



# Continuity of care by a primary midwife (caseload midwifery): a cost analysis using results from the COSMOS randomised controlled trial

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## ABSTRACT

**Introduction** Caseload midwifery (continuity of midwifery carer) offers benefits including lower caesarean section rates, lower risks of preterm birth and stillbirth, and improved maternal satisfaction of care. Despite these advantages, concerns about additional costs hinder widespread implementation. This study examines the cost of caseload midwifery compared with standard maternity care from the perspective of both public hospitals and public funders.

**Methods** A cost analysis was conducted using data from a randomised controlled trial of 2314 low-risk pregnant women in Melbourne, Australia. Women randomised to caseload care received antenatal, intrapartum and postpartum care from a primary midwife, with some care provided by a 'back-up' midwife. Women in standard care received midwifery-led care with varying levels of continuity, junior obstetric care or community-based medical care. The cost analysis compared differences in mean costs of health resources to public hospitals and to public funders. Additionally, a budget impact analysis estimated total costs to the health system between 2023 and 2027.

**Results** For public hospitals, there was no significant difference in overall costs between women receiving caseload midwifery (n=1146) versus standard care (n=1151) (\$A12 363 (SD: \$A4967) vs \$A12 323 (SD: \$A7404); p=0.85). Conversely, public funders incurred lower expenditures for women receiving caseload midwifery (\$A20 330 (SD: \$A8312)) versus standard care (\$A21 637 (SD: \$A11 818); p<0.001). The budget impact analysis estimated savings of \$A625 million to the health system over the next 5 years with expanded access to caseload midwifery in Australia.

**Conclusion** Caseload midwifery in low-risk women is cost-neutral to public hospitals and cost-saving to public funders.

**Tweetable abstract** Continuity of midwifery for low-risk women reduces costs to public funders, with no additional costs to hospitals.

## INTRODUCTION

High-income countries are grappling with the concurrent challenges in maternity care of rapidly increasing intervention

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Continuity of care by a primary midwife (caseload midwifery) is associated with beneficial health outcomes and increased rates of maternal satisfaction.
- ⇒ Despite positive effects, uncertainty regarding the economic consequences associated with this model of care remains a significant barrier to the uptake of this highly effective maternal health intervention.

## WHAT THIS STUDY ADDS

- ⇒ To drive changes in the uptake of caseload midwifery, this study assessed the cost implications of caseload midwifery in comparison to standard maternity care from the perspective of both public hospitals and public funders.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Caseload midwifery was found to reduce costs to public funders for low-risk women without increasing costs for public hospitals.

rates, particularly caesarean sections, and the imperative to prevent rare but catastrophic outcomes such as morbidity and death.<sup>1 2</sup> This is set against a background of rapidly increasing healthcare costs and tightening government expenditure.<sup>3</sup> Caesarean section is a high-cost medical procedure that comes with an increased risk of adverse outcomes.<sup>4 5</sup> Consequently, reducing the need for caesarean section is an ongoing international priority.<sup>6</sup>

While high-income countries have very low rates of maternal and neonatal morbidity and mortality, some individual health services have recently been identified as service 'failures', with clusters of catastrophic adverse events.<sup>7-9</sup> These incidents have highlighted the need for attention to maternal experience and maternal and neonatal safety.<sup>10 11</sup> Furthermore, follow-up responses have also highlighted the need to prioritise



the implementation of evidence-based responses both within these individual services, and across maternity care more broadly.<sup>12</sup>

Continuity of midwifery carer in women of low obstetric risk has been shown in the COmparing Standard Maternity care with One-to-one midwifery Support (COSMOS) randomised controlled trial (RCT) to reduce the risk of caesarean section, and admission to special or neonatal intensive care for the infant.<sup>13</sup> The model, called 'caseload midwifery', where women received antenatal, intrapartum and postpartum care from a primary midwife, also resulted in an improvement in birth experience for women,<sup>14 15</sup> and has been associated with lower risk of preterm birth, stillbirth and neonatal death.<sup>16</sup> Other RCT evidence from all-risk women concluded that caseload midwifery is safe for women of any risk and produces cost savings for hospital funders.<sup>17</sup> As such, increasing access to caseload midwifery should be a key strategy to concurrently address rising intervention rates, while improving experience and safety.

A key barrier to wider implementation or scale-up of caseload midwifery is the perceived additional costs to public hospitals associated with this model.<sup>18</sup> Comprehensive evidence of the costs of caseload midwifery and standard care is thus needed in order to inform decision-making about establishment or scale-up. The objective of this study was to identify the cost and budget impact of caseload midwifery compared with standard care among women of low obstetric risk in Australia.

## METHODS

### Study setting and location

In Australia, caesarean section rates were 37% in 2020, which is above the Organisation for Economic Co-operation and Development average.<sup>19 20</sup> It is projected that 45% of births in Australia will be by caesarean section by 2030.<sup>21</sup> Maternity care is funded through a mix of public funding, out-of-pocket fees and private health insurance funds.<sup>22</sup> Public hospitals are funded jointly by both the federal and state governments through Public Hospital Funding Agreements on an activity-based funding model. Each episode of inpatient, outpatient and emergency department care in public hospitals is funded at a set rate determined by the Independent Hospital Pricing Authority, with no out-of-pocket fees for Medicare-eligible patients.<sup>23</sup> Any care provided outside of public hospitals is partly subsidised through a different pool, Medicare, which is funded solely by the federal government.

Public hospitals are owned and managed by state governments, with individual hospitals being operated by a board and executive responsible for the provision of services and financial sustainability. Once government funding reaches a hospital, the hospital is then responsible for providing the care, including payment of staff, consumables and facility costs. This includes midwife and medical salaries associated with providing maternity care. Caseload midwifery in Australia is designed for

implementation in the public hospital setting. As such, it will have cost implications to public funders as it will affect the types of activities or episodes of care being funded, and to individual hospitals as it involves different staff, consumable and facility costs.

### Study population

COSMOS was a two-arm RCT designed to compare caseload midwifery to standard maternity care in women at low risk of obstetric complications. The trial design is described in detail elsewhere.<sup>13 24</sup> Briefly, women at low risk of obstetric complications were recruited at the Royal Women's Hospital, a public tertiary women's hospital in Melbourne, Australia, between September 2007 and June 2010. Women were eligible for inclusion in the trial if they were able to speak, read and write English, if they had a singleton pregnancy of less than 24 weeks gestation at recruitment and if they were considered low obstetric risk, with no complications during the current pregnancy and no precluding medical conditions (eg, cardiac disease, diabetes, epilepsy, substance use, obesity or significantly underweight). Women with a previous caesarean section were excluded. Caseload midwifery was not available to women outside the trial.

### Comparators

#### Caseload midwifery care

Women randomised to the intervention group received the majority of their antenatal, intrapartum and postnatal care from a primary caseload midwife at the hospital. If complications arose, the primary midwife collaborated with other health professionals (eg, obstetricians) while continuing to provide caseload care. Caseload midwives provided 'back-up' care for each other, so that if a caseload midwife was sick, on personal leave or unavailable the back-up midwife would provide care for a woman. Women saw an obstetrician at booking, at 36 weeks of gestation and if the pregnancy lasted beyond 40 weeks' gestation. Intrapartum care was provided in the birth suite by the caseload midwife (89% of the time), or otherwise by a core hospital midwife. Postpartum, the caseload midwife saw women on most days in hospital to provide postnatal care and provided domiciliary care following discharge from hospital. All care was provided according to hospital guidelines and protocols. Full-time midwives had a caseload of 45 women per annum.

#### Standard maternity care

Women randomised to the control group could choose from the standard hospital options for low-risk women (referred to as 'standard care'). These included midwife-led care (78%), which generally meant that women saw a different midwife at each visit, based on who was rostered to work at the time of care; obstetric trainee care (2%); or shared care where antenatal care is shared between an accredited general medical practitioner (GP) and the hospital (15%). Five per cent transferred their care elsewhere. As with caseload midwifery care,

women in the standard care model saw an obstetrician at booking, and 36 weeks' gestation and at 41 weeks' gestation if required. Care was provided according to the same hospital guidelines and protocols as women in the caseload midwifery arm.

