



## Original Article

# Preparedness for severe maternal morbidity in European hospitals: The MaCriCare study



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## ABSTRACT

**Purpose:** To evaluate obstetric units (OUs) and intensive care units (ICUs) preparedness for severe maternal morbidity (SMM).

**Methods:** From September 2021 to January 2022, an international multicentre cross-sectional study surveyed OUs in 26 WHO Europe Region countries. We assessed modified early obstetric warning score usage (MEOWS), approaches to four SMM clinical scenarios, invasive monitoring availability in OUs, and access to high-dependency units (HDUs) and onsite ICUs. Within ICUs, we examined the availability of trained staff, response to obstetric emergencies, leadership, and data collection.

**Results:** 1133 responses were evaluated. MEOWS use was 34.5%. Non-obstetric early warning scores were being used. 21.4% (242) of OUs provided invasive monitoring in the OU. A quarter lacked access to onsite HDU beds. In cases of SMM, up to 13.8% of all OUs indicated the need for transfer to another hospital. The transfer rate was highest (74.0%) in small units. 81.9% of centers provided onsite ICU facilities to obstetric patients. Over 90% of the onsite ICUs provided daily specialist obstetric reviews but lacked immediate access to key resources: 3.4% - uterotonic drugs, 7.5% - neonatal resuscitation equipment, 9.2% - neonatal resuscitation team, 11.4% - perimortem cesarean section equipment. 41.2% reported obstetric data to a national database.

**Conclusion:** Gaps in provision exist for obstetric patients with SMM in Europe, potentially compromising patient safety and experience. MEOWS use in OUs was low, while access to invasive monitoring and onsite HDU and ICU facilities was variable. ICUs frequently lacked resources and did not universally collect obstetric data for quality control.

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## Introduction

Severe maternal morbidity (SMM), leading to intensive care unit (ICU) admission, ranges from 2 to 17 cases per 1000 deliveries [1–5]. SMM refers to a significant and adverse health outcome or

complication during pregnancy, childbirth, or the postpartum period that poses a serious risk to a woman's health. These conditions are life-threatening or have the potential for long-term health consequences. The main causes of severe maternal morbidity are diverse and present in the antepartum, intrapartum, or postpartum period. Some common causes include hemorrhage, hemodynamic shock, hypertensive disorders, infections, post-surgical complications, cardiomyopathy, thromboembolism, amniotic fluid embolism, placental abruption, uterine rupture, maternal mental health disorders, and pre-existing medical conditions. Although SMM can arise at any time, the day of birth sees the highest rate of obstetric ICU admissions [3]. The ICU admission rate has risen recently, mainly due to hemorrhage and sepsis [4,5]. Prompt recognition and management of critical illness in these women are paramount. However, even in high-income healthcare environments, challenges can emerge if essential systems and services are lacking. Many countries have adopted early warning systems to aid in detecting patient deterioration and the onset of critical illness, yet the extent of their use in the obstetric setting is uncertain. Once deterioration has been identified, specialist critical care management may be necessary, however, not all obstetric units (OUs) have access to high-dependency units (HDUs) beds and onsite ICU facilities. Furthermore, once in the ICU, the availability of expert obstetric review and the ability to respond to obstetric emergencies may vary [6].

The MaCriCare study network of anesthesiologists, intensive care physicians, obstetricians, critical care nurses, and midwives examined the availability of services and facilities to obstetric patients with SMM. The project aimed to examine obstetric critical care provision in European hospitals, focusing on three core themes: 1) preparedness for SMM, 2) OU resources, and 3) patient experience. This article presents the findings related to the first theme and considers (i) the use of modified early obstetric warning scores (MEOWS), (ii) local approaches to four standardized SMM clinical scenarios (iii) the ability to provide routine invasive monitoring in OUs (iv) OUs' access to HDU beds and (v) the availability of onsite ICU facilities. Within the ICUs associated with the OU, we examined (vi) the availability of trained personnel, (vii) the ability to respond to obstetric emergencies, and (viii) leadership and data collection relevant to obstetric care.

