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Amniocentesis and chorionic villus sampling

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Amniocentesis and chorionic villus sampling

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This is an update of the 2010 version of this guideline in the new format. It is the fifth edition, which was previously published in October 1996, February 2000, January 2005 and June 2010.

1. Key recommendations

- Women should be informed that the additional risk of miscarriage following amniocentesis or CVS performed by an appropriately trained operator is likely to be below 0.5%. [Grade B]
- Amniocentesis should not be performed prior to 15^{+0} weeks' gestation. [Grade A]
- CVS should not be performed prior to 10^{+0} weeks' gestation. [Grade D]
- Where possible, to reduce the risk of technical challenges, CVS should be performed from 11^{+0} weeks' gestation onwards. [Good Practice Point]
- Women with multiple pregnancies should be informed that the additional risk of miscarriage for twin pregnancy following CVS or amniocentesis performed by an appropriately trained operator is around 1%. [Grade B]
- Screening results for blood borne viruses, viral load and antigen test results should be reviewed when an invasive test is considered and individualised risk of viral transmission should be discussed. [Grade C]

2. Aim

The aim of this guideline is to provide a concise set of evidence-based standards for provision and performance of amniocentesis and chorionic villus sampling (CVS) used for prenatal diagnosis.

An infographic (Inforgrpahic S1) of this guideline is available as supplemental information, and an audio version at www.rcog.org.uk/gtg8.

3. Background

Pregnant women are offered amniocentesis or CVS for prenatal diagnosis for a variety of reasons including a higher chance aneuploidy screening result, fetal structural anomaly, or a known risk of inherited genetic disease.

Implementation of national combined aneuploidy screening and increasing use of cell free DNA testing from maternal blood has resulted in a significant decline in screen positive results and therefore fewer invasive prenatal tests are being carried out. However, both CVS and amniocentesis remain, at present, the only definitive diagnostic tests for aneuploidy in pregnancy.

CVS, carried out to obtain placental villi for analysis, is usually performed between 11^{+0} and 13^{+6} weeks of gestation. If required, CVS can be performed between 14^{+0} and 14^{+6} weeks' gestation. Individualised counselling of the merits of CVS versus amniocentesis should be provided for women considering CVS during this time period; a video demonstrating the recommended technique for transabdominal CVS is available online at www.rcog.org.uk/gtg8. Amniocentesis, performed to obtain amniotic fluid for analysis, is usually offered from 15^{+0} weeks; a video demonstrating the recommended technique for amniocentesis is available online at www.rcog.org.uk/gtg8. Informed written consent is advised prior to either procedure, and should be in line with existing consent advice from the GMC and Royal College of Obstetricians and Gynaecologists recommendations.[1,2] The consent process must include procedure risks, timing and method of communicating results, sample/tissue storage, benefits, alternatives and option to opt out. Wherever possible contemporaneous local data for procedure related complications should be quoted. Women should receive information on aftercare including, where appropriate, the need for prophylactic anti D in non-sensitised rhesus negative women and indications to seek medical advice following the procedure.

4. Identification and assessment of evidence

The Cochrane Library (including the Cochrane Database of Systematic Reviews), EMBASE, Medline and PubMed electronic databases were searched for relevant meta-analyses, systematic reviews, randomised controlled trials (RCTs), and cohort studies. TRIP, NICE evidence and the Guideline International Network were searched to identify relevant guidelines. Databases were searched for the terms 'amniocentesis' and 'chorionic villus sampling' appearing in the title or abstract. The search was limited to humans and the English language. The search was restricted to articles published until October 2019. The full search strategy is available to view online as supporting information (Appendix S1 and S2).

