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ORIGINAL RESEARCH – QUANTITATIVE

A retrospective, descriptive study of maternal and neonatal transfers, and clinical outcomes of a Primary Maternity Unit in rural Queensland, 2009–2011

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ABSTRACT

Background: A widely held view in maternity services in rural Australia is they require 24-h on-site surgical and anaesthetic capability to be considered safe. This study aimed to provide a detailed description of three years of activity (2009–2011) of a rural maternity unit approximately 1 h from the nearest surgical service. We describe the reasons for transfer to and from the unit, transfer times and the clinical health outcomes of all women (all risk status) and their babies.

Methods: This retrospective study utilised contemporaneously, purposefully collected audit data, routinely collected data and medical chart review. Data were analysed based on the model of care that women were allocated to at the time of booking.

Results: The PMU provided care to twice as many young women (13.3% MDH vs. 5.1% QLD) and almost five times as many Aboriginal and/or Torres Strait Islander women (27.5% MDH vs. 5.7% QLD). A total of 506 women booked to receive care through a midwifery group practice (MGP), and 377 (74.5%) gave birth at the local facility as planned. Clinical outcomes for women and babies birthing both at the PMU and those transferred were comparable or better than other published data.

Conclusion: The results challenge the notion that birthing services can only be offered in rural areas with onsite surgical capability. More PMUs should be made available in rural areas, in line with national and state policy and international evidence.

1. Background

A widely held view in the provision of maternity care services in rural Australia is that maternity units must have 24 h on-site surgical and anaesthetic capability to be considered safe.[1,2] However, workforce shortages and a trend towards centralising health services to regional centres has resulted in many rural maternity units being unable to sustain such capability.[2–7] Thus many rural women travel long distances to regional centres for maternity care[4,8] with reports of: increased financial burden on familes[2]; negative psychosocial consequences including increased stress, feelings of isolation and loneliness as well as decreased bonding time with family members[9–15]; and non-favourable clinical outcomes including increased perinatal mortality and an increased incidence of babies being born before arrival.[3,5,16–19] Having to travel long distances for maternity care is particularly burdensome on Aboriginal and/or Torres Strait Islander women living in rural and remote Australia who are required to relocate for birth without access to support people and with added life stressors such as socio-economic disadvantage and the ongoing impacts of colonisation.[20–23]

One solution may lie in the opening, or in some cases re-opening, of primary maternity units (PMUs).[3,24–26] Indeed, increasing the number and improving the accessibility of PMUs in rural Australia is supported by the current National Maternity Service Plan,[7] with a framework for implementation endorsed by all Health Ministers.[27]

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Primary Maternity Units, also referred to as freestanding/stand-alone midwifery units or birth centres, provide maternity care services to women with limited obstetric, anaesthetic, laboratory or paediatric support available on site.[2] In PMUs, a woman's antenatal, intrapartum and postnatal care is most often managed by midwives,[2] sometimes in collaboration with local General Practitioners (GPs). A woman is usually assigned to a primary or caseload midwife who assumes responsibility for all maternity care, working with a small number of midwives in a Midwifery Group Practice (MGP).[28] Alternatively, a woman may have her maternity care provided by a small team of midwives with no allocated primary midwife, referred to as team midwifery.[28] Despite a supportive policy framework, the number of PMUs in Australia is thought to be small although not nationally reported.[2]

Whilst PMUs are geographically separate, they operate within a collaborative network of secondary and tertiary obstetric facilities. If complications arise, risk assessment guidelines are used to identify women who require consultation, referral or transfer to a higher level obstetric facility.[29] A *transfer of care* occurs "when a referral results in the need for the woman to continue care at a higher level service or with a more experienced clinician".[30] A *transfer* is distinguishable from a *referral* which occurs when a woman has a consultation with a higher level obstetric service however then returns to the original carer for continuing management and care.[30] The focus of this paper is women and/or newborns who have experienced a *transfer of care*.

In Australia, most PMUs are classified as Level 2 maternity services and provide planned intrapartum support for women ≥37 weeks gestation without identified risk factors.[30,31] State Capability Frameworks[31] state Level 2 facilities provide "access to a functional operating theatre (not necessarily on-site) and the anaesthetic capability to bring about a baby's birth in an unplanned caesarean section within 75 min of booking the procedure, in normal circumstances".[31(p.9)] A 75 min 'decision to delivery interval' is thought to be the critical time period for safe caesarean section deliveries,[32] however the evidence is mostly based on research conducted in tertiary settings.[33,34]

Current evidence demonstrates PMUs provide safe care for women classified as low-risk[8,35–41] when compared to standard maternity care with no differences in perinatal mortality[35,42]; no difference or improved outcomes for perinatal morbidity[35,36,42]; improved outcomes for maternal morbidity[36]; less birth interventions including caesarean section[8,35,36,40,42] and improved neonatal outcomes.[40,41]

While PMUs are uncommon in rural and remote Australia,[2] in countries with comparable health systems (New Zealand, Canada) PMUs offer equitable and safe maternity care to rural women.[43–45] New Zealand supports 58 primary units with 51 located in rural or remote settings, and 31 over an hour from tertiary services.[46] Some of these services get cut off from the tertiary hospitals due to weather restrictions in the winter months. Maternity services in rural Canada also provide intrapartum care without onsite surgical capacity, including in very remote areas up to 4 h from surgical services, with excellent clinical outcomes.[47]

A search of literature published in the last 10 years identified only four PMU studies that included any information on the clinical outcomes of transferred women.[38,45,48,49] The only Australian study was conducted by Scherman et al. in 2008, which described the clinical outcomes of the PMU of the Mareeba District Hospital (MDH), the same PMU described in this current study.[38] However, the paper described the first year of operation only with limited clinical outcome data on the women transferred to Cairns Base Hospital (CBH), the nearest tertiary obstetric service.

We aimed to contribute to the evidence by providing a detailed description of three years of activity of MDH. We included reasons for transfer to and from the unit, transfer times and the clinical health outcomes of all risk women who attended the facility antenatally and their babies. The results provide a better understanding of the safety and clinical appropriateness of rural PMUs.

2. Methods

2.1. Design

A retrospective, descriptive study.

