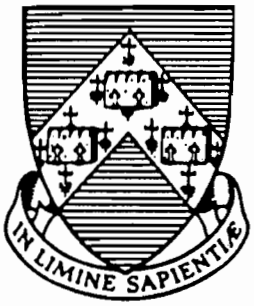

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The costs of induction of labour by Prostaglandin E_2 or Oxytocin: Refining the estimates

by
Linda Davies and Michael Drummond

DISCUSSION PAPER 109

THE COSTS OF INDUCTION OF LABOUR BY PROSTAGLANDIN E_2 OR OXYTOCIN: REFINING THE ESTIMATES

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ABSTRACT

Approximately 17.5% of all pregnancies in England are induced. Induction of labour may be required for several reasons. These include hypertension, intra-uterine growth retardation, diabetes, poor weight profile of the mother and prolonged pregnancy. The two principal methods used to induce labour are artificial rupture of the membrane (ARM) with or without oxytocin and prostaglandin E_2 (PGE_2). Both methods have been shown to be effective. However, there are substantial differences in the acquisition costs of the drugs. The cost of oxytocin is approximately 18 pence per 5 units compared to £21 for PGE_2. However, there are likely to be differences in the costs of other health care services associated with induction of labour. This means that it is important to examine the broader costs and consequences of these two methods of induction, particularly as it is a frequently applied procedure with large resource consequences.

A preliminary economic evaluation of PGE_2, compared with oxytocin and ARM found that, when the broader costs and consequences were considered, PGE_2 for women with an unripe cervix was cost neutral or cost saving under many assumptions. In the case of women with a ripe cervix, savings in the use of health care resources would only partially offset the additional cost of PGE_2.

Due to a lack of data, the earlier analysis was based upon a number of assumptions about the level of health care resources used in the management of labour and complications associated with childbirth, and limited clinical data of effectiveness. The results of the analysis were shown to be sensitive to changes in the assumptions made about resource use and the probability values used. When economic evaluation results are sensitive to key

assumptions or data, the appropriate response is to attempt to collect better data where feasible. Health care purchasing decisions need to be based on reliable and up–to–date information. The objective of this paper is to refine the earlier estimates and also to assess the reliability of the previous study.

In the primary analysis for this study, the expected net saving of PGE_2 was £50 for women with an unripe cervix. This was slightly lower than the expected net saving estimated in the previous study. In contrast, the expected net saving of PGE_2 for women with a ripe cervix in this study was £5 compared to an expected net cost of £17 in the first analysis.

Overall, the conclusions of this analysis confirm those of the previous evaluation for women with an unripe cervix, but not for women with a ripe cervix. Given the growing importance being attached to economic evaluation results in health care decision making, consideration should more often be given to refining the estimates of earlier evaluations as new data become available.

INTRODUCTION

Induction of labour may be required for several reasons. These include hypertension, intra-uterine growth retardation, diabetes, poor weight profile of the mother and prolonged pregnancy. The induction rate for England in 1985 was 17.5% of all pregnancies (Department of Health and Office of Population Censuses and Surveys, 1988). This would suggest that approximately 114,300 women had labour induced in 1990 (Royal College of Obstetricians and Gynaecologists, 1991).

The two principal methods used to induce labour are artificial rupture of the membrane (ARM) with or without oxytocin and prostaglandin E_2 (PGE_2). Induction by ARM and oxytocin has been shown to be an effective method for women in whom cervical ripening has taken place. However, ARM and oxytocin is less effective in inducing labour for women with an unripe cervix. If the induction fails following ARM then caesarian section is required (Kurup et al, 1991, Noah et al, 1987). Furthermore, ARM before the onset of uterine contractions can be a painful procedure. The addition of intravenous oxytocin requires sophisticated infusion equipment and limits the mobility of the woman. Many women find this method of induction to be unpleasant (Kennedy et al, 1982a). PGE^2 appears to be equally effective in inducing labour for women with a ripe cervix, and is associated with a lower rate of failed inductions in women with an unripe cervix. Furthermore, the drug is less invasive, is thought to result in a more natural labour, and is associated with a higher level of mobility during labour.

There is a substantial difference in the acquisition cost or purchase price of oxytocin and PGE_2. The purchase price of oxytocin is approximately 18 pence per 5 units, compared to £21 for PGE^2 (MIMS, 1991) used at the dosage levels suggested by the literature. Although not a significant extra cost for a given woman, the total impact on the pharmacy budget of a hospital may mean that this expenditure comes under close scrutiny.

However, it is also important to examine the broader costs and benefits of these two methods of induction. These include the costs of the drugs themselves, the costs of nursing and medical time in monitoring labour and the costs of managing complications such as failed induction and post partum haemorrhage. In addition, there are other non financial consequences, such as the pain and suffering associated with the complications of labour and the utility or disutility associated with the process of labour and type of delivery.

