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Feature

# Safety of non-medically led primary maternity care models: a critical review of the international literature

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**Abstract.** The Australian government has announced major reforms with the move to a primary maternity care model. The direction of the reforms remains contentious; with the Australian Medical Association warning that the introduction of non-medically led services will compromise current high standards in maternity services and threaten the safety of mothers and babies. The purpose of this paper is to conduct a critical review of the literature to determine whether there is convincing evidence to support the safety of non-medically led models of primary maternity care. Twenty-two non-randomised international studies were included representing midwifery-led care, birth centre care and home birth. Comparative outcome measurements included: perinatal mortality; perinatal morbidity; rates of medical intervention in labour; and antenatal and intrapartum referral and transfer rates. Findings support those of the three Cochrane reviews, that there is sufficient international evidence to support the conclusion of no difference in outcomes associated with low risk women in midwifery-led, birth centre and home birth models compared with standard hospital or obstetric care. These findings are limited to services involving qualified midwives working within rigorous exclusion, assessment and referral guidelines, limiting the number of urgent intrapartum transfers that come with increased risk of perinatal mortality.

**What is known about the topic?** Systematic reviews of maternal and perinatal outcomes associated with midwifery-led care when compared to conventional intrapartum hospital care concluded that these non-medically led models of care are associated with several benefits for low risk women and their babies with no identified adverse effects.
**What does this paper add?** The finding of no difference in outcomes associated with midwifery-led, birth centre and home birth compared with standard hospital or obstetric care is limited to international studies involving women in the care of qualified midwives working within rigorous guidelines for practice involving inter-professionally agreed exclusion, assessment and referral criteria.
**What are the implications for practitioners?** Midwives caring for women in non-medically led models are urged to be vigilant to the need for early detection and prompt action in the event of unforseen complications to avoid an over emphasis on normality. This decreases the likelihood of urgent intrapartum transfers that come with an increased risk of perinatal mortality.

**Additional keywords:** antenatal and intrapartum transfer rates, birth centre, home birth, midwifery-led, perinatal mortality and morbidity.

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## Introduction

The Australian government has announced a major program of reform with the move to a primary maternity care model in response to the need to achieve a balance between safety and improving women's experience associated with giving birth.[1] It is argued that the current model of maternity care, characterised by an obstetric monopoly[2] is deemed to be unnecessarily costly and associated with a negative effect on the health of women.[3–5] A main driver for reform is the need to curtail the financial extravagance associated with the majority of women reasonably expected to give birth without medical intervention being allocated the same expensive resources as women who require specialist medical care to give birth safely.[1] The direction of the reforms does not come with consensus agreement within the key stakeholder group.[6] The agenda for change has been influenced by a strong consumer voice,[7] the Australian College of Midwives (ACM) and persuasive rural alliances advocating for women's right to choose the maternity care that best suits their needs near to where they live.[4,8] The Australian Medical Association (AMA) has challenged the direction of the reforms, warning that the introduction of non-medically led services will compromise current high standards in maternity services and threaten the safety of mothers and babies.[6] The Royal Australian and New Zealand College of Obstetrics and Gynaecologists

warns that no pregnancy or labour is without risk and that only they have the training and expertise for safe birth outcomes to be achieved.[9]

This critical review of the international literature was undertaken to determine whether there is convincing evidence in support of safety to mothers and babies associated with non-medically led primary maternity models of care.

## Method

### Search strategy

A search of research articles between 2004 and 2011 was conducted on MEDLINE and CINHAL using the following keywords: primary maternity care, birth, midwifery, birth centre, home birth, outcomes, perinatal morbidity, mortality. CINAHL is the primary resource for international research articles related to midwifery. MEDLINE is the mainstream database for international medical papers. The author confined the search to peer-reviewed articles published in English available online in full text. The review also included Australian Government publications pertinent to the proposed reform. The years 2004–11 were selected as they coincide with a series of new maternity service policies generated by Australian states and territories. Several studies have reported findings of consumer satisfaction related to models of maternity care[10–15] and this work is not duplicated in this study.