The recommendations given in this guideline have been graded according to the guidance for the development of RCOG Green-top Guideline.[3]

5. How should care be organised in providing amniocentesis and CVS?

The scope of this guideline is confined to technical aspects of the two procedures. For the woman and her family, good care in these circumstances encompasses more than the procedure. Women facing either procedure are usually anxious and clinicians should bear this in mind. The RCOG, Royal College of Midwives (RCM) and Society and College of Radiographers have produced a consensus statement on supporting women and their partners through prenatal screening which,[4] while developed to support the evaluative roll-out of non-invasive prenatal testing (NIPT) for Down's syndrome, Edwards' syndrome and Patau's syndrome within the NHS fetal anomaly screening programme, is also relevant to the provision of amniocentesis and CVS.

Care for women who consent to have CVS or amniocentesis should be organised in accordance with Fetal Anomaly Screening Programme guidance.[5] This includes an appropriate environment, skilled staff, access to allied specialties and appropriate support for continuation of pregnancy or termination of pregnancy, depending on the choices made by the woman and her partner where chromosomal or genetic anomalies are identified.

Evidence level 4

It is important to remember that most women will not have expected screening to result in unexpected news about their baby, and that this is therefore a very stressful time. A sensitive approach is extremely important and choice of words, such as the use of 'difference' rather than 'abnormality' in certain situations, is really important. All options should be presented in an unbiased manner so that the woman and her partner can make a personal, informed choice. These options should include continuing the pregnancy with a view to keeping the baby; continuing the pregnancy with a view to having the baby adopted; continuing the pregnancy with a view to palliative care in the case of severely life limiting conditions; and ending the pregnancy at that point. It may also be appropriate to discuss religious aspects of care as well. Women should be given time to discuss this decision with their partner and friends if they wish, to meet with a paediatrician or learning disability nurse used to caring for people with the condition if appropriate, or to meet with families who have a child with the identified condition if they wish either through local or national support groups for those with the condition (e.g. Antenatal Results and Choices [ARC, www.arc-uk.org] or Support Organisation for Trisomy 13 and Trisomy 18 [SOFT, www.soft.org.uk)].

Evidence level 4

6. What are the additional risks associated with invasive testing?

6.1. What is the additional risk of miscarriage associated with amniocentesis and CVS?

Recommendation	Evidence quality	Strength	Rationale for the recommendation
Women should be informed that the additional risk of pregnancy loss following transabdominal CVS performed by an appropriately trained operator is likely to be below 0.5%	**2++**	**B**	It is important to be aware that the risk may be higher with less skilled operators or units carrying out fewer procedures. The risk is also likely to be higher where the fetus has a chromosomal, genetic or structural abnormality
Women should be informed that the additional risk of pregnancy loss following an amniocentesis performed by an appropriately trained operator is likely to be below 0.5%	**2++**	**B**	It is important to be aware that the risk may be higher with less skilled operators or units carrying out fewer procedures. The risk is also likely to be higher where the fetus has a chromosomal, genetic or structural abnormality
If amniotic fluid appears cloudy or purulent or there are clinical features of intra-amniotic infection consider microbial analysis and antibiotic treatment	**4**	**GPP**	Maternal sepsis is a rare but potentially serious complication of amniocentesis and CVS

The only RCT on which previous estimate of additional risk of pregnancy loss following amniocentesis has been based was published in 1986.[6] The trial reported a 1% additional risk of pregnancy loss, but the estimate was rather imprecise with 95% confidence intervals including both no additional risk and 2% risk.[6] It is now unlikely that an appropriately sized, high quality RCT trial will ever be repeated. Two RCTs published in 1991 and 1993 compared CVS carried out either transabdominally (TA) or transvaginally (TV) with midtrimester amniocentesis and found an increase in overall pregnancy loss

Evidence level 1+

following CVS (11.1% versus 8.2%; RR 1.43, 95% CI 1.22–1.67) which was attributed to increased spontaneous pregnancy loss after CVS (7.1% versus 5.0%; RR 1.51, 95% CI 1.23–1.85).[7–9]

