Cardiac Disease in Pregnancy

Version 3

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Division	:	Women and Children's
First implemented	:	August 2013
This version implemented	:	21st February 2025
Planned Full Review	:	February 2028
Keywords	:	Heart problems, pregnancy; Cardiac disease, pregnancy
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Consultation	:	Dr S Rutter, Consultant Obstetrician, Steph Chatham, Guideline Midwife 2-week MDT consultation
Comments	:	References to SaTH Guidelines in the text pertain to the latest version of the Guideline on the intranet. Printed copies may not be the most up to date version. Also refer to Cardiac disease in pregnancy: management for the anaesthetist Guideline.

For triennial review

Version	Implementation Date	History	Ratified By	Full Review Date
1	23rd August 2013	New	Maternity Guidelines Group (MGG) Maternity Governance	August 2016
1.1	30th September, 2014	Revision due to reconfiguration	GC Authorised	August 2016
2	28th November 2016	Full Review	MGG Maternity Governance	Nov 2021
2.1	November 2022	Audit & Monitoring paragraph updated to reflect new process		Nov 2021
3	21st February 2025	Full version review	Maternity Governance	February 2028

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1.0 Introduction

1.1 Cardiac Disease & Pregnancy

- Cardiac disease is the third major cause of maternal mortality (MBRRACE, 2024). Although the majority of cardiac disease in pregnancy relates to preexisting disease the majority of cardiac maternal deaths were in women not known to have preexisting cardiac disease eg myocardial infarction .
- Cardiac disease occurs in 0.4 - 4% of pregnancies.
- Cardiac disease can be structural or functional, acquired or congenital.
- Pre-conception care including discussion of genetic risk (especially in cardiomyopathy/channelopathies /Family History and if there is a syndromic component) to their offspring is beneficial **(see 5.1)**

1.2 Risk Stratification

Detailed advice about the management of individual cardiac conditions can be found within the European Society of Cardiology (ESC) guidelines, found here. All women with cardiac disease will be risk stratified using the Modified World Health Organisation Classification which provides a framework to guide the appropriate place of care and delivery. (See Appendix 1)

Pregnant women with cardiac disease will be managed by a multi-disciplinary team, requiring involvement of a Consultant Obstetrician, Consultant Cardiologist and Anaesthetist as well referral to the Maternal Medicine Network as required – Page 8 in the "Complex Medical Conditions in Pregnancy: Referral to the Maternal Medicine Network" guideline.

Classes of recommendation:

Classes of recommendations	Definition	Suggested wording to use
Class I	Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective.	Is recommended/is indicated
Class II	Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure.	
Class IIa	*Weight of evidence/opinion is in favour of usefulness/efficacy.*	Should be considered
Class IIb	*Usefulness/efficacy is less well established by evidence/opinion.*	May be considered
Class III	Evidence or general agreement that the given treatment or procedure is not useful/effective; and in some cases may be harmful.	Is not recommended

1.3 Maternal Obstetrical Risk

Mothers with cardiac disease are at an increased risk of the following obstetric complications:

- **PPROM**
- **Pre-term labour and delivery**
- **PPH**
- **PIH / PET**
- **Placental Abruption**
- **IUFD**

1.4 FETAL / NEONATAL RISK

Adverse fetal and neonatal outcomes complicate up to 15-40% of pregnancies of mothers with cardiac disease:

- **Premature birth: RDS, IVH**
- **SGA birthweight**

2.0 Aim

To ensure a clear pathway is followed for the management of pregnant women with cardiac disease.

3.0 Objectives

To ensure optimum care is achieved for women with cardiac disease in the Preconceptual, Antenatal, Intrapartum and Postnatal periods.

4.0 Definitions

Cardiac disease in this guideline refers to pre-existing heart disease (including cardiac valve disease and cardiomyopathy) or cardiac problems that develop during pregnancy.

ACE inhibitors - Angiotensin-converting enzyme inhibitors	**LMWH** – Low Molecular Weight Heparin
ANC – Antenatal Clinic	**PPROM** – Preterm Pre-labour Rupture of Membranes
MDT – Multidisciplinary Team	**PPH** – Post Partum Haemorrhage
CHD – Congenital Heart Disease	**PIH** – Pregnancy Induced Hypertension
ASD – Atrial Septal Defect	**PET** – Pre-Eclampsia
VSD – Ventricular Septal Defect	**IUFD** – Intra-Uterine Fetal Death
PDA – Patent Ductus Arteriosus	**APH** – Antepartum Haemorrhage
MI – Myocardial Infarction	**RDS** – Respiratory Distress Syndrome
TIA – Transient Ischaemic Attack	**IVH** – Intraventricular Haemorrhage
LV – Left Ventricle	**SGA** – Small for Gestational Age
LVEF – Left Ventricular Ejection Fraction	**EFM** – Electronic Fetal Monitoring
AV – Arterio-Venous	**TOP** – Termination of Pregnancy
CAD – Coronary Artery Disease	

5.0 Process

5.1 Pre-conception

Women of reproductive age, with congenital or acquired cardiac disease, may be referred for pre-conception counselling via their GP. We cannot offer this service locally at this time and so in these circumstances, women will be referred via the Maternal Medicine Network for counselling.

Led by the adult cardiology team, a pre-pregnancy consultation would be expected to include:

- Assessment and information gathering
  - Previous cardiac history, obstetric history and co-morbidities
  - Assessment of current functional status
- Optimisation
  - Optimise condition- medical, surgical or other interventions
  - Lifestyle modification, smoking cessation, folic acid and vitamin D supplements
- Medications
  - Determine if current medications are safe for pregnancy and create a plan for changing any medications that are not considered safe

- Information provision
    - Risks to woman and fetus
    - Risk of recurrence of cardiac condition in the fetus and testing options
    - Management plan for pregnancy and birth
    - Clear documentation of discussions/information provided to facilitate the woman to reach a decision about whether or not to proceed with a pregnancy
    - Information about appropriate conception
    - How to access care when pregnant.