2.2. Setting

The MDH is a public Queensland Health facility located in the rural town of Mareeba, Queensland, Australia servicing a population of approximately 10,000.[50] Until recently, MDH operated as a PMU, providing low risk birthing services and all risk antenatal and postnatal care in collaboration with either local GPs or obstetricians at CBH. The CBH is a Level 5 hospital and is capable of providing planned care for women at 29 weeks gestation or more with infants who are expected to have a birth weight of 1000 g or more.[31] Women expecting to give birth to infants less than 29 weeks gestation, should transfer directly to The Townsville Hospital, the nearest Level 6 facility with the capability of caring for extreme prematurity.[33]

The CBH is located 64 km to the east and is accessible via a sealed road down a mountain range. The travel time in a private vehicle is approximately 60 min. For an emergency ambulance transfer, the travel time can be reduced to approximately 50 min. Heavy rainfall cause landslips on the mountain range and results in road closures for a few hours several times each wet season.

In 2005, the only local practising GP obstetrician resigned from the hospital, ceased obstetrics and went into private general practice. This led to the closure of the maternity unit. A widespread consumer response resulted in the reopening of the unit as a PMU in 2005.

Between 2005 and 2012, MDH was Queensland's only rural PMU and was classified as a Level 2 maternity service. During this time, the MDH infrequently increased its capability to a Level 3, due to the availability of obstetric and theatre staff, to perform a limited number of onsite caesarean sections. From 2013, the availability of local GP Proceduralists has led to an increase in capacity to a full-time Level 3 maternity service. This paper reports on data collected prior to the establishment of the full time Level 3 capability.

Approximately 200 pregnant women book into MDH to receive care each year. Based on their risk classification at the time of booking women were allocated to one of three models of care; either Midwifery Group Practice (MGP) care, GP co-operative care or obstetric shared-care with CBH. In the MGP model, women are allocated a primary midwife who provides antenatal, intrapartum and postnatal care to a caseload of 30–40 women per year per full time equivalent (FTE) midwife (depending on the complexity of the caseload). During the study period (2009–2011), the PMU was staffed by approximately 5 FTE caseload midwives, 0.5 FTE Indigenous support worker in the MGP, 4.5 FTE core nurse-midwives and 4.2 FTE enrolled nurses who worked in the combined maternity and paediatrics unit. MGP care was provided to women who had no identified risk factors at booking, with all antenatal, intrapartum and postnatal care provided by a primary midwife, either at the MDH or in the community via home visiting or at outreach clinics.

The GP co-operative care model was provided by local GP Proceduralists on ad hoc basis. This model differs to a traditional 'GP shared-care' model and was only available to women booked to

have a planned repeat caesarean at MDH performed by the local GP Obstetrician, with the majority of antenatal and postnatal care provided by a primary midwife from the MGP. The third model was 'CBH shared-care' where women requiring specialist obstetric involvement, including planned birth at CBH, were cared for under a shared-care arrangement between MGP midwives sharing care with obstetric staff at the CBH. These women received the majority of antenatal and postnatal care from an MGP midwife in consultation with obstetricians at CBH, with all intrapartum and immediate postnatal care provided at CBH. All women cared for were classified as public patients.

When a change in a women's risk classification necessitated a *transfer of care*, the majority of women were transferred to CBH via road with the Queensland Ambulance Service. These transfers, referred to as an *inter-hospital transfer*, took place from MDH to CBH. In a very small number of cases, women were instructed to travel directly to CBH without being admitted to MDH first. On a few occasions women with babies requiring high-level neonatal care were transferred to the Level 6 neonatal unit at Townsville. The majority of neonatal transfers occur via ambulance, with helicopter retrieval infrequently provided for high priority or acuity.

A small number of women were able to birth at Mareeba, despite a change in their risk category, due to the availability of onsite medical and theatre support, which temporarily increased MDH's capacity to a Level 3 maternity service. For example, some women were able to have a planned induction of labour at MDH because the outreach-visiting obstetrician was on site and had agreed to oversee the care of these women and theatre staff were available.

2.3. Participants

A total of 731 pregnant women who accessed maternity care at the MDH with an estimated date of delivery between 2009 and 2011 were assessed for inclusion in the study, with 138 women excluded from the study due to the reasons outlined in Table 1. The largest proportion of excluded women (45.7%) were due to having received only minimal care (i.e., less than two antenatal appointments) before they relocated or elected to change their care provider. Other than 13 women who gave birth at the MDH despite being previously unknown to the midwives, none of the excluded women gave birth at the MDH. One woman in the CBH shared-care group was transferred to Townsville Base Hospital due to preterm labour at 24 weeks gestation, however as limited outcome data was available she was excluded from the study. Women who planned to give birth at one of the two settings and birthed before arrival were included in the study however women who were planning homebirths and received limited care through MDH were excluded. A total of 593 pregnant women of all risk status booked to receive ongoing care at the MDH with an estimated due date of birth between 2009 and 2011 were included in the study.

Table 1
Reasons for exclusion.

Reason	Frequency (%)
Received less than 2 antenatal appointments	
Relocated/changed provider/transient visitors	63 (45.7)
Unplanned/client previously unknown – inter-hospital transfer to CBH or Cairns Private Hospital	17 (12.3)
Unplanned/client previously unknown – birth at Mareeba MDH	13 (9.4)
Unplanned/client previously unknown – born before arrival (BBA)	2 (1.4)
Received postnatal care only	1 (0.7)
Received more than 2 antenatal appointments	
Fetal loss less than 24 weeks gestation	14 (10.1)
Planned home birth, antenatal support only	13 (9.4)
Relocated/changed provider	10 (7.2)
Unplanned birth elsewhere	4 (2.9)
Inter-hospital transfer to Townsville Base Hospital	1 (0.7)
Total	138

2.4. Outcomes

The outcomes of interest included: the number and primary reason for all antenatal, intrapartum and postnatal transfers; the progression of care; intrapartum inter-hospital transfer times and the clinical outcomes of all women and neonates including mode of birth, preterm birth, induction of labour Apgar score at 5 min and special care nursery (SCN) admissions.

2.5. Data sources

Data were collected from transfer and clinical outcome data recorded contemporaneously into Microsoft Office Excel 2010 by the Midwifery Unit Manager (MUM).