### Study selection

A total of 22 Australian and international research studies met the selection criteria in addition to three systematic reviews from the Cochrane Collaboration. Studies included: midwifery-led ($n = 7$), birth centre ($n = 8$), home birth ($n = 7$). A summary of the research studies including sample sizes are provided in Table 1.

Criteria for inclusion were confined to studies reporting one or more of the four chosen outcome measures. Several studies were excluded from the review as they did not report on any of these outcome measures.

### Outcome measures and analysis

Four general outcome measures were examined: perinatal mortality, and morbidity ($n = 15$), birth intervention ($n = 11$) and transfer rates ($n = 6$). Types of measurement included: rates of perinatal morbidity and perinatal mortality in otherwise healthy term infants (baby), rates of medical intervention in labour (mother) or transfer rates (mother or baby) inclusive of clinical indications for transfer. Perinatal morbidity is defined as any term infant in the absence of congenital abnormality requiring admission to special care nursery or the neonatal intensive care unit.[16]

Maternal mortality and morbidity has not been included as a measurement in this paper as maternal mortality is such a rare event that comparisons do not result in useful conclusions and maternal morbidity has been reported in another study.[17] In the absence of any randomised controlled trials identified for inclusion, in this review the analytic strategy involved summarising the studies under outcome measures and producing a structured narrative analysis of the findings.

## Results

Key findings of the 22 studies included in the study are grouped by model of care and reported according to type of measurement used in the study. Non-medically led primary maternity care models include midwifery-led units, birth centres and home birth and are defined for the purposes of this study. 'Midwifery-led care where the midwife is the lead professional in the planning, organisation and delivery of care given to a woman from initial booking to the postnatal period in a maternity setting',[16] 'birth centre care where the midwife is the lead professional in the planning, organisation and delivery of care to low risk women in a home like setting' and 'planned home birth care refers to the midwife as the lead professional in the planning, organisation and delivery of care involving low risk women in their home'.

### General quality of studies

International studies were derived from Australia ($n = 5$), Canada ($n = 3$), the Netherlands ($n = 4$), New Zealand ($n = 1$), Sweden ($n = 3$), the United Kingdom ($n = 2$), the United States ($n = 3$) and a group of other developed Western countries ($n = 1$). The majority of studies used a matched comparative group design and achieved large cohorts through use of aggregated data retrieved from national or regional birth registers, enhancing statistical power. Large cohort studies are deemed necessary in obtaining meaningful results in the measurement of uncommon events, such as potentially avoidable perinatal deaths in term babies in developed countries.[18,19]

Seven international studies met the inclusion criteria for midwifery-led care with each study using different types of measurement. Five of these studies used aggregated data from national birth registers or midwifery databases to achieve sample sizes large enough for comparative analysis with standard hospital care.[20–23] These very large cohort studies were undertaken in Canada, New Zealand and the Netherlands. The sixth smaller UK study analysed survey data,[24] the seventh small rural Australian study examined locally recorded birth data.[25]

Eight international studies were included related to birth centre care including five large comparative studies using aggregated data from national birth registers[18,26–29] undertaken in Australia, the US and Sweden. A further three of these studies analysed birth data associated with specified birth centres in Australia, Sweden and the UK.[30–32]

Seven international studies from Canada, the Netherlands, the US, Australia and Sweden were included into this review comparing home birth outcomes with outcomes for standard hospital care. All studies are characterised by very large cohorts achieved through use of aggregated data derived from national birth registers.[33–39]

### Perinatal morbidity and mortality rates

Eighteen studies in this review reported perinatal morbidity and mortality rates (baby) in midwifery-led care, birth centre or home birth. Fourteen of these studies concluded that non-medical-led models are as safe as or safer for babies than standard hospital or obstetric care, with four studies reporting that babies are less safe. Refer to Table 2 for the most recent perinatal mortality rates per 1000 births for each non-medically led model of maternity care reported by seven western countries. A Dutch study reported that

