

Antenatal Ultrasound Screening

Ultrasound Survey of England : 2002

April 2005

Commissioned by the UK
National Screening Committee



UK National Screening Committee

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Abbreviations/Glossary

Abbreviations

ARC	Antenatal Results and Choices
BPD	Biparietal diameter
CASE	Consortium for the Accreditation of Sonographic Education
CRL	Crown rump length
FL	Femur length
HTA	Health Technology Assessment
NSC	National Screening Committee
NT	Nuchal translucency, a measurement in the first trimester used as a screening test for Down's Syndrome (to be differentiated from nuchal fold thickness measurement performed at 20 – 24 weeks' gestation)
RCOG	Royal College of Obstetricians & Gynaecologists
RCR	Royal College of Radiologists
WTE	Whole time equivalent

Glossary

Booking

This is the visit/consultation at which the woman receives information about her pregnancy care and is registered for care either with her midwife and/or hospital/unit for delivery. Women are usually seen by about 14 weeks but up to 20% may not be seen by this time.

Dating scan

This is usually the first pregnancy scan undertaken. It may be performed in a variety of settings but usually will be done at the time the pregnancy is "booked". Dating by ultrasound is best undertaken in the first trimester but acceptable accuracy can be achieved up to about 24 weeks.

HEI 98

Health Effects Institute (HEI), an organisation that oversees the safety standards of medical equipment. Directive no. 98 refers to the use of maternity ultrasound equipment for screening examination purposes.

IEC 1157

International Electrotechnical Commission (IEC), the leading international organisation for worldwide standardisation in electrotechnology. Directive no. 1157 refers to safety guidelines for acoustic power output (1992).

Midwife

A midwife is a person who, having been regularly admitted to a midwifery educational programme, has successfully completed the prescribed course of studies in midwifery and has acquired the requisite qualifications to be registered and/or legally licensed to practice midwifery.

Obstetrician

A medical practitioner trained in obstetrics. In the context of the survey he/she will also be trained in ultrasound to a varying degree.

Radiographer

Someone who is trained in both the use of X-rays (and maybe other imaging modalities) and who will also have received training in the use of ultrasound. They will not be exclusively involved with ultrasound.

Radiologist

A medical practitioner trained in imaging techniques including ultrasound.

Regional Coordinator *(Also referred to in the text as Regional Antenatal Screening Coordinator)*

The person designated by the Regional Director of Public Health to coordinate antenatal screening services within a given region.

Routine anomaly screening scan

This is usually done between 18 to 20 weeks.

Screening Coordinator

A person, usually a midwife, who coordinates local antenatal screening services within a hospital.

Sonographer

Someone who has received specific training in the use of ultrasound although who usually will also have been trained as a radiographer. They will usually spend most if not all their time using ultrasound but may well undertake other general radiology activities.

Tertiary centres

A unit is designated as tertiary centre if it has a well-developed fetal maternal department and accepts referrals from other units. These units are usually attached to teaching hospitals.

Third trimester scans

Scans performed at this time are usually to establish fetal wellbeing and involve fetal measurements, amniotic fluid volume assessments and, increasingly, Doppler measurements of blood velocity in the umbilical artery. Other assessments involve placental site.

Two schedules scan

This comprises a booking (or dating) scan and anomaly screening scan usually performed between 18 to 20 weeks.

Ultrasound markers

These are transient changes seen within the fetus which may indicate an added risk of a number of conditions, such as karyotypic abnormalities or conditions such as cystic fibrosis.

Introduction

The National Screening Committee has been involved in enhancing the performance of a number of antenatal screening programmes, most recently Down's Syndrome and haemoglobinopathy screening. Routine fetal anomaly scanning forms a standard part of many antenatal screening packages, but there is evidence to suggest that its application is very variable.^{1,2} In order to evaluate the routine second trimester ultrasound screening programme information regarding current protocols, capacity and the state of supporting infrastructure was required. A detailed questionnaire was sent to all maternity ultrasound units in England for completion, which covered a complete range of issues pertaining to routine ultrasound scanning in England. It was designed to provide a comprehensive insight into the current availability of ultrasound not only for screening but also for dating and fetal assessment, and to highlight whether significant deficiencies existed in staffing, variation in the information women received before scanning, and in the auditing and monitoring processes. The data presented here show areas of concern and should provide information, which will lead to the improvements necessary to produce an equitable and high quality ultrasound service.

Objectives

The aim of the questionnaire was to ascertain the state of antenatal ultrasound programmes provided by NHS maternity services in England in order to:

- a) map the provision of routine antenatal ultrasound in England, including first, second and third trimester scans
- b) inform the development of national guidance and quality assurance mechanisms
- c) provide a body of knowledge to guide maternity services in the development of antenatal ultrasound
- d) assess the capacity of the system with respect to staffing and equipment
- e) indicate the training and educational needs to deliver a quality service.

Methods

A detailed postal survey was developed and piloted in a small number of units before being sent (after some revisions) to all maternity units in the 9 regions of England (Table 1). The survey covered a period of 12 months commencing in January 2002 and was divided into nine sections:

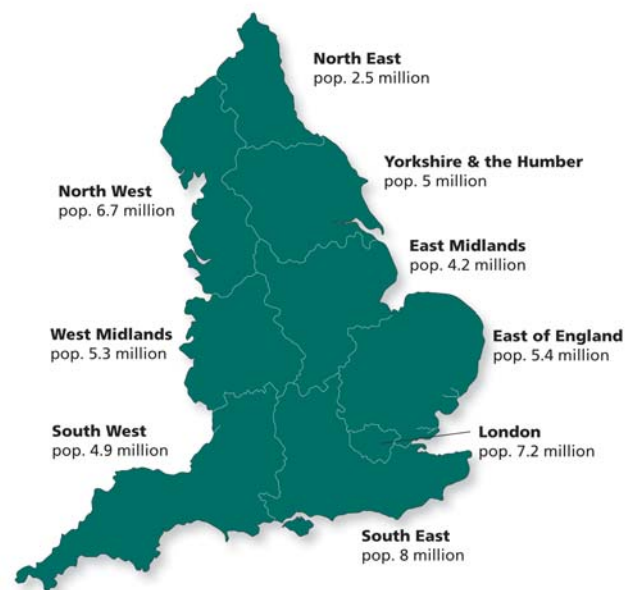
1. Policies, protocols and accountability
2. Antenatal ultrasound package
3. Information and support for parents
4. Staffing for antenatal ultrasound scans
5. Education and training for staff
6. Technical information, including measurements taken
7. Management following identification of an abnormality/variant
8. Equipment and facilities, including storage of images
9. Standards, audit and monitoring

Heads of midwifery in all the units were contacted to identify the lead for obstetric ultrasound. Questionnaires were then sent to the leads, who arranged for their completion, usually by the ultrasound superintendents.

The Regional Antenatal Screening Coordinators supervised data collection for the respective regions. The completed questionnaires were returned for analysis in July 2003. Late responders were sent reminders by the screening coordinators, who were also responsible for confirming the accuracy of the data.

The survey covered the 9 regions of England (regional boundaries as of 1 April 2003) and their respective populations, and the number

of deliveries, as shown in Table 1. Each of the regions has produced an individual report, which can be obtained from the addresses given in Appendix 1, or can be downloaded from the web site <http://www.nelh.nhs.uk/screening/> More information about the regions can be obtained from <http://www.pho.org.uk>.



Approval for distribution of the questionnaire to NHS maternity units in England was sought from, and given by, the Department of Health's Review of Central Returns Steering Committee. The survey was carried out under the direction of each Regional Consultant in Public Health identified as the lead for screening, and under the auspices of each Regional Director of Public Health.

Analysis of data

Data were recorded and analysed using a custom made Access database (BioMedical Computing Limited) according to a predetermined specification by NSC. Further analysis was undertaken by Dr. H. Honest and Professor M. J. Whittle using Excel spreadsheets.

Results

The survey covered 547,114 births in 2002 from 202 units (Box 1). All 202 units returned the questionnaire, but not all units answered all the questions from each section. The total number of units responding to each section is indicated at the beginning of each section.

Table 1

Population coverage by Region (boundaries as at 1st April 2003) including number of deliveries and number of maternity units for each region.

Region	Population*	Deliveries	No. of items
East Midlands	4,200,000	41,385	15
East of England	5,400,000	61,267	19
London	7,200,000	98,428	32
North East	2,500,000	27,323	15
North West	6,700,000	68,239	31
South East	8,000,000	86,874	30
South West	4,900,000	47,148	21
West Midlands	5,300,000	61,957	20
Yorkshire and the Humber	5,000,000	54,493	19
Total for regions	49,200,000	547,114	202

*Data from <http://www.pho.org.uk> (22nd November 2004)

Box 1

2002 Survey

- **Covers England**
- **9 Regions:** North East, North West, Yorkshire and the Humber, East of England, East Midlands, West Midlands, South East, South West, London
- **547,114 births from 202 units**

1. Policies, protocols and accountability (202 units)

The clinical lead for maternity ultrasound was an obstetrician in 64% of the units with radiologists leading in only 24% and other clinicians in 9%; the clinical lead was not defined in the remaining units.

There was a clear written policy defining which women should be offered scans in 78% of units, when scans should be done in 81% and the action to follow in the event of an abnormal result in 81%. 2.5% of units did not reply to this question (Box 2). Only 48% of units had a local ultrasound screening monitoring group and 82% of these met on a regular basis usually no less than every four months.

The majority of units (94%) had a written guideline and/or policy for the scan procedure, and in most circumstances these had been developed by both obstetricians (78% of units) and sonographers (82% of units). These results seem to indicate considerable collaboration between obstetricians and sonographers in the running of the ultrasound departments. Radiologists were involved in guidelines and protocol production in only 35% of units and in the reviewing process in only 28%. Service users had regular input to antenatal ultrasound screening policies in 27% of units.

Only 56% of units appeared to have a mechanism for reviewing guidelines and policies, the process being agreed by obstetricians in 81% of units and by sonographers in 75%. These policies were reviewed on an annual basis in 54% and at least every two years in 26%. An annual report for the ultrasound screening service was produced in very few units (16%).

Box 2

Policies, protocols and accountability

- 78% of units had written policy on which women should be scanned, and when, and action required when scan abnormal.
- 94% of units had written guideline or policy for scan.
- 48% had local advisory group.
- Policies were reviewed either annually (54%) or every two years (26%).
- Annual report produced by 16% of units.

