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GUIDELINES

ISUOG Practice Guidelines (updated): performance of 11–14-week ultrasound scan

Clinical Standards Committee

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INTRODUCTION

Performing a routine first-trimester ultrasound examination at 11 + 0 to 14 + 0 weeks' gestation is of value for confirming viability and plurality, accurate pregnancy dating, screening for aneuploidies, identification of major structural anomalies and screening for preterm pre-eclampsia. This document aims to provide guidance for healthcare practitioners performing, or planning to perform, pregnancy scans at 11 + 0 to 14 + 0 weeks. Details of the grades of recommendation and levels of evidence used in ISUOG Guidelines are given in Appendix 1.

GENERAL CONSIDERATIONS

What is the purpose of a first-trimester ultrasound scan?

In general, the main goal of a pregnancy ultrasound scan is to provide accurate information which will facilitate delivery of optimized antenatal care, ensuring the best possible outcomes for mother and fetus. In early pregnancy, it is important to confirm viability, establish gestational age accurately, determine the number of fetuses and, in the presence of a multiple pregnancy, assess chorionicity and amnionicity. Towards the end of the first trimester, the scan also offers an opportunity to detect major fetal abnormalities and, in healthcare systems that offer first-trimester aneuploidy screening, to measure the nuchal translucency (NT) thickness. However, many major malformations may develop later in pregnancy or may not be detected even with appropriate equipment and in the most experienced of hands.

When should a first-trimester ultrasound scan be performed?

If an earlier first-trimester ultrasound scan has not been done, it is advisable to offer the first scan when gestational age is estimated to be between 11 + 0 and 14 + 0 weeks' gestation, as this provides an opportunity to achieve the aforementioned aims, i.e. confirm viability, establish gestational age accurately, determine the number of viable fetuses and, if requested, evaluate fetal anatomy and risk of aneuploidy[1–18]. Before starting the examination, a healthcare provider should counsel the woman/couple regarding the potential benefits and limitations of the first-trimester ultrasound scan (**GOOD PRACTICE POINT**).

Who should perform the first-trimester ultrasound scan?

Individuals who perform obstetric scans routinely should have specialized training that is appropriate to the practice of diagnostic ultrasound for pregnant women (**GOOD PRACTICE POINT**).

To achieve optimal results from routine ultrasound examinations, it is suggested that scans should be performed by individuals who fulfill the following criteria:

- have completed training in the use of diagnostic ultrasonography and related safety issues;
- participate in continuing medical education activities;

- follow established appropriate care pathways for suspicious or abnormal findings;
- participate regularly in established quality-assurance programs[19].

What ultrasonographic equipment should be used?

It is recommended to use equipment that undergoes regular maintenance and servicing and has at least the following capabilities:

- real-time, grayscale two-dimensional (2D) ultrasound;
- color (power) and spectral Doppler;
- M-mode;
- transabdominal ultrasound transducers;
- transvaginal ultrasound transducers;
- adjustable acoustic power output controls with output display standards;
- freeze frame and zoom capabilities;
- electronic calipers;
- capacity to print/store images.

How should the scan be documented?

An examination report should be produced as an electronic and/or paper document (see Appendices 2 and 3 for examples). The document should be stored locally and, in accordance with local protocol, made available to the woman and referring healthcare provider (**GOOD PRACTICE POINT**).

Is prenatal ultrasonography safe during the first trimester?

There are no indications that the use of B-mode or M-mode prenatal ultrasonography may be harmful during the first trimester, due to their limited acoustic output[20,21]. However, scanning time should be limited and the lowest possible power output should be used to obtain diagnostic information according to the ALARA (As Low As Reasonably Achievable) principle (**GOOD PRACTICE POINT**).

Doppler ultrasound is, however, associated with greater energy output and, therefore, there are more potential bioeffects, especially when it is applied to a small region of interest and in the embryonic period before 11 weeks' gestation[20,22,23]. From 11 + 0 to 14 + 0 weeks, spectral Doppler, color flow imaging, power Doppler imaging and other Doppler ultrasound modalities may be used routinely for certain clinical indications, such as screening for aneuploidies and cardiac anomalies. When performing Doppler ultrasound, the displayed thermal index (TI) should be ≤ 1.0 and the exposure time should be kept as short as possible (usually no longer than 5–10 min). Scanning of the maternal uterine arteries (UtA) at any point in the first trimester is unlikely to have any fetal safety implications as long as the embryo/fetus lies outside the Doppler ultrasound beam[22].

What if the examination cannot be performed in accordance with these Guidelines?

These Guidelines represent an international benchmark for the first-trimester ultrasound scan, but consideration must be given to local circumstances, protocols and medical practice. If the examination cannot be completed in accordance with these Guidelines, it is advisable to document the reasons for this. In most circumstances, it will be appropriate to repeat the scan, or to refer the case to another healthcare practitioner. This should be done as soon as possible, to minimize unnecessary patient anxiety and any associated delay in achieving the desired goals of the initial examination (**GOOD PRACTICE POINT**).

What should be done in case of multiple pregnancy?

Determination of chorionicity and amnionicity is important for care, testing and management of multifetal pregnancies. Chorionicity should be determined in early pregnancy, when characterization is most reliable[24,25]. Once this is accomplished, further antenatal care, including the timing and frequency of ultrasound examinations, should be planned according to the available health resources and ISUOG or local guidelines[26] (**GOOD PRACTICE POINT**).

GUIDELINES FOR EXAMINATION

Assessment of viability

In early pregnancy, viability is defined by identification of a fetal heartbeat, which is achieved most easily using ultrasound. Fetal cardiac activity can be identified with 2D B-mode ultrasound and the heartbeat can be heard using spectral Doppler. The heart rate, which should be recorded, can be measured using either M-mode or spectral Doppler and is best assessed over a number of cycles (**GOOD PRACTICE POINT**).

Cardiac activity is typically visible from 5–6 weeks' gestation. Heart rate increases with gestational age up to 10 weeks' gestation (mean, 171 bpm) and then decreases through to 14 + 0 weeks' gestation (mean, 156 bpm)[27].

Fetal tachy- or bradycardia may be indicative of aneuploidy or associated with a structural cardiac abnormality[28,29]. If the fetal heart rate lies outside the normal range, it should be reassessed later in the examination.

Confirmation of intrauterine pregnancy/uterine integrity

Once viability has been demonstrated, it is important to confirm the intrauterine nature of the pregnancy. An intrauterine gestational sac should be bounded completely by myometrium. This is best assessed by performing a sweep covering the entire uterus (**GOOD PRACTICE POINT**).

The integrity of the uterus may be breached when a pregnancy is located in a Cesarean section scar (see

