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COSTS OF PROVIDING NHS MATERNITY CARE FOR WOMEN WITH MULTIPLE VERSUS SINGLETON PREGNANCIES

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Abstract

Aims: A recent study in the Netherlands found that a small number of women expecting multiple births are driving the costs for maternity care. A twin pregnancy costs double that for a singleton pregnancy after IVF treatment [Lukassen, 2004]. In a London region, Henderson et al observed a similar variation in obstetric costs [Henderson et al, forthcoming]. We aim to identify patient attributes that are driving these cost differentials in singleton and multiple pregnancies.

Methods: A prospective audit was conducted over 15 months in four district hospitals in Kent and Essex covering all multiple pregnancies and high risk singleton pregnancies, and a sample of normal risk women. A total antenatal care cost and obstetric care cost was derived for all resource use incurred.

Results: 973 pregnant women were analysed and 25% (244) had a multiple pregnancy. The mean cost for antenatal care including prenatal admissions for multiple pregnancies (£1,043) and singleton women with cardiac risk factors (£1,136) was significantly greater than singleton women with Down's syndrome risk or normal risk women (£596 and £598, respectively, $p < 0.001$). Obstetric care was approximately £1,000 more costly for multiple maternities compared with all singleton maternities, because of the more frequent use of caesarean section resulting in longer stays on postnatal wards. Regression analysis was used to determine the key drivers for both antenatal and obstetric costs using patient characteristics, including their risk factors and co-morbidities.

Conclusion: Our analyses confirmed that the cost of maternity care is substantially higher for multiple pregnancies than most singleton pregnancies and that diabetic pregnancies are also costly. Our results should help inform decision makers in the UK about key drivers of maternity costs.

Introduction

In 2004, women pregnant with more than one baby (multiple pregnancies) formed 14.9% of all women who were delivered (maternities) in England and Wales, and since 2000, the annual multiple pregnancy rate per 1000 maternities has remained relatively constant, ranging between 14.7 and 15.0 [ONS, 2005]. The practice of assisting couples to conceive has contributed to the annual number of multiple pregnancies in the United Kingdom, as 1 in 4 of in vitro fertilisation (IVF) births result in twins or triplets (23.6% of 8251 IVF births in 2003-4) [HFEA, 2006]. Thus, assisted conception occurs in about 18% of all UK multiple pregnancies [ONS, 2006].

Whether occurring spontaneously or assisted, maternal care for twin pregnancies appears to be twice as costly as care for mothers of singletons, although very little relevant information is available. Henderson et al estimated the costs of hospital obstetric care in a London health region and found that mean obstetric costs (in 1998 prices) totalled £1,360 for mothers of singletons and £2,836 for mothers of twins [Henderson et al, forthcoming]. In the Netherlands, among IVF pregnancies, antenatal care, delivery, and maternal hospital care averaged (in 2003 prices) 1,794 euros for singleton pregnancies and 3,935 euros for twin pregnancies [Lukassen, 2004]. Gestational age at delivery was much lower in the IVF twin pregnancies (36.5 weeks vs. 39.6 weeks) and the caesarean section rate was much higher (40% vs. 20%).

Among British women experiencing singleton pregnancies, pre-gestational diabetes is an important risk factor for maternal complications leading to preterm delivery (before 37 weeks), and caesarean section as the mode of delivery [CEMACH, 2005]. However, no data appear to have been published on the comparative costs of singleton high-risk pregnancies, pregnancies in average risk women, and women with multiple pregnancies.

We now have an opportunity to explore the relative costliness of care for women with multiple and singleton pregnancies using a dataset that was assembled for a study in south-east England evaluating the role of telemedicine in fetal cardiology – the TelePaed project.[1] To establish the annual incidence of cardiac anomalies in obstetric caseloads in four maternity services, clinical events were audited prospectively for cohorts of women with cardiac risk factors including multiple

[1] see www.brunel.ac.uk/about/acad/herg/research/recent.

pregnancies and women with risk factors for Down's syndrome, and for a sample of women of average risk. Unit costs were applied to the events. Thus the dataset facilitates analyses to isolate patient attributes that may be driving cost differentials between singleton and multiple pregnancies.

