

# Serial ultrasound scanning in pregnancies at risk of intrauterine growth restriction



## COST BENEFIT ANALYSIS

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### Summary

This paper estimates the costs and benefits of a comprehensive ultrasound surveillance protocol for fetal growth in pregnancies at increased risk as defined by the new RCOG guidelines, based on data from the West Midlands.

#### Additional costs:

- Up to 25% of the maternity population fall into the category that would require 3-weekly growth scans;
- this translates to approximately 600–700 additional scans per 1000 births, depending on current provision;
- at £ 15 per scan this represents a cost of £10 per pregnancy, or £30,000 for a unit with 3000 deliveries

#### Benefits:

Improved antenatal detection of IUGR has many benefits, including reduction in stillbirths, neonatal admissions, perinatal morbidity, cerebral palsy and litigation. We estimate that together, these will result in savings of at least £120 per pregnancy or £360,000 for a unit with 3000 births, representing a 12 fold return on investment.

### Introduction

The Perinatal Institute (PI) is engaged in the national roll-out the Growth Assessment Protocol (GAP) [1, 2] which is based on the award winning programme that has succeeded in reducing stillbirth rates to their lowest ever levels in each of the three regions in which it was implemented. The initiative is supported by NHS England [3] and the Scottish Government.

GAP focuses on better detection of IUGR related risk in low risk pregnancies by standardised fundal height measurement, plotting on customised charts and using appropriate referral pathways. Increased identification of IUGR is accompanied by fewer false positives and hence a reduced need for referral [2, 4, 5]. With appropriate implementation, the programme is cost saving because of fewer unnecessary scans, or at least cost neutral to current ultrasound resources.

Pregnancies at increased risk of IUGR require an increased level of surveillance with serial (3 weekly) ultrasound biometry, as recently recommended by the RCOG Green-Top guidelines [6]. The guidelines provide a thorough review of the published evidence on the factors which need to be considered when assessing risk in early pregnancy.

However these guidelines have brought to the fore the endemic shortage of obstetric ultrasound, and many units report that they are struggling to provide enhanced scan services with current staffing resources.

Therefore, in response to many requests from units in the GAP programme, we have undertaken this cost - benefit analysis for the RCOG scanning protocol for high risk pregnancies, using the West Midlands database of 160k pregnancies (2009-2011).

#### Our starting points were the following observations:

- Confidential enquiries of stillbirths with IUGR have shown that instances of IUGR were missed because of inadequate provision of third trimester scans in pregnancies at increased risk [7].
- Typical ultrasound provision for pregnancies at increased risk (example taken was p/h of SGA birth) was 2 to 3 scans in the third trimester, while some units did not scan high risk pregnancies at all [8].
- Antenatal detection rate of IUGR was proportional to the number of scans ordered [8].
- The service can be enhanced by midwives who have undergone short, focussed courses in growth scanning [9].

## Costs

### 1. Prevalence of risk factors requiring growth scans

The West Midlands database contains most of the variables which were considered significant by the RCOG Green Top Guidelines [6]. Taken together, close to 60% of stillbirths in the region occurred in pregnancies with one or more of these risk factors.

We selected the factors which are known at the *beginning of pregnancy* (Appendix - **Table 1a & b**)

1a	Major risk factors for SGA (Table 1a)	20.6%
1b	Minor risk factors (3 or more): (Table 1b): 4.9% - these are recommended to have UA Doppler to determine which are at risk. We estimate that less than half of these will have an abnormal uterine artery Doppler measurement indicating need for serial scans according to the RCOG guideline →	2.4%
	Note: our database does not contain several other, less frequent risk factors listed in the guideline (cocaine user, daily vigorous exercise, antiphospholipid syndrome, renal impairment, maternal or paternal SGA). We estimate that together, these would add up to a further 2%	2%

**Thus the estimated overall prevalence of risk factors in this database, as defined by RCOG guidelines, is 25% .**

### 2. Significance of being 'at risk' (Appendix Table 2)

Table 2 shows that the cohort designated 'increased risk' does indeed have an **increased rate of SGA births (OR 2.0) and stillbirths (OR 1.6)**.