**Table 1. Research-based studies on the safety of mothers and babies in primary maternity care models, 2004–11**

Outcome measures: A, rates of birth intervention; B, rates of referral or transfer from midwifery-led primary care to obstetric services; and C, rates of perinatal mortality and morbidity

| Study | Country | Focus of study | Type of PMC | Method | Sample characteristics | Outcome measures |
|---|---|---|---|---|---|---|
| Davis *et al*. (2011)[21] | New Zealand | Place of birth, mode of birth and intervention | Home birth<br>Birth centre or midwifery-led<br>Hospital | Descriptive (2006–07) | Home births ($n$ = 1830)<br>Birth centre ($n$ = 2877)<br>Hospital ($n$ = 4503) | A |
| Gottvall *et al*. (2011)[30] | Sweden | In-hospital birth centre compared to standard care | Birth centre<br>Hospital | Comparative (2004–08) | Birth centre ($n$ = 2555)<br>Hospital ($n$ = 9382) | A, C |
| Laws *et al*. (2010)[26] | Australia | Perinatal outcomes of women who give birth in birth centres | Birth centre | Comparative (2001–05) | Birth centre ($n$ = 22 222; 2.7%) | C |
| Wax *et al*. (2010)[27] | United States | Morbidity by birth facility | Birth centre<br>Home birth Hospital birth | Meta-analysis (2006) | Hospital ($n$ = 733 143; 97%)<br>Birth centre ($n$ = 4661; 0.6%)<br>Home ($n$ = 7427; 0.9%) | C |
| Malloy (2010)[28] | United States | Births attended by midwives | Home birth<br>Birth centre | Comparative (2000–04) | Home births ($n$ = 45 904)<br>Birth centre ($n$ = 25 319)<br>Hospital birth ($n$ = 1 237 129) | C |
| Wax *et al*. (2010)[36] | Developed Western nations | Planned home *v*. planned hospital | Home birth<br>Hospital birth | Meta-analysis (1950–2009) | 12 studies including: Canada ($n$ = 3); the UK ($n$ = 2); the US ($n$ = 2); Sweden ($n$ = 1); Australia ($n$ = 1); the Netherlands ($n$ = 2); Switzerland ($n$ = 1) | C |
| Rogers *et al*. (2010)[31] | United Kingdom | Outcomes for women at a stand- alone birth centre | Birth centre | Descriptive (2000–08) | Birth centre ($n$ = 5099) | B, C |
| Evers *et al*. (2010)[22] | The Netherlands | Midwife-led primary care compared to high risk hospital obstetric care | Midwife–led obstetric care | Comparative (2007–08) | Births of normally formed infants at full term ($n$ = 37 735) | C, B |
| de Jonge *et al*. (2010)[39] | The Netherlands | Planned home *v*. low risk hospital births | Home birth<br>Hospital birth | Comparative (2000–06) | Planned home ($n$ = 321 307; 60.7%)<br>Planned hospital ($n$ = 163 261; 30.8%).<br>Unknown ($n$ = 45 120; 8.5%) | C |

