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Community-based continuity of midwifery care versus standard hospital care: a cost analysis

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Abstract

This paper reports the costs of providing a new model of maternity care compared to standard care in an Australian public hospital. The mean cost of providing care per woman was lower in the group who had the new model of care compared with standard care (\$2 579 versus \$3 483). Cost savings associated with new model of care were maintained even after costs associated with admission to special care nursery were excluded. The cost saving was also sustained even when the caesarean section rate in the new model of care increased to beyond that of the standard care group.

Introduction

Maternity care is a significant user of resources in public hospital systems. The majority of care for pregnancy and birth in Australia takes place in the public hospital system. In NSW, 83 per cent of women had their babies in public hospitals in 1998 (NSW Health 2000). The cost of providing maternity care is therefore an important consideration in the design and implementation of new services.

In the past decade, a number of state and national government reports in Australia have recommended major changes to the provision of maternity services. Recommendations have included the development of new models of care that provide continuity, increasing collaboration between midwives, obstetricians and general practitioners and moving antenatal care to community settings (Department of Health Western Australia 1990; NHMRC 1996; NSW Health Department 1989; Senate Community Affairs References Committee 1999; Victorian Department of Health 1990). Despite these reviews, widespread change in the provision of maternity services and the development of new models of care have not occurred.

Anecdotes suggest that one of the reasons preventing implementation of new midwifery models of care in Australia is cost. Within the current climate of cost containment, many midwifery managers and hospital administrators seem unable to consider introducing a new model of care because "the budget does not allow for it" or "we need additional funds".

Economic analyses of new models of maternity or midwifery care are uncommon. Only three trials of new models of maternity care have performed economic analyses (Kenny et al. 1994; Rowley et al. 1995; Young et al. 1997). In one Australian trial (Rowley et al. 1995), Australian national cost weights for diagnostic-related groups (AN-DRGs) were used. There are problems with using AN-DRGs to cost maternity care as they address acute inpatient care and do not account for outpatient care and are limited in their capacity to determine and refine costs (Rigby, Clark, & Runciman 1999; Lee, Eagar, & Smith 1998; Phelan et al. 1998). In another Australian trial (Kenny et al. 1994), costs were only calculated for statistically significant outcomes during labour and birth. Overall, the new model represented a cost saving compared to standard care, although the variability was not given. Sensitivity analyses were not conducted in either trial so it is difficult to determine if cost savings would remain if the birth outcomes were altered. The trial in Scotland (Young, Lees, & Twaddle 1997) measured the costs of providing midwife-led care compared with shared care. The analysis found no significant differences in the median costs of antenatal and intrapartum care, although postnatal care was associated with higher costs in the midwife-led group.

These three studies demonstrate that there are inadequacies in our understanding of the costs associated with models of maternity care. Further research is necessary to provide information about the cost implications of new models of care. This paper reports an economic evaluation comparing a new model of

continuity of midwifery care, the St George Outreach Maternity Project (STOMP), with the standard model. The cost analysis is made from the perspective of the health care provider and evaluates costs borne by the organisation, for example, salaries and wages, goods and services and repair, maintenance and renewal (RMR). Our hypothesis was that the new model of care would cost the organisation no more to provide than standard care.

Methods

Design

A cost analysis was undertaken from the perspective of the health system (Drummond & Stoddart 1984). In a cost analysis, a detailed examination of the comparative costs of the two alternatives is undertaken to determine whether the model of care is sustainable from an economic perspective. The alternatives were hospital-based standard care or the community-based STOMP model.

Women were eligible for the study if they were less than 24 weeks gestation at their first visit and lived in a designated catchment area. Eligible women were randomly allocated to the STOMP model or to standard care. The sample consisted of 1089 women, with 550 women randomly allocated to the STOMP group and 539 to the control group. Approval was obtained from the Ethics Committee at St George Hospital prior to the commencement of the study.