In 1990 Davies and Drummond (Davies and Drummond, 1991) undertook an economic evaluation of PGE_2, compared with oxytocin and ARM. Their conclusion was that, when the broader costs and consequences were considered, PGE_2 for women with an unripe cervix was cost neutral or cost saving under many assumptions. In the case of women with a ripe cervix, savings in the use of health care resources would only partially offset the additional cost of PGE_2.

Due to a lack of data, the earlier analysis was based upon a number of assumptions about the level of health care resources used in the management of labour and complications associated with childbirth. In addition, data on the probability of events were derived from a few small clinical trials of PGE_2 and a meta analysis of clinical trials of all prostaglandins

and oxytocins. The results of the analysis were shown to be sensitive to changes in the assumptions made about resource use and the probability values used.

When economic evaluation results are sensitive to key assumptions or data, the appropriate response is to attempt to collect better data where feasible.

However, this is seldom done, so the reliability of economic studies is rarely assessed. In this case it was possible to collect more data about health care resource use and costs and the probability of events. The objective of this paper is to refine the earlier estimates and also to assess the reliability of the previous study.

METHODS

Approach

The aim of the initial economic evaluation was to compare the direct health care costs to the hospital or maternity unit of induction by oxytocin plus artificial rupture of the membranes (ARM) and PGE_2. The direct health care costs were calculated from estimates of resources used for induction of labour and events associated with childbirth and the unit costs (prices) of those resources. The cost data were then combined with probability data to estimate the expected costs of the alternative methods of induction. The same approach was used in this second analysis to ensure comparability of results.

Analytic framework

Decision analysis was used to assess the expected costs and consequences of induction by oxytocin plus ARM or PGE_2. The analysis was undertaken for two cases: women with unripe cervix (Bishop score of 4 or less) and women with ripe cervix (Bishop score of 5 or more). No distinction was made between primigravida and multigravida women owing to a lack of data. In each case the analysis started from the point at which, for whatever reason, induction of labour was indicated. The decision trees used for both the initial and subsequent analyses were very similar. However, additional information has meant that the clinical decision path has been modified. The decision tree is described below.

The decision tree for a woman with an unripe cervix is shown in Figure 1. Decision nodes are indicated by boxes and chance nodes by circles. The flows are from left to right and the probabilities at any chance node sum to unity (Weinstein and Fineberg, 1980). For a woman with an unripe cervix a choice has to be made between immediate formal induction with intravenous oxytocin plus ARM, or administration of PGE_2 to encourage cervical ripening (decision node A in Figure 1).

If formal induction is chosen there are two possible occurrences: either labour starts or does not start (chance node B in Figure 1). In this analysis, if labour starts there are three possible events: spontaneous delivery, instrumental delivery or emergency intrapartum caesarian section (chance node C). The previous evaluation did not include the possibility of intrapartum caesarian section. Following delivery there is a chance that post partum

haemorrhage of greater than 500 mls could occur requiring blood transfusion (chance node D). If labour does not start, emergency antepartum caesarian section is necessary.

If PGE_2 is administered either labour will start or not start in the cervical ripening period (12 hours) (chance node F). In the latter case formal induction with oxytocin and ARM will be carried out. There is also the possibility of caesarian section within the cervical ripening period. However, this was not considered since the probability is very low at less than 1% (Noah et al, 1987).

As before, delivery can be spontaneous, instrumental or by emergency intrapartum caesarian section, and post partum haemorrhage requiring blood transfusion may or not may not occur. Emergency antepartum caesarian section will again be indicated in women not starting labour after formal induction. The key differences between induction by PGE_2 and oxytocin are in the probabilities of emergency intrapartum and antepartum caesarian section, instrumental delivery and post partum haemorrhage requiring blood transfusion. These have consequences both for resource use and quality of care.

For women with a ripe cervix the choice is between induction with PGE_2, followed by oxytocin and ARM in those women not starting labour, or formal induction with oxytocin and ARM. The possible sequences of events are the same as above, although the probabilities may differ.

Probability of events

For women with an unripe cervix, the main source of data for probability values in the initial study was one controlled multicentre trial of PGE_2 in 416 women and 404 controls. The probability values for this evaluation were taken from the results of a meta-analysis of three pre-registration clinical trials of PGE_2 in 884 women and 847 controls (Hass, 1993). For women with a ripe cervix, the probability values for the primary analysis were taken from a published controlled trial of induction of labour with PGE_2 versus oxytocin plus ARM. These were the same as the values for the initial evaluation.

Resource use

The original economic evaluation was based on resource use data for induction and labour. This included the quantities of drugs used, midwifery time to monitor progress from induction to membrane rupture and from membrane rupture to delivery and the probability of epidural anaesthesia during labour. It was assumed that a midwife would be present for 50% of the time to monitor progress from induction to delivery. The estimates of midwifery time were therefore based on the length of time from induction to membrane rupture and membrane rupture to delivery. In this analysis, the costs of equipment for ARM, infusion of oxytocin, fetal monitoring and epidural anaesthesia have been included. In addition, it is assumed that a midwife would be present all of the time from cervical ripening and induction to delivery. This assumption biases the analysis against PGE_2. The use of PGE_2 involves a period of time for cervical ripening, which is not required by the use of oxytocin and ARM.