| | | | | | | |
|---|---|---|---|---|---|---|
| Janssen *et al*. (2009)[34] | Canada (British Columbia) | Home births (midwife) *v*. low risk hospital births (midwife or doctor) | Home birth<br>Hospital birth | Comparative (2000–04) | Home births - midwives ($n$ = 2889)<br>Hospital births - midwives ($n$ = 4752)<br>Hospital births - doctor ($n$ = 5331) | C |
| Hutton *et al*. (2009)[35] | Canada (Ontario) | Home births *v*. low risk Hospital births (midwives) | Home birth<br>Hospital birth | Comparative (2003–06) | Home births - midwives ($n$ = 6692)<br>Hospital births ($n$ = 6692) | B, C, A |
| Kennare *et al*. (2009)[37] | Australia | Planned home births *v*. hospital births | Home birth<br>Hospital birth | Comparative (1991–2006) | Home births ($n$ = 1141)<br>Hospital births ($n$ = 297 192) | B, C, A |
| Amelink-Verburg *et al*. (2009)[20] | The Netherlands | Midwifery-led care and rates of referral to obstetric care | Midwifery-led | Descriptive (1988–2004) | Midwifery-led care ($n$ = 1 977 006) | B |
| Scherman *et al*. (2008)[25] | Australia | Midwifery–led rural | Midwifery–led in hospital | Descriptive (2005–06) | Births ($n$ = 170) | B, C |
| Lindgren *et al*. (2008)[38] | Sweden | Planned home births compared to hospital births | Home birth<br>Hospital birth | Comparative (1992–2004) | Home births ($n$ = 897)<br>Hospital ($n$ = 11 341) | C, A |
| Janssen *et al*. (2007)[40] | Canada (British Columbia) | Home births attended by midwives *v*. home births by doctor | Home birth | Comparative | Midwives ($n$ = 488)<br>Doctors ($n$ = 572) | A, C |
| Tracey *et al*. (2007)[18] | Australia | Perinatal mortality with giving birth in a birth centre | Birth Centre | Comparative (1999–2002) | Birth centre ($n$ = 21 800; 2.18%) | C |
| Symon *et al*. (2007)[24] | United Kingdom | Outcomes of obstetric-led and midwifery-led units | Midwifery-led in hospital<br>Hospital | Descriptive (6 months) | Midwife-led ($n$ = 294)<br>Obstetric-led ($n$ = 138) | A |
| Amelink-Verburg *et al*. (2008)[23] | The Netherlands | Evaluation outcomes of midwifery-led care | Midwifery-led care in hospital and home | Descriptive (2001–03) | Midwife-led ($n$ = 280 000) | B |
| Johnson and Daviss (2005)[33] | USA | Planned home births with midwives | Home birth | Comparative (2000) | 409 Midwives<br>Home births ($n$ = 7623) | B, C, A |
| Ryan and Roberts (2005)[32] | Australia | Birth centre outcomes compared to standard care | Birth centre<br>Hospital | Comparative (1995–96) | Birth centre ($n$ = 720)<br>Hospital ($n$ = 2963) | A, C |
| Gottvall *et al*. (2004)[29] | Sweden | Birth centre care compared to standard hospital care | Birth centre<br>Hospital | Comparative (1989–2000) | Birth centre ($n$ = 2534)<br>Hospital ($n$ = 126 818) | C |

**Table 2. Most recent perinatal mortality by country and non-medical-led model**

| Country | Model | Perinatal mortality (per 1000 births) |
|---|---|---|
| Australia (2009)[37] | Birth centre (low risk) | 1.3 |
| | Hospital (low risk) | 1.7 |
| New Zealand (2011)[21] | Home birth (low risk) | 0.9 |
| | Hospital | 1.0 |
| United Kingdom (2010)[21] | Birth centre (low risk) | 1.1 |
| The Netherlands | Home birth (low risk) | 1.0 |
| (2009, 2010)[22,39] | Midwifery-led (low risk) | 1.3 |
| | Hospital (low risk) | 0.6 |
| Sweden (2004, 2011)[29,30] | Home birth | 2.2 |
| | Birth centre | 5.5 |
| | Hospital (low risk) | 0.7 |
| United States (2010)[28] | Birth centre (low risk) | 0.6 |
| | Home birth (low risk) | 1.0 |
| | Hospital (low risk) | 0.5 |
| Canada (2009)[35] | Home birth (low risk) | 1.0 |
| | Hospital (low risk) | 1.0 |