Two Excel datafiles, 'Bookings' and 'Birth Stats', are work activity planning and review tools used by midwives and updated at weekly MGP team meetings. The data from these files are used by the MUM for clinical governance activities, e.g., to compile monthly and annual reports for Stakeholders Committee and to manage Multidisciplinary Case Reviews (MCR). Throughout the study period, the MCR meeting was held 8–10 times/year with the visiting CBH Obstetrician, MGP midwives and interested local GPs. The CBH obstetrician would bring copies of relevant CBH client records for all interhospital transfers from the list supplied by the MUM.

The 'Bookings' datafile records all women booked into the MDH along with risk category at booking, and summary birth outcomes. The 'Birth Stats' datafile records birth outcomes for all booked women and inter-hospital transfers and is compiled by reference to the Birth register, Admission and Discharge book (manual record of transfer/escort times), discharge summaries, patient notes (from both CBH and MDH), as well as the Perinatal Data Collection. The Midwifery Regional Co-ordinator in Cairns assisted with missing data (usually neonatal unit information around neonatal length of stay, diagnosis and treatment) as requested by the MUM. State-wide data was sourced from the publicly available perinatal data, held and managed through the Queensland health department.[51]

2.6. Data analysis

Data were analysed based on the model of care that women were allocated to at the time of booking. Denominators were the total number of women minus the number of participants known to have missing data. Where data was available on twin births, these were added to neonatal denominators. Microsoft Office Excel 2010 and Microsoft Office Visio 2010 were used to compile the data.

Ethical approval was obtained through relevant committees at both university and Queensland Health bodies.

3. Results

3.1. Participant characteristics

The participant characteristics, including age, parity and indigeneity, are shown in Table 2. Fifty-six women are represented twice as they gave birth a second time during the study period and two women are represented three times as they gave birth three times during the study period. In comparison to Queensland-wide data from 2010,[51] the MDH provided care to higher proportions of younger women with over twice as many women aged less than

Table 2
Participant characteristics by model of care.

Characteristics	MGP *n* (%)	GP co-op care *n* (%)	CBH shared-care *n* (%)	Total *n* (%)	2010 QLD *n* (%)
Age					
Less than 20 years	72 (14.2)	1 (9.1)	6 (7.9)	79 (13.3)	3344 (5.1)
35 years or older	74 (14.6)	3 (27.3)	13 (17.1)	90 (15.2)	12,144 (19.8)
Parity					
Primiparous	203 (40.1)	0 (0.0)	12 (15.8)	215 (36.3)	24,878 (40.8)
Multiparous	303 (59.9)	11 (100.0)	64 (84.2)	378 (63.7)	36,149 (59.2)
Aboriginal and/or Torres Strait Islander	131 (25.9)	2 (18.2)	30 (39.5)	163 (27.5)	3505 (5.7)
Total	506 (85.3)	11 (1.9)	76 (12.8)	593	61,027

20 years (13.3% MDH vs. 5.1% QLD). The MDH also cared for almost five times as many Aboriginal and/or Torres Strait Islander women than the state average (27.5% MDH vs. 5.7% QLD).[51] The sample was comparable with regard to parity with 36.3% of women recorded as primiparous compared to 40.6% of women state-wide. The rate of primiparous mothers was also similar to other international studies, which report primiparous rates between 25.6% and 49.7%.[17,36,48,52] The division of women by model of care, based on allocation at the time of booking, is also shown in Table 2. The large majority of women (85.3%) received MGP care. Less than 2% (1.9%) were cared for under GP co-operative care and almost 13% (12.8%) were cared for under obstetric shared-care.

3.2. Progression of care

As shown in Fig. 1, of the 593 women booked to receive some level of care at the MDH (i.e., including all three models of care available), 391 (65.9%) gave birth to their baby at MDH and 196 (33.1%) gave birth to their baby at CBH. Six babies were 'born before arrival' (BBA), representing 1% of all women who received ongoing care from the MDH, slightly higher than the Queensland rate of 0.7% births,[51] possibly due to the large rural catchment area.

Fig. 2 shows the progression of care, including all transfers, for the 506 women booked to receive MGP care at the time of booking. Of those women 377 (74.5%) gave birth at MDH as planned and five