Methods

Study design

The project took place in four district hospitals in Essex and Kent, which recorded between 3,100 and 3,800 maternities annually. Over 15 months, three main groups of pregnant women were identified at the time of their anomaly scan (usually between 18 to 20 weeks gestation).

i) All women with risk factors for fetal congenital heart disease;
ii) All women with an elevated risk for Down's syndrome;
iii) Samples of normal risk women (baseline women) cared for locally.

The risk factors for the first two groups are described in the text box. It was beyond the scope of the original telemedicine study to collect information on all normal risk women. Instead, women in groups i) and ii) were matched in terms of their year of birth, parity and month of gestation with normal risk women, in order to obtain a representative sample of normal risk women. A fifth of the high risk women were matched.

Cardiac risk factors:
- Maternal dependency on insulin (Type 1 diabetes) or anti-epilepsy or lithium therapies;
- Family history of congenital heart disease;
- Previous pregnancy with a chromosomal disorder;
- Current multiple pregnancy.

Down's syndrome risk factors:
- Woman's adjusted risk based on serum test result greater than the `at risk' cut off level adopted by the local screening programme;
- Nuchal translucency measurement of 3.0 or greater;
- Abnormal chromosome test result.

Project facilitators in the district hospitals identified the eligible women and entered demographic and clinical details from their maternity records in an audit database. The women were followed prospectively from the date of the anomaly scan until they delivered and were discharged from the post-natal ward. Multi-centre and local research ethics committees approved the project.

NHS resources and costs

Antenatal care from mid-way through the second trimester covered antenatal and specialist ultrasound scans, antenatal clinic attendances inclusive of staff time, specialist consultations (either face-to-face or via telemedicine), and pre-natal inpatient stays until 48 hours prior to admission to a labour ward. Obstetric care was comprised of pre-natal admissions within 48 hours of admission to a labour ward or obstetric theatre, labour/delivery bed day (recorded in hours), mode of delivery, blood products that may have been administered, and post-natal stay. Home births were included.

Finance departments in the district hospitals and two fetal medicine centres in London provided unit costs, including overheads, for the resource items at 2001-2002 prices. As there were wide variations in both the hospitals' caseloads of eligible patients and the district costs, weighted unit costs were attributed [Longworth et al, 2003]. The weights for the unit costs were derived according to the overall distribution of eligible women in each hospital. For specialist antenatal care, an average cost was calculated (as the comparative costs from the fetal medicine centres were similar). Discounting was not required as women spent less than 12 months in the study. Hourly rates of pay for midwives and doctors were costed using NHS salary scales [Department of Health, 2002a and 2002b] and Netten and Curtis [Netten and Curtis, 2002]. The hourly rates were pro-rated according to the mean duration of the patient consultations. Finally, a mean antenatal cost and a mean obstetric cost per woman were generated (see the Appendix 1).

Statistical analysis

Comparative analyses between singleton and multiple pregnancies by risk group are presented in the paper. Analysis of variance (ANOVA), t tests and Chi-squared tests were used and all statistical tests were two-sided. A p value of less than 0.05 was considered to be statistically significant for the comparative analyses. As the distributions of patient costs within the risk groups were skewed, bias adjusted non-parametric bootstrapping was performed, taking 2000 iterations of the data, in order to generate confidence intervals around the mean [Manly, 1997]. All statistical analyses were conducted using Stata version 8 [StataCorp, 2003] and S-PLUS [S-PLUS, 2000].

Modelling

In order to determine what risk factors were important predictors of the cost of maternity care for singleton and multiple pregnancies, a multiple regression model was fitted to the observed caseloads of women with cardiac risk. A backward regression approach was adopted for the multivariate analysis, whereby all potential risk factors are included in a multiple regression model and the least significant variables are removed from the model, one at a time, until only those variables with a significance level of less than 0.1 remain. Models were fitted separately for antenatal costs and obstetric costs.