### Study design: cost analysis

We conducted a cost analysis using data from the COSMOS RCT to determine if there are differences in cost between caseload midwifery and standard care for individual public hospitals providing care, and public funders.

#### Time horizon, discount rate

The time horizon for the cost analysis was from booking at around 16 weeks' gestation, through to 2 months post partum. Since the follow-up period was less than 12 months, discounting of costs was not required.

### Measurement and valuation of resources

#### Public hospital costs

Use of public hospital resources was identified from a combination of self-reported health service use from a survey administered to women at 2 months post partum, data collected from hospital records by the study team and administrative data. Health resources were costed from the hospital's perspective. These are described in detail in online supplemental appendix 1.

#### Expenditure by public funders

Expenditure by public funders was based on all episodes of care, also identified from self-reported health service use survey data administered to women at 2 months post partum, data collected from hospital records by the study team and administrative data. Funding per activity was based on the Independent Hospital Pricing Authority National Efficient Price Determination for 2022/2023,<sup>25</sup> with the Inlier weight per activity multiplied by the National Efficient Price.<sup>25</sup> These are described in detail in online supplemental appendix 1.

### Study design: budget impact analysis

The second analysis was a budget impact analysis including costs to the health system, comprising both public hospital costs and expenditure by public funders for caseload midwifery and standard care in women at low risk of obstetric complications. This was designed to capture the cost implications of hypothetical national implementation. We assumed that uptake of caseload would be 70% in women at low risk of obstetric complications, and that adherence would be 90%; this was considered more reflective of potential use in practice. The analysis was designed to represent the Australian population of births between 2023 and 2027. Full methodological details are provided in online supplemental appendix 2.

#### Time horizon

The model took a 5-year time horizon, including all births and considering costs and outcomes between 2023 and

2027 (ie, for births in 2023 costs and outcomes will be considered for up to 5 years post partum, whereas those born in 2026 will only have costs and outcomes considered up to 1 year post partum). No discounting was applied.

### Currency, price date and conversion

All costs are presented in 2021/2022 Australia dollars. For reference, at time of writing 1 Australian dollar is equal to 0.56 Pounds sterling, 0.63 Euros and 0.67 United States Dollars. When unit prices and funding amounts were not recorded in the original source in this price date, they were adjusted for inflation using the Reserve Bank of Australia inflation figures.<sup>26</sup>

### Data analysis

Data were analysed on an intention-to-treat basis. Demographic characteristics of women receiving caseload midwifery and standard care were compared. Differences between groups were calculated using Pearson's  $\chi^2$  test, and Student's t-test (p values reported). The average number of, or frequency of access to, different resources was then compared, followed by costs to public hospitals and expenditure by public funders. A supplementary analysis was conducted that compared costs to public hospitals and expenditure by public hospitals for women receiving shared care (with a GP). For costs, generalised linear models were used to compare differences, with a gamma distribution and log link function to account for the skewed nature of the cost data. Health service use was analysed as count data with negative binomial distribution. All analysis was conducted using SAS V.9.4.

## RESULTS

There were 1146 women allocated to caseload care and 1151 women allocated to standard care. Of the 1151 women allocated to standard care, 79.7% (917/1151) received public antenatal care with either midwives or obstetric trainees; 15.1% (174/1151) received shared care (with a GP); and 5.2% (60/1151) transferred to care elsewhere. Of the 1146 women allocated to caseload care, 3.3% (38/1146) received other care either at the Royal Women's Hospital, or at a facility outside of Melbourne due to relocation. [Table 1](#) demonstrates that the two groups were similar in terms of demographic characteristics.

In terms of health resources used, women allocated to caseload midwifery accessed slightly more antenatal midwife appointments (6.7 vs 6.1;  $p < 0.001$ ) but were less likely to have an epidural (28.3% vs 30.8%;  $p = 0.04$ ) than women in the standard care group. They also were less likely to have a caesarean section birth (19.3% vs 24.8%;  $p = 0.001$ ), had a shorter length of labour (12.9 hours vs 14.0 hours;  $p = 0.04$ ), and a shorter postnatal ward stay (55.5 hours vs 60.2 hours;  $p < 0.001$ ). The babies of women allocated to caseload midwifery had fewer admissions to special care nursery (SCN) or neonatal intensive care unit (NICU) (5.9% vs 9.2%;  $p = 0.002$ ) and had shorter lengths

**Table 1** Demographic characteristics of women receiving caseload and standard care

	Caseload (n=1146)	Standard care (n=1151)	P value
Model of care received within allocated group	Caseload only care—1108 (96.7%)	Midwives or obstetrics trainees—917 (79.7%)	n/a
	Transferred to care elsewhere—38 (3.3%)	Share care with a GP—174 (15.1%)	n/a
		Transferred to care elsewhere—60 (5.2%)	n/a
Age at booking visit—mean (SD)	31.2 (4.6)	31.3 (4.7)	0.62
Body mass index at booking visit—mean (SD)	24.1 (3.7)	23.8 (3.7)	0.13
Gestation at booking—mean (SD)	16.3 (2.8)	16.3 (2.9)	0.57
Nulliparous—n (%)	803 (70.1%)	799 (69.4%)	0.73
Married or de facto—n (%)	1076 (93.9%)	1062 (92.3%)	0.33
Postsecondary education—n (%)	874 (76.3%)	828 (71.9%)	0.05
Born in Australia—n (%)	652 (56.9%)	644 (56.0%)	0.79

GP, general medical practitioner; n/a, not applicable.

of stay post birth (68.2 hours vs 73.9 hours;  $p < 0.001$ ). Women in the caseload group also had slightly more postnatal home visits (2.1 visits vs 1.7 visits;  $p < 0.001$ ) (table 2).

Based on annual caseload midwife salary and a caseload of 45 women, caseload midwives cost public hospitals \$A3414 per woman to provide care through the antenatal,

intrapartum and postnatal time period. Women receiving caseload midwifery had lower mean costs associated with antenatal visits (which includes non-caseload midwife, obstetrician and GP time) (\$A214 vs \$A316;  $p < 0.001$ ), epidural use (\$A94 vs \$A110;  $p = 0.04$ ), birth suite (\$A1376 vs \$A3,729;  $p < 0.001$ ) and postnatal ward costs for mother

**Table 2** Health service use of women

	N	Caseload Mean (SD)/n (%)	N	Standard care Mean (SD)/n (%)	P value
Antenatal visits					
Antenatal visits—midwife	1146	6.7 (0.7)	1151	6.1 (1.7)	<0.001
Antenatal visits—GP*	1146	0.0 (0.0)	1151	0.6 (1.6)	n/a
Antenatal visits—obstetrician	1146	2.3 (0.5)	1151	2.2 (0.5)	0.42
Emergency department presentations	1146	0.7 (0.9)	1151	0.7 (1.0)	0.46
Induction—n (%)	1146	351 (30.6%)	1151	386 (33.5%)	0.54
Epidural—n (%)	1146	324 (28.3%)	1151	354 (30.8%)	0.04
Birth					
Caesarean section—n (%)	1146	221 (19.3%)	1151	285 (24.8%)	0.001
Vaginal birth: instrumental—n (%)	1146	202 (17.6%)	1151	222 (19.3%)	0.31
Vaginal birth: unassisted—n (%)	1146	719 (62.7%)	1151	637 (55.3%)	<0.001
Length of labour (hours)	1146	12.9 (30.1)	1151	14.0 (27.9)	0.04
Postnatal—baby					
SCN or NICU admission	1146	67 (5.9%)	1151	106 (9.2%)	0.002
Baby length of stay (hours)	1146	68.2 (45.7)	1151	73.9 (40.0)	<0.001
Postnatal ward—mother					
Mother length of stay (hours)	1146	55.5 (31.2)	1151	60.2 (24.9)	<0.001
Postnatal visits, after discharge (home visits)					
Postnatal home visits	1146	2.1 (1.0)	1151	1.7 (0.7)	<0.001

\*0 for those receiving caseload, as antenatal care by a GP was only provided for those receiving 'shared care' as a subset of those in standard care.  
GP, general medical practitioner; NICU, neonatal intensive care unit; SCN, special care nursery.