Since then many observational studies, including large national registry-based studies, have reported much lower complications rates for both amniocentesis and CVS, including no significant increase in pregnancy losses above the background rate.[10] Ideally, these studies should attempt to estimate the procedure-related risk for structurally and genetically normal fetuses. Such estimates should come from cohorts with genetic testing of all pregnancy losses, irrespective of whether they had a prior invasive test or not and include control groups matched for all important confounders including maternal age. These factors should be taken into account for future studies. Even with all these criteria fulfilled, in the absence of randomization, clinically important differences between women undergoing invasive testing and those who do not undergo testing will remain. Nevertheless, it is plausible that lower pregnancy loss rates reported in more recent studies reflect improvements in technology, techniques and experience.

Evidence level 2++

A systematic review including data from observational studies published between 2000 and 2014 with a minimum of 1000 women per study reported weighted pooled procedure-related risk of pregnancy loss of 0.11% (95% CI 0.04–0.26) for amniocentesis and 0.22% for CVS (95% CI 0.71–1.16).[11] The authors published an update including studies up to September 2017 with data from 10 studies of amniocentesis with 64 901 procedures and 6 studies of CVS with 19 000 procedures and performed a meta-analysis.[12] The weighted pooled procedure-related risk of pregnancy loss was 0.35% for both procedures (amniocentesis 95% CI 0.07–0.63, CVS 95% CI −0.31 to 1.00).[12] However, the pregnancy loss rates in included studies show large variations. For amniocentesis, two studies reported higher pregnancy loss rate in the control group than after amniocentesis,[13,14] while in others the excess risk following amniocentesis varied from 0.06 to 1.24%.[10,15–21] Similarly for CVS, two studies reported higher numbers of pregnancy losses in their control groups,[10,15] while in the remainder reported excess pregnancy loss rates after CVS ranged from 0.2 to 1.5%.[16,22–24] It is worth noting that six out 10 studies reported amniocentesis-related risk of 0.2% or less and three out six studies reported no additional risk from CVS.

Evidence level 2++

A recently updated Cochrane Review of amniocentesis and CVS for prenatal diagnosis reported low quality randomised evidence comparing transabdominal and transvaginal CVS.[9] A retrospective cohort study published in 2008 reported outcomes for 5148 CVS, 96% of which were transcervical procedures using a catheter method.[15] Pregnancy losses were below the background rate regardless of CVS route (TA −0.2%, TC −0.5%).[15] A retrospective cohort study published in 2017 reported outcomes following 4862 CVS procedures, 2833 of which were transcervical (1787 using forceps and 1046 using cannulae).[16] The procedure-related pregnancy loss rate was 1.4% for transcervical CVS and 1.0% for transabdominal CVS.[16] However, the risk of pregnancy loss after transcervical CVS was only 0.27% when forceps was used and 3.12% for those done with cannula, suggesting that forceps may offer a safety advantage.[16] See Table 1 for an overview of other risks associated with amniocentesis and CVS.

Evidence level 4

Procedure-related risks may be increased when procedures are performed by less skilled operators, as there is an inverse association between experience and procedure-related pregnancy loss.[15,26] Recently, Bakker et al.[16] stratified fetal losses by operator experience, according to number of procedures performed and confirmed lower losses with increasing experience for both transabdominal CVS and for amniocentesis. There is no evidence to specify the optimal number of procedures for trained operators to

Evidence level 4

Table 1. What other risks are associated with amniocentesis and CVS?

	Amniocentesis	CVS
Second sampling/repeat procedure	Up to 6%	Up to 6%
Blood stained sample	0.8%	Not applicable
Confined placental mosaicism	Not applicable	<2%
Maternal cell contamination	1–2%	1–2%
Rapid test failure	2%	2%
Failed cell culture	0.5–1%	0.5–1%
Severe infection	Rare	Rare
Fetal injury	Rare	Rare
Maternal visceral injury	Rare	Rare

maintain their skills. It is advised that appropriately trained operators complete, or supervise, ideally at least 20 amniocentesis or CVS procedures annually. See Table 2 for requirements for training to carry out amniocentesis and CVS and advice on maintaining good practice.