5.2 Termination of Pregnancy

Rapid access to termination of pregnancy services should be facilitated if the woman is opting for this. Multidisciplinary care will be necessary for some women around the time of termination of pregnancy. For women with severe forms of cardiac disease, it is important that the termination occurs in an NHS hospital setting with co-located cardiac facilities, in these situations, women will be directed to Birmingham Women's Hospital.

5.3 Miscarriage

The care of women who miscarry requires a multi-disciplinary approach, including the appropriate cardiologist, gynaecologist and anaesthetist. The MDT should decide the best place and method for management of the woman having a miscarriage.
The options for management are surgical evacuation, medical management or Manual Vacuum Aspiration (less than 9 weeks gestation). Each have their own risks and benefits, especially in the context of cardiac disease.

5.4 Antenatal

Women with pre-existing cardiac disease or cardiac disease in their current/previous pregnancy will be classified as high risk and referred urgently to the maternal medicine clinic, as per the Clinical Risk Assessment Guideline. They will also consequently, be referred, as indicated to the Maternal Medicine Network, to formulate their plan according to their individualised risk at their initial consultant clinic appointment.
Refer to Complex Medical Conditions in Pregnancy: Referral to the Maternal Medicine Network Guideline.

Note: Immigrants to the UK who have not had childhood health screening are a high-risk group for undiagnosed cardiac disease, and any cardiovascular or respiratory symptoms will lead to careful clinical and echocardiographic assessment, with consideration of additional imaging as appropriate.

5.4.1 Specific Obstetric Antenatal Care at the Maternal Medicine Clinic

Appointment	Care
First appointment	Take full clinical assessment to establish the extent of cardiac-related disease Identify baseline investigations required Review risk factors and functional status Review medications for cardiac disease and its complications (**see 5.4.2**) Identify obstetric cardiac risk- Prognosis for successful pregnancy outcome (Maternal health – short & long-term) Offer information, advice and support. Including difficult conversations: -Maternal-Fetal triage decisions need to be addressed early in pregnancy with the family and MDT and documented clearly on the MIS; the women may not survive a 'crash induction of GA' and the fetus may be a secondary consideration, even in cases of acute fetal compromise; alternatively, if the maternal condition is terminal, the fetus may take priority. -Fetal anomalies / Fetal loss: Cyanosis poses a significant risk to the fetus; a livebirth is unlikely (<12%) if maternal oxygen saturation <85%. - Women at risk of aortopathy (e.g. those with repaired coarctation, Marfan's syndrome or aortopathy associated with bicuspid aortic valve) will be made aware of the symptoms of *acute dissection* and be advised to seek urgent help if they experience any of them (**See 5.4.3 for investigations in pregnancy**) Discuss option of termination with women with extremely high risk cardiac disease Refer as necessary to MMN For women with inherited cardiac conditions refer for genetics as they may be offered prenatal diagnosis and the baby will need follow up
By 10 weeks	Confirm viability of pregnancy Discuss information, education and advice about how cardiac disease will affect the pregnancy, birth and early parenting (such as breastfeeding and initial care of the baby)
By 22 weeks	Offer fetal echo to women with structural congenital heart disease between 18 and 22 weeks by a consultant in Fetal Medicine.**
Number and timing of further appointments will depend on the nature/severity of cardiac disease.	Plan appropriate intra-partum care at the CLU at PRH or tertiary unit, according to complexity of the woman's cardiac disease, her risk assessment and the locally available facilities and expertise (e.g very high-risk women may require delivery in cardiac theatres with bypass facilities). Start regular tests of fetal wellbeing including serial scans for growth and liquor volume Refer all women with WHO II – IV cardiac disease to anaesthetist (Appendix 1) Involve other members of MDT as appropriate Offer information and advice about: • Timing, mode and management of birth • Analgesia and anaesthesia • Fluid balance • Medication • Need for invasive maternal monitoring and postnatal management • Management of the baby after birth • Initiation of breastfeeding and the effect of medication on breastfeeding • Generate postnatal care plan, including follow up • Advice regarding contraception. **Clearly document on the MIS:** -Decision regarding planned mode of delivery (after careful consideration of appropriate options based on individual risk) -Individual management plans for: *If anticoagulated, need to switch to LMWH for delivery (see below) *1st, 2nd and 3rd stage of labour *Analgesia/anaesthesia options *Requirement of intra-partum antibiotic prophylaxis (see below) *Postnatal care / follow-up / timing of obstetric / cardiology review

****** Women with functional congenital heart disease (i.e. patent ductus arteriosus (PDA), patent foramen ovale (PFO), atrial septal defect (ASD)) do not need fetal echocardiogram for their pregnancies as these conditions cannot be diagnosed antenatally.

****** Women with acquired heart disease or inherited cardiac conditions with a structurally normal heart (Marfan's, long QT syndrome) do not need fetal echocardiography.

5.4.2 Medication assessment

The benefits of any drug given in pregnancy must outweigh the risks.

Drugs with significant risks to the fetus in pregnancy are:

- Warfarin – teratogenic and fetotoxic (intracranial haemorrhage)
- ACE inhibitors and ARBs - teratogenic and fetotoxic (renal impairment)
- Amiodarone - sustained use may cause fetal thyroid goitre
- Statins – impair myelination and neurodevelopment (no conclusive data)
- Beta blockers – no teratogenic effect, possible slight reduction in birthweight (benefit usually outweighs risk)

5.4.3 Investigations/Management in pregnancy for women with cardiac disease

Aortic dissection will be considered in any woman with pre-existing cardiac disease with chest pain during pregnancy.
Dissection occurs most often in the last trimester of pregnancy (50%) or the early postpartum period (33%).

ECG

- The great majority of pregnancy women have a normal electrocardiogram (ECG)
- In pregnancy normal changes include transient ST segment and T wave changes, the presence of a Q wave and inverted T waves in lead III, an attenuated Q wave in lead AVF, and inverted T waves in leads V1, V2, and, occasionally,V3. ECG changes can be related to a gradual change in the position of the heart and may mimic left ventricular (LV) hypertrophy and other structural heart diseases.
- Holter monitoring should be performed for women with known previous paroxysmal or persistent documented arrhythmia [VT, atrial fibrillation (AF), or atrial flutter] or those reporting palpitations.