Results

All women

1,311 women met the selection criteria identified earlier. However, we excluded 338 women (including 19 multiple pregnancies) for the following reasons: a) 55 women had terminations or miscarried; b) 257 women had missing labour information (most had become eligible in the last three months of recruitment); and c) 26 women had missing information. In total, our analysis concentrates on 973 women, of whom 244 (25%) had a multiple pregnancy (239 were expecting twins and 5 were expecting triplets). Of the 729 singleton women, 322 were at risk of Down's syndrome, 244 had cardiac risk factors and 163 were normal risk women.

Demographic characteristics and birth outcomes (Table 1)

There were significant differences in the attributes in the four groups of women.

- In terms of mother's age, the Down's risk women and normal women were a year or two older than the cardiac risk and the multiple birth women (t test[2] – t = 7.98, p < 0.001).
- With regards to parity, for three-quarters of cardiac risk women this was a second or subsequent pregnancy compared with just over half for the multiple birth women (Chi-squared test[3] – χ_1^2 = 17.57, p < 0.001).
- Down's risk women were more likely to undergo an anomaly scan early in their second trimester (before 18 weeks) compared to the other categories of women (Chi-squared test - χ_6^2 = 221.55, p < 0.001).

[2] Test conducted on Down's risk and normal women combined vs. cardiac risk and multiple births women combined

[3] Test conducted on cardiac risk vs. multiple birth women.

- Virtually none of the women expecting multiple births exceeded 39 weeks gestation; 35% of cardiac risk women reached 40 weeks compared with 55% of the Down's risk women, and normal women (Chi-squared test [4]- χ^2_6 = 197.41, p < 0.001).
- Birthweights were similar between the singleton risk groups; however, birthweights were significantly lower for multiple birth babies (t test[5] – t = 23.48, p < 0.001).
- There were no significant differences in the number of babies born with abnormalities within the different risk groups (Fishers Exact test - p = 0.445).

Length of stays (Table 2)

Cardiac risk women and multiple birth women had significantly longer pre-natal stays (until 48 hours prior to admission to a labour ward or obstetric theatre) than both the Down's risk and normal women (t test[6]: t = -3.06, p = 0.002; and within 48 hours of admission: t test[7]: t = -3.09, p = 0.002). Women who experienced multiple births had significantly longer stays in hospital after the baby was born compared with the singleton risk groups (F test: $F_{3, 816}$ = 33.14, p < 0.001).

Looking at the cardiac risk women and multiple birth women separately, cardiac risk women spent a day longer on prenatal wards during the antenatal period than multiple birth women, although this finding was not statistically significant (until 48 hours prior to admission: t test: t = 1.43, p = 0.155). Conversely, multiple birth women spent on average two days more in hospital after giving birth, than cardiac risk women, this difference in length of stay was statistically significant (t test: t = -6.41, p < 0.001).

Bootstrapped mean antenatal and mean obstetric costs (Table 3)

Antenatal mean costs for cardiac risk women and multiple birth women were nearly double that of the Down's risk and normal women, and these cost differences were significant (t test[8]: t = -7.68, p < 0.001). Between these two risk groups (multiple birth and cardiac risk), differences in antenatal costs were not significant (t test: t = 0.81, p = 0.420).

[4] Test conducted on Down's risk and normal women combined vs. cardiac risk vs. multiple births women
[5] Test conducted on Down's risk, normal women and cardiac risk women combined vs. multiple births.
[6] Same as footnote 2
[7] Same as footnote 2
[8] Same as footnote 2

The obstetric mean cost for multiple birth maternities was approximately £1,000 greater than for singleton maternities in all risk groups and the difference was always significant (e.g. multiple birth vs. cardiac risk - t test: $t = -7.10$, $p < 0.001$). The difference was attributable to 63% of multiple birth women having a caesarean section and requiring longer stays to recover compared with 30% of all singleton women (36% for cardiac risk women), and possibly because mothers of twins, who had lower birthweights, stayed on until the babies were ready for discharge.

