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The cost of vaginal birth at home, in a birth centre or in a hospital setting in New South Wales: A micro-costing study

<p>Problem or issue</p> <p>Anecdotally, it is often perceived by health services that giving birth at home or in a birth centre is more expensive than being in a hospital for women with a healthy pregnancy.</p>
<p>What is already known</p> <p>Availability of home and birth centre options for women in NSW, Australia, is limited.</p> <p>International and national studies have shown that birth at home or in a birth centre is a cost-effective option for women with a healthy pregnancy. This is largely due to the lower intervention rates and higher spontaneous birth rates in these women. Interventions are a strong driver of costs in maternity care.</p>
<p>What this paper adds</p> <p>This paper reports the costs of providing care to women with a healthy pregnancy who plan to give birth at home, in a birth centre or in a hospital setting and have a vaginal birth. Midwifery time confers the highest proportion of the cost of homebirth however this is offset by the uncomplicated vaginal birth rate as overhead costs are not included in a homebirth.</p>

Abstract

Background

Women want greater choice of place of birth in New South Wales, Australia. It is perceived to be more costly to health services for women with a healthy pregnancy to give birth at home or in a birth centre. It is not known how much it costs the health service to provide care for women planning to give birth in these settings.

Aim

The aim of this study was to determine the direct cost of giving birth vaginally at home, in a birth centre or in a hospital for women at low risk of complications, in New South Wales.

Methods

A micro-costing design was used. Observational (time and motion) and resource use data collection was undertaken to identify the staff time and resources required to provide care in a public hospital, birth centre or at home for women with a healthy pregnancy.

Findings

The median cost of providing care for women who plan to give birth at home, in a birth centre and in a hospital were similar (AUD \$2150.07, \$2100.59 and \$2097.30 respectively). Midwifery time was the largest contributor to the cost of birth at home, and overhead costs accounted for over half of the total cost of BC and hospital birth. The cost of consumables was low in all three settings.

Conclusion

In this study, we have found there is little difference in the cost to the health service when a woman has an uncomplicated vaginal birth at home, in a birth centre or in a hospital setting.

Keywords

Homebirth; birth centre; micro-costing; vaginal birth

Introduction

Along with safety, the economic implications of giving birth at home or in a birth centre have been the subject of research in high income countries for some time ¹. In Australia, maternity services are the third most common service and 'single spontaneous delivery' is the most common principal diagnosis for admissions to hospital ². Women in New South Wales (NSW) have available to them three settings for birth: Home, birth centre and hospital, however home and birth centre settings are not universally available across the state. Homebirth can be accessed through a publically funded homebirth model attached to a public hospital (there are four such services in NSW) or through privately practising midwives where the cost is borne by the individual women. Birth centres are either co-located on a hospital campus, usually as a separate area within the hospital birth suite (alongside birth centres), or located in a separate building on the grounds of a hospital which does not provide obstetric or neonatal services (freestanding birth centres). There are currently five alongside and five freestanding birth centres in NSW. Birth centres are staffed by midwives and are all publicly funded in NSW.

While the majority of women (96.6%) give birth in a hospital birth suite (also referred to as a labour ward, delivery suite, birth unit), a small proportion of women plan birth in a birth centre (2.2%) and 0.2% plan to give birth at home ³. The demand for greater choice of place of birth is increasing ⁴⁻⁶, which was supported by the National Maternity Services Plan released in 2010 ⁷. Strengthening the evidence on the cost savings of providing homebirth and birth centre options for women with a healthy pregnancy may assist health service managers to re-think how they provide out-of-hospital birthing services and therefore to assist further reform in the health system ⁸⁻¹⁰.

Economic evaluations are a means to give guidance to health service providers and planners, providing evidence on the actual or modelled costs of service provision ¹¹. Economic evaluations of health related services and interventions draw from many data sources including clinical outcomes, interventions, resource use and financial expenditure. We undertook a micro-costing study, where

actual staff time and resources were observed and recorded to estimate the cost of having a vaginal birth at home, in a birth centre or, in a hospital. We chose to examine the costs of vaginal birth only as a means to compare like with like across settings.

