

## ‘Maternal Intensive Care’: a systematic literature review

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### Abstract

**Objective:** The objective of this systematic literature review is to review current scientific knowledge on the definition of and the indications for maternal/obstetric intensive care (MIC).

**Methods:** We conducted an extensive search in OVID MEDLINE, EMBASE, COCHRANE, CINHALL and CEBAM using the keywords: maternal/obstetric intensive care, subacute care, intermediate care, postacute care, critical care, sub intensive care, progressive patient care, postnatal care, perinatal care, obstetrical nursing, neonatology, pregnancy, maternal mortality/morbidity and pregnancy complication. A total of 180 articles and one guideline were identified and supplemented by a hand search. After title, abstract and full text evaluation, the articles and guideline were subjected to critical appraisal.

**Results:** Out of 180 potentially relevant articles, we identified 44 eligible articles of which 14 relevant MIC-articles of relatively good quality were selected. The concept ‘maternal intensive care’ was not found elsewhere, “high-dependency care” and “obstetrical intermediate care” appeared to be best comparable to what is understood as a MIC-service in Belgium. This thorough literature search resulted in a limited amount of scientific literature, with most studies retrospective observational tertiary centre based. No clear definition and admission criteria for maternal intensive care were found.

**Conclusion:** This systematic literature review revealed that 1) there is no standard definition of maternal intensive care and 2) that admission criteria to a MIC unit differ widely. Further research is needed to create an evidence-based triage system to help clinicians attribute women to the appropriate level of care and thus stimulate an efficient utilization of maternal/obstetric intensive care services.

**Key words:** maternal/obstetric intensive care, intermediate care, high risk obstetric service/unit, maternal mortality/morbidity, pregnancy complication.

### Introduction

In Belgium, the Maternal Intensive Care (MIC) concept was introduced by law in 1996. The Royal Decree (RD) of August 20th 1996 defines Maternal Intensive Care as follows:

*“The MIC-service is recognized as a division of the maternity department. This division is dedicated to the intensive observation of high-risk pregnancies. The division also admits in its P\* function, patients with a pregnancy at high risk for neonatal observation at a Neonatal Intensive Care (NIC) service and patients who will need highly specialized postpartum care.” The P\* function is mandatory constituted by*

*a MIC-service and a NIC (Neonatal Intensive Care) service; the MIC-service will serve as a referral centre for a group of hospitals totalizing a minimum of 5000 deliveries per year”.*

However, the Royal Decree has not precisely defined the statute, the purposes, nor the function and terms of reference of a MIC-service. What is intensive observation? What are the indications for which a baby potentially needs neonatal intensive care? How are high-risk pregnancies defined? When does a patient need highly specialised post partum care?

Hence, the indications during pregnancy, delivery, or post-partum leading to an admission in a MIC-service are not specified. This legal frame with

regard to maternal intensive care seems not sufficient to guide the daily obstetrical practice.

In this article, we conducted a systematic literature review in an effort to resolve the vagueness related to the definition and admission criteria for optimal maternal intensive care, based on the current scientific knowledge and evidence.

### Sources and study selection

This systematic literature review was based on a extensive search in the electronic databases OVID MEDLINE, EMBASE, COCHRANE and CINHAL. The CEBAM database was accessed to review the relevant (clinical) guidelines on the topic.

The limits were set on English, Dutch or French publications from January 1997 to December 2007. The searches were systematically updated during the writing process, the last update took place July 15<sup>th</sup>, 2009. Following keywords and combinations of these keywords were used: maternal/obstetric intensive care, subacute care, intermediate care, postacute care, critical care, sub intensive care, progressive patient care, postnatal care, perinatal care, obstetrical nursing, neonatology, pregnancy, maternal mortality/morbidity and pregnancy complication.