**Table 3** Mean costs to public hospitals per woman

	Caseload	Standard care	P value	Difference
	n=1146	n=1151		
Caseload midwife salary cost	\$A3414	–	n/a	\$A3414
Antenatal visits (non-caseload midwife, obstetrician), mean (SD)	\$A214 (\$A55)	\$A316 (\$A63)	<0.001	–\$A102
Emergency department presentations*, mean (SD)	\$A487 (\$A659)	\$A508 (\$A699)	0.29	–\$A21
Induction*, mean (SD)	\$A35 (\$A53)	\$A39 (\$A55)	0.22	–\$A4
Epidural*, mean (SD)	\$A94 (\$A139)	\$A110 (\$A145)	0.04	–\$A16
Birth suite, mean (SD)	\$A1376 (\$A1694)	\$A3729 (\$A4855)	<0.001	–\$A2353
Postnatal (ward, SCN or NICU)—baby, mean (SD)	\$A3731 (\$A2557)	\$A4154 (\$A2263)	<0.001	–\$A423
Postnatal ward—mother, mean (SD)	\$A2993 (\$A1619)	\$A3239 (\$A1289)	<0.001	–\$A246
Postnatal costs, after discharge (home visits), mean (SD)	n/a included in caseload midwife salary cost	\$A198 (\$A81)	n/a	–\$A197
Total costs for all services, mean (SD)	\$A12363 (\$A4967)	\$A12323 (\$A7404)	0.85	–\$A41
Midwife and obstetrician staff costs only				
Caseload midwife salary cost, mean (SD)	\$A3414	–	n/a	\$A3414
Hospital midwife staff costs (excluding caseload midwives), mean (SD)	\$A2877 (\$A1619)	\$A5627 (\$A4670)	<0.001	–\$A2749
Obstetric staff costs, mean (SD)	\$A521 (\$A245)	\$A561 (\$A251)	<0.001	–\$A41
Total, mean (SD)	\$A6812 (\$A1721)	\$A6188 (\$A4734)	<0.001	\$A624

\*Mean cost across all women in each group.  
NICU, neonatal intensive care unit; SCN, special care nursery.

(\$A2993 vs \$A3239;  $p < 0.001$ ) and baby (\$A3731 vs \$A4154;  $p < 0.001$ ). Women receiving caseload care had \$A0 for postnatal costs after discharge as these costs were included in caseload midwife salary costs. There was no significant difference in overall costs between women allocated to the caseload group compared with women allocated to standard care (\$A12 363 vs \$A12,323;  $p=0.85$ ) (table 3). There was also no significant difference in costs per woman for public hospitals for women receiving shared care (with a GP), and women receiving caseload midwifery (online supplemental appendix 3). In the

scenario analysis where women received intrapartum care from their caseload or back-up midwife *and* the rostered hospital midwives as well, costs were \$A1971 higher for women receiving caseload midwifery (online supplemental appendix 4).

Expenditure by public funders on midwife antenatal outpatient episodes (\$A1380 vs \$A1260;  $p < 0.001$ ) and obstetrician antenatal outpatient episodes (\$A597 vs \$A583;  $p=0.01$ ) was higher for women receiving caseload midwifery care compared with women receiving standard care (table 4). In contrast, expenditure by public

**Table 4** Expenditure by public funders per woman

	Caseload	Standard care	P value	Difference
	Mean (SD)	Mean (SD)		
Antenatal health service use				
Outpatient episodes—midwife	\$A1380 (\$A143)	\$A1260 (\$A348)	<0.001	\$A119
Outpatient episodes—obstetrician	\$A597 (\$A126)	\$A583 (\$A119)	0.01	\$A13
Outpatient episodes—general practitioner	n/a no shared care	\$A47 (\$A128)	n/a	–\$A47
Emergency department episodes	\$A408 (\$A551)	\$A426 (\$A584)	0.62	–\$A17
Antenatal expenditure total	\$A2384 (\$A588)	\$A2316 (\$A665)	0.01	\$A68
Labour, birth, postnatal in-hospital service use				
Induction of labour	\$A1676 (\$A2522)	\$A1835 (\$A2583)	0.36	–\$A159
Labour and birth inpatient episodes—mother	\$A7885 (\$A2516)	\$A8234 (\$A2753)	<0.001	–\$A349
Neonatal inpatient episode—baby	\$A4920 (\$A6368)	\$A5193 (\$A10 650)	0.02	–\$A273
Postnatal inpatient episode, prior to discharge	\$A3041 (\$A2509)	\$A3707 (\$A2281)	0.01	–\$A666
Labour, birth, postnatal in-hospital expenditure total	\$A17 521 (\$A8361)	\$A18 967 (\$A11 811)	<0.001	–\$A1447
Postnatal outpatient episode (home visits)	\$A424 (\$A181)	\$A348 (\$A143)	<0.001	\$A76
Total expenditure for all services	\$A20 330 (\$A8312)	\$A21 637 (\$A11 818)	<0.001	–\$A1307

**Table 5** Modelled budget impact analysis of caseload midwifery compared with standard care, assuming 70% uptake rate and 90% adherence

	2023	2024	2025	2026	2027
Australian population of women giving birth	300 680	298 056	298 160	296 603	296 645
Public hospital births	231 532	233 772	233 412	234 828	236 690
Low-risk women (target population)	165 582	166 691	157 457	149 625	144 185
Uptake	104 317	105 015	99 198	94 264	90 837
Standard care					
Costs to public hospitals (A)	\$A1 285 494 201	\$A1 294 103 912	\$A1 222 415 845	\$A1 161 612 191	\$A1 119 378 806
Expenditure by public hospital funders (B)	\$A2 257 099 572	\$A2 272 216 695	\$A2 146 345 179	\$A2 039 584 759	\$A1 965 430 432
Net costs from health system's perspective	\$A3 542 593 774	\$A3 566 320 607	\$A3 368 761 024	\$A3 201 196 950	\$A3 084 809 238
Caseload midwifery					
Costs to public hospitals (A)	\$A1 289 666 868	\$A1 298 304 525	\$A1 226 383 761	\$A1 165 382 741	\$A1 123 012 268
Costs to public hospital funders (B)	\$A2 120 757 698	\$A2 134 961 659	\$A2 016 693 510	\$A1 916 382 038	\$A1 846 707 062
Net costs from health system's perspective	\$A3 410 424 565	\$A3 433 266 184	\$A3 243 077 272	\$A3 081 764 779	\$A2 969 719 329
Savings from caseload midwifery	-\$A132 169 208	-\$A133 054 423	-\$A125 683 752	-\$A119 432 171	-\$A115 089 909

fundes on labour, birth and postnatal inpatient episodes of care was lower for women receiving caseload midwifery care compared with women receiving standard care (\$A17 521 vs \$A18 967;  $p < 0.001$ ). In all, expenditure by public funders was \$A1307 less for women receiving caseload midwifery than women receiving standard care ( $p < 0.001$ ).

The modelled budget impact analysis (table 5) shows the overall cost implications of caseload midwifery compared with standard care for low-risk women in Australia, with hypothetical nationwide implementation. The overall number of eligible women (women of low obstetric risk, giving birth in a public hospital) is expected to initially rise, due to the increasing proportion of women giving birth in public hospitals, and then decline due to the decreasing proportion of women considered to be low obstetric risk. There would be net cost savings of \$A132 million to the public health system in year 1 (2023), and \$A115 million in year 5 (2027). Overall, there would be savings of \$A625 million to the health system over the next 5 years if 70% eligible women had access to caseload midwifery in Australia, with 90% adherence.

## DISCUSSION

### Main findings

Caseload midwifery for women at low obstetric risk was not associated with increased overall costs to public hospitals (\$A12 363 for women receiving caseload; \$A12 323 for women receiving standard care). Caseload midwifery was associated with a reduction in expenditure to public funders of \$A1307 per woman compared with standard care. This was primarily by lower use of epidural, caesarean section, instrumental vaginal birth, fewer special care nursery and neonatal intensive care unit admissions, and shorter length of labour and length of stay post birth for women receiving caseload midwifery compared with standard care. The lower use of these

resources, and thus lower costs to public hospitals, offset the additional staffing costs for midwife and obstetric time. When considered at the national level from a health systems perspective (considering both costs to public hospitals and expenditure by public funders), caseload midwifery is cost saving. If implemented at a national level in Australia, caseload midwifery for low-risk women could save the system \$A625 million over the next 5 years.

