she could not be resuscitated.

Comments

This woman's case illustrates suboptimal preconception and prenatal care in this case in which she had a known — and surgically treated — valve disease. The preexisting valvular heart disease was not taken into account. Regular cardiologic monitoring should have been performed between the pregnancies and during the current pregnancy, even though she was asymptomatic and her previous pregnancies went well. This pregnancy should have been monitored in a referral maternity ward with access to a cardiology department. A cardiac ultrasound (or cardiologic consultation) at her admission to the maternity ward could have enabled an early transfer to the cardiology department. Finally, the cesarean delivery for maternal salvage, which was probably not indicated on an emergency basis because at high risk of decompensation and without any immediate benefit for the heart disease, illustrates the modification of medical reasoning that occurs once a pregnancy is underway.

Coronary disease

In 2013-2015 in France, 4 maternal deaths were caused by ischemic heart disease; this number was stable in comparison with earlier periods. All the patients had at least 2 cardiovascular risk factors (overweight, hypertension, type 2 diabetes, and smoking) as well as an advanced age (35, 39, and 40 years). There was 1 case of coronary dissection (by a mechanism different from that associated with atheroma). The other 3 cases involved almost complete ostial stenosis, occlusion of the common trunk, and extensive tight stenoses.

Pregnancy is associated with an increased risk of coronary insufficiency (16). In addition to the standard risk factors (advanced age, obesity, smoking, and hypertension), other risk factors include preeclampsia, thrombophilia, infection, and postpartum hemorrhage and/or transfusion

(3). Maternal mortality by coronary artery disease has been increasing regularly over the past 20 years in some countries, in particular, in the USA (17). This trend contrasts with the French profile, which shows that this disease has a stable and relatively low contribution to maternal mortality. Prognosis is linked to the speed of diagnosis (ECG, troponin) and management.

Case report 8

This woman, just entering her 40s, was a grand multipara, current smoker, with class II obesity. She gave birth with an epidural at term with no complications. Moderate hypertension with no functional signs was observed in the postpartum period but not treated because considered "borderline." The laboratory results were normal and proteinuria was moderate. At D2 postpartum, the patient complained of severe shoulder pain, radiating into the hands with paresthesia, rated on a simple numerical scale at 8/10. This pain had previously been present during this pregnancy. She was diagnosed with bilateral carpal tunnel syndrome and discharged on D4 with an appointment in the rheumatology department and a planned work-up for hypertension. At D9 postpartum, she had a cardiac arrest at home; the EMS performed thrombolysis. The coronary angiography confirmed myocardial infarction due to dissection of the common trunk extending to the anterior interventricular artery (also known as the left anterior descending artery (LADA)) and enabled stents to be placed. She died several days later of multiple organ failure.

Comments

This case illustrates the difficulty of departing from standard diagnoses in cases of frequent symptoms too often attributed to pregnancy. The hand pain erroneously led to a carpal tunnel diagnosis, not challenged by the team despite its atypical character (NS 8/10, shoulder radiation).

4.1.4 Preventability and optimality of care

In this 2013-2015 period, care for cardiovascular diseases was considered nonoptimal in 72% of cases (26/36 cases), an increase from the preceding period, when it was 50%. Of the 35 deaths for which preventability could be assessed, 12 (34%) were judged unpreventable, 18 (52%) perhaps preventable, and 5 (14%) probably preventable. Compared with the preceding period (2010-2012), this was a significant increase in preventability (perhaps or probably), which rose from 35% to 66%. The preventable factors involved in these deaths were inadequate care (96% of the preventable deaths), flawed organization of care (33%), and flawed interaction between the patient and the health care system (35%).

The analysis of the inadequacy of care shows 2 main pictures of preventability:

- In women with known cardiovascular diseases, flaws in the multidisciplinary preconception assessment and in follow-up during pregnancy were found most frequently. This was the case, for example, for the 4 women with valvular disease for whom no roadmap of specific follow-up had been drawn up. It was also the case for the patients with long-term or severe hypertension during this study period: the effect of their hypertension on their cardiac function was not assessed.
- In the women whose cardiovascular disease was not known, the erroneous diagnoses and the absence of any suspicion of a cardiac cause were significant. The normally low prevalence of these diseases in the young female population probably plays a role in the failure to call it to mind, despite clearly evocative symptoms. In 5 of 9 AD cases, the women were managed in hospitals for very disabling unexplained chest or lumbar pain with progressive deterioration of their condition and died there before this diagnosis was mentioned. In 4 of the 5 cases with major dyspnea, the diagnosis of PPCM was mentioned very late, several days to several weeks after the onset of symptoms.

The low frequency of these complications compared with the high prevalence of these nonspecific symptoms may maintain an "optimism bias" among the professionals, causing them to suggest diseases that are frequent and unremarkable in pregnant women. This is particularly true for primary emergency care, including GPs, out-of-hospital EMS, and EDs.

Most of the suboptimal care discussed in this section was attributed to the preconception and prenatal periods (21/26), which is a particularity of these cardiovascular diseases, with this percentage higher in this group than among all of the deaths from indirect causes. The collective effort here must cover these management periods by integrating the cardiologic sphere into the patient's overall management: clinical history that asks about personal and family risk factors, a clinical and paraclinical examination, and a request for an opinion or consultation in case of any doubt at all or due to the patient's history.

The flaws in the organization of care stem from technical equipment and facilities that are inadequate for managing women with serious cardiovascular comorbidity and/or a lack of referral pathways for patients requiring a cardiology or cardiovascular referral. The definition and organization of such networks throughout all the regions needs to be prioritized.

The defective interactions between patients and the health care system involved women whose pregnancies were clearly not recommended or who did not adhere to instructions for cardiologic follow-up (during and/or between pregnancies).

The analysis of these deaths from cardiovascular causes during this period showed the following points for improvement, noted repeatedly:

1. Look for cardiovascular diseases and personal or family risk factors at the beginning of pregnancy to be able to monitor and refer women to appropriate maternity units.
2. Take steps to ensure that out-of-hospital EMS, but also obstetric and general ED teams recognize or know to look for cardiovascular diseases in women with symptoms that, while certainly frequent during pregnancy or postpartum, should alert professionals, especially if they grow progressively worse.
3. Enlarge the spectrum of supplementary examinations in women with dyspnea or chest pain (utility of the Nt-proBNP assay, described in the vignette below).

4.1.5 Lessons to learn and recommendations

- Preexisting cardiovascular diseases and both personal and family risk factors must be asked about at the start of pregnancy and recorded in the obstetric file.
- A multidisciplinary preconception consultation must be proposed to women with a known preexisting heart disease. A specific cardiac follow-up throughout the pregnancy must be prepared and a roadmap proposed (place of delivery, specialists for the disease, frequency of consultation and monitoring).
- A need for an urgent care or emergency consultations (ED) for symptoms normally banal during pregnancy must alert professionals and lead them to encourage further exploration.
- **Recent dyspnea**, worsening especially at the end of pregnancy and postpartum, is not trivial and must suggest a cardiac complication. An Nt-proBNP assay can guide subsequent explorations.
- **Aortic dissection** must be envisioned in pregnant women with chest pain with the same degree of urgency as a myocardial infarction or pulmonary embolism, even in the absence of a known connective tissue disease (illustration 1).

- It is essential to look for acute lung edema and/or signs of right heart failure (lower limb edema and jugular turgescence) in patients with dyspnea, malaise, even in the presence of "distracting" symptoms (slight fever, coughing, and anxiety).
- **2I2A chest pain** requires a search for a cardiac cause: Intense (resistant to level-1 and -2 analgesics) and Irradiating pain (upper limbs, back, epigastric), Sudden Appearance, Association of signs (dyspnea, tachycardia, syncope, agitation, malaise).
- Cardiac ultrasound, a CT chest scan, and Nt-proBNP and troponin are the examinations to envision in cases of "2I2A" chest pain or recent dyspnea.
- Patients with cardiac symptoms must be referred to an ED that can perform a complete cardiovascular work-up (and not necessarily at the obstetric ED)
- A pathway for access to a cardiology department must be organized in each maternity ward, including in establishments that do not have such a department.

NT-proBNP and Pregnancy

N-terminal pro brain-type natriuretic peptide (NT-proBNP) is secreted when hypervolemia or excessive ventricular pressure occurs.

Nt-proBNP is normal throughout pregnancy (<100 pg/mL), with a slight increase in the peripartum. It rises in women with hypertensive disease or preeclampsia.

An Nt-proBNP level > 128 pg/mL after 20 weeks is an independent risk factor for a cardiovascular event in pregnant women with a cardiovascular disease(18).

An Nt-proBNP assay can be useful during pregnancy to:

- 1/ Suggest heart disease in women with nonspecific symptoms (dyspnea, orthopnea, and chest pain).
- 2/ Assess the cardiac effects of a known hypertensive or cardiovascular disease.
- 3/ Monitor the effectiveness of decompensation treatment (prognostic value).

4.1.6 Sudden maternal cardiac death

The sudden death of young adults, outside an obstetric context

Generally, a sudden adult death (SAD) is defined as a death that is natural (nontraumatic) and unexpected (excluding terminal stage chronic diseases), occurring suddenly within an hour after the onset of symptoms in the presence of witnesses or within 24 hours in their absence (19). Sudden deaths of young adults that occur before the age of 35 are a special category of their own.

SAD is of cardiovascular origin in most cases, linked with heart rhythm disorders such as ventricular fibrillation (20). The appearance of these arrhythmias is frequently induced by exertion, stress, or adrenergic treatments, some of which may be used during childbirth. Moreover, exposure to drugs with adrenergic action, principally cocaine and its derivatives, can also be a risk factor for SAD. Acute myocardial infarction is the leading cause of SAD after the age of 35 years (21). Before that age, while acute coronary syndromes remain possible in individuals with family predispositions, the cardiac causes are often congenital, either by an organic disease (e.g., cardiomyopathy, right ventricular arrhythmogenic dysplasia, myocardial bridging on coronary arteries, or ostia implantation anomalies in coronary arteries), or by disorders of conduction or rhythmogenesis (channelopathies). *The age group of pregnant*

women thus straddles the populations of sudden deaths of young adults and of adults aged 35 years or older.

The sudden onset of cardiac arrest in an individual presumably in good health is nonetheless not synonymous with SAD of cardiac origin. Thus, at autopsies, in clinical contexts suggestive of SAD, more than 40% of the causes of these sudden deaths are not cardiac (22). The most frequent causes of noncardiac sudden deaths are drug overdoses, strokes, hemorrhagic ruptures of great vessels, and pulmonary embolisms; these last 3 nonetheless are cardiovascular causes.

Most SAD occur outside hospitals, and the survival rate without major neurological sequelae is less than 3% in France (23). Training the general public in life-saving techniques and the widespread availability of semiautomatic or automatic defibrillators must remain public health priorities.

The particular case of sudden maternal death

Because of its relatively low frequency, sudden maternal death (SMD) has until now been very little studied; it was identified for the first time in France in the last (2010-2012) CNEMM report (24). Particular attention to SMD appears valuable because cardiovascular causes are currently the leading cause of maternal mortality in high-resource countries, and autopsy use is extremely inadequate in unexplained maternal deaths in France (24, 25, 26).

The sudden onset of a maternal cardiac arrest is a rare event that requires specific management, which is currently well codified. The algorithm for managing cardiac arrest is the same during and outside pregnancy, with in addition a left uterine displacement of the gravid uterus and the urgency of performing a so-called perimortem cesarean delivery if effective cardiac activity does not resume at the end of 4 minutes of well-performed resuscitation (in practice, think about it immediately) (27). Maternal mortality in cases of cardiac arrest is on the order of 40 to 60% with as risk factors its occurrence at home and a cesarean performed too late (28).

It is important to know the causes of SMD to be able to anticipate the specific causal management associated with it. This requires the performance of standardized autopsies to learn the precise causes of maternal death. The *CAPS study* performed in the UK found the following principal causes of maternal deaths after cardiac arrest: amniotic fluid embolism, rupture of the great arteries, including AD, cardiomyopathy, and pulmonary embolism (28).

During this study period, 34 maternal deaths could be classified as sudden. A cause for the SMD was identified for 14, of which 6 (43%) were cardiovascular: 2 ADs, 1 hypertensive cardiomyopathy, 1 arrhythmia with preexisting heart disease, 1 myocardial infarction, and 1 arrhythmia of an unknown cause. For the other 20 sudden maternal deaths, the cause was not identified.

These **20 sudden unexplained deaths account for 8% of all maternal deaths**, unchanged from the 2010-2012 period, with an MMR then of 0.7 per 100 000 LBs. Among these 20 deaths, 8 (40%) occurred in ongoing pregnancies (1 before 22 weeks and 7 afterwards), 1 (5%) after a miscarriage, and 11 (55%) after a delivery.

Among the characteristics of women who died from sudden unexplained death, the most striking is the high prevalence of obesity: 7 women (35%) had a BMI > 30 kg/m² (or almost 3 times more than in the population of parturients in France (11.8% in the 2016 NPS) (11). Their other characteristics were unremarkable: 5 women (25%) were aged 35 years or older (21% of the parturients in the 2016 NPS), and 4 (20%) were born outside France (19%, respectively) (6).

All these cardiac arrests occurred outside a hospital: 17 at home and 3 on a public thoroughfare. Among the cases for which information was available, resuscitation by a witness began for 7/14 women (50%), an increase over the preceding study period. The place of death was the home (or some other nonhospital site) in 45% of cases (9/20), and in a health care facility in 55% (11/20). A perimortem cesarean was performed in 27% of cases (3/11 ongoing pregnancies with a cardiac arrest after 22 weeks). ECMO was instituted for 1 woman. An autopsy took place in only 20% of these cases (4/20). In 2 cases, the autopsy was well performed (complete examination including the heart, with toxicological testing) and showed no abnormalities. A primary malignant ventricular arrhythmia was mentioned in these 2 cases but was not retained as a priority by the experts because the woman was asystole when the EMS arrived — very rapidly after the cardiac arrest. In another case, the autopsy mentioned in describing the examination of the heart an appearance compatible with right ventricular arrhythmogenic dysplasia, but this too was not retained as a priority by the experts because she was asystole at the arrival of the EMS. In the fourth case, the clinical picture was that of ventricular fibrillation; examination of the heart showed myocardial ischemia associated with a thrombus of the anterior interventricular artery, but it could not be determined if the myocardial infarction was primary, or secondary to arrhythmia.

Case report 9

A young nulliparous woman with an unremarkable history had a sudden cardiac arrest at home at the end of her second trimester of pregnancy. Her husband was awakened by her gasps and began an external cardiac massage without any delay, and then an external electric shock with the aid of a nearby semiautomatic defibrillator. The EMS arrived in less than 15 minutes and immediately began CPR. Seven external cardiac massages were performed for ventricular fibrillation without resolving it. After a 60-minute low flow, the patient was transferred to intensive care, where multiple organ failure was observed. The cardiac ultrasound showed neither hypertrophy nor ventricular dilatation. The ECG showed a sinus rhythm without signs of coronary insufficiency. The resuscitation care stopped at the end of 24 hours in view of the diffuse edema observed in a CT cerebral scan, with no sign of a stroke. There was no autopsy.

Comments

This SMD of a cardiovascular cause was attributed to arrhythmia, but it could not be determined if it was a primary arrhythmia or occurred secondarily to a preexisting heart disease. An autopsy is the only examination that enables the certain differentiation of an SMD linked to cardiomyopathy from an SMD by primary malignant ventricular arrhythmia. The latter is defined by sudden cardiac death associated with a well conducted autopsy examination that is strictly normal and includes a detailed examination of the heart and a negative result of the search for toxicological substances. It is important to be able to identify the SMD due to primary malignant ventricular arrhythmia, to be able to perform a family genetic study to look for a primary dysfunction of the cardiac ion channels transmitted as an autosomal dominant trait (long-QT syndrome, for example) and set up methods of prevention among the family members (29).