The resources used for events associated with childbirth included staff time, equipment and supplies and any additional length of inpatient stay for post natal care. The health care resources used for the induction of labour and events associated with childbirth were estimated from published studies and expert opinion. The quantity of all the resources used have been revised for this analysis.

Unit costs (prices)

The unit costs of resources used in the initial evaluation were calculated for 1988/89. These have been updated to 1991/93 prices for this analysis. The unit costs (prices) of staff time, operating theatre and supplies, drug therapy were calculated from national statistics and published literature for the UK. The cost per day of additional inpatient stay was modified for this analysis. The first evaluation calculated the cost of additional stay as the cost of medical and nursing staff required for post natal care (Mugford et al, 1989). The estimate used here also includes the cost per day of patient related and non patient related general services for maternity units (CIPFA, 1989). The unit costs of other consumables were estimated from the price of the items to an NHS hospital and RHA purchasing department.

The unit cost of infusion and monitoring equipment was estimated as the annual equivalent cost of the equipment (Richardson and Gafni, 1983), plus annual maintenance costs, divided by the estimated number of births per year requiring the equipment[1].

The prices were expressed in 1991/92 prices, adjusted where necessary by Hospital and Community Health Services price index (NAHA, 1990, NAHAT, 1991).

Sensitivity analysis

Conservative assumptions in favour of oxytocin plus ARM were used throughout the analysis. However, the values for certain key assumptions were uncertain. A sensitivity analysis was conducted to assess the impact of different assumptions on the study results. By varying the values of key probability and cost parameters it was possible to assess their impact on the expected costs of each method of induction. Minimum and maximum values for the probability estimates were obtained from a meta-analysis of published and unpublished trials of all prostaglandins and oxytocin, and published controlled trials of PGE_2 and oxytocin plus ARM. Minimum and maximum values for resource use and unit costs were generated from the published literature where available.

RESULTS

Probability of events

The probability of events occurring are shown in Table 1 for women with an unripe cervix and Table 2 for women with a ripe cervix. In each table where the estimates have been modified for this analysis, the estimates for the first evaluation are also given. In both cases the probability of events associated with childbirth were lower for induction with PGE_2 than for oxytocin plus ARM.

For women with an unripe cervix, the probability of labour starting during the cervical ripening period following PGE_2 was estimated at 0.44, which was lower than the figure used

in the first study (0.58). This meant that 56% of women who had PGE_2 also required induction with oxytocin plus ARM. The probabilities of antepartum caesarian section, instrumental delivery, epidural anaesthesia and post partum haemorrhage greater than 500 mls were higher for those women who received oxytocin plus ARM only than those women who also had PGE_2. However, the probability of intra partum caesarian section was higher for women who had PGE_2 than for those who did not. In addition, all of the estimates of the probability of these events occurring differed from those used in the first analysis. In particular, the probability of labour starting following formal induction was lower for this evaluation than the previous estimates.

For women with a ripe cervix induced by PGE_2, it was estimated that 25% of women would need ARM. In addition, 8% of these women would also require oxytocin. The probability that labour would start following induction was high for both methods (0.98 for PGE_2 +/− oxytocin and ARM and 0.96 for oxytocin plus ARM). As for women with an unripe cervix the probabilities that women would need emergency caesarian section, instrumental delivery and epidural anaesthesia were higher for those women who were induced by oxytocin plus ARM only, than for those who received PGE_2. It was also estimated that the probability of post partum haemorrhage greater than 500 mls was higher for women induced by oxytocin plus ARM only.

Again the probability of events associated with childbirth occurring were slightly modified for the women who received PGE_2. However, no changes were made to the estimates for women who did not have PGE_2.

Unit costs of resources

The unit costs or prices of resources used in the induction of labour and events associated with childbirth are shown in Table 3 for both studies. There were differences between the initial study and this analysis in the unit costs of resources. This was due partly to updating the costs of resources to 1991/92 prices. In addition information on the costs of equipment were not available for the first study, but have been included in the current study.

Furthermore, the costs of some resources were re-estimated using additional information. The cost of oxytocin was reduced substantially, as information on the quantity used became available. The cost of cross matching tests for blood transfusions was taken from one NHS hospital in the first analysis. In this evaluation a more conservative estimate from a non commercial pathology laboratory was used.

The costs of additional inpatient length of stay in the first study were based on the costs reported by Mugford et al (1989). These included the costs of medical and nursing staff, supplies and equipment, microbiology, pharmacy, miscellaneous treatment and diagnostic tests, administration, hotel and overhead costs for all women having a caesarian section. The costs of many of these services were substantially higher than the national average cost reported for obstetric care (CIPFA, 1989). The costs for this second analysis were revised to include the medical and nursing staff costs estimated by Mugford et al, which were based on measurements of staff time in one maternity hospital, and the national average costs of general services reported by CIPFA (1989).