Modelling (Table 4)

We wanted to determine what demographic characteristics and risk factors were important predictors of the cost of maternity care for singleton and multiple pregnancies. We concentrated on the 244 cardiac risk women and the 244 multiple birth women, as these groups had similar demographic characteristics. This should help us identify what patient attributes are driving these cost differentials.

Demographic characteristics and risk factors (Appendix 2)

The first step for the modelling process was to identify for these two groups those demographic characteristics and risk factors which may have a potential impact on costs. The table in Appendix 2 shows that cardiac risk women were: slightly younger; a significantly larger proportion were multiparous; and a higher proportion reached full term in comparison with mothers of multiple pregnancies. According to the risk factors, a quarter had Type 1 diabetes, and another quarter was on anti-epileptic therapy, and the remainder had a family history of congenital heart disease or chromosomal abnormality.

How might these patient attributes generally influence costs?

- Mother's age – older women may require extra antenatal monitoring for physiological reasons;
- Parity – primaparous mothers may get extra antenatal care. They are also more likely to have a hospital birth than a home birth to minimise the risk of complications arising during delivery;
- Gestation at time of anomaly scan – if they had an anomaly scan early in their second trimester, they may have additional antenatal check-ups before delivery;

- Gestation at time of delivery – if a mother has a pre-term delivery because of complications she may require additional obstetric care, even though her period of antenatal care has been shortened;
- Diabetes – if women are diabetic, this may lead to maternal complications, and the women may require extra antenatal and obstetric care [CEMACH, 2005];
- Anti-epileptic therapy – if they are on anti-epileptic therapy, this may lead to maternal complications, and they may require extra antenatal and obstetric care [Marrow, 2006]; and
- Family history of congenital heart disease or chromosomal abnormality – maternal congenital heart disease may lead complications, and may require extra antenatal and obstetric care [Uebing, 2006].

Determining demographic characteristics and risk factors for costs

The next step was to fit individual regression models to the variables listed in Appendix 2, in order to determine which factors were significantly related to antenatal costs and to obstetric costs (results are not shown in this paper). The risk factors which were significantly related to antenatal costs were: whether the woman had Type 1 diabetes ($p = 0.003$); and whether they had a family history of congenital heart disease or chromosomal abnormality ($p = 0.023$). Likewise, risk factors and demographic characteristics which were significantly related to obstetric costs were: parity ($p < 0.001$); gestation at time of delivery ($p < 0.001$); and Type 1 diabetes ($p < 0.001$).

Model results

Multivariate regression analysis was applied to antenatal and obstetric costs in order to establish all significant factors that affect costs (Table 4). For antenatal costs the multivariate model shows two variables which were significant predictors: Type 1 diabetes; and anti-epileptic therapy. The costs per type of pregnancy (cardiac risk or multiple birth) did not differ significantly between groups ($p = 0.193$). The reduced model for obstetric costs found three significant predictors: Type 1 diabetes; parity; and gestation in weeks at time of delivery. Further, multiple births were, on average, £804 more costly than cardiac risk births ($p < 0.001$).

Discussion

Representativeness of the datasets. The project was carried out in 4 district hospitals over 15 months in 2001-02, with a total caseload of 17,700 maternities. A total of 263 multiple pregnancies were identified, giving a rate per 1000 for all maternities of 14.9 which is the virtually same as the national rate of 15.0 [ONS, 2005]. We do not know, however, the proportion of women with multiple pregnancies whose conception was assisted. Among the women with singleton pregnancies, 61 were identified as having pre-gestational Type 1 diabetes and there were four diabetic women with multiple pregnancies. Thus the rate of diabetic Type 1 cases per 1,000 all maternities was 3.6, which is higher than the rate of 3.0 for South East England recorded in the 2002-03 audit of maternity units for the Confidential Enquiry into Maternal and Child Health [CEMACH, 2005]. Around 2500 women with epilepsy in the United Kingdom give birth annually [UK Epilepsy & Pregnancy Register, 2006] or 1.8 per 1000 maternities; in our cohort, the rate was substantially higher at 3.3 (58 women). Our higher rates for diabetes and epilepsy may have been attributable to our reliance on the TelePaed facilitators in the district hospitals monitoring all maternity records for eligible cases to enter in the project's audit database. It is also likely to be due to the fact that the TelePaed study purposely focused on women at risk and thus the ratio of normal to at risk women from our sample might not be representative of the population of pregnant women.