The lessons to draw about sudden maternal death

A **high-quality standardized autopsy** according to European guidelines is always essential in SMD (30). The autopsy rate for this study period is very low 30%) (chapter 2, Table 6), especially as compared with the UK, for example (84%) (31). Accordingly, the number of unexplained SMDs remains very high (45%) for this period and does not allow us to assess more accurately the exact prevalence rates of its causes, especially cardiac, in France. The analysis of maternal mortality in the UK for the 2009-2014 period showed that sudden death by primary malignant ventricular arrhythmia was the leading cause (31%) of maternal deaths by cardiovascular diseases (25).

Appendix A. Modified World Health Organization classification of maternal cardiovascular risk (3)

	mWHO I	mWHO II	mWHO II-III	mWHO III	mWHO IV
Diagnosis (if otherwise well and uncomplicated)	Small or mild – pulmonary stenosis – patent ductus arteriosus – mitral valve prolapse Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage) Atrial or ventricular ectopic beats, isolated	Unoperated atrial or ventricular septal defect Repaired tetralogy of Fallot Most arrhythmias (supraventricular arrhythmias) Turner syndrome without aortic dilatation	Mild left ventricular impairment (EF >45%) Hypertrophic cardiomyopathy Native or tissue valve disease not considered WHO I or IV (mild mitral stenosis, moderate aortic stenosis) Marfan or other HTAD syndrome without aortic dilatation Aorta <45 mm in bicuspid aortic valve pathology Repaired coarctation Atrioventricular septal defect	Moderate left ventricular impairment (EF 30–45%) Previous peripartum cardiomyopathy without any residual left ventricular impairment Mechanical valve Systemic right ventricle with good or mildly decreased ventricular function Fontan circulation. If otherwise the patient is well and the cardiac condition uncomplicated Unrepaired cyanotic heart disease Other complex heart disease Moderate mitral stenosis Severe asymptomatic aortic stenosis Moderate aortic dilatation (40–45 mm in Marfan syndrome or other HTAD; 45–50 mm in bicuspid aortic valve, Turner syndrome ASI 20–25 mm/m ² , tetralogy of Fallot <50 mm) Ventricular tachycardia	Pulmonary arterial hypertension Severe systemic ventricular dysfunction (EF <30% or NYHA class III–IV) Previous peripartum cardiomyopathy with any residual left ventricular impairment Severe mitral stenosis Severe symptomatic aortic stenosis Systemic right ventricle with moderate or severely decreased ventricular function Severe aortic dilatation (>45 mm in Marfan syndrome or other HTAD, >50 mm in bicuspid aortic valve, Turner syndrome ASI >25 mm/m ² , tetralogy of Fallot >50 mm) Vascular Ehlers–Danlos Severe (re)coarctation Fontan with any complication
Risk	No detectable increased risk of maternal mortality and no/mild increased risk in morbidity	Small increased risk of maternal mortality or moderate increase in morbidity	Intermediate increased risk of maternal mortality or moderate to severe increase in morbidity	Significantly increased risk of maternal mortality or severe morbidity	Extremely high risk of maternal mortality or severe morbidity
Maternal cardiac event rate	2.5–5%	5.7–10.5%	10–19%	19–27%	40–100%
Counselling	Yes	Yes	Yes	Yes: expert counselling required	Yes: pregnancy contraindicated; if pregnancy occurs, termination should be discussed
Care during pregnancy	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease
Minimal follow-up visits during pregnancy	Once or twice	Once per trimester	Bimonthly	Monthly or bimonthly	Monthly
Location of delivery	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease

ASI = aortic size index; EF = ejection fraction; HTAD = heritable thoracic aortic disease; mWHO = modified World Health Organization classification; NYHA = New York Heart Association; WHO = World Health Organization.

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Appendix B

Aortic dissection Awareness (from www.thinkaorta.org)

Unexplained Severe Pain?

THINK AORTA

Aortic Dissection is an emergency
that is often fatal when missed

CT Scan for a definitive diagnosis

Symptoms

- Pain is the #1 symptom
- Neck, back, chest or abdomen
- Numbness or weakness in any limbs
- History of collapse

Pain characteristics can be:

- Maximal in seconds
- Migratory & transient
- Pain can be sharp, tearing, ripping

Patient Risk Factors

- Hypertension
- Aortic aneurysm
- Bicuspid aortic valve
- Familial aortic disease
- Marfans and other connective tissue disorders

Physical Examination

- Pulse deficit or vascular signs
- Neurological signs of stroke or paraplegia

Diagnostic Warning

- Chest x-ray, ECG, ultrasound & blood tests can be normal

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4.2 Maternal deaths by suicide

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- Leading cause of postpartum maternal deaths
 - 1 maternal suicide per month
- Median time to occurrence: 120 days postpartum
- Preventability 90%, therefore great margin for improvement
 - Know how to identify warning signs in the prenatal and postpartum periods
 - Organization of coordinated follow-up essential in situations of psychiatric vulnerability

4.2.1 Introduction

With approximately 9000 suicide deaths a year, France has 1 of the highest suicide rates in Europe (1). Deaths by maternal suicide, that is, during pregnancy and in the year after the birth, are tragic events that have a profound effect on the children and families left behind. During this perinatal period, a suicide rate lower than in the general population has been reported, especially in a Swedish study covering the long period from 1974 to 2009 (2). This is responsible for the common belief that pregnancy and motherhood are protective factors. This rapid conclusion does not consider that pregnant women constitute, within the group of women of childbearing age, a particular subgroup in better psychological health and therefore at lower risk of suicide at baseline. It would be necessary to have a group of women with a similar health status for comparison to be able to judge the effect of pregnancy per se on the risk of suicide; finding such a group would be difficult.

Moreover, the risk of decompensation during the perinatal period among women with chronic psychiatric diseases is well known. Women with well-stabilized mental illnesses can present signs of acute decompensation from the first weeks after giving birth. Their risk of suicide rises considerably (3, 4). Pregnancy and the postpartum period are associated with a higher risk of the onset of mental disorders of varying intensity and severity. The physiological and psychosocial issues of the perinatal period make vulnerable women still more fragile. During this period, 20% of women may present mental disorders ranging from anxiety or the baby blues to depression and, more rarely, postpartum psychosis (5, 6). Between 5% and 14% of women may have suicidal ideas or intentions, which is a major risk factor for acting on them (7, 8). These points show that pregnancy and the postpartum period are life events at risk of suicide.

This context has only recently been taken into account in maternal mortality surveillance, as recommended by the WHO in 2014 (see below). In the high-income countries that have focused on this cause, suicide has become 1 of the principal causes of maternal mortality, responsible for 12% to 20% of maternal deaths considered up to 1 year postpartum; 60% to 80% of these suicides take place between 42 days and 1 year postpartum (9, 10, 11, 12). These numbers are probably still underestimated (4, 13) especially in the countries that do not use file linkage to identify maternal deaths. The French profile now shows the same reality: maternal suicide has become 1 of the top 2 causes of maternal mortality (see chapter 2, Table 7 and below).

Moreover, the reports on maternal mortality of the countries that have already focused on this cause of death insist, beyond the numbers, on the early and sudden onset of severe mental disorders after childbirth and on the lack of communication between primary care practitioners, maternity units, and mental health care facilities and professionals (4, 3, 10). Identified risk factors include young age at pregnancy, the absence of a partner, the unplanned nature of the pregnancy, the existence of a known psychiatric disease, a history of suicide attempts, and in some countries ethnic minorities (14, 3).

4.2.2 Epidemiology of maternal suicides in France

Frequency

Since 2014, in an effort to raise awareness of the importance of maternal mental health and the lack of attention paid to it, the WHO has recommended classifying all suicides occurring during pregnancy and up to 1 year postpartum as maternal deaths, without trying (as we do for the other causes of these deaths) to isolate the causal role played by pregnancy, a role very difficult to substantiate after a death and always difficult to exclude in this context (15). The ENCMM adopted this recommendation, starting with the 2013-2015 study period, and this report includes for the first time all the maternal suicides among the maternal deaths. Given the multiplicity of databases that the ENCMM uses to identify maternal deaths, and especially the linkage with birth files, which allows us to identify all women who died in the year after they gave birth, we can reasonably think that our level of exhaustiveness in the identification of maternal suicides in France is now good.

The complete WHO recommendation states for the same reasons that the suicides must be considered to be *direct* maternal deaths. The ENCMM chose not to follow this component of the recommendation, but instead to consider maternal suicide as a separate category of maternal deaths, without determining whether the association was direct or indirect (see Table 7 chapter 2).

Beyond applying this inclusive approach to suicides, the ENCMM also added new resources to explore these cases and extract the information useful for their prevention. These steps included a specific module of the survey questionnaire (Appendix 1), the recruitment of psychiatrists and child psychiatrists as assessors (their contribution enabled relevant documentation of the suicides), and the participation of a psychiatrist as an associated expert in the CNEMM sessions for analyzing the adequacy of management and the preventable factors in these cases.

These changes in classification and survey methods clearly make it difficult to compare this period with the earlier periods for this category of maternal deaths. (12) They nonetheless allow us to paint a more accurate picture of the current weight of mental illness in maternal mortality in France and to identify avenues for prevention.

Between 2013 and 2015, 35 maternal suicides took place in France, for an MMR of 1.4 per 100 000 LBs (95%CI 1.0-2.0). This group accounts for 13% of all maternal deaths for the

period, which makes suicide 1 of the 2 **leading causes of maternal mortality**, when considered up to 1 year postpartum.

This period shows a significant increase compared with the 2010-2012 period for which the MMR was 0.4 per 100 000 LBs. Nonetheless, it is probable that this change is due essentially, or even totally, to the new classification and the ENCMM's efforts to improve the identification of these women. This increasing interest in maternal mental illness is also reflected by the higher number of suicides spontaneously reported by the perinatal health networks.

It should be noted that maternal mortality considered up to 42 days postpartum is less affected by these trends, because most suicides occurred after this earlier cutoff date (see below). Suicides accounted for 4% (8/196) of the maternal mortality up to 42 days for 2013-2015 (see Table 7, chapter 2).

In addition to their quantitative importance, **the maternal suicides involve a high proportion of nonoptimal care (72%)**, with a stronger involvement than for other causes of inadequate prenatal care, as well as a **very high proportion of probably or possibly preventable deaths (91%)** with, among the preventable factors, a notable role for the lack of multidisciplinary management and the flawed interactions between patients and the health care system (see chapter 3).

The risk of suicide in the year following childbirth is still too little known and requires the awareness and training of all professionals involved in pregnancy and the postpartum period, as well as of families. A more qualitative analysis of the health care pathway of the women who died is therefore essential to be able to isolate specific elements for improvement. Sections 4.2.3 to 4.2.5 offer this analysis.

Women's characteristics

The mean age of these women was 31.4 years, and their range 20 to 41 years. By far most of these women were born in France: 88% (31/34, missing data for 1 woman). This was the first child for 68% of the women (21/31, missing data for 4 cases) and a twin pregnancy for 9% (3/35).

Context of vulnerability

Of these 34 women, 15 (43%) had factors of psychosocial vulnerability, a history of violence, eviction, or financial problems.

Eight women (24%) were not living with a partner at the moment of their death: 3 following a separation during pregnancy, 4 in the process of divorce or separation, and 1 after her husband's death by hanging 8 days before her suicide.

Eleven of 33 women (33%) had a known psychiatric history, including only 2 who had had joint obstetric and psychiatric prenatal care. In 10 cases (30%), the patients turned out to have a history of psychological distress or psychiatric care known only partially or not at all to the professionals caring for their pregnancy.

Five women (14%) had documented addictive comorbidities that had been badly managed (3 with mixed multiple addictions to alcohol, cannabis, and opiates, 1 to alcohol, and 1 to cannabis and benzodiazepine), either because the addiction was not known or because she refused treatment for it. In 2 additional cases, we can wonder if there was not an addiction to actiskenan and a relapse of a cannabis addiction at the time of death. These comorbidities were associated with a context of social vulnerability (e.g., separation, precarious housing), a personality disorder, and depression.

Circumstances around the suicide

Timing

Among the 35 suicides during this period, 1 occurred 2 months after an elective abortion, 8/35 (23%) in the first 42 days postpartum, and 26/35 (77%) between 43 days and a year after giving birth. The median interval between delivery and postpartum suicide was 126 days, or about 4 months afterwards. This interval expressed the existence of a severe mental disease appearing postpartum or the decompensation of a preexisting mental illness (5 cases of bipolar disorders that had been stabilized before the pregnancy) very rapidly after delivery, or even before birth for 10 of them. It also underlines the difficulty women have in consulting for either anxious or depressive disorders in the perinatal period, the difficulty of identification by professionals, and the importance of screening by primary care providers: midwives, GPs, obstetricians, and then in the postpartum, pediatricians, GPs, midwives, and specialized child-care attendants from the local maternal and child protection program (PMI).

Four women (13%) killed themselves following their child's death (one sudden unexplained infant death, 1 death from infectious complications on D16, a triple infanticide, and an unexplained death with suspicion of infanticide).

Methods

Among these suicides, 29 were violent deaths (83%). The means used were hanging (18 women or 51%), throwing themselves under a train (6 cases, 17%), defenestration (4 cases, 11%), and a firearm (1 case, 3%); the means did not vary by the date of occurrence relative to the date of delivery. These modes of suicide expressed a clear intention to die and an underlying mental illness that appeared during pregnancy or postpartum; postpartum depression was the most frequent.

Four women used intentional ingestion of medication (12%).

Place

Two suicides took place in prison, 2 in a psychiatric hospital, and 1 at the maternity ward. The others took place at the woman's home (23 women or 66% of cases) or outdoors or in public for 7 women (20%) (throwing oneself under a train or subway, drowning, and suicide in a park or a forest).

4.2.3 Description of exemplary cases

Of the 35 deaths by suicides during this period, the CNEMM analyzed 31 (89%), as a confidential enquiry was impossible or too incomplete for 4 cases. The CNEMM examined only the deaths for which the information allowed a detailed analysis of the circumstances of the occurrence and management of the morbid event (see chapter 3.1).

Moreover, 2 maternal deaths in a context of psychoactive substance abuse, considered to be suicidal behavior, are also discussed here. These 2 maternal deaths are described in the box below to underline the complexity of the cases and their often multiple and intertwined risk factors.

Death by opiate overdose at 2 months postpartum

This woman was around 30 years old, multiparous (with a history of termination of pregnancy for social distress and her children in placement), with very great social precarity. Her history was marked by polysubstance abuse and a deprived past with placements both in childhood and adolescence. Pregnancy was diagnosed in the ED during the first trimester, but the patient began prenatal care only in the middle of the second trimester, when she consulted with her partner. The couple separated, as the father did not wish to keep the child. The woman, without housing or income, was referred for social work, addiction treatment, and obstetric follow-up. The latter was chaotic with several appointments she failed to keep. She continued abusing benzodiazepine and methadone. She was hospitalized twice during pregnancy, including once near term for benzodiazepine detoxification and left against medical advice each time. At the end of the ninth month of pregnancy, the maternity ward contacted her GP and discovered that she had continued to receive the usual benzodiazepine prescription and was thus not cooperating with either the addiction specialist or the maternity ward. Vaginal delivery was induced at term. She remained hospitalized in the kangaroo care unit for 3 weeks. She was seen twice by the maternity ward psychiatrist. She refused the suggestion that she be admitted with the newborn to the mother-baby hospitalization unit (UHME) and did not present any indications for psychiatric hospitalization. She showed an investment, indeed an overinvestment in the child. Two multidisciplinary meetings were set up during the postpartum period to organize a discharge plan. The patient left for home, with support including a family worker (social intervention and family technician) 3 times a week, PMI, and a psychiatric consultation every week. At this point, she was in conflict with a member of her family, also drug dependent but the only resource person the patient designated; she was very socially isolated. She was found dead at home at 2 months postpartum, lying next to the baby (alive). The autopsy and the toxicological analyses found a potentially lethal concentration of morphine.

Comments

Of note, the absence of communication with the GP from the beginning of the pregnancy, the absence of any defined management for the postpartum period besides the kangaroo care unit, the failure to inform the unit for the collection of disturbing information (UCDI) about this situation (see textbox below) despite the histories of placement, the social precarity, the apparent addictions, and the patient's quite superficial adherence to care during pregnancy.