Micro-costing studies

Micro-costing studies involve gathering information on the quantity and value of resources used in the delivery of a health service or procedure^{12,13}, in this case the provision of maternity care in three different settings. This method of data collection also characterises a ‘bottom-up’ approach. Micro-costing studies directly measure resource use by observation (time and motion, for example), activity logs and survey style data collection tools^{14,15}. These cost components are then valued and by assigning a cost for the direct resource use associated with patient care result in an estimation of costs specific to patient care¹⁶.

Time and motion data collection

Time and motion (or time-motion) studies have been used to gather information on clinical workflow, staff time and resource use in health settings, providing important information for service management and clinical research¹⁷. Time and motion studies can be used to measure productivity and the drivers of inefficiency in health care settings¹⁸. Intensive care units (ICU) have been the subject of time and motion studies to provide clarity around activity and workload of nurses in this setting¹⁹ as well as evaluating the introduction of a clinical management plan²⁰. Time and motion techniques use an observer to follow or ‘shadow’ staff over a period of time and their actions are recorded on a data collection tool²¹. While it is usually only feasible to involve a small sample of participants as this method is time-consuming, it has the potential to collect a large amount of data¹⁹. ICUs are not dissimilar to maternity settings in that the challenges presented by the patients (and women in the case of hospital birth) can be complex and rapidly changeable and much of the care is delivered one to one. Our study employed an observational time and motion technique to collect

resource use data, including staff time and resources such as consumables to estimate the cost of giving birth at home, in a birth centre or in a hospital.

Costing studies in maternity settings

Few studies have applied micro-costing methods in the maternity setting. Schroeder et al. conducted a micro-costing study in an inner city area of London comparing the cost of a birth in a freestanding midwifery unit and an obstetric unit²². They collected data from the clinical notes of 'low risk' women relating to resource use such as admission time, interventions, consumables and birth outcomes. This study found an £850 cost saving for women planning birth in a midwife-led birth centre compared to women in the obstetric unit²². A cost-effectiveness study in Ireland combined both 'bottom-up' and 'top-down' methods to evaluate the cost of trial of labour after caesarean versus elective repeat caesarean section²³. Rather than using prospective or observational data for the bottom-up component, Fawsitt et al. (2013) developed an inventory listing all resources used during various procedures and modes of delivery. This inventory was developed in collaboration with a group of clinicians including a midwifery manager, consultant obstetrician and health economist. Costs were applied to a hypothetical model derived from literature and they found unassisted vaginal birth was found to be the most cost-effective (€627.94), followed by vacuum assisted birth (€1637.09). Emergency caesarean section was the most costly mode of birth (€4423.39) and elective caesarean section was marginally less costly at €4095.01.

A multi-centre prospective non-randomised study in The Netherlands compared the cost of giving birth at home or in a short-stay hospital setting for two groups of nulliparous women²⁴. Data were collected from different sources, including cost diaries, questionnaires and birth registration data. The women involved in the study recorded their contact with a healthcare provider and any medication used in the cost diaries. The questionnaires collected demographic and birth preference information in the first instance, and a second and third questionnaire collected information on other costs incurred during the pregnancy and details on transportation required during the birth

and immediate postnatal period. The cost of giving birth at home was calculated at €3695 and €3950 for those women giving birth in the short-stay hospital unit. The increase in costs were found to be associated with travel and hospital admission ²⁴.

The goal of our study was to examine the comparative costs across the three publicly funded health settings using only women who gave birth vaginally in their planned place of birth. The aim of this study therefore was to determine the direct cost of giving birth vaginally at home, in a birth centre or in a hospital for women at low risk of complications, in NSW.