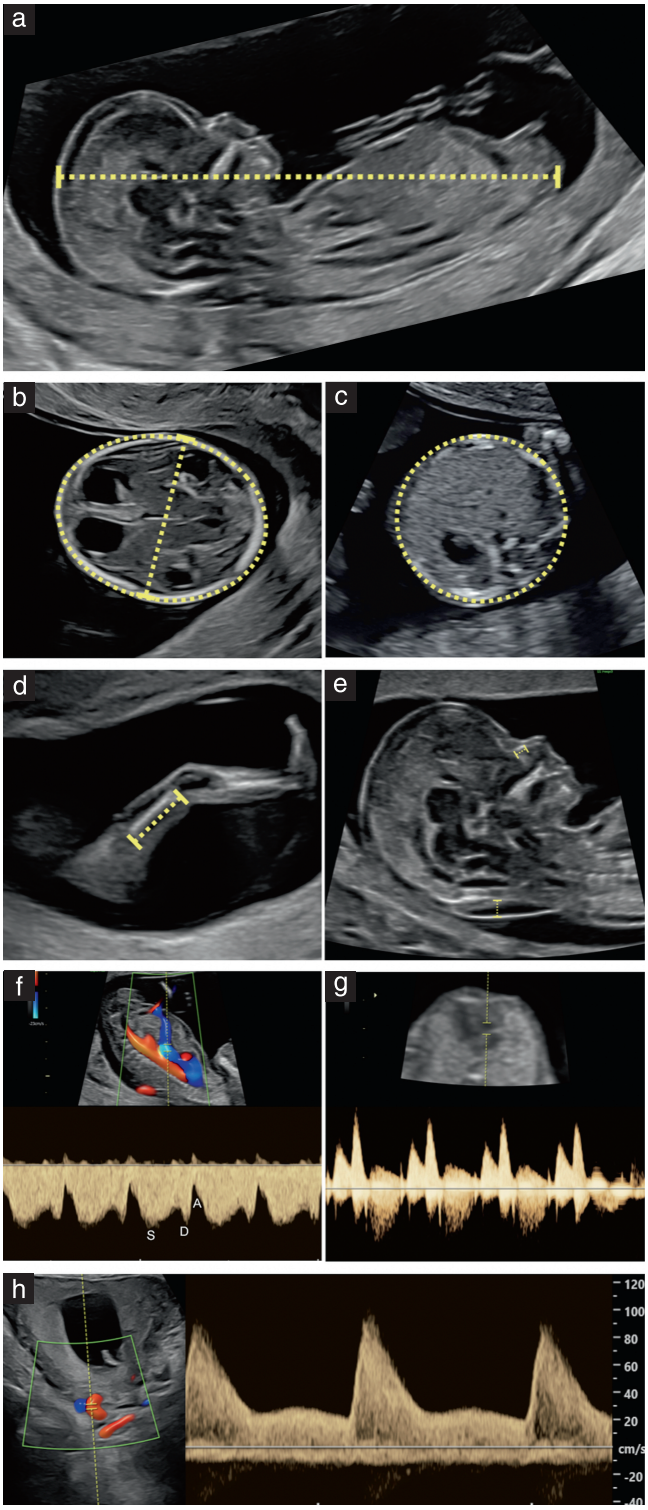

Figure 1 Measurements that can be obtained on fetal ultrasound examination at 11 + 0 to 14 + 0 weeks. (a) Fetal crown–rump length (CRL) measurement for assessment of gestational age. Caliper placement for CRL measurement should correspond to the longest straight line from top of fetal head to rump. Note neutral position of the fetus. (b) Axial view of fetal head at the level of the thalami, demonstrating measurements of biparietal diameter (BPD), with calipers placed outer-to-outer, and head circumference. The midline falx and thalami are visible in this plane. In some national guidelines, BPD measurement is achieved by measuring the outer-to-inner diameter. (c) Axial view of upper fetal abdomen, demonstrating abdominal circumference measurement. Note presence of stomach bubble and umbilical vein, with the spine in cross-section at the three o'clock position and one rib visible on each side. The fetal kidneys should not be visible in this plane. (d) Femur length measurement. The whole femur diaphysis is visible, with calipers placed at each end. The longest diaphysis visible should be measured. (e) Midsagittal view of fetal face, demonstrating nuchal translucency and nasal bone measurements. (f) Parasagittal view of fetal thorax and abdomen with color and pulsed Doppler, demonstrating blood flow in the umbilical vein and ductus venosus (DV). The DV velocity waveform is characteristically triphasic with antegrade flow in systole (S), diastole (D) and end-diastole (A-wave) under normal conditions. (g) Axial view of fetal thorax at the level of the four-chamber view of the heart, with pulsed Doppler examination demonstrating a normal velocity waveform across the tricuspid valve, without tricuspid regurgitation. See Figure 2j for cardiac axis. (h) Color and pulsed Doppler examination of uterine arteries (UtA). UtA Doppler velocity waveforms can be used to assess uteroplacental impedance as part of an integrated early screening test for pre-eclampsia. Measurements for both right and left uterine arteries should be assessed. A larger version of this figure is available online as supporting information (Figure S1).

section on 'Assessment of risk of obstetric complications') or associated with a rudimentary uterine horn.

Fetal biometry

There are specific charts for assessing first-trimester fetal biometry[38]. Systematic measurement of cephalic, abdominal and femoral biometry enables documentation of the presence of essential anatomical landmarks, and abnormalities in measurements can reveal early expression of serious pathologies. However, the cut-off values to be used and the follow-up procedures must be decided in accordance with local protocols, in order to avoid an excessive number of false-positive findings or follow-up examinations.

Crown–rump length

Crown–rump length (CRL) should be measured as part of the routine first-trimester scan, either transabdominally or transvaginally (Figure 1a). This measurement should be performed, following standard criteria, with the fetus oriented horizontally on the screen so that the measurement line between crown and rump is at about 90° to the ultrasound beam. The fetus should be in a neutral position (i.e. neither flexed nor hyperextended). The image should be magnified to fill most of the width of the ultrasound screen. Calipers should be placed on the end points of the crown and the rump, which need to be visualized clearly[30,31]. The measurement of CRL should be used to estimate gestational age in all cases except in pregnancies conceived by *in-vitro* fertilization[32,33]. When multiple CRL measurements have been taken, gestational age should be assessed based on the best-quality CRL measurement between 45 and 84 mm.

A number of different charts have been published and there are small but significant variations in reported measurements for gestational age[34]. Although older charts are still used widely, it is recommended to use

recent, international, prescriptive charts[35], because these take into account improvements in image and machine quality and aim to avoid possible statistical bias[36,37]. The CRL (and not the calculated gestational age) should be used as a gestational reference to define where measurements of NT, UtA Doppler pulsatility index (PI) and biochemical markers free β-human chorionic gonadotropin (β-hCG), pregnancy-associated plasma protein-A (PAPP-A) and placental growth factor (PlGF) lie in relation to the normal range.

The CRL is reduced in fetuses affected by trisomy 18 and triploidy, and care should be taken not to 'normalize' findings by changing dates in fetuses that have obvious structural anomalies. Particular attention should be paid if the CRL is smaller than expected based on an earlier ultrasound measurement.

Biparietal diameter and head circumference

Biparietal diameter (BPD) and head circumference are measured in the largest symmetrical axial view of the fetal head (Figure 1b). Two techniques for measurement of BPD have been described, placing calipers outer-to-inner (leading edge) or outer-to-outer, perpendicular to the midline falx. Measurements should be made in accordance with the methodology used to establish the nomogram employed.

BPD measurements adjusted for CRL[38] and/or abdominal circumference (AC) or transverse abdominal diameter (TAD) may be useful in early screening for myelomeningocele[39–42] and holoprosencephaly[43].

Abdominal circumference

AC is measured in an axial section of the fetal abdomen at the level in which the stomach is visualized (Figure 1c), at the outer surface of the skin line. It is either measured directly with ellipse calipers or calculated from perpendicular linear measurements, usually the anteroposterior abdominal diameter (APAD) and TAD. To measure APAD, the calipers are placed on the outer borders of the body outline, from the posterior aspect (skin covering the spine) to the anterior abdominal wall. To measure TAD, the calipers are placed on the outer borders of the body outline, across the abdomen at the widest point. AC may be calculated using the formula: $AC = \pi\,(APAD + TAD)/2 = 1.57\,(APAD + TAD)$.

An advantage of performing this measurement is that the image used to record it also shows the stomach in place.

Femur length

Femur length is measured in the long-axis plane of the femur (Figure 1d). The calipers are placed at either end of the ossified diaphysis, which is clearly visible. An advantage of performing this measurement is that it ensures that the sonographer checks the development of the lower limbs which may reveal early the presence of severe skeletal anomalies[44].