The STOMP model

Continuity of midwifery care was a focus of the STOMP model. Two teams each with six full-time midwives provided care for 600 women per year, that is, 25 births per month per team. Antenatal care was provided in community centres. Two midwives and an obstetrician or obstetric registrar attended each clinic. One midwife from each STOMP team was rostered 'on call' for women in labour and to provide advice and information. For women who underwent an elective or an emergency caesarean section, the STOMP midwife provided midwifery care in the Operating Theatre. After the birth, women either chose to remain in hospital for postnatal care with STOMP midwives or to be discharged early and receive domiciliary care by the STOMP midwives.

Standard care was predominately provided through the hospital-based antenatal clinic. Women saw a variety of caregivers antenatally with different caregivers during labour and birth and again postnatally. Domiciliary postnatal midwifery care was provided by a different group of midwives.

Data collection

The resources used to provide antenatal, intrapartum and postnatal care for each woman in the trial were calculated for each aspect of care, including salaries and wages, goods and services and RMR. The components of care were: antenatal clinic; antenatal admission; day assessment unit; labour and birth; hospital-based postnatal care; domiciliary postnatal care; and, admission of neonates to the special care nursery (SCN). STOMP midwives also incurred an on-call cost. All costs are presented in Australian dollars. Salaries and wages were calculated at market prices (Robinson 1993). In this case, the 1997 NSW industrial award rates including 'on-costs' (sick leave, annual leave, long service leave and superannuation) were used. Midwifery care was calculated at the level of an 8th year midwife, which was the average in the maternity unit. Medical officers were costed at the average year of service. Consultant obstetricians were costed at their hourly rate. Other personnel, including midwifery managers, clerical staff, enrolled nurses and porters were costed at their current level and grading.

Analysis

Costs associated with all aspects of care were calculated and presented as the mean cost per woman per group. Ninety-five per cent confidence intervals were used to represent the variability of mean. Describing the variability of mean costs per woman requires acknowledgement that the data may be highly skewed (Barber & Thompson 1998). This is because small subsets of 'patients' incur particularly high costs. The usual method of calculating the standard error (via the standard deviation) may result in a biased estimate of this statistic. A non-parametric technique known as bootstrap resampling was undertaken to overcome the problem of skewed data (Barber & Thompson 1998). Bootstrapping enables the estimation of the variability of statistics (such as means) without making any assumptions about the underlying distribution of data (Efron & Tibshirani 1993). It was unlikely that the cost data in the study were normally distributed.

Bootstrapping was therefore used to estimate the variability of mean costs (standard error and 95% confidence intervals). Ten thousand bootstrap replications were used to calculate these results.

Sensitivity analyses were performed on sub-sections of the analysis. The first sensitivity analysis examined the impact of admission to SCN on total costs between the allocated groups. The second sensitivity analysis evaluated the impact of the assumptions surrounding the efficiency of the STOMP clinics. Finally, the rates of obstetric intervention in the STOMP group were varied to determine the cost difference. This analysis allowed the estimation of the caesarean section rate that would nullify cost savings from the STOMP model.

Assessment of resources

Antenatal care

Salary and wage costs incurred in conducting the hospital-based antenatal clinic and the community-based STOMP clinics were calculated and divided by the number of women usually seen per clinic (50 per hospital-based clinic; 30 per community-based clinic) to obtain an average cost per visit per woman per site. Women in the STOMP group attended a mean of 8.3 [SD 2.2] antenatal visits and those in the control group attended a mean of 7.4 [SD 2.8] antenatal visits.

Virtually all women attending St George Hospital have an obstetric ultrasound and routine pathology and urine tests. Capital costs, stationery, linen and cleaning costs were not included in the analysis as the practices and costs were the same for each group. Neither model of care offered a specific antenatal education program as a routine component.

Each hospital-based clinic was staffed by five midwives and one resident, registrar, consultant doctor, enrolled nurse, nurse manager and appointments clerk. The midwives, enrolled nurse, clerk and manager attended the clinic for four hours, which included initial setting up and cleaning and restocking at the conclusion. The resident and registrar attended the clinic for three hours and the obstetrician for two hours. A registrar checked all pathology and ultrasound reports prior to each clinic. During the study the antenatal records were stored in three filing cabinets in the delivery suite. Hospital porters transported these cabinets to and from each antenatal clinic. Clerks retrieved and replaced antenatal records.