## Methods

A multicenter international survey was designed and conducted by experts in obstetric anesthesia and intensive care. It adhered to the BRUSO methodology (brief, relevant, unambiguous, specific, and objective) [7]. The survey is found in Supplementary file A1 and covers general unit characteristics, available facilities, accepted practices in obstetric units and intensive care units, and approaches to four specific SMM scenarios. Respondents could enter free-text comments to capture potential issues related to SMM care in their respective centers. Supplementary file A2 details the survey development process, translation, and pilot testing, along with the key role of designated national coordinators (NCs) in facilitating survey distribution and coordination across participating countries. The common definitions and abbreviations used in the article are presented in Table 1.

Institutional Review Board (IRB) approval was obtained. NCs further secured ethical approval or waivers in each country. NCs listed centers in their countries that met the survey's ethical criteria.

Various terms describe obstetric-specific early warning scores and systems. 'Modified Early Obstetric Warning Score' (MEOWS) itself encompasses various distinct tools [8]. Worldwide, several obstetric-specific tools exist, each with its acronym, including

**Table 1**  
Abbreviations and/or definitions.

Term	Abbreviation and/or definition
High-Dependency Unit	HDU
Intensive Care Unit	ICU
Obstetrics Unit	OU
Center	The institution in which its affiliated OU and ICU are located

Obstetric National Early Warning Score (ONEWS), Maternal Early Warning Score (MEWS), Maternal Early Warning Criteria (MERC), Maternal Early Warning Trigger (MEWT), and Obstetric Early Warning Score (OEWS). In the absence of a universally accepted umbrella term, MEOWS is used to refer to any obstetric-specific tool [8].

The data were collected using LimeSurvey<sup>®</sup>, an online tool [9], and incorporated security measures, including encryption, to ensure data anonymity and confidentiality according to the institutional digital data protection policy [10].

In view of the impact of the SARS-Cov-2 pandemic, the data collection window, initially three months, was extended by 30 days. NCs received monthly updates on response rates. Unfinished surveys received reminders at 30-day intervals.

Only completed surveys were analyzed, with one survey selected per center. Incomplete records were excluded. In cases of duplicates, which could occur when two respondents from the same center independently completed the survey, NCs coordinated with units to determine the intended response to include in the analysis.

The number of deliveries covered by the survey was calculated by the number of annual births reported by respondents (OU capacity). In the case of the open-ended upper range of annual births (>7500), we assumed a fixed value of 10,000 as an estimation. NCs reported total live births for each country in 2020.

Simple descriptive statistics were used to present data as mean  $\pm$  standard deviation (SD), median values with interquartile range (IQR), or percentages (%). These descriptive statistics were performed using R software (ver. 4.1.3; R Development Core Team, Austria, Vienna) [11].

## Results

During the study period from 1st September 2021 until 1st January 2022, a total of 1207 complete responses were recorded. After data cleaning, the final analysis included responses obtained from 1133 OUs across 26 countries, representing over 2.5 million deliveries annually. The list of participating countries, the response rate, the survey coverage per country, and access to ICU are presented in Table 2. Out of the 1133 OUs, 928 (81.9%) had an ICU in the same center. Detailed information about participating units' characteristics is presented in Supplementary Tables A1 and A2.

MEOWS use by responding OUs in each country ranged from 11 to 100% (Fig. 1) and averaged 34.5% among surveyed OUs. MEOWS use varied by OU characteristics (Fig. 2, Supplementary Table A3) and increased incrementally with both the OU size and level of care. Free-text response analysis revealed that a variety of obstetric-specific early warning systems, for example, obstetric national early warning score (ONEWS) in Sweden and Norway, as well as non-obstetric early warning scores e.g. national early warning score-2 (NEWS-2) being used in the obstetric setting. The summary of the free-text comments is presented in the Supplementary file A3.

Regarding local approaches to four standardized SMM clinical scenarios, we found marked differences in obstetric patient