Women should be aware that the results of CVS can be affected by confined placental mosaicism in 1–2% of cases. If there is a fetal structural anomaly, it is reasonable to move forward with discussions regarding ongoing care, including the option of termination of pregnancy if the woman or couple wish to consider this. If there are no structural anomalies, and QFPCR results following CVS suggest a chromosomal anomaly, a full karyotype should be awaited before any decisions are made. Discussions under these circumstances should reflect the RCOG, RCM and Society and College of Radiographers consensus statement on prenatal testing.[4]

Table 2. What is required for training and maintaining good practice for amniocentesis and CVS?

Training	Maintaining good practice
Achieved competency with Maternal Fetal Medicine subspecialty training, fetal medicine Advanced Skills Training Modules or equivalent international qualification	Maintain competency by completing or supervising, ideally, a minimum of 20 amniocentesis or CVS procedures annually
Simulation training and directly supervised procedures are integral	Communications skills training
	Continuous audit; multiple insertions, failures, bloody taps and procedure-related losses/PPROM/PTB within 14 days of procedure
	Seek support from a more experienced operator if anticipated/encountered difficulties
	Review practice where an operator's annual loss rate of normal babies exceeds 3% for either amniocentesis or CVS

6.2. *What are the additional risks associated with invasive testing?*

Severe maternal sepsis is a very rare complication. Infection may arise from organisms present on the skin, ultrasound probe, gel or via needle puncture of the bowel. Skin decontamination, use of separate sterile gel sachet, enclosing the ultrasound probe in a sterile bag and continuous ultrasound are recommended prior to amniocentesis and CVS. If, on inspection, amniotic fluid has a cloudy or purulent appearance or the woman shows clinical features to suggest intra-amniotic infection, the operator should consider sending a small quantity of amniotic fluid for microbiological analysis and consider antibiotic treatment.

Evidence level 4

7. At what gestation should amniocentesis and CVS be carried out?

7.1. *At what gestation should amniocentesis be carried out?*

Recommendation	Evidence quality	Strength	Rationale for the recommendation
Amniocentesis should be performed after 15^{+0} weeks' gestation	**1+**	**A**	This trial compared amniocentesis after 15^{+0} weeks to early amniocentesis and found an increased risk of talipes equinovarus in the earlier group

There is good evidence that amniocentesis should not be performed before 15^{+0} weeks' gestation owing to the higher risk of pregnancy loss and the potential for talipes equinovarus.[9,27] A Canadian multicentre trial published in 1998 reported 24/2612 cases of talipes equinovarus with early amniocentesis compared to 5/2693 cases with CVS.[25] Early amniocentesis also resulted in an increase of 3% in requirement for multiple needle insertions (4.7% versus 1.7%; RR 2.79, 95% CI 1.92–4.04).[27] Early amniocentesis has cytogenetic implications, with increased risk of failed culture of 1.8% compared to 0.2% with midtrimester amniocentesis and potential for false negative results (3 versus 0, 0.05% versus 0.0%; RR 3.00, 95% CI 0.12–73.67) when compared to midtrimester amniocentesis.[28]

Evidence level 1+

Individual laboratories have reported increased risk of obtaining low quantities of DNA from direct extraction when amniocentesis is performed before 16^{+0} weeks. Clinicians should be aware of the potential for impact on turn-around-time for results to allow informed discussions during the consent process for procedures carried out before 16^{+0} weeks.