We started our literature search in OVID MEDLINE and applied the same search strategy in EMBASE, COCHRANE and CINHAL. The different steps followed were: enter MeSH terms/keywords in selected databases, title and abstract evaluation (selection criteria below), full text evaluation, critical appraisal and selection of articles. The detailed flow chart from the search strategy used for the different databases is presented in Figure 1. Several articles were found through the snowball method (hand search). During full text evaluation, one article of high relevance written by Zeeman (2006), was retrieved by hand search. This systematic literature review evaluated 30 articles about obstetric intermediate and intensive care, hence we retrieved and evaluated all studies selected by Zeeman. The studies of fairly good quality were included in our selection.

The selection criteria used for the title and abstract evaluation were:

- No comments and case reports;
- No specific ‘intensive care’ research: articles that only describe research on mechanical ventilation, multiple organ support, invasive monitoring and artificial life support were excluded;
- No specific ‘neonatologic’ research: articles describing research on science in medically caring for the newborn were excluded (for example research about growth retardation and very low birth weight);

- No ‘infertility’ research: articles on specific research on infertility were excluded (for example ovarian hyperstimulation syndrome).

The critical appraisal of the selected articles (after full text evaluation) was based on “The checklist for observational studies” from the Agency for Healthcare Research and Quality (West *et al.*, 2002). Two individual researchers (ASVP and HV) performed separately the assessment of the selected studies and attributed a level of evidence based on the above mentioned checklist. Evidence level 3 is non-experimental descriptive research with a good design: comparative research, correlation studies, case-series. Level 4 are reports of expertgroups, expert opinions, clinical experience of respected authorities. A detailed overview of the selected articles (evidence table) is available in the annexes.

As stated above, relevant guidelines on definitions and admission criteria were also retrieved through CEBAM (this is the Belgian branch of the Cochrane collaboration and has a portal site that gathers up to date evidence based search engines). The following search engines were systematically explored in the **Dutch**-language databases: CBO, Nederlands Huisartsengenootschap, Richtlijnen Kenniscentrum (KCE), NVOG, RIZIV richtlijnen and WVVH Domus Medica. Furthermore, **Anglo-Saxon** guidelines search engines (Guideline Finder UK, National Guideline Clearinghouse, New Zealand Guidelines Group, RCOG, ACOG, Tripdatabase, Sumsearch, Prodigy Guidelines and WHO) were searched with keywords: maternal/obstetric intensive care, subacute care, intermediate care, postacute care, critical care, sub intensive care, progressive patient care, postnatal care, perinatal care, obstetrical nursing, neonatology, pregnancy, maternal mortality/morbidity and pregnancy complication. We identified 4 potential relevant guidelines and explored everything related to high-risk, complication and problem. Similar selection criteria as in the above literature search were used and critical appraisal was done by means of the Appraisal of Guidelines Research and Evaluation instrument (The AGREE collaboration, 2001).

### Results

The search in OVID MEDLINE, EMBASE, COCHRANE and CINHAL retrieved 180 potentially relevant articles. Based on title and abstract evaluation, 136 articles were excluded, 44 articles were eligible for more detailed evaluation. After full text evaluation another 30 were excluded and 14 studies were submitted to critical appraisal. The quality of all 14 studies were evaluated as fairly good and therefore included in the systematic review (Table I, Fig. 1).