Comprehensiveness of the costs. Whilst the study took place in four district maternity services, the derived costs of maternity care may not be nationally representative because of variations in the delivery of care, including different policies regarding admission to prenatal wards during the antenatal period (a point noted by Henderson and Petrou [Henderson and Petrou, forthcoming]. Moreover, our antenatal costs apply from midway through the second trimester when the women underwent their anomaly scan (The reason for monitoring resource events from this time point is that structures of the fetal heart can be satisfactorily imaged via telemedicine from 18 weeks gestation). Thus we omitted two or more ultrasound scans performed earlier in the women's pregnancies and a blood serum screening test for Down's syndrome that was offered to all women, as well as chromosomal diagnostic procedures (e.g. amniocentesis) performed on selected women in the Down's syndrome risk group.

A prenatal bed was the costliest antenatal resource, with a weighted bed day costing £280. Our analysis found that women with multiple pregnancies and singleton women with cardiac risk factors who were admitted to these beds stayed for a total of 4 or 5 days on average, significantly more than the 2 to 3 days for Down's risk and normal singleton women. Henderson and Petrou likewise observed over two years, 1996 and 1997, in North West Thames, that the duration of antenatal bed-days for mothers of twins was nearly twice the duration for singleton mothers (5.24 vs. 2.68 in 1997), although in 1998 there was no difference between the two cohorts [ibid].

The most costly obstetric resource was mode of delivery, with the weighted costs for a spontaneous vaginal delivery and a caesarean section being £941 and £1,604 respectively. These costs (in 2001-02 prices) are comparatively similar to those identified in Scotland by Petrou and Glazener - £712 and £1,733 in 1999-2000 prices [Petrou and Glazener, 2002]. Their Scottish study was confined to singleton maternities and 14.5% of the deliveries were by caesarean section. In contrast, the caesarean section rates for our Down's risk and normal women were 26% and 29% respectively, and 36% for the cardiac risk women (In England, in 2001, the rate overall was 21% [NCCWCH, 2004]). More striking still in our study was the multiple pregnancy caesarean section rate of 63%, which far exceeded the rate of 40% for IVF twin pregnancies in the Netherlands [Lukassen, 2004]. The type of delivery naturally impacted on the length of time women remained on the postnatal wards before discharge. For mothers of twins or triplets (in 5 cases), the mean duration overall was 5.6 (SD 4.0) days, compared with 3.4 (SD 2.7) for cardiac risk women. Thus the mean cost of obstetric care for the multiple pregnancy mothers was significantly more costly.

Impact of diabetes on maternity care. The identification of Type 1 diabetes in the multivariate model as a significant predictor of costlier antenatal and obstetric care is entirely consistent with epidemiological evidence from national audits of diabetic pregnancies. Blood glucose levels require careful monitoring, so women may attend diabetic clinics as well as antenatal clinics. The events around childbirth are also more acute: in the audit of diabetic pregnancies in England, Wales and Northern Ireland, delivery before 37 weeks gestation was five times that in the general population, and the caesarean section rate overall was 67% [CEMACH, 2005]. The audit covered women with Type 1 and Type 2 diabetes, whereas our study concentrated on women with Type 1 disease only. The prevalence of Type 2 diabetes is about half that for Type 1, but the annual incidence of Type 2 disease is growing and these women experience similar levels of complications during pregnancy as Type 1 women [CEMACH, ibid].