The community-based STOMP clinic was organised differently to the hospital-based clinic. One STOMP midwife was responsible for preparation of the antenatal records, usually the day before the clinic. Preparation involved: retrieving antenatal records; checking that pathology and ultrasound reports were available; following up results; contacting the consultant or registrar about the time that they were likely to be needed at the clinic; and, travelling to the clinic. The obstetrician attended the clinic for two hours and alternated attendance at the clinic with an obstetric registrar.

The STOMP midwives travelled to the community sites in a leased hospital vehicle. Costs for the hospital vehicles were based on an average cost per vehicle including the lease, petrol, insurance, servicing and maintenance.

The sites for the STOMP clinics were both owned and operated by the NSW Health Department. This meant that we were not required to pay rent or contribute to operating costs. A small amount of additional equipment was purchased to set up the STOMP clinics. This included: portable examination beds; automated urine-testing machines; small cases to transport records; hand-held fetal heart rate 'doppler' machines; and, long range 'pagers' for the midwives. These initial 'set up' costs (\$9130) were not included in the overall analysis as they were used for longer than the period of the study.

A clinical midwifery consultant provided training, mentoring and leadership to the STOMP midwives during the first year. This was a developmental role and was reduced over time. The costs of this role were not included in this analysis.

The cost of a day in a hospital bed in an antenatal ward was \$216 in 1997 and 1998 (St George Hospital average cost 1997-8). In total, antenatal women in the STOMP group spent 147 days and antenatal women in the control group spent 243 days in hospital.

The day assessment unit (DAU) is a clinic for antenatal women who required more intensive monitoring but did not require admission to hospital. At St George Hospital the DAU is conducted three days per week from 9am to 1pm. One midwife coordinated the DAU and spent approximately six hours per day in the clinic. This time accounted for preparation, attendance at the clinic and follow up of results. Each woman had a

cardiotocograph and blood tests at each visit. An obstetrician and physician reviewed the women at each visit. Women in the STOMP group made 74 visits and women in the control group made 52 visits to the DAU.

Intrapartum care

Intrapartum care was based on four categories of birth outcome: normal vaginal delivery; assisted vaginal delivery (forceps, vacuum extraction or breech); elective caesarean section; or, emergency caesarean section. The level of care and resources required for each category was different. This method is known as 'product costing' (Hindle 1993).

Costing was based upon an uncomplicated normal vaginal birth. The assumption of 10 hours of midwifery care per woman was based on data currently used within the hospital to calculate staffing requirements. This time includes direct care as well as telephone support and advice, liaison with team members, transfer and restocking. Background costs, that is, costs of providing a service even though it was not specifically required (for example, obstetric and paediatric cover) were also included. All other assumptions were based on the usual estimates within the hospital. As the number of women who had epidural analgesia during a normal labour and birth was similar between the groups (STOMP n=51; control n=56), the cost was not included in the normal birth resources.

The costs for a complicated vaginal birth, elective caesarean or emergency caesarean section used the baseline resources for a normal birth with additional costs. For example, it was assumed that an obstetric registrar, anaesthetist and paediatric registrar would provide care and a consultant obstetrician and paediatrician would be on-call. There was an increased use of goods and services, such as an epidural anaesthetic and an intravenous line. Operating theatre costs were included for women who underwent emergency or elective caesarean sections. These were taken from current estimates used in the hospital.

The 'care during labour' cost was not included for women who underwent an elective caesarean section. Instead, midwifery and medical time to prepare the woman for the operating theatre were substituted. The proportions of each category of birth outcome in the study are presented in Table 1.

Postnatal care

The cost of providing postnatal care fell into two general categories: after a vaginal birth (normal or complicated); or, after a caesarean section (elective or emergency). The assumptions used were the same for the STOMP group and the control group. The costs only differed depending on the birth outcome.