Assessment of fetal anatomy

A significant proportion of structural anomalies can be detected through detailed systematic examination of fetal anatomy at 11 + 0 to 14 + 0 weeks' gestation[45–47]. These anomalies will be detected reliably only if:

- examination of the structure is included in the protocol for routine assessment;
- adequate time is allocated for a detailed structural survey.

Successful early detection of fetal structural anomalies is also dependent on the standard of equipment available for screening, the skill set of the sonographers and sonologists and the prevalence of the anomalies in the population. Some sonographic features of structural abnormality have been described only relatively recently, and it is not yet clear how these markers perform in population screening. We therefore describe two levels of screening, presenting both a checklist of 'minimum requirements' for a basic structural survey at 11 + 0 to 14 + 0 weeks' gestation (Table 1) and a more advanced level of 'best practice' for comprehensive detailed examination of the fetus in the first trimester (Table 2). There is currently limited evidence describing the health economic benefit of early identification of fetal structural abnormalities.

Table 1 Minimum requirements for scan at 11 + 0 to 14 + 0 weeks' gestation

Anatomical region	*Minimum requirements for scan*
General	Confirm singleton pregnancy
Head and brain	Axial view of head: Calcification of cranium Contour/shape of cranium (with no bony defects) Two brain halves separated by interhemispheric falx Choroid plexuses almost filling lateral ventricles in their posterior two-thirds (butterfly sign)
Neck	Sagittal view of head and neck: Confirm whether nuchal translucency thickness < 95th percentile
Heart	Axial view of heart at level of four-chamber view: Heart inside chest with regular rhythm
Abdomen	Axial view: Stomach visible Intact abdominal wall Axial or sagittal view: Bladder visible and not dilated
Extremities	Visualize four limbs, each with three segments
Placenta	Ascertain normal appearance without cystic structures
Biometry	Sagittal view: Crown–rump length and nuchal translucency thickness Axial view: Biparietal diameter

Corresponding images are shown in Figures 1 and 2.

Table 2 Anatomical structures that can potentially be visualized on detailed fetal scan at 11 + 0 to 14 + 0 weeks' gestation (in sagittal, axial or coronal view as needed)

Anatomical region	*Structures that can potentially be visualized in detailed anatomic survey*
General	Confirm singleton pregnancy Overview of fetus, uterus and placenta
Head and brain	Calcification of cranium Contour/shape of cranium (with no bony defects) Two brain halves separated by interhemispheric falx Choroid plexuses almost filling lateral ventricles in their posterior two-thirds (butterfly sign) Thalami Brainstem Cerebral peduncles with aqueduct of Sylvius Intracranial translucency (fourth ventricle) Cisterna magna
Face and neck	Forehead Bilateral orbits Nasal bone Maxilla Retronasal triangle Upper lip Mandible Nuchal translucency thickness No jugular cysts in neck
Thorax	Shape of the thoracic wall Lung fields Diaphragmatic continuity
Heart	Heart activity present with regular heart rhythm Establish situs Position: intrathoracic heart position with cardiac axis to left (30–60°) Size: one-third of thoracic space Four-chamber view with two distinct ventricles on grayscale and color Doppler in diastole Left ventricular outflow tract view on grayscale or color Doppler Three-vessel-and-trachea view on grayscale or color Doppler Absence of tricuspid regurgitation/antegrade ductus venosus A-wave on pulsed-wave Doppler
Abdomen	Stomach: normal position in left upper abdomen Bladder: normally filled in pelvis (longitudinal diameter < 7 mm) Abdominal wall: intact with umbilical cord insertion Two umbilical arteries bordering bladder Kidneys: bilateral presence
Spine	Regular shape and continuity of spine
Extremities	Upper limbs with three segments and free movement Lower limbs with three segments and free movement
Placenta	Size and texture normal, without cystic appearance Location in relation to cervix and to previous uterine Cesarean section scar Cord insertion into placenta
Amniotic fluid and membranes	Amniotic fluid volume Amniotic membrane and chorion dissociated physiologically

Selected corresponding images are shown in Figures 1 and 2.

Basic examination with minimum requirements for scanning a fetus at 11 + 0 to 14 + 0 weeks

The 11 + 0 to 14 + 0-week scan provides an opportunity to assess fetal anatomy and should not be limited to assessment of fetal CRL and NT. Whilst cell-free (cf) DNA provides a highly effective means of screening for common aneuploidies, this test cannot identify structural defects, which may be associated with a more extensive range of rarer chromosomal abnormalities. Identification of a structural abnormality may support an invasive rather than a non-invasive approach to testing for aneuploidy[48–50]. Several severe structural anomalies can be detected in almost all cases[45] and their presence or absence should be assessed as a minimum standard in all patients presenting for an 11 + 0 to 14 + 0-week scan (**GOOD PRACTICE POINT**).

Detailed assessment of fetal anatomy at 11 + 0 to 14 + 0-week scan

Most structural anomalies occur in pregnancies categorized as being at 'low risk' by traditional (history-based) approaches to screening. Effective detection of structural anomalies therefore relies on routine examination of the whole population rather than examination of predefined

risk groups only. Demonstration of normal anatomy at 11 + 0 to 14 + 0 weeks provides early reassurance for most pregnant women. Early identification of a major anomaly allows earlier genetic diagnosis and more time for parental counseling and decision-making.

Detailed assessment of fetal anatomy at 11 + 0 to 14 + 0 weeks is best achieved using high-resolution transabdominal and transvaginal transducers. Both transabdominal and transvaginal approaches may be required to complete a systematic examination of fetal organs and adequate time needs to be scheduled for this assessment. While a transvaginal examination is not mandatory, it may provide better image resolution for the assessment of fetal anatomy, especially in women with increased body mass index, uterine fibroids and/or retroverted uterus. Within this 3-week time interval, the fetus almost doubles in size (CRL, 45–84 mm). Visualization of many anatomical details by ultrasound is best achieved at around 13 weeks' gestation (**GOOD PRACTICE POINT**).

Several studies have shown that the adoption of a systematic examination including a standardized protocol is associated with a significant increase in the detection rate of anomalies in early gestation[46,47,51,52]. As sonographers and sonologists gain more experience in screening at 11 + 0 to 14 + 0 weeks, changing from a protocol based on 'minimum requirements' to a more extensive 'best-practice' systematic review will allow detection of a higher proportion and a wider range of structural anomalies.

A systematic approach to detailed assessment of the fetal anatomy at 11 + 0 to 14 + 0 weeks should include the following (Table 2).

Overview of fetus, placenta and uterus. An overview of the fetus should be assessed (Figure 2a). The placenta should appear as slightly echogenic, with uniform, homogeneous echotexture, without small or large cysts or lacunae (Figure 2b). The presence or absence of a subchorionic hematoma should be assessed. Prediction of the final placental location in relation to the internal cervical os can be challenging in the first trimester and subject to false-positive reporting of low-lying placenta. However, in a patient with a history of a previous Cesarean section, a careful assessment of the placenta could help in the early detection of an abnormal invasive placenta. This is discussed in the section on 'Assessment of risk of obstetric complications'. Within the uterus, the presence or absence of fibroids, amniotic bands and synechiae should be evaluated.

Amniotic fluid and membranes. A change in amniotic fluid volume is rarely observed in early gestation, so, unlike in the second-trimester scan, this cannot be used as a hint for anomalies. The amniotic membranes are often well visualized as a sac surrounding the fetus and not yet fused with the chorion. When there is a history of bleeding, a blood clot is often identified in the retroamniotic space. In multiple pregnancy, chorionicity and amnionicity should be determined and documented (Figure 2c).