7.2. *When should CVS be carried out?*

Recommendation	Evidence quality	Strength	Rationale for the recommendation
CVS should not be performed before 10^{+0} weeks' gestation	**3**	**D**	With CVS before 10^{+0} weeks' gestation there is a possible association with oromandibular and limb defects

(Continued)

Recommendation	Evidence quality	Strength	Rationale for the recommendation
Where possible, CVS should be performed from 11^{+0} weeks' gestation to reduce the risk of technical challenges	**4**	**GPP**	CVS before 11^{+0} weeks' gestation can be more technically challenging

Possible associations between CVS and both oromandibular disruption and limb reduction defects were first reported in 1991 following procedures carried out between 8^{+0} and 9^{+3} weeks' gestation.[29] Since then, reports have emerged refuting the association, though most procedures were performed after 10^{+0} weeks.[30] It is possible that any potential risk is gestation dependent and as a result most guidelines discourage performing CVS before 10^{+0} weeks.[9,11] Additionally, CVS prior to 11^{+0} weeks' gestation can be more technically challenging due to access and thinner, less developed placental tissue.

Evidence level 3

8. What are the considerations when performing amniocentesis or CVS for multiple pregnancy?

Recommendation	Evidence quality	Strength	Rationale for the recommendation
Women considering amniocentesis or CVS should receive detailed counselling and pregnancy mapping by suitably trained healthcare professionals	**4**	**GPP**	Mapping of the pregnancy is essential to ensure accurate sampling
In multiple pregnancies amniocentesis or CVS should be performed by an operator with the skills to perform selective termination of pregnancy if required	**4**	**GPP**	This provides reassurance of accurate fetal identification to the woman and operator, should termination of pregnancy be requested
Women with multiple pregnancies should be informed that the additional risk of pregnancy loss for twin pregnancy following CVS or amniocentesis performed by a skilled operator is around 1%	**2++**	**B**	It is important to be aware that the overall risk of pregnancy loss is higher in twin pregnancies due to an increased background risk of pregnancy loss
Women with multiple pregnancies and a confirmed diagnosis of anomaly from amniocentesis or CVS should be provided with information and supported in a nondirective way, including referral to specialist counselling services if required	**4**	**GPP**	It is important support women to make the decisions that are appropriate for them and their families

A high level of expertise in ultrasound scanning is essential for operators undertaking amniocentesis or CVS in multiple pregnancies, because the pregnancy needs to be mapped with great care.[31] Mapping is essential prior to any invasive testing to ensure each fetus is identified and sampled appropriately with samples labelled correctly for analysis. As some women and couples may choose a selective termination of their pregnancy based on the results of amniocentesis or CVS, it is recommended that an operator skilled in performing selective termination conducts fetal mapping as it is unlikely that any operator would be comfortable performing selective termination based on labelling performed by a referring doctor. Labelling by assigning numbers should be avoided. It is more reproducible to map by lateral orientation, as maternal left and maternal right twins or vertical orientation, as upper and lower twins, this approach is recommended by NICE.[31] Labelling is assisted in the presence of a discordant fetal structural anomaly or discordant fetal sex, but extra care must be taken where there is no clearly identifiable ultrasound difference. In such cases it is advised that two operators confirm labelling.

Evidence level 4

Two systematic reviews have assessed the risks of mid-trimester pregnancy loss following amniocentesis, with no RCTs identified in either systematic review.[32,33] There was considerable variation in how individual studies defined fetal loss (a single twin or both twins) and several studies did not provide any definition of fetal loss. Agarwal et al. reported pregnancy loss rate following amniocentesis of 3.07% (95% CI 1.83–4.61) and estimated procedure-related risk of pregnancy loss before 24 weeks' gestation at 1% (2.59% versus 1.53% RR 1.81; 95% CI 1.02–3.19). This estimate was derived from four cohort studies with 695 procedures and 18 pregnancy losses.[34–37] Vink et al.[33] captured publications over a longer time period between 1970 and 2010. The pooled odds ratio for total pregnancy loss after amniocentesis was 1.8 (95% CI 1.2–2.7), derived from seven controlled studies with 1530 procedures and 73 fetal losses.[35–40]

