Hypertension - Antenatal, Intrapartum and Postpartum

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1. Purpose of guideline

This guideline describes evidence-based care for women with hypertension and pre-eclampsia in pregnancy for clinicians within Auckland District Health Board (Auckland DHB).

2. Guideline management principles and goals

All Hypertensive Disorders of Pregnancy (HDP) affect 5 - 10% of all pregnancies. Pre-eclampsia complicates 3 - 8% of pregnancies in New Zealand (4 - 5% of nulliparous women, 2 - 3% of low risk multiparas and up to 20% in women with Major Risk Factors (MRF) (MOH, 2018).

A priority of antenatal care in the second half of pregnancy is to detect the development of pre-eclampsia. When pre-eclampsia develops, delivery of the baby and placenta is the only cure. Management is aimed at timing delivery to prevent maternal complications whilst minimising fetal morbidity and mortality from prematurity and associated intrauterine growth restriction.

3. Definitions/symbols

SBP = systolic blood pressure
DBP = diastolic blood pressure
PCR = protein creatinine ratio
MFM = maternal fetal medicine
MRF = major risk factor
± plus or minus
≥ greater than, or equal to

Hypertension: SBP ≥ 140 mmHg **OR** DBP ≥ 90 mmHg measured on two or more consecutive occasions at least 4 hours apart or one measurement SBP ≥ 160 **OR** DBP ≥ 110 mmHg (Cluver *et al.,* 2017 and MOH, 2018).

Women with an incremental increase from baseline booking BP of SBP ≥ 30 mmHg and/or DBP ≥ 15 mmHg, do not meet the criteria of defined hypertension, however, such women should be monitored more closely (MOH, 2018).

Chronic/pre-existing hypertension: Hypertension confirmed pre-conception or prior to 20 weeks of gestation with or without a known cause - measured on two or more consecutive occasions at least four hours apart (MOH, 2018).

Severe hypertension: SBP ≥ 160mmHg **OR** DBP ≥ 110 mmHg on one occasion at any time (MOH, 2018).

Gestational hypertension: New onset hypertension after 20 weeks' gestation (in a woman who was normotensive before 20 weeks of gestation) (Cluver *et al,* 2017) when:

- SBP ≥ 140 mmHg **OR** DBP ≥ 90 mmHg (MOH,2018)
- Without any of the abnormalities that define pre-eclampsia (MOH,2018)
- Followed by return of blood pressure within three months postpartum (MOH,2018)

Proteinuria: Spot urine PCR ≥ 30 mg/mmol or ≥ 2+ on dipstick testing subsequently confirmed by a spot urine protein/creatinine (PCR) ratio ≥ 30 mg/mmol. Once diagnostic proteinuria has been detected, there is no established role for serial testing (MOH, 2018).

Proteinuria is not essential for a pre-eclampsia diagnosis (MOH, 2018).

Pre-eclampsia

The new onset of hypertension after 20 weeks of gestation (in a woman who was normotensive before 20 weeks gestation) or superimposed on pre-existing hypertension **and** the coexistence of **one or more** of the following new onset conditions (MOH, 2018)**.**

- **Renal involvement** (MOH, 2018):
  - Proteinuria – Spot urine PCR ≥ 30 mg/mmol or ≥ 2+ on dipstick testing subsequently confirmed by a spot urine protein/creatinine (PCR) ratio ≥ 30 mg/mmol.
  - Serum or plasma creatinine > 90 µmol/L
  - Oliguria - urine output < 80mL/4 hours

- **Haematological involvement** (MOH, 2018):
  - Thrombocytopenia (platelet count below 100 x 10^9/L)
  - Haemolysis
  - Disseminated intravascular coagulation

- **Liver involvement** (MOH, 2018):
  - Elevated serum transaminases (AST & ALT) - at least twice the upper limit of normal range ± right upper quadrant or epigastric abdominal pain (may be referred to upper back).
  - **Note:** normal ranges are: ALT 0-30 u/L and AST 10-50 u/L

- **Neurological complications (examples commonly include)** (MOH, 2018)**:**
  - Seizure (eclampsia)
  - Hyper-reflexia when accompanied by clonus
  - Severe headache
  - Persistent visual disturbances (altered mental status, photopsia, persistent visual scotomata, cortical blindness, retinal vasospasm)

- **Stroke**

- **Uteroplacental dysfunction** (MOH, 2018):
  - Fetal growth restriction
  - Placental abruption

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Severe pre-eclampsia (MOH, 2018):

- SBP ≥ 160 mmHg **OR** DBP ≥ 110 mmHg on one occasion at any time.
- **Thrombocytopenia** (platelet count below 100 x 10^9/L)
- **Impaired liver function not responding to treatment** and:
    - Not accounted for by alternative diagnosis
    - AST & ALT at least twice the upper limit of normal range ±
    - Right upper quadrant or epigastric abdominal pain (may be referred to upper back)
- **Progressive renal insufficiency**:
    - Serum or plasma creatinine > 90 µmol/L or
    - Doubling of serum creatinine in the absence of other renal disease
    - Oliguria, urine output <80 mL/4 hours
- **Pulmonary oedema**
- **New onset of headaches and visual disturbances**

Unstable pre-eclampsia

Women with pre-eclampsia who have worsening pre-eclampsia blood results and severe hypertension not controlled by antihypertensive medication. Also known as fulminating pre-eclampsia (MOH, 2018).

HELLP syndrome

A variant of severe pre-eclampsia (elements include **H**aemolysis, **E**levated **L**iver enzymes and **L**ow **P**latelet count). In a woman with pre-eclampsia, the presence of any of the following is an indicator of HELLP:

- Maternal platelet count of less than 100 x 10^9/L
- Elevated transaminases (elevated blood concentrations of liver enzymes to twice normal concentration)
- Microangiopathic haemolytic anaemia with red cell fragments on blood film

Eclampsia

New onset of seizures in association with pre-eclampsia. It is a severe manifestation of pre-eclampsia and can occur before, during or after birth. It can be the presenting feature of pre-eclampsia in some women (MOH, 2018).