Echocardiography
Because echocardiography does not involve exposure to radiation, is easy to perform and can be repeated as often as needed, it has become an important tool during pregnancy and is the preferred screening method to assess cardiac function.
Transoesophageal echocardiography can also be considered and is safe in pregnancy.

Radiation Exposure
The effects of radiation on the fetus depends on the radiation dose and the gestational age at which the exposure occurs. If possible, procedures should be delayed until at least the completion of the period of major organogenesis (12 weeks after menstruation). There is no evidence of an increased fetal risk of congenital malformations, intellectual disability, growth restriction or pregnancy loss at doses of radiation to the pregnant woman of <50mGy22,23.

Table 1. Estimated fetal and maternal effective doses for various diagnostic and interventional radiology procedures.

Procedure	Fetal Exposure	Maternal Exposure
Chest radiograph- (PA and lateral)	<0.01 mGy <0.01 mSv : 0.1 mGy	0.1 mSv
CT chest	0.3 mGy 0.3 mSv : 7 mGy	7 mSv
Coronary angiography	1.5 mGy 1.5 mSv : 7 mGy	7 mSv
PCI or radiofrequency catheter ablation	3 mGy 3 mSv : 15 mGy	15 mSv

Magnetic resonance imaging (MRI) and computed tomography (CT)

MRIs may be useful in diagnosing complex heart disease or pathology of the aorta. It should only be performed if other diagnostic measures, including transthoracic and transoesophageal echocardiography, are not sufficient for complete diagnosis.
Limited data during organogenesis is available, but MRI is probably safe, especially after the first trimester.

CT is usually not necessary to diagnose CVD during pregnancy and, because of the radiation dose involved, is therefore **not** recommended.

Direct current (DC) cardioversion

Considered safe, although attention will be paid to airway management because of the risk of aspiration/regurgitation of gastric contents, and care will be taken to avoid the supine position with its accompanying risk of aortocaval compression. Careful fetal monitoring is also advisable.

Timely restoration of sinus rhythm is strongly advisable in pregnant women with tachyarrhythmias and underlying heart disease.

5.4.4 Thromboprophylaxis

- Most women with cardiac disease who require anticoagulation, are managed on subcutaneous low molecular weight heparin (LMWH) throughout pregnancy, with monitoring of Anti Xa levels.
- There will be a plan made during antenatal clinic appointments regarding peripartum anticoagulation management. If there is no documented plan in place, the consultant haematologist will be contacted when the woman is admitted.
- Recommend that last dose of LMWH is stopped >12 hours prior to labour/ IOL/ birth.
- Pregnant women with previous *Kawasaki disease and coronary artery aneurysm* (with or without coronary artery stenosis) will be given *antiplatelet and/or anticoagulant thromboprophylaxis.*
- If the woman requires delivery while on **warfarin**, contact the consultant haematologist immediately for advice. Clopidogrel is a platelet inhibitor. Due to the irreversible binding of platelets, effects last 7-10 days after exposure.
- Aspirin does not usually cause problems with surgical haemostasis.
- For women with a planned caesarean section, therapeutic LMWH dosing can be simply omitted for 24 h prior to surgery. If delivery has

to be performed earlier, then anti-Xa activity can guide the timing of the procedure.

5.4.5 Planning for Birth

- High risk birth: Induction, management of labour, birth and postnatal surveillance require specific expertise and collaborative management by skilled cardiologists, obstetricians and anaesthetists, in experienced maternal-fetal medicine units.

Timing of birth

- Spontaneous onset of labour is appropriate for women with normal cardiac function however, induction of labour will be considered at 40 weeks in all women with cardiac disease as it reduces the risk of EMCS by 12% as per ESC.

Induction of Labour

- There is no absolute contraindication to dinoprostone, it has more profound effects on BP than prostaglandin E1, and is therefore contraindicated in active CVD
- Mechanical methods such as CRB, would be preferable to pharmacological agents, particularly in the women with cyanosis, where a drop in systemic vascular resistance and/or BP would be detrimental.
- Daily physical consultant review is required to ensure that appropriate progress is being obtained eg avoidance of prolonged time off anticoagulation.
- If labour is induced, normal indication regimes can be used but consideration will need to be given regarding volume restriction with syntocinon infusions, if they are used.

Mode of Birth: Vaginal or Caesarean

- The preferred mode of birth is vaginal, with an individualised birth plan which informs the team of timing birth (spontaneous/induced), method if induction, analgesia/regional anaesthesia, and level of monitoring required.
- In high-risk lesions, birth should take place in a tertiary centre with specialist MDT care.
- Vaginal birth is associated with less blood loss and infection risk compare with caesarean birth- which also increases the risk of venous thrombosis and thromboembolism.
- Generally, caesarean birth is reserved for obstetric indications.
- Caesarean birth should be considered for women on oral anticoagulants (OACs) in preterm labour, patients with Marfan syndrome and an aortic diameter .45mm, women with acute or chronic aortic dissection, and those in acute intractable heart failure.

5.5 Intrapartum

Also refer to guideline: Care in Labour on a Consultant Unit

5.5.1 General Points around Admission

- All women with cardiac disease will be advised to give birth on the consultant unit at PRH. (unless tertiary unit care has been arranged).
- Women will be given clear advice on how to recognise the onset of labour and be instructed to attend the labour ward as soon as possible.

- The consultant obstetrician and consultant anaesthetist should be informed of the woman's admission. The woman will have a face-to-face review by the consultant obstetrician and consultant anaesthetist (in hours) or the middle grade anaesthetist (out of hours).
- The Maternity Manager of the Day (bleep 254) should be informed of the admission also.
- The woman's admission and progress will be discussed at every MDT handover.
- All women with cardiac disease need FBC, U&Es and Group and Save on admission.