See Box 18

2. Antenatal ultrasound package

Scan Availability (202 units)

First trimester scan

57 % of units offered an early dating scan for all women and 32% offered it to some usually on the basis of uncertain dates or clinical indication (Box 3). Booking scans were performed in the booking hospital in only 56% of the units; the remainder were performed in a variety of settings, including GP surgery and GP/Midwife unit in just over a quarter of the units. When offered, there was a variation in each region's ability to offer an early scan before 14 weeks' gestation to all or some of the women. (Figure 1).

16% of the units offered all women an NT scan at the time of dating while 27% offered it to some. Availability of both dating and NT service to all women occurred most often in London and South East units (Figure 2).

A 1st trimester anomaly scan was undertaken in only 6% of units for all women and 18% for some. However, in London 21% of units, offered 1st trimester anomaly scans to all women (Figure 2).

When NT was not offered 21% of units provided information on the availability of a local private service to all women, 53% only if requested and 7% only to some women (Box 4). 20% of units not offering NT did not respond to this question.

Box 3

1st Trimester Scan

- 57% offered **dating** scan to all women.
- 32% offered to some women.
- 16% offered **dating and NT** scan to all women.
- 27% offered to some women.
- 6% offered an **anomaly** scan to all women.
- 18% offered to some women.

(% percentage of units)

Figure 1

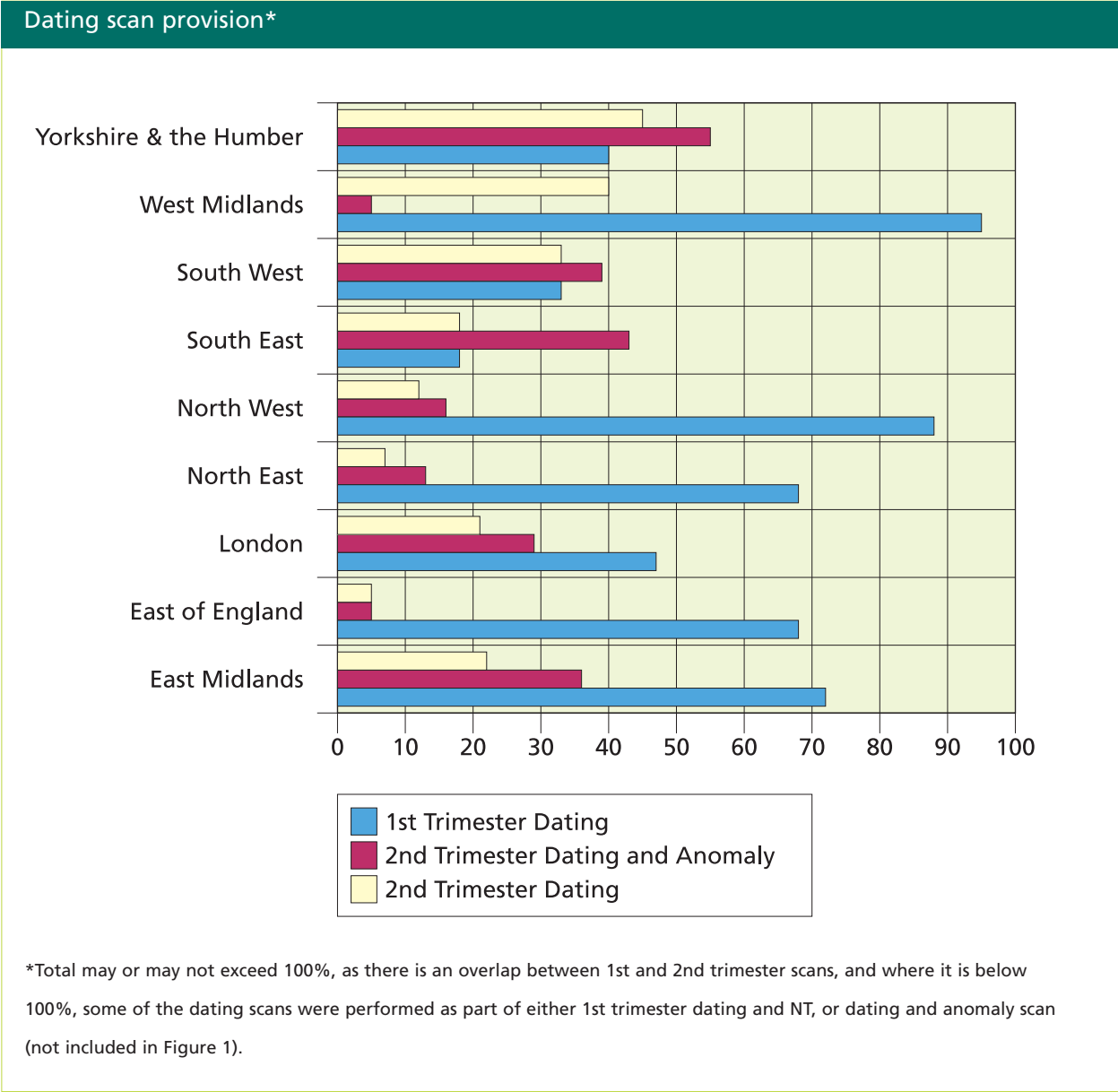
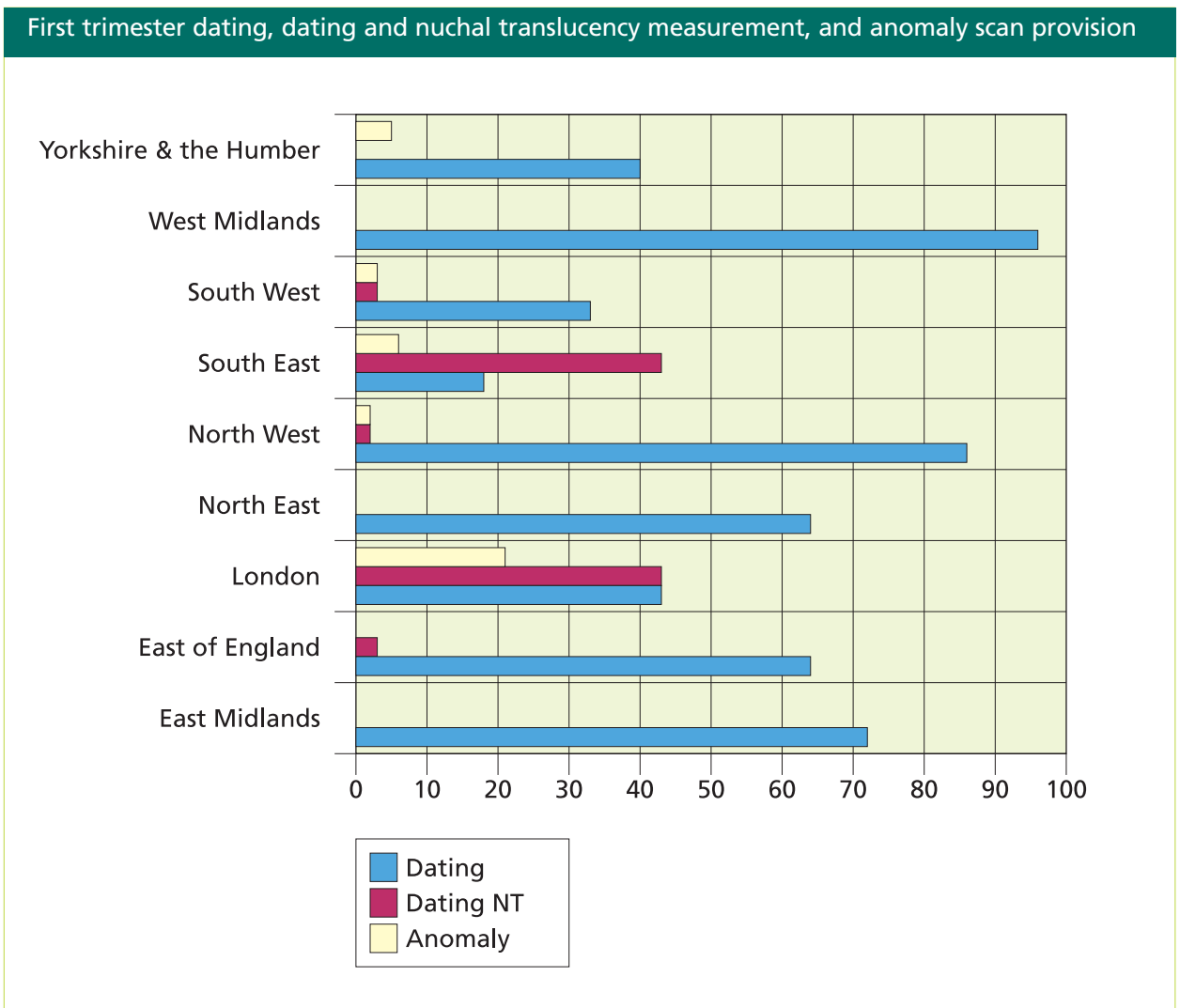


Figure 2



Box 4

NT scan

- 20% offered NT measurements to all or some of the women.
- **When NT not available;**
 - a) 21% provided information on availability of a private service to all women.
 - b) 53% provided that information upon request.
 - c) 7% would give the information to some women.

Second trimester scan (202 units)

A dating scan alone in the second trimester was offered to all or some of the women in 5% and 21% of the units respectively (Box 5) and (Figure 1). The two most common reasons for second trimester dating were late booking and uncertain dates. Of the units who answered the question on screening for fetal anomalies 195 (97%) indicated that they offered a scan to all women while only 7 offered it on clinical indication (Table 2). Uterine artery screening for all women was only performed in 2% of units.

Table Table 2

Regional availability of 2nd trimester anomaly ultrasound scans.

Region	All women	Selective*
East Midlands	15	0
East of England	19	0
London	31	1
North East	15	0
North West	31	0
South East	28	2
South West	21	0
West Midlands	18	2
Yorkshire and the Humber	17	2
Total for regions	195	7

*Based on clinical indications (e.g. previous abnormalities or family history)

Third trimester (202 units)

Routine fetal Doppler or scans in the third trimester were only undertaken in 1.5% of the units. However 87% and 93% of units would perform Doppler* or a third trimester scan respectively where there is a clinical indication to do so.*In 44% of the units, a routine fetal umbilical artery blood flow was done whenever a 3rd trimester scan had been performed.