The length of time that midwives spent with a woman after a vaginal birth was estimated at 1.5 hours per woman per day. The length of time that midwives spent with a woman after a caesarean section increased to 3 hours per day. Estimates of midwifery time were made from recent research in our unit (Stacey 2000). Medical care after a vaginal birth was one visit by a resident medical officer to authorize discharge from hospital. Medical care increased to 20 minutes per day for women who had a caesarean birth. A paediatric resident medical officer reviewed all neonates. Background support included a midwifery manager, a lactation consultant and an administrative assistant. Goods and services included meals, consumables, pharmacy, cleaning, linen and laundry.

The mean length of stay in hospital after a vaginal birth was 3.5 days (STOMP 3.47 days; Control 3.61 days) and 6.2 days after a caesarean section (STOMP 5.52 days; Control 6.81 days).

Domiciliary postnatal care means that midwives visit women at home. Each home visit involved up to one hour of preparation time, which included visiting the woman on the ward prior to discharge and reviewing and preparing records. The average length of the visit was estimated to be 42 minutes (using 1998 data from domiciliary midwives at St George Hospital). Each midwife used a leased hospital vehicle and it was assumed that each vehicle attended four visits per day. More women in the STOMP group utilised domiciliary midwifery care [STOMP n=240 (43.6%); Control n=187 (34.7%)]. The mean number of visits was 3.4 (STOMP 3.2; Control 3.6).

Costs of midwifery 'on-call' for STOMP

STOMP midwives provided 24 hour on-call cover for women in labour. On-call costs were calculated using the NSW Nurses Award (1997 and 1998) assuming two on-call shifts per day per team. The total cost was divided by the number of women to obtain a mean 'cost per woman'.

Neonatal admission to Special Care Nursery

The daily cost of a neonatal bed in a Level 2 SCN in 1997 and 1998 was \$1700 (St George Hospital data). This incorporates midwifery and medical care, goods and services and repair and maintenance of equipment. Resource costs related to admission to SCN were calculated on the number of days in hospital in each group. Neonates in the control group spent more days in the SCN (STOMP: 80 days; control: 97 days).

Results

The costs associated with each of the nine components of care were calculated and are presented as the mean cost per woman by group (Table 2). The largest difference in the mean cost was in admission to SCN, although, there were also cost savings in antenatal clinic care, antenatal inpatient admissions and intrapartum and postnatal care. STOMP had slightly higher DAU and domiciliary midwifery care. Only STOMP women incurred on-call costs. Overall, the mean cost of providing care per woman was lower in the STOMP group compared with the control group (\$2 579 versus \$3 483).

Sensitivity analyses were used to evaluate the robustness of the results in three areas. These were: neonatal admission to SCN; efficiency of the antenatal clinics; and proportion of elective caesarean sections performed.

Neonatal admission to SCN

Control group infants used more resources than STOMP infants (control: \$683 220; STOMP: \$325 680) and admission to SCN skews the overall cost and contributes to the increased variation in costs of the control group. The costs of SCN admission were removed from the analysis to determine if a cost saving still existed. Cost savings associated with STOMP were maintained even after the SCN admission costs were excluded (Table 3). These costs are used for the subsequent sensitivity analyses as they were a more accurate reflection of the costs of the models of care

Throughput in antenatal clinics

The cost analysis was based upon 50 women per hospital-based clinic and 30 women per STOMP clinic (60 women per week). This sensitivity analysis assessed overall cost savings when the throughput (the number of women per clinic) was altered. When the STOMP clinic saw less than 10 women per week (five women per clinic), STOMP cost more than standard care. Once the STOMP clinic saw more than 10 women per week, it resulted in cost savings. When the STOMP clinic saw between 20 and 60 women per week the saving rose from \$10 to \$40 per woman compared with standard care (Figure 1). The rate of cost saving slowed once the throughput reached 60 women per week.

Altered caesarean section rate

It is possible that the cost saving is only because the birth outcomes are different between the groups, particularly the caesarean section rate. To evaluate this, the rates of caesarean section were varied and the cost differences assessed.