5.5.2 Preterm Labour

Also refer to: Preterm Birth Guideline

- Tocolytics should not be commenced without prior discussion with the consultant obstetrician, as they may severely compromise cardiac function, especially nifedipine.
- Atosiban has the least cardiovascular side effects of all the tocolytics and is the tocolytic of choice for women with severe cardiac disease.
- Steroids for fetal lung maturity are **not** contraindicated.
- Magnesium infusions for neuroprotection can also be used but may cause hypotension, so should be used with care and frequent blood pressure monitoring.

5.5.3 Analgesia

- Analgesia will form some of the antenatal discussions in the obstetric clinic.
- Any form of analgesia is suitable for women with mild (WHO I) disease but epidural analgesia has particular benefits for women with more severe disease as it provides effective analgesia, greater cardiovascular stability and facilitates a longer passive second stage prior to pushing whilst also being useful should an instrumental or operative birth become necessary.
- Also refer to Obstetric Anaesthetic Guideline: Cardiac disease in pregnancy management for the anaesthetist.
    - If labour starts when the woman is on **LMWH anticoag**:
        - **Epidurals/Spinals** are considered ***safe*** as long as the last LMWH dose was:
            - >12hrs ago if on prophylactic LMWH
            - >24hrs ago if on therapeutic LMWH

5.5.4 Prophylactic Antibiotics

- Current NICE guidance states that antibiotic prophylaxis against infective endocarditis should not be routinely offered for obstetric procedures/childbirth.
- Antibiotics will be given for all the usual obstetric indications but with a lower threshold for women who are at an increased risk of endocarditis; for example, women with prosthetic valves, endocarditis history, valvulopathy.
- Refer to ESC guidance.

5.5.5 Monitoring

- CEFM is advised
  Refer to Fetal Monitoring Guideline
- Consider ECG as necessary
- Maternal monitoring will be dictated by the nature of the cardiac condition but at a minimum, completed in line with the frequency set out by the Care in Labour on a Consultant Unit Guideline.
- Plans for monitoring will be considered at the consultant review on admission to the unit.
- For some conditions, hypotension is poorly tolerated and so prompt and accurate replacement of lost volume is necessary.
- Vasoactive medications e.g. nifedipine, should be used with extreme care and **only** after discussion with the consultant.

5.5.6 Fluid Balance

- Essential for all women with cardiac disease
- Large fluid shifts occur around the time of delivery.
- Hypotension due to hypovolaemia is dangerous for women with some types of cardiac disease, for example aortic stenosis.
- For many women with cardiac disease, fluid overload could precipitate **heart failure**
- Hourly input/output will be used in high risk cases.
- Blood loss will be assessed as accurately as possible, by weighing swbas, pads, incos etc
- There will be meticulous attention to haemostasis.
- **Intravenous (IV) line filters will be used to prevent air embolism, particularly if there is a right to left circulatory connection (ASD etc)**

5.5.7 The Second Stage of Labour

- If the **active** second stage is to be limited, allowing maximum descent of the vertex, by facilitating a two hour passive second stage is sensible.
- The Tier 2 Obstetrician will be kept informed of progress.
- After 30 minutes of active pushing, the woman will be assessed with a view to performing instrumental birth, unless a vaginal birth appears imminent and she is haemodynamically stable.

5.5.8 The Third Stage of Labour

- Ergometrine and syntometrine are contraindicated in some women with cardiac conditions as they cause a rapid increase in preload (venous return) and a hypertensive surge (examples of undesirable conditions include mitral stenosis, poorly functioning ventricles or aortopathies.
- A syntocinon bolus can cause tachycardia and hypotension- see next point.
- For women with moderate or severe cardiac conditions, syntocinon will be given as a **slow** IV infusion:

Syntocinon 5 units in 20ml of Sodium Chloride 0.9% over 20 minutes via an infusion pump

- In cases where there is uncertainty about what to use in the third stage of labour, the above regime will be used as it has the least vasoactive side effects.
- **Women with cardiac disease who are anticoagulated are at risk of bleeding and haematoma formation. There should be meticulous attention to haemostasis whether this is at LSCS or after a vaginal birth.**
- **Perineal trauma must be repaired by a senior clinician.**

5.5.9 Management of Post Partum Haemorrhage

(also refer to Postpartum Obstetric Haemorrhage Guideline)

- Syntocinon infusions can be used although in some women the volume of fluid may need to be limited (ie a more concentrated infusion)
- Mechanical methods such as bimanual compression, B-Lynch suture and Bakri balloon can also be used in problematic hypotonia.
- Misoprostol (1000 micrograms rectally or 800 micrograms sublingually) should be used in preference to carboprost (Haemobate), since the former is less vasoactive.
- If a woman is becoming unstable due to blood loss caused from hypotonia the syntometrine **can** be used.
- Seek advice from a haematologist prior to administering tranexamic acid in women who have needed additional anticoagulation in pregnancy.

5.6 Caesarean Birth

Some women with cardiac conditions pose complex anaesthetic challenges and cannot safely undergo rapid anaesthesia and this will have been discussed in the antenatal period.

- Caesarean birth may be chosen by the woman or indicated during labour, usually due to obstetric reasoning as per local guidance.
- There will be close communication between the obstetric, anaesthetic and midwifery teams over any concerns around the fetal condition and the woman's progress through labour to allow for timely preparation and involvement from specialist area if required (ie haematology, critical care)
- The priority is to maintain maternal safety and a longer anaesthetic time may therefore be needed, even in cases of fetal concern.
- **Women with cardiac disease who are anticoagulated are at risk of bleeding and haematoma formation. There should be meticulous attention to haemostasis whether this is at LSCS or after a vaginal birth.**

5.7 Postnatal Care

5.7.1 Monitoring

- Immediately postnatal is a time of decompensation and so women with cardiac disease will remain on delivery suite to receive a higher level of observation, with the frequency of observations determined by the obstetrician in conjunction with the MDT.
- Fluid balance will continue to be monitored accurately.

- Women with cardiac disease will have a face-to-face cardiovascular assessment by the consultant obstetrician at a minimum of daily, until discharged home- these reviews will include a plan for any medication changes (see 5.7.3) and will be documented on the MIS.