The purchase price of infusion pumps and fetal monitors were estimated at £705 and £5169 respectively. It was assumed that the equipment would be used for 5 years and have no resale or scrap value at the end of this time. The annual equivalent costs of an infusion pump was £167 and that of a fetal monitor was £1228. The annual maintenance costs for the equipment were £150 (infusion pump) and £400 (fetal monitor). The total annual costs of an infusion pump and fetal monitor were £317 and £1628 respectively. It was assumed that the equipment would be dedicated to the maternity ward or unit and would only be used for women requiring induction. The average number of inductions per hospital per year was estimated at 525 (Royal College of Obstetricians and Gynaecologists, 1991, Department of Health and Office of Population Censuses and Surveys, 1988). The cost of equipment per induction was calculated as the total annual cost divided by the average number of inductions per year.

Resource use and costs of events associated with childbirth

Tables 4 and 5 present the average resource use and costs of events associated with childbirth used for both economic evaluations. In this second analysis, the average cost of epidural anaesthetic during labour was estimated as £23 (range £21–£26). The average cost of caesarian section was estimated at £983 per caesarian section. The cost ranged between £765 and £1201, depending on the average length of additional stay used. The average cost of instrumental delivery was estimated at £246 with a range of £28–£464 if alternative estimates of the additional length of inpatient stay were used. The average cost of blood transfusion for women with post partum haemorrhage greater than 500 mls was £30.

Overall the costs were higher for the present study than the initial analysis. This was due to differences in resource use estimates as well as changes to the estimates of unit costs. In particular, higher estimates of additional length of stay following instrumental delivery and caesarian section were used for this evaluation. The first analysis calculated the additional length of stay for caesarian section as the average length of stay for caesarian section (7 days) reported by the Oxford obstetric data system (Mugford et al, 1989), minus the national average length of post natal stay (4 days) for all deliveries (Department of Health and Office of Population Censuses and Surveys, 1988). Data was not available for the additional length of stay following instrumental delivery, so a best guess figure of 1 day was used.

In this analysis, the additional length of stay was based on data from the St. Mary's Maternity Information System for 1988. This covered approximately 37,000 singleton births in 17 hospitals in the North West Thames Health Region (Clark et al, 1991). Detailed information on the average length of stay by type of delivery was available from this system. The average length of post natal stay was 2 days for women having a spontaneous vaginal delivery, 4 days for women having an instrumental delivery and 7 days for women who had an emergency caesarian section.

Resource use and costs of induction and labour

Details of the resources used for induction and labour are given in Tables 6 and 7 for women with unripe and ripe cervix. Tables 8 and 9 present the average costs of induction and labour for both cases.

For this analysis, the average costs of induction and labour for women with an unripe cervix were higher than for women with a ripe cervix. The average costs of induction by PGE_2 and subsequent labour were £131 and £97 respectively. For women induced by oxytocin plus ARM only the average costs of induction and labour were £18 and £123 respectively.

For women with a ripe cervix, the average cost of induction by PGE_2 only was £70. This ranged from £39 to £104 if minimum and maximum estimates of the time from induction to membrane rupture are used. In contrast, the average cost of induction by oxytocin plus ARM only was £18. The average cost of labour following induction by PGE_2 was £48 (range £19–£118). This was lower than the cost of labour following induction by oxytocin plus ARM only (£74, range £35–£194).

Overall the estimates of resource use and costs of induction and labour were higher for this analysis than those used previously. This was for two reasons. First, this analysis assumed that a midwife would be present all the time during induction and labour, compared to 50% of the time in the previous study. Second, data on the use and costs of a range of equipment were not available for the first evaluation, but were included in this analysis.

Expected savings (costs) of induction by PGE_2

Tables 10 and 11 present the expected costs per woman of induction by PGE_2 and oxytocin plus ARM for the primary analysis using base case estimates. The tables also include the results of the sensitivity analysis for those variables which had a substantial

impact on the level of net savings (costs) associated with PGE_2.

In the primary analysis for this study, the expected net saving of PGE_2 was £50 for women with an unripe cervix. This was slightly lower than the expected net saving estimated in the previous study. In contrast, the expected net saving of PGE_2 for women with a ripe cervix in this study was £5 compared to an expected net cost of £17 in the first analysis.

In both the ripe and unripe cervix cases the results of this analysis were sensitive to estimates of resource use and costs of caesarian section and instrumental delivery. If lower estimates of the additional length of stay for these procedures were used, PGE_2 resulted in a net cost of £11 for women with a ripe cervix. For women with an unripe cervix the net saving associated with PGE_2 was reduced to £8. If it was assumed that only part of the costs of caesarian section and instrumental delivery are saved (ie costs of additional inpatient stay), then PGE_2 resulted in net costs of £5 for women with a ripe cervix and £33 for women with an unripe cervix.

In addition, the results of the analysis for women with an unripe cervix were sensitive to the probability estimates used for caesarian section and instrumental delivery. If lower rates of all caesarian section and instrumental delivery are used then PGE_2 results in a net cost of £44.