Methods

Design

A micro-costing design was utilised through observation (time and motion) and resource use data collection using a specifically developed data collection form. This study identified the staff time and resources required to provide care in a public hospital, birth centre or at home for healthy women at low risk of complications. All costs are presented in Australian dollars (AUD). Costs data were collected on women with uncomplicated vaginal births completed in the woman's planned birth place, ie. Home, birth centre or hospital. An uncomplicated vaginal birth comprises no labour intervention, no transfer from intended place of birth, spontaneous vaginal birth, and a complete third stage. The total cost to the health service includes antenatal consultations (reported to be one hour in duration for a homebirth, 30 minutes for a birth centre birth and 15 minutes for a planned hospital birth), travel to and from each antenatal appointment when conducted at the women's home, length of care in labour by the primary and secondary midwives, hospital overheads and the cost of consumables. This paper follows the structure of the Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement ²⁵ where applicable.

Ethical approval was obtained from the NSW Population and Health Services Research Ethics Committee (Ref: 2014/02/515) and site specific approval was granted by the Local Health District involved in the data collection.

The setting was a local health district (LHD) in New South Wales, which offers a publicly funded homebirth service, a freestanding, and alongside birth centre and hospital birth services. The homebirth service operates out of the freestanding birth centre in the same LHD and has around 70 homebirths and 75 freestanding birth centre births per year. The alongside birth centre and hospital birth suite are located in a large, tertiary referral hospital which has around 200 and 4000 births per year respectively. The study is from the perspective of the health system.

Observational data collection

Identification of resources- Homebirth:

A specifically designed data collection form, similar to an activity log, was developed and piloted with a group of privately practising midwives in the Sydney Metropolitan area (Supplementary file 1). The first component of the form consisted of questions regarding the time spent with women during the antenatal period including travel and telephone contact. The next section had a table of equipment required to provide birth care for women at home. The midwives were asked to complete this data collection form retrospectively and prospectively and return it with feedback on its accuracy and efficacy. The midwives agreed that the form contained all the items of equipment and consumables they regularly used at a homebirth and suggested to include additional items such as administrative time.

The same data collection form was given to a group of midwives who were employed in a publicly funded homebirth program. These midwives completed the form both retrospectively and prospectively. When the data was collated and medians were calculated, a focus group was held with the midwives from the publicly funded homebirth program to validate the findings.

Identification of resources - Birth centre and hospital setting:

Data were collected between the months of November 2017 and February 2018. This service consists of an alongside birth centre and hospital birth suite where the two areas are separated by a corridor. Due to this, data for these two settings were collected concurrently, depending on the activity on the day. The researcher was situated outside the room in either the hospital birth suite or the birth centre. A standardised resource data collection tool (Supplementary file 2) was developed to record observational data including the time staff members spent in the room and an inventory of consumables/equipment used, as well as information on unit activity and staffing, details of the woman's medical and pregnancy history and discharge details. Each staff member who entered the birth room was identified on the resource survey by a single column labelled with their role (e.g. midwife, obstetric registrar, obstetrician etc.). This preserved the privacy of the women and removed the element of scrutiny on the activities of the midwives when they were behind the closed door.

The total time spent by the women in the birth suite or birth centre was calculated by noting the time the woman was transferred home or to the postnatal ward. The time and date of discharge was used to calculate the length of stay in the postnatal ward. Discharge data were collected from eMaternity, the hospital database used to record the birth admission, which is completed at the point of care by the midwives in the birth settings.

Following the collation and analysis of the data collected on this form, midwives who work in the birth centre and midwives who work in the birth suite attended a focus group to validate the data collected and provide insights into the time spent during antenatal appointments and any other items used routinely during birth that may have been overlooked. The midwifery managers of both services were also contacted to discuss the duration of antenatal appointments and staffing levels.

Participants

The population of interest consisted of women with the following characteristics: Healthy pregnancy with no medical or obstetric complications at the start of care in labour; spontaneous

onset of labour; planned birth in the birth centre or hospital birth suite; singleton pregnancy with a cephalic (head down) presentation; both nulliparous (no previous births greater than 20 weeks gestation) and multiparous (one or more births greater than 20 weeks gestation). Observations were of the midwives and other hospital staff including medical, nursing and ancillary staff.