Further, the results from our multivariate modelling also confirmed our pre-model hypothesis relating to parity, gestation and anti-epileptic drugs, although mother's age was not shown to be a significant driver of costs in the multivariate models.

Conclusion. Our analyses of a dataset covering cohorts of women receiving maternity care in four district hospitals have confirmed that the cost of maternity care from midway through the second trimester is substantially higher for multiple pregnancies than most singleton pregnancies – the comparative mean costs (SD) overall were £4,428 (£1,971) vs. £2,755 (£1,546) for singleton women with an elevated serum test result and £2,616 (£1,105) for normal women. We have also shown that diabetic pregnancies are particularly costly – the overall mean cost (SD) for 61 singleton women being £4,745 (£2,167). This finding is important, because there are public health concerns that standards of care for these women are often not optimal prior to conception, or during pregnancy, to the obvious detriment of mother and baby. Our results should help inform decision makers in the UK about key drivers of maternity costs.

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Table 1: Demographic characteristics and birth outcomes

	Singleton pregnancies			Multiple pregnancies n = 244
	Down's risk n = 322	Cardiac risk n = 244	Normal n = 163	
Age				
Mean (SD)	32.7 (6.2)	28.7 (5.6)	31.1 (5.8)	29.7 (5.0)
Median	34	29	31	30
IQR	29 to 37	24 to 33	28 to 36	27 to 33
Parity				
Primaparous	107 (33.2%)	58 (23.8%)	53 (32.5%)	101 (41.4%)
Multiparous	214 (66.5%)	185 (75.8%)	109 (66.9%)	141 (57.8%)
Unknown	1 (0.3%)	1 (0.4%)	1 (0.6%)	2 (0.8%)
Gestation at anomaly scan				
≤ 18 weeks	135 (41.9%)	15 (6.1%)	6 (3.7%)	13 (5.3%)
19 - 21 weeks	102 (31.7%)	146 (59.8%)	121 (74.2%)	157 (64.3%)
≥ 22 weeks	85 (26.4%)	83 (34.0%)	36 (22.1%)	74 (30.3%)
Gestation at time of delivery				
≤ 25 weeks	0 (0.0%)	1 (0.4%)	0 (0.0%)	2 (0.8%)
26-30 weeks	2 (0.6%)	6 (2.5%)	1 (0.6%)	9 (3.7%)
31-35 weeks	22 (6.8%)	19 (7.8%)	4 (2.5%)	82 (33.6%)
36-37 weeks	26 (8.1%)	53 (21.7%)	9 (5.5%)	82 (33.6%)
38-39 weeks	96 (29.8%)	78 (32.0%)	61 (37.4%)	61 (25.0%)
40 weeks	69 (21.4%)	45 (18.4%)	41 (25.2%)	5 (2.0%)
≥ 41 weeks	107 (33.2%)	42 (17.2%)	47 (28.8%)	3 (1.2%)
Birthweight (in kgs)				
Number of babies*	312	234	158	491**
Mean (SD)	3.4 (0.7)	3.4 (1.2)	3.4 (0.5)	2.4 (0.6)
Median	3.5	3.4	3.4	2.4
IQR	3.1 to 3.8	2.9 to 3.8	3.1 to 3.7	2.0 to 2.8
*Baby outcome****				
Normal	315 (97.8%)	229 (93.9%)	156 (95.7%)	483 (98.0%)#
Abnormal heart	4 (1.2%)	8 (3.3%)	1 (0.6%)	7 (1.4%)
Abnormal	0 (0.0%)	3 (1.2%)	1 (0.6%)	1 (0.2%)
Multi-organ abnorm.	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (0.4%)
Unknown	3 (0.9%)	4 (1.6%)	5 (3.1%)	0 (0.0%)

* Not all birthweights were recorded
** In total, there were 493 babies (239 women were expecting twins and 5 were expecting triplets), however, 2 birthweights were not recorded
*** The majority of births were live, however there were 8 still births (1 for both Down's and normal group, 2 for the cardiac risk group and 4 for the multiple births group)
# In total, there were 493 babies (239 women were expecting twins and 5 were expecting triplets).