Evidence level 2++

It is also possible that the true amniocentesis-related risk of pregnancy loss in twins may be less than 1% as several studies published in the last 5 years have reported no increase in pregnancy losses above background risk.[41,42]

Evidence level 2+

Data for procedure-related pregnancy losses following CVS are more limited. Agarwal et al.[32] meta-analysed data from four observational studies of CVS in twin pregnancies (632 procedures) and reported an overall pregnancy loss rate of 3.8% (95% CI 2.5–5.5) following CVS. It was not possible to estimate risk of pregnancy loss less than 24 weeks with CVS due to heterogeneity of the data.[32] For both amniocentesis and CVS, the majority of studies have not stratified their outcomes by chorionicity and it is therefore not possible to accurately determine procedure-related losses separately for monochorionic diamniotic and dichorionic diamniotic twins.

Evidence level 2++

Most operators use double uterine entry when performing amniocentesis or CVS in multiple pregnancies. However, the limited data available suggest no significant difference in risk for amniocentesis performed with single or double uterine entry.[32] Similarly for CVS, there appears to be no significant differences in pregnancy loss with transabdominal versus transcervical CVS, or with use of a single versus double needle technique, or single versus double uterine entry.[32] The risk of cross-contamination during CVS is approximately 1% and may be mitigated by using a double uterine entry technique.[32] Based on currently available evidence, operators should use the technique with which they are most comfortable.

Evidence level 2++

There are insufficient data available to comment on procedure-related risks for higher order multiple pregnancies.

9. What is the role of third trimester amniocentesis?

Recommendation	Evidence quality	Strength	Rationale for the recommendation
The risks associated with third-trimester diagnostic amniocentesis, including the risk of pre-term labour, are likely to be low	**2+**	**D**	The risk of preterm labour before 34 weeks is in the region of 3–4% based on limited studies
Women should be informed that there is a higher risk of cell culture failure with amniocentesis performed in the third-trimester	**2++**	**C**	Overall there is a 10% risk of culture failure for third trimester amniocentesis, but the risk is higher with advancing gestation

Third trimester amniocentesis may be offered for newly identified fetal structural anomalies, suspected fetal infection and fetal growth restriction. Serious complications, requiring emergency birth are unusual following third trimester amniocentesis. Two retrospective cohorts have reported preterm labour before 37 weeks of 4–8% and before 34 weeks of 3–4%.[43,44] There is an increased risk of requiring more than one needle insertion (5% of procedures), with bloodstained samples reported in 5–10% of procedures.[45,46] There is an increased risk of culture failure following third trimester amniocentesis, with a rate of 9.7% overall reported in 2007.[47] A retrospective database analysis of amniocentesis procedures performed between 24^{+0} and 39^{+0} weeks between 2002 and 2014 reported increased overall culture failure rate of 10.2% that increased with gestational age from 2.1% between 24^{+0} and 27^{+0} weeks to 40.6% between 36 and 40 weeks.[48]

Evidence level 2+

10. What are the risks of mother to child transmission of infection?

Recommendation	Evidence quality	Strength	Rationale for the recommendation
Screening results for blood borne viruses, viral load and antigen test results should be reviewed when an invasive test is considered and individualised risk of viral transmission should be discussed	**4**	**GPP**	Operators should be aware of screening results to appropriately weigh the indication for testing and individual risk of mother to child transmission of viral infection
Where screening results for blood borne viruses are not known, testing should be delayed until HIV status can be determined	**4**	**GPP**	The risk of mother to child transmission of HIV is higher for women not on highly active antiretroviral therapy and with higher viral loads
The risk of mother to child transmission of HIV for women on highly active antiretroviral therapy is very low	**2++**	**C**	Several large retrospective cohorts reported no cases of mother to child transmission for women on highly active antiretroviral therapy with undetectable viral loads

(Continued)