Acute alcohol poisoning at 1 month postpartum

This very young nulliparous woman was living with a partner, had no remarkable history, and was unemployed. She received antenatal care in a private maternity hospital. She appeared anorexic, with vomiting, and lost 4 kg. Contact with this patient was difficult, as she cried during consultations. A request for a psychiatric consultation was found, but no follow-up could be traced. She was hospitalized in the maternity ward for more than a week at the beginning of the third trimester for threatened preterm delivery, fetal growth restriction, and pregnancy-related vomiting, with a weight loss of 6 kg. A complex psychological context motivated a consultation with a psychologist who described mutism in the young woman without proposing a more detailed exploration by a psychiatrist or setting up any specialized care. She was referred to a midwife twice a week. She gave birth spontaneously near the end of the third trimester but preterm. She remained hospitalized for 10 days because of the persistence of vomiting. At consultations, eye contact remained elusive: she avoided everyone's gaze. She returned home without any request made for a specific psychiatric consultation and without any referral by the maternity ward to the local PMI. The neonate died of bacterial meningitis during the first month of life. The patient's anorexia worsened substantially and she abused alcohol massively daily. She had a consultation with a physician 1 week before her death, without any specific referral for psychiatric care. She died at home after ingesting a massive amount of alcohol and multiple psychoactive agents in her partner's presence. The autopsy and the toxicological analyses performed found a blood alcohol concentration of 4.5 g/L, MDMA (ecstasy), cocaine, heroin, and benzodiazepines.

Comments

Of note, the absence of an effort to set up psychiatric care during pregnancy even though warning signs were identified and documented, including vomiting, extreme weight loss, and a contact disorder. Neither her history nor her environmental context was explored. No psychiatric follow-up was proposed after the child's death or at the medical consultation that preceded her death.

The rest of this section therefore concerns the 31 maternal suicides assessed without considering with them the two maternal deaths described in the box above.

We have chosen to describe several exemplary cases among the 31 suicides that enable us to illustrate the recurrent preventable factors and the elements of suboptimal care. These cases underline the importance of thinking about women's mental health from the beginning of their pregnancy by considering their family and personal history, along with their factors of social vulnerability, as much as their physical health and gynecologic/obstetric history. The objective is to implement a health care pathway as early as possible during pregnancy to prevent the risk of suicide.

Case n°1

This woman in her 30s died by hanging at 4 months postpartum. She had regular prenatal care and gave birth at term. The postpartum team noted a loss of contact with avoidance of eye contact especially in the 48 h after delivery. A consultation was organized with the maternity unit psychologist, who recommended follow-up without requesting a specialized psychiatric consultation after discharge. The only appointment set up was with the PMI, a week after discharge. The psychologist knew her before this birth, but the obstetric team did not know this, and there was no documentation of it in the file. She had previously had a reactive depression after a miscarriage several years earlier, another fact not known to the obstetric team. She killed herself at home after entrusting the child to a third party, and left a suicide note.

Comments

The inadequate questioning about the patient's psychiatric, personal, and family history, as well as the flawed communication between the psychologist and the obstetric team, with the absence of documentation of pre- and postnatal observations, prevented any specific surveillance and any request for a psychiatric opinion. The GP was not contacted. Despite the warning signs, the seriousness of the clinical picture was underestimated. Accordingly no specific evaluation was set up and no psychiatric care pathway specialized in the postpartum period was planned.

Case n°2

This primiparous, socially integrated woman died by hanging in the second month postpartum, while admitted to a psychiatric hospital. She had been diagnosed with bipolar disorder with comorbid anxiety 10 years earlier, with 1 episode treated by psychiatric hospitalization and 2 delusional episodes treated on an outpatient basis. The diagnosis and mood stabilizer treatment (lamotrigine) were known at registration at the maternity ward. This treatment was modified several months earlier by her private-practice psychiatrist as part of her plan to become pregnant (she stopped sodium valproate and started lamotrigine). This psychiatrist reduced this treatment to nontherapeutic doses throughout the pregnancy without informing the obstetric team or requesting any specific opinion. The psychotropic medication was documented in the maternity ward file. No coordination between the psychiatrist and the maternity ward was set up. The maternity ward's specific psychiatric history document was not found in the file, nor was there any planning anticipated for postpartum management with specialized perinatal follow-up for this woman with bipolar disorder. The patient did not meet the maternity ward psychologist or psychiatrist during her pregnancy and did not have a psychiatric evaluation during the postpartum period, despite documented anxiety. The discharge was organized with an independent midwife, at home during the first postpartum week. During the second week, she presented anxiety and sleep disorders. She was hospitalized at her own request for 10 days for a postpartum psychosis that improved rapidly, with nonetheless residual psychomotor deceleration from treatment by risperidone, lamotrigine, and cyamemazine. The patient's discharge, at her request and that of her family, was organized without assessment of the mother-child bond and without any proposal for specific care during the perinatal period. No contact was made with the PMI because of the presence of her supportive family and friends. At a month and a half postpartum, she was again admitted to a psychiatric ward for major psychomotor deceleration, apragmatism, a feeling of incapacity, and dysthymia. She was found hanged 3 hours after her admission to the psychiatry department. No assessment of her suicidal risk was found in the file for either her first or second hospitalization.

Comments

In this record, the points that could be improved include the modification of the psychotropic treatment during pregnancy without collaboration with a specialized psychiatric team, the lack of questioning about the psychiatric history at the maternity ward, even though the diagnosis and the psychotropic medication were documented, and the lack of referral to the maternity ward psychologist and psychiatrist. They also concern the absence of coordination, both pre- and post-partum, between the psychiatrist in private practice and the maternity ward, the lack of anticipation of management after delivery and postpartum in a woman with bipolar disorder, the lack of reevaluation of her psychiatric status and treatment postpartum, the falsely reassuring nature of the presence of family and friends, the absence of any consideration of the particularities of the postpartum period by the adult psychiatry team, with no specific mother-child care established.

Case n°3

This woman in her 30s died jumping out a window in front of her family 8 months after giving birth. She had a family history of depression on her mother's side, a recurrent depressive disorder, and an addiction to cannabis. Her psychiatric and gynecologic care were erratic before the pregnancy. She stopped all psychiatric follow-up and all psychotropic medication

during pregnancy, on her own initiative. The maternity ward was not aware of her history. During the second month postpartum, her depression recurred; treatment by escitalopram, then fluoxetine, and then venlafaxine were successively ineffective. A episode of acute drunkenness with suicidal intent motivated her visit to an ED and then her admission to a psychiatry ward for a month and a half for a major depressive episode with psychotic characteristics. She was seeking care. She presented major sadness, with anxious rumination, anhedonia, and guilt about being unable to care for her child. Her treatment at discharge included aripiprazole and venlafaxine at therapeutic doses. Outpatient follow-up was organized 3 days after, with sick leave from her job. In the eighth month postpartum, as she was returning to work part-time, she took an intentional overdose of medication. She and her family refused voluntary hospitalization. Lithium treatment was initiated for mood stabilization on an outpatient basis. No application for admission by a third party was made, although the hospital could legally have made such an application. The patient killed herself by jumping out a window, in front of her family, the day after lithium treatment began.

Comments

Notable factors include the maternity unit team's lack of knowledge of the patient's psychiatric, personal, and family history, her irregular obstetric follow-up, the lack of contact between the psychiatrist in private practice and the maternity ward, although perhaps the former was not aware of her pregnancy. Later, no specific perinatal follow-up was proposed in the adult psychiatry department, in particular, a potential admission to a mother-baby unit. The suicide risk at the return to work was clearly underestimated. Admission for care at a third party's request was indicated during this specific postpartum period, due to her family and personal history, and recent suicidal act. Her family was not made aware of the suicide risk.

Case n°4

This young woman was nulliparous before this delivery, lived with a partner, worked, and had no known social or psychiatric vulnerability. She died by throwing herself under a train during the third month postpartum.

The pregnancy was wanted, and adherence to care good. Spontaneous vaginal delivery took place near term. The child died due to sudden unexplained infant death during the second month of life. Both parents and the grandmother were seen in the ED by the emergency specialist and a child psychiatrist, who found that the mother felt guilty and powerless, and the father powerless. The organization of care after this consultation is unknown, and we do not know if the mother subsequently received specialized care. She threw herself under a train while depressed, 3 weeks after the baby's death, that is, 3 months after giving birth.

Comments

This particular case, the loss of the child, with very strong feelings of guilt, impotence, and sadness, required specific management. This file does not indicate what was proposed and/or performed; there was no documentation. It is an occasion to recall that these situations of perinatal mourning must not be underestimated.

Case n°5

This woman in her 30s gave birth to her second child 4 months before dying of deliberate self-poisoning. Her bipolar disorder, diagnosed in adolescence, was treated and controlled. Her history was marked by multiple impulsive suicidal acts, emotional immaturity, a pregnancy-related depression during her first pregnancy with a suicide attempt followed by postnatal depression, and several psychiatric hospitalizations for mood disorders. She met her spouse during 1 of these hospitalizations; he was also receiving psychiatric care. Under guardianship, she received a disability allocation and had social difficulties. Her first child was placed with her parents. She and her new husband both wanted this pregnancy. After 3 years of stability, she had a mood decompensation during pregnancy, while reducing her treatment dose. In the middle of the third trimester, she was hospitalized in a psychiatric ward, after a suicide attempt by ingesting medication (olanzapine and benzodiazepine); she required intensive care for 3 days and then spent 2 days in the obstetrics ward before discharge. She gave birth to a health child by spontaneous vaginal delivery, at term. During her postpartum stay, she left on D8 amid

family conflicts, leaving the newborn in her hospital room. She was seen by the child psychiatrist affiliated with the maternity ward. She refused hospitalization in a mother-baby unit as too far from her home. She was discharged on D9 with follow-up planned in a perinatal day psychiatric unit, with support from PMI, and treatment by olanzapine, venlafaxine, and lorazepam. She was reassuring, critical about her action, and enveloped by her spouse. She took a new overdose before admission to the mother-child day hospital and was hospitalized in the adult psychiatry department as in imminent danger for a month. Conflict with her parents, who wanted the child placed, continued. She attempted suicide while her husband was sleeping shortly after her discharge; she was then readmitted full-time, with transfer planned to the adult psychiatric day hospital. She disappeared 3 months after her delivery, several days before the transfer to the day hospital. She was dead a month later, on a public thoroughfare.

Comments

The reduced treatment at the beginning of pregnancy was inappropriate, with the mood stabilizing treatment diminished to nontherapeutic doses. After delivery, her treatment remained underdosed and continued not to include an anti-impulsivity agent. Moreover, given her poor adherence in the past, it is uncertain whether she was taking it correctly. No specific perinatal management to assess her capacity to invest in and care for the child was organized before she gave birth. We also note the absence of communication between the maternity ward and the psychiatrists she saw before birth: she went back and forth between obstetric and psychiatric care, not giving any impression that the birth had been thought out and prepared with her. The contextual elements — her husband's illness, the placement of her first child, conflicts with her parents, multiple suicidal acts, and social difficulties — do not appear to have been taken into account; she returned home without anyone having notified the appropriate agency (see textbox below) of the disturbing information about her vulnerability, immaturity, and inability to care for the child.

Case n°6

This migrant woman in her 30s had no LBs but a history of several miscarriages. Initial prenatal care for her spontaneous twin pregnancy was provided by a private practitioner. She consulted at the hospital's obstetric ED during the fifth month of pregnancy (the term of her preceding late miscarriage) for 3 episodes of anxiety in the previous 2 weeks with a sensation of suffocation and fear that something would happen to her or the fetus. The examination was normal, and she was advised to consult a psychologist. The follow-up continued once a month. In the sixth month, we note that the pregnancy was officially declared, she had anemia, and was receiving home care from a midwife. In the eighth month, the midwife noted "fewer anxiety attacks." Labor was induced at term with epidural analgesia: the first twin was born spontaneously, and the second by forceps after internal version failed. The postpartum hospitalization was prolonged for the twins' phototherapy. The patient "cracked" and insisted on leaving on D9. The children's father was present and the referral with the PMI had been set up. Discharge was authorized. Five months later, she called the emergency number for danger (firefighters) to warn them she was going to jump out the window to kill herself; she then did so, immediately, in front of a family member who tried to stop her. The firefighters arrived almost immediately. She was transferred, with multiple injuries, to an ICU where she died that evening, at 5 months postpartum.

Comments

We note in these records the absence of any information about follow-through about the suggestion to see a psychologist and the persistent anxiety attacks, which by diminishing may have falsely reassured the professionals. The patient was not reported to the maternity ward psychiatrist/psychologist, even when she "cracked" postpartum and demanded to leave. Neither psychocultural elements (representations of miscarriages and twin pregnancies in sub-Saharan Africa) nor her social isolation were taken into account.

Case n°7

This young multipara had older children who were living with their father and younger children by a different father, an alcoholic. She had no job, lived in a precarious environment, and had

a personal and family history of suicide and alcohol abuse. Her addictions to alcohol and smoking were known. Alcohol detoxification was prioritized, consultations with an addiction specialist were suggested, but the patient did not really want them. During the second month of pregnancy, an episode of intimate partner violence led her to cut herself. She filed a complaint with the police and separated from her partner. During her irregular prenatal care, we note a positive screening for gestational diabetes with a hospitalization during the fifth month and problems with glycemia follow-up, vomiting with abnormal liver function tests in the seventh month, persistent alcohol consumption, and a refusal of hospitalization. She gave birth rapidly and spontaneously at term to a child the father did not recognize. She breastfed and was discharged home on D3 "without the need for any particular surveillance." Two months later, she consulted in the ED for alcohol abuse. She returned the next day with an overdose of medication and alcohol, carrying a written document explicitly stating her suicidal intentions in the context of the placement of her last 2 children. She returned to the ED again for alcohol abuse 6 weeks later and then at 6 months postpartum, again mentioning suicide. Several days later, she was seen lying on train tracks and was hit by a TGV (a high-speed train). She died immediately at 6 months postpartum. The toxicological analysis found a blood alcohol concentration of 1.46 g/L and benzodiazepines in her blood. A suicide note was found.

Comments

The points that could have been improved in this history are the absence of a psychological evaluation during her ED visit for drunkenness and domestic violence in the context of early pregnancy (second month), and the failure to consider the couple's separation early in pregnancy.

The management in addiction medicine was irregular because of the patient's lack of adherence; the team probably underestimated the extent of her addictions. The obstetric team failed to identify the domestic violence or her history of suicide attempts.

The hospital team only contacted the PMI once the patient failed to appear for a consultation. No postpartum contact with the PMI was set up at discharge, nor was she screened for postpartum depression.

During her various visits to the ED for alcohol abuse and suicidal discourse after delivery and then her suicide attempts, the perinatal context was not taken into account, nor was placement of the children envisioned to enable specialized hospitalization.

Case n°8

This very young nullipara, neither working nor in school, was living with her parents and had no plans to live with the child's father. Starting in the eighth month of pregnancy, she consulted at the ED several times for suspected loss of amniotic fluid. After cervical ripening was performed, labor was induced at term for oligohydramnios and diminution of active movements; she finally gave birth by cesarean for failure to progress. Difficulties with breastfeeding were noted; nonetheless, family support enabled her to be discharged, with follow-up care by the GP. At 2 and a half months postpartum, she was hospitalized in the ED one night for acute alcohol abuse with head trauma after hitting her head against the wall in a dispute with her boyfriend. The psychiatric evaluation noted a suicide attempt 4 years earlier, a history unknown to the obstetric team. No indication of hospitalization or treatment was found. The maternity ward staff gave her contact information for the mental health clinic. before her discharge. No record was made of any interviews with the family. At 8 months postpartum she was found hanged at home, after an alert by a friend who could not reach her.

Comments

The improvable points in this record are the failure to take into account the psychosocial aspects and to conduct a psychological evaluation throughout the pregnancy of this very young woman living with her parents and with no plan to live with the father of the child, the failure to take the warning signs into account, such as the recurrent consultations at the obstetrics ED or the important problems with breastfeeding. Moreover, the obstetric teams was unaware of her suicide attempts in adolescence. The committee also noted the absence of follow-up after the ED visit. The address of a mental health clinic was given to the patient without verifying her adherence. No link was established between the clinic and the maternity ward.