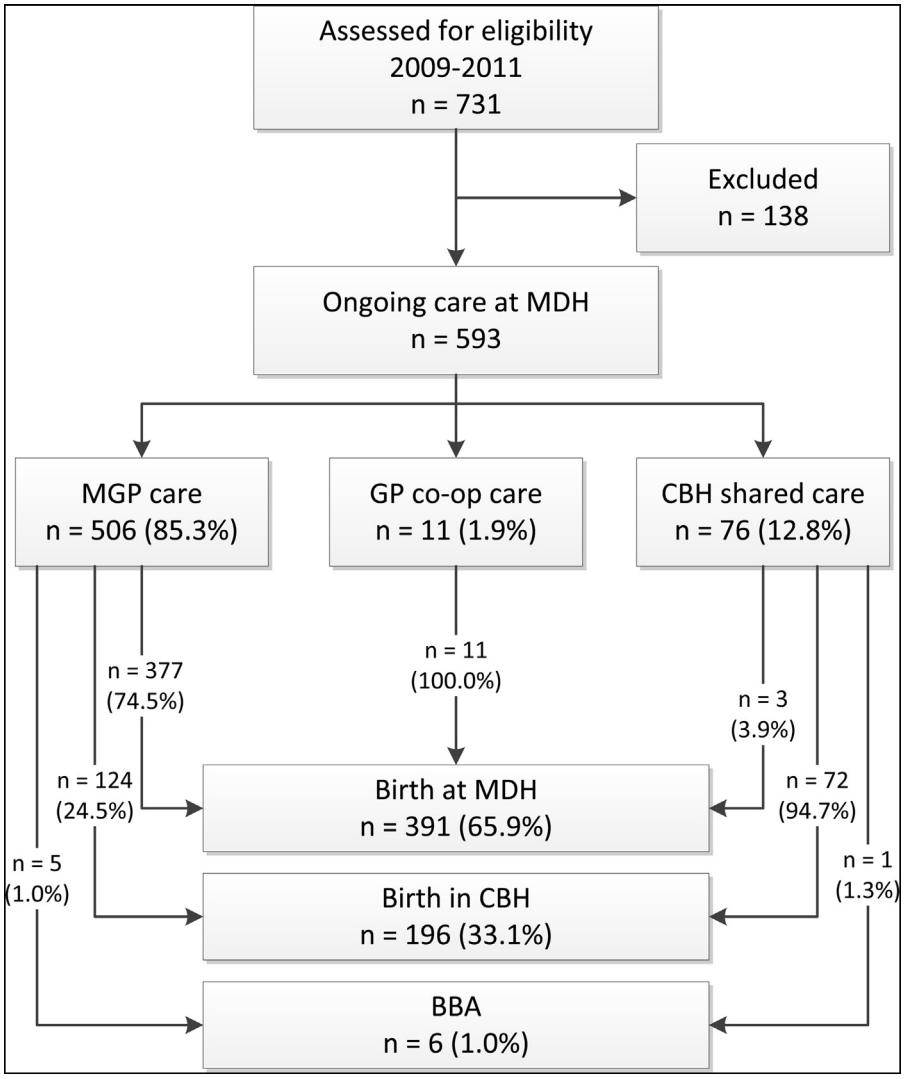

Fig. 1. Progression of care for 593 women (all risk) booked to receive care at the MDH from 2009 to 2011.

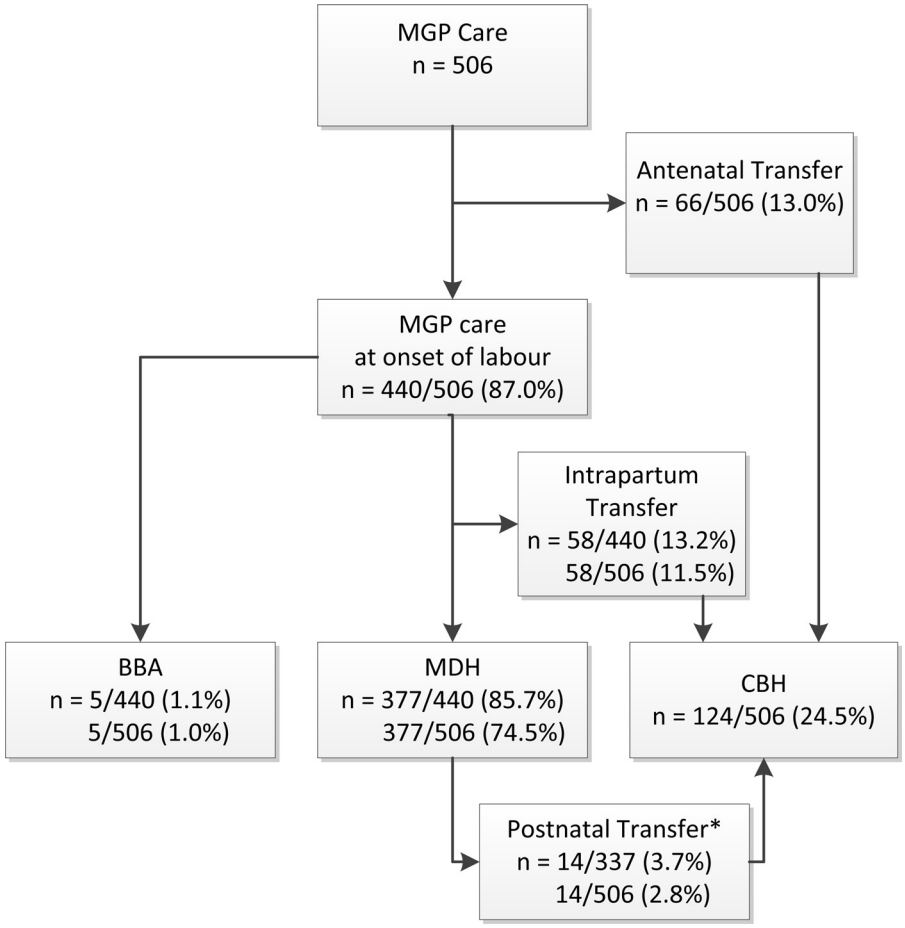

Fig. 2. Progression of care for 506 women (low risk) booked to give birth at the MDH with MGP care from 2009 to 2011, including type of transfer.

(1.0%) were BBA. The remaining 124 (24.5%) women had their care transferred to CBH. As shown in Fig. 2, 66 women were transferred during the antenatal period (13.0%) leaving 440 who commenced labour at MDH; of these 58/440 (13.2%) women transferred intrapartum. A further 14 (3.7%) women were transferred to CBH postnatally; one women was transferred for manual removal of placenta which is a third stage intrapartum transfer, however, as the baby was born at the MDH the transfer has been included with postnatal transfers.

All 11 women who had received GP co-operative care gave birth as planned at MDH. Only a very small proportion of women ($n = 3$, 3.9%) who received CBH shared-care ($n = 76$) gave birth at MDH, with the remaining 72 (94.7%) birthing at the CBH as planned. The outcomes for all births can be found in Section 3.6.

3.3. Reasons for transfers from MDH to CBH

The reasons for all 138 transfers of care for women booked to receive MGP care are displayed in Table 3. A number of women from the MGP care group were *referred* for review at CBH via an inter-hospital transfer but returned to their original model of care (described below). Close to half of all transfers ($n = 66$, 47.8%) occurred during the antenatal period. Prolonged pregnancy and the associated induction of labour was the most common reason for antenatal transfer ($n = 18$, 27.3%). Following that was concern regarding fetal well-being ($n = 11$, 16.7%; which included indications such as small for gestational age/IUGR, decreased liquor/AFI, fetal heart rate abnormality and USS detected fetal abnormality) and preeclampsia/hypertension ($n = 8$, 12.1%).

A total of 59 transfers (42.8% of all transfers) occurred in the intrapartum period, mostly in first stage of labour ($n = 54$, 91.5%) with small numbers in second ($n = 4$, 6.8%) and third ($n = 1$, 1.7%) stage of labour. There were no intrapartum births during transfer recorded.

Labour dystocia (recorded as 'failure to progress') resulting in a Lower Segment Caesarean Section (LSCS; $n = 15$, 25.4%), prolonged first stage with vaginal birth ($n = 11$, 18.6%) and induction for prolonged rupture of membranes ($n = 10$, 16.9%), were the most frequent reason for first stage transfers. This was followed by meconium stained liquor ($n = 6$, 10.2%) and preterm labour ($n = 4$, 6.8%). Similar to first stage intrapartum transfers, labour dystocia resulting in LSCS was the most frequent reason for second stage transfers ($n = 3$; 5.1%). The remaining second stage intrapartum transfer was recorded as prolonged second stage ($n = 1$, 1.7%). The only third stage intrapartum transfer was for retained placenta ($n = 1$, 1.7%).