Box 5

2nd Trimester Scan

- 5% offered **dating scan** to all women.*
- 21% offered **dating scan** to some women.*
- 97% offered **anomaly scan** to all women.

*The two most common reasons for second trimester dating were late booking and uncertain dates.

Organisation (194 units)

Routine scans could always be performed as part of an antenatal visit in 17% and, when possible, in another 62%, of units. However it was not possible to perform a scan at the time of the antenatal clinic in 17% of the units. Nearly all units (97%) allowed companions to be present during the scan. Most of the units (84%) would reveal fetal sex to the women if requested while 15% would decline the request; 1% of the units did not respond to the question. Virtually every unit (99%) offered a photograph but only a minority, 2.5% offered a video recording of the scans. 88% of units made a charge, which was £1 to £3 in 75% and more than £5 in 2.3%. In the few units offering videos the charge was £5 or greater (Box 6).

Time allocated for different types of scans varied between units (Table 3). For first trimester dating, the majority of units (43%) allocated 10 to 15 minutes, and a further 31%, 5 to 10 minutes. Just under a quarter allocated 15 to 20 minutes. For NT and dating 50% of units allocated 15 to 20 minutes and a further 27%, 20 to 30 minutes. In 22% of units time allocated was 10 to 15 minutes.

Second trimester anomaly screening was allocated 15 to 20 minutes by 58% of units and 20 to 30 minutes by a further 33%. Only 9% of units allocated 10 to 15 minutes to 2nd trimester anomaly scanning. Following the scan, just over 90% of units issued women with a written report.

For mothers with pre-existing risk factors, some units have policy for additional specific scans, either within the same hospital but different department or referral to tertiary centres (Table 4).

Box 6

Organisation

- Routine scans performed with ANC in only 17%; if possible in a further 62% of units.
- 84% would reveal fetal sex to the woman if requested while 15% would decline the request.
- 17% of units could never perform scan at ANC.
- 97% of units allowed a companion.
- 99% of units offered a photograph; 88% charged.

Scan Type	5-10	10-15	15-20	20-30
1st trimester dating scan	31	43	24	2
1st trimester dating and NT	2	22	50	26
1st trimester NT	0	27	44	29
1st trimester anomaly (detailed) scan	3	13	51	33
2nd trimester dating only*	5	48	36	11
2nd trimester anomaly only	1	5	58	36
2nd trimester dating and anomaly	0	9	58	33

*2nd trimester dating scan is assumed to be undertaken where there is no initial booking/1st trimester dating scan.

Table 3 (above)

Time allocated for the various routine ultrasound scans (Time shown in minutes and expressed as a percentage).

Table 4 (below)

Commonly selected maternal condition for further scanning referral to tertiary centres and their respective rates.

Selected maternal condition	Units using selected condition for further scanning (%*)	Tertiary Referral (%*)
Epilepsy	35.6	4.5
Poor obstetric history	42.6	8.9
Congenital heart disease	43.6	42.6
Family history of genetic disease	37.6	37.6
Family history of neural tube defect	36.1	6.4
Raised MSAFP	38.1	8.4
Consanguinity	22.3	5.9
Maternal age	24.8	5.4
Maternal drugs	36.1	5.9
Multiple pregnancies	43.1	14.9
Late booker (> 14 weeks' gestation)	24.8	1.5

*Out of a total of 202 units.

3. Information and Support For Parents

Information regarding scans and support for parents (199 units)

Written information concerning ultrasound screening was available for parents in 91% of units, but not in 7%. The literature was prepared in-house in 92% of units but in only 31% was there input from women themselves. Information concerning the different types of routine scans (e.g. dating scan, fetal anomaly screening, etc.) was available in 76% of units (Box 7). The information on scanning was given before the booking appointment in only 42% of units and at the time of booking in 52%. The written information was discussed with the women in 77% of units, usually by the midwife (Box 8). When this did not occur, 73% of the units made it a policy to discuss the scan before it was performed, usually by the person undertaking the scan (69%) or if not by the obstetrician (21%), midwives (35%) or either.

In spite of the availability of written information, 22% of units did not routinely provide additional opportunities to discuss the written information further. Out of the 7% of units that did not provide written information, 75% routinely discussed the scan before it was performed. The information given to women, either verbally or written varied considerably between units (Table 5).

Table 5

Information offered to women before ultrasound screening.

Topic discussed	Verbal explanation	Printed information
The difference between screening and diagnosis	74%	39%
An abnormal scan and its implications	83%	63%
The findings may result in discussion of termination of pregnancy	67%	36%
Possibility of a false positive result	52%	33%
Possibility of a false negative result	83%	55%
Soft markers	58%	36%
Local detection rates	19%	13%

*Out of a total of 202 units.

Written consent was obtained in only 9% of units for an NT scan and 10% for the 20-week anomaly scan. However the opportunity to verbally decline a 1st trimester NT scan existed in 46% of units and for a 2nd trimester scan in 95%. A quiet room was available for discussion of the abnormal scan results in 84% of units.

Aspects discussed in leaflets or at the time of the scans are particularly interesting. In 74% of units the differences between screening and diagnosis were explained and this appeared as written information in 39% of the units. An abnormal scan and its implications were explained verbally in 83% of units but appeared as written information in 63% of the units (Box 9). The implication that a termination of the pregnancy may be the end result of the scan finding was verbally discussed in 67% of units but only appeared in a leaflet in 36% of units.

The possibility of a false positive result was verbally explained in 52% of units but only appeared in the leaflet of 33% of units (Box 10). However the problem of a false negative result (missed diagnosis) was discussed in over 83% of units and appeared in the leaflet of 55%. Soft markers were mentioned verbally in 58% of units but only in the leaflet of 36%. Local detection rates were discussed in only 19% of units and appeared in a leaflet of 13% of the units.

In only 10% of units the leaflet was printed in a language other than English although 90% of units indicated that they did have link workers available (Box 11). Very few units (< 5%) have information available in other formats (e.g. websites, audio, video or CD-ROM).

Box 7

Information and support for parents (1)

- 76% have information for the different types of routine scans (e.g. dating, fetal anomaly screening, etc.)
- 92% were prepared in-house.
- 42% sent the information before booking appointment, while 52% gave it at the time of booking.

Box 8

Information and support for parents (2)

- 77% had dedicated personnel (usually midwives) to routinely discuss the written information given before the scans.
- When not routinely discussed, 73% had a policy to discuss information at the time of scanning.
- 5% discussed the written information neither before nor at the time of the scans.

Box 9

Information and support for parents (3)

- 74% offered information regarding differences between screening and diagnosis but only 39% provided written information.
- 83% offered information regarding abnormal scans but only 63% had written information.

Box 10

Information and support for parents (4)

- **Potential false positive** results were verbally explained in 52% of units but only 36% had accompanying written information.
- **Potential false negative** results were verbally explained in 83% of units and in 55% there was accompanying written information.
- **Detection rates** were discussed in 19% of units but they appeared as written information in only 13%.

Box 11

Information and support for parents (5)

- 10% offered information in languages other than English, although 90% indicated that link workers are available if required.
- <5% have information in other formats (e.g. websites, audio, CD, etc.).

4. Staffing For Antenatal Ultrasound Scans

Staffing (202 units)

The majority of routine obstetric scanning was undertaken by sonographers together with radiographers (7.1 sessions/1000 births).

Midwife sonographers undertook 0.8 sessions/1000 births and obstetricians 0.6/1000 births (Box 12).

Box 12

Staffing (1)	
Average number of sessions / 1000 births	
Sonographers	5.7
Radiographers	1.4
Midwives	0.8
Obstetricians	0.6

45% of units had sonographer vacancies with a mean vacancy rate of nearly 2 WTE. Table 6 showed the WTE vacancies per 1000 births by the regions, which showed that East of England, has the highest number of vacancies for WTE in England (Box 13).

Box 13

Staffing (1)
<ul style="list-style-type: none"> • 45% of units had sonographer vacancies • Average vacancy rate about 2 WTE / unit • Wide regional range for vacancies <ul style="list-style-type: none"> Lowest 0.1 / 1000 deliveries (E. Midlands) Highest 0.5 / 1000 deliveries (E. England)

Table 6

Number of whole-time equivalent (WTE) vacancy per 1000 deliveries by regions.

Region	Deliveries	Total vacancies WTE	Vacancy WTE/1000 deliveries
East of England	41385	19.8	0.5
London	98428	38.3	0.4
North East	27323	11	0.4
South East	86874	22.6	0.3
North West	68239	10	0.2
South West	47148	9.6	0.2
West Midlands	61957	12.9	0.2
Yorkshire and the Humber	54493	9.8	0.2
East Midlands	61267	5.5	0.1

The survey also looked at five specialist groups involved in delivering the service of obstetrics ultrasound scanning. Table 7 indicates that the type of personnel varies depending on the nature of the ultrasound scan. The majority of the units used sonographers for the bulk of obstetrics scanning. Midwife sonographers undertook dating, anomaly and emergency scanning in about a quarter of the units. Consultant obstetricians usually performed NT measurement, a group who also provided substantial services for anomaly and emergency scanning (Figure 3).