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4. Summary table - management

Problem	Recommended Action
Background hypertension or previous PET	• Review cause and effect • Refer MFM if severe hypertension or previous early onset pre-eclampsia ≤ 30 weeks • Consider prophylaxis with aspirin/calcium • Coordinate more frequent antenatal reviews • Regular fetal growth assessment (monthly if uncomplicated, more frequently if additional clinical concerns)
Antenatal Hypertension	• Review cause and effect • Consider treatment if SBP ≥ 140 mmHg – 160 mmHg OR DBP ≥ 95mmHg – 100 mmHg consistently • Discuss case with obstetric senior clinical staff member (Obstetrician +/- Physician) and MFM as appropriate (especially if ≤ 30 weeks)
Hypertension in Labour	• Review cause and effect • Treat if SBP ≥ 160 mmHg OR DBP ≥ 100 mmHg on two occasions, 15 minutes apart • See Hypertension in Labour - Management for recommended medications • Consider use of epidural to reduce pain associated hypertension • Consider use of magnesium sulfate (see Associated documents section below for guideline) • Discuss with obstetric senior clinical staff member (Obstetrician +/- Physician) and MFM as appropriate (especially if ≤ 30 weeks)
Post natal hypertension	• Review cause and effect • Treat if SBP ≥ 160 mmHg and or DBP ≥ 100 mmHg consistently • Treat if SBP ≥ 170 mmHg, DBP ≥ 110 mmHg consistently • Discuss case with senior clinical staff member and MFM if additional concerns
Eclampsia	• Use ABCD for immediate resuscitation • Blood pressure (BP) control primary importance if severe • Magnesium sulfate to prevent further eclamptic seizures • See Associated documents section below for magnesium sulfate guideline • Seek advice, support and High Dependency Unit (HDU/maternity complex care setting) care (see below) • Recommended total fluid rate = 80 mL/hour

5. Pre-pregnancy and early pregnancy care

Hypertension arising before pregnancy or detected in the first 20 weeks of pregnancy implies long-standing or chronic hypertension (MOH, 2018). The majority of these women have essential hypertension with no underlying renal or adrenal cause however should be referred for medical opinion early in pregnancy. Very rarely pre-eclampsia may present before 20 weeks often in the context of an abnormal fetus/baby or severe maternal disease and usually with abnormal indices of utero placental circulation (Parrott *et al*., 2017).

5.1 Management of chronic hypertension

Other causes of chronic hypertension should always be considered (e.g. renal disease, phaeochromocytoma, Cushing's syndrome, Conn's syndrome or coarctation of aorta) (Lowe *et al*., 2014).

Hypertension should ideally be controlled *before* conception. Specific consideration should be given to the choice of anti-hypertensive in women who may become pregnant. For those women with complicated pre-existing hypertension (including those on more than one antihypertensive agent), we would recommend preconception referral for obstetric physician review and discussion.

It seems reasonable for non-pregnant women already on ACE inhibitors to continue treatment, especially in those on treatment for specific indications (i.e. diabetic nephropathy). However, they should be provided with specific instructions to discuss switching to an alternative antihypertensive with her specialist when pregnancy is anticipated (see Table 3), or to stop treatment and attend for medical review as soon as pregnancy is suspected (MOH, 2018).

ACE inhibitors are contraindicated in pregnancy as their use in the second and third trimesters have been associated with oligohydramnios, renal failure, bony malformations and prolonged hypotension (MOH, 2018).

5.2 Prediction and prevention of pre-eclampsia

5.2.1 Prediction

As part of a comprehensive health assessment at booking, all women should be reviewed for the risk factors for pre-eclampsia (Table 1). This will help to appropriately identify the most at-risk women. Women who have a major risk factor (MRF) have an approximate 20% risk of developing pre-eclampsia and should be considered as high risk (MOH, 2018).

Table 1: Increased risk of developing pre-eclampsia if a woman has pre-existing risk factors (MOH, 2018):

Pre-existing Risk Factor	Relative risk/Odds Ratio[95% CI	Notes
Antiphospholipid antibody/SLE	9.72 [4.34,21.75]	**MRF**
Previous history of pre-eclampsia	7.19 [5.85,8.83]	**MRF**
ART (oocyte donation)	4.34 [3.10, 6.06]	**MRF**
Renal disease	4.07 [2.17, 7.66]	**MRF**
Chronic hypertension	3.60 [2.0, 6.6]	**MRF**

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Pre-existing Risk Factor	Relative risk/Odds Ratio[95% CI	Notes
Previous history of HELLP	3.70 [0.9, 16.1]	**MRF**
Pre-existing diabetes	3.56 [2.54,4.99]	**MRF**
Genetic ancestry African Indian Māori Pacific	 2.97 [1.98, 4.4] 2.66 [1.29, 5.48] 1.51 [1.16, 1.96] 1.21 [0.99, 4.57]	
Nulliparity	2.91 [1.28, 6.61]	
Multiple pregnancy	2.93 [2.04, 4.21]	
Family history of pre-eclampsia (father of baby)	2.10 [1.0, 4.3]	
Change in partner	2.50 [1.8, 3.5]	
Elevated BMI > 35 (early pre-pregnancy)	2.47 [1.66, 3.67]	
Maternal age ≥ 40 (multiparous)	1.96 [1.34, 2.87]	
Maternal age ≥ 40 (primiparous)	1.68 [1.23, 2.29]	
Pregnancy interval >10 years	1.83 [1.72, 1.94]	
ART (sperm donation)	2.50 [1.8, 3.5]	
Diastolic BP ≥ 80 mmHg at booking	1.38 [1.01, 1.87]	
Any ART	1.17 [1.10-1.24]	

Low dose aspirin (LDA)

Prophylactic LDA use in pregnancy should be considered in women with an increased risk of pre-eclampsia. Low Dose Aspirin (LDA) of 100mg taken in the evening or at bedtime is indicated in women at high-risk of developing pre-eclampsia (MOH, 2018, Ayala *et al.,* 2013, Meher *et al.,* 2017).

Timing of aspirin: Evidence demonstrates LDA commencement between 12-16 weeks has a significant risk reduction for pre-eclampsia (MOH, 2018, Roberge *et al.*, 2017, Tong *et al.,* 2017). LDA demonstrates a 17% risk reduction in pre-eclampsia, 8% reduction in the risk of pre-term birth and 10% reduction of SGA (MOH, 2018).

Discontinuation of aspirin: There is limited evidence to guide practice in regards to the optimal gestation to discontinue aspirin, however the use of LDA in many studies is until 36 weeks (Roberge *et al.*, 2017).