Head and brain. Examination of the fetal head and central nervous system is best achieved using a combination of axial and midsagittal planes. The axial plane is used to visualize ossification of the skull and the symmetry of the developing brain structures. Cranial bone ossification should be visible by 11 completed gestational weeks. The cerebral region is dominated by lateral ventricles that appear large and are almost filled in their posterior two-thirds with the slightly asymmetric echogenic choroid plexuses (Figure 2d). The hemispheres appear symmetrical and are separated by the interhemispheric fissure and falx. The brain mantle is very thin and best appreciated anteriorly, lining the large fluid-filled ventricles (Figure 2e). A lower plane within the head shows the two thalami and the posterior fossa region with the cerebral peduncles and the aqueduct of Sylvius, the fourth ventricle and the future cisterna magna as fluid-filled structures (Figure 2f).

A midsagittal plane of the head/face can also be used to assess the posterior fossa and visualize the intracranial translucency (fourth ventricle) and brainstem as a screening test for open neural tube defects and cystic posterior fossa malformations (Figure 2g).

Fetal face. Visualization of the fetal face is best achieved in the midsagittal plane, which should be complemented with examination in either an axial or a coronal plane. The magnified midsagittal plane of the head and neck enables assessment of several anatomic regions of the face, including the forehead, nasal bone, maxilla, mandible and mouth (Figure 2g). Different facial angles and markers (e.g. maxillary gap, superimposed-line sign) have been proposed to assess the presence of facial clefts in the midsagittal view but these need confirmation in other planes[53,54]. In an axial or coronal view an attempt should be made to visualize the eyes with their interorbital distance and the retronasal triangle, demonstrating the maxilla and the mandible (Figure 2h and 2i). The nasal bone is 'absent' or hypoplastic in 50–60% of fetuses with trisomy 21 and this can be used as an additional marker to improve efficacy of ultrasound-based screening.

Neck. Sonographic assessment and measurement of NT should be part of the screening protocol (Figure 1e), independent of whether it is used for risk assessment for aneuploidy. Increased NT may be a marker for rarer aneuploidies in pregnancy, while cfDNA has been used mostly to screen for a more limited range of common aneuploidies. The standardized method for measurement of NT is reviewed in the aneuploidy section of these Guidelines. Other discrete fluid-filled collections may be seen in the sides of the neck and are associated with dilated jugular lymph sacs and cystic hygroma.

NT is increased in up to 40% of fetuses that have a major cardiac abnormality and is associated with other structural and genetic anomalies and an increased risk of intrauterine fetal death[55,56].

Thorax and heart. The thoracic cavity with lungs and heart are evaluated in the fetal four-chamber plane

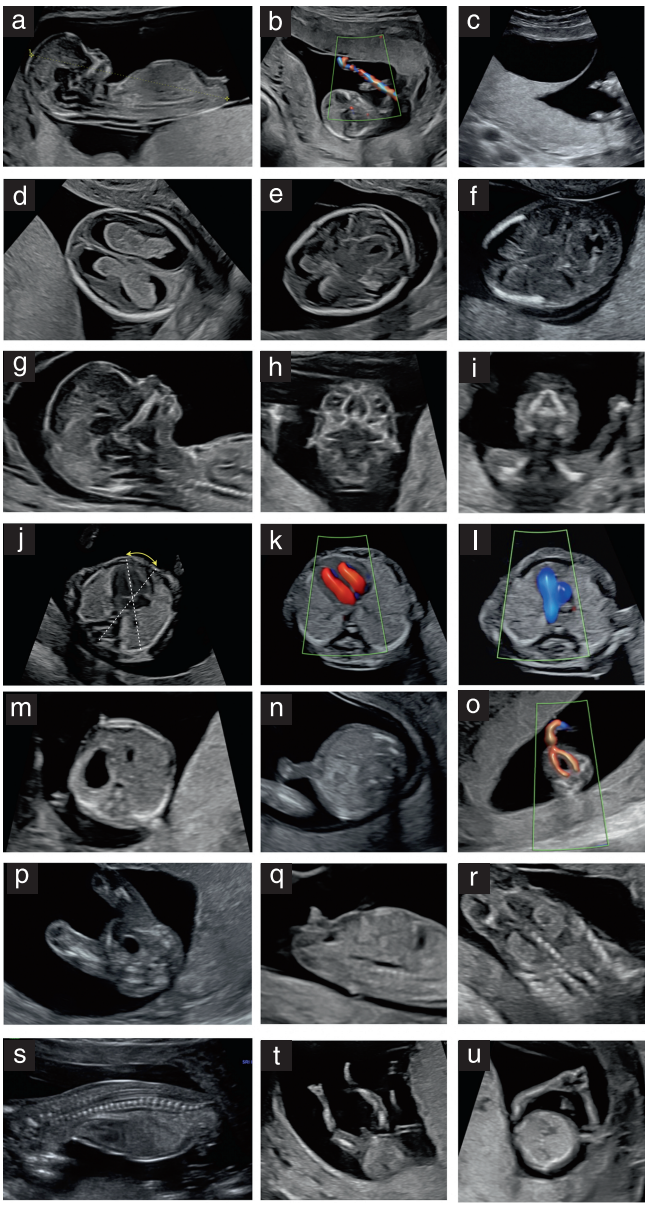

Figure 2 Anatomical views that can be obtained as part of a detailed fetal ultrasound examination at 11 + 0 to 14 + 0 weeks. See also Table 2. Figures (a), (b), (d), (g), (j), (m), (n), (p), (q), (t) and (u) represent the mandatory planes for a basic evaluation as listed in Table 1. (a) Midsagittal view of first-trimester fetus. Many structures can be visualized in this plane, including facial profile, nasal bone, posterior brain and intracranial translucency (IT), nuchal translucency, heart activity, spine, abdominal wall, diaphragm and bladder. The head-to-body proportion is assessed subjectively. (b) Assessment of placental appearance and location. The placenta appears homogeneous without cystic appearance. In addition, color Doppler can help in demonstrating placental attachment of the umbilical cord, if needed. (c) In multiple gestation, chorionicity and amnionicity should be assessed by seeking the lambda sign (as shown here in twin pregnancy) or the T-sign. (d) Axial view of fetal head in the transventricular plane, demonstrating a normal, oval-shaped head, ossification of the fetal cranium, the interhemispheric falx dividing the fetal brain into two relatively symmetrical hemispheres and the choroid plexuses almost filling the lateral ventricles in their posterior two-thirds (butterfly sign). (e) Axial view of fetal head in the transthalamic plane, demonstrating a normal, oval-shaped head, ossification of the fetal cranium, interhemispheric falx, thalami, lateral ventricles and cerebral peduncles. (f) Axial view of fetal head at the level of the posterior fossa, demonstrating the thalami, cerebellum, fourth ventricle, aqueduct of Sylvius and cisterna magna. (g) Midsagittal view of fetal head demonstrating the facial profile. A number of structures can be assessed in this plane, including forehead, nasal bridge, nasal bone, maxilla and mandible. The anatomy of the posterior fossa can also be examined, with visualization of thalamus, brainstem, IT, choroid plexus and cisterna magna. (h) Axial view of fetal head demonstrating orbits and lenses, maxillary processes and nose. (i) Oblique coronal view of fetal face demonstrating orbits and retronasal triangle, which consists of the nasal bones, maxillary processes and alveolar ridge of the anterior maxilla. The mandibular gap can also be visualized in this plane. (j) Axial view of fetal thorax at the level of the four-chamber view of the heart, demonstrating the fetal lungs, rib cage and thoracic aorta and the intrathoracic position of the heart. Note the normal cardiac axis (dotted lines and yellow arrow) and relative symmetry of the atria and ventricles. (k) Four-chamber view of fetal heart with color Doppler, demonstrating diastolic flow from the right and left atria into the right and left ventricles, respectively. (l) Three-vessel-and-trachea view of fetal heart with use of color Doppler, demonstrating the direction of blood flow in the aorta and pulmonary artery, respectively, with both vessels pointing to the left side. (m) Axial view of fetal abdomen at the level of the stomach. Note presence of the fluid-filled stomach in the left quadrant and normal appearance and position of the fetal liver and ribs. (n) Axial view of fetal abdomen, demonstrating intact anterior abdominal wall and the site of umbilical cord insertion. (o) Axial view of fetal pelvis with color Doppler, demonstrating presence of two umbilical arteries encircling the fetal bladder, thus establishing a three-vessel umbilical cord. In addition, the intact anterior abdominal wall is confirmed using color Doppler. (p) Axial view of fetal pelvis, demonstrating presence of the fetal bladder. (q) Sagittal view of fetal abdomen, demonstrating fetal bladder, genital tubercle, diaphragm and spine. Any measurement of the fetal bladder at this gestational age should be taken longitudinally and in a sagittal plane. (r) Coronal view of fetal thorax and abdomen, with visualization of bilateral fetal kidneys (slightly echogenic), thoracic and lumber spine and pelvic bones. (s) Sagittal view demonstrating the length of the fetal spine from the neck to the sacrum. Note visible intact overlying skin and ossification of the vertebral bodies, which has begun in the sacrum and the lumbar and thoracic spine. (t) Coronal view of bilateral lower limbs, with clear visualization of the three segments: upper legs, lower legs and feet. (u) Axial view of bilateral upper limbs, with clear visualization of the three segments: upper arms, lower arms and hands. The first-trimester fetus often presents with open hands, which may facilitate assessment of hands and digits. A larger version of this figure is available online as supporting information (Figure S2).