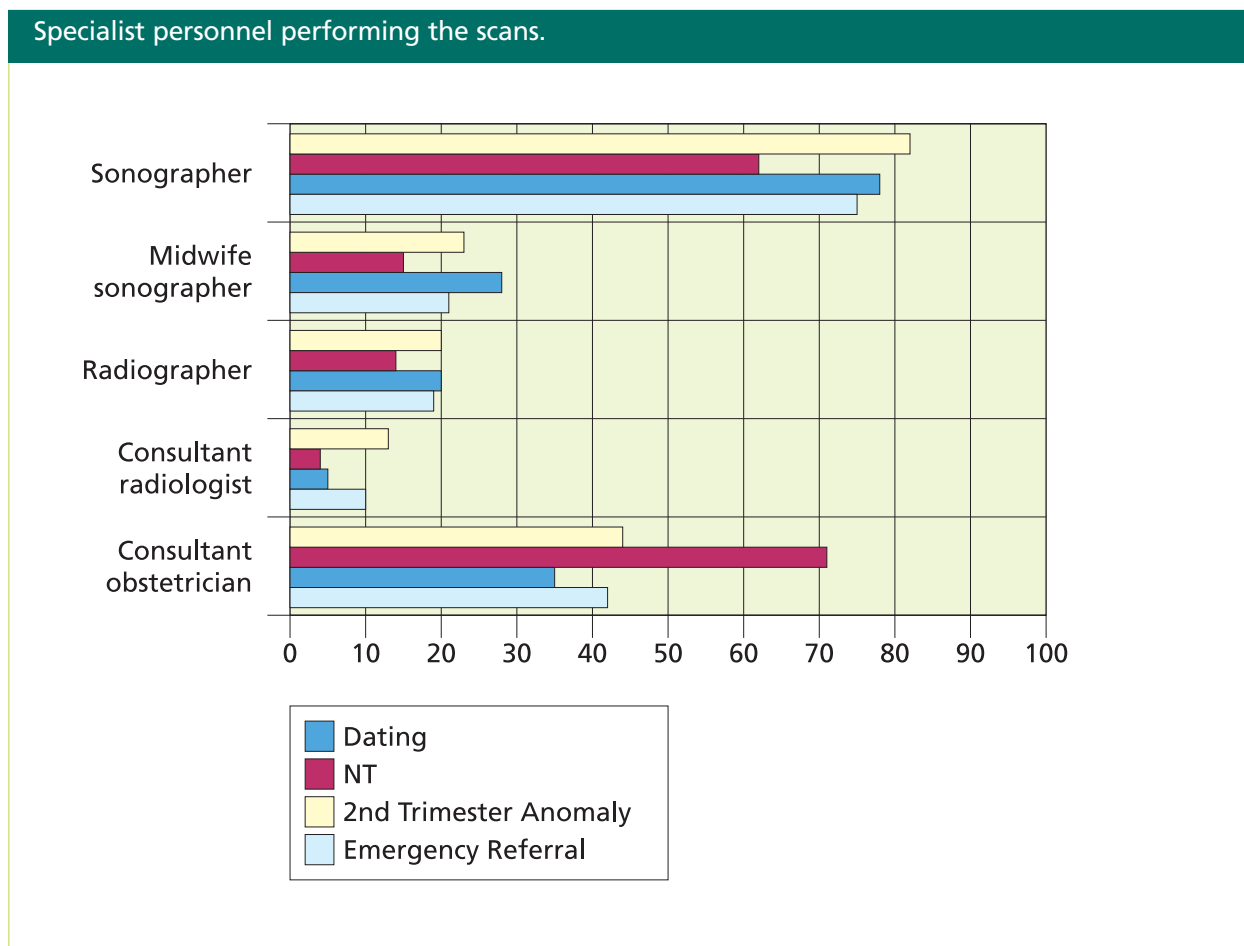
Table 7

Specialists who perform the procedures listed below.

Specialist	1st trimester Dating (%)	1st trimester NT (%)*	2nd trimester Anomaly (%)	Emergency referral (%)
Consultant obstetrician	35	71	45	43
Consultant radiologist	5	5	13	10
Radiographer	19	14	20	18
Midwife sonographer	28	15	24	21
Sonographer	79	62	82	76

*87 units offer NT measurement.

Figure 3



5. Education and Training For Staff

Qualifications for sonographers (202 units)

In about 90% of units non-medical staff held a recognised ultrasound qualification (Postgraduate certificate or diploma and MSc in ultrasound). Medical staff undertaking ultrasound scanning for fetal abnormalities held the RCOG/RCR Advanced Certificate of Ultrasound Training in 35% of the units and more than 70% had doctors scanning who had equivalent training and experience. However, doctors who scanned only did so for at least two sessions a week in only 33% units.

In 91% of units undertaking NT scanning, staff held the appropriate qualification from the Fetal Medicine Foundation. In 87% of the units, the clinical lead for fetal ultrasound scanning service held an appropriate qualification.

Education, training and funding for training (202 units)

A postgraduate diploma is the commonest ultrasound qualification offered by the units followed, in descending order of frequency, by a postgraduate certificate, an MSc in medical ultrasound, and an RCOG/RCR qualification. Furthermore, although there are sessions set aside for training leading to these qualifications, the sessions appear under utilised. Only small proportions of these courses are CASE accredited (Table 8). In 94% of the units, staff have access to continuous professional development for antenatal ultrasound screening (Box 14).

There is no single source of funding for education and training. In most units, support comes from either a combination of hospital funding (80%) or money derived from a photo fund (45%). Personal funding was required in 41% of units (Box 14). Only 66% of the units could allow their staff to be released for sufficient training and updating activities. The commonest reason for the failure to release staff was because of staff shortages.

Regular meetings to discuss particular ultrasound cases arising from screening occurred in 65% of units. Most units (51%) met at least once a month and in 80% of units, the meetings were multidisciplinary.

Box 14

Education, training and funding

- 94% have access to continuing education.
- 66% of units released staff for training, 34% could not because of staff shortages.
- 80% offer limited hospital funding.
- 45% derived from photograph fees.
- 41% required self funding.

Table 8

Range of qualifications of personnel providing maternity ultrasound scanning services.

Ultrasound qualification	Yes	CASE accredited?	Number of sections			
			Allocated		Filled	
			Range	Mean	Range	Mean
Postgraduate Certificate	66	46	0 - 6	2.00	0 - 6	1.38
Postgraduate Diploma	80	59	0 - 8	2.77	0 - 8	2.20
MSc in Medical Ultrasound	43	30	0 - 8	1.58	0 - 8	0.92
RCOG/RCR Advanced Certificate of Ultrasound Training	28	8	0 - 6	1.60	0 - 6	1.37
Other	11	1	0 - 6	1.39	0 - 6	0.74

Total number of total units responding to this question.

6. Technical Information, Including Measurements Taken (202 units)

Dating in first and second trimesters

All but a few units had agreed protocols (92%) and checklists (90%). Virtually all units (97%) had the capability to perform a vaginal scan. In the first trimester 97% of units performed a crown-rump length and 61% did a biparietal diameter (BPD) measurement if the gestation was appropriate. In the second trimester the most commonly used measurements were BPD (96%), head circumference (93%), femur length (97%) and abdominal circumference (76%) (Table 9).

Third trimester measurements

Only 1.5% of units offered routine third trimester scanning to all women but virtually all other units offered it to some women presumably, mainly, in response to concerns about fetal growth. Measurements undertaken were BPD (80%), head and abdominal circumference (95%), femur length (82%) and amniotic fluid assessment (85%) (Table 9). Interestingly only 44% of the units would offer umbilical artery Doppler measurements as routine investigations when performing a third trimester scan. Measurement of the BPD was made from outer to inner cranial table in 78% of the units. Ellipse facility was used in 87% of units for head circumference measurements and in 83% of the units for abdominal circumference measurements.

Fetal charts used

Only 1.5% of units used different charts for different ethnic groups and all units used the same charts for both singleton and twins (3 units did not respond to the question, see above). Estimation of fetal weight was from a measurement of the abdominal circumference in 93% and in addition to BPD (45%), head circumference (42%) and femur length in 60%. The fetal charts in use varied considerably although just over half of the units used Chitty et al,3-5 (Table 10).

Placenta

The placenta was assessed at the 20 weeks scan in 95% of units. A "low lying" placenta led to a further scan in 91% of units and this scan was most often undertaken between 30 and 35 weeks (87%). Five percent of units did the scan at 36 weeks or later.

Twin pregnancies

Chorionicity was assessed by a combination of methods in 97% of units using twin peak sign (91% of units), membrane thickness in (70%) and fetal sex differences (52%) (Table 11). The majority of units used the twin peak sign at less than 16 weeks (73%). A different scanning policy was adopted for monochorionic and dichorionic pregnancies in 76% of units but serial scanning was offered to both types in virtually all units. However, only 25% and 10% of units respectively had a special ultrasound scanning session for monochorionic and dichorionic pregnancies.

Fetal Abnormalities

Table 12 indicates that the structural scan recommended by the RCOG⁶ was performed in the vast majority of units (95%).

However cardiac outflow tracts were visualised routinely in only 57% of units.

There were considerable Regional variations as shown in Table 13. Aspects of the face identified were as follows; profile 78% of units, orbits 69%, lips 82% and nostrils 64% (Box 15).

Table 9

Routine biometry measurements used in all trimesters.

Measurement	% of units		
	1st trimester	2nd trimester	3rd trimester
Crown-rump length	97		
Biparietal diameter	61	96	80
Head circumference		93	95
Femur length		97	82
Abdominal circumference		76	95
Low lying placenta assessment		91	88*
Amniotic fluid assessment			85
Umbilical artery Doppler			44

*30-35 weeks' gestation window, a further 5% assessed after 36 weeks' gestation.

Table 10

Fetal size charts used as reference for biometry measurements (No. of units)

Source	AC	BPD	HC	FL	CRL
Chitty et al., 19943-5	59	55	57	55	
Deter et al., 19827	8				
Hadlock et al., 19828-10	16	25	25		
Robinson and Fleming, 197911					73
Snijders et al., 199412	7	7	7	7	5
Warda et al., 198513				18	
Locally derived	2	2	2	2	
Other	8	9	6	10	6

Table 11

Preferred methods of assessing twin chorionicity in relation to various gestations (Number of units)

Weeks	Twin peak sign (%)	Membrane thickness (%)	Fetal sex (%)
<16	129 (72.9)	80 (58.4)	5 (4.9)
16-20	6 (3.4)	16 (11.7)	68 (66.7)
21-25	1 (0.6)	2 (1.5)	5 (4.9)
26-30	0	0	1 (1.0)
>30	0	0	0
Not stated	41 (23.2)	39 (28.5)	23 (22.5)
Total (no. of units)	177	137	102

Table 12

Structures routinely examined at the second trimester anomaly scan.

Structures	% (of units)
Head shape	97.0
Internal structures	
Cavum pellucidum	94.1
Cerebellum	97.0
Ventricular size at atrium	91.1
Spine	
Coronal	94.6
Transverse	96.5
Sagittal	96.5
Abdominal shape and content at level of stomach	97.5
Cord insertion	97.5
Kidneys	95.5
Bladder	96.0
Longitudinal axis: abdominal-thoracic appearance	86.6
Diaphragm	91.6
Heart	
Four-chamber view	97.5
Outflow tracts	56.9
Arms: three bones and hand (not counting fingers)	95.0
Legs: three bones and foot (not counting toes)	94.6
Face:	
Profile	77.7
Orbits	69.3
Lips	81.7
Nostrils	63.9
Other	12.9

Table 13

Routine visualisation of the cardiac outflow tract at 2nd trimester fetal anomaly scans and accuracy in diagnosing cardiac defects.