5.7.2 Thromboprophylaxis

- Women with cardiac disease, who have had a caesarean birth will receive LMWH thromboprophylaxis.
- LMWH will not be administered until 4 hours after removal of an epidural catheter.
- Thromboprophylaxis in other circumstances is not contraindicated and will follow local guidance: Thromboprophylaxis in Pregnancy and Puerperium.
- Women undergoing prolonged LMWH use will have a plan in place from the consultant haematologist which will include postnatal management.

- Recommence LMWH at the same **therapeutic** dosage, reintroduce warfarin when risk of PPH is deemed minimal (often >2 days postpartum). Discontinue LMWH when INR is in therapeutic range

5.7.3 Medication Assessment

- All cardiac medications will be reviewed postnatally as drugs and doses may need changing.
- Any medication which was discontinued before or during pregnancy may need restarting, taking into consideration if the woman is breastfeeding.
- **ACE inhibitors- Captopril and Enalapril** are considered ***safe*** for breastfeeding mothers
- **Anticoagulant- LMWH** or **Warfarin** are considered ***safe*** for breastfeeding mothers.

5.7.4 Contraception

- Contraceptive options will be discussed with women prior to discharge.
- Guidance about contraception for women with heart disease is available on the Faculty of Sexual and Reproductive Health website: here.

5.7.5 Neonatal Care

- Babies of mothers with congenital heart disease have an increased incidence of CHD themselves.
- Babies will undergo the Newborn and Infant Physical Examination by an appropriately trained clinician and managed as per guideline: Newborn and Infant Physical Examination.

5.7.6 Follow up

- MDT surveillance will be maintained until the woman is well enough to leave hospital.
- For women with unstable cardiac conditions (pulmonary hypertension or cardiomyopathy), surveillance may be required for up to 2 weeks.
- The woman's cardiology team will be informed of her delivery and any intrapartum complications.
- The consultant reviewing and determining if the woman is fit for discharge will ensure that the postnatal management plan is completed, including actions required from the GP and detail planned follow up for cardiac care.

- If correspondence is required to the adult cardiology services, the consultant will dictate an urgent letter to the department **or** speak directly to the cardiologists to arrange follow up.
- Cardiac nurses are available at both RSH and PRH for advice and can be contacted via switchboard.
- Women will be advised that should she experience any worsening or a new onset of symptoms to attend the Emergency Department urgently (ie unexpected/persistent dyspnoea or unusually tachypnoeic or tachycardic).
- The woman will have a follow up assessment 6 weeks after the birth as set out in the postnatal management plan.
- Thereafter, the woman returned to her pre-pregnancy Cardiology team.

6.0 Training

All new midwives, students and medical staff will be informed about the process for accessing guidelines, protocols and policies during their induction.

7.0 Monitoring/Audit

Compliance with this guideline / SOP will be audited as part of the Shrewsbury and Telford Hospital NHS Trust's five-year rolling programme of NICE and local guideline audits, unless circumstances require an earlier or more frequent audit. The audit will be carried out against the auditable standards and the results of the audit will be reported and acted on in accordance with the Trust Clinical Audit Policy (CG25).

8.0 References

European Society of Cardiology 2018. Cardiovascular Diseases during Pregnancy (Management of) Guidelines. Aug 2018 http://www.escardio.org/guidelines-surveys/esc-guidelines/Pages/cardiovascular-diseases-during-pregnancy.aspx

Faculty of Sexual and Reproductive Health Clinical Effectiveness Unit Clinical Effectiveness Unit. Clinical Guidance. Contraceptive Choices for Women with Cardiac Disease. June 2014. Available at: www.fsh.org

Kampman MA, Valente MA, van Melle JP, Balci A, Roos-Hesselink JW, Mulder BJ, van Dijk AP, Oudijk MA, Jongbloed MR, van Veldhuisen DJ, Pieper PG. Cardiac adaption during pregnancy in women with congenital heart disease and healthy women. *Heart* 2016;102:1302–1308.

Lupton M, Oteng-nim *et al*. 2002 Cardiac Disease in Pregnancy: Surr Opin. *Obs Gynaecol.*14(2), B7.43.

Maternal, Newborn and Infant Clinical Outcome Review Programme. MBRRACE-UK. Saving Lives, Improving Mothers' Care 2020-22. October 2024.

National Institute of Clinical Excellence (2019) Intrapartum Care for Women with Existing Medical Conditions or Obstetric Complications and their Babies. NG 121.

Fernandes SM, Arendt KW, Landzberg MJ, Economy KE, Khairy P. March 2010. Pregnant women with congenital heart disease: cardiac, anesthetic and obstetrical implications. *Expert Review of Cardiovascular Therapy.*8/3(439-48), 1477-9072;1744-8344.

Roos-Hesselink JW, Budts W, Walker F, De Backer JFA, Swan L, Stones W, Kranke P, Sliwa-Hahnle K, Johnson MR. Organisation of care for pregnancy in patients with congenital heart disease. *Heart.* 2017;103:1854–1859

Royal College of Physicians. Acute Care Toolkit 15: Managing Acute Medical Problems in Pregnancy. Flowcharts. November 2019 acute-care-toolkit-15_flowcharts_nov19_0.pdf

The Criteria Committee of the New York Heart Association. Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Great Vessels. 9th ed. Boston, Mass: Little, Brown & Co; 1994:253-256