(Figure 2j). In this plane, the ribs, lungs, situs and cardiac position in the chest are assessed, with the cardiac axis pointing to the left (the normal axis is at 30–60°)[57,58]. The lungs should appear homogeneously echogenic, and there should be no sign of pleural effusion. Diaphragmatic continuity is evaluated in an axial, sagittal/parasagittal or coronal plane, noting normal intra-abdominal position of the stomach and liver. Early assessment of the fetal heart is achieved more reliably by combining grayscale with color Doppler imaging. Color Doppler helps to confirm the presence of two distinct ventricles with separate filling in diastole and to exclude significant atrioventricular valve regurgitation (Figure 2k). Examination of the great vessels through identification of the left ventricular outflow tract and three-vessel-and-trachea view with color Doppler demonstrates the presence, number and size of

the great vessels, their anatomic relationship and the direction of blood flow, along with the continuity of the ductal and aortic arches, enabling ruling out of most complex anomalies affecting the great vessels (Figure 2l). Multicenter studies have shown better detection rates of cardiac anomaly when using multiple planes in addition to the use of color Doppler[59].

Abdominal content. The stomach and bladder are the only echolucent fluid-filled structures in the abdomen and pelvis. The position of the stomach on the left side of the abdomen, together with levocardia, helps confirm normal visceral situs (Figure 2m). The fetal kidneys can often be seen in their expected paraspinal location as bean-shaped, slightly echogenic structures, with typical hypoechoic central renal pelvis (Figure 2r). By 12 weeks' gestation, the fetal bladder should be visible as a median hypoechoic round structure in the lower abdomen, with a longitudinal diameter < 7 mm (Figure 2p and 2q).

Abdominal wall. The normal insertion of the umbilical cord should be documented after 12 weeks (Figure 2n). Physiologic midgut herniation is present up to 11 weeks and should be differentiated from omphalocele and gastroschisis.

Umbilical cord. The number of cord vessels and the cord insertion at the umbilicus should be noted. Brief evaluation of the paravesical region with color or power Doppler can be helpful in confirming the presence of two umbilical arteries (Figure 2o). Single umbilical artery (SUA) does not constitute an anomaly, but is associated with congenital anomalies and fetal growth restriction. Care should be taken not to cause anxiety to the parents when SUA is detected, if no major anomaly is found at the first-trimester scan. There is, as yet, no consensus regarding the potential impact of SUA on pregnancy outcome. Placental cord insertion can also be assessed reliably at this stage with color Doppler.

Spine. The spine should be examined, when possible, in a sagittal view, to assess vertebral alignment and integrity of skin covering (Figure 2s). Vertebral bodies are ossified after 12 weeks' gestation. Particular attention should be paid to the appearance of the spine when any intracranial signs suspicious for open spina bifida are found[60].

Limbs. Presence of the three segments of both upper and lower limbs and presence and normal orientation of the two hands and feet should be noted at the 11 + 0 to 14 + 0-week ultrasound scan (Figure 2t and 2u).

Genitalia. Evaluation of the external genitalia and fetal sex is based upon the orientation of the genital tubercle in the sagittal plane (Figure 2q).

Role of three-dimensional (3D) and four-dimensional (4D) ultrasound. 3D and 4D ultrasound are not currently used for routine first-trimester fetal anatomical evaluation. However, in experienced hands, these methods may be helpful in evaluation of abnormalities, especially with multiplanar reconstruction of selected diagnostic planes.

Assessing risk for common forms of aneuploidy (trisomies 21, 18 and 13)

Pretest counseling

Women should be made aware of and consent to screening for common aneuploidies before such an assessment is carried out. This requires:

- specification of conditions for which testing is being carried out, and those for which it is not;
- clarification of the differences between screening and diagnostic testing;
- identification of patient-specific factors that will impact on the appropriateness of a test;
- discussion of baseline levels of risk based on maternal age and family history;
- shared decision-making;
- explanation of how test results will be communicated after the test;
- discussion of the various screening and diagnostic options and of their merits and limitations.

Ultrasound-based assessment at 11 + 0 to 14 + 0 weeks' gestation

There are two tests that are generally used to screen for common aneuploidies: combined first-trimester screening (includes risks derived from maternal history, ultrasound and maternal serum biochemistry); and cfDNA testing (also known as non-invasive prenatal testing (NIPT) or non-invasive prenatal screening (NIPS)). Combined first-trimester screening tests for common trisomies, which comprise approximately 50% of all genetic aberrations identifiable prenatally by array-based genomic assessment. Combined first-trimester screening is also effective to diagnose Turner syndrome. cfDNA testing may be extended to include other aneuploidies, including microdeletions and microduplications. The range of conditions for which testing is carried out is dependent on the test provider.

Most clinicians using combined first-trimester screening to calculate risks for the common aneuploidies, i.e. trisomies 21, 18 and 13, use a risk algorithm that is freely available from The Fetal Medicine Foundation[61,62]. The basic algorithm combines an *a-priori* risk based on maternal age, gestational age and maternal history of previous pregnancy with trisomy 21, 18 or 13 with ultrasound measurement of NT thickness and assessment of maternal serum free β-hCG and PAPP-A[63,64]. The *a-priori* risk is altered by multiplying it by a likelihood ratio derived for each of these factors. Likelihood ratios are calculated by comparing frequency distributions for each specific marker in chromosomally normal and abnormal populations.

Nuchal translucency thickness

The term NT describes the echolucent region seen at the back of the fetal neck during sonographic assessment. NT

should be measured in the midsagittal section (Figure 1e), using an image that:

- has been magnified to include only the head and thorax of the fetus;
- is magnified such that calipers measure 0.1-mm increments;
- allows assessment of the entire length of the nuchal region and measurement at its maximum thickness;
- demonstrates the fetus in a neutral position (extension or flexion of the neck affect measurement);
- demonstrates the fetus separate from the amnion to ensure the appropriate space is measured.

The NT is measured with cross calipers placed on its echogenic margins. Three measurements should be made (on separate images) and the largest is used for risk assessment.

The correct, standardized technique for NT measurement has been described by Nicolaides[65]. As this measurement is used to calculate a likelihood ratio for risk calculation, accurate assessment is essential. This is achieved by restricting performance of NT measurement to trained personnel who agree to undergo a continuous process of quality assurance that compares reported measures to a recognized international standard. Some quality-assurance programs are run nationally; others allow sonographers to participate internationally (www.fetalmedicine.org).