Region	No. of units	Routine cardiac outflow scans (% of units)
East of England	7	50.0
East Midlands	16	84.2
London	20	76.5
North East	9	60.0
North West	12	37.5
South East	22	73.3
South West	7	38.9
West Midlands	5	25.0
Yorkshire and the Humber	11	55.0

Box 15

Fetal anomaly screen

- RCOG recommended scan in 95% of units.
- However;

Cardiac outflows in	57% (of units)
Orbits / nostrils in	66%
Markers in	95%
45% of units report single marker	
25% of units need to refer for detailed scan	

Fetal cardiac scanning

96% of units had access to specialist fetal echocardiography but this was provided "in house" in only 28% of units. Paediatric cardiologists and obstetricians provided the service in 73% and 35% of the units respectively. Obviously in some units both were involved. A radiologist was providing the service in 16% of units. Indications for referral were varied but the two most common were either a previous history of child, or parent, with congenital heart disease, or suspicious appearance of the four chambers. Concerns about the appearance of the outflow tracts and increased NT were less frequent indications for referral probably reflecting the fact that neither was often assessed. The obstetrician made most of the referrals to specialists outside the base hospital although sonographers would make some of the referrals to tertiary units (Table 14).

Table 14

Ultrasound staff making the referral and the specialist referred to.

Specialist referred to	Ultrasound department staff making referral			
	Obstetrician	Radiologist	Radiographer*	Midwife sonographer
Obstetrician outside unit	140 (69.3%)	18 (8.9%)	25 (12.4.5%)	13 (6.4%)
Radiologist outside unit	76 (37.6%)	26 (12.9%)	15 (7.4%)	6 (3.0%)
Tertiary fetal medicine unit	160 (79.2%)	26 (12.9%)	81 (40.1%)	31 (15.3%)
Paediatrician outside unit	127 (62.9%)	19 (9.4%)	6 (3.0%)	7 (3.5%)
Specialist paediatrician /surgeon outside unit	140 (69.3%)	17 (8.4%)	4 (2.0%)	7 (3.5%)
Clinical geneticist outside unit	150 (74.3%)	13 (6.4%)	7 (3.5%)	9 (4.5%)
Fetal cardiologist outside unit	151 (74.8%)	22 (10.9%)	51 (25.2%)	16 (7.9%)
Genetic counsellor	148 (73.3%)	17 (8.4%)	11 (5.5%)	14 (6.9%)
Other	12 (5.9%)	3 (1.5%)	5 (2.5%)	2 (1.0%)

*Included ultrasound department sonographer staff

Markers of aneuploidy

Markers of aneuploidy were looked for in 95% of units and there seemed to be reasonable agreement about the different markers used (Table 15). There was, however, some variation in the way in which pregnancies with markers were managed. Table 16 showed the different soft markers and the frequency with which they would be reported. 49% of units would tell a woman if one marker was present in isolation but it was clear that in all units the woman would be informed when either two or more markers or a marker in addition to another risk factor were present. In these circumstances 75% of the units offered detailed scanning in the base unit.

Table 15

Number of units (and percentage), using the following as markers (and their criteria) of aneuploidy.

Sonographic marker of aneuploidy?	Yes	Criteria?	Yes
Choroid plexus cyst 1 Bilateral \geq 5mm	169 (88.5%)	Bilateral any	113 (66.9%)
		Unilateral \geq 5mm	66 (39.1%)
		Unilateral any	88 (52.1%)
		Other	23 (13.6%)
Ventriculomegaly	175 (91.6%)	Posterior horn \geq 10mm	152 (86.9%)
		Raised V:H ratio	85 (48.6%)
		Other	2 (1.1%)
Echogenic bowel	182 (95.3%)	Bright as bone	178 (97.8%)
		Bright as liver	4 (2.2%)
		Other	4 (2.2%)
Head shape	170 (89.0%)	Strawberry shaped skull	159 (93.5%)
		Brachycephaly	72 (42.4%)
		Other	30 (17.6%)
Nuchal fold	149 (78.0%)	\geq 5mm \geq 20 weeks	28 (18.8%)
		\geq 6mm \geq 20 weeks	112 (75.2%)
		Other	8 (5.4%)
Cisterna magna	141 (73.8%)	\geq 10mm	132 (93.6%)
		Other	6 (4.3%)
Echogenic foci in heart	124 (64.9%)		
Dilated renal pelvis	176 (92.1%)	AP \geq 4mm	4 (2.3%)
		AP \geq 5mm	137 (77.8%)
		Variable with gestation	54 (30.7%)
		Other	15 (8.5%)
Short femur	171 (89.5%)	< Fifth centile	154 (90.1%)
		Raised FL:BPD	28 (16.4%)
		Other	3 (1.8%)
Short humerus	78 (40.8%)	< Fifth centile	63 (80.8%)
		Raised HL:BPD	7 (9.0%)
		Other	5 (6.4%)
Sandal gap	145 (75.9%)		
Clinodactyly	130 (68.1%)		
Clenched hand	140 (73.3%)		
Two-vessel cord	145 (75.9%)		
Other	26 (13.6%)		

Table 16

Number of units reporting various soft markers for aneuploidy.

Sonographic marker of aneuploidy?	Yes	
Echogenic bowel	182	(95.3%)
Dilated renal pelvis	176	(92.1%)
Ventriculomegaly	175	(91.6%)
Short femur	171	(89.5%)
Head shape	170	(89.0%)
Choroid plexus cyst	169	(88.5%)
Nuchal fold	149	(78.0%)
Sandal gap	145	(75.9%)
Two-vessel cord	145	(75.9%)
Cisterna magna	141	(73.8%)
Clenched hand	140	(73.3%)
Clinodactyly	130	(68.1%)
Echogenic foci in heart	124	(64.9%)
Short humerus	78	(40.8%)
Other	26	(13.6%)

7. Management Following Identification of an Abnormality/Variant (202 units)

Management following identified and suspected abnormality

Although in two thirds of units the sonographer gave the information immediately when a definite abnormality was identified, this fell to 47% if there was only a suspicion of an abnormality. In most units the sonographer would make the referral but the types of abnormality referred varied presumably with the certainty of the original diagnosis. Thus, only 67% of units reported that the sonographer would refer spina bifida whereas 85% of units reported referral for a cardiac anomaly (Table 17).

The interval between the scan and being seen at a referral unit was less than 2 working days in 45% of units but a further 35% indicated that the time was dependent on availability. When an abnormality was identified virtually all units could offer counselling usually by an obstetrician or by a specialist screening midwife. This counselling session occurred within 2 working days in 79% of units.

Table 17

Number of units, which would refer the following definite or suspicious abnormalities for a second opinion.

Fetal anomalies	Definite (%)	Suspicious (%)
Cardiac anomaly	171 (84.7%)	162 (80.2%)
Spina bifida	135 (66.8%)	154 (76.2%)
Skeletal	152 (75.2%)	145 (71.8%)
Hydrocephalus	152 (75.2%)	144 (71.3%)
Other central nervous system	151 (74.8%)	142 (70.3%)
Major renal	148 (73.3%)	135 (66.8%)
Cleft lip	134 (66.3%)	132 (65.3%)
Congenital diaphragmatic hernia	109 (54.0%)	107 (53.0%)
Other	79 (39.1%)	84 (41.6%)
Any	95 (47.0%)	104 (51.5%)

In 74% of units women received written information and details about the abnormality. Patient information sheets were available for very few specific abnormalities and they were found most frequently for spina bifida (31%). ARC were involved in 81% of units once an abnormality had been identified and psychological support was available from a variety of sources (Table 18) most frequently from a midwife.

Once an abnormality has been identified, the pregnancy is usually managed in a standard antenatal clinic (84%). Amniocentesis, if required, could be offered in 87% of units. Following either a death or termination, an autopsy was performed by a perinatal pathologist in 84% of units but this was only able to be undertaken in-house in 24% of units. If the pregnancy was terminated, follow up with an obstetrician and, if appropriate, a geneticist occurred in the vast majority of the units (95%) and a plan for the next pregnancy devised in 94% of units.

Table 18

Personnel providing psychological support.

Personnel	Number	%
Midwife	155	76.7
Consultant	144	71.3
Specialist screening midwife	95	47.0
External support group	95	47.0
Hospital chaplain	83	41.1
GP	82	40.6
Genetic counsellor	80	39.6
Bereavement counsellor	62	30.7
Trained counsellor	56	27.7
Psychologist	16	7.9
Other	13	6.4

8. Equipment and Facilities, Including Storage of Images (202 units)

Equipment and facilities

Table 19 shows that about 20% of ultrasound machines in use are designated "old" at the time of the survey (built before 1997). The region with the fewest old machines is the North East (4% of units) and that with the greatest number is the West Midlands (25%) (Figure 4). Only 65% of units indicated that they had sufficient numbers of machines (Box 16). 87% of units had machines, which would measure down to tenths of a millimetre (needed for NT measurement), but only 61% of units indicated that the machines in use provided sufficient image quality. Less than half the units had a "rolling programme" for machine replacement but when such a system was in place 56% had machines changed at 5 years and 32% at seven years. Only 47% of units had "upgradeable machines" and 80% had machines, which complied with IEC 1157 and HEI 98 standards. Quality assurance checks were made in 85% of units and 86% had checks on power outputs with power outputs being monitored on a regular basis in 80% of units.

Box 16

Equipment (1)

- 65% have sufficient machines for workload.
- 20% used old machines (<1997).
- NE has fewest 'old' machines (<4%) while West Midlands has the most (25%).
- 87% measured to 0.1mm (NT).
- 61% provided 'sufficient' image quality.
- 56% have 5 years replacement programme, 32% - 7 years.
- 80% compliant with IEC 1157 and HEI 98.