In contrast, the results of the previous evaluation were not so sensitive to changes in the values of key parameters. For women with a ripe cervix the use of PGE_2 resulted in a net expected cost for all the variables tested. For women with an unripe cervix, there were

expected net savings regardless of the values assigned to key parameters.

DISCUSSION

This analysis has demonstrated that although the acquisition cost of PGE_2 is higher than that of oxytocin, the expected cost of PGE_2 to the hospital is likely to be lower than that of oxytocin. The expected cost to the hospital of the alternative strategies include a number of clinical and economic variables, such as the probability of labour starting, the length of labour, the probability of caesarian section and instrumental delivery, the probability of post partum haemorrhage requiring blood transfusion and staff monitoring during induction and labour.

Under many assumptions the administration of PGE_2 is cost neutral or cost saving. However, the extent of savings or net costs is critically dependant on the costs of caesarian section and instrumental delivery and the probability of these two events. The costs of these events are largely determined by the additional length of inpatient hospital stay associated with them. The length of stay may vary between settings, resulting in higher or lower costs. For example, the length of stay used in this analysis for caesarian section was based on data for women who were given antibiotic prophylaxis for wound infection. If antibiotic prophylaxis is not routinely given, the average length of additional stay for this procedure may be higher (Mugford et al, 1989), resulting in increased net savings associated with PGE_2.

Overall, the conclusions of this analysis confirm those of the previous evaluation. However, refinement of the estimates of the probability of events and of resource use and

costs has resulted in higher overall expected costs associated with the use of PGE_2 and oxytocin plus ARM. The expected net savings for women with an unripe cervix were similar for each of the evaluations, despite the higher costs of events incorporated into the analysis. In contrast, the results for women with a ripe cervix changed from an expected net cost to an expected net saving associated with PGE_2. Finally, the results of this analysis were shown to be more sensitive to the values assigned to key parameters than the previous analysis.

These results strengthen another conclusion of the previous analysis, that the realisation in practice, of the potential resource savings indicated by this type of analysis, is a matter for local discussion and debate. In particular, the additional cost of PGE_2 will appear as an item on the pharmacy budget. Therefore any freed resources in the maternity unit or in the hospital more generally, need to be identified clearly. This suggests that an analysis of midwifery tasks and workloads would be advantageous, as would an assessment of the value to the hospital, of released bed space. In addition, local decision makers need to compare the rates of caesarian section and instrumental delivery used in this analysis with those that pertain to their own situation.

In concentrating on the immediate resource consequences the analysis has ignored other considerations which are likely to favour the use of PGE_2. First, there may be other long term resource implications of perineal suturing, manual removal of the placenta, excessive post partum haemorrhage and an increased rate of caesarian sections. For example, previous caesarian section is usually taken as an indication for future caesarian section. In addition, some women may require hysterectomy following excessive post partum haemorrhage. The analysis has also ignored the remote, but significant long term costs

associated with damage to the child during instrumental delivery and any reductions in infant health from protracted labour.

As in the previous study, the analysis has not attempted to quantify the intangible benefits of induction of labour by PGE_2. These include reductions in the pain and suffering associated with the complications of labour and the utility associated with greater mobility during induction and a more natural labour. However, since the analysis shows an overall preference, based on cost, for induction by PGE_2, consideration of these additional factors would only reinforce the study conclusions.

Finally, apart from providing more recent and more accurate data on the relative costs of induction of labour by oxytocin and PGE_2, this study is significant in that it represents one of a few cases where the estimates in an earlier economic evaluation were refined. On this occasion the re-analysis largely confirmed the results of the original study. However, given the growing importance being attached to economic evaluation results in health care decision making, consideration should more often be given to refining the estimates of earlier evaluations as new data become available.

NOTES

1. The formula used to calculate the annual equivalent cost of equipment was:

$$AEC = \frac{[P - S(1 + r)^{-n}]}{A(n,r)}, \quad \text{and } A(n,r) = \frac{[1 - (1 + r)^{-n}]}{r}$$

where:

P = the cost of purchasing the equipment,

S = the scrap value of the equipment (after n years in service),

n = the total number of years the equipment is used,

r = the discount rate

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Table 1: **Probability of events: unripe cervix**

Event	Probability (range)*	
	PGE_2	Oxytocin plus ARM
Labour starts during cervical ripening period	0.44[1] (0.22–0.75)[2] *0.58*	n.a.
Oxytocin plus ARM	0.56[1] (0.25–0.78)[2] *0.42*	1.00 –
Labour starts	0.65[1] (0.65–0.84[3]) *0.84*	0.59[1] (0.59–0.79[3]) *0.79*
Ante partum caesarian section	0.35[1] (0.16[3]–0.35) *0.16*	0.41[1] (0.21[3]–0.41) *0.21*
Spontaneous delivery	0.75[1,2,3] (0.54–0.90)[2,4] *0.82*	0.69[2,3] (0.50–0.93)[2,4] *0.71*
Instrumental delivery	0.18[2] (0.03–0.30)[2]	0.29[2] (0.05–0.40)[2]
Intra partum caesarian section	0.07[1,3] (0.07–0.16[4]) *0.00*	0.02[3] (0.00[2]–0.10[4]) *0.00*
Post partum haemorrhage >500 mls	0.02[5] –	0.06[5] (0.06–0.16)
Epidural anaesthesia during labour	0.42[5] –	0.72[5] –