4.2.4 Preventability and optimality of care

This report furnishes for the first time a reliable assessment of the reality of maternal suicide in France. It underlines the major role of mental health in maternal mortality and the importance of analyzing these women's trajectories to identify avenues of prevention.

Among the 31 suicides evaluated, 8 lacked sufficient documentation of their history for the preventability to be assessable; they were thus classified as not established. Among the 23 cases adequately documented, the suicide was judged perhaps or probably preventable for 21 women or 91% of the cases, and unpreventable in 2 cases (Tables 11 and 12). Care was suboptimal for 21 of these women (72%) (Table 9). **The overall figures show that maternal suicides were not only 1 of the 2 leading causes of maternal mortality, but also 1 of the most preventable.** Several improvable elements, concerning the quality of care, its organization, but also the women's interaction with the health care system, were found repeatedly in these records.

Factors associated with the content of care that might have prevented or avoided the suicide were found in 100% of the preventable suicides (Table 13), including:

- an inappropriate drug treatment or management in 19 of the 21 preventable deaths (90%). Treatment for bipolar disorder was reduced or stopped by the psychiatrist in private practice or the woman herself, without any referral for a specific consultation with an expert. Moreover, these treatments, often at nontherapeutic levels, were not reassessed postpartum before discharge from the maternity ward. This disorder was thus poorly controlled with an important risk of decompensation. Moreover, addictions were inadequately managed when they were identified.
- a diagnostic error (not made or made late) in 13 of 21 preventable suicides (62%), especially a failure to identify the risk of psychological fragility. Several obstetric files show inadequate questioning about
 - history of suicide attempts or psychiatric disorders from the first consultation at the maternity ward, especially for women currently taking psychotropic medication. It must be remembered that a history of suicide attempts is the most important predictive factor of subsequent fatal suicidal behavior.
 - a history of depression in previous pregnancies, in particular, miscarriages or elective abortions.
 - family psychiatric history.
 - depression not diagnosed despite warning signs, or was suspected but the suspicion was not followed by specific appropriate management or by a rapid reassessment after discharge from the maternity ward.

We also note a flaw in the consideration of the specificity of the perinatal period by the psychiatrists working with adults and those in EDs, which often resulted in an underassessment of the suicide risk. They did not take into account the elevated risk of severe psychiatric disease from the beginning of the postpartum period, the possibility of a rapid degradation in the psychological condition, or the risk of suicide.

The other factors inadequately taken into account in assessing the suicide risk were the psychosocial stress factors: young age, social isolation, separation during pregnancy or postpartum, financial difficulties, housing problems, addictions, placement of children preceding the current pregnancy, all of which provide orientation about the woman's psychological vulnerability, as well as about the fragility of the spouse or other family members and close friends. The child's death is not specifically considered although it can lead to or aggravate an acute psychiatric disease.

A flawed organization of care is also an important factor associated with preventability, as it was involved in 81% of the preventable suicides (compared with 47% of all preventable maternal deaths) (Table 13). This flaw in organization can be linked to:

- Defective communication in 11/21 preventable suicides (52%). The absence of communication between the various parties involved (the maternity ward, PMI, psychiatrists and psychiatry departments, EDs, and GPs) is frequent and prevents the adaptation of treatment and/or psychiatric management in the pre- and post-partum periods.
- Care was provided at an inappropriate site in 10/21 preventable suicides (48%).
- Specialized management was not set up or even envisioned although clearly indicated by the disease or warning signs during pregnancy, immediately afterwards, and in the late postpartum period.
- When a psychiatric consultation was recommended during pregnancy, no follow-up was planned, verify that it took place.

Preventable factors associated with the interaction of the patient and/or the family with the health care system played a role in 71% of the preventable suicides (compared with 29% of all preventable maternal deaths (Table 13), especially the refusal of care.

The higher frequency of refusal of care in women with addictions underlines the importance of taking this factor into consideration to coordinate care with the GP and with a department of addiction medicine as early as possible, to assess the social repercussions of polysubstance abuse and the need to report (or not) disturbing information about the child at birth.

Refusing care in a mother-baby hospitalization unit can be attributable to the patient, due to a lack of preparation for this possibility during pregnancy, or the distance of the unit from her home, or because it involves full-time care. Refusal of hospitalization in a psychiatric unit can be due to family and friends who trivialize or minimize the woman's clinical condition.

Finally, refusal of care can be expressed by lack of adherence to the psychotropic treatment during pregnancy or postpartum. Late declaration of a pregnancy, failure to keep appointments for prenatal consultations, or excessive use of the ED are warning signs that must be heeded.

4.2.5 Lessons to be drawn and recommendations

The recommendations from these expert assessments fall into 5 categories:

1. *Screen for psychological disorders*

During booking at the maternity ward and/or during the early prenatal interview (EPI), it is important to question women meticulously about:

- possible **family and personal psychiatric history**
- possible **history of addictions;**
- **the psychosocial context** (couple problems, financial difficulties, any domestic violence).

**Questions about their psychiatric history, with open questions
for example,**

- Have you ever experienced an important difficult event in your life?
- Did you have problems in adolescence?
- Did you have eating disorders in adolescence?
- Have you ever consulted a psychiatrist? for what reasons?
- Have you ever had ideas about death or suicide or have you ever attempted suicide? At what moment in your life?
- Have you ever taken drugs? Which ones? Did you ever smoke? Drink alcohol? Use cannabis? Do you still? How often?

The objective is simultaneously to identify risk factors in women with no known psychiatric disease and to **identify women with psychiatric and/or addictive diseases** to set up appropriate joint management with the psychiatrist and/or addiction specialist.

The **psychosocial context** must be taken into account from the beginning of pregnancy and all of the professionals in health and the perinatal period — ED, PMI, the obstetric team, psychiatrists in the maternity ward, social workers — must be mobilized around the pregnant woman.

These questions to woman about their psychological health status must be **renewed throughout the pregnancy and postpartum**, to search for warning signs and symptoms.

2. Identify warning signs

At the maternity ward

It is important to pay attentive to women's **mood variations** during the perinatal period, to **sleep disorders, anxiety**, and anxiety attacks (even if they improve during the pregnancy), to the possible verbalization of **dark ideas or self-deprecation**, to **sudden modification of eye contact and nonverbal communication**, and to **withdrawal**. It is important to take **cultural representations** into account.

Consultation with a psychologist and/or psychiatrist must be systematic when warning symptoms are identified, especially if there is a **sudden or durable modification of the woman's mental state**, in particular, if the delivery resulted in a situation that could create a post-traumatic syndrome or if the midwife expresses worry before the discharge. Screening with the *Edinburgh Postnatal Depression Scale (EPDS)* can help (16). More particularly, it is necessary to look for the patients' ideas about death or suicide by simple questions in cases of depressive symptoms. The evaluations by the psychologist and/or psychiatrist and their establishment of a specific care pathway (organization of an appointment at a specialized psychiatric consultation/clinic and/or a proposal for hospitalization in a mother-baby unit or a perinatal psychiatric consultation) must be documented in the patient's file.

The postpartum discharge must be delayed if there is any doubt of an anxiety or depression disorder (avoid weekend discharge) to ensure home follow-up has been set up (Prado, HAD, private-practice midwife, PMI, appointment with mental health professionals). Useful telephone numbers and internet links (PMI, SOS allaitement, Maman Blues...) should be provided at discharge.

The GP must always be contacted, and this contact documented in the file. **The mother's family and friends must be warned that the postpartum period is quite particular** and they must not hesitate to consult.

Special attention must be paid to situations of mourning, especially perinatal. It is essential to offer to the woman and parents care by professionals experienced in perinatal grief. Referral toward organizations providing support for perinatal mourning is also very useful (Repertoire d'associations sur le deuil périnatal, Réseau de Périnatalité du Sud de l'Île de France: - www.perinatifsud.org).

It is sometimes necessary to envision contacting the unit for the collection of **disturbing information (UCDI)**, in the case of mental or social vulnerability (including addictions), and if her other children have been placed. **This decision is made by a multidisciplinary team.**

Disturbing information

Any kind of information, including medical, likely to cause fear that a child is in danger or at risk of danger and might need assistance must be transmitted. The purpose is to enable assessment of the child's situation and to determine actions that might protect and assist this child and family. The DI report, generally drafted after **multidisciplinary cooperation** is transmitted to the physician liaison for the **unit for the collection of potentially disturbing information (UCDI) in each district**. It is limited to the elements strictly necessary for consideration and assessment of the risk of danger to the child. The essential data for the DI report are: civil status information (last name, first name, date of birth, place of birth of the child or children), parents' names, telephone number, address, and legal custody. Information about the sender (institutional letterhead, correspondence number, signature on report, access by file users). The content of the DI comprises: the history of the family and the child, the current difficulties, the objectives of the DI report with, in particular, the professionals' concerns and the time within which intervention is needed.

The Warning

Term reserved for referral by the Prosecutor of the Republic "in cases of extreme seriousness." Regardless of the term used, the parents must be informed that the procedure has been initiated.

In psychiatric practice and institutions

Mental health professionals must be made aware of the specific risks of the perinatal period so that they can anticipate and plan a **specific health care pathway** for women with a **psychiatric disease via coordination between the referring psychiatrist, the maternity unit, the PMI, and the GP** with:

- Referral to a maternity ward with a psychiatric team from the beginning of pregnancy. A specific consultation with the maternity ward psychiatrist should occur as early as possible to assess the treatment with the referring psychiatrist, assess the environment, and anticipate the delivery.
- Reinforcement of the adult psychiatric follow-up during pregnancy and the postpartum.
- **From the start of the pregnancy, set up a perinatal psychiatric consultation or, if this is not available in the area, a consultation with a child psychiatrist**, who can, as a function of the patient's disease and environmental context, set up continuous **care of variable types** (outpatient consultations, home visits, day hospital (or other) management, hospitalization in a mother-baby unit).

It is recommended **to develop referral or expert outpatient and second-line consultations** focused on the adaptation of psychotropic treatment in the perinatal period, parenting support, to develop this specific care pathway, and to coordinate them.

At the ED, EMS, and GP

Primary care physicians, ED physicians, and liaison psychiatry teams must do a better job of taking the context of recent childbirth into account. The referrals and advice about consultations made by a psychologist or at a mental health center must be followed up by a liaison letter to the proposed participants; a post-emergency consultation can be proposed while awaiting the organization of this follow-up and it is strongly recommended to telephone the woman seen in the ED to verify her condition.

The mental health of the woman who has recently given birth must be **re-evaluated regularly** during the first year after delivery by **primary care physicians** (GP, pediatrician, PMI), and she should be rapidly referred for a specialized psychiatric consultation if there are signs of strong depression and/or anxiety or if psychotic symptoms appear, even if they fluctuate over time.

3. Know the indications for psychiatric hospitalization

Hospitalization in an adult psychiatry unit is necessary in cases of **acute postpartum (puerperal) psychosis, a recent suicidal act, major depressive disorder with or without a risk of suicide**, especially if there is either a personal or family psychiatric history. It is then necessary to take the time to meet the family and explain the specific risks of this perinatal period. If the patient may be a threat to her own life or that of her child, is unaware of her disorder, and if she has refused hospitalization, it is necessary to use hospitalization without consent in an adult psychiatric department at the request of a third party, that is, the family, or as required due to imminent danger, if one cannot obtain the family's consent or if the person is socially isolated. The physician then makes the decision to hospitalize the patient. During hospitalization in an adult psychiatric department, care in the perinatal psychiatry department or in child psychiatry if there is no specific perinatal consultation in the area, should be associated — as soon as the mother's condition allows, that is, not during an emergency — in a full-time mother-baby unit or as part of variable gradation outpatient care (a day hospital if sustained support is needed) to enable the continuation of care for the mother and the beginning of the first mother-child bonds.

Indications for referral to a perinatal psychiatry department

- Women presenting symptoms of psychosis, severe anxiety or depression, or of suicidal ideation.
- Women with a recurrent depressive disorder, bipolar disorder, or schizophrenia.
- Women treated with a complex psychotropic drug regimen.
- Women with moderate anxiety or depressive disorders and a first-degree relative who has a bipolar disorder or had a postpartum psychosis.
- Women with a history of psychiatric hospitalization.

Psychiatric hospitalization

Type of hospitalization	Context	Requirements for hospitalization
Voluntary hospitalization	Patient's consent To be preferred +++	The patient's consent is sufficient
Hospitalization at the request of a third party	Criteria: <ul style="list-style-type: none"> - Mental illness - It must be impossible for the patient to consent to care - Care needed immediately together with constant or regular medical surveillance. A third party must accept/request the hospitalization The third party must be a family member or a friend or another person who can justify by the existence of a relationship with the patient preceding this request for care his or her qualification to act in the patient's best interest; excluding health care staff practicing in the institution in question.	<ul style="list-style-type: none"> - A letter by the third party addressed to the director of the psychiatric hospital explaining the reasons for the request - A medical certificate from a physician outside the receiving hospital - A medical psychiatric certificate
Hospitalization for imminent danger	The same circumstances but the family and friends are either absent or not favorable to the 'hospitalization, although the woman's life is in imminent danger	<ul style="list-style-type: none"> - No third-party letter because no third party - A medical certificate from a physician outside the receiving hospital
Psychiatric care by decision of a representative of the State (SDRE)	Four criteria: <ul style="list-style-type: none"> - Mental illness - It must be impossible for the patient to consent to care - Care needed immediately together with constant or regular medical surveillance. - Severe breach of public safety and order 	<ul style="list-style-type: none"> - A medical certificate established by a psychiatrist outside the establishment

4. Increase awareness and knowledge of mental health in the perinatal period

It is necessary to train the **professional staff of maternity wards, PMI, and GPs** about the specific psychiatric disorders of the perinatal period (depression, anxiety disorders) and psychiatric diseases likely to be aggravated during pregnancy or in the year after delivery (bipolar disorder, psychotic disease, serious personality disorders). **Mental health professionals** must also be trained in the specificity of the perinatal period.

5. Develop resources throughout France

Supporting parenthood among women with mental disorders that occur during pregnancy or postpartum, or who have preexisting mental illness is a **real public health issue** with the following objectives:

- Ensure better follow-up during pregnancy for women with psychiatric vulnerabilities and of any psychiatric disease during the perinatal period to make these women's pathways safer and to support them in their parenting.
- Promote the definition of the most personalized, secure, and coordinated health care pathways possible to prevent suicides.
- Prevent as much as possible disorders in mother-child interactions and thus eventual subsequent disorders in the children.

Resources are currently insufficient in maternity units with too few psychologists and/or psychiatrists, varying with the area.

The development of outpatient consultations of experts and of joint child and adult psychiatrist referrals at the regional level and for each territory is recommended; these consultations should be responsible for providing this resource for maternity units and local care providers, for coordinating the pathways for complex cases, and training first-line teams, whether in private or institutional practice.

It is also necessary to organize the supply of care in the perinatal period locally in promoting access to variable grades of care for each woman with psychiatric disorders.

Key messages

1. **Women must be questioned about their current mental health throughout their prenatal care and during the postpartum period.**
2. **A systematic referral to a psychiatrist or psychologist must be made for any woman showing warning signs or symptoms, especially if their mental state changes suddenly and/or durably:** mood variations, sleep disorders, anxiety, anxiety attacks, verbalization of dark ideas or self-deprecation, guilt, sudden modification of contact. **The postpartum discharge must be delayed** if there is any doubt of an anxiety or depression disorder (avoid weekend discharge/visits) to ensure home follow-up has been set up (Prado, HAD, private-practice midwife, PMI, appointment with mental health professionals). **The GP must always be contacted**, and this contact documented in the file.
3. The woman and her family and friends must be warned that the postpartum period is at particular risk of **psychiatric complications, and they should not hesitate to seek help.**
4. In cases of known mental illness, a specific health care pathway must be developed from the **beginning of pregnancy and coordinated** between the maternity ward, the referring psychiatrist/psychiatric team, the PMI, and the GP. The pregnancy must be anticipated, and treatment adapted throughout the pregnancy and after delivery. The mother's capacity to care for her child must be evaluated, and management after delivery must be organized.