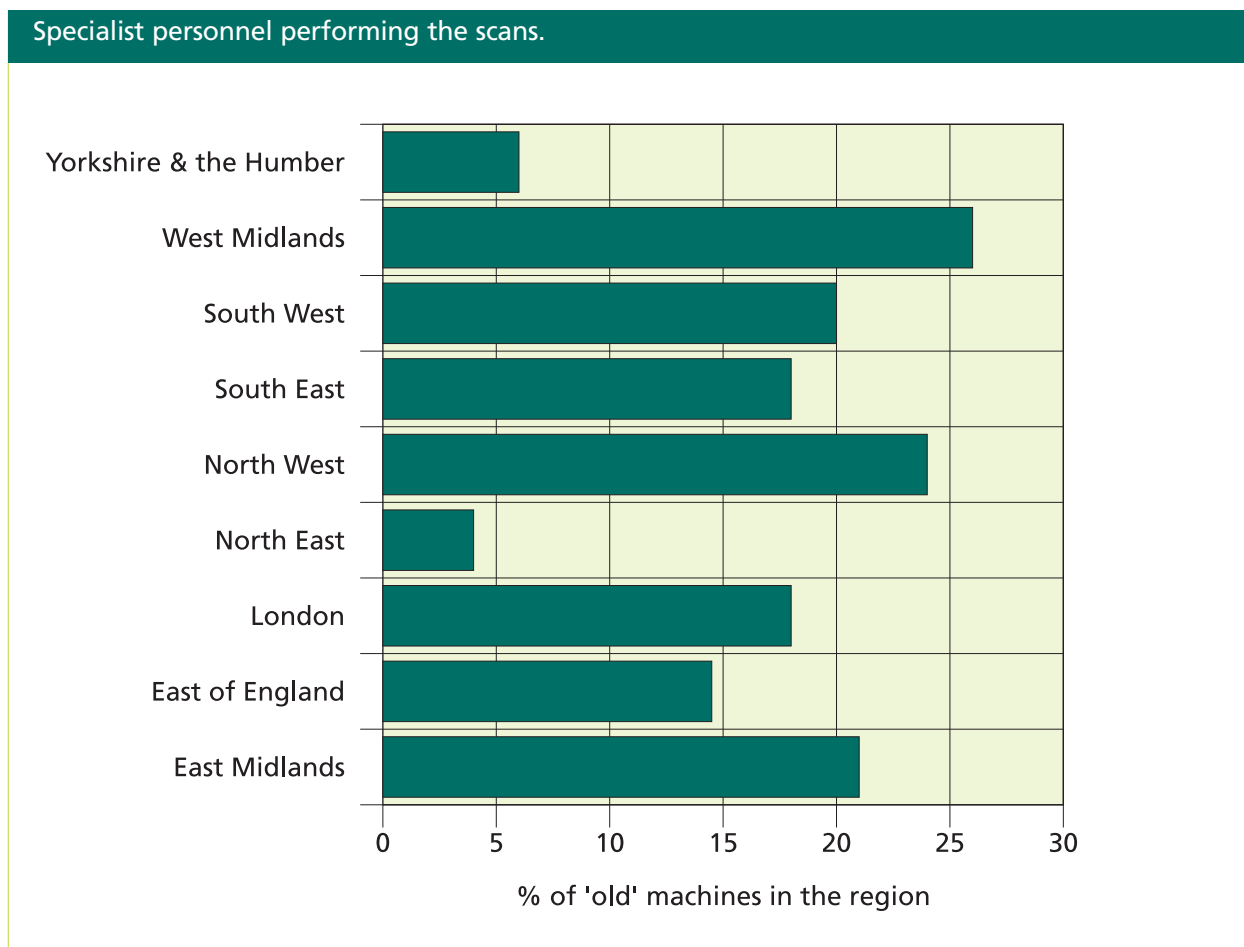
Table 19

Regional differences in the provision of ultrasound capital infrastructures.

Region	No. of units	Total no. of machines	% of machines 'old'*	% Rolling replacement programme	% Upgrade programme**	% IEC 1157 compliant	% HEI 98 compliant
East of England	19	68	14.7	47.4	52.6	84.2	78.9
East Midlands	15	53	20.8	40.0	46.7	73.3	80.0
London	32	136	18.4	50.0	40.6	81.3	87.5
North East	15	49	4.1	86.7	73.3	93.3	100.0
North West	31	111	23.4	38.7	38.7	48.4	64.5
South East	30	114	18.4	23.3	40.0	86.7	86.7
South West	21	65	20.0	38.1	42.9	85.7	85.7
West Midlands	20	91	25.3	30.0	40.0	80.0	80.0
Yorkshire and the Humber	19	77	5.2	73.7	68.4	100.0	100.0
Total	202	764					
*Defined as older than 5 years							
** Either a 5 year or 7 year replacement programme							

Figure 4

Regional differences of pre-1997 ultrasound machines.



Storage of images was for between 21 to 25 years in 50% of units but for less than 5 years in 21% (Box 17). Most units (84.7%) used thermal images and 66% of units expressed satisfaction at the way the images were stored. Scan reports were recorded manually in 27% of units and on computer in 48%. All the rest used both methods.

A computerised information system was used in 71% of units but it was linked with the maternity system in only 19% of units.

Box 17

Equipment (2)

- 50% stored images for 20-25 years, 21% <5 years.
- 84.7% stored as thermal images; 66% reporting satisfaction with this method.
- 48% had computerised reports, but only in 19% of units were they linked to maternity record/detail.
- 27% recorded reports manually.

9. Standards, Audit and Monitoring (169 units)

Systems were in place to monitor the screening service in 54% of units (Box 18). Detection rates were audited in 60% of units mostly on an annual basis. False positive rates were monitored in only 28% of units again annually and the reliability and accuracy of measurements were monitored in just over 40% of units mainly every six to twelve months. Less than 20% of units could provide an actual detection rate for a range of abnormalities. Patient satisfaction was audited in only 32% of units. The sonographers were those mainly involved (88% of units) in the audit process. Just 8% of units involved lay representatives in the audit process. 70% of units contributed to an anomaly register. Only 16% of units produced an annual report.

Box 18

Standard, audit and monitoring

- 80% were not able to provide the unit's detection rate for various abnormalities.
- 54% have system in place to monitor the screening service.
- 60% audited their detection rate (usually on annual basis).
- 28% monitored false positive rates (False negative rates (missed diagnosis) monitoring were not surveyed).
- 16% produced annual report.

See box 10

Discussion

This is the first comprehensive survey of ultrasound screening services in England and it provides a snapshot view of the situation as it existed in 2002. It has provided some important insights into the way in which the service was organised and run and does highlight some serious gaps and deficiencies.

Policies, protocols and responsibility

It appears that the great majority of units have written policies for the types of scan offered, when scans should be done and the action to be taken in the event of an abnormality. Thus, although the types of protocol may vary there seems to be a structure of sorts in place. Less than half the units had a monitoring group but the guidelines/policies were constructed in most units by both obstetricians and sonographers. Indeed radiographers were involved only in about a third of units.

The clinical lead was an obstetrician in about two thirds of units and a radiologist in just under a quarter. This suggests that over the years there has been an increasing influence from obstetricians in the area of antenatal scanning. In a survey of practice in SE Thames in 1984, 47% of obstetric scanning was done in radiology departments and 45% in obstetric units with only 5% in ultrasound departments (RCOG 1984).¹⁴

Although it is good to see that many units have protocols and guidelines it was disturbing to note that just 16% of units produce an annual report. It is difficult to see how a unit can be clear about the outcome of their scanning policies without such a report

and we would recommend that all departments should produce one.

Antenatal Ultrasound Package

Pregnancy dating

In the HTA review of the value of routine ultrasound in pregnancy it was clear that accurate dating of the pregnancy conferred an advantage.¹ This survey indicates that all units will offer pregnancy dating which will be complete by about 20 weeks. However routine dating in the first trimester was only offered in 57% of units although selective dating, and probably viability scanning, was undertaken in a further 32%. The rest appeared to offer dating either separately or usually with, the screening anomaly scan.

NT/first trimester fetal anomaly screening

As shown by the Down's Syndrome survey (2001) NT screening occurs routinely in the minority of units but just over a quarter offered NT measurement to some women and it is clear that the majority of these units exist in London and the South East.¹⁵ Why this should be is less obvious but at least some of the units would have been part of the NT study started by Professor Nicolaides and the Fetal Medicine Foundation in the early 1990's and they have presumably continued to provide the service.

First trimester anomaly scanning is undertaken in very few units and again these tend to be based in London. A recently completed, but as yet unpublished, study in

the Northern region has demonstrated the feasibility of the approach but whether it could be widely applicable, or indeed adds much more than a competent booking scan, remains to be seen.

Screening for fetal anomaly

Of those units offering anomaly screening 97% did so on a routine basis. The HTA report questioned the value of fetal anomaly screening and acknowledged that few of the studies available did provide definite evidence of benefit.¹ However Smith and Hau (1999)¹⁶ demonstrated in a Scottish population that detection rates for a variety of abnormalities was enhanced through use of a routine 18 to 20 weeks anomaly screen. The use of ultrasound in this way has been the subject of a number of reports and working parties, all of which concluded that anomaly screening should be adopted. Most recently the NICE guidelines have confirmed this and a recent report from Scotland has also recommended this approach.^{2,17}

The probable benefits of ultrasound screening at this time can be divided into four groups although they may well overlap.

- a) The identification of a fetal anomaly offers the woman the choice about whether to continue with the pregnancy or not. It also helps in obstetric decision making such that unnecessary obstetrics interventions can be avoided.
- b) Conditions that carry considerable morbidity may be identified which may offer the woman choices about continuing with the pregnancy.

Thus, conditions such as spina bifida may be viable but often with considerable handicap.

- c) Screening, in some circumstances, may help to optimise the care of the baby at delivery. There is some evidence now that certain congenital cardiac lesions such as transposition¹⁸ and Fallot's tetralogy¹⁹ may have improved outcomes if identified antenatally. Diaphragmatic hernia may be another condition to benefit.²⁰
- d) There may be a few conditions which may benefit from fetal treatment although this group is very small at the moment.

One problem emphasised by the survey is that the poor quality of the monitoring and audit of ultrasound makes it impossible to discern advantages and this is an area of considerable concern.

Information and support for parents

The report highlights significant problems concerning the quality of information received by women before the anomaly scan and indicate a wide range of practice with respect to the type of information and the way in which it is delivered. There appeared to be disparity between what women were told and what appeared in any written information, something, which would clearly lead to confusion. While most units (83%) discussed, to some extent, false negative results (missed diagnosis) this only appeared in 55% of units' literature. Conversely fewer units (52%) discussed mentioned the possibility of false positive results even

though these may lead to considerable anxiety and occasionally inappropriate intervention – only a third placed anything in their leaflets on the matter.

Few units could provide local detection rates for a variety of abnormalities. Of particular concern was the fact that only two thirds of units dealt verbally with the possibility that an abnormal result may lead to a discussion about termination of an affected pregnancy and only just over a third put this in their literature.