* The figures in italics are the values used in the previous analysis, Davies and Drummond (1991)

1. Hass SL (1993)
2. Kierse and van Oppen, 1989
3. Noah et al, 1987
4. Bernstein, 1991
5. Kennedy et al, 1982a

Table 2: **Probability of events: ripe cervix**

Event	Probability (range)*	
	PGE_2	Oxytocin plus ARM
Oxytocin	0.08 (0.08–0.15)	1.00 –
ARM	0.25 –	1.00 –
Labour starts	0.98[1] (0.94[2]–0.98) *0.97*	0.96[1] (0.91[2]–0.96)
Spontaneous delivery	0.92[1] (0.89[2]–0.92) *0.89*	0.86[1] (0.85[2]–0.86)
Instrumental delivery	0.08[1] (0.08–0.11[2]) *0.11*	0.14[1] (0.14–0.15[2])
Post partum haemorrhage >500 mls	0.02[1] –	0.06[2] (0.06–0.16[1])
Ante/intra partum caesarian section	0.02[1] (0.02–0.06[2]) *0.03*	0.04[1] (0.04–0.09[2])
Epidural anaesthesia during labour	0.42[1] –	0.72[1] –

* The figures in italics are the values used in the previous analysis, Davies and Drummond (1991)

1. Kennedy et al, 1982a

2. Kierse and van Oppen, 1989

Table 3: Unit costs (prices) of resources, UK, 1991/92

Item	Unit cost	
	previous study*	current study
PGE_2 (1 mg per 3 mg gel)	14.52	14.52[1]
Oxytocin (1 ampoule)	1.00	0.18[1]
Saline (ampoule)	na	0.45[2]
Marcaine (vial)	na	1.13[1]
Infusion equipment		
– controller and lines	na	0.70[3]
– infusion pump (per induction)	na	0.60[3]
– dextrose/saline (per litre)	na	2.92[2]
Fetal monitor		
– electrodes (each)	na	6.00[3]
– monitor (per delivery)	na	3.20[3]
VE pack	na	0.75[2]
Sterile gloves (pair)	na	0.80[2]
Amnihook	na	0.83[2]
Epidural pack	na	15.62[2]
Venflon	na	0.78[2]
Delivery pack	na	5.88[2]
Sutures	na	1.75[2]
Blood products (per unit)	14.00	18.00[4]
Cross matching (per woman)	12.00	10.50[5]
Giving set (blood)	na	1.04[2]
Operating theatre and supplies (per hour)	250.00	308.44[6,7]

Table 3: Unit costs (prices) of resources, UK, 1991/92 (Continued)

Item	Unit cost	
	previous study*	current study
Staff time (per hour)		
– consultant	21.26	26.40[8]
– registrar	na	12.31[8]
– senior house officer	9.09	11.19[8]
– midwife/scrub nurse/baby nurse	7.55	9.70[9]
– trainee midwife	4.40	5.21[9]
Additional inpatient stay (per day)	107.00	109.00[10,11]

Notes to Table 3

*. Davies and Drummond, 1991

1. Monthly Index of Medical Specialties, 1991

2. NHS hospital, 1992

3. Regional Health Authority Purchasing Department, 1991

4. Department of Health, 1990

5. Non commercial pathology laboratory, 1991

6. Rutherford et al, 1990

7. Chartered Institute of Public Finance Accountants, 1990

8. Review Body on Doctors and Dentists Remuneration, 1991

9. Review Body for Nursing Staff, Midwives, Health Visitors and Professions Allied to Medicine, 1991

10. Mugford et al, 1989

11. Chartered Institute of Public Finance Accountants, 1989

Table 4: Resource utilization for events associated with childbirth

Item	Average use (range) previous study#	current study
Epidural during labour		
(a) Anaesthetist (hours)	0.25	0.25[1] (0.17–0.50)[1]
(b) Equipment		
– epidural pack	na	1.00[2]
– sterile gloves (pair)	na	1.00[2]
– venflon	na	1.00[2]
– saline (ampoule)	na	1.00[2]
– marcaine (vial)	na	1.00[2]
Caesarian section		
– operating theatre (hours)	1.00	1.00[1]
– anaesthetist* "	1.50	1.50[1]
– surgeon 1 "	1.00	1.00[1]
– surgeon 2 "	1.00	1.00[1]
– paediatrician* "	0.33	0.33[1]
– scrub nurse "	1.00	1.00[1]
– midwife "	1.00	1.00[1]
– trainee midwife "	1.50	1.50[1]
– baby nurse "	0.33	0.33[1]
– additional inpatient stay (days)	3.00	5.00[3] (3.00–7.00)[3]
– antibiotic prophylaxis (number of doses)	3.00	3.00[4]
Instrumental delivery		
– clinician (hours)*	1.00	1.00[1]
– nurse	1.00	0.00
– delivery pack	na	1.00[2]
– suture pack	na	1.00[2]
– additional length of stay (days)	1.00	2.00[3] (0.00–4.00)[3]
Blood transfusion		
– blood products (units)	1.00	1.00[1]
– cross matching	1.00	1.00[1]
– giving set	na	1.00[1]