Appendix 1
Modified World Health Organisation Classification of Maternal Cardiovascular Risk

	mWHO I	mWHO II	mWHO II–III	mWHO III	mWHO IV
Diagnosis (if otherwise well and uncomplicated)	Small or mild – pulmonary stenosis – patent ductus arteriosus – mitral valve prolapse Successfully repaired simple lesions (atrial or ventricular septal defect, patent ductus arteriosus, anomalous pulmonary venous drainage) Atrial or ventricular ectopic beats, isolated	Unoperated atrial or ventricular septal defect Repaired tetralogy of Fallot Most arrhythmias (supraventricular arrhythmias) Turner syndrome without aortic dilatation	Mild left ventricular impairment (EF >45%) Hypertrophic cardiomyopathy Native or tissue valve disease not considered WHO I or IV (mild mitral stenosis, moderate aortic stenosis) Marfan or other HTAD syndrome without aortic dilatation Aorta <45 mm in bicuspid aortic valve pathology Repaired coarctation Atrioventricular septal defect	Moderate left ventricular impairment (EF 30–45%) Previous peripartum cardiomyopathy without any residual left ventricular impairment Mechanical valve Systemic right ventricle with good or mildly decreased ventricular function Fontan circulation. If otherwise the patient is well and the cardiac condition uncomplicated Unrepaired cyanotic heart disease Other complex heart disease Moderate mitral stenosis Severe asymptomatic aortic stenosis Moderate aortic dilatation (40–45 mm in Marfan syndrome or other HTAD; 45–50 mm in bicuspid aortic valve, Turner syndrome ASI 20–25 mm/m^2, tetralogy of Fallot <50 mm) Ventricular tachycardia	Pulmonary arterial hypertension Severe systemic ventricular dysfunction (EF <30% or NYHA class III–IV) Previous peripartum cardiomyopathy with any residual left ventricular impairment Severe mitral stenosis Severe symptomatic aortic stenosis Systemic right ventricle with moderate or severely decreased ventricular function Severe aortic dilatation (>45 mm in Marfan syndrome or other HTAD, >50 mm in bicuspid aortic valve, Turner syndrome ASI >25 mm/m^2, tetralogy of Fallot >50 mm) Vascular Ehlers–Danlos Severe (re)coarctation Fontan with any complication
Risk	No detectable increased risk of maternal mortality and no/mild increased risk in morbidity	Small increased risk of maternal mortality or moderate increase in morbidity	Intermediate increased risk of maternal mortality or moderate to severe increase in morbidity	Significantly increased risk of maternal mortality or severe morbidity	Extremely high risk of maternal mortality or severe morbidity
Maternal cardiac event rate	2.5–5%	5.7–10.5%	10–19%	19–27%	40–100%
Counselling	Yes	Yes	Yes	Yes: expert counselling required	Yes: pregnancy contraindicated: if pregnancy occurs, termination should be discussed
Care during pregnancy	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease
Minimal follow-up visits during pregnancy	Once or twice	Once per trimester	Bimonthly	Monthly or bimonthly	Monthly
Location of delivery	Local hospital	Local hospital	Referral hospital	Expert centre for pregnancy and cardiac disease	Expert centre for pregnancy and cardiac disease

ASI = aortic size index; EF = ejection fraction; HTAD = heritable thoracic aortic disease; mWHO = modified World Health Organization classification; NYHA = New York Heart Association; WHO = World Health Organization.

Appendix 2

Additional Information on CAD, Cardiomyopathy & Arrhythmia

Coronary Artery Disease (CAD)

- Primary PCI (with bare metal stent) is the treatment of choice in pregnant women with ACS/STEMI.
- Pregnancy may be considered in women with known CAD, if there is no residual ischemia
  and LVEF >40%

Cardiomyopathy

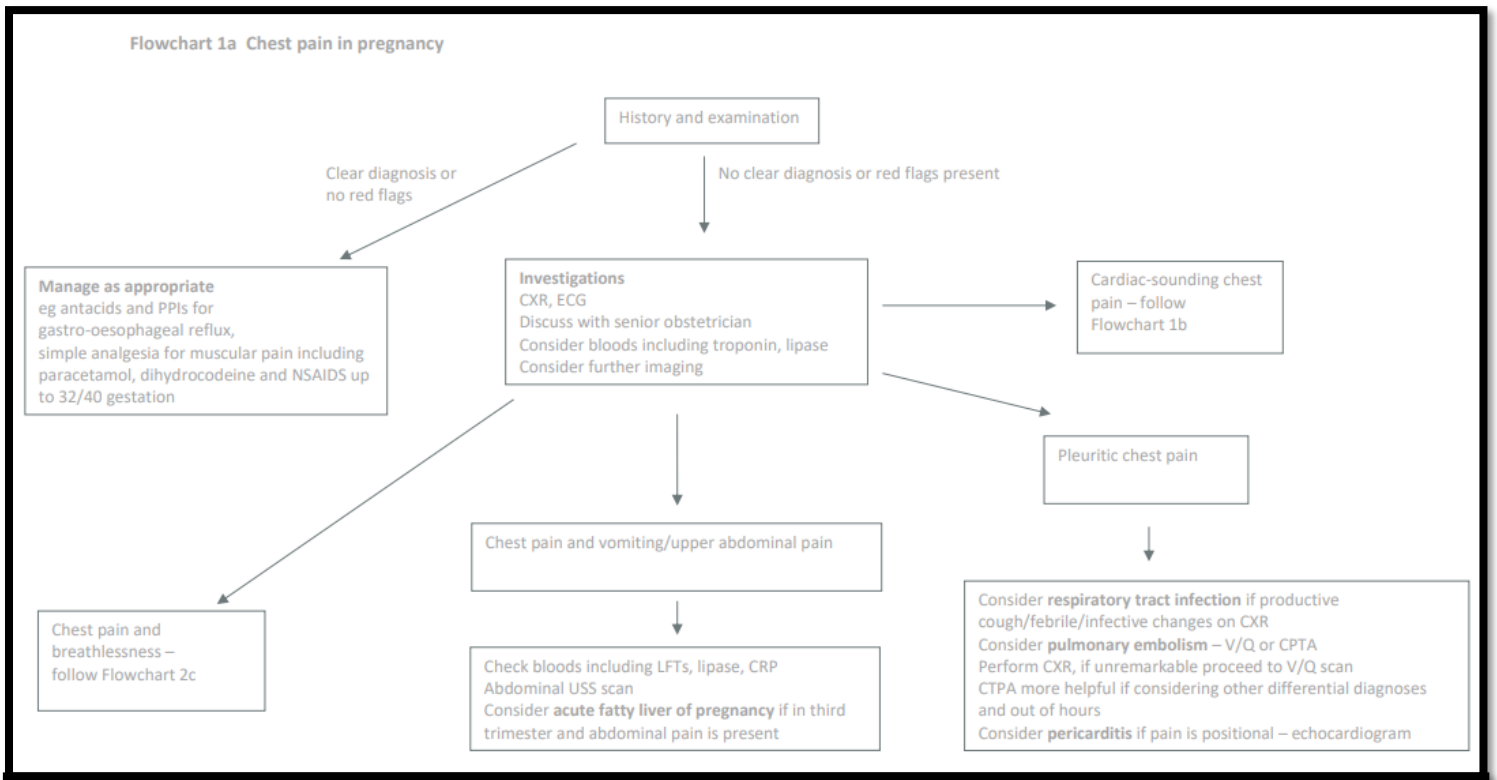
- Deterioration in LV function occurs in up to 50% of cases despite optimal treatment
- Subsequent pregnancies carry a recurrence risk of 30–50%
- When ejection fraction has not normalized a subsequent pregnancy will be discouraged.
- Women with dilated cardiomyopathy will be informed about the risk of deterioration during
  pregnancy and peripartum
  - LVEF <40% is a predictor of high risk
  - LVEF <20% implies a very high mortality and TOP will be considered
- Most women with hypertrophic cardiomyopathy tolerate pregnancy well; use of ß-blockers is
  recommended if tolerated.