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THE 30 KEY MESSAGES OF THE NATIONAL EXPERT COMMITTEE ON MATERNAL MORTALITY: BETTER PREVENTION OF MATERNAL DEATHS IN FRANCE

From the analysis of all the maternal deaths that occurred in 2013-2015, the CNEMM has drawn these 30 key messages. According to this enquiry's general principle, "better understanding for better prevention", these messages target the elements of care or its organization that can be improved, are involved in the preventability of these deaths, and were repeatedly identified during this study period.

General messages

1. The reporting and review of maternal deaths are recognized criteria of good clinical practice.

- ✓ The generalized reporting of the deaths of women during pregnancy or postpartum by care providers is fundamental for ensuring the best knowledge of the national profile of these cases and for improving care and its organization; these reports can be made through the perinatal networks and via the death certificate.
- ✓ The participation of clinicians and health care facilities in the national confidential enquiry of maternal mortality (ENCMM) is essential to ensure the collection of the most relevant information for each case.
- ✓ The collective review by audit of these maternal deaths locally at the level of the hospital or of the perinatal network is essential for identifying methods of prevention in the local context. The lessons drawn from the examination of all the maternal deaths in the framework of a national confidential enquiry complement those drawn from local reviews.

2. Postmortem examinations should be systematically envisioned in maternal deaths without any evident cause.

- ✓ Autopsies allow the diagnosis of rare diseases that sometimes preexisted the pregnancy and that are sometimes familial. The proportion of maternal deaths for which an autopsy was performed (30%) remains insufficient in France. This observation should lead to local, regional, and national consideration of how to remove the obstacles to the implementation of autopsies. In all cases, it is possible to sign the death certificate stating that there is a medicolegal obstacle, which opens up the possibility of a medicolegal autopsy.
- ✓ If an autopsy is impossible or while awaiting it, a whole-body CT scan, rapidly performed, can identify some causes of death.

3. Risk assessment before conception and at the beginning of pregnancy enables individualized primary and secondary prevention

- ✓ Vaccination against **influenza** is recommended in the epidemic period for all pregnant women, regardless of gestational age.
- ✓ A disease existing before the pregnancy and that constitutes a situation at clear maternal risk (especially heart disease, psychiatric disorders, neurological diseases, and cancer) makes it essential to conduct a **preconception evaluation of the disease** and inform the woman of the risks involved. This evaluation should be **multidisciplinary**, bringing together obstetricians, anesthesiologists, and specialists of the disease concerned, and it should be documented. If the situation so warrants, pregnancy will be clearly advised against from a medical point of view, and this opinion will be documented in writing.
- ✓ **This maternal risk assessment, before or at the beginning of pregnancy, must also allow planning for the management of the pregnancy** (a "roadmap" mentioning the appropriate setting and care providers) **according to the risks anticipated for mother and child**. Referral to the hospital most appropriate for this management must take place as early as possible.

4. The medical examination of the pregnant woman must be able to go beyond the strictly obstetric sphere.

- ✓ **Screening for psychosocial vulnerability** and asking about psychiatric and addiction history is part of the examination of pregnant women and can be facilitated by simple tools.
- ✓ During prenatal consultations and more particularly at the first one, the physical examination must systematically include **cardiac auscultation** and a **breast examination**.

5. In the case of an acute maternal complication

- ✓ In the case of acute maternal disease during pregnancy, maternal exploration and resuscitation prevail over emergency fetal operative delivery, unless there is associated fetal distress.
- ✓ If the complication is not obstetric, the woman must first be referred to a center with the resources necessary for its specific management and not in principle toward the maternity ward and its ED (for example, stroke or aortic dissection).
- ✓ **In an in hospital cardiac arrest**, cardiopulmonary resuscitation is based on 3 principles:
 - Begin where the event happened,
 - Include operative fetal intervention at that site in the absence of rapid recovery

- Persist because these young women, often without comorbidities, have a real chance of recovery.

6. Radiologic examinations with injection of contrast product are not contraindicated in pregnant women, regardless of gestational age.

Cardiovascular diseases

7. A recent dyspnea, worsening, in particular at the end of pregnancy or postpartum is not trivial and must suggest a cardiac complication.
An NT-proBNP assay can guide the subsequent exploration.

8. When a pregnant woman reports chest pain, aortic dissection must be envisioned with the same degree of urgency as myocardial infarction or pulmonary embolism, even in the absence of a known connective tissue disease (such as Marfan).

Maternal mental health

9. Women must be questioned about their current mental health throughout their prenatal care and during the postpartum period.

10. Systematic referral to a psychiatrist or psychologist is required for women with warning signs or symptoms, especially if their mental state changes suddenly and/or durably: mood variations, sleep disorders, anxiety, anxiety attacks, verbalization of dark ideas or self-deprecation, sudden modification of eye contact, facial expression, and other nonverbal communication.

11. In the case of psychiatric disorders either known or discovered during pregnancy, a multidisciplinary collaboration must be set up as early as possible to:

- Adapt the treatment before the pregnancy, if possible, monitor adherence to it, and adapt it during pregnancy, if necessary;
- Evaluate the mother's capacity to invest in and care for her child during pregnancy and in the postpartum period.
- Inform the woman and her family and friends that the postpartum period is at risk of **psychiatric complications** and they should not hesitate to seek help.

12. In cases of known mental illness, a specific health care pathway must be developed and coordinated between the maternity ward, the referring psychiatrist/psychiatric team, the PMI, and the GP; it must be documented (see key message 3.).

13. Postpartum discharge must be delayed in the case of doubt about an anxiety disorder or depression. The organization of follow-up at home can make this discharge safer (PRADO, HAD, private practice midwife, PMI, appointment with mental health professionals). **The GP must always be contacted,** and this contact documented in the file.

Infections

14. In the case of intrauterine infection with signs of severity (hemodynamic disorders, coagulation disorders, cytolysis, or kidney failure), **termination of the pregnancy** after initiation of a wide-spectrum antibiotic therapy is an integral part of the treatment.

15. In cases of peripartum or peri-abortion sepsis with signs suggestive of a toxin-mediated infection (fever associated with analgesic-resistant abdominal pain, diarrhea, attenuated endometritis signs) or with signs of severity (see message 14), **beta hemolytic streptococci A infections must be considered**. In this case, an antibiotic therapy combining an antitoxin (clindamycin, linezolid) will be started in extreme urgency without awaiting diagnostic confirmation.

Obstetric hemorrhages

16. Signs of hypovolemia **after a cesarean delivery**, in the absence of exterior bleeding, suggest an **occult hemorrhage**. Bedside ultrasound should be used to search for it. Its existence requires immediate surgical revision and contraindicates a transfer to another hospital.

Venous thromboembolic complications

17. When a thromboembolic complication is strongly suspected, **anticoagulation** (LMWH at a dose adapted to real weight) **must be started** without awaiting the results of the diagnostic examinations.

18. In case of **fibrinolysis**, the hemorrhagic risk is real around delivery and postpartum, but it must be evaluated in relation to the catastrophic prognosis of refractory cardiac arrest. Fibrinolysis does not contraindicate secondary placement of ECMO.

19. The mobilization of a patient in obstructive cardiogenic shock is extremely dangerous because the migration of a new clot will cause cardiac arrest. It is preferable to start the treatment onsite (noradrenaline, fibrinolysis, even ECMO).

Amniotic fluid embolism

20. The hemorrhage of an amniotic fluid embolism is not a hemorrhage like others: the coagulopathy precedes the bleeding, which testifies to its intensity. From the start, the resources necessary — human and technical — are greater.

21. A hysterectomy must be rapidly envisioned when hemorrhagic shock is not immediately corrected by fluid resuscitation and transfusion.

Hypertensive complications

22. The existence of eclampsia requires an infusion of **magnesium sulfate** (bolus then maintenance doses), an anticonvulsant recommended to prevent the recurrence of convulsions and to optimize the management of hypertension.

23. Primary disseminated intravascular coagulation (DIC) can lead to postpartum hemorrhage in a hypertensive context. DIC must be sought, especially in the presence of HELLP syndrome or a abruptio placenta, because it requires specific treatment.

Cancer and pregnancy

24. A clinical examination of the breasts must be systematically performed at the first prenatal visit and during pregnancy in the event of any mammary anomaly. Onset of a mammary tumor must not be misjudged and its exploration and treatment must not be deferred.

25. In preconception, in a woman with a history of neoplasia, only an **oncological assessment** can determine the risks of a possible pregnancy.

26. An impairment of general condition during pregnancy, and especially weight loss, in a woman with a history of cancer must lead to additional examinations with no delay to seek a possible tumor recurrence.

The organization of care in a maternity unit

Preparation for the management of maternal emergencies

27. The sequence of the management of inhospital maternal cardiac arrest must be known and able to be applied without delay in maternity units.

28. Cognitive aids, validated by professional societies, are available to guide management of maternal emergencies.

29. Each unit must have defined **the resources to mobilize for a "life-threatening maternal emergency"** and have available the emergency procedures (access to blood, to ECMO, rapid laboratory tests, with telephone numbers). These procedures must be regularly tested..

Autopsy

30. The existence of an institutional protocol defining access to maternal autopsies and postmortem whole-body CT scans should be encouraged to facilitate the implementation of these examinations.

Appendix

- 1. ENCMM standardized questionnaire**
- 2. Summary of the experts' conclusions for each death**

APPENDIX 1. ENCMM standardized questionnaire

COMITÉ NATIONAL D'EXPERTS SUR LA MORTALITÉ MATERNELLE



Rapport confidentiel à usage médical

Merci d'envoyer le dossier avant le : ___/___/___

À : Dr. Catherine Deneux-Tharaux

Inserm 1153-EPOPé

Maternité de Port Royal, 6e étage

53, avenue de l'observatoire

75014 Paris.

Dossier:



Inserm U1153-EPOPé : Epidémiologie obstétricale, périnatale et pédiatrique.

CONSIGNES POUR LE REMPLISSAGE DU QUESTIONNAIRE

De la qualité des informations recueillies dans ce dossier dépendront directement la validité de l'analyse qui sera effectuée et la pertinence des recommandations qui en découleront.

Le contenu de ce dossier doit être traité de façon strictement confidentielle. Le nom de la femme, les noms des médecins concernés et de l'établissement, **ne doivent pas figurer** dans ce rapport.

Les copies des partogramme, fiche d'anesthésie, comptes-rendus opératoires, comptes-rendus du séjour en réanimation et rapport d'autopsie (si disponibles) **doivent être impérativement jointes**.

La partie droite est réservée pour le codage, **ne rien inscrire sur les cases**. La partie **observations** vous permettra de détailler des points que vous considérez importants ou bien des informations qui ne figurent pas sous forme de question.

Exemples du remplissage :

Espace réservé au choix des réponses proposées.

⊕ Entourer la bonne réponse.

• Intervenant :

1. SAMU	2. Pompiers	3 : Médecin de garde ou d'urgences	4. Autre
---------	-------------	------------------------------------	----------

⊕ Cocher la case correspondante

• Traitement entrepris :

	Non	Oui
Stéroïdes	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Anticonvulsivants	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Sulfate de magnésium	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Antihypertenseurs	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Anticoagulants	<input checked="" type="checkbox"/>	<input type="checkbox"/>

⊕ Espace réservé pour inscrire une information en clair :

Si autre à préciser :

Motif(s) de l'intervention.....

.....

II. PRISE EN CHARGE INITIALE HORS ETABLISSEMENT 0: Non 1: Oui

(Remplir en cas de prise en charge à domicile, sur la voie publique, en cabinet médical ou autre lieu)

• Moment de l'intervention

Si la femme était enceinte, préciser l'âge gestationnel (AG) auquel est survenue l'intervention (sem + nb jours):

Si la femme avait accouché récemment, préciser le délai entre l'accouchement et l'intervention (en J):

• Lieu de l'intervention: 1: Voie publique 2: Domicile 3: Cabinet médical

4: Autre *Si autre, à préciser:*

• Intervenant: 1: SAMU 2: Pompiers 3: Médecin de garde ou d'urgences 4: Autre *(2 intervenants possibles)*

• Motif(s) de l'intervention:

• Etat de la femme à l'arrivée de l'intervenant:

Glasgow: Fréquence cardiaque: Fréquence respiratoire:

Pression artérielle (mm/Hg) Systolique: / Diastolique: SpO2:

Arrêt cardiaque: 0: Non 1: Oui Durée du no flow (en min):.....

• Prise en charge: Massage cardiaque débuté par témoin 0: Non 1: Oui

Application d'oxygène: 0: Non 1: Oui *Si oui, débit: (O2 l/min):*

Ventilation au masque: 0: Non 1: Oui Intubation: 0: Non 1: Oui

Massage cardiaque externe: 0: Non 1: Oui Défibrillation: 0: Non 1: Oui

Abord veineux: *Si oui, précisez:*

Remplissage 0: Non 1: Oui Type de produits et quantité:

Médicaments 0: Non 1: Oui Type et dose:

Autre(s) intervention(s), à préciser:

• Evolution: 1: Amélioration 2: Stabilisation 3: Aggravation 4: Décès

Si décès, indiquer le délai entre l'arrivée de l'intervenant et la constatation du décès (en min): Délai en min

• Délai entre premier symptôme et décès (en min):

• Transfert dans un établissement hospitalier 0: Non 1: Oui

Si oui, indiquer le délai entre l'arrivée de l'intervenant et l'arrivée à l'établissement hospitalier (en min): Délai en min

Sem

Nb de jours

Glasgow

FC

FR

S

D

SpO2

Délai en min

Délai en min

Délai en min

OBSERVATIONS

Commentaires sur prise en charge initiale, ou décès, hors établissement:

III. CIRCONSTANCES DU DECES EN ETABLISSEMENT

ne rien inscrire dans cette partie prévue pour le codage

• Service d'arrivée:

Date et heure d'arrivée dans l'établissement:
 / / H

Si service de gynécologie-obstétrique ou maternité, indiquez le type de soins périnataux: 1:I 2:II 3:III

S'agit-il de la maternité de suivi? 0: Non 1: Oui

Diagnostic porté à l'arrivée:

La patiente est arrivée? 1: Par ses propres moyens 2: Avec le SAMU 3: Autre

• Service où a eu lieu le décès:

Date et heure d'arrivée dans ce service:
 / / H

Si le service où a eu lieu le décès est différent du service d'arrivée, précisez le type de transfert:

Transfert: 1: Interne 2: Externe

Cause(s) du décès retenue par l'équipe soignante:

Délai entre les premiers symptômes et le décès (en jour et heure)J etH

Délai entre le diagnostic de la pathologie causale et le décès (en jour et heure)J etH

Date et heure du décès:
 / / H

J	M	A		
			H	Mn
J	M	A		
			H	Mn
J	M	A		
			H	Mn

IV. EXAMENS POST MORTEM

• Autopsie: 0: Non 1: Oui Si non, proposée: 0: Non 1: Oui 2: NSP
 refusée par la famille: 0: Non 1: Oui 2: NSP

Si oui, était-ce à visée: 1: Scientifique 2: Médico-légale

Le compte rendu est-il disponible? 0: Non 1: Oui

Si oui, conclusion de l'autopsie:

Si oui, veuillez joindre une copie du CR

• Autres examens post-mortem: 0: Non 1: Oui

Si oui, précisez le(s) que(s):

Détaillez les résultats:

Veuillez joindre une copie de ces résultats

OBSERVATIONS

Antécédents médicaux:

Indiquez comment ils ont été pris en charge et quelles décisions ont été prises (traitements, surveillance accrue de cette grossesse)

Antécédents chirurgicaux:

Conduites addictives:

Antécédents obstétricaux:

Indiquez comment ils ont été pris en charge et quelles décisions ont été prises (traitements, surveillance accrue de cette grossesse)