A recent meta-analysis is reassuring that there is no increased risk of abruption or antepartum haemorrhage with LDA started before 16 weeks and at a dose of at least 100mg daily, however gestation at discontinuation was not reported (Roberge *et al.*, 2017).

If a woman presents for review > 16 weeks ("late booker" for example)

Although the optimal timing throughout literature is for commencement of aspirin between 12-16 weeks, there is evidence suggesting that there are benefits of commencing aspirin > 16 weeks (Meher *et al*, 2017; Tong *et al.,* 2017).

Note: There is some evidence that the optimal effectiveness of LDA occurs if taken at night (Ayala et al., 2013).

Calcium

Calcium supplementation in conjunction with dietary advice* should be offered to women at high risk of pre-eclampsia to achieve 1g elemental calcium per day (MOH, 2018).

Calcium carbonate 1.25g contains 500 mg of elemental calcium - two tablets daily are necessary to provide the recommended amount of elemental calcium.

Timing of calcium: Ideally commencing from booking until birth.

***Dietary advice/practical advice (MoH 2006):**

- Pregnant women should eat at least three servings of calcium-rich foods such as milk, cheese and yoghurt every day to ensure an adequate intake of calcium.
- Women who avoid milk and milk products need to maintain adequate intakes by eating non-dairy sources of calcium, such as calcium-fortified soy milk, canned fish (with bones), nuts, green leafy vegetables, dried fruit, tofu, and wholegrain breads and cereals.

6. What to do before developing an antenatal care plan

Identify the presence of any MRF (refer to Table 1) that predispose women in a given pregnancy to pre-eclampsia.

7. What to do after the risk assessment

Offer women a referral before 20 weeks for specialist input to their antenatal care plan if they have one of the MRF (refer to Table 1).

7.1 Doppler studies

Where possible, women with a major risk factor (MRF) for pre-eclampsia should have uterine artery Doppler studies performed at their 20-week anatomy scan. The result of this assessment can be used to plan the schedule for serial growth assessment (MOH, 2018).

7.2 Severe or atypical disease

For advice on the management of women with a history of particularly severe or atypical disease, contact the MFM consultant or an obstetric physician. Women with a history of severe pre-eclampsia (complicated or leading to delivery before 32 weeks) should be referred to MFM consultant care in the first trimester and have at least fortnightly BP and urine checks after 20 weeks. Each woman engaged in MFM clinic should be informed verbally and given written information about the symptoms and signs of pre-eclampsia and the reasons why BP and urine are checked.

8. General antenatal care

8.1 Patient information

Each woman should be informed verbally and given written information by her lead maternity carer (LMC) at booking about the symptoms and signs of pre-eclampsia and the reasons why BP and urine are checked at each visit.

8.2 Maternal fetal medicine referral

Please see associated documents for referral

8.3 Taking the blood pressure

It is recommended that automated blood pressure values should be compared with conventional sphygmomanometery at admission or at the beginning of treatment.

8.4 Day Assessment Unit (DAU)

Referral to the DAU for further assessment and investigation should be considered when there is a suspected hypertensive disorder of pregnancy, and there is a need for visits outside the weekly clinic setting. DAU is open 5 days a week and is established for women to improve continuity of care, improve psychological wellbeing, reduce disruption to family life and reduce inpatient stays. This model of care has been proven to be successful and safe and may improve outcomes for the woman. When referring to DAU please use the referral form in the clinical areas and ensure a member of the clinical team has been identified who is contactable and will be responsible for the care on DAU.

8.5 Admission - Day Assessment Unit

Please see the Associated documents.

8.6 Inpatient admission

Criteria for recommending inpatient admission for assessment include:

- Symptoms of headaches, visual disturbance or epigastric pain
- Proteinuria (PCR ≥ 30 mg/mmol on a spot urine sample or ≥ 2+ on dipstick testing confirmed by a PCR) with hypertension
- SBP ≥ 160 mmHg and or DBP > 100 mmHg
- Abnormal blood results:
  - Falling or low platelets < 150 x 10^9/L, raised creatinine (abnormal if > 90 µmol/L)
  - Raised ALT, AST (at least twice the upper limit of normal range ± right upper quadrant or epigastric abdominal pain. **Note:** normal ranges are: ALT 0-30 u/L and AST 10-50 u/L)
- Antepartum haemorrhage
- Reduced fetal movements
- Uterine activity

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8.7 Outpatient care

Women with pre-eclampsia should be managed as inpatients. Consideration should be given to re-assessing thromboembolic risk when admitted for in-patient care. Thromboembolic stockings (TEDs) are strongly recommended and low molecular weight heparin (LMWH) should also be considered. Some women at lower risk may be suited to outpatient care and care should be individualised in consultation with a Senior Medical Officer (SMO) (obstetrics or obstetric medicine).

8.8 Bed rest

For mild hypertension in pregnancy, bed rest in a home or hospital setting has not been shown to be beneficial and may be harmful, potentially increasing the risk of venous thromboembolism.

Delivery should be in a secondary or tertiary unit

8.9 Severe hypertension detected outside of hospital setting

Women detected with severe pre-eclampsia or with severe hypertension outside the hospital setting require urgent admission to hospital (accompanied by a doctor or midwife) (MOH, 2018). It is important to discuss the admission with the SMO on-call for obstetrics and obstetric medicine.

9. Antenatal management of chronic hypertension

Normal BP profile in pregnancy

BP decreases in normal pregnancy, reaching its lowest at 20 weeks before rising to pre-pregnant levels or slightly higher at term. Similar changes are often seen in chronic hypertension and therefore anti-hypertensive therapy may need to be reduced or discontinued in early pregnancy.

Threshold for treatment

Anti-hypertensive therapy for mild chronic hypertension decreases the incidence of severe hypertension, but the impact on perinatal outcomes is unclear.

- Anti-hypertensive drugs may be initiated or increased when the BP is consistently above:
  SBP ≥ 140mmHg –160 mmHg and or **DBP ≥ 95 mmHg-100 mmHg**

- Treatment targets should be individualised. However, in general treatment target recommendations are (Lowe *et al.,* 2014, MOH, 2018):
  SBP 130 mmHg -150 mmHg and **DBP 90mm Hg – 100 mmHg**

Medications

A number of drugs have demonstrated efficacy and safety. Treatment options are the same as those used for treating gestational hypertension, which include labetalol, sustained-release nifedipine and methyldopa (Lowe *et al.,* 2014, MOH, 2018) - see Table 3.