### 3. Number of *additional* scans required according to RCOG guidelines

**Table 3** sets out the estimated no. of scans needed for the 'increased risk' population as 1100 scans / 1000 births.

To calculate the **additional** scans required, we estimated current scan provision in increased risk pregnancies. In the West Midlands, about 20% of pregnancies were considered needing 'serial scans' and received typically 2 - 3 scans per pregnancy. However some mothers in this group received *no* third trimester scans at all. Therefore we estimate current provision to be between 4-500 scans per 1000 pregnancies, and the additional scan requirement to be (1100 minus 4-500) = **600 – 700 scans / 1000 births**

### 4. Cost per additional scan :

**Table 4** outlines a whole time equivalent / service capacity estimate for scans done by additional ultrasonographers, or midwives trained in focussed ultrasound courses to undertake 3<sup>rd</sup> trimester scans (for an example of such a course at Birmingham City University, see [www.perinatal.org.uk/GAP/ultrasound.aspx](http://www.perinatal.org.uk/GAP/ultrasound.aspx))

This analysis results in an estimated cost of **£ 15 per scan**

### 5. Estimated scan costs per delivery

The predicted additional workload, (see 3 above) of 600-700 scans per 1000 births, represents a cost of **£ 10,000 per 1000 births, or £ 10 per pregnancy**

### 6. Cost of intervention

Improved antenatal detection of IUGR will lead to more inductions of pregnancies determined to be at risk. Increased costs due to induction of labour are however likely to be offset by a reduction in Caesarean sections, as suggested by a recent systematic review [10]. This effect may be related to the length of time clinicians can afford to allow for cervical ripening, which in turn would depend on the severity of FGR when the decision to deliver is made. Awareness of IUGR and hence diminished fetal reserve may improve intrapartum management and reduce emergency caesarean sections due to 'fetal distress'. However in the absence of good evidence, such points are speculative. We contend that management following improved antenatal recognition of FGR will be cost neutral.

## Benefits

Improved antenatal detection of FGR has a beneficial effect on the rate of stillbirth, perinatal morbidity, learning and developmental delays and cerebral palsy. **The primary benefit is reduced human suffering and enhanced safety and well being of mother and baby.**

The **health service** also benefits through enhanced confidence in those working within it. This in turn results in improved job satisfaction and reduced stress and absenteeism by those striving to provide an optimal service.

**Financial savings** are difficult to estimate as they are secondary to the need and desire to achieve best practice in maternity care. In the absence of formal research undertaken to quantify such savings, we set out the main categories for consideration and make best guess estimates, on the basis of data where available.

Cost savings associated with improved IUGR detection		Estimated saving per 1000 births
<b>A Stillbirth</b>	FGR fetuses have a reduced risk of demise if IUGR is recognised antenatally [11, 12];	
	1. Enhanced growth assessment is estimated to save <b>one stillbirth per 1000 births</b> [11]	unknown
	2. Reduces need for investigation following stillbirth and in subsequent pregnancies (1 & 2 - approx £ 3000 per stillbirth) [13]	£ 3000
	- Savings on care for depression and other mental health problems following stillbirth	£ 1000
	- Additional cost of admin and investigations examining adverse outcome	£ 1000
<b>B Intrapartum related death</b>	Clinical case reviews have shown that unrecognised IUGR is more likely to result in intrapartum complications and death. [14; 15]	Saving unknown but substantial as most litigation relates to intrapartum causes
<b>C Neonatal unit admission and care</b>	FGR baby born at or near term spends on average 2 days more on a neonatal unit than a baby of same gestation but not SGA [16] -reasons ranging from need for observation to encephalopathy. Approx. 1% of births in the West Midlands were admitted with FGR at 36+ weeks gestation, equivalent to 10 cases/1000 births, resulting in 20 days stay on the neonatal unit at an approx cost of £ 1000 / day. Earlier delivery in better condition, or improved awareness that labouring fetus is FGR, may help reduce such morbidity[16]	£ 20,000
<b>D Cerebral Palsy (CP)</b>	There is a strong link between prematurity and CP, but the majority of children with cerebral palsy were born at term. FGR at term is associated with a significantly increased risk of subsequent development of CP [16]. With a prevalence of CP of 2%, we estimate that 0.5/1000 births at term that developed CP were FGR, and that at least half of these (0.25/1000) could be prevented by earlier recognition and avoidance of antepartum or intrapartum hypoxia. At an estimated lifetime cost of over £1 Million [18] or £100,000+ per year, the savings would be approx £25,000 / 1000 births	£ 25,000
<b>E Litigation</b>	According to NHSLA, inappropriate antenatal risk assessment is a frequent factor in litigation [19]. The national audit office calculated the obstetric / maternity litigation cost to the health service as approx £700 per pregnancy [20]. Recognition of FGR is central to risk assessment and we estimate conservatively that this will lead to at least 10% reduction in litigation costs, i.e. £70/per pregnancy or £ 70k/1000 births.	£ 70,000
<b>Total per 1000 births</b>		<b>£ 120,000</b>