The remaining 9.4% ($n = 13$) of transfers for the MGP group occurred during the postnatal period, of which over half were required for the woman ($n = 7$, 53.8%; 5.1% of all transfers) and the remaining required for the neonate ($n = 6$, 46.2%; 4.3% of all transfers). The most frequent reason for maternal transfer was post-partum haemorrhage ($n = 3$, 23.1% of all postnatal transfers), followed by complex perineal repair ($n = 2$, 15.4%), hypertension ($n = 1$, 7.7%) and pyrexia ($n = 1$, 7.7%). With regard to neonatal

Table 3
Reasons for transfer from MDH to CBH.

Reason	MGP (%)
Antenatal	
Prolonged pregnancy	18 (27.3)
Concern re fetal well-being	11 (16.7)
Preeclampsia/hypertension	8 (12.1)
Breech	6 (9.1)
Gestational Diabetes Mellitus	5 (7.6)
Pre-labour Rupture of Membranes (ROM)	6 (9.1)
Antepartum haemorrhage/Placenta Praevia	5 (7.6)
Medical Condition	4 (6.0)
Other	3 (4.6)
Antenatal sub-total	66 (47.8)
Intrapartum (1st stage)	
FTP resulting in LSCS	15 (25.4)
Prolonged first stage resulting in vaginal birth	11 (18.6)
Induction for Prolonged Rupture of Membranes (ROM)	10 (16.9)
Meconium stained liquor (MSL)/fetal concern	8 (13.6)
Preterm labour	4 (6.8)
Requested epidural	4 (6.8)
Other	2 (3.4)
Intrapartum (2nd stage)	
FTP resulting in LSCS	3 (5.1)
Prolonged second stage resulting in vaginal birth	1 (1.7)
Intrapartum (3rd stage)	
Retained placenta	1 (1.7)
Intrapartum sub-total	59 (42.8)
Postnatal maternal	
Maternal – postpartum haemorrhage	3 (23.1)
Maternal – perineal repair	2 (15.4)
Maternal – other	2 (15.4)
Postnatal neonate	
Neonate – preterm and/or birth weight < 2500 g	3 (23.1)
Neonate – respiratory distress	3 (23.1)
Postnatal sub-total	13 (9.4)
Total	138

transfers, the reasons for transfer were preterm/low-birth weight ($n = 3$, 23.1% of all postnatal transfers) and respiratory distress ($n = 3$, 23.1%).

In addition to the transfers described in Table 3, 15 women from the CBH shared-care group presented to MDH in labour despite being booked to birth in CBH. After an initial assessment by the MDH midwives, 12 of these women were transferred to CBH via an inter-hospital transfer and three were advised to stay at MDH due to impending birth. One women from the CBH shared-care group was transferred postnatally to receive treatment for a post-operative infection after discharge from CBH.

3.4. Additional inter-hospital patient flow from MDH to CBH

Over the 3-years, there were 31 inter-hospital antenatal referrals (MGP care = 25, CBH shared-care = 6) recorded. Unlike complete transfers of care, these women later returned for ongoing antenatal care within their allocated model. Some were referred several times. Inter-hospital referrals do not include women who were referred as outpatients to CBH for specialist medical (e.g., cardiac) or obstetric (e.g., previous poor obstetric history) reviews as these women were not easily identified.

For women in MGP care, the majority of referrals were for threatened preterm labour ($n = 16$, 64.0%), followed by medical conditions ($n = 4$, 16.0%), antepartum haemorrhage ($n = 3$, 12.0%), concern regarding fetal well-being ($n = 1$, 4.0%) and vaginal loss ($n = 1$, 4.0%). Similarly, for women in the CBH shared-care group, threatened preterm labour was the most common reason for antenatal referral ($n = 3$, 50.0%), followed by antepartum haemorrhage ($n = 2$, 33.3%) and medical condition ($n = 1$, 16.7%).

Table 4
Transport time for all intrapartum inter-hospital transfers to CBH for all women who received MGP care.

Timeframe	Fullterm transfers	Preterm transfers
Less than 2 h	6	0
2–4 h	8	1
4–6 h	7	0
6–8 h	7	1
8–10 h	7	0
10–12 h	4	0
12–18 h	5	0
18–24 h	4	0
More than 24 h	1	3
Avg. (range in min)	495 (80–1676)	Unknown (185 – more than 24 h)
Total	49	5[a]

[a] Missing data: 1 case.

3.5. Transfer to delivery time period for intrapartum transfers

For all inter-hospital, intrapartum transfers for women who received MGP care, midwives recorded the time period that elapsed between when the ambulance departed MDH to when the baby was born at CBH (Table 4). Times were not recorded for women who received CBH shared-care nor women who used private transport to reach CBH. A total of 55 MGP women were recorded as having an inter-hospital transfer (i.e., from MDH to CBH via ambulance); 49 (89%) of whom were fullterm at the time of transfer and six (11%) were preterm. For fullterm intrapartum transfers, six (12.2%) were recorded as less than 2 h with 80 min being the smallest time period reported. The average time period that elapsed was 8 h and 15 min. The transfer times were evenly distributed between 2–4 h and 8–10 h. With regard to preterm transfers, more than 24 h elapsed between when the ambulance arrived and when the baby was born for three of the five transfers recorded (60.%). Time for transfers that took longer than 24 h was not recorded, therefore, an average timeframe for preterm transfers could not be calculated.

3.6. Maternal and neonatal clinical outcomes

Table 5 outlines the clinical outcomes for the 593 women booked to receive care at the MDH, based on model of care at time of booking and birth hospital. As limited outcome data were available for women whose babies were born before arrival ($n = 6$) they have not been included in the table.