**Table I.** — Overview selected studies maternal intensive care

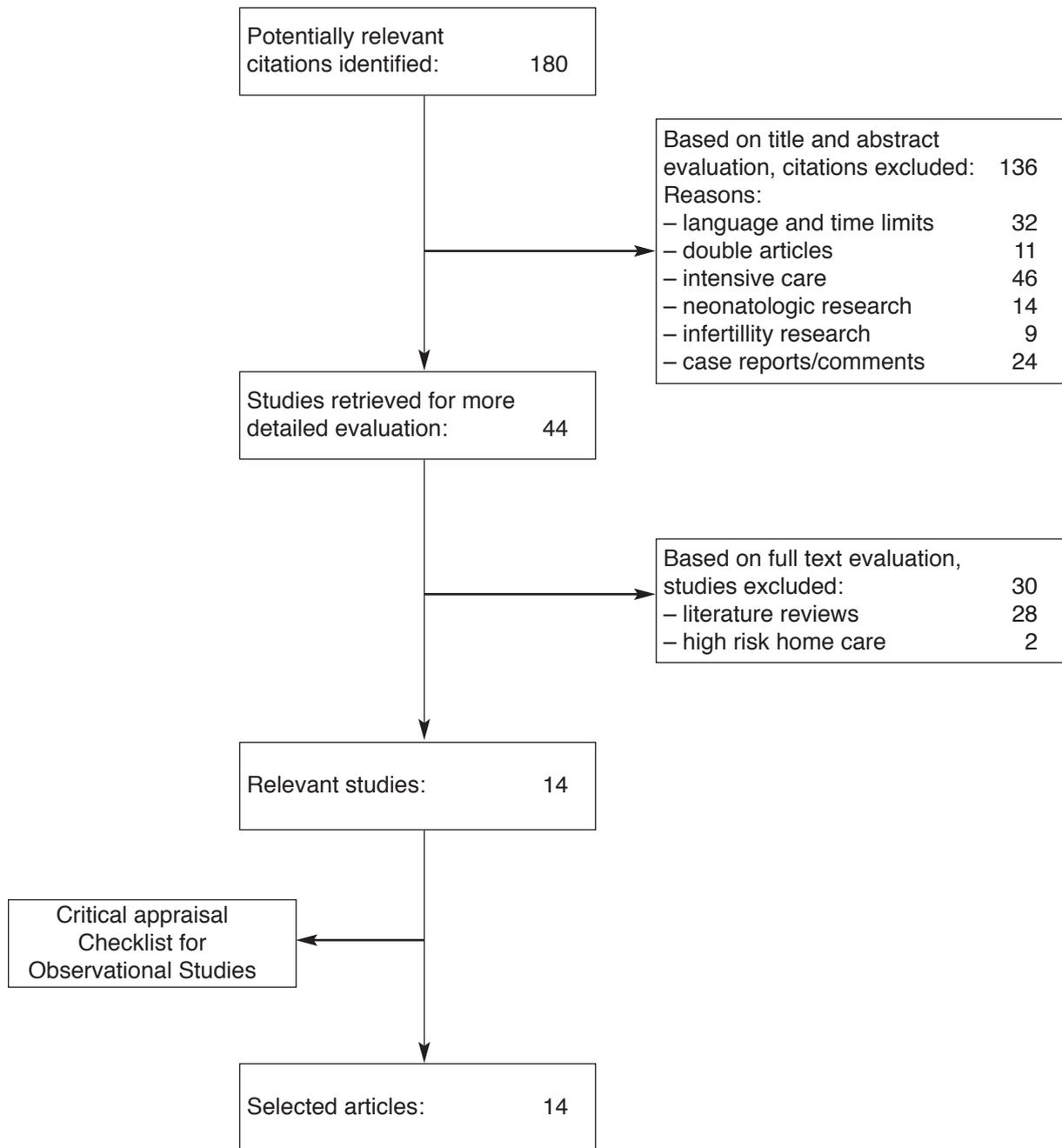
Ref.	Study	Country	Population	Study type	EL <sup>1</sup>
1	Neto MT (2006)	Portugal	Perinatal care in Portugal	National perinatal database analysis	3
2	Keizer JL <i>et al.</i> (2006)	The Netherlands	142 women admitted at ICU Leiden University Medical Centre (1991-2001)	Retrospective tertiary centre based analysis of medical records of all obstetric admissions ICU	3
3	Zeeman G (2006)	The Netherlands	/	(syst.) literature review	3
4	Fowler SJ (2005)	New Zealand (Wellington)	240 hospitals	International retrospective health care survey of operative obstetric services	3
5	Biswas AB <i>et al.</i> (2005)	India (West Bengal)	408 health facilities	Cross sectional health facility survey of minimum levels of Emergency ObstC	3
6	Lee B (2004)	UK	/	Meeting report of the Forum on Maternity and the Newborn, Royal Society of Medicine (17 June 2004)	4
7	Okafor U and Aniebue U (2004)	Nigeria	18 patients admitted to an obstetric ICU	Retrospective tertiary centre based analysis of obstetrical ICU admissions (health care survey)	3
8	Zeeman G <i>et al.</i> (2003)	USA	483 critically ill peripartum women	Prospective evaluation and analysis of OICU and M/S ICU obstetrical admissions (health care survey)	3
9	Schatz <i>et al.</i> (2003)	USA	1739 pregnant asthmatic patients, < 26 weeks gestation	Prospective observational cohort study	3
10	Heinonen S <i>et al.</i> (2002)	Finland	22 consecutive obstetric patients admitted to a mixed medical/surgical ICU	Retrospective tertiary based review of all obstetric patients treated on the ICU at Kuopio University Hospital	3
11	Afessa B <i>et al.</i> (2001)	USA	74 obstetric patients admitted to the ICU	Tertiary centre based retrospective analysis of obstetric ICU admissions (health care survey)	3
12	Ryan M <i>et al.</i> (2000)	Ireland	123 patients admitted on the HDU of an regional obstetric centre (free standing maternity unit)	Regional obstetric hospital based retrospective analysis of all hospital case notes and HDU/ICU registers from HDU admissions and medical charts from the referral ICU (health care survey)	3
13	Baskett T and Sternadel, J (1998)	Canada	55 patients that required transfer for critical care and 2 maternal deaths	Retrospective tertiary centred analysis of all maternal deaths and referrals to critical care.	3
14	Cordingley J and Rubin A (1997)	UK	232 consultant obstetric units	Retrospective nationwide health care survey of all UK units providing obstetric recovery facilities, high dependency and intensive care	3