The women were selected using a convenience sample. The midwives attending homebirths were asked to complete the data collection form for the last five homebirths they attended (retrospective) and the next five homebirths they attend (prospective). The data collected in the birth centre and hospital settings were collected over a period of three months. Midwives at all three settings attended in-service education on the research project and were familiarised with the data collection forms. Regular communication between the hospital staff and the researcher enabled timely arrival at the hospital or birth centre setting to commence data collection at a time that was convenient to both the staff and the researcher. If a second eligible woman was in labour at the same time, data was collected on her also.

Estimating resource use and costs – sources of unit costs and prices

Table 1 describes what costs were identified and where the costs were derived from.

Table 1: Resources identified and costing sources used.

Resource identified	Costing source
Staff time (observation): Midwifery and nursing Junior medical officers Registrar medical officers Consultant medical officers	State awards indicating salary arrangements. Hospital based Human Resource department consulted on salary on-costs. ^a
Consumables (Observation)	Hospital based equipment pricing lists * Pharmacy pricing lists
Accommodation and overhead costs AR-DRGs	National Hospital Cost Data Collection Australian Public Hospitals Cost Report 2015-2016

* Information on salary on-costs and hospital stock items was obtained from the hospital involved in the observational data collection.

Analytical methods

Staff time was calculated, and hourly rates were applied according to the NSW Public health System’s Nurses and Midwives (state) award (2018) for the midwives who were involved in the care of the women and the Public Hospital Medical Officers (State) Award (2018) for the medical staff. Staff employed in the public sector are remunerated according to an incremental pay structure based on years of service and level of education. Following discussions with maternity unit managers, assumptions were made regarding the level of experience of the staff in the different settings and hourly rates of pay were allocated according to these levels. Staff hourly rates are represented in Table 2 and were calculated by adding hospital on costs (28%) and the annualised shift loading (29%) and was divided by 38 hours to obtain a gross hourly rate. The health service involved in the data collection employs midwives in the homebirth service at a Clinical Midwifery Specialist level so cost calculations for the publicly funded homebirth service were calculated with this hourly rate. This salary level is not necessarily adopted at all services of this type so costs were calculated using the ‘8th year thereafter’ and ‘5th year’ hourly rates as a comparison.

Table 2: Staff salaries calculated with loadings

Staff member	Weekly award rate \$	Annualised shift loading	Shift loading \$	On cost	On cost \$	Weekly total \$	Hourly rate (/38)
Midwife 8th thereafter	1685.10	0.29	488.68	0.28	470.14	2643.92	69.58
Midwife 5th year	1470.20	0.29	426.36	0.28	410.19	2306.74	60.70
Resident MO 3rd year	1901.50	0.29	551.44	0.28	530.52	2983.45	78.51
Registrar MO 3rd year	2227.73	0.29	646.04	0.28	621.54	3495.31	91.98
Specialist/consultant SNR	4325.71	0.29	1254.46	0.28	1206.87	6787.04	178.61
Neonatal registrar	2227.73	0.29	646.04	0.28	621.54	3495.31	91.98
Anaesthetic registrar	2227.73	0.29	646.04	0.28	621.54	3495.31	91.98

Fixed costs (hospital overheads, administrative staff costs, etc) were derived from the Independent Hospital Pricing Authority (IHPA) cost weights Australian Refined Diagnosis Related Groups (AR-DRG) 2015-2016 ²⁶. AR-DRGs represent classes of patients with similar clinical conditions who needed similar hospital services. These are displayed as codes within major diagnostic categories (MDCs) and are calculated to represent the cost of an average stay with the attributed condition. AR-DRGs contain costs of an average length of stay dependent on the level of intervention and are rated by the severity of the complications and thus the resource consumption (A being the highest severity and C being the lowest in this case). Overhead costs associated with AR-DRG 'O60C' were added to the calculation of an uncomplicated vaginal birth for the women who gave birth in the birth centre and hospital setting.