### Strengths and limitations

The primary limitation of the study was that it was based on a single site, in an urban setting with strong leadership. This may mean that the findings may be different to those seen with wider implementation. Previous studies from this trial<sup>13</sup> have noted some differences in the characteristics of women participating in the trial compared with the overall population, notably the higher proportion of women who were married or living with their partner, nulliparous women and women born overseas. The key strength of this study is that it is based on results directly collected during an RCT and thus represents a balanced comparison between study groups. Furthermore, the study took a comprehensive approach to cost measurement, capturing both public hospital costs and expenditure by public funders.

### Interpretation

Few studies have assessed the costs of caseload midwifery relative to standard care, and the limited evidence base on costs of caseload midwifery is still considered a barrier to implementation. The M@NGO RCT of all risk women found cost savings to hospital funders associated with the birth event for women receiving caseload midwifery, compared with standard care.<sup>17</sup> A Cochrane review<sup>16</sup> published in 2016 compared midwife-led continuity of care models with other models of care and found a trend towards cost-saving for midwife-led continuity of care models. More recently, an observational study from

Australia comparing the real-world costs of caseload midwifery and standard care demonstrated cost-savings of AU\$A5208 per woman in the caseload model from the public funder's perspective; however, this is related to all-risk women.<sup>27</sup> Two modelling studies have also been conducted—one study from the USA demonstrated that a shift from obstetric-led to midwife-led care could be cost saving for low-risk pregnancies<sup>28</sup> and another Australian study identified that caseload midwifery in low-risk nulliparous women was cost-saving compared with standard care.<sup>29</sup> However, none of these previous studies have considered staffing costs to public hospitals.

Our study also highlighted a number of important factors that need to be considered as a part of implementation to ensure financial sustainability. First, when considering only midwifery staffing costs, caseload midwifery is higher cost than standard care. It is also higher cost when the caseload midwife *and* rostered hospital midwives both provide intrapartum care. Cost savings to public hospitals are seen through a small reduction in obstetric staff time but also through a reduction in costs of anaesthetists for epidurals and caesarean sections, theatre costs for providing caesarean section, SCN and NICU admissions. Thus, for implementation within public hospitals, there would need to be a redistribution of cost savings from other areas into midwifery salary to support the additional midwifery staffing costs required for caseload midwifery. Another crucial finding from this study is that caseload midwifery will result in higher costs to public hospital funders if the number of midwives rostered to birth suite to provide standard care is not proportionately reduced with caseload midwifery.

Our findings that demonstrated substantial cost savings for public hospital funders are also an important consideration for implementation. The cost-saving per woman receiving caseload midwifery to public funders (\$A1307 per woman) is larger than the potential additional staffing costs for midwives incurred by public hospitals (\$A624 per woman). From a policy perspective, public hospital funders (in Australia, state and Federal governments) could fund individual hospitals to support start-up costs of caseload midwifery, given the previously noted need for hospitals to internally redistribute staff savings and reduce birth suite midwives providing standard care. This could still be cost saving to public funders given the reduction in expenditure associated with reduced numbers of caesarean section births, reduction in length of stay in birth suite and postnatal ward, and fewer neonatal admission to special care.

## CONCLUSION

Among low-risk women, caseload midwifery is not associated with increased costs to public hospitals compared with standard care, and significantly reduces costs to public funders. Overall, to health systems, caseload midwifery reduces costs compared with standard care

in low-risk women and could result in substantial cost savings if fully implemented.

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## REFERENCES

- Boerma T, Ronsmans C, Melesse DY, *et al*. Global epidemiology of use of and disparities in caesarean sections. *The Lancet* 2018;392:1341–8.



- 2 Koblinsky M, Moyer CA, Calvert C, *et al.* Quality maternity care for every woman, everywhere: a call to action. *The Lancet* 2016;388:2307–20.
- 3 Callander EJ, Teede H, Enticott J. Value in maternal care: using the learning health system to facilitate action. *Birth* 2022;49:589–94.
- 4 Smith GC, Pell JP, Bobbie R. Caesarean section and risk of unexplained Stillbirth in subsequent pregnancy. *The Lancet* 2003;362:1779–84.
- 5 Sandall J, Tribe RM, Avery L, *et al.* Short-term and long-term effects of caesarean section on the health of women and children. *The Lancet* 2018;392:1349–57.
- 6 The Lancet. Stemming the global caesarean section epidemic. *The Lancet* 2018;392:1279.
- 7 Ockenden D. Independent review of maternity services at shrewsbury and telford hospital NHS trust. 2019.
- 8 Kirkup B. Reading the signals maternity and neonatal services in East Kent – the report of the independent investigation. London; 2022.
- 9 Duncombe G, Weaver E, Sidebotham M, *et al.* Mackay HHS obstetrics and gynaecology investigation report. Mackay: Mackay Hospital and Health Service, 2022.
- 10 Sibley M. Ockenden report: the refusal of our healthcare service to take patient experience seriously. *BMJ* 2022;377:875.
- 11 Thornton J. Ockenden report a 'watershed moment'. *The Lancet* 2022;399:1371.
- 12 de Jonge A, De Vries R, Declercq E. Where the Ockenden report goes wrong: let us keep calm and follow the evidence. *BJOG* 2023;130:11–4.
- 13 McLachlan H, Forster D, Davey M, *et al.* Effects of continuity of care by a primary midwife (caseload Midwifery) on Caesarean section rates in women of low obstetric risk: the COSMOS randomised controlled trial. *BJOG* 2012;119:1483–92.
- 14 McLachlan H, Forster D, Davey M, *et al.* The effect of primary midwife-Led care on women's experience of childbirth: results from the COSMOS randomised controlled trial. *BJOG* 2016;123:465–74.
- 15 Forster DA, McLachlan HL, Davey MA, *et al.* Continuity of care by a primary midwife (caseload midwifery) increases women's satisfaction with antenatal, Intrapartum and postpartum care: results from the COSMOS randomised controlled trial. *BMC Pregnancy Childbirth* 2016;16:28.
- 16 Sandall J, Soltani H, Gates S, *et al.* Midwife-Led continuity models versus other models of care for childbearing women. *Cochrane Database Syst Rev* 2013;2016.
- 17 Tracy S, Hartz D, Tracy M, *et al.* Caseload Midwifery care for women of all risk compared to standard hospital care: a randomized controlled Trial. (Midwives@ new group practice options: M@ NGO trial). *Lancet* 2013;382:1723–32.
- 18 Dawson K, McLachlan H, Newton M, *et al.* Implementing caseload Midwifery: exploring the views of maternity managers in Australia - a national cross-sectional survey. *Women Birth* 2016;29:214–22.
- 19 Organisation for Economic Development and Cooperation (OECD). Health at a Glance. New York: OECD, 2019.
- 20 Australian Institute of Health and Welfare. Mothers and Babies. Canberra: AIHW, 2020.
- 21 Betran AP, Ye J, Moller A-B, *et al.* Trends and projections of caesarean section rates: global and regional estimates. *BMJ Glob Health* 2021;6:e005671.
- 22 Fox H, Topp SM, Callander E, *et al.* A review of the impact of financing mechanisms on maternal health care in Australia. *BMC Public Health* 2019;19:1540.
- 23 Independent Hospital Pricing Authority (IHPA). Pricing Framework for Australian Public Hospital Services 2021–22. Sydney, Australia: IHPA, 2021.
- 24 McLachlan HL, Forster DA, Davey M-A, *et al.* COSMOS: comparing standard maternity care with one-to-one midwifery support: a randomised controlled trial. *BMC Pregnancy Childbirth* 2008;8:35.
- 25 National Efficient Price Determination 2022/23. Independent Hospital Pricing Authority. Sydney: IHPA, 2022.
- 26 Reserve Bank of Australia. Inflation Calculator. Sydney: RBA, 2021.
- 27 Callander EJ, Slavin V, Gamble J, *et al.* Cost-effectiveness of public caseload midwifery compared to standard care in an Australian setting: a pragmatic analysis to inform service delivery. *Int J Qual Health Care* 2021;33.
- 28 Attanasio LB, Alarid-Escudero F, Kozhimannil KB. Midwife-led care and obstetrician-led care for low-risk pregnancies: a cost comparison. *Birth* 2020;47:57–66.
- 29 Callander EJ, Creedy DK, Gamble J, *et al.* Reducing caesarean delivery: an economic evaluation of routine induction of labour at 39 weeks in low-risk nulliparous women. *Paediatr Perinat Epidemiol* 2020;34:3–11.