First-trimester biochemistry

First-trimester screening efficacy is improved by combining ultrasound-based NT measurement with assessment of maternal free β-hCG and PAPP-A. Most national guidelines recommend combining these markers when screening for trisomies 21, 18 and 13. These markers show different patterns of up- or down-regulation in the three common trisomies, which enables individualized risk assessment for each of these aneuploidies.

Recently, data have demonstrated that low maternal serum concentrations of PlGF at 11 + 0 to 14 + 0 weeks' gestation are associated with common trisomies, suggesting that PlGF can be incorporated within the risk calculation, especially when it has already been measured in screening for preterm pre-eclampsia (see section on 'Assessment of risk of obstetric complications').

Additional ultrasound markers

Nasal bone. Several other ultrasound markers for aneuploidy have been described. Delayed ossification of the nasal bone, reported as 'hypoplastic' or 'absence of the' nasal bone at 11 + 0 to 14 + 0 weeks' gestation, is a powerful marker in screening for trisomy 21. The nasal bone is rarely hypoplastic or absent in euploid fetuses and consequently this dichotomized variable is associated with large positive and negative likelihood ratios[66–69]. This potentially allows significant improvement in specificity whilst maintaining high sensitivity[69].

The nasal bone is assessed in the same midsagittal section as NT, with a magnified image that includes the echogenic tip of the nose and the rectangular shape of the palate anteriorly. Posterior to it, and centrally in the brain, the translucent diencephalon and the nuchal membrane can be identified. The nasal bone lies below the echogenic skin line of the face. The nasal bone should normally be more echogenic than the skin at the tip and the bridge of the nose, which lies immediately above the bone itself (Figure 1e)[67]. If the nasal bone cannot be demonstrated to be more echogenic than the skin above, then it is deemed hypoplastic or absent.

Ductus venosus flow (Figure 1f). Fetuses affected by aneuploidy are more likely to have structural or functional cardiac defects at 11 + 0 to 14 + 0 weeks' gestation. Functional anomalies include abnormal flow in the ductus venosus and tricuspid regurgitation.

Initial studies demonstrated an association between reversal of the ductus venosus A-wave and aneuploidy[70,71], but more recent studies showed that an increase in ductus venosus pulsatility index for veins (PIV) was associated with an increased risk for common trisomies. The latter ultrasound marker can be used as a continuous variable, with less significant changes in likelihood ratios, thus allowing easier incorporation into a screening program[71–73].

The ductus venosus is normally assessed in a right paramedial section. Color Doppler is used to identify flow returning through the umbilical vein and ductus venosus to the right atrium. A 1-mm pulsed-wave Doppler gate can be used to demonstrate the waveform, which has a typical appearance (Figure 1f)[70]. The PIV is measured by autotracing.

Tricuspid flow (Figure 1g). Flow through the tricuspid valve is assessed by identifying the four-chamber view in an axial section of the thorax and placing the ultrasound transducer so that the apex of the heart appears at either a 12 o'clock or a 6 o'clock position. A 2–4-mm pulsed-wave gate is placed across the anterior semilunar valve (the tricuspid valve) and used to interrogate the waveform (Figure 1g). Tricuspid regurgitation is defined as flow > 60 cm/s for > 50% of the cardiac cycle[74]. This dichotomous variable is rarely abnormal in euploid fetuses and is associated with high positive and negative likelihood ratios[75,76].

Screening performance. The mixture model[63] proposed by The Fetal Medicine Foundation (and made freely available) has been assessed prospectively and found to have 90% sensitivity for 97% specificity when screening for trisomy 21[77]. Similar screening efficacy for trisomy 21 was reported in a second, national, screening program[78]. The Fetal Medicine Foundation has also reported the effectiveness of screening for a wider range of chromosomal abnormalities in a study including > 100 000 pregnancies. At a specificity of 96%, the detection rate for trisomy 21 was 90%, that for

trisomy 18 was 97%, that for trisomy 13 was 92% and that for Turner syndrome was > 95%[62] (**LEVEL OF EVIDENCE: 2+**).

Whilst inclusion of other markers may improve screening efficacy and, most significantly, specificity, these ultrasound markers require additional skills for reliable assessment and there is the potential to reduce screening efficacy if they are applied poorly. As a consequence, in clinical practice, many examiners continue to use a combination of NT thickness and the biochemical markers free β-hCG and PAPP-A.

Screening for trisomy 21 and other common trisomies has evolved over the years in an attempt to increase the detection rate and reduce the false-positive rate. In recent years, screening by cfDNA has been demonstrated to achieve excellent performance for common aneuploidies. For trisomy 21, the cfDNA test can detect 99.7% of cases at a 0.04% false-positive rate; for trisomy 18, it can detect 97.9% of cases at a 0.04% false-positive rate; and for trisomy 13, it can detect 99.0% of cases at a 0.04% false-positive rate[79]. Currently, the cfDNA test has been introduced as second-tier screening, following first-trimester combined screening (**LEVEL OF EVIDENCE: 1+**). It is not recommended as a standalone test without performance of the 11 + 0 to 14 + 0-week scan.

Different screening algorithms are available and the choice will depend on the available resources[62,71,80–82] (Table 3). The different screening strategies are explained and detection rates and false-positive rates are reported based on available studies.

Post-test counseling. During post-test counseling, the result(s) should be provided and the ongoing risk interpreted for the patient. If a screening test describes an 'increased chance' then the likelihood of the pregnancy being truly affected (positive predictive value) should be discussed. Counseling should include:

- discussing the options for further testing, including benefits and limitations and risks associated with invasive procedures;
- establishing whether the individual wishes to proceed with further testing;
- ensuring that other health professionals involved in managing the pregnancy are aware of the tests that have been performed and their results.

Assessment of risk of obstetric complications

Scar pregnancy and placental abnormalities

The echostructure of the placenta should be evaluated. Abnormal findings, such as masses, single or multiple cystic spaces or a large subchorionic fluid collection (> 5 cm), should be noted and followed up. The position of the placenta in relation to the cervix is of less importance at this stage of pregnancy, since most placentas are not low-lying until the mid trimester[83]. Placenta previa should not be reported at this stage (**GOOD PRACTICE POINT**).

Special attention should be paid to the increasing number of patients with a prior Cesarean delivery, who may be predisposed to scar pregnancy or placenta accreta spectrum (PAS) disorders, with significant complications[84]. Prenatal diagnosis of these placental anomalies at any gestational age is associated with improved maternal outcome, by allowing treatment in centers with expertise

Table 3 Selected first-trimester screening strategies for trisomy 21 and other chromosomal abnormalities

		DR / FPR (%)	
Screening strategy	*Description*	*Trisomy 21*	*Trisomy 18 and trisomy 13*
Combined screening	MA + GA, fetal NT, free β-hCG, PAPP-A in all patients Cut-off: 1 in 100[62] **LEVEL OF EVIDENCE: 2+**	92 / 4.6[62]	96.4 and 92.9[62] (no increase in FPR)
Combined screening with additional markers in intermediate-risk group	Combined screening with NB, DV or TR in women with a risk of 1 in 50 to 1 in 1000 only **LEVEL OF EVIDENCE: 2+**	93–96 / 2.5[71]	Trisomy 18: 91.8[71] Trisomy 13: 100[71] (no increase in FPR)
cfDNA and anomaly scan with NT	Anomaly scan and NT assessment prior to cfDNA screening in all patients; CVS if NT > 3.5 mm or anomalies at ultrasound; otherwise, cfDNA (cfDNA test failure = reflex testing*) **LEVEL OF EVIDENCE: 1+**	100 / 0.1 + additional 2.5% FPR if NT > 3.5 mm or anomalies present[80]	Trisomy 18: 100[80] Trisomy 13: 100[80]
Contingent combined screening with cfDNA	Combined screening with cfDNA in women with a risk of 1 in 10 to 1 in 1000 only **LEVEL OF EVIDENCE: 2+**	98.4 / 0.7[81]	No data