ACE inhibitors, diuretics and atenolol should be avoided during pregnancy due to their associated fetal side-effects (MOH, 2018). If conception occurs whilst on ACE inhibitors, diuretics or atenolol, anti-hypertensive therapy should be medically reviewed as soon as possible. Methlydopa is usually recommended in pregnancy and it has a sound pregnancy safety history (MOH, 2018).

Discussion with MFM/obstetric physician, including consideration of a MFM clinic review is usually indicated.

Super-imposed pre-eclampsia

Women with chronic hypertension are at increased risk of super-imposed pre-eclampsia and require careful assessment if there is an apparent rise in BP or the development of proteinuria (MOH, 2018).

10. Antenatal monitoring and assessment for pre-eclampsia

Several points to emphasise:

- Pre-eclampsia is a multisystem disease, where each end organ (e.g. blood vessels, kidney, CNS, liver, clotting system and placenta) may be affected to a greater or lesser extent. Careful assessment of each end organ is essential for optimal management.
- Severe pre-eclampsia and eclampsia are life-threatening conditions; the labour and birthing suite (LBS) registrar on call should always inform and involve SMO on-call (+/- obstetric physician) and the anaesthetist. A management plan should be made and written in the patient's clinical record. The duty paediatrician should also be informed if preterm delivery is expected.
- Pre-eclampsia progresses at different rates in different cases; occasionally the rate of progress can be remarkably rapid. Eclampsia rarely occurs without premonitory symptoms (e.g. severe headache, visual disturbance, epigastric pain) and symptoms should always be taken seriously.
- Hypertension is a treatable manifestation of pre-eclampsia. Reducing high blood pressure will not alter the underlying progression of the disease although in the short term it may reduce the risk of eclampsia and a cerebrovascular accident.
- The LBS registrar on call must be informed if any woman has SBP ≥ 160 mmHg OR DBP ≥ 110 mmHg, which has not fallen below these levels on rechecking 20 minutes later (MOH, 2018).

  Note: a BP within the parameters of SBP ≥ 160 mmHg OR DBP ≥ 110 mmHg will activate a Maternity Early Warning Score (MEWS) escalation pathway requiring a Team Registrar review within 20 minutes and a PaR (Patient at Risk) team review within 30 minutes. A SBP ≥ 200 mmHg will activate a 777 code (obstetric emergency and adult code Red and SMO input from obstetrics and obstetric medicine).
- The LBS registrar on call will be responsible for instituting appropriate antihypertensive treatment, with supervision from the relevant SMO (see Acute Management of Hypertension below).

Women whose condition is difficult to control, or who may have renal or hepatic involvement should be discussed urgently with the on-call SMO for obstetrics and obstetric medicine.

Forty percent (40%) of eclamptic seizures occur after delivery thus, post-natal vigilance is essential, although the disease will resolve spontaneously in all but a few cases.

Note: Eclampsia can occasionally occur in the absence of hypertension or proteinuria.

10.1 Assessment, physical signs and monitoring

These should be documented in the patient's clinical record. The development of hepatic tenderness, hyperreflexia ± clonus, breathing difficulties, abdominal pain, antepartum haemorrhage or altered fetal movements are an indication for urgent senior physician review.

Daily assessment of maternal and fetal condition is required at registrar level or above to determine that conservative management, rather than delivery, is safe and can be continued.

Assessment should include systematic review for symptoms and signs that indicate severe pre-eclampsia including:

- Persistent severe hypertension (SBP ≥ 160 mmHg **OR** DBP ≥ 110 mmHg)
- Oliguria less than 80 mL/4 hours
- Oliguria less than 500 mL/24 hours
- Serum creatinine > 90 µmol/L
- Signs of neurological involvement (persistent headache, visual disturbance, hyperreflexia with clonus)
- Pulmonary oedema
- Liver dysfunction (abdominal pain with abnormal LFTs)
- Haematological involvement (thrombocytopenia < 100 x 10^9/L or falling platelets, disseminated intravascular coagulopathy (DIC)
- Assessment should also include systematic review of the fetus including:
    - Fetal wellbeing (movements, cardiotocography (CTG), ultrasound and Doppler assessments)
    - Signs of placental abruption (vaginal bleeding, uterine contractions or irritability, abdominal discomfort or pain)

10.2 Maternal monitoring (refer to Table 2)

Recommended standards for inpatient maternal monitoring include (MOH, 2018):

- 4-6 hourly BP (except overnight when an interval of 8 hours is acceptable, provided the BP is < 160/100 mmHg on retiring)
- Twice weekly full blood count (including haemoglobin, platelet count), creatinine, liver function tests (albumin, ALT and AST)
- Coagulation studies should be performed if falling platelets (< 100 x 10^9/L) or abnormal liver tests or concern about possible placental abruption
- Laboratory investigations should be repeated more often if there are concerns about either the maternal or fetal condition

Fluid balance

Women with pre-eclampsia are generally hypovolaemic but their tissues are fluid overloaded. Specific attention should be paid to fluid balance, which should be closely monitored if there are concerns about rapidly accumulating oedema, rapidly increasing proteinuria, reduced urine output or rising creatinine.

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10.3 Fetal assessment

As a minimum, include fortnightly:

- Growth measurements
- Amniotic fluid volume estimates
- Umbilical artery Doppler studies

More frequent ultrasound assessment including Doppler studies may be required especially in severe or complicated disease progression.

Umbilical artery Doppler

The frequency of umbilical artery doppler studies and liquor volume assessment may need to be increased if either are abnormal or in the presence of intrauterine growth restriction (IUGR) (abdominal circumference (AC) < 10% or estimated fetal weight (EFW) < 10% on customised charts or reduced growth rate). Consider discussion with MFM if there are additional concerns.

Cardiotocography (CTG) monitoring

Inpatient daily CTGs are recommended for all fetuses considered viable and not usually indicated before 25 weeks. The timing of 'viability' at early gestations can be very complex and should ideally involve a multidisciplinary approach and include careful discussion with the parents by the obstetric and neonatology team. You may wish to consult with the MFM team for guidance.

Neonatal Review

Referral for expert neonatal opinion should always be considered, and is critical when imminent pre-term birth is likely. Ideally, referral would be made at a consultant/specialist level. The on-call neonatal specialist can be contacted via switchboard.