## SUPPLEMENTARY MATERIAL

### *Continuity of care by a primary midwife (caseload midwifery): A cost analysis using results from the COSMOS randomised controlled trial*

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## Appendix 1: Measurement and valuation of resources

### Public hospital costs

For women receiving caseload midwifery care, a single cost per woman was assigned for the caseload midwife's time to cover the costs of antenatal, intrapartum and postnatal care provided by this midwife (Appendix Table 1). This was calculated as an annual caseload midwife salary, taken from hospital payroll records, divided by 45 women in the caseload.

For women receiving antenatal care and standard care, antenatal visits occurred per the following schedule:

Visit	Provider
Booking clinic	Midwife and obstetric consultant/registrar
22 week consultation	Midwife (GP for women receiving shared care)
28 week consultation	Midwife
32 week consultation	Midwife (GP for women receiving shared care)
34 week consultation	Midwife (GP for women receiving shared care)
36 week consultation	Obstetric consultant/registrar
38 week consultation	Midwife (GP for women receiving shared care)
39/40 week consultation	Midwife (GP for women receiving shared care)
41 week consultation	Obstetric consultant/registrar

The average duration of each antenatal appointment was recorded as a part of trial data collection. Midwife and obstetrician salary time was multiplied by the length of each appointment and who the care provider was. No costs to public hospitals were incurred for GP appointments. For women receiving caseload midwifery, the antenatal care consultations with a midwife were provided by the caseload midwife, with additional costs for obstetric consultant/registrar (Appendix Table 1.1). For women in the standard care arm, the costs of each antenatal consultation is outlined in Appendix Table 1.2 (below).

For women in both arms of the study, emergency department presentations during the antenatal time period was identified based upon self-reported data. Costs were assigned based upon the Independent Hospital Pricing Authority National Hospital Cost Data Collection (NHCDC) Round 24,[1] and the mean costs to hospitals for pregnancy-related emergency department presentations. Induction of labour and epidural use by women was identified based upon hospital records. Costs of induction of labour was assumed to be staff time and consumables, and costs of epidural covered staff time and consumables.

For women in the caseload arm who had a vaginal birth, it was assumed that the caseload midwife provided intrapartum care. Additional costs for ward supplies and hotel costs (i.e. accommodation costs) were identified from NHCDC, for disaggregated costs of vaginal birth. In a scenario analysis, the assumption was made that caseload midwives provide intrapartum care in addition to the cost of the birth suite midwives who had to be rostered to provide that care, as per the required ratios, regardless of whether they also provided care to the woman, and this was tested. For women in the standard care arm who had a vaginal birth, the length of labour recorded in hospital records was multiplied by midwife time, and salary costs. Midwife time in birth suite was calculated based upon midwife to woman ratios of two midwives per three women in birth suite[2]. Additional costs for ward supplies and hotel costs were identified from NHCDC, for disaggregated costs of vaginal birth. For women in the caseload arm and standard care arm who had a vaginal birth with forceps or vacuum it was assumed that an obstetric registrar or trainee also attended for 1.5 hours. For women in the caseload arm and standard care arm

who had a caesarean section, additional staff time was identified during the study, and the additional costs for operating room, ward supplies and hotel costs were identified from the NHCDC, for disaggregated costs of caesarean section.

For women in the caseload and standard care arms postnatal ward use was based upon maternal time in hospital from birth to discharge. Costs were based upon midwife time for providing care in postnatal ward, and salary costs. Midwife time in the postnatal ward was calculated based upon midwife to woman ratios of 1:4 in am and pm shifts, and 1:6 in night shifts.[2] It was assumed that core midwifery staff provided the care. For the baby, staff time for the provision of care was based upon the length of admitted time from birth obtained from hospital records, and multiplied by midwife salary to identify costs. For babies admitted to the special care nursery (SCN) or neonatal intensive care unit (NICU), it was assumed that they were admitted to these units for 4.8 days, based upon national average for length of stay identified from the NHCDC. This was then multiplied by nurse staff time, based upon SCN and NICU ratios of 1:2,[2] plus neonatologist time, pathology, critical care, consumables and hotel costs identified from the NHCDC.[1]

For women in the standard care arm, the number of postnatal home visits were identified based upon women's self-reported data at two months postpartum, the length of visit assumed to be 1.5 hours, including travel time and costed based upon midwife salary. For women in the caseload arm, postnatal home visits are provided by caseload midwife and thus included in the caseload midwife cost per woman.

#### Expenditure by public hospital funders

Outpatient episodes were categorised into activities for funding purposes based upon Tier-2 codes and whether the episode was provided by a midwife, or obstetrician. GP-services for women receiving shared care were based upon Medicare Benefits Schedule item numbers. Emergency department episodes were assumed to be presentations for pregnancy related conditions and were categorised as such based upon Australian Emergency Classification Codes. Inpatient episodes were categorised based upon Australian Refined-Diagnostic Related Groups (AR-DRG) codes and if a woman had a caesarean section or vaginal birth.

For women receiving caseload midwifery and standard care, activities were costed the same, with only the type and volume of activities varying between the groups (Appendix Table 1.3, below). Funding for antenatal care followed the standard schedule of antenatal visits, based upon whether the appointment was provided by a midwife, an obstetric consultant/registrar or a GP (for women receiving shared care); the number of visits was dependant on the duration of the pregnancy. Emergency department presentations during the antenatal time period was identified based upon self-reported data, and assigned the cost to funders of the corresponding AECC codes. Induction of labour was assumed to be associated with an obstetrician outpatient consultation, and then an antenatal admission. Epidural use does not have a specific activity code and so did not attract a cost to funders.

Funding for vaginal birth and caesarean section birth was assigned based upon the weighted average of AR-DRG codes relating to type of birth from the NEPD.[3] Funding for the baby was based upon the AR-DRG code assigned to the baby for the birth. If maternal length of stay was longer than 48 hours, then a separate postnatal admission activity was assumed. For domiciliary visits post birth, each home visit was funded as a midwife outpatient activity.

**Appendix Table 1.1: Caseload midwifery – costs to public hospitals**

Resource	Units consumed	Cost per unit
Caseload midwife time	= 1/45 One full-time caseload midwife cares for 45 women per year	\$153,648 Based upon hospital payroll records.
<i>Antenatal care</i>		
Booking clinic – obstetric consultant/registrar	40 minutes All women	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records.
36 week consultation with obstetric consultant/registrar	15 minutes All women whose pregnancy progressed beyond 35 weeks' gestation	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records.
41 week consultation with obstetric consultant/registrar	15 minutes All women whose pregnancy progressed beyond 40 weeks' gestation	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records.
Emergency department use	Use identified self-reported data for each woman at 2 months postpartum	\$736 Cost to public hospitals identified from AECC Code E1420A and B (average) NHCDC
<i>Labour and birth</i>		
Induction of labour	Use of induction identified from hospital records for each woman 20 minutes Obstetric consultant/registrar's time - assumption	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records. Consumables \$80
Epidural	Use of epidural identified from hospital records for each woman	\$301.10  Based on Medicare item number 18226, which covers costs of anaesthetist's time and consumables
Vaginal birth	Identified from hospital records for each woman Maternal length of stay from admission to birth – based on hospital records	Ward supplies - \$294 Hotel costs - \$3.8 per hour Based on NHCDC
Vaginal birth with forceps or vacuum	Identified from hospital records for each woman 1.5 hours Obstetric consultant/registrar's time – assumption  Maternal length of stay post-birth – based on hospital records	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records.  Ward supplies - \$294 Hotel costs post birth - \$3.8 per hour Based on NHCDC
Caesarean section	Identified from hospital records for each woman  2 hours Obstetric registrar's time – based on trial data 1 hour Obstetric resident's time – based on trial data 1 hour paediatrician's time – based on trial data 1 hour anaesthetist's time – based on trial data	Obstetric consultant/registrar: \$210/hour Obstetric resident: \$126/hour Paediatrician: \$210/hour Anaesthetist: \$210/hour Anaesthetic nurse: \$78/hour Scrub nurse: \$78/hour Theatre technician: \$78/hour Recovery nurse: \$78/hour Based upon hospital payroll records.