infants had a higher risk of delivery-related perinatal death (1.39 per 1000 births) in low risk maternity-led care,[22] compared with low risk obstetric care (0.7 per 1000 births), in contrast to another Dutch study investigating home birth outcomes,[39] which reported low rates of perinatal mortality (1.0 per 1000 births). A Swedish study reported a higher neonatal mortality rate in planned home birth (2.2 per 1000 births)[38], higher than in low risk maternity-led care (0.7 per 1000 births). Two Canadian studies[34,41] reported no difference in perinatal mortality rates between planned home birth (1.0 per 1000 births) and low-risk obstetric care (1.0 per 1000 births). These results are congruent with a US study[33] that found perinatal mortality rates in home birth were low and did not differ significantly from that of planned low risk hospital birth (1.0 per 1000 births *v.* 0.5 per 1000). Australian and UK studies[18,24,26] also reported lower rates or no difference in perinatal mortality associated with birth centre care (1.3 per 1000 births) compared with low risk obstetric care (1.7 per 1000 births). Rogers *et al.* reported a lower perinatal mortality rate of 1.1 per 1000 births for those women admitted to the birth centre in labour.[31] These findings vary slightly from two other large cohort studies from the US[28] and Sweden[29] which report no statistical difference between a birth centre group (0.6 per 1000 births) and standard hospital care (0.5 per 1000 births). Findings from a New Zealand study concurred, reporting that newborns of women planning to give birth in secondary and tertiary hospitals had a higher risk of admission to NICU.[21] A study reporting findings of a multi-country meta-analysis by Wax *et al.* claimed a tripling of the neonatal mortality rate in planned home birth compared with planned hospital birth.[36]

### *Rates of medical intervention*

All studies included in this review using medical intervention as an outcome measure reported that women in midwifery-led, birth centre or home birth services in the care of registered midwives experienced fewer obstetric interventions and were more likely to have a normal delivery than women receiving standard hospital or obstetric care.[21,24,30,32–34,36–38,40] Hutton *et al.* found that all measures of serious maternal morbidity were lower in the planned home birth group as were all interventions including Caesareans sections.[35] A Canadian study by Janssen *et al.* concluded that healthy women planning hospital births attended by midwives *v.* physicians experienced lower rates of obstetric interventions and similar rates of perinatal morbidity.[40]

### *Rates of referral from primary care to obstetric care*

Six studies reported antenatal and intrapartum transfer rates. Findings from a UK birth centre reported by Rogers *et al.* concluded that approximately half of all women deemed at low risk of obstetric or medical complications required transfer to consultant obstetric services at some stage during their maternity episode with the intrapartum transfer rate for nulliparae women being significantly higher than for multipara women.[31] This finding was supported in a Canadian study reported by Hutton *et al.* who found nullipara women were less likely to deliver at home and had higher rates of intrapartum ambulance transfer from home to hospital[35] and Gottvall *et al.* who reported that infants of primiparas were at greater risk of requiring intrapartum transfer.[29] Amelink-Verburg *et al.* reported a 31.9% transfer rate[20,23] in contrast to Scherman *et al.* who reported an antenatal and intrapartum transfer rate of 14%.[25]

## Discussion

This review of the international literature has found sufficient evidence to support the conclusion that low risk women in midwifery-led, birth centre or home birth services in the care of registered midwives experienced fewer obstetric interventions and were more likely to have a normal birth than low risk women receiving standard hospital or obstetric care.[21,24,30,32–34,36–38,40] This finding appears to be consistent with the conclusions of the three systematic reviews including: midwifery-led care *v.* other models of care,[16] alternative *v.* conventional institutional settings for birth[43] and home *v.* hospital birth.[44] The three Cochrane reviews concur that non-medically led models of care are associated with several benefits for low risk women and their babies with no identified adverse effects.[16,41] Despite these reassuring findings,[16,43,44] the critical point of debate concerns the quality of evidence available related to prevalence of perinatal mortality and morbidity in the babies of low risk women receiving non-medically led care compared with babies of low risk women receiving standard hospital or obstetric care. Four large cohort studies included in this review reported an increased risk to babies[22,29,36,38] in contrast to 14 studies reporting no difference or tendency to decreased risk. To improve clarity around these findings, in-country differences need to be accounted for to avoid comparing findings of countries with different childbirth cultures,[19] in particular those with a strong home birth culture such as the Netherlands[20] with countries who do not, such as Australia, Canada, the UK and the US. In this review, in-country studies reporting different findings include Australia, the Netherlands and Sweden.