Across all the models of care, a total of 391 women gave birth at MDH (MGP care = 377, GP co-op care = 11, CBH shared-care = 3). Of the 377 women who received MGP care and gave birth at MDH as planned: 94.2% ($n = 355$) of women had a vaginal birth; less than 1% of women ($n = 2$) were recorded as having either a third or fourth degree perineal tear; 5.0% ($n = 19$) of neonates were preterm; 1.1% ($n = 4$) of fullterm neonates and 5.3% ($n = 1$) of preterm neonates were recorded as having an Apgar less than 7 at 5 min and 0.8% ($n = 3$) of full term neonates and 15.8% ($n = 3$) of preterm neonates were recorded as being admitted to the SCN located at CBH.

The MDH was able to increase its capacity on a number of occasions to perform 12 instrumental births and 22 caesarean sections. The MDH also attended 20 preterm births (MGP = 19, CBH shared-care = 1): one twin birth at 24 weeks; the remainder singletons at 30 weeks, two at 34 weeks, two at 25 weeks and 13 were 36 weeks gestation; and for one neonate the gestation was missing.

Three women gave birth at MDH despite being booked to receive CBH shared-care. Of these, one woman received a

Table 5
Maternal and neonatal clinical outcomes by model of care* and birth location.

Model of care*,[a]	MGP care n = 506 (%)			GP co-op care n = 11 (%)	CBH shared-care n = 76 (%)		Total n = 593 (%)	2010 QLD (%)
Birth hospital	MDH	CBH antenatal transfer	CBH intrapartum transfer	MDH	MDH	CBH	MDH + CBH	
Total	377 (74.5)	**66 (13.0)**	**58 (11.5)**	11 (100.0)	3 (3.9)	72 (94.7)	587 (99.0)	61,027
Primiparous	124 (32.8)	**29 (43.9)**	**49 (84.5)**	0	0	12 (16.7)	214 (36.5)	24,878 (40.8)
Indigenous	98 (26.0)	**18 (27.3)**	**15 (25.9)**	2 (18.2)	2 (66.6)	28 (38.9)	163 (27.8)	3505 (5.7)
Maternal outcomes								
IOL	2 (0.5)	**27 (40.9)**	**12 (20.7)**	0	0	6 (8.3)	46 (7.8)	13,579/60,041 (22.2)
Method of delivery								
Vaginal	355 (94.2)	**41 (62.1)**	**26 (44.8)**	1 (9.1)	1 (33.3)[i]	33 (45.8)[i]	457 (77.9)	35,278/62,032 (56.9)
Instrumental	12 (3.2)	**4 (6.1)**	**9 (15.5)**	0	0	0	25 (4.3)	5932/62,032 (9.6)
LSCS	10 (2.7)	**21 (31.8)**	**23 (39.7)**	10 (90.9)	2 (66.6)	39 (54.2)[ii]	105 (17.9)	20,821/62,032 (33.6)
VBAC	0	**0**	**0**	0	0	5 (6.9)	5 (0.9)	Not available
3rd/4th degree perineal tear (vaginal births)	2 (0.6)	**1 (2.4)**	**2 (7.7)**	0	0	1 (3.0)	6 (1.3)	692/42,029 (1.7)
Neonatal outcomes								
Gestation								
Fullterm	359 (95.2)	**41 (62.1)**	**54 (93.1)**	11 (100.0)	2 (50.0)	71 (94.6)	537/591 (90.9)	55,877/60,041 (93.1)
Preterm	18 (4.8)	**25 (37.9)**	**4 (6.9)**	0	2 (50.0)	4 (5.4)	53/591 (8.7)	4164/60,041 (6.9)
Apgar < 7 @ 5 min (livebirths)								
Fullterm	3 (0.8)	**0**	**1 (1.9)**	0	2 (100.0)	NR	NR	689/56,272 (1.2)
Preterm	1 (5.6)	**0**[a]	**0**[a]	–	2 (100.0)	NR	NR	Not available
Fetal death								655/62,032
Fullterm	0	**0**	**0**	0	0	0	0	Not available
Preterm	0	**1 (4.0)**	**0**	–	2 (100.0)	0	3/54 (5.6)	Not available
SCN admissions @ CBH (livebirths)								
Fullterm	3 (0.8)	**5 (12.2)**	**10 (18.5)**	0	0	0	18/537 (3.4)	Not available
Preterm	3 (16.7)	**18 (72.0)**	**3 (75.0)**	–	0	3 (75.0)	27/54 (50.0)	Not available
Avg. length of stay (days)								
Fullterm	3	**2**[b]	**3**	–	–	–	NR	Not available
Preterm	27.3	**15.9**[a]	**4**[a]	–	–	NR	NR	Not available
Range length of stay (days)								
Fullterm	1–5	**1–3**[b]	**1–7**	–	–	–	NR	Not available
Preterm	3–39	**1–76**[a]	**1–7**[a]	–	–	NR	NR	Not available

Note. No outcome data available for six BBAs. For all neonatal outcomes, the denominator was total number of fullterm or preterm births. Bolded text refers to all antenatal and intrapartum transfers to CBH.

* Model of care at time of booking.

NR = not recorded.

[a] Missing data: one case.

[b] Missing data: two cases.

[i] Twins: one case.

[ii] Twins: two cases.

pre-planned LSCS as staff were available on site, one woman had an emergency LCSC for cord prolapse (full term, with an Apgar score of nine at 5 min) and one spontaneous vaginal birth of twins at 24 weeks (already reported above).

The clinical outcomes of the 124 MGP women who initially planned to give birth at MDH but during the course of their pregnancy or labour, were transferred and ultimately gave birth at CBH are displayed in bolded text in Table 5.

Of the 66 women transferred antenatally, 43.9% were primiparous and 27.3% were Indigenous. Of the 64 women transferred intrapartum, 84.5% of women were primiparous and 25.9% were Indigenous. Forty-one percent ($n = 27$) of women transferred antenatally were recorded as having an induced onset of labour (the majority of whom were transferred for prolonged pregnancy) and 20.7% ($n = 12$) of women transferred intrapartum had an induced onset of labour (10 prolonged ruptured membranes, one high head at SROM, and one prolonged first stage).

More than half of all women transferred antenatally had a vaginal birth ($n = 41$, 62.1%), almost one third LSCS ($n = 21$, 31.8%) and a small number had instrumental deliveries ($n = 4$, 6.1%). One women in the antenatal transfer group was recorded as having a third degree perineal tear ($n = 1$, 1.5%). For women transferred intrapartum, 44.8% ($n = 26$) had a vaginal birth, 39.7% ($n = 23$) had a LCSC and 15.5% ($n = 9$) had an instrumental delivery. Two women from this group were recorded as having third or fourth degree perineal tears ($n = 2$, 7.7%).