*Combined screening using additional plasma sample drawn at time of nuchal translucency (NT) measurement. β-hCG, beta-human chorionic gonadotropin; cfDNA, cell-free DNA; CVS, chorionic villus sampling; DR, detection rate; DV, ductus venous flow; FPR, false-positive rate; GA, gestational age; MA, maternal age; NB, nasal bone assessment; PAPP-A, pregnancy-associated plasma protein-A; TR, tricuspid flow (to assess for regurgitation).

in surgical management. Moreover, early first-trimester diagnosis of Cesarean scar pregnancy is associated with a lower risk of adverse maternal outcome[85]. Therefore, some authors have recently proposed that a policy of early (5–7 weeks) transvaginal ultrasound screening of women with a prior Cesarean delivery would predict reliably the ultrasound stage of a PAS disorder[85,86]. However, these Guidelines refer only to a 'standard' late first-trimester ultrasound examination, i.e. performed at 11 + 0 to 14 + 0 weeks, and do not address the issue of very early scans. At 11 + 0 to 14 + 0 weeks, ultrasound signs suggestive of PAS disorders can be detected[84,87–90]. Low anterior implantation of the placenta/gestational sac, next to or in the scar niche, is the most common early ultrasound sign associated with PAS disorders (Figure 3a). Depending on local resources, this may be sought using transvaginal ultrasound at the time of the late first-trimester scan in women with prior Cesarean delivery. A finding of placental implantation over an exposed scar predicts the risk of PAS with an excellent negative predictive value[89].

In the first trimester, women who are likely to give birth prematurely tend to have a shorter cervix compared with those who will give birth at term[91–93]. First- and second-trimester cervical-length measurements correlate[94]. Measurement of the cervix in the first trimester (Figure 3b), possibly in combination with personal history, could identify a group at increased risk of preterm birth[91]. However, it has not yet been proven that measuring the cervix in the first trimester improves outcome. Such an approach needs to be fully standardized and more data should be obtained before this can be recommended routinely[95,96].

Gynecological pathology, both benign and malignant, may be detected during any first-trimester scan. Abnormalities of uterine morphology, such as presence of uterine septa and bicornuate uteri, should be described. The adnexa should be surveyed for abnormalities and masses. The relevance and management of such findings are beyond the scope of these Guidelines.

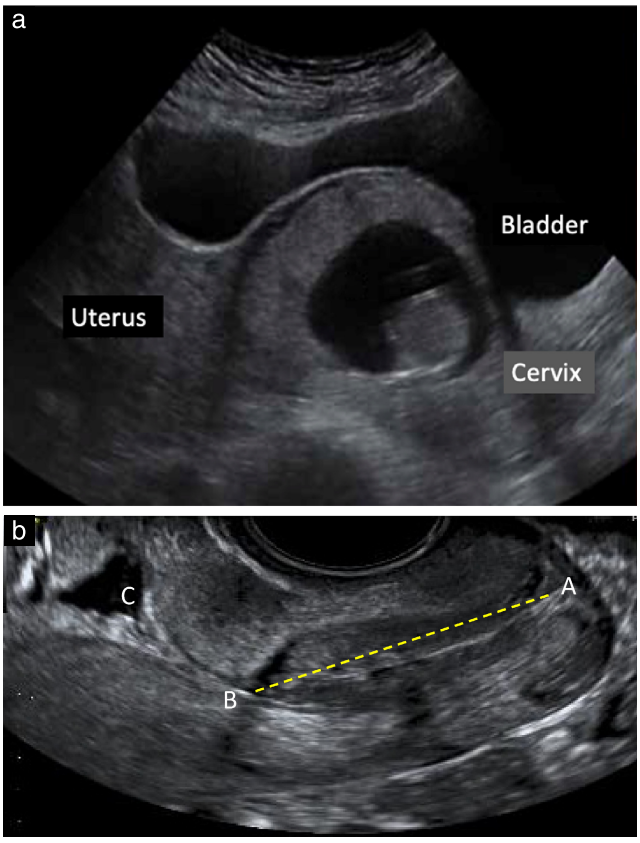

Figure 3 (a) Ultrasound image of Cesarean scar pregnancy, located at the top of the cervix and bulging into the bladder. Determining placental position in relation to a previous Cesarean section scar may be beneficial for early detection of an abnormal invasive placenta. (b) Ultrasound image illustrating measurement of cervical length (A to B) and the isthmus (B to C) at 11 + 0 to 14 + 0 gestational weeks.

Screening for pre-eclampsia at 11 + 0 to 14 + 0-week scan

There is a substantial body of evidence to support risk-based screening for preterm pre-eclampsia using various biomarkers. The most established approach to screening, namely, the first-trimester combined test for pre-eclampsia, combines the *a-priori* risk from maternal characteristics and medical history (Table 4) with measurement of UtA-PI, serum PlGF and mean arterial pressure (MAP)[97–99]. This method of screening has been validated prospectively in countries within and beyond Europe[100–103].

Pregnant women with singleton pregnancy attending for the 11 + 0 to 14 + 0-week scan should be offered screening for preterm pre-eclampsia by the first-trimester combined test, with maternal factors (Table 4) and biomarkers, as a one-step procedure. The risk calculator is available free of charge at https://fetalmedicine.org/

Table 4 Screening for pre-eclampsia: maternal factors

Maternal demographic characteristics
Age (in years), weight (in kg), height (in cm)
Maternal ethnicity: Caucasian, Afro-Caribbean, South Asian, East Asian, Mixed
Obstetric history
Parity: nulliparous, parous
Parous: without prior pre-eclampsia, with prior pre-eclampsia
Interpregnancy interval (in years) between birth of previous child and conception of index pregnancy
Gestational age at delivery (in weeks) and birth weight (in g) of previous pregnancy delivered > 24 weeks
Method of conception: spontaneous, ovulation induction, *in-vitro* fertilization
Family history of pre-eclampsia (mother)
Medical history
Smoking habit
History of chronic hypertension
History of diabetes mellitus: Type 1, Type 2, insulin intake
History of systemic lupus erythematosus or antiphospholipid syndrome

research/assess/pre-eclampsia. The best combined test is one that includes maternal factors and measurements of UtA-PI, PlGF and MAP[104], with a risk cut-off of ≥ 1 in 100 to define screen positivity[104,105] (**LEVEL OF EVIDENCE: 1+**).

The UtA-PI should be measured during the same transabdominal scan as that for measurement of fetal NT thickness and diagnosis of major fetal defects at 11 + 0 to 14 + 0 weeks' gestation (corresponding to fetal CRL of 45–84 mm). Gestational age must be determined from the fetal CRL measurement (see section on 'Assessing fetal biometry'). During this scan, a sagittal section of the uterus is obtained and the cervical canal and internal cervical os are identified. Then, keeping the transducer in the midline and tilting it gently to each side, with the use of color flow mapping, each UtA is identified along the side of the cervix and uterus, at the level of the internal os (Figure 1h). Pulsed-wave Doppler is used, with a sampling gate of 2 mm to cover the whole vessel, and care is taken to ensure that the angle of insonation is < 30°. When three similar consecutive waveforms have been obtained, the UtA-PI is measured with automatic tracing and the mean PI of the left and right UtAs is calculated[105,106]. The measurement of UtA-PI must be carried out by sonographers who have received appropriate training and accreditation, such as that provided by The Fetal Medicine Foundation (www.fetalmedicine.org).