VI. HISTOIRE DE LA GROSSESSE CONSIDEREE

ne rien inscrire dans cette partie prévue pour le codage

• S'agit-il d'une grossesse spontanée? 0: Non 1: Oui

Si non, quel traitement a été utilisé? (plusieurs réponses possibles)
 1: Stimulation hormonale seule 2: FIV 3: Insémination 4: Autre

Si FIV, y a-t-il eu des ovocytes? 0: Non 1: Oui *Si oui, don à l'étranger:* 0: Non 1: Oui

• La grossesse était-elle médicalement déconseillée? 0: Non 1: Oui 2: non documenté

Si oui, précisez la raison:

• La grossesse a-t-elle été suivie? 0: Non 1: Oui *Si oui: Veuillez remplir le tableau ci-contre*

AG (SA) à la 1ère consultation:
 Surveillance prénatale adéquate: 0: Non 1: Oui Nombre total de consultations (urgence comprises):

Qui a majoritairement suivi la grossesse? 1: généraliste - Sage-femme 2: libérale 3: hôpital -Gynécologue obstétricien 4: libérale 5: hôpital

• Date des dernières règles: / /

Date prévue pour l'accouchement: / /

Confirmation par échographie au 1er trimestre: 0: Non 1: Oui

• S'agit-il d'une grossesse multiple? 0: Non 1: Oui *Si oui, nombre de fœtus:*

• Prise de poids total au cours de la grossesse (kg):

• Bilan sanguin à la fin du 3ème trimestre de la grossesse: 0: Non 1: Oui

Hémoglobine(g/dl): Hématocrite (%): Plaquettes (10³):

• Pathologie(s) de la grossesse: 0: Non 1: Oui *Si oui, veuillez les détailler:*

Pathologie	AG à la détection (SA *)	Pathologie	AG à la détection (SA *)
* SA= semaines d'aménorrhée			
1	2		
3	4		

• Hospitalisation(s) au cours de la grossesse: 0: Non 1: Oui *Si oui, y a-t-il eu un transfert?* 0: Non 1: Oui

Si oui, merci de remplir la fiche hospitalisation/transfert en page 19

• Caractéristiques de l'établissement* où la femme avait prévu d'accoucher:

Nature : 1: CHU / CHR 2: CHG 3: Etablissement privé participant au service public 4: Etablissement privé autre 5: Autre

Si autre, précisez:

Type de soins périnataux: 1: I 2: II 3: III Nombre annuel de naissances:

Personnel médical: Gynécologue-obstétricien Anesthésiste-réanimateur
Cochez les cases correspondantes: Présent D'astreinte dans le service / Présent D'astreinte dans l'établissement
 Non Oui, de jour Oui, de nuit

Nombre de sages-femmes présentes en salle de naissance et aux urgences: le jour: la nuit:

Si une seule sage-femme est présente, a-t-elle en charge d'autres secteurs? 0: Non 1: Oui

Lieu de surveillance post-opératoire des femmes ayant eu une césarienne:

Services présents dans l'établissement: Banque de sang Dépôt de sang Radiologie interventionnelle Laboratoire d'analyses médicales Réa adulte Médicale Chirurgicale
 Non Oui

Si dépôt: Nombre de culots disponibles

AG

J M A

Pathologie AG

GO AR

* de l'année du décès

OBSERVATIONS

Si la grossesse s'est terminée sans accouchement:

(Indiquez de façon détaillée la chronologie des événements permettant de comprendre l'évolution du cas et préciser de façon plus complète le traitement entrepris, l'intervention effectuée, ...)

VIII. ACCOUCHEMENT (suite)

> CARACTERISTIQUES DE L'ETABLISSEMENT OU LA FEMME A ACCOUCHE

Même maternité que celle prévue pour l'accouchement: 0: Non 1: Oui

*Si oui, remplir seulement page 7
Si non, compléter ci-dessous*

Nature : 1: CHU / CHR 2: CHG 3: Etablissement privé participant au service public 4: Etablissement privé 5: Autre

Si autre, précisez:

Type de soins périnataux: 1: I 2: II 3: III Nombre annuel de naissances:

Personnel médical: Gynécologue-obstétricien Anesthésiste-réanimateur
Cochez les cases correspondantes: Présent D'astreinte dans le service Présent D'astreinte dans l'établissement

Non Oui, de jour Oui, de nuit

Nombre de sages-femmes présentes en salle de naissance et aux urgences: le jour: la nuit:

Si une seule sage-femme est présente, a-t-elle en charge d'autres secteurs? 0: Non 1: Oui

Lieu de surveillance post-opératoire des femmes ayant eu une césarienne:

Services présents dans l'établissement: Banque de sang Dépôt de sang Radiologie interventionnelle Laboratoire d'analyses médicales Réa adulte Médicale/Chirurgicale

GO | AR

|

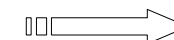
Veillez indiquer de façon détaillée:

- les hospitalisations et les transferts intervenus pendant la grossesse, l'accouchement et le post-partum et le moment de survenue de la complication grave
(dont passage en réanimation, en unité de soins intensifs ou en unité de surveillance continue)



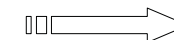
Veillez préciser:

- l'établissement d'hospitalisation ou du transfert ainsi que la nature du service d'accueil



Veillez également indiquer dans les commentaires:

- les circonstances du transfert (en urgence?)
- la qualité de la personne qui a décidé du transfert ou de l'hospitalisation



☛ Si présence d'HTA, éclampsie, hémorragie, embolie amniotique ou pulmonaire, infection AVC, pathologie chronique préexistante, et/ou suicide veuillez remplir la(es) fiche(s) spéciale(s):

- page 25 si hémorragie
- page 31 si embolie amniotique
- page 35 si embolie pulmonaire
- page 39 si HTA, pré-éclampsie, éclampsie, Hellp syndrome
- page 43 si infection
- page 47 si accident vasculaire cérébral
- page 49 si pathologie chronique préexistante
- page 51 si suicide

☛ Si la patiente est décédée durant l'accouchement ou pendant les suites de couches dans d'autres circonstances, veuillez indiquer ci-contre:

- quand la complication a été détectée,
- quand le diagnostic a été fait
- quel type de traitement a été entrepris.

☛ Si la pathologie a entraîné un transfert, une anesthésie et/ou une admission en réanimation, en USI ou en surveillance continue, veuillez remplir les fiches correspondantes situées ...

- page 21 si analgésie, anesthésie
- page 55 si transfert en réanimation, en unité de soins intensifs ou en surveillance continue

FICHE HOSPITALISATION - TRANSFERT

Date et heure		Etablissement	Service	Motifs, Commentaires et difficultés au transfert
d'entrée	de sortie			
1				
2				
3				
4				
5				
6				
7				
8				

OBSERVATIONS

Commentaires sur l'anesthésie:

Si l'anesthésie a joué un rôle essentiel ou aggravant dans le décès maternel, veuillez indiquer la chronologie des événements

Merci de joindre une copie de la feuille d'anesthésie

FICHE ANESTHÉSIE / ANALGÉSIE

ne rien inscrire dans cette partie prévue pour le codage

Pour chaque acte, joindre une copie de la fiche d'anesthésie

I. POUR L'ACCOUCHEMENT

> GENERALITES

• Date et heure de l'acte: / / H

J	M	A		

• Où a-t-il eu lieu ?

1: Salle de travail	2: Bloc opératoire	3: Salle de réveil	4: Réanimation	5: Autre
---------------------	--------------------	--------------------	----------------	----------

H	Min

Si autre, précisez :

• Personnel(s) anesthésique(s) présent(s) pour l'acte:

Cochez les cases correspondantes: Médecin anesthésiste Infirmier d'anesthésie Interne d'anesthésie

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

• Une consultation de pré anesthésie a-t-elle eu lieu? 0: Non 1: Oui
Si oui, risque(s) particulier(s) signalé(s)? 0: Non 1: Oui

Si oui, le(s)quel(s):

• L'acte a eu lieu en urgence: 0: Non 1: Oui

• L'acte: 1: Analgésie 2: Anesthésie

Type: 1: Péridurale	2: Rachianesthésie	3: Péridurale Rachianesthésie combinée	4: Anesthésie générale
5: Autre	Si autre, précisez:		

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

Produits utilisés, précisez:

II. ACTES D'ANESTHÉSIE EN URGENCE EN DEHORS DE L'ACCOUCHEMENT

> GENERALITES

• Date et heure de l'acte: / / H

J	M	A		

• Où a-t-il eu lieu ?

1: Salle de travail	2: Bloc opératoire	3: Salle de réveil	4: Réanimation	5: Autre
---------------------	--------------------	--------------------	----------------	----------

H	Min

Si autre, précisez :

• Personnel(s) anesthésique(s) présent(s) pour l'acte:

Cochez les cases correspondantes: Médecin anesthésiste Infirmier d'anesthésie Interne d'anesthésie

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
--------------------------	--------------------------	--------------------------

Nature de l'intervention ayant nécessité l'anesthésie:

Type: 1: Péridurale	2: Rachianesthésie	3: Péridurale Rachianesthésie combinée	4: Anesthésie générale
5: Autre	Si autre, précisez:		

<input type="checkbox"/>

Produits utilisés, précisez:

OBSERVATIONS

Commentaires sur l'anesthésie:

Si l'anesthésie a joué un rôle essentiel ou aggravant dans le décès maternel, veuillez indiquer la chronologie des événements

Merci de joindre une copie de la feuille d'anesthésie

III. COMPLICATIONS D'UN ACTE ANESTHESIQUE/ANALGESIQUE

• RESPIRATOIRES:		<input type="checkbox"/> 0: Non		<input type="checkbox"/> 1: Oui					<input type="checkbox"/>
	Non	Oui		Non	Oui				
Intubation impossible	<input type="checkbox"/>	<input type="checkbox"/>	Intubation œsophagienne	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>
Intubation difficile	<input type="checkbox"/>	<input type="checkbox"/>	Syndrome de Mendelson	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>
Bronchospasme	<input type="checkbox"/>	<input type="checkbox"/>	Œdème pulmonaire	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>
Extubation accidentelle	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>			
• HEMODYNAMIQUES:		<input type="checkbox"/> 0: Non		<input type="checkbox"/> 1: Oui					<input type="checkbox"/>
	Non	Oui		Non	Oui				
Choc	<input type="checkbox"/>	<input type="checkbox"/>	Troubles du rythme cardiaque	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>
Arrêt cardio-circulatoire	<input type="checkbox"/>	<input type="checkbox"/>	Si oui, type:			<input type="checkbox"/>			
• REACTION ANAPHYLACTIQUE:		<input type="checkbox"/> 0: Non		<input type="checkbox"/> 1: Oui					<input type="checkbox"/>
• COMPLICATION D'ANESTHESIE LOCOREGIONALE		<input type="checkbox"/> 0: Non		<input type="checkbox"/> 1: Oui					<input type="checkbox"/>
• AUTRES COMPLICATIONS:		<input type="checkbox"/> 0: Non		<input type="checkbox"/> 1: Oui					<input type="checkbox"/>
Précisez lesquelles:									
.....									
.....									
.....									

OBSERVATIONS

Commentaires sur l'hémorragie:

Indiquez de façon détaillée la chronologie des événements (date et heure) permettant de comprendre l'évolution du cas, et précisez de façon plus complète les décisions prises: Appel de renfort, personnels présents, traitement médical, chirurgical, transfert, ...

FICHE HEMORRAGIES OBSTETRIQUES (suite)

ne rien inscrire dans cette partie prévue pour le codage

> EVOLUTION

• EVENEMENTS MORBIDES:

	Non	Oui	Heure	Lieu		
Syndrome de détresse respiratoire	<input type="checkbox"/>	<input type="checkbox"/> /	<input type="checkbox"/>	<input type="checkbox"/>
Œdème pulmonaire	<input type="checkbox"/>	<input type="checkbox"/> /	<input type="checkbox"/>	<input type="checkbox"/>
Coagulopathie intra-vasculaire disséminée	<input type="checkbox"/>	<input type="checkbox"/> /	<input type="checkbox"/>	<input type="checkbox"/>
Insuffisance rénale aigue nécessitant une dialyse	<input type="checkbox"/>	<input type="checkbox"/> /	<input type="checkbox"/>	<input type="checkbox"/>
Etat de choc	<input type="checkbox"/>	<input type="checkbox"/> /	<input type="checkbox"/>	<input type="checkbox"/>
Arrêt cardiaque (précisez le nombre)	<input type="checkbox"/>	<input type="checkbox"/> /	Nb	<input type="checkbox"/>	<input type="checkbox"/>
Embolie pulmonaire cruorique	<input type="checkbox"/>	<input type="checkbox"/> /	<input type="checkbox"/>	<input type="checkbox"/>
Thrombose veineuse profonde (précisez le site)	<input type="checkbox"/>	<input type="checkbox"/> /	Site	<input type="checkbox"/>	<input type="checkbox"/>
Infection	<input type="checkbox"/>	<input type="checkbox"/> /	Site	<input type="checkbox"/>	<input type="checkbox"/>
Autre(s):	<input type="checkbox"/>	<input type="checkbox"/>	<i>Si oui, indiquez le(s)quel(s):</i>		<input type="checkbox"/>	<input type="checkbox"/>

• TRANSFERT:

0: Non 1: Oui

Si oui, indiquez le lieu et la(es) cause(s):

Lieu Causes

Si transfert en réanimation ou USI, durée du séjour en réa (en J):

Si oui, veuillez remplir la fiche réanimation située page 55

• CAUSE PRINCIPALE DE L'HEMORRAGIE

Atonie utérine	0: Non	1: Oui	<input type="checkbox"/>
Placenta prævia	0: Non	1: Oui	<input type="checkbox"/>
Placenta accreta, increta, percreta	0: Non	1: Oui	<input type="checkbox"/>
Embolie amniotique	0: Non	1: Oui	<input type="checkbox"/>
Hématome rétroplacentaire	0: Non	1: Oui	<input type="checkbox"/>
Coagulopathie	0: Non	1: Oui	<input type="checkbox"/>
Rupture utérine	0: Non	1: Oui	<input type="checkbox"/>
Quand	1: Oui, avant travail	2: Oui, pendant travail	<input type="checkbox"/>
Site:	<i>Si oui, précisez:</i>		<input type="checkbox"/>
Etait-elle traumatique?	0: Non	1: Oui	<input type="checkbox"/>
Extension de l'incision lors de la césarienne	0: Non	1: Oui	<input type="checkbox"/>
Extension lors de la césarienne d'une cicatrice de césarienne antérieure:	0: Non	1: Oui	<input type="checkbox"/>
Lésion traumatique: per césarienne:	0: Non	1: Oui	<input type="checkbox"/>
cervico-vaginale:	0: Non	1: Oui	<input type="checkbox"/>
Autre cause:	<i>Si autre cause, spécifiez:</i>		<input type="checkbox"/>

Merci de joindre les compte rendus opératoires de césarienne, embolisation, ...

OBSERVATIONS

Commentaires sur l'embolie amniotique:

Indiquez de façon détaillée la chronologie des événements (date et heure) permettant de comprendre l'évolution du cas, et précisez de façon plus complète les décisions prises: Appel de renfort, personnels présents, traitements médical, chirurgical, transfert, ...

FICHE EMBOLIE AMNIOTIQUE

ne rien inscrire dans cette partie prévue pour le codage

• Date et heure des 1ers symptômes: / / H

• Moment de survenue:

1: Avant travail	2: Pendant travail	3: Post-partum
------------------	--------------------	----------------

• Où ont-ils eu lieu ?