In order to conduct this analysis, the birth outcomes in each group were converted to proportions. The birth outcomes (normal birth, complicated vaginal birth, elective caesarean section and emergency caesarean section) each have different costs. A ratio of vaginal birth to caesarean section was calculated for each allocated group. This ratio was manipulated to increase the caesarean section rate in the STOMP group. The overall cost of STOMP care at each 0.5 per cent increase in caesarean section rate was compared with the rate in the control group (17.8%). Postnatal care was adjusted accordingly as the increase in caesarean section rate in the STOMP group altered the costs of postnatal care (Figure 2).

Figure 2 illustrates that as the caesarean section rate rises in the STOMP group, the cost saving is reduced. The cost saving was maintained with an increase in caesarean section rate to beyond that of the control group. The caesarean section rate in the STOMP group would have to reach almost 20 per cent (with the control group staying at 17.8%) for the models of care to have similar cost.

Discussion

This cost analysis has demonstrated that there are savings associated with the STOMP model of care. This saving is maintained even when the largest single aspect of resource usage (SCN admission) is removed. The throughput of the antenatal clinic also alters the cost. However, the cost saving related to this aspect of care was only removed when the STOMP clinics catered for few women (five per clinic). It is important to balance potential cost savings related to increased throughput with the quality of care associated with adequate time during consultations. Higher throughput means women are more likely to feel rushed, with a shorter visit and longer waiting times. Sixty women per week (30 per session) seems to provide a balance between cost and quality.

The cost analysis makes evident the high costs associated with caesarean sections. Emergency caesareans are more than five times and elective caesareans more than four times the cost of a normal vaginal birth. While it is appreciated that some rate of caesarean section is inevitable (and necessary) in any health system, additional resources will be expended as the rates increase in Australia and elsewhere. It was possible that the cost savings demonstrated by the STOMP model are only due to the reduction in caesarean section rates. However, the sensitivity analysis showed that the caesarean section rate in the STOMP group would need to be well above the rate in the control group before the cost saving is lost.

The STOMP model currently caters for approximately 28 per cent of women booked into the St George Hospital. It is not clear whether the cost saving demonstrated in this analysis would persist if the STOMP model catered for a greater proportion of women. Further research needs to be conducted to determine the cost efficiency of more widespread implementation.

This cost analysis was restricted to an examination of the comparative costs of the alternative treatments (Drummond & Stoddart 1984). The costs are calculated from the perspective of the health system (the provider of the service). Many hospital administrators believe that the introduction of a new model of maternity care is impossible due to constraints on their budget or the need to attract additional funding. This was why a detailed analysis of the costs to the health care system was valuable. It is acknowledged that while a broader perspective, that included the costs to the individual and to society, is ideal, this was not the objective of this analysis.

Conclusion

Economic analyses of maternity services seem to have been a low priority area. Twaddle and Young (1998) call for more research in this area, especially as scarce resources in public health care systems should be used efficiently. The STOMP model was established within the current budget of the maternity unit at St George Hospital and it was hoped that it would be cost neutral (cost the organisation no more than the current system of care). Results indicate that the STOMP model resulted in a cost saving.

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Table 1: **Birth outcome by group.**

	STOMP n=550 Number (%)	Control n=539 Number (%)
Normal birth	402 (73.1)	374 (69.4)
Complicated vaginal birth ^a	75 (13.6)	69 (12.8)
Emergency caesarean section	52 (9.5)	62 (11.5)
Elective caesarean section	21 (3.8)	34 (6.3)

^aComplicated vaginal birth included forceps and vacuum extraction and vaginal breech birth.

Table 2: Mean cost per woman by the nine components of maternity care by group.