<sup>1</sup> EL: Evidence Level

The search for guidelines resulted in two types of guidelines, general (low risk) maternity care guidelines and guidelines on a specific topic of complicated peripartal care e.g. diabetes and pregnancy, cardio-vascular problems during pregnancy, etc. . Only one guideline (Duodecim, 2006) was selected because it specified management/treatment of pregnant women with heart and vascular diseases (hypertension, heart disease), thrombotic complications, metabolic disorders (diabetes, hypothyroidism, hyperthyroidism, obesity), neurological diseases (epilepsy, migraine, disturbances of cerebral circulation), renal diseases, rheumatic disorders, psychi-

atric problems, bronchial asthma and cancer. Unfortunately no recommendations were made about the appropriate level of care for each type of pathology.

We found no specific guidelines concerning overall maternal/obstetrical intensive/intermediate care, we did find some general guidelines concerning admission and discharge from general intensive care and high dependency/intermediate care units (Nasraway *et al.*, 1998). Within these general admission and discharge criteria nothing was specifically mentioned for pregnancy and childbirth. The search for guidelines resulted in the selection of only one guideline.



*Fig. 1.* — Flow Chart study selection procedure

An important finding of this systematic literature review is that there is hardly any literature on maternal intensive care. This thorough literature search did not reveal any publication that contributes to a sizeable extent on how qualitative maternal intensive care should be defined and what the admission criteria for a MIC-service should be. Most articles on the subject are literature reviews, no Cochrane reviews and only very few systematic reviews, no randomized controlled trials and controlled clinical trials were found. The majority of the selected articles were retrospective observational tertiary centre based studies, with levels of evidence between 3 and 4. These studies explored the individual tertiary

settings and findings can not be generalized because of the limited number of patients and the randomly selected criteria for admission.

The results of our literature review are described below in three separate sections: terminology, definition of maternal intensive care and admission criteria for a MIC-service.

### Terminology

#### *Graded Care*

Health care organisations around the globe need to cope with a rising demand for care, (evidence based)

scientific evolutions, increasing costs and limited budgets, limited beds, insufficient medical and paramedical personnel, etc. . These restrictions stimulate health care managers and policy makers to reorganise healthcare services more efficiently. An example of a reasonably new health care structure is the 'graded care' structure (Popovich, 1991; Vincent and Buchardi, 1999). The levelled/graded care structure contains three levels of care. Beside the established general ward and Intensive Care Unit (ICU), the intermediate care level was introduced in the nineties. These intermediate care units (also termed high-dependency or step-up/step-down units) have generally a higher nurse/patient ratio and more facilities for intensive monitoring than a general ward, but fewer staff and less invasive equipment than on an ICU. This intermediate care facility is required for patients who have a condition that warrants more intensive care or monitoring than can be provided on a general ward, to step up to care intermediate between that on a general ward and the ICU, and for others appropriate to step down from ICU to a general ward. Such areas cater for patients who do not require full ICU care but are thought to need more care than can be offered on the general ward.