10.4 Table 2 – Summary table: Monitoring for women with hypertensive disorders (adapted from MOH, 2018)

Treatment of Hypertension in Pregnancy Summary						
Pre-existing/chronic	**Gestational hypertension**	**Pre-eclampsia with expectant management (hospital inpatient)**	**Severe unstable pre-eclampsia/ eclampsia (MCCA like setting)**	**Magnesium sulfate monitoring (MCCA like setting)**	**Intrapartum pre-clampsia/ eclampsia**	**Postpartum**
BP Monitoring						
Consider more frequent **blood pressure measurements and appointments** than normal if for pregnant women who have any of the risk factors and unstable pre-eclampsia; individualise the decision to the woman	Blood pressure 1-2 times/week	4-6 hourly blood pressure (except overnight when an interval of 8 hours may be acceptable at discretion of parent team if <150/90 mmHg on retiring)	One-on-one care **Blood pressure** at least hourly**,** respiratory rate, oxygen saturation	One-on-one care **Blood pressure** every 5 minutes during loading dose then hourly during maintenance dose	**Blood pressure** at least hourly	4-6 hourly blood pressure (except overnight when an interval of 8 hours is acceptable while inpatient) After discharge, **blood pressure** daily for first 7 days, then weekly up to 6 weeks postpartum

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Pre-existing/chronic	Gestational hypertension	Pre-eclampsia with expectant management (hospital inpatient)	Severe unstable pre-eclampsia/ eclampsia (MCCA like setting)	Magnesium sulfate monitoring (MCCA like setting)	Intrapartum pre-eclampsia/ eclampsia	Postpartum
Testing						
Identify risk factors	**Urinalysis testing for proteinuria** at least weekly[a] Pre-eclampsia bloods if sudden increase in BP or new proteinuria Pre-eclampsia bloods = full blood count (including haemoglobin, platelet count), creatinine, electrolytes, liver function tests (albumin, ALT and AST), urate	Twice weekly **pre-eclampsia bloods** Perform **coagulation studies** if liver tests are abnormal or you have concerns about possible placental abruption Repeat **laboratory investigations** more often if you have concerns about the condition of either mother or fetus	At least daily **pre-eclampsia bloods** Perform **coagulation studies** if liver tests are abnormal or you have concerns about possible placental abruption Repeat **laboratory investigations** more often if you have concerns about the condition of either mother or fetus	At least daily **pre-eclampsia bloods** Perform **coagulation studies** if liver tests are abnormal or you have concerns about possible placental abruption Repeat **laboratory investigations** more often if you have concerns about the condition of either mother or fetus Consider magnesium levels as per guideline	Pre-eclampsia bloods at start of IOL, on admission to L+BS, then as advised by the obstetric or anaesthetic team FBC should be taken within 6 hours of epidural insertion and removal, and an APTT + PT if platelet count <100 x10^9/L	Monitor for **all signs** of pre-eclampsia (**including pre-eclampsia bloods)** returning to normal but beware of postpartum deterioration and eclampsia

a. Urinalysis by dipstick followed by spot urine PCR if ≥2+ proteinuria. Once significant proteinuria has been detected, there is no established role for serial testing.

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Pre-existing/chronic	Gestational hypertension	Pre-eclampsia with expectant management (hospital inpatient)	Severe unstable pre-eclampsia/ eclampsia (MCCA like setting)	Magnesium sulfate monitoring (MCCA like setting)	Intrapartum pre-eclampsia/ eclampsia	Postpartum
Fetal Assessment						
Ongoing fetal assessment[b] for growth. If IUGR detected follow the SGA pathway	Fetal assessment at time of diagnosis. Do not repeat USS in <2 weeks, unless fetal indications[b] Changes in fetal movements, other signs/symptoms of pre-eclampsia. Woman advised to assess daily and her maternity carers assess when they see her	**Cardiotocography (CTG)** daily once 26 weeks gestation if inpatient. Decision for CTG at 24-25^{+6} gestation requires full discussion with obstetric and neonatal teams regarding resuscitation attempts	**Cardiotocography (CTG)** daily	Continuous **cardiotocography**	Continuous **cardiotocography**	N/A

b. Fetal assessment with ultrasound for early dating and fetal growth at the time of diagnosis, and repeat if suspected growth restriction on clinical assessment by LMC. Umbilical artery velocimetry and cardiotocography only if fetal growth restriction or distress is suspected. C. Educate the woman around the need to contact her LMC urgently if she experiences symptoms of pre-eclampsia/eclampsia or any changes in fetal movements. ALT = alanine aminotransferase, AST = aspartate aminotransferase, BP = blood pressure, IUGR = intrauterine growth restriction, SGS = small for gestational age, Sp02 = peripheral capillary oxygen saturation, USS = ultrasound scan

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Pre-existing/chronic	Gestational hypertension	Pre-eclampsia with expectant management (hospital inpatient)	Severe unstable pre-eclampsia/ eclampsia (MCCA like setting)	Magnesium sulfate monitoring (MCCA like setting)	Intrapartum pre-eclampsia/ eclampsia	Postpartum
Fluid Balance						
			Fluid restriction 80-85 mL/hour total fluid for severe pre-eclampsia **Fluid balance chart**	**Fluid restriction** 80-85 mL/hour total fluid for severe pre-eclampsia **Fluid balance chart**	**Fluid restriction** (replace loss at birth and then 80-85mL/hour total fluid for severe pre-eclampsia. This may require **Fluid balance chart**	

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Pre-existing/chronic	Gestational hypertension	Pre-eclampsia with expectant management (hospital inpatient)	Severe unstable pre-eclampsia/ eclampsia (MCCA like setting)	Magnesium sulfate monitoring (MCCA like setting)	Intrapartum pre-eclampsia/ eclampsia	Postpartum
Special Considerations						
		Symptoms of labour (presence of contractions, rupture of membranes, abdominal pain, bleeding) **Symptoms of severe pre-eclampsia** (headache, visual changes, shortness of breath, epigastric pain, retrosternal pressure/pain, nausea, vomiting, hyperreflexia)	**Symptoms of labour** (presence of contractions, rupture of membranes, abdominal pain, bleeding)	**Toxicity Monitoring** **Respiratory rate/Sp02** hourly **Patella reflexes** hourly **Urine output** (>100mL per 4 hour epoch)		If magnesium sulfate started ante/intrapartum, continue 24 – 48 hours. Recommend women who have had pre-eclampsia **stay in secondary or tertiary facility** for at least 72 hours postpartum. Base the decision for discharge timing on the individual woman and on whether satisfactory monitoring and follow-up care arrangements have been made

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11. Antenatal therapy in pre-eclampsia and hypertension

Disease progression
It should be stressed that anti-hypertensive therapy **does not prevent** the progression of the underlying disease process and close maternal and fetal surveillance should be continued.