### Estimated benefits according to unit size (x 1000 £ Sterling)

No. of deliveries per annum	1000	2000	3000	4000	5000
Expected stillbirths (5/1000)	5	10	15	20	25
<b>Expected stillbirths saved</b> (22%) [10]	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Estimated cost savings</b>	<b>120k</b>	<b>240k</b>	<b>360k</b>	<b>480k</b>	<b>600k</b>

Extrapolated across UK (>800k births), this could result in potential savings of £ 100 Million per annum.

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## APPENDIX: Tables 1-4

**Table 1**

*Risk factors according to RCOG Green Top Guidelines which can be determined at the beginning of pregnancy. Analysis of West Midlands PEER Database 2009-11; n=161,936*

**Table 1a - Major risk factors**

Major Risk Factor	Primips	Multips	All	SGA
	%	%	%	%
Maternal age >40	1.0	2.6	1.9	17.2
Smokes >10	2.7	5.3	4.2	28.4
BMI >35	6.0	9.1	7.8	16.7
Diabetes (excl GDM)	0.5	0.8	0.7	9.1
Pre-existing Hypertension	1.7	2.9	2.3	18.9
Previous SGA birth	0.0	10.5	5.9	28.2
Previous Stillbirth	0.0	0.6	0.3	17.6
<b>One or more factors</b>	<b>11.9</b>	<b>31.8</b>	<b>20.6</b>	<b>22.0</b>

**Table 1b Minor risk factors**

*(Risk is considered to be significant if 3 or more factors are present)*

Minor Risk Factor	Prevalence	SGA
	%	%
Maternal age 35-40	13.4	14.8
Primipara	42.5	13.8
BMI<20 or 25-35	50.3	14.8
Smokes 1-10	13.7	23.5
<b>Three or more</b>	<b>4.9</b>	<b>21.0</b>

**Table 2** Likelihood of SGA and SB in increased risk pregnancies, based on factors known at booking

Risk factors	Prevalence %	SGA %	Stillbirth /000
One or more 'major'	20.6		
Three or more 'minor'	4.9		
Increased risk *	<b>25.5</b>	20.8	6.7
Low risk	<b>74.5</b>	11.9	4.2

\* One or more major or three or more minor

<b>Odds Ratio High / Low risk</b>	<b>2.0</b>	<b>1.6</b>
Confidence Interval	1.9-2.0	1.3-1.9

**Table 3** Scan numbers required according to RCOG guideline (per 1000 pregnancies)

25 % of maternity population designated as incr. risk = 250

Serial scans: at 28, 31, 34, 37 + ½ at 40 weeks =  $4.5 \times 250$  = 1125  
 Minus: 7% prem deliveries x 1.5 fewer scans = 10% of 250 - 25

No. of scans needed 1100

No. of serial scans already done: 400 – 500 dependent on current policies

→ **Estimate of additional scans needed 600 - 700 per 1000 pregnancies**

**Table 4** Capacity and cost of additional 'growth' scan service

Calculation is for enhanced scan service by additional ultrasonographers or midwives trained in focussed courses as provided by Birmingham City University ([www.perinatal.org.uk/GAP/ultrasound.aspx](http://www.perinatal.org.uk/GAP/ultrasound.aspx))

#### Capacity

Scans up to 15 minutes each + 5 min changeover & admin →	3 scans per hour
Per working week (WTE = 37h) →	approx 100 scans
Per year (excl holidays / annual & sick leave) x 40 weeks →	<b>4000 scans per year</b>

#### Cost

1 WTE ultrasonographer or midwife band 7 + overheads :	£ 50,000
Scan equipment - lease per year	£ 5,000
Training costs incl travel	£ 2,000
Staff back-fill during training	£ 3,000
Cost per annum	<b>£ 60,000</b>

**Cost per growth scan** £ 60,000 / 4000 scans per year → **£ 15 / scan**