Table 3: AR-DRG definitions[#]

AR-DRG code	Definition	Cost AUD
O60C	Vaginal delivery (minimal complications, singleton) - including women who had no intervention, or received any of the following: induction or augmentation of labour, epidural analgesia, narcotic pain relief, and/or minor perineal trauma.	\$4289

[#]Australian Refined Diagnosis Related Groups Version 5.2 Definitions Manual

Statistical analysis

Analysis was undertaken using the Statistical Package for the Social Sciences® (SPSS) V25. Minimum, maximum, mean and median values were calculated for all components of the data.

Results

Data was collected on 100 births. Table 4 contains the parity of the women observed by place of birth. One hundred women were observed in labour in three birth settings. Data was collected on 50 homebirths by the midwife attending the birth and consisted of 28 percent nulliparous women and 72 percent multiparous women. Twenty-seven women were included in the birth centre group containing 10 nulliparae (37%) and 17 Multiparas (73%). The hospital group contained 23 women,

with 10 nulliparae and 13 multiparas (34% and 66% respectively). In total, there were 34 nulliparous women and 66 multiparous women in the dataset.

Table 4: Parity of women observed by place of birth.

<i>Birth Setting</i>	Nulliparous (%)	Multiparous (%)	Total
<i>Home</i>	14 (28%)	36 (72%)	50
<i>Birth Centre</i>	10 (37%)	17 (63%)	27
<i>Hospital</i>	10 (43%)	13 (57%)	23
<i>Total</i>	34 (34%)	66 (66%)	100

Consumables

Table 5 contains the list of consumables by place of birth. Mean and median values are shown for all items and the total cost is calculated at the bottom of the table. The least amount of consumables were used at homebirths, followed by the birth centre. The maximum cost for consumables was \$241.02 for a birth in the hospital followed by the birth centre at \$194.93, however the median cost in these settings was \$48.96 and \$51.43 respectively and \$10.46 in a homebirth which indicates that very few women required extensive use of consumables during birth. Overall, the cost of consumables is low across all three settings.

Table 5: Consumables used during care in labour in three settings (AUD)

<i>Consumables</i>	Unit cost AUD	Homebirth			Birth Centre			Hospital		
		Range	Mean	Median	Range	Mean	Median	Range	Mean	Median
<i>Amnihook</i>	1.40				0-1	0.15	0	0-1	0.36	0
<i>'Blueys'</i>	0.19	0-20	9	10	4-20	9	8	4-30	12	10
<i>Blood Collection tube</i>	0.12	-			0-2	0.26	0	0-3	0.64	0
<i>Cannula</i>	1.68	-			0-4	0.65	0	0-5	0.86	1
<i>Cord clamps</i>	0.71	1-3	1.42	1	0-3	1	1	1-2	1.05	1
<i>Delivery set</i>	4.29	-			0-1	0.93	1	1	1	1
<i>Epidural block</i>	25.0 0	-			0-1	0.22	0	0-2	0.5	0
<i>Dressing pack</i>	0.48	-			0-1	0.22	0	0-2	0.3	0
<i>Transparent dressing</i>	0.38	-			0-1	0.22	0	0-2	0.3	0
<i>Fetal scalp electrode</i>	7.96	-			0-1	0.13	0	0-2	0.3	0
<i>Indwelling catheter + bag</i>	10.9 8	-			0-2	0.4	0	0-2	0.68	0
<i>IDC insertion</i>	6.78	-			0-2	0.4	0	0-2	0.68	0
<i>ID Band</i>	0.13	-			1-2	1	1	1-2	1	1
<i>IV giving set</i>	1.47	-			0-2	0.5	0	0-2	0.73	1
<i>IV Fluids (1L)</i>	1.10	-			0-4	0.83	0	0-8	1.4	0.5
<i>IMI analgesia (morphine/pethidine)</i>	0.55	-			0-1	0.15	0	0-1	0.14	0
<i>Local anaesthetic</i>	1.50	0-2	0.26	0	0-2	0.8	1	0-2	0.9	1
<i>Needles</i>	0.18	0-4	0.9	1	0-9	3.9	4	1-8	3.8	4
<i>Nitrous Oxide (tubing)</i>	1.45	-			0-1	0.56	1	0-2	0.8	0
<i>Pulse oximeter probe</i>	16.5 6	-			0-1	0.19	0	0-1	0.09	0
<i>Scissors</i>	0.85	1	1	1	0-1	0.85	1	0-1	0.91	1