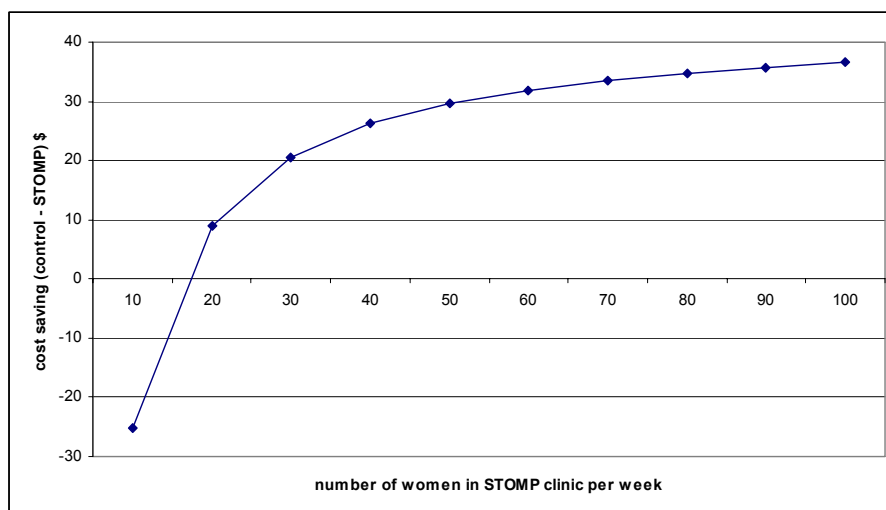
	STOMP Mean \$	Control Mean \$	Cost saving Control-STOMP \$
Antenatal clinic	200.45	229.29	28.84
DAU	26.40	20.98	-5.42
Antenatal inpatient	57.84	96.58	38.74
On-call costs	21.81	0.00	-21.81
Labour and birth	704.74	773.57	68.83
Hospital postnatal care	373.75	417.60	43.85
Domiciliary care	121.59	110.53	-11.06
Special care nursery	7 416.25	10 217.53	2 801.28
Total per woman	2 578.70	3 482.79	904.09

Table 3: Total mean costs (excluding costs associated with SCN admission) by group.

	STOMP n=550 \$ ^b	Control n=539 \$ ^b	Cost saving Control-STOMP \$ ^b
Total cost per group	827 213	885 133	57 920
Mean cost per woman	1 504	1 643	139
Standard Error ^a	33	50	
95% CI for mean	1 449-1 559	1 563-1 729	
Minimum cost	490	513	
Maximum cost	5 976	16 097	

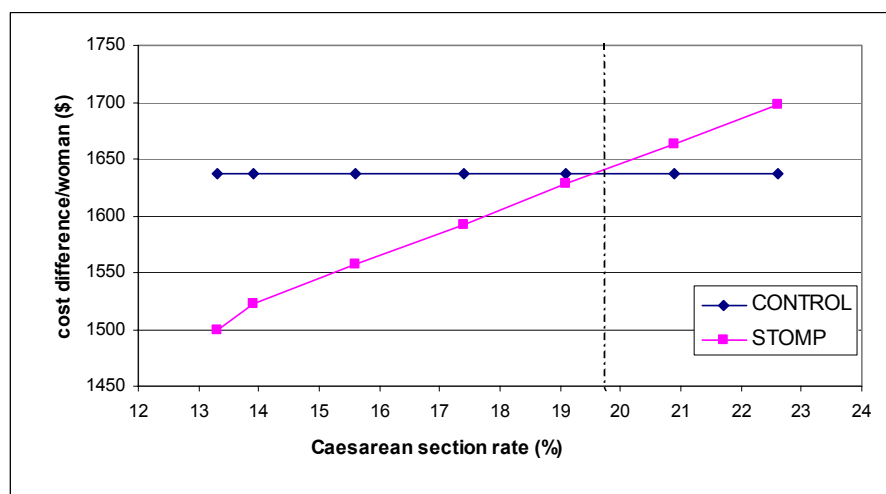
^aStandard errors and 95% confidence intervals (CI) were calculated using the bootstrap technique. ^b Costs were rounded to the nearest dollar.

Figure 1: Cost saving (Control – STOMP) when the throughput in the STOMP clinic is varied.



The STOMP clinics currently cater for 60 women per week. STOMP costs less than standard care once more than 10 women are seen per week. The cost saving is stable once more than 60-70 women are seen per week.

Figure 2: Cost saving (Control – STOMP) as the caesarean section rate in the STOMP group increases.



The rate of caesarean section in the control group remains the same (17.8%) as the rate of caesarean in the STOMP group increases. The dotted line represents the point at which the cost saving is lost, that is, when the rate of caesarean section in the STOMP group is around 19.5%.