Table 2: Length of stay (in days) per woman on pre-natal and post-natal wards

	Singleton pregnancies			Multiple pregnancies
	Down's risk n = 322	**Cardiac risk n = 244**	**Normal n = 163**	**n = 244**
Pre-natal stay (until 48 hrs prior to admission to labour ward)				
Number of women	86	102	65	115
Mean (SD)	3.3 (3.8)	5.0 (6.4)	2.5 (2.4)	4.0 (4.0)
Median	2.0	3.0	2.0	3.0
IQR	1.0 to 4.0	1.0 to 5.0	1.0 to 3.0	1.0 to 5.0
Pre-natal stay (within 48 hrs of admission to labour ward)				
Number of women	94	89	45	113
Mean (SD)	1.5 (2.2)	2.8 (5.1)	1.2 (1.1)	2.7 (4.7)
Median	1.0	1.4	0.8	1.4
IQR	0.6 to 2.0	0.7 to 2.9	0.5 to 2.0	0.6 to 2.7
All post-natal stay				
Number of women	264	199	129	228
Mean (SD)	3.2 (3.2)	3.4 (2.7)	2.7 (1.8)	5.6 (4.0)
Median	2.4	3.2	2.5	4.6
IQR	1.4 to 4.0	1.5 to 4.3	1.2 to 3.6	3.3 to 6.4

Table 3: Bootstrapped costs for pregnant women

	Antenatal costs	**Obstetric costs**
Singleton pregnancies		
Down's risk		
N	322	322
Mean (SD)	£596 (£757)	£2,158 (£1,215)
95% CI	£530 to £701	£2,033 to £2,296
Cardiac risk		
N	244	244
Mean (SD)	£1,136 (£1,395)	£2,434 (£1,364)
95% CI	£982 to £1,329	£2,284 to £2,625
Normal		
N	163	163
Mean (SD)	£598 (£632)	£2,018 (£816)
95% CI	£510 to £709	£1,905 to £2,159
Multiple pregnancies		
N	244	244
Mean (SD)	£1,043 (£990)	£3,384 (£1,610)
95% CI	£934 to £1,188	£3,213 to £3,642
Statistical test (All groups)	F test: $F_{3, 969} = 19.98$, $p < 0.001$	F test: $F_{3, 969} = 52.54$, $p < 0.001$

Table 4: Multivariate regression reduced model for antenatal and obstetric costs

	Coefficient	Standard error	t	p value
Antenatal costs				
Type of pregnancy				
Cardiac risk births	Base	*	*	*
Multiple births	165.758	127.083	1.30	0.193
Diabetes				
Yes	629.413	176.904	3.56	< 0.001
No	Base	*	*	*
Anti-epileptic therapy				
Yes	476.795	184.519	2.58	0.010
No	Base	*	*	*
Constant	864.787	103.702	8.34	< 0.001
Obstetric costs				
Type of pregnancy				
Cardiac risk births	Base	*	*	*
Multiple births	803.896	153.637	5.23	< 0.001
Parity				
Primaparous	Base	*	*	*
Multiparous	-567.646	139.691	-4.06	< 0.001
Gestation at time of delivery	-89.244	23.974	-3.72	< 0.001
Diabetes				
Yes	689.742	207.489	3.32	0.001
No	Base	*	*	*
Constant	2795.819	150.501	18.58	< 0.001

Appendix 1: Weighted costs for key resource components of antenatal and obstetric care and the numbers of women who used the items