	<p>1 hour anaesthetic nurse's time – based on trial data  1 hour scrub nurse's time – based on trial data  1.5 hour operating theatre technician's time – based on trial data  1 hour recovery nurse's time – based on trial data</p> <p>Maternal length of stay post-birth – based on hospital records</p>	<p>Operating room costs - \$2,748  Ward supplies - \$402  Hotel costs post birth - \$3.8 per hour  Based on NHCDC</p>
Postnatal ward - mother	<p>Identified from hospital records for each woman  Maternal length of stay post-birth – based on hospital records</p>	<p>Midwife time on postnatal ward, based upon ratio of 1:4 am and pm, 1:6 night</p> <p>Midwife salary: \$78/hour  Based upon hospital payroll records.</p>
Postnatal ward - baby	<p>Identified from hospital records for each baby  Baby's length of stay post-birth – based on hospital records</p>	<p>Midwife time on postnatal ward, based upon ratio of 1:4 am and pm, 1:6 night</p> <p>Midwife salary: \$78/hour  Based upon hospital payroll records.</p>
Special care nursery or neonatal intensive care unit admission	<p>Admission identified from hospital records for each baby  Length of stay assumed to be 4.8 days per average reported in NHCDC</p>	<p>Nurse time based upon ratio of 1:2  Intensive care nurse: \$78/hour  Neonatologist: \$210/hour  Based upon hospital payroll records.</p> <p>Critical care costs - \$2,748  Pathology - \$249  Consumables - \$271  Hotel costs post birth - \$1.9 per hour  Based on NHCDC</p>

**Appendix Table 1.2: Standard care – costs to public hospitals**

Resource	Units consumed	Cost per unit
Booking clinic – midwife and obstetric consultant/registrar	<p>40 minutes – midwife  20 - minutes obstetric consultant/registrar  All women</p>	<p>Midwife: \$78/hour  Obstetric consultant/registrar: \$210/hour  Based upon hospital payroll records.</p>
22 week consultation with midwife	<p>20 minutes - midwife  All women not receiving shared care, whose pregnancy progressed beyond 21 weeks' gestation</p>	<p>Midwife: \$78/hour  Based upon hospital payroll records.</p>
28 week consultation with midwife	<p>20 minutes - midwife  All women whose pregnancy progressed beyond 27 weeks' gestation</p>	<p>Midwife: \$78/hour  Based upon hospital payroll records.</p>
32 week consultation with midwife	<p>20 minutes - midwife  All women not receiving shared care, whose pregnancy progressed beyond 31 weeks' gestation</p>	<p>Midwife: \$78/hour  Based upon hospital payroll records.</p>

34 week consultation with midwife	20 minutes - midwife All women not receiving shared care, whose pregnancy progressed beyond 33 weeks gestation	Midwife: \$78/hour Based upon hospital payroll records.
36 week consultation with obstetric consultant/registrar	15 minutes All women whose pregnancy progressed beyond 35 weeks' gestation	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records.
38 week consultation with midwife	30 minutes - midwife All women not receiving shared care, whose pregnancy progressed beyond 37+6 weeks' gestation	Midwife: \$78/hour Based upon hospital payroll records.
39/40 week consultation with midwife	20 minutes - midwife All women not receiving shared care, whose pregnancy progressed beyond 38 weeks' gestation	Midwife: \$78/hour Based upon hospital payroll records.
41 week consultation with obstetric consultant/registrar	15 minutes All women whose pregnancy progressed beyond 40 weeks' gestation	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records.
Emergency department use	Use identified self-reported data for each woman at 2 months postpartum	\$736 Cost to public hospitals identified from AECC Code E1420A and B (average) NHCDC
<i>Labour and birth</i>		
Induction of labour	Use of induction identified from hospital records for each woman 20 minutes Obstetric consultant/registrar's time – assumption	Obstetric consultant/registrar: \$210/hour Based upon hospital payroll records. Consumables \$80
Epidural	Use of epidural identified from hospital records for each woman	\$301.10 Based on Medicare item number 18226, which covers costs of anaesthetist's time and consumables
Vaginal birth	Identified from hospital records for each woman  Maternal length of time in birth suite based on length of time from admission to labour to birth – based on hospital records  Maternal length of stay post-birth – based on hospital records	Midwife time on birth suite, based upon ratio of 2:3 Midwife salary: \$78/hour Based upon hospital payroll records.  Ward supplies - \$294 Hotel costs post birth - \$3.8 per hour Based on NHCDC
Vaginal birth with forceps or vacuum	Identified from hospital records for each woman 1.5 hours Obstetric consultant/registrar's time – assumption  Maternal length of stay post-birth – based on hospital records	Obstetric consultant/registrar: \$210/hour Midwife salary: \$78/hour Based upon hospital payroll records.  Ward supplies - \$294 Hotel costs post birth - \$3.8 per hour Based on NHCDC
Caesarean section	Identified from hospital records for each woman	Obstetric consultant/registrar: \$210/hour

	<p>2 hours Obstetric registrar's time – based on trial data  1 hour Obstetric resident's time – based on trial data  1 hour paediatrician's time – based on trial data  1 hour anaesthetist's time – based on trial data  1 hour anaesthetic nurse's time – based on trial data  1 hour scrub nurse's time – based on trial data  1.5 hour operating theatre technician's time – based on trial data  1 hour recover nurse's time – based on trial data</p> <p>Maternal length of stay post-birth – based on hospital records</p>	<p>Obstetric resident: \$126/hour  Paediatrician: \$210/hour  Anaesthetist: \$210/hour  Anaesthetic nurse: \$78/hour  Scrub nurse: \$78/hour  Theatre technician: \$78/hour  Recovery nurse: \$78/hour  Based upon hospital payroll records.</p> <p>Operating room costs - \$2,748  Ward supplies - \$402  Hotel costs post birth - \$3.8 per hour  Based on NHDC</p>
Postnatal ward - mother	<p>Identified from hospital records for each woman  Maternal length of stay post-birth – based on hospital records</p>	<p>Midwife time on postnatal ward, based upon ratio of 1:4 am and pm shift, 1:6 night shift</p> <p>Midwife salary: \$77.76/hour  Based upon hospital payroll records.</p>
Postnatal ward - baby	<p>Identified from hospital records for each baby  Baby's length of stay post-birth – based on hospital records</p>	<p>Midwife time on postnatal ward, based upon ratio of 1:4 am and pm shift, 1:6 night shift</p> <p>Midwife salary: \$77.76/hour  Based upon hospital payroll records.</p>
Special care nursery or neonatal intensive care unit admission	<p>Admission identified from hospital records for each baby  Length of stay assumed to be 4.8 days per average reported in NHDC</p>	<p>Nurse time based upon ratio of 1:2  Intensive care nurse: \$78/hour  Neonatologist: \$210/hour  Based upon hospital payroll records.</p> <p>Critical care costs - \$2,748  Pathology - \$249  Consumables - \$271  Hotel costs post birth - \$1.9 per hour  Based on NHDC</p>
<i>Postnatal</i>		
Postnatal home visits	<p>Number of visits based upon women's self-reported data at 2 months</p> <p>Length of visit assumed to be 1.5 hours, including travel time</p>	<p>Midwife salary: \$78/hour  Based upon hospital payroll records.</p>