Two Australian studies[18,26] reported different findings concerned with perinatal mortality and morbidity in low risk women in birth centres compared with women receiving standard hospital care. Using National Perinatal Data Collection records based on

actual place of birth Tracey *et al*. found the total perinatal death rate attributed to birth centres was 1.51 per 1000 births compared with 10.03 per 1000 births in hospitals.[18] The validity of these findings attracted criticism[42] related to the inability to account for outcomes associated with transfer in labour. Laws *et al*. using recent data from the same source resolved the methodological deficits in the earlier study to allow analysis based on intended place of birth for low risk women. In doing so, they found no significant difference (1.3 *v.* 1.7 per 1000 births) in perinatal mortality between the two low risk groups,[26] a finding shared by a UK birth centre study which reported a perinatal mortality rate of 1.1 per 1000 births.[31] These findings are consistent with those of the two relevant Cochrane reviews.[16,43] Another Australian study by Kennare *et al*. using a small home birth sample similarly reported no difference in perinatal death rates between planned home and planned hospital births. However, they did report a 7-fold risk of intrapartum death explained by the inappropriate inclusion of women with risk factors that should have precluded them from giving birth at home.[37]

Maternity care in the Netherlands has a home birth rate of 33% in contrast to Australia's 0.9%[45] and a higher perinatal mortality rate in normally formed term babies of 2.8 per 1000 births to 1.3 per 1000 births in Australia.[22,26] Two studies involving midwifery-led care and home birth in the Netherlands using the same source of aggregated birth registration data reported substantially different perinatal mortality and morbidity outcomes.[22,39] Evers *et al*. reported that infants of pregnant women at low risk whose labour started in primary care under the supervision of a midwife in the Netherlands had a higher risk of delivery-related perinatal death (1.39 per 1000 births) and the same rate of admission to NICU compared with infants of pregnant women at high risk whose labour started in secondary care under the supervision of an obstetrician (0.6 per 1000 births).[22] This is the first Dutch study to show a higher mortality rate among birth started in primary care compared with standard hospital care. Methodological inconsistencies are evident due to the limitations of using an aggregated data source.[22] de Jonge *et al*. in a similarly designed Dutch study investigating home birth outcomes found low rates of perinatal mortality and admission to NICU[40] compared with hospital births, a result consistent with previous Dutch studies. Methodological flaws in the de Jonge *et al*. study include the exclusion of home births in the presence of prolonged rupture of membranes. This exclusion may have served to decrease perinatal mortality rates or rates of serious morbidity. The study does report a transfer rate of 49% in nullipara women planning home birth against 15% of multiparas consistent with Canadian findings reported by Hutton *et al*.[35] The results of the low risk group in the Evers *et al*. study[22] differs from those of de Jonge *et al*.[40] because different exclusion criteria were used and different comparisons were made.

Swedish studies involving birth centre and home birth also reported different findings.[30,38] Lindgren *et al*. reported a perinatal mortality rate of 2.2 per 1000 births associated with planned home births compared with 0.6 per 1000 births in the hospital group.[38] This difference is explained by home birth practices in Sweden reported in this study that do not exclude multiple birth nor post mature pregnancies greater than 42 weeks, whereas the comparison group did exclude these risks. Gottvall *et al*. reported no significant difference between the birth centre group and standard hospital care but created controversy at the time identifying a higher rate of perinatal mortality in the babies of primiparas,[29] a finding that has not been replicated in a more recent study,[30] but has been demonstrated in a Canadian study by Hutton *et al*.[35] This study also highlighted a concern regarding the identified number of avoidable baby deaths involving post term pregnancies in birth centre care.[29]