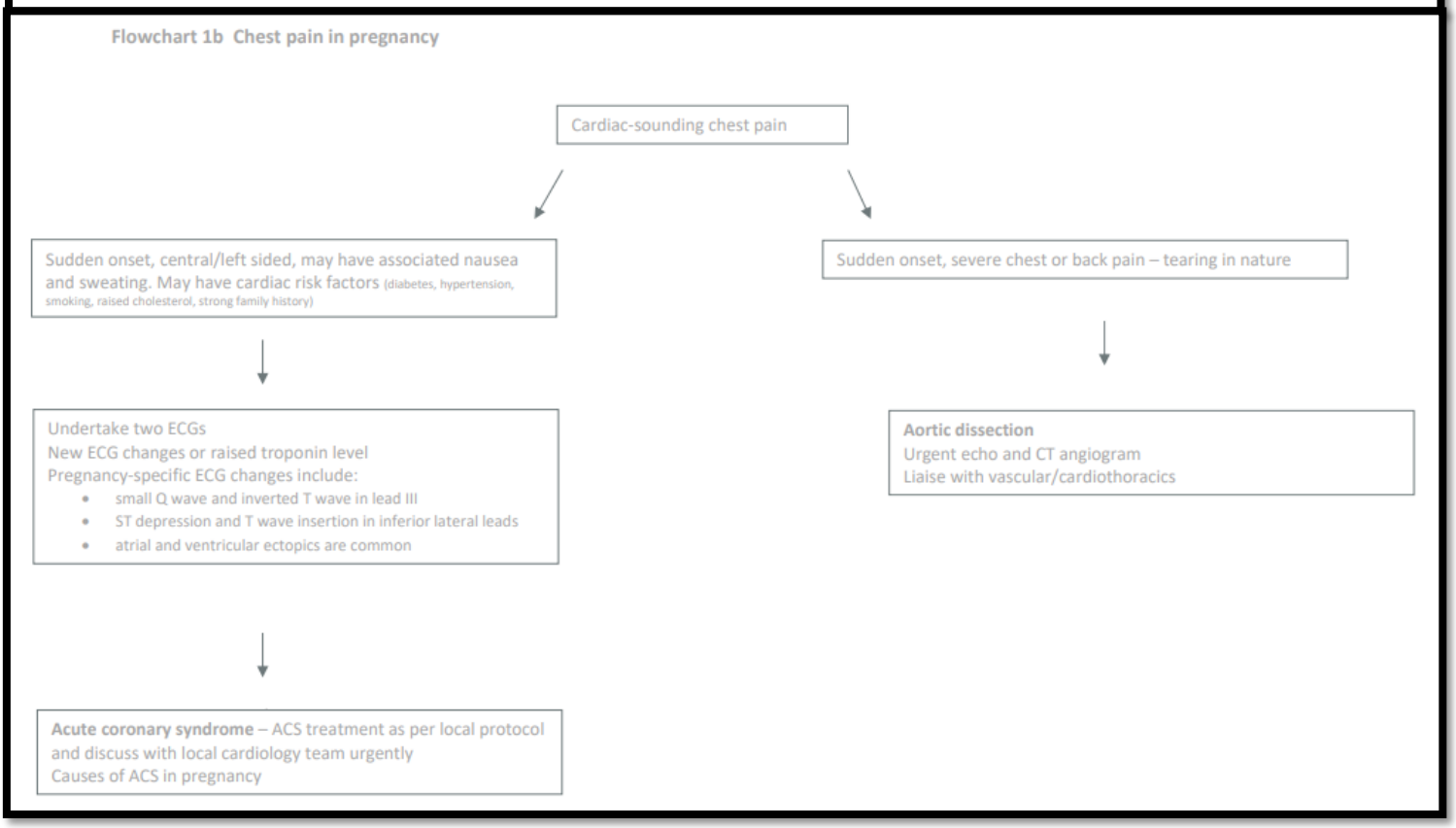
Arrhythmia

- Arrhythmias may become more frequent or may manifest for the first time during pregnancy
- Arrhythmias requiring treatment develop in up to 15% of women with structural and CHD
- In haemodynamically unstable women with tachycardias, DC cardioversion will be considered
- AV nodal re-entry tachycardia or AV re-entry tachycardia can be terminated by vagal manoeuvres or, if that fails, by intravenous adenosine
- Life-threatening ventricular arrhythmias during pregnancy are rare; the presence of an ICD does not itself contraindicate future pregnancy
- Temporary pacing during delivery is recommended in presence of complete heart block and symptoms; the risks of permanent pacemaker implantation are generally low.