Very few units offered leaflets in any language other than English although 90% had access to link workers. All women, English or non-English speaking, need to be provided with appropriate written information early in pregnancy and its absence, therefore, is of particular concern. Whilst link workers are a crucial component of the communication chain they are in limited supply and would be unable, for example, to meet with all non-English speaking women at booking. The use of other communication techniques needs to be seriously considered and it is interesting that less than 5% of units have alternative arrangements in place.

Staffing for antenatal ultrasound scans

The survey indicates some concerning issues with respect to levels of staffing and vacancy rates. There appears to be a wide range of staffing vacancies across England but the average unit appears to be about 2 WTE short. In fact 45% of units indicated that they had staffing problems. There was a wide range of vacancies across the regions with the

lowest being in the East Midlands and the highest in the East of England. It is difficult to know how this translates into difficulties with maintaining services but it is something that needs to be remembered when additional services are being planned. It is also important to remember that obstetric ultrasound is only one of the modalities offered by the majority departments and so extra work in this area may impact on other imaging services.

The survey indicates that sonographers or radiographers undertake the majority of obstetric scanning. The 1984 survey (RCOG 1984) showed that radiographers performed 63%, obstetricians 14%, radiologists 7% and midwives 8%.¹⁴ Since then the number of sonographers has increased and the present survey shows that they now are involved in about 70 to 75% of the units, with obstetricians in 40% and midwives in 20%. Increasingly other health care professionals, including midwives, are becoming involved in scanning often dating and third trimester scans but also anomaly screening scans. While this development might be seen as a solution to the staffing challenges it is, of course, well recognised that there is also a shortage of midwives. Increasingly obstetricians are becoming involved in ultrasound and the RCOG has in place not only an advanced training for ultrasound but also a “special interest” module, which provides basic training and experience in ultrasound techniques.

The proposal by the National Screening Committee to introduce nuchal translucency screening²¹ nationally has the potential to place an additional burden on the ultrasound services. The challenge will need to be met either by increasing the number of staff

scanning or by rationalising the current service by perhaps being more critical about the indications for scanning in the third trimester. Alternatively limiting training for personnel such as midwives to just the first trimester, and perhaps specifically for Down's syndrome screening, could be considered.

Education and training

Ultrasound examination by untrained staff is clearly unacceptable and the majority of ultrasonographers and radiologists have undergone suitable professional training. As mentioned above, other professionals will receive training in a variety of ways but unfortunately many of the courses are not CASE approved and so the consistency of the training cannot be confirmed. However, ongoing experience is also required for optimum service provision, and this survey showed that obstetricians scanned for 2 sessions a week as recommended by the RCOG in only 33% of units.

A major problem which seems to have emerged is the difficulty staff experience in attending updating courses either because of lack of funds or because there are insufficient staff to allow days off for training. It is also a fact that taking on the training of individuals is time consuming making it difficult to handle the daily workload.

Training requirements include not only technical issues such as nuchal translucency measurement, but also generic issues such as the principles of screening and the development of communication skills.

Technical information, including measurements taken

Interestingly most units appeared to have guidelines/protocols, which delivered an anomaly screening scan in the way suggested by the RCOG 2000 report. This report set out a check list for a screening scan at two levels, minimum standard and an optimal standard which was to include the examination of the fetal face and also the cardiac outflow tracts. There seems to be increasing justification to assess the outflow tracts so that conditions such as transposition of the great vessels can be identified, since antenatal diagnosis may improve eventual outcome (see above). However only just over 50% of units indicated that they routinely assessed outflow tracts and this is probably reflected in the low detection rate of cardiac abnormalities. There appears to be a large regional variation which is concerning. Bull 1999 found only a 23% detection rate of serious cardiac abnormalities on average in the UK. Although this study included all pregnancies whether or not an anomaly scan was performed, detection was probably better in units which undertook a full cardiac view.²²

The survey failed to establish detection rates because few (less than 20%) units could provide them once again underlining the deficiencies that exist in audit and follow up. It is interesting to consider on what basis individual units indicate their detection rates in the literature they give to women although it is likely that they quote the nationally acceptable figures (RCOG, 2000)⁶.

The use of markers appears almost universal. Nuchal fold, echogenic bowel and dilated renal pelvis are used by most units and yet the paper by Bindman-Smith et al (2001)²³

indicates that at least the last two have only weak predictive power for Down's Syndrome. Just under half the units would not report a single marker but the presence of two or more would initiate a detailed scan. In a quarter of units, this would require the woman to be referred.

The use of ultrasound markers remains controversial but clearly most units do report them. It has been shown that the use of markers increases the false positive rate for ultrasound 12 - fold²⁴ with the benefit of increasing detection rates by only 4%. The Smith-Bindman paper demonstrates that the use of single markers as an indication for amniocentesis will result in the loss, from amniocentesis, of greater numbers of normal babies than affected cases identified, emphasising the need for caution in their use.²³ Indeed the recent Quality Improvement Scotland Report (HTA Report 5) suggests that one of the justifications for nuchal translucency screening is to negate the need to respond to markers in the second trimester.² There is clearly a need to rationalise the use of markers and probably an increased nuchal fold thickness is the single marker, which should be used as an indication for amniocentesis.

The technical aspects of scanning indicate some uniformity in the types of measurement made but a variety of charts are used to interpret the figures. The Chitty charts³⁻⁵ are used by about 55% of units and interestingly, for the early pregnancy measurements of crown rump length, most units still use the Robinson and Fleming chart published in 1979¹¹. Whether the fact that a variety of charts are used is important is uncertain. Those used probably depend on the measurement package installed in the ultrasound machine.

Umbilical artery Doppler measurements in the third trimester were available in 44% of units. This is disappointing because Doppler has been shown to improve outcome in high-risk pregnancies and is a recommended evaluation in a recent RCOG guideline on the management of intrauterine growth restriction.²⁵

Nearly all units assessed chorionicity in twins mostly by the "twin peak sign". Although about three-quarters had a different policy for monochorionic and dichorionic pregnancies virtually all had some policy of serial measurement. However the availability of special scanning sessions occurred in only a quarter of units.

Management following identification of an abnormality/variant

This section of the survey gave some concern, as there seemed less clarity about how units managed abnormal results. Thus in about two thirds of units a definite abnormality was reported to the women by the sonographer but this happened in only just under a half when a problem was suspected. The need to refer depended upon the type of abnormality so that 85% of units would refer a definite cardiac abnormality and 67% spina bifida. The fact that two thirds of the units would refer a definite spina bifida is surprising since the diagnosis is usually fairly obvious. However, it may be that couples request referral for confirmation or further advice. In cardiac conditions the diagnosis is often more complex and prognosis requires often the expertise of a specialist in fetal echocardiography.

Referral was achieved in less than two working days in 45% of units and counselling by obstetrician and/or midwife within two working days in 78%. In just over 50% of units was there a referral for congenital diaphragmatic hernia. This is surprising because it is usually appropriate to undertake more high resolution scanning with karyotyping to establish the prognosis and the evaluation would require a tertiary referral.

Of concern is that only 75% of units could offer literature about abnormalities and that patient information sheets were available for only very few specific abnormalities. Even for one of the commonest, spina bifida, information was found in only 31% of units. The reason for this is, presumably, that all these abnormalities are relatively unusual and average sized units will only see a few cases in a year. However it is important that when they do appear the appropriate information exists.

Equipment and Facilities

It has been suggested by a number of studies that ultrasound equipment should not be older than 5 years unless it can be upgraded, but this was possible in less than 50% of the units.²⁶ In the survey a fifth of units indicated that they had equipment older than 5 years but the range across the regions was considerable with fewest old machines in the North East and Yorkshire and Humber and the greatest number of old machines being found in the West Midlands and North West. Just over half the units had a 5-year replacement programme, with the remaining units having to make do with a longer replacement programme of 7 years.

Although 87% of units said they had machines capable of measuring 0.1mm, necessary for nuchal translucency measurement, it was not clear how many such machines they had. These data do not help in judging capacity to undertake NT although since only two thirds of units indicated they had sufficient equipment, and a further 40% that they did not have machines producing an adequate image, there may be significant hardware problems.

It is of concern that reports were hand – written in just over a quarter of units and on a computer in just under half. There were few units whose ultrasound computer system linked with the maternity system.

Image storage has always been challenging and the survey showed that only half the units aim to keep images for 21 to 25 years and that most use thermal imaging which has a limited useful life of about 20 years.

Standards, audit and monitoring

This area gives rise to serious concern since any form of monitoring of the screening service was found in just over half of the units. Even assessing the accuracy of the ultrasound measurements themselves only occurred in about 40% of units. Less than 20% of units could offer detection rates although 70% contributed to an anomaly register. Presumably the detection rates the units placed in their patient information literature were taken from so-called national figures rather than their own.

Conclusions

Policies, Protocols and Accountability (Page 09)

1. The clinical lead for maternity ultrasound was usually an obstetrician in 64% of the units.
2. About 80% of units had written policies and 90% had written guidelines / protocols. This survey has not evaluated the adequacy of these.
3. Only 48% of units had a local ultrasound monitoring group.
4. About 80% of units had both obstetricians and sonographers involved in guideline and protocol production.
5. Policies were reviewed on an annual basis in 56% of units.

Antenatal Ultrasound Package (Page 10)

6. The survey indicates that the offer of an early dating scan is not universal. Just over 57% of units offered it to all women and a further 32% offered it to some. When such a scan was not offered dating was usually undertaken at the time of the anomaly screening scan.
7. Only 16% of units offered NT to all women, and 27% offered it to some. Most of these units were in London or the South East.
8. First trimester anomaly scans were offered in only 6% of units mostly in London.
9. A dating scan in the second trimester was offered to all or some women in 5% and 21% of units respectively most often because of late booking or uncertain dates.

10. 97% of units offered an anomaly screening scan in the second trimester to all women.
11. Routine Doppler or a scan in the third trimester was undertaken in only 1.5% of units.
12. Only 17% of units could always perform scans as part of an antenatal visit. A further 62% could sometimes achieve this but it was never possible in 17% of units.
13. 97% of units allowed companions in to the scan.
14. 99% of units offered a photo and 2.5% a video.
15. Time allocated for a first trimester dating scan was between 5 to 10 minutes whilst time for NT measurement and screening anomaly scan was between 20 and 30 minutes for each.

Information and Support For Parents (Page 16)

16. Most (91%) of units supplied written information on ultrasound screening but this was given to women before the scan appointment in only 42% of units.
17. Further opportunities to discuss scans existed in 78% of units.
18. The difference between screening and diagnosis was discussed verbally in 74% of units but only in written information in 39%.
19. In general there appeared to be variance between what was discussed verbally and, that which appeared in leaflets.
20. Only 10% of units had information in languages other than English.