**Appendix Table 1.3: Expenditure by public funders, based upon health service use activities**

Health service activity	Units consumed	Cost to funders per activity
<i>Antenatal care</i>		
Booking clinic – midwife and obstetric consultant/registrar	Tier 2 code 40.28 Midwifery and Maternity Tier 2 code 20.40 Obstetrics - management of pregnancy without complications	\$205.21 \$265.5 Based upon NEPD
22 week consultation with midwife (GP for women receiving shared care)	Tier 2 code 40.28 Midwifery and Maternity  MBS Item number 16500 and 16591	\$205.21 Based upon the NEPD  \$49.85 \$150.75 Based on Medicare benefits Schedule
28 week consultation with midwife	Tier 2 code 40.28 Midwifery and Maternity	\$205.21 Based upon the NEPD
32 week consultation with midwife (GP for women receiving shared care)	Tier 2 code 40.28 Midwifery and Maternity  MBS Item number 16500	\$205.21 Based upon the NEPD  \$49.85 Based on Medicare benefits Schedule
34 week consultation with midwife (GP for women receiving shared care)	Tier 2 code 40.28 Midwifery and Maternity  MBS Item number 16500	\$205.21 Based upon the NEPD  \$49.85 Based on Medicare benefits Schedule
36 week consultation with obstetric consultant/registrar	Tier 2 code 20.40 Obstetrics - management of pregnancy without complications	\$265.50 Based upon the NEPD
38 week consultation with midwife (GP for women receiving shared care)	Tier 2 code 40.28 Midwifery and Maternity  MBS Item number 16500	\$205.21 Based upon the NEPD  \$49.85 Based on Medicare benefits Schedule
39/40 week consultation with midwife (GP for women receiving shared care)	Tier 2 code 40.28 Midwifery and Maternity  MBS Item number 16500	\$205.21 Based upon the NEPD  \$49.85 Based on Medicare benefits Schedule
41 week consultation with obstetric consultant/registrar	Tier 2 code 20.40 Obstetrics - management of pregnancy without complications	\$265.50 Based upon the NEPD
Emergency Department	AECC Code E1420A and B (average)	\$615.35 Based upon the NEPD
<i>Labour and birth</i>		
Induction of labour	Obstetrician consultation: Tier 2 code 20.40 Obstetrics - management of pregnancy without complications  Antenatal admission: AR-DRG code O66A.	\$265.50  \$5,203.39 Based upon the NEPD
Epidural	-	-



Vaginal birth	Weighted average of AR-DRG codes O60A, O60B, O60C	\$6,655.73 Based upon the NEPD, Round 24
Caesarean section	Weighted average of AR-DRG codes O01A, O01B, O01C	\$13,030.89 Based upon the NEPD, 24
Postnatal ward – mother, if length of stay >48 hours	Weighted average of AR-DRG codes O61A, O61B	\$5,108.61 Based upon the NEPD, Round 24
Postnatal ward - baby	AR-DRG: P03Z P04Z P06A P60A P61Z P62Z P64Z P65B P65C P65D P66A P66B P66C P66D  P67A  P67B  P67C  P67D	\$129,748.45 \$98,240.31 \$121,033.82 \$8,403.33 \$269,055.58 \$187,168.03 \$49,064.94 \$43,771.41 \$35,841.68 \$26,744.46 \$32,750.73 \$21,043.69 \$14,136.56 \$7,159.30  if gestation<37 weeks then \$31,075.98 if gestation>37 weeks then \$17,770.72 if gestation<37 weeks then \$18,282 if gestation>37 weeks then \$7,943.02 if gestation<37 weeks then \$14,914.52 if gestation>37 weeks then \$5,778.45 if gestation<37 weeks then \$9,073.46 if gestation>37 weeks then \$3,927.47  Based upon the NEPD, Round 24
<i>Postnatal</i>		
Postnatal home visits	Tier 2 code 40.28 Midwifery and Maternity	\$205.21 Based upon the NEPD, Round 24

## **Appendix 2: Budget Impact Analysis additional methodological details**

To identify the size of the future eligible population, data were drawn from the *Queensland Perinatal Data Collection* (PDC), containing all pregnancies and births (n=365,138) between 01/07/2012 and 30/06/2018 in Queensland (QLD), Australia.[4] The PDC contains the details of all births regardless of location (private hospital, public hospital), information on maternal demographics, maternal clinical characteristics, medical interventions performed in pregnancy and childbirth, and infant outcomes. This was considered the most current source of whole of population, individual level data containing obstetric risk status of women, which was required to identify eligibility for caseload midwifery.

We reweighted the data of births over 20 weeks' gestation between 01/07/2013 and 30/06/2018 (n=302,169) to reflect the Australian population of women giving birth between 01/01/2023 and 31/12/2027. Reweighting was conducted using GREGWT, a generalised regression reweighting algorithm developed by the Australian Bureau of Statistics (ABS).[5] Weighting was conducted using national benchmarks for mother's age by First Nations identification, private hospital births, mother's age by parity, and age by caesarean section using data from the Australian Institute of Health and Welfare's (AIHW) Mothers and Babies 2012 - 2020 reports.[6] Linear trends were fitted to extrapolate benchmarking figures between 2023 and 2027.

**Appendix 3: Comparison of costs to public hospitals and public funders for caseload midwifery, standard care and shared care.**

**Appendix Table 3.1 Costs to public hospitals per woman – Caseload midwifery, Standard Care, Shared Care**

	<b>Caseload</b>	<b>Control</b>	
		<b>Standard care</b>	<b>Shared care</b>
		n=1,146	n=1,151
Caseload midwife salary cost	\$3,414	-	-
Antenatal visits (non-caseload midwife, obstetrician), mean (SD)	\$214 (\$55)	\$337 (\$30)	\$166 (\$17)
Emergency department presentations*, mean (SD)	\$487 (\$659)	\$528 (\$718)	\$369 (\$524)
Induction*, mean (SD)	\$35 (\$53)	\$40 (\$55)	\$38 (\$54)
Epidural*, mean (SD)	\$94 (\$139)	\$113 (\$146)	\$97 (\$141)
Birth Suite, mean (SD)	\$1,376 (\$1,694)	\$3,665 (\$3,899)	\$4,184 (\$9,141)
Postnatal (ward, SCN or NICU) - baby, mean (SD)	\$3,731 (\$2,557)	\$4,202 (\$2,142)	\$4,075 (\$3,401)
Postnatal ward - mother, mean (SD)	\$2,993 (\$1,619)	\$3,242 (\$1,285)	\$3,217 (\$1,318)
Postnatal costs, after to discharge (home visits), mean (SD)	n/a included in caseload midwife salary cost	\$198 (\$77)	\$195 (\$110)
<b>Total costs for all services, mean (SD)</b>	\$12,363 (\$4,967)	\$12,320 (\$6,299)	\$12,341 (\$12,801)

**Grey shaded cells indicate statistically significant difference with caseload**



Appendix Table 3.2: Expenditure by public funders per woman – Caseload midwifery, Standard Care, Shared Care

	Caseload		Control			
			Standard care		Shared care	
	Mean	SD	Mean	SD	Mean	SD
<i>Antenatal health service use</i>						
Outpatient episodes - Midwife	\$1,379.71	\$142.91	\$1,378.97	\$151.47	\$410.42	\$0.00
Outpatient episodes - Obstetrician	\$596.80	\$126.42	\$580.95	\$117.09	\$600.67	\$129.47
Outpatient episodes - General Practitioner	\$0.00	\$0.00	\$0.00	\$0.00	\$387.63	\$34.31
Emergency department episodes	\$407.40	\$550.78	\$441.07	\$600.39	\$308.85	\$438.44
<b>Antenatal costs TOTAL</b>	\$2,383.95	\$588.31	\$2,401.37	\$644.20	\$1,707.57	\$469.52
<i>Labour, birth, postnatal in-hospital service use</i>						
Induction of labour	\$7,885.15	\$2,516.30	\$8,208.49	\$2,737.78	\$8,419.07	\$2,861.87
Labour and birth inpatient episodes - mother	\$1,675.03	\$2,521.98	\$1,846.43	\$2,587.52	\$1,745.39	\$2,558.39
Neonatal inpatient episode - baby	\$4,920.13	\$6,367.80	\$5,178.16	\$10,900.87	\$5,296.50	\$8,673.57
Postnatal inpatient episode, prior to discharge	\$3,040.20	\$2,508.76	\$3,722.71	\$2,272.54	\$3,586.90	\$2,344.61
<b>Labour, birth, postnatal in-hospital costs TOTAL</b>	\$17,520.51	\$8,360.82	\$18,955.79	\$11,982.59	\$19,047.86	\$10,541.75
<b>Postnatal outpatient episode (home visits)</b>	\$410.42	\$0.00	\$410.42	\$0.00	\$410.42	\$0.00
<b>Total costs for all services</b>	\$20,320.51	\$8,333.33	\$21,774.43	\$12,006.87	\$21,165.85	\$10,452.46