With regard to neonatal outcomes, 37.9% ($n = 25$) of antenatal transfers and 6.9% ($n = 4$) of intrapartum transfers were recorded as preterm. No fullterm, liveborn neonates born to women transferred to CBH antenatally were recorded as having an Apgar score of less than seven at 5 min. For intrapartum transfers, one fullterm infant was recorded as having an Apgar score of less than seven (1.9% of fullterm births). One fetal death was recorded for the antenatal transferred group: an intra-uterine fetal death (IUFD) at 26 weeks gestation. With regard to Special Care Nursery (SCN) admissions from the antenatal transfer group, 12.2% ($n = 5$) of fullterm neonates were admitted for an average of 2 days and 72.0% ($n = 18$) of preterm infants were admitted for an average of 15.9 days. For intrapartum transfers, 18.5% ($n = 10$) of fullterm neonates and 75.0% ($n = 3$) of preterm neonates were admitted to the SCN with and average length of stay of 3 (term) and 4 (preterm) and a range of 1–7 days for both groups.

4. Discussion

This study aimed to provide a detailed description of three years of transfer activity and clinical outcomes from a rural PMU without local emergency obstetric or anaesthetic backup. Surgical services

were available intermittently either by a visiting obstetrician or through resident medical staff who supported planned caesarean sections for some women. Less commonly, unscheduled caesarean sections and instrumental vaginal deliveries were performed.

4.1. Transfer rates

Despite high rates of teenage mothers and Indigenous women in the population, close to two-thirds of the 593 women booked to receive one of three models of care at MDH, had their baby locally. This is higher than the proportion reported in rural British Columbia, where it is estimated that only 40% of all women, whose local intrapartum service does not have caesarean section capability, are able to give birth locally[53] but lower than the remote Inuit Nunavik community where 86.3% of women gave birth locally.[47] This is possibly an undercount as there could be women from the catchment who never presented for care, including women choosing private obstetric care in Cairns. Data on these women are not available but considered by the authors to be very low in numbers.

Eighty-six percent of women booked with the MGP, at the onset of labour, gave birth locally with only 13.2% transferring during the intrapartum period, arguably the most stressful time for transfer.[38] This falls within the range of intrapartum transfer rates reported in other PMU studies, including four prospective cohort studies conducted in: Denmark (11.6%)[36]; Germany (13.4%)[48]; the UK (13.9%)[37]; and the Birthplace in England study (16.0%),[52] as well as in New Zealand (12.6%).[54]

Only 3.7% of women transferred postnatally, seven for maternal indications and six were neonatal. Only three were for post-partum haemorrhage (0.7% of women birthing locally) which is one of the common emergencies that midwives fear.[55] Neonatal transfers were for preterm/low-birth weight ($n = 3$) or respiratory distress ($n = 3$). Other studies to include postnatal transfers for both mothers and neonates listed perineal trauma (30.2–46.7%) and retained placenta (19.6–28.0%) as the most frequent reasons for maternal postnatal transfers, and respiratory conditions (12.7–42.3%) and low Apgar scores (3.8–12.8%) as the most frequent reasons for neonatal transfers.[36,37,48,52]

4.2. Time between transfer and birth

We were unable to calculate the decision to delivery intervals. All inter-hospital intrapartum transfers for women who received MGP care included the time from when the ambulance departed MDH to when the baby was born at CBH. The average time to birth, for full-term intrapartum transfers, was 8 h and 15 min, with 80 min being the smallest time reported. For three of the five preterm transfers, more than 24 h elapsed between when the ambulance arrived and when the baby was born which was likely delayed where possible to administer drugs for lung maturation. As data recording was capped at >24 h an average timeframe for preterm transfers was not able to be calculated. These results demonstrate that for most women, urgent delivery was not needed and emergency situations requiring immediate, life saving operative delivery (i.e., cord prolapse or amniotic fluid embolism) are rare in low risk populations. They also provide reassurance that skilled midwives working within a supportive network are able to offer PMU services in a majority of women.

4.3. Clinical outcomes

The clinical outcomes of all women, including the 377 women who gave birth in the primary unit, are reassuring. The large majority of MGP women experienced a vaginal birth (94.2%) with less than 1% recorded as having a third or fourth degree perineal tear, a full term neonate with an Apgar score <7 at 5 min or admitted to the SCN. These findings are consistent with other studies that assess the clinical outcomes of those women who give birth at PMUs.[8,35–37,39–41]

Occasionally, the Mareeba PMU was able to increase its clinical service capability whereby 12 instrumental deliveries and 20 LSCS occurred. A number of women in preterm labour at 35–36 weeks gestation were kept at MDH rather than risk transfer with potentially imminent birth. After birth, assessment by the midwife and resident medical officer would determine if the neonate's condition required admission to the CBH SCN or could be safely managed at MDH. This demonstrates that a well functioning primary maternity unit can provide more care options for supporting those women who require low level secondary care without having to dislocate families and distress women through the transfer to large tertiary units.

The major focus of the study, however, was the 124 women booked to give birth at MDH that transferred and delivered at CBH. A high proportion of women transferred during the intrapartum period were primiparous (84.5% compared to 43.9% of women transferred antenatally and 36.5% of the whole sample). This finding is consistent with other PMU studies that report parity on transfer rates.[36,37,52] A high proportion of women transferred antenatally had an induced onset of labour (40.9%), mostly for prolonged pregnancy, yet induction rates were low (7.8%) when compared to Queensland average (22.2% in 2010).[56]

More than half of all women transferred antenatally had a vaginal birth (62.1%), followed by LSCS (31.8%) and instrumental delivery (6.1%). One woman in this group was recorded as having a third degree perineal tear (1.5%). Whilst no other study was identified that reported on the clinical outcomes of women transferred antenatally from PMUs, these outcomes are consistent with Queensland-wide data provided in Table 5.[56] Intrapartum transfer mode of birth outcomes are consistent with the two other studies to report on method of delivery after intrapartum transfer[47,48] and demonstrate that transfers are not solely required to access surgical services.