Recommendation	Evidence quality	Strength	Rationale for the recommendation
Antiretroviral treatment should be optimised to aim for an undetectable viral load prior to amniocentesis or CVS	**2++**	**C**	The risk of mother to child transmission is very low once viral load is undetectable
The risk of mother to child transmission of Hepatitis B is low with viral load less than 6.99 log_{10} copies/ml but increases with higher viral loads	**2+**	**C**	A retrospective analysis indicated no significant difference in mother to child transmission of Hepatitis B below a viral load of 7log_{10}
There is no evidence of risk of mother to child transmission of Hepatitis C based on limited data available	**2+**	**C**	Limited available studies have not reported mother to child transmission of Hepatitis C

Recent studies demonstrate a very low risk of mother to child transmission (MTCT) of HIV for women on highly active antiretroviral therapy (HAART) with undetectable viral loads. Four retrospective cohorts with 317 procedures spanning 1985 to 2015 contained no cases of MTCT in women on HAART.[49–52] Conversely, a retrospective cohort study published in 2017 reported 2.3% MTCT of HIV for women not on HAART, performed prior to 2005 arising from 113 total CVS and amniocentesis procedures.[49]

Evidence level 2++

A multicentre retrospective case-control study including 166 amniocentesis procedures published in 2009 reported a non-significant increase in MTCT for women without antiretroviral therapy (25.0% versus 16.2%) and for those treated with zidovudine monotherapy or a double-nucleoside reverse transcriptase inhibitor combinations (6.1% versus 3.3%).[51] The same study found no cases of MTCT in 81 women on HAART.[51] Operators need to be aware and inform women that the vast majority of evidence is based on amniocentesis and that data on CVS are limited. Where screening results for blood borne viruses are not known, testing should be delayed until HIV status can be determined. Where screening is declined, informed consent should include discussion of the risk of MTCT and that this is increased for women with higher viral load and not on antiretroviral treatment.

Evidence level 2+

The overall risk of MTCT for Hepatitis B is low, but increased viral load is a risk factor for transmission.[53] A small retrospective case-control study of infants of HBsAg+ women of whom 63/642 has amniocentesis demonstrated a significant increase in MTCT when the HBV DNA was over 500 copies/ml (4.2% versus 17.4%; OR 4.76 [95% CI 1.17–19.33]).[54] There is an absence of high quality data on the risk of MTCT with Hepatitis C, but currently no evidence of risk of MTCT following amniocentesis.[55]

Evidence level 2+

11. Recommendations for future research

- Rates of procedure related pregnancy loss in multiple pregnancies based on chorionicity.
- Risk of mother to child transmission following procedures during acute infections (e.g. Hepatitis C).

12. Auditable topics

- Rate of pregnancy loss of fetuses (with and without chromosomal or genetic anomaly) within 14 days of procedure. These data should be quoted on local consent forms (<0.5%).
- Local cytogenetic laboratory culture failure rates for amniocentesis and CVS (<0.5%).
- Operator specific proportion of procedures requiring more than one needle insertion.
- Operator specific proportion of procedures with failure to obtain an adequate sample.
- Rate of anti–D prophylaxis for women who are RhD-negative (with Rh positive fetus) undergoing invasive procedures (100%).
- Maintenance of a register of invasive diagnostic procedures to facilitate audit (100%).
- Local audit should be performed annually and the results available for external assessment (100%).

13. Useful links and support groups

- Public Health England *Screening in pregnancy: CVS and amniocentesis information for parents* [www.gov.uk/government/publications/cvs-and-amniocentesis-diagnostic-tests-description-in-brief/nhs-fetal-anomaly-screening-programme-chorionic-villus-sampling-cvs-and-amniocentesis-information-for-parents]
- Antenatal Results and Choices [www.arc-uk.org]
- Support Organisation for Trisomy 13 and Trisomy 18 www.soft.org.uk

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Appendix S1. Amniocentesis and CVS literature search strategy.

Appendix S2. Amniocentesis and CVS search strategy top up.

Infographic S1. Infographic version of the guideline.

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