Staffing For Antenatal Ultrasound Scans (Page 19)

21. 45% of units had sonographer vacancies with a mean of nearly 2 WTE

Education and Training For Staff (Page 22)

22. In about 90% of units non-medical staff held a recognised ultrasound qualification.
23. Medical staffs either held the RCOG/RCR Advanced certificate of Ultrasound Training or had equivalent training/experience.
24. Individual medical staff scanned for two sessions in only 33% of units.
25. 91% of units undertaking NT held a qualification from the Fetal Medicine Foundation.
26. Most units (94%) provided access to their staff for training/courses but only 66% could release them, those that could not, stated staff shortages as the commonest reason.

Technical Information, Including Measurements Taken (Page 24)

27. Crown rump length and biparietal diameter remained the commonest measurement for pregnancy dating.
28. Biometry charts varied but those created by Chitty et al were used in just over half the units.
29. 44% of units could offer Doppler scanning
30. The placenta was assessed at the anomaly screening scan in 95% of

units and if found low a further scan was generated sometime between 30 and 35 weeks in 87% of units.

31. In twin pregnancies chorionicity was assessed in 97% of units.
32. 95% of units undertook an anomaly-screening scan using the RCOG recommendations for a minimum standard scan.
33. Only 57% of units identified cardiac outflow tracts routinely.
34. Views of the face (orbits/ nostrils) were only obtained routinely in 66% of units.
35. Ultrasound markers were used in 95% of units; 45% reported a single marker; 25% of units needed to refer outside their unit in the presence of markers.

Management Following Identification of an Abnormality/Variant (Page 32)

36. The identification of an anomaly was related to the women immediately by the sonographer in 66% of units. However if it was only a suspicion, this fell to 47%.
37. Interval between identification and being seen at a referral unit was less than 2 working days in 45% of the units.
38. In 74% of units, written information is available about processes once an abnormality had been found.
39. Very few units had patient information sheets for specific abnormalities – information on spina bifida was the most commonly available, in 31% of the units.
40. ARC leaflets were offered in 81% of units once an abnormality had been found.

41. Amniocentesis was available in 87% of units.
42. If termination or death occurred, an autopsy was undertaken, this was done in 84% of the units by a perinatal pathologist although only in-house in 24% of units.
43. Follow-up of an abnormal baby occurred in 95% of units usually with the obstetrician with or without a geneticist as appropriate/required.

Equipment and Facilities, Including Storage of Images (Page 34)

44. About 20% of ultrasound machines were deemed "old" (greater than 5 years old) at the time of the survey.
45. Only 61% of units indicated that they had machines capable of producing images of sufficient quality.
46. 47% of units had upgradeable machines but 80% had machines complying with IEC 1157 and HEI 98.
47. Quality assurance checks were made in 85% of units and 86% had checks on power outputs.
48. 85% of units stored thermal images.
49. 48% had computerised reports but these were linked with the maternity record in only 19% of units.

Standards, Audit and Monitoring (Page 37)

50. 54% monitor the screening service but 80% could not provide detection rates.
51. 28% of units monitored false positive rates.
52. Only 16% of units produced an annual report.

Recommendations

Policies, Protocols and Accountability

1. Each unit should have an ultrasound screening monitoring group.
2. There is a need for regular review of guidelines and policies.

Antenatal Ultrasound Package

3. All women should be offered a dating scan preferably in the 1st trimester or early 2nd trimester (i.e. before 16 weeks' gestation).
4. Routine scans should always be performed as part of the antenatal visit whenever possible.
5. All women should be offered a scan at around 20 weeks to screen for fetal anomalies.

Information and Support For Parents

6. Written information should be made available to all women before their booking appointment and discussed with a dedicated specifically trained healthcare professional.
7. All units should have written information in languages appropriate for the ethnic groups, which they serve.
8. Units should move towards providing information in a variety of modalities.
9. There should be consistency between verbal and written information and individual units should be aware of their false positive and negative, as well as their detection rates. A national

template, which could be adapted for local use, may be helpful.

10. Because many anomalies are rare the provision of information leaflets centrally for many conditions should be considered.

Staffing For Antenatal Ultrasound Scans

11. There should be a drive to increase sonographer numbers and/ or consideration should be given to provision of modules such as NT, or 3rd trimester scanning, perhaps as an extension of midwifery roles.

Education and Training For Staff

12. Appropriate funding and increasing the number of personnel would allow for training/study leave to facilitate training for staffs.

Technical Information, Including Measurements Taken

13. There should be a review of the various measurement packages used and adoption of a nationally uniform measurement package should be considered.
14. There is a need to rationalise the use of ultrasound markers.
15. More consistent visualisation of cardiac outflow tracts should be attempted.

Recommendations / Acknowledgments

Management Following Identification of an Abnormality/Variant

16. Management after the identification of an actual or suspected fetal abnormality requires more standardisation nationally.

Equipment and Facilities, Including Storage of Images

17. There needs to be a more standardised approach to the storage of images and the recording of scan reports.
18. There is a need for ultrasound computer system to be linked to the hospital systems.
19. There should be a review of ultrasound equipment in-use to ensure standardisation.

Standards, Audit and Monitoring

20. An annual report should be produced.
21. Units must monitor their ultrasound service activities, including the reproducibility of measurements.
22. Detection and false positive rates should also be monitored.

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Reference List

1. Bricker L, Garcia J, Henderson J, Mugford M, Neilson J, Roberts T et al. Ultrasound screening in pregnancy: a systematic review of the clinical effectiveness, cost-effectiveness and women's views. *Health Technol Assess* 2000;4.
2. Ritchie, K., Boynton, J., Bradbury, I., Foster, L., Iqbal, K., Kohli, H., Love, C., Penney, G., Quinn, S., Reid, M., Slattery, J., and Wright, D. Routine ultrasound scanning before 24 weeks of pregnancy. *Health Technology Assessment Report 5*. 2004. Glasgow: NHS Quality Improvement Scotland.
3. Chitty LS, Altman DG, Henderson A, Campbell S. Charts of fetal size: 4. Femur length. *Br J Obstet Gynaecol* 1994;101:132-5.
4. Chitty LS, Altman DG, Henderson A, Campbell S. Charts of fetal size: 3. Abdominal measurements. *Br J Obstet Gynaecol* 1994;101:125-31.
5. Chitty LS, Altman DG, Henderson A, Campbell S. Charts of fetal size: 2. Head measurements. *Br J Obstet Gynaecol* 1994;101:35-43.
6. Routine Ultrasound Screening in Pregnancy: Protocol, Standards and Training. Supplement to Ultrasound Screening for Fetal Abnormalities Report of the RCOG Working Party. 2000. London, RCOG Press.
7. Deter RL, Harrist RB, Hadlock FP, Carpenter RJ. Fetal head and abdominal circumferences: II. A critical re-evaluation of the relationship to menstrual age. *J Clin Ultrasound* 1982;10:365-72.
8. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal biparietal diameter: a critical re-evaluation of the relation to menstrual age by means of real-time ultrasound. *J Ultrasound Med* 1982;1:97-104.
9. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal head circumference: relation to menstrual age. *Am J Roentgenol* 1982;138:649-53.
10. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal abdominal circumference as a predictor of menstrual age. *Am J Roentgenol* 1982;139:367-70.
11. Robinson HP, Sweet EM, Adam AH. The accuracy of radiological estimates of gestational age using early fetal crown-rump length measurements by ultrasound as a basis for comparison. *Br J Obstet Gynaecol* 1979;86:525-8.
12. Snijders RJ, Nicolaides KH. Fetal biometry at 14-40 weeks' gestation. *Ultrasound Obstet Gynecol* 1994;4:34-48.
13. Warda AH, Deter RL, Rossavik IK, Carpenter RJ, Hadlock FP. Fetal femur length: a critical reevaluation of the relationship to menstrual age. *Obstet Gynecol* 1985;66:69-75.
14. Report of the RCOG Working Party on Routine Ultrasound Examination in Pregnancy. 1984. London, RCOG Press.

15. UK National Screening Committee. Antenatal Screening Service for Down Syndrome in England: 2001. 2002. NHS England.
16. Smith NC, Hau C. A six year study of the antenatal detection of fetal abnormality in six Scottish health boards. *Br J Obstet Gynaecol* 1999;106:206-12.
17. NICE Clinical Guidelines. Antenatal care: routine care for the healthy pregnant woman. 2003. National Collaborating Centre for Women's and Children's Health.
18. Bonnet D, Coltri A, Butera G, Fermont L, Le Bidois J, Aggoun Y et al. [Prenatal diagnosis of transposition of great vessels reduces neonatal morbidity and mortality]. *Arch Mal Coeur Vaiss* 1999;92:637-40.
19. Allan LD, Sharland GK. Prognosis in fetal tetralogy of Fallot. *Pediatr Cardiol* 1992;13:1-4.
20. Spina V, Bagolan P, Nahom A, Trucchi A, Aleandri V, Fabiani C et al. [Prenatal diagnosis of congenital diaphragmatic hernia: an update]. *Minerva Ginecol* 2003;55:253-7.
21. Wald NJ, Rodeck C, Hackshaw AK, Walters J, Chitty L, Mackinson AM. First and second trimester antenatal screening for Down's syndrome: the results of the Serum, Urine and Ultrasound Screening Study (SURUSS). *Health Technol Assess* 2003;7:1-77.
22. Bull C. Current and potential impact of fetal diagnosis on prevalence and spectrum of serious congenital heart disease at term in the UK. *British Paediatric Cardiac Association. Lancet* 1999;354:1242-7.
23. Smith-Bindman R, Hosmer W, Feldstein VA, Deeks JJ, Goldberg JD. Second-trimester ultrasound to detect fetuses with Down syndrome: a meta-analysis. *JAMA* 2001;285:1044-55.
24. Boyd PA, Chamberlain P, Hicks NR. 6-year experience of prenatal diagnosis in an unselected population in Oxford, UK. *Lancet* 1998;352:1577-81.
25. RCOG. The investigation and management of the small-for-gestational-age fetus. http://www.rcog.org.uk/resources/Public/Small_Gest_Age_Fetus_No31.pdf . 2002.
26. Independent Inquiry into Obstetric Ultrasound Procedures at the University Hospital of Wales. 1994.

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