Grey shaded cells indicate statistically significant difference with caseload

**Appendix 4:****Appendix Table 4.1 : Costs to public hospitals in the scenario analysis where caseload midwives are not included in birth suite ratios (i.e. their time in birth suite is an additional cost)**

	<b>Caseload</b>	<b>Standard care</b>	<b>p-value</b>	<b>Difference</b>
	n=1,146	n=1,151		
Caseload midwife salary cost	\$3,414	-	n/a	\$3,414
Antenatal visits (non-caseload midwife, obstetrician), mean (SD)	\$214 (\$55)	\$316 (\$63)	<0.001	-\$102
Emergency department presentations*, mean (SD)	\$487 (\$659)	\$508 (\$699)	0.29	-\$21
Induction*, mean (SD)	\$35 (\$53)	\$39 (\$55)	0.22	-\$4
Epidural*, mean (SD)	\$94 (\$139)	\$110 (\$145)	0.04	-\$16
Birth Suite, mean (SD)	\$3,306 (\$5,145)	\$3,729 (\$4,855)	<0.001	-\$423
Postnatal (ward, SCN or NICU) - baby, mean (SD)	\$3,731 (\$2,557)	\$4,154 (\$2,263)	<0.001	-\$423
Postnatal ward - mother, mean (SD)	\$2,993 (\$1,619)	\$3,239 (\$1,289)	<0.001	-\$246
Postnatal costs, after to discharge (home visits), mean (SD)	n/a included in caseload midwife salary cost	\$198 (\$81)	n/a	-\$197
<b>Total costs for all services, mean (SD)</b>	<b>\$14,294 (\$8,120)</b>	<b>\$12,323 (\$7,404)</b>	<b>&lt;0.001</b>	<b>\$1,971</b>
<b>Midwife and obstetrician staff costs only</b>				
Caseload midwife salary cost, mean (SD)	\$3,414	-	n/a	\$3,414
Hospital Midwife Staff Costs (ex Caseload Midwives), mean (SD)	\$4,829 (\$5,104)	\$5,627 (\$4,670)	<0.001	-\$798
Obstetric Staff Costs, mean (SD)	\$521 (\$245)	\$561 (\$251)	<0.001	-\$41
<b>Total, mean (SD)</b>	<b>\$8,764 (\$5,168)</b>	<b>\$6,188 (\$4,734)</b>	<b>&lt;0.001</b>	<b>\$2,576</b>

### Appendix References

1. Independent Hospital Pricing Authority. National Hospital Cost Data Collection, Round 24 (2019-20). Sydney: IHPA; 2022.
2. Nursing A, Federation M. Nurse/midwife: patient ratios. It's a matter of saving lives. 2016.
3. Independent Hospital Pricing Authority. National Efficient Price Determination 2022/23. Sydney: IHPA; 2022.
4. Callander EJ, Fox H. What are the costs associated with child and maternal healthcare within Australia? A study protocol. *BMJ Open*. 2018;8(2):e017816.
5. Bell P. GREGWT and TABLE macros – users guide. Canberra: Australian Bureau of Statistics (ABS); 2000.
6. Australian Institute of Health & Welfare. Australia's mothers and babies 2017—in brief. Canberra: AIHW; 2019. Report No.: 978-1-76054-553-6 Contract No.: Perinatal statistics series no. 35 Cat no. PER 100.

## CHEERS 2022 Checklist

Topic	No.	Item	Location where item is reported
<b>Title</b>			
	1	Identify the study as an economic evaluation and specify the interventions being compared.	Title
<b>Abstract</b>			
	2	Provide a structured summary that highlights context, key methods, results, and alternative analyses.	Abstract
<b>Introduction</b>			
<b>Background and objectives</b>	3	Give the context for the study, the study question, and its practical relevance for decision making in policy or practice.	Introduction, paragraphs 1-4
<b>Methods</b>			
<b>Health economic analysis plan</b>	4	Indicate whether a health economic analysis plan was developed and where available.	Not reported
<b>Study population</b>	5	Describe characteristics of the study population (such as age range, demographics, socioeconomic, or clinical characteristics).	Methods, Study population; Table 1
<b>Setting and location</b>	6	Provide relevant contextual information that may influence findings.	Methods, Study setting and location, paragraphs 1-2.
<b>Comparators</b>	7	Describe the interventions or strategies being compared and why chosen.	Methods, Comparators
<b>Perspective</b>	8	State the perspective(s) adopted by the study and why chosen.	Methods, Study Design - cost analysis, Measurement and valuation of resources
<b>Time horizon</b>	9	State the time horizon for the study and why appropriate.	Methods, Study Design - cost analysis, Time horizon, discount rate
<b>Discount rate</b>	10	Report the discount rate(s) and reason chosen.	Methods, Study Design - cost analysis, Time horizon, discount rate

Topic	No.	Item	Location where item is reported
<b>Selection of outcomes</b>	11	Describe what outcomes were used as the measure(s) of benefit(s) and harm(s).	Not applicable
<b>Measurement of outcomes</b>	12	Describe how outcomes used to capture benefit(s) and harm(s) were measured.	Not applicable
<b>Valuation of outcomes</b>	13	Describe the population and methods used to measure and value outcomes.	Not applicable
<b>Measurement and valuation of resources and costs</b>	14	Describe how costs were valued.	Methods, Study Design - cost analysis, Measurement and valuation of resources
<b>Currency, price date, and conversion</b>	15	Report the dates of the estimated resource quantities and unit costs, plus the currency and year of conversion.	Methods, Study Design - cost analysis, currency, price date and conversion
<b>Rationale and description of model</b>	16	If modelling is used, describe in detail and why used. Report if the model is publicly available and where it can be accessed.	Methods, Study Design - budget impact analysis
<b>Analytics and assumptions</b>	17	Describe any methods for analysing or statistically transforming data, any extrapolation methods, and approaches for validating any model used.	Appendix 2
<b>Characterising heterogeneity</b>	18	Describe any methods used for estimating how the results of the study vary for subgroups.	Methods, Data analysis; Appendix 3
<b>Characterising distributional effects</b>	19	Describe how impacts are distributed across different individuals or adjustments made to reflect priority populations.	Not reported
<b>Characterising uncertainty</b>	20	Describe methods to characterise any sources of uncertainty in the analysis.	Results, Paragraph 3; Appendix 4
<b>Approach to engagement with patients and others affected by the study</b>	21	Describe any approaches to engage patients or service recipients, the general public, communities, or stakeholders (such as clinicians or payers) in the design of the study.	Page 15, Patient and public involvement
<b>Results</b>			
<b>Study parameters</b>	22	Report all analytic inputs (such as values, ranges, references) including uncertainty or distributional assumptions.	Appendix 1 & Appendix 2

Topic	No.	Item	Location where item is reported
<b>Summary of main results</b>	23	Report the mean values for the main categories of costs and outcomes of interest and summarise them in the most appropriate overall measure.	Table 3 and Table 4
<b>Effect of uncertainty</b>	24	Describe how uncertainty about analytic judgments, inputs, or projections affect findings. Report the effect of choice of discount rate and time horizon, if applicable.	Results, paragraph 3, Appendix 3 & Appendix 4
<b>Effect of engagement with patients and others affected by the study</b>	25	Report on any difference patient/service recipient, general public, community, or stakeholder involvement made to the approach or findings of the study	Not reported
<b>Discussion</b>			
<b>Study findings, limitations, generalisability, and current knowledge</b>	26	Report key findings, limitations, ethical or equity considerations not captured, and how these could affect patients, policy, or practice.	Discussion section
<b>Other relevant information</b>			
<b>Source of funding</b>	27	Describe how the study was funded and any role of the funder in the identification, design, conduct, and reporting of the analysis	Page 3, Funding
<b>Conflicts of interest</b>	28	Report authors conflicts of interest according to journal or International Committee of Medical Journal Editors requirements.	Page 15, Competing Interests

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