Corticosteroids
Steroids should be considered for all women ≤ 34^{+6} weeks gestation. Refer to Auckland DHB guideline: *Antenatal Corticosteroids to Improve Neonatal Outcomes*.

Magnesium sulfate for fetal neuroprotection
Magnesium sulfate should be considered when a decision to deliver at less than 30 weeks gestation is made (MOH, 2018). Refer to Auckland DHB guideline: *Magnesium Sulfate for Pre-eclampsia and for Neuroprotection in Pre-term Births < 30^{+0} Weeks*

Anti-hypertensive therapy (refer to Table 3)

- Anti-hypertensive therapy should be considered if:
  SBP consistently ≥ 140mmHg –160 mmHg OR **DBP consistently ≥ 95mmHg – 100 mmHg** (MOH, 2018)
- Always give anti-hypertensive therapy if:
  SBP > 160 mmHg OR **DBP > 100 mmHg** at *any one time* (MOH, 2018)

Table 3 – Antihypertensive Treatment in Pregnancy
(adapted from MOH, 2018 and Lowe *et al*, 2014)

Drug	Dose	Action	Contra-indications	Practice Points
Methyldopa	250mg po TDS (up to 750mg po TDS)	Central	Depression	• Slow onset of action over 24 hours • Adverse Effects: dry mouth, sedation, depression, blurred vision • Withdrawal effects: rebound hypertension
Labetalol	100mg po BD (up to -400mg po Q8H)	ß-blocker (with mild α-vasodilator-effect)	Asthma, chronic airways limitation	• Adverse Effects: bradycardia, bronchospasm, headache, nausea, scalp tingling (which usually resolves within 24-48 hours)
Nifedipine (sustained release)	20mg po BD *or* 30-60mg po DAILY (Maximum 60mg/BD)	Calcium channel blocker	Aortic stenosis	• Can be added as 2nd line agent to labetalol or methyldopa • Sublingual nifedipine is not recommended in any instance for BP reduction • Immediate release formulation is not recommended for long-term treatment • Adverse Effects: severe headache, peripheral oedema, constipation

The medications in Table 3 have been listed in order of international experience and extent of published safety data). There is no clear evidence that one particular medicine is better than any other and evidence shows no significant differential effects (MOH, 2018). The choice of anti-hypertensive should depend on the experience and familiarity of the individual clinician and should include current knowledge of adverse maternal and fetal adverse effects (MOH, 2018).

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The Auckland DHB supports the "Anti-BP's in Preeclampsia Study" which investigates the endothelial activation in an attempt to answer the questions as to which medication is better for treatment.

12. Timing of birth

The timing of birth will usually be decided by a specialist obstetric consultant. Pre-eclampsia on its own is not an indication for caesarean delivery.

Consideration should be given to the usual obstetric parameters of achieving safe vaginal birth within a reasonable time. Epidural analgesia for women with pre-eclampsia is generally recommended as long as there is no coagulopathy.

Note: stabilisation of the maternal condition first will lead to a safer birth by whatever route.

a) For non-severe hypertensive disorders (includes chronic hypertension, gestational hypertension and stable pre-eclampsia in the absence of severe features)

Maternal outcome is improved by planned birth; however, there may be benefit of avoiding birth prior to 37 weeks to improve neonatal outcomes (MOH, 2018).

b) Early onset and/or severe pre-eclampsia - less than 30 weeks gestation or pre-eclampsia complicated by disseminated intravascular coagulopathy (DIC), haemolysis, elevated liver enzymes & low platelet count (HELLP) or multisystem derangement.

The decision around timing of birth should be individualised. There may be benefit in avoiding birth before 34 weeks to improve neonatal outcomes (MOH, 2018).

A discussion with and referral to MFM/obstetric physician is strongly recommended.

All women with early onset severe pre-eclampsia or complicated disease should have careful postnatal follow up and review after hospital discharge. We recommend this should be by the obstetric physicians and/or MFM team. At this time, a plan should be made for any future pregnancies and recommended on-going general health follow-up.

c) Peri or pre-viability

Manage in consultation with MFM and neonatal team.

If indication for delivery presents, administer corticosteroids and if <30 weeks, magnesium sulfate protocol for fetal neuroprotection.

Refer to Auckland DHB guidelines (in Associated documents):

- *Antenatal Corticosteroids To Improve Neonatal Outcomes*
- *Magnesium Sulfate for Pre-eclampsia and for Neuroprotection in Pre-term Births < 30 Weeks*

d) For women with HELLP or eclampsia

Seizures

All cases of unexpected seizures in pregnant women should be assumed to be eclampsia until proven otherwise (need to exclude other acute neurological causes, e.g. subarachnoid haemorrhage).

The mother should be stabilised and transferred to the High Dependency Unit (HDU/maternity complex care setting).

Magnesium sulfate IV should be given for prevention of recurrent seizures (MOH, 2018).
See Associated documents for magnesium sulfate guideline.

Any gestational age: Recommend delivery after stabilising woman, administer corticosteroids (if ≤34^{+6}) (MOH, 2018).

Eclamptic seizure is not an indication for immediate delivery.

13. Management in labour (refer to Table 2)

Investigations

- Full blood count (FBC)
- Coagulation screen - if platelets falling rapidly or (< 100 x 10^9/L or signs of haemolysis, and/or abnormal liver functions)
- Creatinine (abnormal if > 90 µmol/L)
- Serum ALT and AST

Threshold for treatment

Treatment should be individualised however, the previously discussed levels of BP are reasonable to use in labour (SBP 140 mmHg – 160mmHg OR DBP 95 mmHg – 100mmHg). Treatment options are outlined in section Acute Management of Hypertension.

Overall management

Early transfer to a tertiary centre is recommended for women with early onset or severe pre-eclampsia to avoid the adverse outcomes associated with the transfer of a critically ill mother or preterm neonate.