<i>Sterile gloves (pairs)</i>	1.24	1-5	1.6	1	1-10	4.9	5	1-12	6.33	6.5
<i>Non-sterile gloves (pairs)</i>	0.08	0-10	6.5	8	1-20	8.4	7	5-30	13.33	10
<i>Sponges (pack of 5)</i>	1.78	-			0-2	1.4	2	1-5	1.7	1.5
<i>Syringes</i>	0.49	0-3	0.9	1	0-7	2.8	3	1-11	3.59	3
<i>Syntocinon</i>	1.60	0-5	0.14		0-5	1.26	1	0-5	1.91	1
<i>Thermometer probe</i>	0.09	-			0-5	3	2	1-4	3	2
<i>Chlorhexidine</i>	2.50	0-1	0.33		0-1	0.67	1	0-1	0.75	1
<i>Suture material</i>	5.21	0-2	0.26	0	0-3	1	1	0-3	0.95	1
<i>Suture set</i>	5.85	0-1	0.26	0	0-1	0.67	1	0-3	0.68	1
<i>KY Gel</i>	0.09	0-3	2	1	1-4	3	2	1-8	6	3
<i>Sanitary pads</i>	1.28	0-3	3	0	3-20	9	10	2-20	7	5
<i>Vitamin K</i>	1.05	1	1	1	0-1	0.96	1	1	1	1
<i>Hep B vax</i>	0				0-1	0.93	1	1	1	
<i>Total cost \$</i>		8.05 - 76.75	24.67	10.46	7.78 - 196.38	65.9 0	51.43	15.69 - 243.92	76.93	48.96

Resources used in vaginal birth

The median costs for each birth setting were \$2150.07 for a homebirth, \$2100.59 for birth centre birth and birth in hospital cost \$2097.30 (Table 6). The main source of resource use for these settings was midwifery time and a modified cost for overheads was included for women giving birth at home to account for administrative and clerical support. There were no accommodation overhead costs to the health service for the actual birth or postnatal care for a homebirth. Antenatal consultations were reported to be shorter in duration for women planning birth in a birth centre or in hospital (30 minutes and 15 minutes respectively).

Table 6: Salary and non-salary costs of vaginal birth at home, in a birth centre and in a hospital (AUD)

	HOME			BIRTH CENTRE			HOSPITAL		
	Units (range)	Unit cost \$ (range)	Total cost \$ (range)	Units (range)	Unit cost \$ (range)	Total cost \$ (range)	Units (range)	Unit cost \$	Total cost \$ (range)
<i>Salaries and wages</i>									
<i>Midwife AN care (hrs)</i>	10 visits (5-13 visits x 1 hr)	69.58	695.80 (347.90- 904.54)	9 visits (6-14 visits 0.5 hr)	34.79	313.11 (208.74- 487.06)	8 visits (4-12 visits x 0.25 hr)	17.40	139.20 (69.60- 208.80)
<i>Midwife travel x 5 visits (hrs)</i>	0.75 hr (0.08hr - 2.75hrs)	52.19 (6.43- 220.91)	260.95 (27.83- 956.73)	N/A	N/A	N/A	N/A	N/A	N/A
<i>Medical AN consult (hrs)</i>	N/A						0.25 hr	178.61	44.65
<i>Midwife 1 birth care (hrs)</i>	6 hrs (2-16 hrs)	69.58	417.48 (139.16- 1113.28)	6 hrs (2.5-15 hrs)	69.58	417.48 (173.95- 1043.70)	7 hrs (3.25-14.25)	69.58	487.06 (226.14- 991.52)
<i>Midwife 2 birth care (hrs)</i>	5 hrs (1.5-10 hrs)	69.58	347.90 (104.37- 695.80)	0.92 hr (0-2 hrs)	60.70	55.84 (0-121.40)	1 hr (0.25-6.25)	60.70	60.70 (15.18- 379.38)