Notes to Table 4

\# Davies and Drummond, 1991

* Assumes 100% consultant time for the first study and 20% consultant and 80% registrar time for the current study

1. Expert opinion

2. NHS hospital, 1992

3. Clark et al, 1991

4. Mugford et al, 1989

Table 5: Costs of events associated with childbirth

Item	Average cost (range) previous study*	current study
Epidural during labour		
(a) Anaesthetist (hours)	3.07	3.78 (2.50–7.50)
(b) Equipment		
– epidural pack	na	15.62
– sterile gloves (pair)	na	0.80
– venflon	na	0.78
– saline (ampoule)	na	0.45
– marcaine (vial)	na	1.16
Total cost	**3.07**	**22.59 (21.31–26.31)**
Caesarian section		
– operating theatre (hours)	250.00	308.44
– anaesthetist* "	31.50	22.69
– surgeon 1 "	21.26	26.40
– surgeon 2 "	9.09	11.19
– paediatrician* "	3.30	5.04
– scrub nurse "	7.55	9.70
– midwife "	7.55	9.70
– trainee midwife "	6.60	7.82
– baby nurse "	2.49	3.23
– additional inpatient stay (days)	321.00	545.00 (327.00–763.00)
– antibiotic prophylaxis (number of doses)	30.00	34.00
Total cost	**696.32**	**983.21 (765.21–1201.21)**
Instrumental delivery		
– clinician (hours)*	21.26	15.13
– nurse	8.00	0.00
– delivery pack	na	5.88
– suture pack	na	7.02
– additional length of stay (days)	107.00	218.00 (0.00–436.00)
Total cost	**136.26**	**246.03 (28.03–464.03)**
Blood transfusion		
– blood products (units)	14.00	18.00
– cross matching	12.00	10.50
– giving set	na	1.04
Total cost	**26.00**	**29.54**

* Davies and Drummond, 1991

Table 6: Resource utilization for induction and labour: unripe cervix

Item	Average use (range) previous study*	current study
Induction by PGE_2		
(a) drug (number of applications)	1.00	1.00
(b) midwifery time (induction to membrane rupture)	6.00	12.00[1] (1.80–8.50)[2]
Labour following PGE_2		
(a) midwifery time (membrane rupture to vaginal delivery)	4.50	9.00[1] (1.00–11.00)[3]
(c) epidural anaesthesia during labour	0.42	0.42[4]
Induction by Oxytocin plus ARM		
(a) drug (5 unit/ml ampoules)	na	4.00[5]
(b) infusion equipment		
– controller and line set	na	1.00[5]
– infusion pump	na	1.00[5]
– dextrose/saline (litres)	na	1.00[5]
(c) ARM		
– midwifery time (hours)	0.50	0.50[5]
– VE pack	na	1.00[6]
– sterile gloves (pair)	na	1.00[6]
– amnihook	na	1.00[6]
(d) fetal monitor		
– electrodes	na	1.00[5]
– monitor	na	1.00[5]
Labour following Oxytocin + ARM only		
(a) midwifery time (hours) (membrane rupture to vaginal delivery)	5.50	11.00[1]
(b) epidural anaesthesia	0.72[4]	0.72[4]

Notes to Table 6

* Davies and Drummond, 1991

1. Noah et al, 1987

2. Kennedy et al, 1982b

3. Cameron, 1985

4. Kennedy et al, 1982a

5. Expert opinion

6. NHS hospital, 1992

Table 7: Resource utilization for induction and labour: ripe cervix

Item	Average use (range) previous study*	current study
Induction by PGE2		
(a) drug (number of applications)	1.47	1.47[1,2]
(b) midwifery time (induction to membrane rupture)	2.50	5.00[1] (1.80–8.50)[3]
Labour following PGE2		
(a) midwifery time (membrane rupture to vaginal delivery)	2.00	4.00[1] (1.00–11.00)[2]
(c) epidural anaesthesia during labour	0.42	0.42[1]
Induction by Oxytocin plus ARM		
(a) drug (5 unit/ml ampoules)	na	2.00[4]
(b) infusion equipment		
– controller and line set	na	1.00[4]
– infusion pump	na	1.00[4]
– dextrose/saline (litres)	na	0.50[4]
(c) ARM		
– midwifery time (hours)	0.50	0.50[4]
– VE pack	na	1.00[5]
– sterile gloves (pair)	na	1.00[5]
– amnihook	na	1.00[5]
(d) fetal monitor		
– electrodes	na	1.00[4]
– monitor	na	1.00[4]
Labour following Oxytocin + ARM only		
(a) midwifery time (hours) (membrane rupture to vaginal delivery)	3.00	6.00[1] (2.00–18.00)[2]
(b) epidural anaesthesia	0.72	0.72[1]