Wax *et al*. undertook a meta-analysis of perinatal mortality in planned home births compared with planned hospital births.[46] The study included 12 studies from seven western countries reporting that less medical intervention during planned home birth is associated with a tripling of the neonatal mortality rate. The study's findings are based on a standard perinatal mortality rate of 0.4 deaths per 1000 births for term infants in the absence of congenital abnormality. This rate compares with figures reported by Malloy in a US study, which found a neonatal mortality rate per 1000 births to range from 0.4 in midwifery-led in-hospital care, 0.6 in birth centre births and 1.0 in home births.[28] These rates are significantly lower than those reported in a US study by Johnson and Daviss who reported 1.7 deaths per 1000 home births.[33] The difference between the base rates of 0.4 and 1.7 perinatal deaths per 1000 births goes some way towards explaining the Wax *et al*. finding of a tripled risk.[46]

The Wax *et al*.[46] study has generated findings that have been challenged on several points. The first point concerns the comparison of home birth outcomes between countries that vary in culture, geography and healthcare systems.[19] Findings are further compromised by methodological variations in measurement used between studies that could not be resolved, such as the use of outdated definitions and combining studies using neonatal mortality rates with those using perinatal mortality rates. Furthermore, this study was not limited to low risk women or those in the care of qualified midwives. When studies including home births attended by other than qualified midwives were excluded, the meta-analysis was unable to demonstrate a significant difference in risk.[21,36] The second point concerns the great variation in sample sizes that may also have influenced outcomes resulting in the majority of births (93.9%)[36] emanating from the de Jonge *et al*. 6-year nationwide study from the Netherlands.[19,39] Sample dominance by the de Jonge *et al*. study rendered the effect of statistical findings from smaller studies included in the meta-analysis to be negligible. These problems raise issues associated with meta-analysis as a reliable methodology in the quest to determine evidence of perinatal risk.

When considering the implications associated with reported rates of transfer from primary midwifery-led care to consultant obstetric care, it is important to clarify differences in admission criteria. The College of Midwives in Ontario, Canada,[35] and Dutch midwives employ rigorous exclusion criteria in which previous Caesarean section, post term pregnancy, twin pregnancy and breech presentations are an absolute contraindication not only for home birth but for the absence of obstetric care during labour and birth.[39] This criteria has contributed to a low rate of 3.6% in urgent intrapartum transfers, considered as being the most dangerous for babies,[22,23] suggesting that risk selection by Dutch and Canadian midwives works well.[20] Amelink-Verburg *et al*. reported a high perinatal mortality rate of 10.7 per 1000 births for women who were transferred during labour for urgent reasons.[23] Evers *et al*. found a 3.5 times higher perinatal mortality rate in

normally formed infants of low risk women transferred from primary to secondary care during labour.[22] The predominant indications for intrapartum transfer were signs of foetal distress and failure to progress in first stage of labour.[20] Van Weel *et al*. warn that if women are not referred in time, perinatal outcomes may be worse in primary midwifery-led care compared with those in obstetric-led care.[47] Rogers *et al*. in a UK study reported a non-urgent antenatal transfer rate of 29.9%, an increase from previous years.[31] The primipara transfer rate being eight times higher,[31] explained by a growing demand for pain relief.[20] That >96% of antenatal or intrapartum referrals are non-urgent is evidence that assessment of risk in non-medically led primary maternity care is taking place in a timely manner.[20,23,47]

## Conclusion

Findings from this critical review support the conclusions of the three Cochrane reviews[16,43,44] that low risk women in midwifery-led, birth centre or home birth services in the care of registered midwives experienced fewer obstetric interventions and were more likely to have a normal birth than low risk women receiving standard hospital or obstetric care. Importantly, there is sufficient international evidence to support the conclusion of no difference in perinatal mortality associated with non-medically led models in the care of qualified midwives working within rigorous guidelines for practice compared with standard hospital or obstetric care. Hodnett *et al*. warns midwives and women against complacency in this regard, stating that an over emphasis on normality in midwifery-led models has the potential to result in delayed recognition or action regarding complications, urging midwives to be vigilant to the need for detection and prompt action in the event of unforseen complications[29,43] and in doing so avoid urgent intrapartum transfers associated with increased risk of avoidable perinatal mortality.

## Competing interests

No conflicts of interest have been declared by the authors. This critical analysis received no specific grant from any funding grant in the public commercial or not-for-profit sectors.

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