Midwife 3 birth care (hrs)	N/A	N/A	N/A	0.02 hr (0-0.5 hr)	60.70	1.21 (0-30.35)	0.3 hr (0-1)	60.70	18.21 (0-60.70)
O&G Resident (hrs)	N/A	N/A	N/A	0.1 hr (0-1)	78.51	7.85 (0-78.51)	0.75 hr (0-1)	78.51	19.63 (0-78.51)
O&G Registrar (hrs)	N/A	N/A	N/A	0.5 hr (0-1.5 hrs)	91.98	45.99 (0- 137.97)	0.75 hr (0-4.25)	91.98	68.99 (0-390.92)
O&G consultant (hrs)	N/A	N/A	N/A	0.1 hr (0-2 hrs)	178.61	17.86 (0-357.22)	0.05 hr (0-0.75)	178.61	8.93 (0-133.96)
Neonatal MO (hrs)	N/A	N/A	N/A	0.1 hr (0-1 hr)	91.98	9.20 (0-91.98)	0.025 hr (0-0.25)	91.98	2.30 (9-23.00)
Anaesthetist (hrs)	N/A	N/A	N/A	0.15 hr (0-0.75 hr)	91.98	13.80 (0-68.99)	0.3 hr (0-1.5)	91.98	27.60 (0-137.97)
NICU nurse (hrs)	N/A	N/A	N/A	0.03 hr (0-0.5 hr)	60.70	1.82 (0-30.35)	0.1 hr (0-1.25)	60.70	6.07 (0-91.05)
Non-salary costs									
Postnatal Overheads	6 visits (5-7 visits)	69.58	417.48 (347.90- 487.06)			1165.00*			1165.00*
Consumables			10.46			51.43			48.96

			(8.05 - 76.75)			(7.78 - 196.38)			(15.69 - 243.92)
Total cost			2150.07 (1486.21- 5015.16)			2100.59 (1555.47- 3808.91)			2097.30 (1545.26- 3949.38)
* Total overhead costs for women giving birth in a birth centre or hospital derived from AR DRG O60C. These costs include ward medical/nursing, non-clinical salaries, accommodation and overheads.									

The total costs included overhead costs for women in the birth centre and hospital groups, which were derived from the IHPA Public Hospital National Cost Data Collection²⁶ estimates of costs associated with a vaginal birth (AR-DRG O60C). This cost was included to account for accommodation during the postnatal period. Women who had a homebirth also accrued the cost of postnatal home visits, whereas postnatal care is included in the above overhead costs for women who gave birth in a birth centre or hospital setting.

Discussion

There is uncertainty in Australia that providing care for women who plan to give birth at home or in a birth centre is more costly for the health service compared to hospital birth, and this has not been tested in NSW. Given that childbirth is the third most common specialist service in Australia and 'single spontaneous delivery' is the most common principal diagnosis among acute overnight admissions to hospital²⁷ delivering economically prudent services should be a priority for health service planners nation-wide. This study attempts to quantify the costs for the same outcomes across the three settings.

The costs of an uncomplicated vaginal birth were similar across the birth centre and hospital groups due to the similarity of the cost components. The greatest difference in cost for women planning a homebirth is in the antenatal period, as time in labour and postnatal costs are comparable across the three settings. This is similar to other studies in this area. An Australian costing study of birth centre birth through Midwifery Group Practice (MGP) demonstrated a similar increase in antenatal costs for women in the birth centre group however, the total cost per women was lower²⁸. A similar variation in antenatal and total costs was found in studies from Canada and the Netherlands^{29,30} which compared planned homebirth with planned birth centre or hospital birth with a midwife or doctor. These studies reported increased costs related to antenatal consultations in the homebirth groups and 'hospital charges' in the other groups, resulting in a higher total cost for women who plan to give birth in hospital or in a birth centre, regardless of caregiver. Importantly, the estimated

total cost of uncomplicated vaginal birth in our study is significantly lower than the lowest AR-DRG (O60C) allocated to vaginal birth.