Notes to Table 7

* Davies and Drummond, 1991

1. Kennedy et al, 1982a

2. Cameron, 1985

3. Kennedy et al, 1982b

4. Expert opinion

5. NHS hospital, 1992

Table 8: Average cost of induction and labour: unripe cervix

Item	Average cost (range) previous study*	current study
Induction by PGE_2		
(a) drug (number of applications)	14.52	14.52
(b) midwifery time (induction to membrane rupture)	45.30	116.40
Total cost	**59.82**	**130.92**
Labour following PGE_2		
(a) midwifery time (membrane rupture to vaginal delivery)	34.00	87.30 (9.70–106.70)
(c) epidural anaesthesia during labour	3.07	9.49 (8.95–11.05)
Total cost (96.25–98.35)	**37.07**	**96.79**
Induction by Oxytocin plus ARM		
(a) drug (5 unit/ml ampoules)	1.00	0.72
(b) infusion equipment		
– controller and line set	na	0.70
– infusion pump	na	0.60
– dextrose/saline	na	2.92
(c) ARM		
– midwifery time (hours)	4.00	4.85
– VE pack	na	0.75
– sterile gloves (pair)	na	0.80
– amnihook	na	0.83
(d) fetal monitor		
– electrodes	na	6.00
– monitor	na	3.10
Total cost	**5.31**	**21.45**
Labour following Oxytocin + ARM only		
(a) midwifery time (membrane rupture to vaginal delivery)	41.50	106.70
(b) epidural anaesthesia (15.34–18.94)	3.80	16.26
Total cost	**45.30**	**122.96 (122.04–125.64)**

* Davies and Drummond, 1991

Table 9: Average cost of induction and labour: ripe cervix

Item	Average cost (range) previous study*	current study
Induction by PGE_2		
(a) drug (number of applications)	21.34	21.34
(b) midwifery time (induction to membrane rupture)	19.00	48.50 (17.46–82.45)
Total cost	**40.34**	**69.84 (38.80–103.79)**
Labour following PGE_2		
(a) midwifery time (membrane rupture to vaginal delivery)	38.80	15.10 (9.70–106.70)
(e) epidural anaesthesia during labour	3.07	9.49 (8.95–11.05)
Total cost (18.65–117.75)	**18.17**	**48.29**
Induction by Oxytocin plus ARM		
(a) drug (5 unit/ml ampoules)	1.00	0.36
(b) infusion equipment		
– controller and line set	na	0.70
– infusion pump	na	0.60
– dextrose/saline	na	1.46
(c) ARM		
– midwifery time (hours)	4.00	4.85
– VE pack	na	0.75
– sterile gloves (pair)	na	0.80
– amnihook	na	0.83
(d) fetal monitor		
– electrodes	na	6.00
– monitor	na	3.10
Total cost	**5.31**	**19.63**
Labour following Oxytocin + ARM only		
(a) midwifery time (membrane rupture to vaginal delivery)	22.50	58.20 (19.40–174.60)
(b) epidural anaesthesia (15.34–18.94)	3.80	16.26
Total cost	**26.30**	**74.46 (122.04–125.64)**

* Davies and Drummond, 1991

Table 10: Expected saving (cost) of PGE_2 in the induction of labour: unripe cervix*

Assumptions	Expected cost of PGE_2	Expected cost of oxytocin	Net saving (cost)
Base case analysis	497 *168*	549 *221*	52 *53*
Resource use is lower			
- 50% staff costs for monitoring and induction	400 *na*	517 *na*	117 *na*
- lower length of stay, caesarian section and instrumental delivery	410 *na*	420 *na*	10 *na*
- partial resource savings from caesarian section and instrumental delivery	393 *144*	360 *148*	(33) *4*
Probability of events associated with childbirth is lower			
- lower rate of all caesarian section and instrumental delivery	340 *199*	336 *208*	(4) *9*

* The figures in italics are the results from the previous analysis, Davies and Drummond, 1991

Table 11: Expected saving (cost) of PGE_2 in the induction of labour: ripe cervix*

Assumptions	Expected cost of PGE_2	Expected cost of oxytocin	Net saving (cost)
Base case analysis	158 *95*	165 *78*	7 *(17)*
Resource use is lower			
– 50% staff costs for monitoring and induction	114 *na*	137 *na*	23 *na*
– lower length of stay, caesarian section and instrumental delivery	136 *na*	127 *na*	(9) *na*
– partial resource savings from caesarian section and instrumental delivery	147 *85*	144 *64*	(3) *(21)*

* The figures in italics are the results from the previous analysis, Davies and Drummond, 1991

FIGURE 1: DECISION TREE: UNRIPE CERVIX