In severe hypertension (**SBP ≥ 160 mmHg** OR **DBP ≥ 110 mmHg**) anti-hypertensive therapy is urgently required to reduce the risk of maternal intracerebral haemorrhage (see Tables 4 and 5).

Senior clinicians should be involved directly in managing the mother and transfer to a HDU/maternity complex care setting, or an area with 1:1 midwifery or nursing care is strongly recommended. Fetal monitoring throughout is strongly recommended. However, the maternal condition must be stabilised before transfer.

Anaesthetic involvement

The senior anaesthetist on call for labour and birthing suite should be involved early in the management plan and process.

Fluid management and urinary output

Whilst pre-eclampsia, and especially severe pre-eclampsia, is a condition with reduced intravascular volume the associated endothelial dysfunction means that fluid typically leaks more quickly from the vascular space into surrounding tissue and compartments (dependent oedema, ascites, pulmonary oedema, pleural and pericardial effusions, cerebral oedema etc).

Because of this, it is essential that strict attention is paid to fluid balance. Usually these women are managed with the fluid restriction (typically 80 mL/hour) though limited fluid challenges may be indicated in exceptional circumstances.

Urinary output

This should be measured on an hourly basis however, it is reasonable to use a definition of oliguria of < 80 mL/4 hours before intervention is considered especially fluid challenges in the oedematous mother.

Mildly elevated serum creatinine is a reflection of the depleted intravascular volume and renal involvement. In nearly all cases, the apparent renal impairment will reverse completely after delivery as pre-eclampsia resolves.

Communication and follow up

Inform the Lead Maternity Carer (LMC) of any woman who has been admitted with severe pre-eclampsia before she is discharged. Postnatal follow-up should be arranged in the appropriate clinic, particularly for women with either early onset (less than 30 weeks) complicated pre-eclampsia or persistent hypertension. There should be a comprehensive discharge summary indicating the need for ongoing follow-up for long-term cardiovascular risk.

14. Acute management of Severe Hypertension (refer to Table 4 and Table 5)

If severe hypertension (**SBP ≥ 160 mmHg** or **DBP ≥ 110 mmHg**) exists for longer than 20 minutes, these women should have urgent medical review. It is recommended that the acute management of these women is directly supervised by a registrar or more senior clinician.

Note: *BP within the parameters of SBP ≥ 160 mmHg OR DBP ≥ 110 mmHg will activate a MEWS escalation pathway requiring a Team Registrar review within 20 minutes and a PaR (Patient at Risk) team review within 30 minutes. A SBP ≥ 200 mmHg will activate a 777 code (obstetric emergency and adult code Red and SMO input).*

Management should commence immediately on the ward pending transfer to HDU/maternity complex care setting. Consider magnesium sulfate administration (see guideline and associated document *Magnesium Sulfate for Pre-eclampsia and for Neuroprotection in Pre-Term Births < 30^{+0}Weeks)*

If severe hypertension is sustained for **more than 30 minutes** or **BP ≥ 160/110 mmHg at any time**, acute treatment is required (see Table 4 below) with the aim of lowering blood pressure to the following ranges (MOH, 2018):

- Diastolic BP: 80-100 mmHg
- Systolic BP: 130-150 mmHg

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Table 4 - Acute blood pressure lowering for severe hypertension
(adapted from MOH, 2018 and Lowe *et al*., 2014):

Drug	Dose	Route	Onset of Action	Practice Points
Nifedipine	10mg Repeat after 30-45 minutes if required Max 80 mg/day	Oral	30-45 minutes	• Use 5 mg immediate release capsules (NOT sublingual or sustained-release tablets) • Once target BP achieved, consider changing to slow-release tablets for long-term management
Labetalol	200 mg Repeat after 30 minutes if required	Oral	30 minutes	• Oral therapy can be given while obtaining IV access • Contraindicated in patients with history of steroid-dependent asthma or obstructive airways disease
	20mg Repeat with 40-80 mg every 5-10 minutes if required Max 300 mg/day	IV bolus (over 2 minutes)	5 minutes	
Hydralazine*	5-10 mg (5 mg if fetal compromise) Repeat every 20 minutes if required. Max 30mg/day	IV bolus (over 3-10 minutes)	20 minutes	• Effect on BP less predictable than with IV labetalol

* IV hydralazine has been associated with precipitous falls in BP, which may cause fetal distress by impairing placental perfusion. Consider whether a bolus of IV fluids is indicated before or when administering first dose (Lowe *et al.* 2014).

Persistent or refractory severe hypertension may require repeated doses of the above agents. If blood pressure is not adequately controlled (e.g. after 4 bolus doses), a continuous infusion of labetalol or hydralazine may be required (Lowe *et al.,* 2014). See **Table 5** below.

Table 5 – Continuous IV infusion for refractory severe hypertension
(adapted from McClintock *et al*., 2015 and Lowe *et al*., 2014):

Drug	Dose	Practice Points
Labetalol	20 mg/hour Can be doubled every 30 minutes until target BP achieved (up to maximum of 160 mg/hour)	• Max cumulative dose 300 mg (including bolus doses) • Discontinue by weaning over 1-2 hours when BP is consistently <155/85 mmHg
Hydralazine	Initially: 200-300 micrograms/minute Rate reduce when adequate response achieved. Usual maintenance: 50 – 150 micrograms/minute	• If >100 mg/day is required, the patient's acetylator status should be evaluated (may provoke an SLE-like syndrome)

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15. Anaesthesia and analgesia for women with pre-eclampsia and hypertension

All women with hypertensive disorder of pregnancy (HDP) should have a platelet count performed on admission to delivery suite.

Severe pre-eclampsia is not a contraindication to epidural analgesia providing the platelet count is > 100 x 10^9/L (within 6 hours of epidural insertion) (MOH, 2018).

If the platelet count is < 100 x 10^9/L a coagulation screen should be sent.

Hypovolemia is part of the pathophysiology of pre-eclampsia, and careful attention to fluid balance is mandatory, particularly with epidural analgesia.

Fluid pre-loading is not routinely recommended prior to epidural insertion (MOH, 2018).

In women with fulminating pre-eclampsia, the platelet count may drop rapidly and needs rechecking prior to insertion of an epidural.

Epidural analgesia is useful to reduce the hypertensive response to painful contractions and provides a means for rapid conversion to epidural anaesthesia suitable for surgery if required. Adequate control of blood pressure prior to operative intervention is essential for optimal maternal safety.