Closer inspection of the consumables used revealed little difference across the three settings.

Although there were items listed that would not be available in a homebirth setting, the median number of consumables used was comparable, with the exception items such as gloves (sterile and non-sterile), IV giving sets and fluids, needles and syringes. There are inherent and unobservable differences in the characteristics of women who plan birth at home or in a birth centre³¹ which can confound the results between the groups. Unobservable contributors to cost may include cost to the woman and family when planning birth at home, for example meals, accommodation and care provided by family members which are not included here due to the perspective of the study. We included women who had a similar risk profile when accounting for observable differences to ameliorate the potential selection bias present in women who chose birth outside a hospital.

Overhead costs contribute over half the estimate for BC and hospital birth, because antenatal consultation costs are lower in both these groups due to the shorter consultation duration and absence of travel to the consultations by the midwifery staff. In the Australian context, Homer et al.³² found women at low risk of complications have lower rates of intervention and adverse outcomes. As soon as labour interventions are introduced, the costs increase significantly consistent with findings by Tracy and Tracy³³ who found an incremental increase in the cost of labour with the introduction of interventions including induction of labour and epidural analgesia. Since women planning a home or birth centre birth have fewer interventions, the costs associated with the group as a whole would be lower in comparison with planned hospital birth. The investment of midwifery time during the pregnancy has been associated with the positive birth outcomes^{34,35} and lower costs^{8,36} in many studies of midwifery-led care undertaken at home, in a birth centre or in a hospital birth setting.

Limitations and strengths

Although the observational data collection for this study was carried out in one health service, the selection criteria of the women the midwives were caring for were strictly adhered to. The midwifery staff enthusiastically engaged with the research project and either facilitated the collection of data by the researcher or completed the data collection themselves with rigour and accuracy. We limited this study to successful vaginal births in the woman's chosen setting to compare the mode of birth which can occur in all three settings. Overheads associated with homebirth differ in some ways. We calculated the cost of birth at home in this study assuming the cost is accounted for by the health service. Midwives working in a publicly funded homebirth service would incur certain overhead costs such as administrative support, IT services, and other corporate services. This cost is difficult to determine as the breakdown of overheads in the AR DRG are not sufficient to accurately estimate the cost of clerical support during the care of women outside the hospital such as occurs for the women under the care of midwives in a publicly funded homebirth model.³⁷ A conservative estimate of the overhead costs per woman could increase the cost of homebirth by \$385 (non-clinical salaries) to up to \$781 if all overhead costs were applied excluding ward medical and nursing overhead costs.³⁷

Women requiring transfer from home or a freestanding birth centre would incur additional costs to the health service in ambulance fees and costs of interventions on arrival to hospital. Estimating all the variations of potential outcomes was beyond the scope of this study, and further research into these additional costs is warranted as this would inform the value and cost of these settings.

In Australia, public health care services provided by hospital local health districts (LHD) are state funded. LHDs have a degree of autonomy which results in variation in the availability of models of care and setting for birth, notwithstanding the existence of documents such as the Maternity Services Plan⁷ and Towards Normal Birth³⁸. With this in mind, the results of this study are

reasonably generalisable due to the fact that salaries and hospital costs are estimated using state award and National Hospital Pricing Authority values.

Conclusion

To our knowledge, this is the first micro-costing evaluation of place of birth for women at low risk of complications who had a vaginal birth in their planned place of birth in New South Wales. In this study we found that when a woman successfully has a vaginal birth in her chosen setting, there is little difference in the cost to the health provider. The main costs are derived from midwifery time, with the additional cost of overheads when a woman is giving birth in a birth centre or hospital. Intervention rates are low among these women which keeps the costs down individually and as a group.

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