### Maternal Intensive care

An important result of this literature review is that the concept 'maternal intensive care' was not found elsewhere. Every country has its own system of healthcare and adapted terminology to refer to what we understand as maternal intensive care. Moreover, these country-specific terminology and concepts are scarcely defined and explained in the retrieved studies. This is probably due to the obviousness of these different health care contexts to the authors.

We did find concepts referring in a certain sense to what ranges under maternal intensive care (MIC) namely: high-dependency care, maternity high-dependency care, obstetrical intensive care, obstetrical intermediate care, emergency obstetric care, and obstetric critical care. Terms that refer to the MIC-service are: intensive care unit, intensive therapy unit, maternity/maternal high dependency unit, high dependency unit, post anaesthesia care unit, critical care obstetric unit, maternity recovery ward, obstetrical intensive care unit, high-risk antepartum unit, maternal-foetal ICU, consultant obstetric unit, recovery area for obstetric patients, (specialised) obstetric ICU's, obstetric hospital (Biswas *et al.*, 2005; Geller *et al.*, 2002; Lee, 2004; Okafor and Aniebue, 2004; Ryan *et al.*, 2000; Sisson *et al.*, 2004; Zeeman, 2006). Furthermore, the concepts referring to certain aspects of maternal intermediate and intensive care

are used interchangeably, depending on the country-specific health care organisation. For example in some countries mechanical ventilation is a part of obstetrical high dependency care and in others it is only located within the intensive care unit.

This confusion of meanings and terminology is also found within the Belgian concept 'maternal intensive care'. Following a widespread definition of intensive care, patients require intensive care when they need mechanical ventilation and/or multiple organ support and/or invasive monitoring and/or artificial life support (Mirghani *et al.*, 2004). This level of care is not provided in the MIC-services, but in the ICU-services. In other words the term 'maternal intensive care' is a rather confusing since it seems to refer to a level of intensive care but is in reality a level of intermediate care. The MIC-service is in this respect best described as a tertiary care function acting on intermediate care level in analogy to the graded care concepts in critical care medicine.

### Definition maternal intensive care

The results of this systematic literature review on maternal intensive care provided a very diverse, but limited amount of scientific literature. The last 15 years several reports from centres all over the world described the characteristics and treatment of critically ill pregnant or puerperal women. Studies report significant variations in patient populations, definitions of major morbidity, ICU admission criteria, utilisation rates, treatment and outcomes, hospital settings, nursing policies, and management protocols (Zeeman, 2006). Most of the published international literature about pregnancy complications and (severe) maternal morbidity deals with intensive care for periparturient women. Research on for example hypertensive problems and pregnancy, cardiac disease and pregnancy, haemorrhage, etc. are omnipresent. All of these articles addressed certain aspects of (possible) life-threatening situations in relation to maternal-foetal morbidity. Specific studies on intermediate levels of obstetric care are scarce. Systems of care applicable to the general (non-obstetrical) critical care have been extrapolated to pregnant patients (Gopalan and Muckart, 2004; Martin and Foley, 2006). Models or detailed guidelines from any specialty organisation describing the plan of care of critically ill obstetric patients do not exist (Zeeman, 2006).

We identified 180 eligible articles of which 14 relevant MIC-articles of relatively good quality were selected. Almost every study focused on a tertiary centre based retrospective analysis of hospital records of parturients admitted to the (obstetrical) ICU or, in a few articles, to the high dependency

unit. These studies explored the individual tertiary settings and findings can not be generalized because of the limited number of patients and the randomly selected criteria for admission. Nearly all evidence regarding maternal intensive care was indirect evidence through ICU literature. Few articles studied investigated the functioning of MIC-services and the organisational aspects of the associated hospital ward in depth (Biswas *et al.*, 2005; Hazelgrove *et al.*, 2001; Ryan *et al.*, 2000).