1: Salle de travail	2: Bloc opératoire	3: Salle de réveil	4: Chambre d'hospitalisation	5: Réanimation	6: Autre
---------------------	--------------------	--------------------	------------------------------	----------------	----------

Si autre, précisez :
 Délai entre les 1ers symptômes et le décès:J etH

• Signes cliniques présentés:

Angoisse subite	Non	Oui	Troubles du rythme cardiaque maternel	Non	Oui
Agitation	<input type="checkbox"/>	<input type="checkbox"/>	Anomalie du rythme cardiaque fœtal	<input type="checkbox"/>	<input type="checkbox"/>
Dysgueusie	<input type="checkbox"/>	<input type="checkbox"/>	Convulsions	<input type="checkbox"/>	<input type="checkbox"/>
Douleur thoracique	<input type="checkbox"/>	<input type="checkbox"/>	Perte de connaissance	<input type="checkbox"/>	<input type="checkbox"/>
Dyspnée	<input type="checkbox"/>	<input type="checkbox"/>	Hémorragie	<input type="checkbox"/>	<input type="checkbox"/>
Choc	<input type="checkbox"/>	<input type="checkbox"/>	Autre(s)	<input type="checkbox"/>	<input type="checkbox"/>

Si autre, précisez :

• Etat des membranes lors des premiers symptômes:

1: Intactes	2: Rompues
-------------	------------

Si rompues, précisez l'heure de la rupture : /

Si rompues, précisez : - si la rupture a été?

1: Spontanée	2: Artificielle
--------------	-----------------

 - l'aspect du liquide amniotique

1: Clair	2: Teinté	3: Méconial
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• Examens et tests réalisés:

Echocardiographie	Non	Oui	Lavage broncho-alvéolaire	Non	Oui
Gazométrie artérielle	<input type="checkbox"/>	<input type="checkbox"/>	Angioscanner du thorax	<input type="checkbox"/>	<input type="checkbox"/>

Si gazométrie faite,
 indiquez : 1er bilan PO2 PCO2
 Paroxysme PO2 PCO2

> Bilans veineux: 1er bilan, lors de l'événement aigu Paroxysme

Date (jour, mois): /	Date et heure
Heure (H, min): /	
Hémoglobine	
Hématocrite	
Plaquettes	
Temps de prothrombine	
TCA ou TCK (ratio)	
Fibrinogène (g/l)	
D-Dimères, complexes solubles	
Créatininémie	

J	M	A	
H	Min		
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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FICHE EMBOLIE PULMONAIRE

ne rien inscrire dans cette partie prévue pour le codage

• Date et heure des 1ers symptômes: / / H

• Où ont-ils eu lieu ?

1: Etablissement hospitalier	2: Domicile	3: Voie publique	4: Autre
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Si **autre**, précisez :

Délai entre les 1ers symptômes et le décès:J etH

> Diagnostic d'embolie pulmonaire évoqué avant décès? 0: Non 1: Oui **Si oui:**

• Date et heure au diagnostic d'embolie pulmonaire: / / H (service)

Délai entre le diagnostic et le décès:J etH

• Signes cliniques :

	Non	Oui		Non	Oui
Angoisse subite	<input type="checkbox"/>	<input type="checkbox"/>	"Cœur pulmonaire aigu"	<input type="checkbox"/>	<input type="checkbox"/>
Agitation	<input type="checkbox"/>	<input type="checkbox"/>	Perte de connaissance	<input type="checkbox"/>	<input type="checkbox"/>
Douleur thoracique	<input type="checkbox"/>	<input type="checkbox"/>	Thrombose veineuse	<input type="checkbox"/>	<input type="checkbox"/>
Dyspnée	<input type="checkbox"/>	<input type="checkbox"/>	Fièvre	<input type="checkbox"/>	<input type="checkbox"/>
Hémoptysie	<input type="checkbox"/>	<input type="checkbox"/>	Choc	<input type="checkbox"/>	<input type="checkbox"/>
Troubles du rythme cardiaque	<input type="checkbox"/>	<input type="checkbox"/>	Autre(s)	<input type="checkbox"/>	<input type="checkbox"/>
Mort subite	<input type="checkbox"/>	<input type="checkbox"/>	Si autre , précisez :		

• Examens réalisés:

	Non	Oui		Non	Oui
Radio du thorax	<input type="checkbox"/>	<input type="checkbox"/>	ECG	<input type="checkbox"/>	<input type="checkbox"/>
Echocardiographie	<input type="checkbox"/>	<input type="checkbox"/>	Scanner du thorax	<input type="checkbox"/>	<input type="checkbox"/>
Gaz du sang	<input type="checkbox"/>	<input type="checkbox"/>	Si oui: injecté ?	<input type="checkbox"/>	<input type="checkbox"/>
Scintigraphie pulmonaire	<input type="checkbox"/>	<input type="checkbox"/>	Echodoppler veineux des membres inférieurs	<input type="checkbox"/>	<input type="checkbox"/>
Phlébocavographie	<input type="checkbox"/>	<input type="checkbox"/>	IRM thoracique	<input type="checkbox"/>	<input type="checkbox"/>

• Type d'embolie pulmonaire:

1: Thrombo-embolique	2: Gazeuse	3: Autre
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• Traitement anticoagulant précédant l'embolie pulmonaire: 0: Non 1: Oui

Si **oui**, précisez:

	Héparine sous cutanée	Héparine IV	AVK		H SC	H IV	AVK
Objectif							
Préventif	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Curatif	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
Dose				
Anticoagulation inefficace significative	<input type="checkbox"/> Non <input type="checkbox"/> Oui	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Date de début du traitement:

Date (Jour, Mois): / /

Heure (H, min): / /

	J	M	A
H	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Min	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Service	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H SC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
H IV	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
AVK	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

OBSERVATIONS

Commentaires sur l'embolie pulmonaire:

Indiquez de façon détaillée la chronologie des événements (date et heures) permettant de comprendre l'évolution du cas, et précisez de façon plus complète les décisions prises: Appel de renfort, personnels présents, traitements médical, chirurgical, transfert, ...

Précisez ci-dessous les conclusions principales

(en l'absence de compte rendu d'autopsie)

FICHE EMBOLIE PULMONAIRE (suite)

ne rien inscrire dans cette partie prévue pour le codage

• Traitement de l'embolie pulmonaire: *Si oui, précisez: Date et heure de la 1ère administration et le service prescripteur (SAMU, urgence, réa)*

Fibrinolytiques (Urokinase, tPA)	Non <input type="checkbox"/>	Oui <input type="checkbox"/> /	h
AVK	<input type="checkbox"/>	<input type="checkbox"/> /	h
Héparine sous cutanée	<input type="checkbox"/>	<input type="checkbox"/> /	h
Héparine IV	<input type="checkbox"/>	<input type="checkbox"/> /	h

	J	M
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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♦ Traitements associés

Dopamine, Dobutamine *Si autre, précisez:*

Autre(s)

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

♦ Chirurgie 0: Non 1: Oui

♦ Circulation extracorporelle 0: Non 1: Oui

♦ Antécédent familial de TEV 0: Non 1: Oui

• Thrombophilie:

	0: Non	1: Oui	2: Recherche non contributive	3: Non recherchée
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Si oui:

- Connue avant l'embolie 0: Non 1: Oui
- Découverte à l'occasion de l'accident 0: Non 1: Oui
- Type:
 - Déficit en protéine C 0: Non 1: Oui
 - Déficit en protéine S 0: Non 1: Oui
 - Déficit en antithrombine III 0: Non 1: Oui
 - Mutation du facteur V 0: Non 1: Oui, homozygote 2: Oui, hétérozygote
 - Autre(s) 0: Non 1: Oui *Si oui, précisez:*

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Si thrombophilie connue, veuillez remplir la fiche de pathologie préexistante page 49

Si transfert en réanimation ou USI ou surveillance continue, veuillez remplir la fiche réanimation située page 55

OBSERVATIONS

Commentaires sur la prééclampsie ... :
Indiquez de façon détaillée la chronologie des événements (date et heures) permettant de comprendre l'évolution du cas, et précisez de façon plus complète les signes maternels et fœtaux manifestés, le personnel mobilisé, le traitement entrepris ...
Détaillez l'évolution des résultats, les décisions prises

FICHE PREECLAMPSIE SEVERE, ECLAMPSIE, HELLP SYNDROME (SUITE)

ne rien inscrire dans cette partie prévue pour le codage

• Examens biologiques: (Joindre une photocopie des bilans biologiques)

Paroxysme

J	M
<input type="checkbox"/>	<input type="checkbox"/>

Date (jour, mois): /

Heure (H, min): /

Protéinurie

Hémoglobine

Hématocrite

Plaquettes

Temps de prothrombine

TCA ou TCK (ratio)

Fibrinogène (g/l)

Créatinine

D-Dimères, complexes solubles

LDH

ASAT

ALAT

Haptoglobine

Schizocytes

• Imagerie cérébrale:

Date et heure

Scanner

0: Non	1: Oui, sans anomalie détectée	2: Oui, avec anomalie détectée
--------	--------------------------------	--------------------------------

IRM

0: Non	1: Oui, sans anomalie détectée	2: Oui, avec anomalie détectée
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<input type="checkbox"/>
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Si anomalie(s) détectée(s), détaillez sur la page de gauche

• Un traitement antihypertenseur a-t-il été entrepris, ou modifié?

0: Non	1: Oui
--------	--------

Si oui, indiquez: la date et l'heure au début du traitement: / /

J	M
<input type="checkbox"/>	<input type="checkbox"/>

le type de traitement:

• Autres traitements:

	Non	Oui		Non	Oui
Corticoides	<input type="checkbox"/>	<input type="checkbox"/>	Anticoagulants	<input type="checkbox"/>	<input type="checkbox"/>
Anticonvulsivants	<input type="checkbox"/>	<input type="checkbox"/>	Diurétiques	<input type="checkbox"/>	<input type="checkbox"/>
Sulfate de magnésium	<input type="checkbox"/>	<input type="checkbox"/>	Autre(s)	<input type="checkbox"/>	<input type="checkbox"/>

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Si autre, précisez:

• Prise en charge obstétricale de la patiente:

Tocolytiques

0: Non	1: Oui
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 Déclenchement

0: Non	1: Oui
--------	--------

Césarienne

0: Non	1: Oui
--------	--------

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

Si oui, détaillez sur la page de gauche, le traitement et les décisions

• Un examen anatomopathologique du placenta a-t-il été réalisé ?

0: Non	1: Oui
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Si oui, précisez les résultats:

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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• La patiente a-t-elle été transférée en réanimation, unité de soins intensifs ou en unité de surveillance continue?

0: Non	1: Oui
--------	--------

<input type="checkbox"/>

Si oui, veuillez remplir la fiche "réanimation" situées page 55

OBSERVATIONS

Commentaires sur l'infection:

Indiquez de façon détaillée la chronologie (date et heures) des événements permettant de comprendre l'évolution du cas, et précisez de façon plus complète les examens pratiqués, le personnel mobilisé, les traitements entrepris ...

FICHE INFECTION GRAVE

ne rien inscrire dans cette partie prévue pour le codage

• Date et heure l'apparition des premiers symptômes / / H

Délai entre premiers symptômes et décès (en jour et heures):J etH

Service ou a été établi le diagnostic:

• Diagnostic (détaillez site et micro organisme):

Délai entre le diagnostic et le décès (en jour et heures):J etH

• Etat de la patiente: Date (jour, mois):/...../..... Heure (H, min):/..... Valeur

Température Maximale / / °C

Minimale / / °C

Fréquence cardiaque Maximale / /

Fréquence respiratoire Maximale

SpO2 Minimale

Pression artérielle Systolique / / Minimale

Diastolique Minimale / /

Apparition de douleurs Si oui, date et heure: / / 0: Non 1: Oui

• Examens sanguins pratiqués: (Joindre la photocopie des bilans)

Paroxysme

Date (jour, mois): / /

Heure (H, min): / /

Numération globules blancs

Hémoglobine

Hématocrite

Plaquettes

Temps de prothrombine

TCA ou TCK (ratio)

Créatinine

D-Dimères, complexes solubles

LDH

ASAT

ALAT

CRP

Lactatémie

	J	M	A
Température Maximale	<input type="text"/>	<input type="text"/>	<input type="text"/>
Température Minimale	<input type="text"/>	<input type="text"/>	<input type="text"/>
Fréquence cardiaque Maximale	<input type="text"/>	<input type="text"/>	<input type="text"/>
Fréquence respiratoire Maximale	<input type="text"/>	<input type="text"/>	<input type="text"/>
SpO2 Minimale	<input type="text"/>	<input type="text"/>	<input type="text"/>
Pression artérielle Systolique	<input type="text"/>	<input type="text"/>	<input type="text"/>
Pression artérielle Minimale	<input type="text"/>	<input type="text"/>	<input type="text"/>
Apparition de douleurs	<input type="text"/>	<input type="text"/>	<input type="text"/>
Paroxysme	<input type="text"/>	<input type="text"/>	

OBSERVATIONS

Commentaires sur l'infection:

Indiquez de façon détaillée la chronologie (date et heures) des événements permettant de comprendre l'évolution du cas, et précisez de façon plus complète le personnel mobilisé, les traitements entrepris, les décisions prises ...

FICHE PATHOLOGIE CHRONIQUE PREEXISTANTE

ne rien inscrire dans cette partie prévue pour le codage

Remplir la fiche si le décès est en rapport avec la pathologie, ou si la pathologie a contribué au décès, même si le diagnostic a été fait pendant la grossesse

> PATHOLOGIE

• Nom de la pathologie (2 possibles):

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------	----------------------	----------------------

• Contexte pathologique familial

0: Non	1: Oui
--------	--------

Si oui, détaillez:

<input type="text"/>	<input type="text"/>
----------------------	----------------------

• Moment du diagnostic:

1: Avant la grossesse	2: Pendant la grossesse
-----------------------	-------------------------

<input type="text"/>	AG	<input type="text"/>
----------------------	----	----------------------

> SI LA MALADIE ETAIT CONNUE AVANT LE DEBUT DE LA GROSSESSE:

• Date du diagnostic:

<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>	<input type="text"/>
----------------------	---	----------------------	---	----------------------	----------------------

• Y avait-il une prise en charge spécialisée?

0: Non	1: Oui
--------	--------

Si oui, précisez

la spécialité :

J	M	A
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

Date de la dernière consultation:

<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>	<input type="text"/>
----------------------	---	----------------------	---	----------------------	----------------------

• Equilibre de la pathologie avant le début de la grossesse:

J	M	A
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

Y avait-il un traitement en cours?

0: Non	1: Oui
--------	--------

Si oui, indiquez le(s)quel(s):

Y avait-il des atteintes viscérales constituées?

0: Non	1: Oui
--------	--------

Si oui, indiquez le(s)quel(s):

<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------	----------------------

La maladie était-elle stabilisée?

0: Non	1: Oui
--------	--------

Y avait-il eu un épisode aigu, une décompensation avant le début de la grossesse?

0: Non	1: Oui
--------	--------

Si épisode aigu, décompensation indiquez,

la date de l'épisode:

<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>	<input type="text"/>
----------------------	---	----------------------	---	----------------------	----------------------

la nature de l'épisode:

J	M	A
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

• Avis médical avant le début de la grossesse:

0: Non	1: Oui	2: non documenté
--------	--------	------------------

Si oui, la grossesse avait-elle été formellement contre-indiquée?

0: Non	1: Oui	2: non documenté
--------	--------	------------------

<input type="text"/>	<input type="text"/>
----------------------	----------------------

> AU COURS DE LA GROSSESSE ET AVANT LA DECOMPENSATION FATALE:

• AG au moment du diagnostic (si fait en cours de grossesse):

(SA)

<input type="text"/>	<input type="text"/>
----------------------	----------------------

• Surveillance spécialisée de la maladie en cours de grossesse:

0: Non	1: Oui
--------	--------

Si oui, indiquez la fréquence des consultations:

<input type="text"/>	<input type="text"/>
----------------------	----------------------

• Discussion d'IMG

0: Non	1: Oui	2: non documenté
--------	--------	------------------

• Modification du traitement de la maladie en cours de grossesse:

0: Non	1: Oui
--------	--------

Si oui, détaillez:

<input type="text"/>	<input type="text"/>	<input type="text"/>
----------------------	----------------------	----------------------

• Le traitement de la maladie était-il une contre-indication à la grossesse?

0: Non	1: Oui
--------	--------

• Evolution de la maladie: Y a-t-il eu décompensation?