When it is not possible to measure UtA-PI and/or PlGF, the baseline screening test should be a combination of maternal factors with MAP, not maternal factors alone. If maternal serum PAPP-A is measured for routine first-trimester screening for fetal aneuploidies (see section on 'Assessing risk for common forms of aneuploidy (trisomies 21, 18 and 13)'), this result can be included for pre-eclampsia risk assessment. Variations of the full combined test, e.g. combining maternal factors with only UtA-PI and MAP, would lead to a reduction in the screening performance[104].

An alternative, if resources are limited, is routine screening for preterm pre-eclampsia by maternal factors and MAP in all pregnancies, reserving measurements of UtA-PI and PlGF for a subgroup of the population selected on the basis of the risk derived from screening by maternal factors and MAP alone[107] (**GOOD PRACTICE POINT**).

Following first-trimester screening for preterm pre-eclampsia, women identified as being at high risk should receive aspirin prophylaxis commencing between 11 and 15 + 6 weeks' gestation at a dose of 150 mg to be taken every night until either 36 weeks' gestation, when delivery occurs or when pre-eclampsia is diagnosed[108]. Such low-dose aspirin should not be prescribed to all pregnant women. In women with low calcium intake (< 800 mg/day), either calcium replacement (≥ 1g elemental calcium/day) or calcium supplementation (1.5–2 g elemental calcium/day) may reduce the rates of both preterm and term pre-eclampsia[109].

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SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:

Figures S1 and S2 Full-size versions of Figures 1 and 2.

APPENDICES

Appendix 1 Grades of recommendation and levels of evidence used in ISUOG Guidelines

Classification of evidence levels	
1++	High-quality meta-analyses, systematic reviews of randomized controlled trials or randomized controlled trials with very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of randomized controlled trials or randomized controlled trials with low risk of bias
1−	Meta-analyses, systematic reviews of randomized controlled trials or randomized controlled trials with high risk of bias
2++	High-quality systematic reviews of case–control or cohort studies or high-quality case–control or cohort studies with very low risk of confounding, bias or chance and high probability that the relationship is causal
2+	Well-conducted case–control or cohort studies with low risk of confounding, bias or chance and moderate probability that the relationship is causal
2−	Case–control or cohort studies with high risk of confounding, bias or chance and significant risk that the relationship is not causal
3	Non-analytical studies, e.g. case reports, case series
4	Expert opinion
Grades of recommendation	
A	At least one meta-analysis, systematic review or randomized controlled trial rated as 1++ and applicable directly to the target population; or a systematic review of randomized controlled trials or a body of evidence consisting principally of studies rated as 1+ applicable directly to the target population and demonstrating overall consistency of results
B	Body of evidence including studies rated as 2++ applicable directly to the target population and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 1++ or 1+
C	Body of evidence including studies rated as 2+ applicable directly to the target population and demonstrating overall consistency of results; or extrapolated evidence from studies rated as 2++
D	Evidence level 3 or 4; or evidence extrapolated from studies rated as 2+
Good practice point	Recommended best practice based on the clinical experience of the guideline development group

Appendix 2 Example examination report for basic first-trimester fetal ultrasound scan

Name of Center

Basic first-trimester examination

Date of exam: **Patient ID:**
Patient name: **Birth date:**

Sonographer:
Ultrasound machine:
Transabdominal ☐ Transvaginal ☐
Indication for scan:
Screening ☐ Other:

Relevant risk factors:

ART pregnancy: N / Y .....

Singleton: ☐
Twins:** ☐ monochorionic / dichorionic
Adnexa: Normal ☐ Abnormal ☐ Not examined ☐

Measurement	mm
Crown–rump length (CRL)	
Biparietal diameter (BPD)	
Nuchal translucency (NT)	
Other	

Gestational age based on ultrasound: .....weeks .....days

Sonographic appearance of fetal anatomy Normal = N Abnormal = A Not visualized = NV	**N**	**A**	**NV**
Head and brain Head shape, ossification Falx present, butterfly-shape choroid plexus			
Heart Intrathoracic position Regular rhythm			
Abdomen Stomach present, abdominal wall intact Bladder not dilated			
Extremities Upper limbs with three segments Lower limbs with three segments			
Placenta Normal appearance without cystic structures			
Other			

CONCLUSION:
☐ Normal and complete examination.
☐ Normal but incomplete examination.
☐ Abnormal examination*
☐ Plans: ☐ No further ultrasound scans required
☐ Follow up planned in ….. weeks.
☐ Referred to ……
☐ Other:

cfDNA test: planned ☐

Remarks:
(* Describe here any abnormal findings)

Signed: .....

***: For multiple pregnancy, specify chorionicity and fill out one sheet for each fetus (labeled Fetus A, B, C, . . .)*

ART, assisted reproductive technology; cfDNA, cell-free DNA, N, no (except where defined as 'normal'); Y, yes.

Appendix 3 Example examination report for detailed first-trimester fetal ultrasound scan

Name of Center

Detailed first-trimester examination

Date of exam: **Patient ID:**
Patient name: **Birth date:**

Sonographer:
Ultrasound machine:
Transabdominal ☐ Transvaginal ☐
Indication for scan:
Screening ☐ Other:

Relevant risk factors:

ART pregnancy: N / Y .....

Singleton: ☐
Twins:** ☐ monochorionic / dichorionic

Adnexa: Normal ☐ Abnormal ☐ Not examined ☐

Placenta: Normal ☐ Abnormal ☐

Biometry	mm
Crown–rump length (CRL)	
Biparietal diameter (BPD)	
Head circumference (HC)	
Abdominal circumference (AC)	
Femoral diaphysis length (FL)	

Risk assessment	
Nuchal translucency (NT) (mm)	
Nasal bone (NB) (mm)	
Ductus venosus A-wave (positive/negative/PI)	
Tricuspid valve regurgitation N / Y	
Right uterine artery PI:	
Left uterine artery PI:	

Gestational age based on ultrasound: .....weeks .....days

CVS / Amnio: planned ☐
cfDNA: planned ☐

CONCLUSION:
☐ Normal and complete examination.
☐ Normal but incomplete examination.
☐ Abnormal examination*
☐ Plans: ☐ No further ultrasound scans required
☐ Follow up planned in ..... weeks.
☐ Referred to .....
☐ Other:

Sonographic appearance of fetal anatomy Normal = N Abnormal = A Not visualized = NV		N	A	NV
Head and brain				
	Intact cranium / normal shape			
	Midline falx			
	Choroid plexus / lateral ventricles			
	IT / brainstem / cisterna magna			
	Cerebral peduncles with AoS			
Face and neck				
	Nuchal translucency			
	Retronasal triangle			
	Maxilla / mandible			
	Orbits			
Thorax				
	Thorax shape with lung fields Diaphragmatic continuity			
Heart				
	Heart intrathoracic with regular rhythm			
	Cardiac size and axis			
	Four-chamber view			
	Left ventricular outflow tract			
	Right ventricular outflow tract			
	Three-vessel-and-trachea view			
Abdomen				
	Stomach filled			
	Bladder filled (length < 7 mm)			
	Intact abdominal wall			
	Two umbilical arteries			
	Kidneys			
Spine				
Limbs				
	Upper limbs with three segments			
	Lower limbs with three segments			

Remarks: (* Describe here any abnormal findings)

Signed: .....

***: For multiple pregnancy, specify chorionicity and fill out one sheet for each fetus (labeled Fetus A, B, C, . . .)*

Amnio, amniocentesis; AoS, aqueduct of Sylvius; ART, assisted reproductive technology; cfDNA, cell-free DNA; CVS, chorionic villus sampling; N, no (except where defined as 'normal'); IT, intracranial translucency; PI, pulsatility index; Y, yes.