### Admission criteria for maternal intensive care

Similar to the lack of a consensus definition for maternal intensive care, an evidence-based model of admission criteria for a MIC-service doesn't exist (Zeeman, 2006). In the underneath listing we present a summary of the most important admission criteria internationally widely used (Afessa *et al.*, 2001; Baskett and Sternadel, 1998; Bewley and Creighton, 1997; Biswas *et al.*, 2005; Farkas and Watson, 1996; Fowler, 2005; Hazelgrove *et al.*, 2001; Heinonen *et al.*, 2002; Keizer *et al.*, 2006; Lee, 2004; Mirghani *et al.*, 2004; Neto, 2006; Okafor and Aniebue, 2004; Panchal and Harris, 2000; Ryan *et al.*, 2000; Schatz, 2003; Wheatley *et al.*, 1997; Zeeman *et al.*, 2003; Zeeman, 2006).

(Pre)eclampsia and haemorrhage are the two commonest mentioned reasons for admission within the reviewed literature. The underneath list of complications is a brief synthesis and is not exhaustive.

**Direct obstetrical complications:** pre-eclampsia, HELLP, severe haemorrhage, trombo-embolic disorders, sepsis, placental abruption/praevia, inevitable premature labour (before 32 weeks), premature rupture of the membranes (before 32 weeks), intra uterine growth retardation (on vascular basis), congenital malformation wherefore early treatment is recommended and multiple pregnancy (more than 2 neonates or threatening premature birth before 34 weeks).

**Indirect obstetrical complications:** Cardiac and vascular disease (e.g. hypertension, thyrotoxicosis, plasmapheresis, anaemia, ...), pulmonary disease (e.g. asthma or pneumonia, ...), neurological disease, gastro-intestinal disease (e.g. diabetes mellitus, cholecystitis, pancreatitis, appendicitis, peritonitis, ...), endocrine disease (e.g. thyrotoxicosis, ...), infectious and parasitical disease, drug dependence, intoxication, trauma, and psychiatric disease.

The available literature and guidelines did not provide clear evidence-based criteria to tackle the question which level of maternal morbidity should ideally be treated at which level of care.

### Discussion / Conclusion

An important result from our systematic literature review was that we were not able to find any literature which mentioned or referred to the concept "maternal intensive care". Concepts as "high-dependency care" and "obstetrical intermediate care" appeared to be best comparable to the typical Belgian MIC-service. MIC-services provide a level of care in between standard and intensive care. Therefore we propose to use the less confusing concept 'Maternal Intermediate Care (MIC)' to refer to what is now understood as 'Maternal Intensive Care'.

The results of this systematic literature review on maternal intensive care provided a very diverse, but very limited amount of scientific literature. A reasonable amount of articles/studies was found about specific aspects of intensive or critical obstetric care. Few articles studied, investigated the functioning of maternal intensive care and the organisational aspects of the associated hospital ward in depth.

Similar to the lack of evidence on the maternal intensive care definition, little information was found on the admission criteria for maternal intensive care. Pre-eclampsia and haemorrhage were the two most common disorders wherefore admission at a maternal intensive care unit was deemed necessary. We did not find any article or guideline that could contribute to a sizeable extent to tackle the question which level of maternal/fetal pathology should be treated at which level of care. Most guidelines focused on normal pregnancy care or on the appropriate care for a specific pregnancy or not-pregnancy related disease.

This systematic literature review revealed a great lack of literature and evidence about definitions and admission criteria for maternal intensive care. Further research is needed to create an evidence-based basis for an efficient utilization of maternal intensive care services. A clear triage-system for maternal morbidity could help clinicians to attribute women to the appropriate level of care. Reorganising the Belgian health care system into 3 distinct levels of care (standard care, intermediate care and intensive care) with clear-cut guidelines and referral pathways could benefit the quality of maternity services.

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