Adequate precautions to obtund the pressor response to laryngoscopy should be taken in the event of general anaesthesia being required (MOH, 2018).

16. Criteria for transfer to Department of Critical Care Medicine (DCCM)

- Persisting seizures
- BP remains uncontrolled despite appropriate doses of labetalol/nifedipine/hydralazine
- Pulmonary oedema requiring additional respiratory support
- Acute Kidney Injury (AKI) requiring hemofiltration
- Compromised myocardial function
- Neurological impairment requiring ventilation
- Other complicating co-morbidities

Women, who do not meet the above criteria, may still need to be transferred to DCCM if appropriate level of care is unable to be provided in the maternity setting.

We recommend early discussion with the relevant clinicians, including the Patient at Risk (PaR) team and the critical care team about the clinical condition of women who may need advanced resuscitation or possible transfer.

17. Postpartum management

17.1 Epidural removal

A platelet count should be checked prior to epidural removal (within 6 hours). If the platelet count is < 100 x 10^9/L a coagulation screen should be sent and the pain team should be consulted for a plan for removal.

17.2 Disease progress and treatment

In the immediate postpartum period women who have pre-eclampsia should continue to be monitored for disease resolution. Women who develop multisystem complications prior to delivery may deteriorate further in the first 48 - 72 hours post partum. Forty percent of eclampsia occurs post-partum.

There is a physiological rise in BP after delivery and treatment instigated before delivery should probably continue for a minimum of 3 - 4 days. In general, we recommend that women with hypertensive disorders in pregnancy (HDP) remain in hospital for at least 72 hours post partum for blood pressure monitoring (MOH, 2018).

17.3 Postpartum management of women with chronic hypertension and new Hypertension

In many women with chronic hypertension or superimposed pre-eclampsia, blood pressure is often unstable for one to two weeks after delivery. It may also be particularly high on the third to sixth day post-delivery, necessitating antihypertensive medication.

Hypertension may also arise *de novo* in the postpartum period in women who did not have hypertension in the antenatal period (MOH, 2018). This could be a non-specific phenomenon but may also be late onset pre-eclampsia or the unmasking of chronic hypertension. The relevant investigations for pre-eclampsia should be performed.

Evidence to guide optimum management of postpartum hypertension is limited, but therapy should generally be considered if:

- **SBP** is **persistently ≥ 150 mmHg** or
- **DBP** is **persistently ≥ 100 mmHg**

The agents mentioned earlier for managing hypertension in pregnancy (i.e. from Table 3) are compatible with breastfeeding, as are **ACE inhibitors** (e.g. enalapril and quinapril) (Lowe *et al.*, 2014, Newton *et al.,* 2015 and MOH, 2018).

Methyldopa is usually avoided postpartum due to its effects on mood and association with depression (MOH, 2018). For women who were previously on treatment with methyldopa, a postnatal change to an oral long-acting beta blocker, calcium channel blocker or an ACE inhibitor is recommended (MOH, 2018).

17.4 Breastfeeding

In general, breastfeeding is strongly recommended in women with hypertension. Treatment with oral anti-hypertensive agents does not preclude breastfeeding. Treatment with ACE inhibitors appears safe during breastfeeding (Hale Drugs in Pregnancy and Lactation, Beardmore, 2008, Lowe *et al.,* 2014 and MOH, 2018).

17.5 Ongoing monitoring post discharge

Blood pressure should be monitored regularly after hospital discharge, ideally, daily for the first 7 days. Once the BP is **≤ 140/90 mmHg** anti-hypertensive therapy can be reduced as necessary by the GP.

A discharge summary/letter dictated by the registrar or SMO is mandatory. Advice about future pregnancies is also recommended. A copy of the discharge summary and the Standard Letter to Patient Re BP (Associated Documents) should be given to the woman. A six-week postnatal visit to the hospital should be arranged for women with hypertension. This only needs to be with the Obstetric Physician team if they have been involved antenatally with the care. It can otherwise be with the appropriate obstetric team.

Women with a history of hypertensive disorders in pregnancy should receive information on long-term risks of pre-eclampsia including cardiovascular disease and the importance of maintaining a healthy lifestyle.

Women with a history of pre-eclampsia should have a yearly assessment of blood pressure, lipids, blood glucose, thyroid function and BMI. Long-term risks appear to increase significantly 10 years after the initial hypertensive event. This timing should be taken into account when advising on on-going surveillance for these risks.

Women with a history of pre-eclampsia should also receive information on risks associated with subsequent pregnancies and have the opportunity to discuss contraceptive options.

17.6 Risk of developing long-term conditions for women who have had gestational hypertension or pre-eclampsia (MOH, 2018)

Future risk	Hypertensive disorder in index pregnancy	
	Gestational Hypertension*	Pre-eclampsia
	Relative risk (95%CI)	
Gestational hypertension in future pregnancy	3.4 (2.0-5.8)	6.3 (3.4-12.0)
Pre-eclampsia in future pregnancy	7.57 (2.31-24.78)	7.19 (5.85-8.83)
Chronic hypertension	3.39 (0.82-13.9)	3.13 (2.51-3.89)
Cardiovascular disease	1.66 (0.62-4.41)	1.76 (1.43-2.21)
Cerebrovascular disease	1.47 (1.05-2.0)	1.76 (1.43-2.21)
Venous thromboembolism	-	1.79 (1.37-2.33)
End-stage kidney disease	-	4.3 (3.3-5.6)

*More research is required around the long-term effects of gestational hypertension

18. Supporting evidence

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19. Associated documents

- Magnesium Sulfate for Preeclampsia and for Neuroprotection in Pre-Term Births <30 weeks
- Antenatal Corticosteroids to Improve Neonatal Outcomes
- Discharge letter to patient
- MFM referral letter

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20. Disclaimer

No guideline can cover all variations required for specific circumstances. It is the responsibility of the health care practitioners using this Auckland DHB guideline to adapt it for safe use within their own institution, recognise the need for specialist help, and call for it without delay, when an individual patient falls outside of the boundaries of this guideline.

21. Corrections and amendments

The next scheduled review of this document is as per the document classification table (page 1). However, if the reader notices any errors or believes that the document should be reviewed ***before*** the scheduled date, they should contact the owner or Document Control without delay.