0: Non	1: Oui
--------	--------

Si oui

indiquez, la date de la décompensation:

<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>	<input type="text"/>
----------------------	---	----------------------	---	----------------------	----------------------

la nature de la décompensation:

J	M	A
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

l'existence d'une hospitalisation:

0: Non	1: Oui
--------	--------

> DECOMPENSATION AYANT CONDUIT AU DECES:

• Date de début de la décompensation:

<input type="text"/>	/	<input type="text"/>	/	<input type="text"/>	<input type="text"/>
----------------------	---	----------------------	---	----------------------	----------------------

• Nature de la décompensation:

J	M	A
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>

• Hospitalisation ¥

0: Non	1: Oui
--------	--------

<input type="text"/>	<input type="text"/>
----------------------	----------------------

En cas d'hospitalisation, veuillez remplir la fiche hospitalisation-transfert page 19

Commentaires sur le suicide:

Indiquez de façon détaillée la chronologie (date et heures) des événements permettant de comprendre l'évolution du cas, et précisez de façon plus complète les examens pratiqués, le personnel mobilisé, les traitements entrepris et les décisions prises ...

FICHE SUICIDE

I. CONTEXTE AVANT LA GROSSESSE

Un trouble psychiatrique était-il diagnostiqué avant la grossesse? 0: Non 1: Oui

Si oui, diagnostic: Age au diagnostic:

Suivi spécialisé: 0: Non 1: Oui

Si oui par qui? 1: CMP 2: Psychiatre libéral 3: Psychiatre hospitalier 4: Autre Si autre, précisez:

Traitement médicamenteux: 0: Non 1: Oui

Si oui, lequel? Observance: 1: Oui 2: Non 3: Partielle

Antécédent d'hospitalisation en psychiatrie: 0: Non 1: Oui

Si oui, date de la dernière hospitalisation: / Motif:

Sous quel mode: 1: libre 2: demande d'un tiers 3: demande du représentant de l'état

Trouble du comportement alimentaire 0: Non 1: Oui

Si oui, lequel?

Existence d'antécédent de passage à l'acte auto agressif? 0: Non 1: Oui

Si oui, préciser le type: Date: /

Contexte familial

Antécédents familiaux au 1er degré de trouble psychiatrique? 0: Non 1: Oui

Si oui, lequel?

Conjoint au courant de la pathologie de la femme? 0: Non 1: Oui

Conjoint atteint d'une pathologie psychiatrique? 0: Non 1: Oui

Conjoint violent? 0: Non 1: Oui

Si autres enfants: présents au domicile? 0: Non 1: Oui

Si non, enfants en placement? 0: Non 1: Oui

II. PERIODE PRENATALE

Nouvel épisode psychiatrique pendant la grossesse (ou exacerbation du trouble préexistant): 0: Non 1: Oui

Si oui, diagnostic: Terme(en SA):

Passage à l'acte auto agressif (avant le suicide): 0: Non 1: Oui

Si oui, terme(en SA):

Prise en charge spécifique pendant la grossesse: 0: Non 1: Oui

Si oui: Modification thérapeutique: 0: Non 1: Oui

Si oui, préciser:

Consultations spécialisées pendant la grossesse: 1: CMP 2: Psychiatre en maternité 3: Autres

Nombres de consultations: Si autres, préciser:

Coordination psychiatre référent/maternité/psychiatre maternité: 0: Non 1: Oui

Suivi spécifique à domicile: 0: Non 1: Oui Si oui, par qui:

Fréquence des visites (par semaine):

Hospitalisation psychiatrique pendant la grossesse: 0: Non 1: Oui

Date de la dernière hospitalisation: / Terme(en SA):

Motif: Service:

Sous quel mode: 1: libre 2: demande d'un tiers 3: demande du représentant de l'état

Risque de psychose du post partum identifié: 0: Non 1: Oui

Prise de toxique pendant la grossesse: 0: Non 1: Oui Si oui, lesquels:

Prise en charge spécifique addictologique pendant la grossesse: 0: Non 1: Oui

OBSERVATIONS

Commentaires sur le suicide:

Indiquez de façon détaillée la chronologie (date et heures) des événements permettant de comprendre l'évolution du cas, et précisez de façon plus complète les examens pratiqués, le personnel mobilisé, les traitements entrepris et les décisions prises ...

FICHE SUICIDE (suite)

Consultation dans un service d'urgence pour surdosage: 0: Non 1: Oui
 Terme:SA

Hospitalisation pour addiction pendant la grossesse: 0: Non 1: Oui

III. ACCOUCHEMENT

Modification de l'état psychiatrique lors de l'accouchement? 0: Non 1: Oui

Si oui, détailler:.....

Nécessité d'une prise en charge spécifique?: 0: Non 1: Oui

Si oui, détailler:.....

IV. PERIODE POSTNATALE

Si pathologie psychiatrique (préexistante, pendant la grossesse ou le post partum immédiat), la sortie a t'elle été organisée en en tenant compte?

0: Non 1: Oui Si oui, selon quelles modalités, préciser:.....

Nouvel épisode psychiatrique (ou exacerbation du trouble préexistant): 0: Non 1: Oui

Si oui, lieu: Date:/...../.....

Symptômes:

Prise en charge proposée: 0: Non 1: Oui

Si oui: type de consultation/prise en charge:

Délai d'apparition entre les symptômes et la prise en charge:.....

Traitement prescrit: 0: Non 1: Oui Si oui, préciser:.....

Hospitalisation spécifique: 0: Non 1: Oui Si oui, date:/...../.....
 Lieu:

Sous quel mode: 1: libre 2: demande d'un tiers 3: demande du représentant de l'état

V. MODALITES DU SUICIDE

Modalité du suicide:

	Non	Oui	
Intoxication médicamenteuse	<input type="checkbox"/>	<input type="checkbox"/>	
Défenestration	<input type="checkbox"/>	<input type="checkbox"/>	
Plaie par arme blanche	<input type="checkbox"/>	<input type="checkbox"/>	
Pendaison	<input type="checkbox"/>	<input type="checkbox"/>	
Dans un contexte de prise de toxique	<input type="checkbox"/>	<input type="checkbox"/>	Lesquels:
Autres:	<input type="checkbox"/>	<input type="checkbox"/>	

Suicide dans un contexte:

	Non	Oui
Dépressif :	<input type="checkbox"/>	<input type="checkbox"/>
Déliquant :	<input type="checkbox"/>	<input type="checkbox"/>
De façon impulsive et non préméditée :	<input type="checkbox"/>	<input type="checkbox"/>
Mettant en danger l'enfant :	<input type="checkbox"/>	<input type="checkbox"/>
Réalisé en présence de tiers :	<input type="checkbox"/>	<input type="checkbox"/>

Lieu de suicide : 1: Domicile 2: Voie publique 3: Hôpital 4: Autre Autre:.....

La patiente était-elle prise en charge sur le plan psychiatrique au moment du suicide ?

0: Non 1: Oui Si oui selon quelles modalités:
 1: Consultation psychiatrique 2: Hospitalisation psychiatrique 3: Hospitalisation mère-bébé 4: Suivi à domicile

OBSERVATIONS

Commentaires sur le séjour en réanimation, unité de soins intensifs ou service de surveillance continue:
 Indiquez de façon détaillée la chronologie (date et heures) des événements permettant de comprendre l'évolution du cas, et précisez de façon plus complète les examens pratiqués, le personnel mobilisé, les traitements entrepris et les décisions prises ...

FICHE REANIMATION

ne rien inscrire dans cette partie prévue pour le codage

Remplir la fiche s'il y a eu une prise en charge réanimatoire en établissement, avec ou sans séjour en réanimation/USI

> Y A-T-IL EU DES GESTES REANIMATOIRES AVANT L'ARRIVEE DANS LE SERVICE?

0: Non 1: Oui Si oui, indiquez:

- La date et l'heure à laquelle ils ont été pratiqués:

/ / H

- Ont-ils eu lieu dans un établissement? 0: Non 1: Oui Si oui, indiquez:

- s'il s'agit 1: Du même établissement 2: D'un autre établissement

Précisez le service:

- Ont-ils eu lieu hors d'un établissement? 0: Non 1: Oui Si oui, précisez:

- Indications: (2 possibles)

- Qualification de l'intervenant:

- Etat de la patiente au moment des premiers gestes réanimatoires:

Glasgow: Fréquence cardiaque: Fréquence respiratoire:

Pression artérielle Systolique: / Diastolique: SpO2:

- Gestes réanimatoires pratiqués:

Application d'oxygène: 0: Non 1: Oui Si oui, quantité: (O2 l/min):

Ventilation non invasive: 0: Non 1: Oui Intubation: 0: Non 1: Oui

Massage cardiaque externe: 0: Non 1: Oui Défibrillation: 0: Non 1: Oui

Abord veineux: 0: Non 1: Oui, central 2: Oui, périphérique

Si oui, précisez:

Remplissage 0: Non 1: Oui Type de produits et quantité:

Catécholamines 0: Non 1: Oui

Autres médicaments 0: Non 1: Oui Type et dose:

Autre(s) intervention(s), à préciser:

- Transfert en unité de réanimation, soins intensifs ou surveillance continue: 0: Non 1: Oui

Si oui, indiquez l'heure du transfert: H

> HOSPITALISATION EN UNITE DE REANIMATION, SOINS INTENSIFS OU SURVEILLANCE CONTINUE*

- Date et heure de l'admission en réanimation: / / H

Service de provenance: 1: Admission Directe 2: Urgence 3: Chirurgie 4: Obstétrique 5: Autre Réa 6: Autres

Nature de l'unité: 1: Surveillance continue 2: Soins intensifs 3: Réanimation Si 6, lequel:

Si réanimation, précisez le type: 1: Réa chirurgicale 2: Réa médicale 3: Réa polyvalente

- Diagnostic à l'arrivée:

(2 possibles)

Merci de joindre une copie du dossier de réanimation

* si plusieurs hospitalisations dans différents services de réanimations ou soins intensifs, remplir une fiche par service

OBSERVATIONS

Commentaires sur le séjour en réanimation, unité de soins intensifs ou service de surveillance continue:

Indiquez de façon détaillée la chronologie (date et heures) des événements permettant de comprendre l'évolution du cas, et précisez de façon plus complète les examens pratiqués, le personnel mobilisé, les traitements entrepris et les décisions prises ...

FICHE REANIMATION (suite)

ne rien inscrire dans cette partie prévue pour le codage

• Etat de la patiente en réanimation:

Bilan à l'arrivée		Episode le plus critique		arrivée		critique	
Valeurs		Valeurs		Date et heure (J, M, H, min):			
Score de Glasgow	Glasgow	J	M	
Fréquence cardiaque	FC			
Fréquence respiratoire	FR			
Pression artérielle	S			
Systolique	D			
Diastolique	T			
Température	SpO2			
SpO2	IGS			
Score d'IGS II				

• Monitoring et assistance:

	Présent à l'arrivée en réa		Fait en réa		Si fait en réa, précisez la date et l'heure:		présent		fait	
	Non	Oui	Non	Oui / /	N/O	N/O	N/O	N/O
Pression veineuse centrale	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> / /	J	M	<input type="checkbox"/>	<input type="checkbox"/>
Pression artérielle invasive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> / /			<input type="checkbox"/>	<input type="checkbox"/>
Intubation/ventilation assistée	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> / /			<input type="checkbox"/>	<input type="checkbox"/>
Ventilation non invasive	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> / /			<input type="checkbox"/>	<input type="checkbox"/>
Echographie cardiaque	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> / /			<input type="checkbox"/>	<input type="checkbox"/>
Autre(s)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/> / /			<input type="checkbox"/>	<input type="checkbox"/>

Si autres, précisez:

Transfusion	Non	Oui	Date et Heure à la 1ère admission	Quantité totale	J	M	Quantité
Culots globulaires	<input type="checkbox"/>	<input type="checkbox"/> /			
Plasma frais congelé	<input type="checkbox"/>	<input type="checkbox"/> /			
Plaquettes	<input type="checkbox"/>	<input type="checkbox"/> /			
Fibrinogène	<input type="checkbox"/>	<input type="checkbox"/> /			

OBSERVATIONS

Commentaires sur le séjour en réanimation, unité de soins intensifs ou service de surveillance continue:

Indiquez de façon détaillée la chronologie (date et heures) des événements permettant de comprendre l'évolution du cas, et précisez de façon plus complète les examens pratiqués, le personnel mobilisé, les traitements entrepris et les décisions prises ...

AVIS SUR LE DEROULEMENT DE LA MISSION

oui non

- Avez vous rencontré des difficultés pour organiser la visite sur site?

Si oui, détaillez:

- Vous êtes vous déplacés sur le lieu du décès (établissement)?

Si non, pourquoi?

Sur un autre lieu:

Si oui, qui vous a accueillis?

Comment qualifieriez vous l'accueil que vous avez reçu par l'équipe soignante?

- Avez vous consulté les documents suivants? (oui/ non/ non applicable au cas)

	Oui	Non	NA		Oui	Non	NA
- Dossier de surveillance prénatale	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Compte rendu césarienne	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Partogramme	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Compte rendu d'accouchement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Fiche(s) d'anesthésie	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Compte rendu opératoire	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Dossier de soins infirmiers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Compte rendu du séjour en réanimation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Examens biologiques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Rapport d'autopsie	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
- Fiche d'intervention SAMU	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Compte rendu RMM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Pour les documents non consultés, détaillez les raisons (dossier perdu, dossier dans un autre établissement, refus d'accès...):

- Détaillez d'autres difficultés rencontrées:

Avez vous des propositions pour améliorer le déroulement de vos futures missions d'assesseurs?

Assesneur gynécologue-obstétricien/ sage-femme

Nom :

Adresse :

Téléphone :

Courriel :

Assesneur anesthésiste-réanimateur

Nom :

Adresse :

Téléphone:

Courriel :

Date d'envoi du dossier à l'Inserm: _____/_____/_____

Nous vous remercions pour votre contribution au dispositif national d'étude de la mortalité maternelle.

APPENDIX 2. Summary of the experts' conclusions for each death

Fiche Expertise

Dossier : _____ Date : _____

I. Cause du décès

- a) Principale :
b) secondaire

- Mort maternelle: OUI NON

Si mort maternelle : Directe Indirecte Lien non déterminé

II. Catégorie

- a) Principale : _____ CIM _____
b) Secondaire : _____ CIM _____
c) Transversale : Mort subite Obésité Vulnérabilité sociale

III. Moment de survenue du décès:

Pendant la grossesse Perpartum/abortum Postpartum/abortum Si au cours de la grossesse SA ____ Si postpartum/abortum : N jours après _

IV. Moment de survenue de la complication ayant entraîné le décès:

Pendant la grossesse Perpartum/abortum Postpartum/abortum Si au cours de la grossesse SA __ Si postpartum/abortum : N jours après ____

II. Adéquation des soins

	Optimaux	Non optimaux	Conclusion non établie	NA*
Préconceptionnels	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Surveillance de la grossesse	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Premiers recours ¹	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Obstétricaux	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anesthésiques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Réanimation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Autre(s) ²	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*NA : Ne s'applique pas

¹Médecin généraliste, urgences, SAMU, autre

² Autre(s) spécialité(s) ex : neurologie, hématologie etc...

Si soins non optimaux, détaillez les raisons :

III. Évitabilité du décès :

Probable

Peut être

Non évitable

Conclusion non établie

Si peut être ou certainement évitable, détaillez les raisons :

(Plusieurs peuvent s'appliquer)

A) Facteurs liés au contenu des soins OUI NON Si oui :

Défaut diagnostique (non fait ou fait avec retard) OUI NON

Retard au traitement OUI NON

Prise en charge ou traitement inadaptés OUI NON

Détails :

B) Facteurs liés à l'organisation des soins OUI NON Si oui :

Lieu de prise en charge non adapté OUI NON

Transfert non fait ou fait avec retard OUI NON

Défaut de communication entre soignants OUI NON

Ressources humaines insuffisantes OUI NON

Ressources matérielles insuffisantes OUI NON

Détails :

C) Facteurs liés à l'interaction de la patiente avec le système de soins : OUI NON

Si oui :

Défaut d'observance d'un traitement OUI NON

Non venue aux consultations ou refus d'hospitalisation OUI NON

Vulnérabilité sociale OUI NON

Vulnérabilité mentale OUI NON

Détails :