With regard to neonatal outcomes, 37.9% of antenatal transfers and 6.9% of intrapartum transfers were recorded as preterm, an overall rate of 9.2%. This is comparable to the Queensland-wide proportion of 8.7%, particularly given the high rates of Indigenous women in the study as 12.7% of Queensland Indigenous mothers currently have a preterm birth.[57] The MDH attended 19 preterm births, mostly at 36 weeks gestation ($n = 13$), with the remaining preterm births recorded at 35 weeks ($n = 2$), 34 weeks ($n = 2$), 30 weeks ($n = 1$) and 24 weeks ($n = 1$). Preterm labour is a common presentation in rural and remote areas.[57] These women would have presented regardless of the capacity of the service being offered as they occurred prior to the usual gestation of 36–38 weeks when women are routinely relocated to regional areas to await birth.[15] It is likely that having a PMU in this rural setting led to better care for these women experiencing preterm birth than what would have happened if the service had been downgraded to a Level 1 (no birthing service) where, similar to many remote Australian settings it is unlikely to recruit and retain experienced midwives.[4] Intervention rates in this cohort of women were low and is supported by evidence that maternal outcomes for low risk women are better in primary units where they suffer less unnecessary intervention than in high technology maternity facilities.[35,40,58–60]

Due to the small numbers, it is not possible to interpret perinatal mortality with confidence. Whist one fetal death was recorded for the antenatal transfer group and two additional neonatal deaths occurred in the CBH group resulting from birth at 24 weeks gestation, no preventable mortality was reported during the study time period.

5. Implications for policy and practice

The National Maternity Services Plan (NMSP)[7] highlights the challenges faced by women living in rural and remote areas of Australia with regard to both access to, and acceptability of, maternity services. The NMSP also acknowledges the challenges faced by Aboriginal and Torres Strait Islander women and families, many of whom also live in rural and remote Australia. Because of this, the NMSP places a high priority on bringing about improvements in maternity services for both Aboriginal and Torres Strait Islander families with a particular emphasis on services in rural and remote areas.

The establishment of PMUs in rural areas offers one solution. This paper adds to the building evidence supporting the safety of rural PMUs.[43,54,61] This study also addresses a research gap by comprehensively describing the reasons and clinical outcomes of all women transferred from a PMU.

At the time of this study, Mareeba was the only rural PMU in Queensland despite "each Australian jurisdiction committed to extending and enhancing primary maternity service models as a preferred approach to providing pregnancy and birthing services to women with uncomplicated pregnancies."[62(p.1)]

This study clearly demonstrates the effectiveness of a rural PMU and supports the Queensland government's current commitment to the reopening of rural birthing services. While the provision of surgical services would be preferable, it is not always possible due the insufficient birthing numbers or lack of suitably qualified medical staff or hospital infrastructure. Increasing evidence suggests no birthing services results in worse outcomes for women and babies, both because women present to poorly prepared health professionals, and because distance to care affects outcomes directly.[63]

The majority of women want to birth close to home[6] with up to 10% of women in some communities birthing in Level 1 facilities against advice and without the infrastructure and the skilled staff to support birthing.[4] This paper provides evidence for planners with approximately two thirds of women (65.9%) able to stay in their community to have their babies in a PMU. It also offers reassurance for all stakeholders, demonstrating 85.7% of women commencing labour in the PMU gave birth in the PMU and transfers occurred in a timely and efficient manner with outcomes comparable to other published papers.

These findings challenge the applicability of the 75-min DDI rule in this setting where decision-making is different to that in urban environments. Emergencies such as cord prolapse and antepartum haemorrhage occur wherever pregnant women live. Having access to a well functioning PMU will result in higher quality of care, compared to treatment at a Level 1 unit where maternity expertise and equipment is minimal.[63] A common belief in Australia is that it is safer to offer no service, than to offer a service that cannot provide a caesarean section. Across Queensland services are put on 'bypass' when resident medical staff are absent and the Level 3 facility reduces to a Level 1. Work published from Canada clearly demonstrates that rural women who have to travel to access maternity services have increased rates of adverse perinatal outcomes.[17] Closing services because of a lack of immediate onsite access to caesarean sections is transferring the notion of risk from the organisation to the family. A Level 2 PMU that provides a local maternity service with reduced capability should be safer than a Level 1 service where all women are transferred to birth at a service some distance away.[63] This paper supports Australian policy recommending PMUs for low risk women[62] demonstrating the safety of a rural midwifery-led PMU working within an effective network offering referral to higher level services, as required.[62] However the persisting lack of Level 2 units throughout rural Australia indicate that leadership driving culture change is probably what is required now, rather than more studies examining safety and effectiveness.

Options for maternity care are different for women living in rural areas. Women's expectations regarding access to immediate high level health care is tempered by the realities of the distances to tertiary facilities. Midwives, women and medical staff have all reported high levels of satisfaction with the Mareeba service.[64] Essential characteristics to the success of the model were reported as requiring: respectful and collaborative relationships between midwives; doctors and management, well established clinical governance; and, management that understands and supports models of continuity of midwifery care.[64]

6. Strengths and limitations

The retrospective nature of this review cannot attribute cause and effect. However it would not be possible to randomise this model of care and the results are still very useful to assist policy makers and health planners in the delivery of rural maternity services.

The access for MDH women to higher level care is through a 50–60 min vehicle transfer and is within the current CSCF guidelines of 75 min.[31] Generalisabilty to other rural facilities is unknown.

One of the key strengths of the study was that it includes the clinical outcomes of women who experienced a transfer of care, separate from the outcomes of the women that birthed at the PMU and separate from the women who planned to birth at Cairns. This demonstrates that those women's outcomes are acceptable and that transfers occur in a clinically appropriate manner.

7. Conclusion

This paper described the detailed activity of a rural maternity unit approximately 1 h from the nearest surgical service and includes reasons for all antenatal, intrapartum and postnatal transfers and the clinical health outcomes of all women and their babies, including those transferred to the regional facility. Although providing services to a community with higher rates of Indigenous women and young women, the MDH demonstrated safe outcomes, comparable to other PMUs and lower than many tertiary level services. The results challenge the notion that closure of birthing services for 'safety' reasons is the only option when rural communities lose their surgical capability. They offer reassurance that a Level 2 service can be safely offered in rural areas and the authors recommend that more Level 2 units be made available, in line with national and state policy and international evidence. A study of the cost implications for health services and families would strengthen this debate.

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