Resource components and number of women for whom the event occurred <u>at least once</u>	Weighted cost (£)	Singleton pregnancies			Multiple pregnancies
		Down's risk (n = 322)	Cardiac risk (n = 244)	Normal (n = 163)	(n = 244)
1. Antenatal ultrasound scans at the district hospitals i.e. anomaly scan or other scans	£22.71	317	240	163	240
2. Antenatal ultrasound scans at the specialist hospitals :					
• Specialist scan	£42.63	50	56	1	59
• Specialist's time (20 mins)	£12.73	50	56	1	59
3. Antenatal clinics *Variable costs:* Hospital or community antenatal or other (review):					
• Nursing staff, admin/clerical staff, consumables, equipment, overheads, and capital costs	£36.00 - £50.51	322	244	163	244
Fixed costs: (mean time in clinics)					
Consultants' time (12.5 mins)	£7.80	-	-	-	-
Midwives' time (10.7 mins)	£2.33	-	-	-	-
4. Telemedicine consultation					
• TM equipment, ISDN-6 line installation and maintenance contract, ISDN line rental and call charges (including cost of specialist consultant, DGH clinician and TM coordinator),	£143.00	4	33	0	0
5. Pre-natal maternity bed day: • Nursing staff, admin/clerical staff, consumables, equipment, overheads and capital costs					
- Until 48 hours prior to admission to labour ward	£279.84	86	102	65	115
- Within 48 hours of admission to labour ward or obstetric theatre	£279.84	94	89	45	113
6. Labour/delivery bed day: • Nursing staff, admin/clerical staff, consumables, equipment, overheads and capital costs	£412.09	312	236	158	243
7. Blood products	-	19	5	7	27
8. Mode of delivery*:					
• Normal birth	£941.16	207	126	100	69
• Forceps birth	£1,043.81	3	7	5	8
• Ventouse birth	£1,026.47	14	14	6	11
• Caesarean birth	£1,603.80	85	88	47	154
• Water birth	£1,013.75	3	1	0	1
• Home birth	£480.75	9	7	5	0
9. Post natal maternity bed day: • Nursing staff, admin/clerical staff, consumables, equipment, overheads and capital costs	£281.90	264	199	129	228

* Three women gave birth in the specialist hospitals (one was a normal birth and the other two were delivered by caesarean section)

Appendix 2: Demographic characteristics and risk factors for pregnant women of cardiac risk used in the multivariate regression models

Demographic characteristics and risk factors	Cardiac risk (n = 244)	Multiple pregnancies (n = 244)
Age		
Mean (SD)	28.7 (5.6)	29.7 (5.0)
Median	29	30
IQR	24 to 33	27 to 33
Parity		
Primaparous	58 (23.8%)	101 (41.4%)
Multiparous	185 (75.8%)	141 (57.8%)
Unknown	1 (0.4%)	2 (0.8%)
Gestation at anomaly scan		
≤ 18 weeks	15 (6.1%)	13 (5.3%)
19 - 21 weeks	146 (59.8%)	157 (64.3%)
≥ 22 weeks	83 (34.0%)	74 (30.3%)
Gestation at time of delivery		
≤ 30 weeks	7 (2.9%)	11 (4.5%)
31-35 weeks	19 (7.8%)	82 (33.6%)
36-37 weeks	53 (21.7%)	82 (33.6%)
38-39 weeks	78 (32.0%)	61 (25.0%)
40 weeks	45 (18.4%)	5 (2.0%)
≥ 41 weeks	42 (17.2%)	3 (1.2%)
Type 1 diabetes		
Yes	61 (25.0%)	4 (1.6%)
No	183 (75.0%)	240 (98.4%)
Anti-epileptic therapy		
Yes	57 (23.4%)	2 (0.8%)
No	187 (76.6%)	242 (99.2%)
Family history of congenital heart disease and/or chromosomal abnormality		
Yes	120 (49.2%)	13 (5.3%)
No	124 (50.8%)	231 (94.7%)

Age: $t = -2.02$, $p = 0.044$; Parity: $\chi_1^2 = 17.90$, $p < 0.001$; Gestation at anomaly scan: $t = 0.59$, $p = 0.555$; Gestation at delivery: $t = 9.39$, $p < 0.001$; Diabetes: $\chi_1^2 = 57.67$, $p < 0.001$; Anti-epileptic therapy: $\chi_1^2 = 58.32$, $p < 0.001$; and Family history: $\chi_1^2 = 118.33$, $p < 0.001$.