Appendix 3a

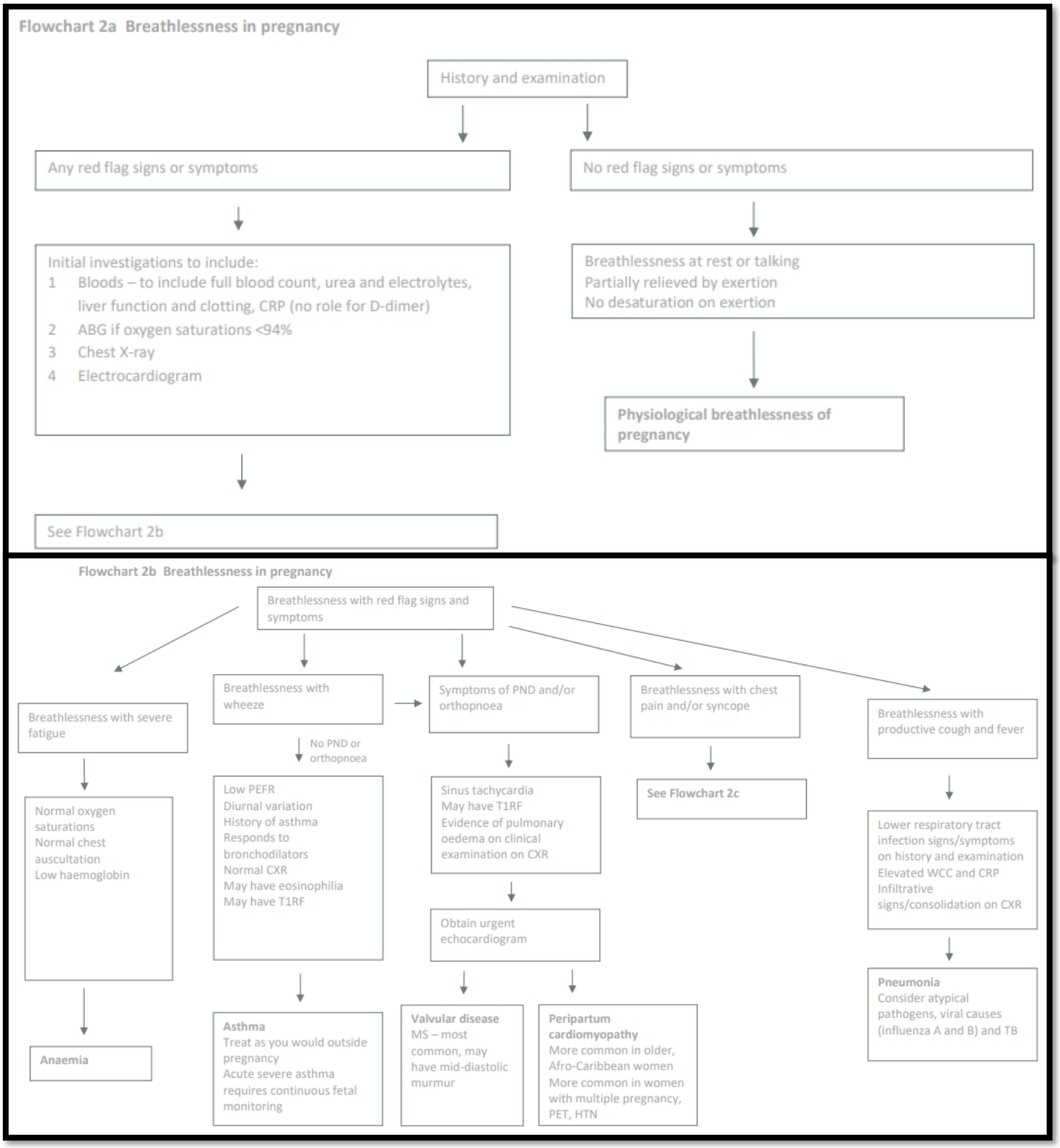
Chest Pain In Pregnancy- Acute Care Toolkit (www.rcplondon.ac.uk/act15)





Appendix 3b

Breathlessness in Pregnancy – Acute Care Toolkit (www.rcplondon.ac.uk/act15)



Appendix 4

Acute Aortic Dissection Toolkit in the West Midlands

1. From 1st October 2024, all emergency referrals of patients with acute aortic dissection in the West Midlands should be made via a Single Point of Contact (SPOC) – this will be ACCOTS (Adult Critical Care Transfer and Co-Ordination Service) contact number 03002001100

2. Once the call is connected to the on-call surgeon, the surgeon will request immediate review of the CT scan via MS Teams call, by sending the referrer an email invitation. Therefore, the referring physician must have access to a computer with Radiology PACS and MS Teams (logged with their email address). As the last resort, Siilo software may also be used for this purpose.

3. The Radiographer should transfer the CT scans to the receiving centre via emergency IEP transfer. The receiving clinician will notify the radiographer of the receiving centre to expect the images.

4. The referring physician may state if the patient has type A or type B dissection but if they are not sure, this is not mandatory.

5. The referring hospital may need to provide medical and/or nursing escort, as ACCOTS do not currently have 24/7 escort cover. This should be provided by the Critical Care Team, or Critical Care Outreach Team, without delay should it be required.

6. Each referring organisation must accept their patient for repatriation if the tertiary centre requests it, both for Critical Care and Ward transfers. It would be appreciated if your organisation could aim to repatriate such a patient within 48 hours of the request. Could you please provide the contact details for repatriation requests? We would expect this to be the Cardiology Ward in most instances. Please reply to maciej.matuszewski@nhs.net.

7. The WM AAD clinical pathway should be displayed in the referring Departments and the Radiology Departments together with the AAD rota planner and the receiving centres for emergency vascular (type B AAD) referrals. Please note that the tertiary centre on call should only be contacted directly if SPOC is impossible to access.

8. Please note that not all patients with acute AAD will be transferred to a tertiary centre. In particular, uncomplicated type B AAD will be managed in the referring hospital with the support and follow up of a tertiary centre MDT.